

The Windsor-Essex Parkway Project

Geotechnical Investigation and Design Report – High Embankments (Sta. 10+030W to Sta. 12+290W)

Geocres No. 40J6-44



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1 Introduction

1.1 Preface

The Windsor Essex Parkway (the Parkway) 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 kilometres 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 kilometres of recreational trails, extensive landscaping throughout the corridor, as well as noise and environmental mitigation measures. The environmental mitigation measures were based upon 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 (PIC). 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 presents the geotechnical design of High Embankments¹ located between Sta. 10+030W and 12+290W along the proposed Highway 401 as well as between Sta. 10+640 to 12+520 along the realigned E.C. Row East Bound Lane (EBL), located in western part of the Windsor-Essex Parkway (WEP) project in Windsor. This report is issued for construction (IFC) and includes the results of geotechnical investigation carried out to support the design other relevant background information, and addresses review comments from peer reviews and MTO.

The 11.2 km long proposed WEP will run generally east-west and connect the existing Highway 401 in Tecumseh to the proposed new international crossing bridge across Detroit River (near Zug Island). It will run successively along segments of Highway 3 and Huron Church Road and then adjacent to the E.C. Row Expressway to its intersection with Ojibway Parkway. It will be constructed mostly within a cut section until the intersection of Huron Church Road and E.C. Row Expressway, beyond which it will be mostly on embankments. The proposed WEP includes major structures including 15 bridges (Bridges B-1 to B-15), 11 tunnels (numbered T-1 to T-11), 9 trail bridges, approximately 5.5 km length of retaining walls, 2 submerged culverts, and other structures.

The design presented in this report was generally advanced from the preliminary geotechnical design developed for the WEMG (Windsor-Essex Mobility Group) proposal in June 2010 (ref. R-46)² and a 60% design memo issued in July 2011. The 60% design memo was based on investigations carried out prior to proposal stage. The present report is based on collective information from pre-bid and additional investigations, and in consideration of review comments by PIC and HMQ. The geotechnical design has been developed through interactive collaboration of the geotechnical, structural, other design disciplines as well as the Parkway Infrastructure Constructors (PIC).

For reasons related with the timelines for the entire project, the construction of the embankments has started early in 2012 on the basis of preliminary designs provided in the so-called “Advanced Package”. At the time of the writing of this IFC report, the construction of the embankments has progressed to near completion of the Stage I loading which incorporates temporary embankments up to 9 m high. A detailed

¹ High embankments are defined as exceeding 4.5 m in height (Project Agreement – Schedule 15-2).

² References are listed in Section 11.

description of the construction stages will be provided latter in the report. Instrumentation and additional testing was carried out to for this Stage I to monitor the geotechnical performance. Details on these activities and results are provided under separate covers (ref. R-2). However, in consideration of the additional soil information from monitoring and testing during construction, updates were incorporated into the geotechnical design were warranted.

The report is organized in two parts. Part 1 is the Factual Information and is presented in Sections 1 to 4. Part 2 presents the geotechnical design and recommendations in Sections 5 to 6. Other information is presented in Sections 9 to 11.

The geotechnical design complies with the requirements of the executable version of the Project Agreement Schedule 15-2 Part 2, Article 5 (PA).

2 Background Information

2.1 Geological Setting

The WEP project site is located within the Essex Clay Plain, a part of the St. Clair Clay Plain physiographic region described in references R-21, R-23 and R-30. 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 clayey silt till, silty clay till and glacio-lacustrine clay. Hudec (ref. R-30) summarized the overburden geology in Windsor as consisting of the following successive strata: desiccated lacustrine clay, normally consolidated lacustrine clay, silty Tavistock till, glacio-lacustrine 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. The eastern part of Windsor is underlain by firm to stiff, glacio-lacustrine silts and clays with upper deposits of stiff sandy to silty weathered clay and a hard to stiff lacustrine clay-silt crust. The western part of Windsor is characterized by a thin surficial granular deposit underlain by a thin crust layer underlain by soft to firm glacio-lacustrine 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 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 consists of limestone, dolostone and shale comprising the Devonian Dundee Formation of the Hamilton Group Formation underlain by the Devonian Lucas Formation of the Detroit River Group Formation.

The Windsor area, referred to as the Essex Domain (with respect to bedrock geology), is located in the Grenville Front Tectonic Zone (GFTZ) (ref. R-30). The bedrock geology within the Essex Domain was formed as part of the midcontinent rift south-eastern extension. The latter 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, the Dundee Formation, and the Detroit River Group Onondaga Formation – all consisting of Limestone, Dolostone, and Shale.

2.2 Site Seismic Background

Windsor-Tecumseh area is described in CHBDC 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 Canadian Highway Bridge Design Code (CHBDC, ref. R-16) the soil profile at the site of the project meets in general the description for Soil Profile Type III (soft clay and silts greater than 12 m in depth). A limited number of cross-hole tests were completed during the background investigation program (ref. R-26) at locations distributed strategically along the project alignment between Howard Road (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.

2.3 Site Conditions

The western part of the WEP project comprises construction of high embankments along the new Highway 401 and the realigned E.C. Row Expressway East Bound Lane (ECR-EBL). Highway 401 high embankment starts at Sta. 10+030W (west end of the project), goes across Matchette Rd (Bridge B-2) and Malden Rd (Bridge B-2) and terminates at Sta. 12+290W. As part of the WEP project a portion of ECR-EBL will be relocated to the south of the proposed Highway 401 alignment. The embankment for the realigned ECR-EBL starts at ECR Sta. 10+640 goes across Highway 401 (Bridge B-3) and Malden Rd (Bridge B-5), crosses back the Highway 401 (Bridge B-6) and reconnects to the E.C. Row Expressway at ECR Sta. 12+520.

The existing topography in the area is relatively flat with existing ground surface varying between elevations 180 and 178³. It is understood that some local residential dwellings will be demolished and the local access roadways will be reconfigured to accommodate the embankment (e.g., closure of 2nd Street). The existing ground surface generally comprises moist to damp top soil and occasional surficial fill.

2.4 Frost Depth

In accordance with MTO-SDO-90-01 Pavement Design and Rehabilitation Manual (ref. R-42) and OPSD 3090.101 the frost depth below the ground surface in Windsor area is estimated to be 1.0 m⁴. 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 (or lower) of the insulation offered by soil deposits /cover, and the depth of frost penetration will have to be increased accordingly.

³ Elevations are in metres and are referred to geodetic datum.

⁴ Ontario Provisional Standard Drawings.

3 Geotechnical Investigations

3.1 Scope of Geotechnical Investigations

Geotechnical investigations involving a number of boreholes, cone penetration tests (CPT) and Nilcon vane tests had been carried out in 2007-09 by Golder Associates (ref. R-21 to R-28) as part of background information for development of the WEP proposal designs. Additional geotechnical investigation was carried out to supplement the previously obtained (pre-bid) subsurface soil data, as required to support the detailed design development of the WEP embankment and structures. As indicated in Table 3-1, the additional investigation program along the high embankment segments along Highway 401 and E.C. Row EBL comprised a total of 13 boreholes, 23 cone penetration tests, 10 Nilcon vane profiles (adjacent to boreholes) and 8 flat plate dilatometer tests. Table 3-1 also lists the test holes put down along the embankment segments of the project during previous geotechnical investigations.

**Table 3-1: Test Holes Along the High Embankments
(Sta. 10+030W to 12+290W)**

Reference	Boreholes	Nilcon Vane Tests	CPT's	DMT's
Additional Investigation (This Design Study)				
Current / Additional Investigation	BH2-RW, BH3-RW, BH4-RW, BH5-RW, BH6-RW, BH B2-1, BH B3-1, BH B3-2, BH B3-3, BH B4-1, BH B6-1, BH B6-2, BH B6-3	NIL2-RW, NIL3-RW, NIL4-RW, NIL5-RW, NIL6-RW, NIL B2-1, NIL B3-1, NIL B3-3, NIL B4-1, NIL B6-1	CPT1-RW, CPT2-RW, CPT3-RW, CPT4-RW, CPT5-RW, CPT6-RW, CPT7-RW, CPT8-RW, CPT9-RW, CPT10-RW, CPT11-RW, CPT12-RW, CPT13-RW, CPT14-RW, CPT15-RW, CPT16-RW, CPT17-RW, CPT18-RW, CPT B2-1, CPT B3-1, CPT B3-2, CPT B6-1, CPT B6-2	DMT1-RW, DMT2-RW, DMT B2-1, DMT B3-1, DMT B3-2, DMT B4-1, DMT B6-1, DMT B6-2
Previous Studies				
MTO Geocres Database (68-F-15-1)	BH-05, BH-06, BH-07, BH-08, BH-13	none	none	none
ref. R-22	BH-23, BH-154, BH-156, BH-158, BH-160, BH-163, BH-164, BH-166	BH-23, BH-154, BH-158, BH-160	CPT 19, CPT21, CPT-23, CPT-150, CPT-153, CPT-154, CPT-155, CPT-159, CPT-160, CPT-161, CPT-162, CPT-165	none
ref. R-27 and R-28	BH-341, BH-343, BH-345	none	CPT-338, CPT-340, CPT-342, CPT-344	none

The locations of boreholes, Nilcon tests, CPTs and DMTs executed during the pre-bid and the additional 2011 investigations, and the associated inferred soil profile along the WEP alignment are shown on Drawings G900 to G904.

As mentioned earlier, a number of CPT and Nilcon tests were carried out in December 2012 in conjunction with the monitoring of the Stage I construction to assess the anticipated ground condition improvement. Details of the tests as well as results of the general ground response monitoring are provided under separate covers.

3.2 Fieldwork for Additional Investigation

The additional investigation fieldwork along high embankments comprised the following exploratory works:

- Boreholes (including conventional vane tests);
- Nilcon Vane Tests;
- Cone Penetration Tests (CPT); and
- Thin-Blade Dilatometer Tests (DMT).

The boreholes were advanced using track-mounted CME 55 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 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 70 mm diameter by 600 mm long thin-walled Shelby tubes. 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 and placed in airtight containers and were transported to AMEC's Tecumseh (Windsor) laboratories for further examination and testing⁵. Rock coring of the bedrock was completed using NQ or HQ sized core barrels with a length of 1.5 m.

Standard Penetration Tests (SPT, ASTM D1586⁶) 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 3-1 were carried typically adjacent the boreholes.

Table 3-2 summarizes the depths of overburden penetration and rock coring as well as the list of instruments and the accompanying Nilcon vane tests.

Rock cores were examined in the field and transported to AMEC's Tecumseh (Windsor) laboratories for further examination and testing. For each core run, rock core recovery and rock quality designation

⁵ Advanced lab tests (consolidation and consolidated undrained triaxial tests) were carried out in AMEC's Scarborough lab

⁶ American Society for Testing and Materials

(RQD) were determined. The core recovery and RQD values are given on the borehole logs. The rock cores were photographed in the laboratory. Compression strength testes were carried out on rock core samples selected from across the Parkway length.

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

The Nilcon vane tests and CPTs were carried out in cohesive soil strata after augering through the stiffer/denser surficial materials. The Nilcon vane tests were carried out at 0.5 to 1.0 m depth intervals at an appropriate rate of rotational strain (ASTM D2573). The CPT cone was pushed at a constant rate into the ground using hydraulic ram system of the drill rig (ASTM D5778). Pore pressure dissipation tests were carried out at selected depths.

The DMT probe was pushed in 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.

Borehole, DMT, Nilcon and CPT logs from the additional 2011 investigation are included in Appendix A. Relevant borehole logs from the pre-bid investigation are included in Appendix B. Borehole logs illustrate the interpreted soil conditions, field test results and laboratory index test results.

Table 3-2: Overburden Thickness and Instrumentation in 2011 Boreholes

Borehole	UTM Location		Over-burden Thickness, m	Test & Instrumentation Elevation				
	Northing	Easting		Rock Coring	Nilcon Vane	VWP	MSG	IN
BH2-RW/ NIL-2RW	4,682,135	328,621	22.5	156.8 to 155.5	176.3 to 161.3	176.3, 166.5 and 157.0	176.3 and 170.3	-
BH3-RW/ NIL-3RW	4,682,240	329,081	22.1	156.8 to 151.8	175.9 to 159.2	175.9 and 168.4	176.5 and 169.9	1
BH4-RW/ NIL-4RW	4,682,217	329,131	22.7	155.6 to 152.5	174.9 to 158.4	170.7, 164.9 and 155.6	172.4 and 168.4	1
BH5-RW/ NIL 5-RW	4,682,349	329,309	27.7	154.8 to 153.3	176.5 to 159.2	174.9 and 165.7	177.1 and 168.3	1
BH6-RW/ NIL 6-RW	4,681,950	330,199	32.2	148.6 to 147.3	177.3 to 153.8	174.3, 163.1 and 148.8	174.4 and 166.8	-
BH B2-1/ NIL B2-1	4,682,253	329,140	22.4	156.2 to 154.5	174.6 to 156.6	175.6, 167.9 and 157.3	-	-
BH B3-1/ NIL B3-1	4,682,268	329,432	21.3	157.6 to 154.7	175.4 to 159.9	175.85, 167.9 and 157.6	176.6 and 170.4	-
BH B3-2	4,682,225	329,491	22.9	156.0 to 153.6	-	-	-	-
BH B3-3/ NIL B3-3	4,682,181	329,559	25.3	153.7 to 152.2	175.2 to 160.2	176, 166.8 and 154.8	176.3 and 169.7	1
BH B4-1/ NIL B4-1	4,681,982	330,154	30.2	150.6 to 149.3	176.8 to 153.3	177.8, 166.5 and 150.9	176.8, 168.1	1
BH B6-1/ NIL B6-1	4,681,787	330,654	30.5	149.7 to 145.5	174.7 to 157.2	177.3, 165.7 and 151.2	177.8 and 169.7	1
BH B6-2	4,681,785	330,731	30.4	149.7 to 146.5	-	-	-	-
BH B6-3	4,681,790	330,794	30.5	149.9 to 146.9	-	177.4, 167.8 and 151.6	180.0 and 172.5	1

Legend:

VWP Vibrating Wire Piezometer
MSG Spider Magnet heave/Settlement Gauge
IN Inclinator casing

Note:

Location coordinates and elevations are in UTM-NAD 83 (Zone 17) and geodetic datum.
Survey coordinates provided by AMICO.

3.3 Instrumentation

Geotechnical instruments, such as, vibrating wire piezometers, spider magnets heave/settlement gauges and slope inclinometers were installed at select locations on completion of boreholes to monitor the pore water pressure and deformation behaviour of the soil strata during and after construction. A brief description of the instruments follows:

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 the designated depths and electrical wires extended to the monitoring station at the ground surface (outside the parkway footprint area). 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.

Slope Inclinometers: Snap-seal 2.75 inch inclinometer casings with grooves were installed in selected boreholes to measure the lateral movement of the soil. The bottom end of the casing was anchored approximately 1.5 m into bedrock, and the annular space around the casing was filled with bentonite-cement grout.

Magnetic Settlement/Heave Gauges: Spider magnets (RST, Model SSMM100 mechanical release spider target for 25 mm pipe) were installed in boreholes at select locations and depths to permit future measurement of heave and settlement. Each magnetic torus was placed around a 25 mm diameter pipe, which was extended to above the ground surface. The spider legs grip into the surrounding soil, which enables the magnetic torus to move up or down on the pipe as the soil settles or heaves. The locations of the magnetic torus are determined by lowering a magnetic probe inside the pipe. The installation of the spider magnets and the grouting of the holes were carried out in accordance with the manufacturer's recommendations.

Sensor elevation and details of installations for various instruments are provided in Table 3-2 and applicable borehole logs. Proper future decommissioning of the instrumentation holes is responsibility of WEMG/PIC.

3.4 Geotechnical Laboratory Testing

All recovered soil samples and rock cores were examined in the laboratory. Natural moisture content tests were carried out on most of the recovered samples; grain size distribution and Atterberg limit tests were carried out on selected representative samples. Following these soil classification tests, selected representative soil samples were transported to AMEC Geotechnical Laboratory in Scarborough, Ontario for advanced tests, such as triaxial compression test, direct shear tests and one-dimensional consolidation tests. Compression strength tests were carried out on selected representative rock core samples. The index test results are shown on borehole logs included in Appendix A. The results of laboratory tests are indicated on borehole logs and included in Appendix C.

3.5 Data Interpretation

Field Vane Test Data Correction: Figure 3-1⁷ 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 (PI) of about 15 (ref. R-12, R-35 and R-37). 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-15). 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:

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

Where:

$S_{u\text{CPT}}$ is the undrained shear strength estimated from the CPT test;

Q_t is the corrected total cone tip resistance;

σ_{vo} is the total vertical stress at corresponding depth of measurement of the Q_t value; and

N_{kt} is an empirical factor, depends on soil type & test arrangement, 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 for different segments of the WEP and the soil strata. Thus, 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, respectively. In CPT 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-36). The following relationship was used to compute the pre-consolidation pressures:

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

⁷ All figures are included at the end of the report text.

Where:

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

Based on plasticity index of the clayey silt to silty clay deposit, 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, σ'_p can then be estimated as:

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

Flat Blade Dilatometer Test (DMT) Data: The DMT 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-31), 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 $S_{u\text{ vo}}$ for OCR=1 curve is based on average plasticity index of the silty clay to clayey silt stratum and Chandler 1988 relationship (Figure 3-2) (ref. R-16 and R-35).

The undrained shear strength (S_u), pre-consolidation pressure (σ'_p), natural water content (w_N) and compression index (C_c) profiles based on field and laboratory testing from boreholes, CPT and DMT carried out between Sta. 9+700W and 12+800W are presented on Figures 3-3 to 3-7. Also included on these figures are $0.18 \times \sigma'_{vo}$ curve (representing OCR=1) and simplified soil stratigraphic deposits to facilitate correlation of soil properties to the individual soil units.

4 Subsurface Conditions

The general soil stratigraphy at the site 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 elevation 176 to 180, and lower granular deposit below about elevation 151 to 158, overlying limestone and dolostone bedrock below about elevation 148 to 158. The thickness of the Clayey Silt to Silty Clay deposit varies between about 19 m and 31 m. The lower granular deposit (sandy silt / silty sand / sand and gravel) varied in thickness between 1 to 3 m.

The bedrock was encountered at depths ranging from about 21 m to 32 m below the ground surface.

Detailed soil properties for each representative soil layers along the 5 soil profiles mentioned earlier are provided later in Table 4-1 to Table 4-5. Below is a description of soil deposits encountered.

4.1 Surficial Fills, Topsoil and Upper Granular Deposit

Majority of boreholes encountered a layer of brown to black topsoil which extended to a depth of up to 1.1 m below grade in the boreholes. The thickness of the topsoil is expected to vary in quality and thickness through the project area.

A non-cohesive fine silty sand was encountered in all boreholes, except Boreholes BH04-RW, BH B2-1, BH B3-1, BH B3-2, BH B6-1, BH B6-2 and BH B6-3 below fill and/ topsoil. The thickness of this unit varies between 0.2 to 1.9 m.

4.2 Silty Clay to Clayey Silt Stratum

A cohesive silty clay stratum was encountered directly underlying the surficial topsoil and/or sand deposit. The encountered depth below existing ground surface and the corresponding elevations were 0.5 to 4.9 m and 178.3 to 177.6. 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, upper grey silty clay to clayey silt deposit (referred to hereafter as upper silty clay), and then a generally coarser lower grey clayey silt to silty clay deposit (referred to as lower clayey silt). The natural water content, Atterberg limits, compression index, and undrained shear strengths properties of the clay sub-strata are shown in Figures 3-3 to 3-7.

As indicated previously, the undrained shear strength of clay has been estimated from CPT sounding, Nilcon vane and DMT measurement results for five approximately 500 m long segments along the high embankments, as shown in Figures 3-3 to 3-7.

The stress-strain properties and the effective shear strength properties of the silty clay to clayey silt soils were based on published correlations (Kulhawy and Mayne, 1990, ref. R-33, Leroueil et al, ref. R-39 and Terzaghi et al. Ref. R-45) and confirmed by tests reported in Golder's Subsurface Condition Interpretation Report (ref. R-24) and the tests performed during the additional geotechnical investigation carried out as part of the detailed design development for the entire WEP length.

The stress-strain properties and the effective shear strength properties of the silty clay to clayey silt soils were based on published correlations (Kulhawy and Mayne, 1990, ref. R-34, Leroueil et al, 2001, R-38 and Terzaghi et al.1990, ref. R-45) as well as on the tests reported in Golder's Subsurface Condition Interpretation Report (ref. R-24) and the tests performed during the additional geotechnical investigation carried out as part of the detailed design development for the entire Parkway length.

The stress-strain properties (compressibility indices) for this layer were determined from correlations to natural water content (w_N , expressed as percent) as illustrated in Figures 4-1 and 4-2, and summarized as follows:

$$C_c = 0.0086w_N - 0.0086$$

$$C_r = 0.11C_c$$

$$C_s = 0.25C_c$$

$$C_\alpha = 0.028C_c$$

The effective shear strength properties applicable to the silty clay to clayey silt stratum were determined from triaxial and direct shear tests performed during the pre-bid and additional geotechnical investigations (Figure 4-3) and supported also by published PI versus ϕ' relationships (ref. R-33, R-37 and R-44, Figure 4-4), and are summarized as follows:

Apparent cohesion, c'	0 kPa
Angle of internal friction, ϕ	30°
Friction angle at critical state, Φ_c	25° to 26°(*)

(*) Based on triaxial tests (ref. R-21)

The modulus of elasticity has been correlated using the empirical relationships listed below with the undrained shear strength of the material in accordance with published information (ref. R-33) and local experience (ref. R-23):

$$E_u = 300S_u$$

$$E' = 0.9E_u$$

The 1-D modulus (or constrained modulus) (E_s) can be estimated from 3-D Young's modulus (E_u):

$$E_s = E_u \times (1-\mu) / (1+\mu) / (1-2\mu)$$

Where, $\mu = 0.35$ is the Poisson's Ratio.

In the case of the clay crust, E_u was estimated between 20 MPa and 35 MPa based on general experience with settlements for shallow foundations in the area.

For design purposes the upper silty clay and the lower clayey silt strata have been subdivided (i.e., the Upper Silty Clay 1 and 2 and the Lower Clayey Silt 1 and 2), as required to reflect better the observed variability of strength and compressibility characteristics.

The hydraulic conductivity of the silty clay to clayey silt stratum was interpreted from pore pressure dissipation tests carried out in the CPT probes as well as the laboratory oedometer tests. The hydraulic conductivity values obtained from previous (2007-09) and additional (2011) investigations are plotted on Figure 4-5.

4.3 Lower Granular Deposit

Underlying the silty clay to clayey silt stratum and overlying the bedrock was a heterogeneous material varying from silty sand, sand and gravel, and clayey silts with sand. The measured thickness of the layer was approximately 0.7 to 3.3 m (varies significantly throughout the project area). Based on SPT N-values ranging generally from 15 to greater than 50, this material is considered to be in a compact to very dense state of compactness.

The modulus of elasticity and hydraulic conductivity of the lower granular layer were estimated based on values suggested in Golder report (ref. R-24).

4.4 Bedrock

Where rock coring was undertaken, a white to grey, limestone bedrock was encountered. The bedrock was generally fresh, medium strong, thinly laminated, fine grained, faintly to moderately porous and moderately fractured. Bedrock was encountered at elevations ranging from 148.6 to 157.7 along this section of Parkway. The Rock Quality Designation (RQD) of the recovered rock cores varied generally between 50 to 100%, indicating a fair to excellent quality. 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-10) and 53 to 58 for the Rock Mass Rating (RMR) based on Bieniawski (1976, ref. R-13) and indicates that the rock mass can be considered as a Fair quality rock mass based on the later system. Boreholes cores show that rock quality generally improves with depth. Selected rock core photos are presented in Appendix F.

Table 4-1: Soil Properties for Design Profile 1 (Sta. 09+700W to 10+400W)

Material Description	Elevation, m	Thickness, m	Unit Weight, γ , kN/m ³	Shear Strength		Undrained Modulus of Elasticity, E, kPa	Moisture Content, W _N , %	Compressibility Characteristics				Hydraulic Conductivity, k _h , m/day
				Undrained , S _w , kPa	Friction Angle, ϕ' , °			C _c	C _r	C _{α}	P' _c , kPa	
Upper Granular	179 – 178	1	21	-	30	30,000	-	-	-	-	-	-
Clay Crust	178 – 176	2	21	75	30	30,000	22	0.18	0.020	0.005	400	6.E-04
Transition Clay	176 – 174	2	21	75 – 32	30	23,000 – 10,000	29	0.24	0.026	0.007	400 – 175	6.E-04
Upper Silty Clay 1	174 – 168	6	20	32 – 22	30	10,000 – 7,000	34	0.28	0.031	0.008	175 – 115	1.E-04
Upper Silty Clay 2	168 – 163	5	20	22 – 30	30	7,000 – 9,000	26	0.22	0.024	0.006	115 – 160	1.E-04
Lower Clayey Silt 1	163 – 160	3	20	30 – 70	30	9,000 – 21,000	19	0.15	0.017	0.004	160 – 400	1.E-04
Lower Clayey Silt 2	160 – 156	4	20	70	30	21,000	21	0.17	0.019	0.005	400	1.E-04
Sand & Gravel	156 – 155	1	21	-	30	40,000	-	-	-	-	-	-

Note: Average ground water level at 179.5.

Table 4-2: Soil Properties for Design Profile 2 (Sta. 10+300W to 10+900W)

Material Description	Elevation, m	Thickness, m	Unit Weight, γ , kN/m ³	Shear Strength		Undrained Modulus of Elasticity, E, kPa	Moisture Content, W _N , %	Compressibility Characteristics				Hydraulic Conductivity, k _h , m/day
				Undrained, S _w , kPa	Friction Angle, ϕ' , °			C _c	C _r	C _{α}	P' _c , kPa	
Upper Granular	179 – 178.5	0.5	21	-	30	30,000	-	-	-	-	-	-
Clay Crust	178.5 – 177	1.5	21	75	30	30,000	20	0.16	0.018	0.005	400	6.E-04
Transition Clay	177 – 175	2	21	75 – 35	30	23,000 – 11,000	25	0.21	0.023	0.006	400 – 200	6.E-04
Upper Silty Clay 1	175 – 167	8	20	35 – 23	30	11,000 – 7,000	31	0.26	0.028	0.007	200 – 125	1.E-04
Upper Silty Clay 2	167 – 163	4	20	23 – 30	30	7,000 – 9,000	23	0.19	0.021	0.005	125 – 165	1.E-04
Lower Clayey Silt 1	163 – 160	3	20	30 – 75	30	9,000 – 23,000	20	0.16	0.018	0.005	165 – 400	1.E-04
Lower Clayey Silt 2	160 – 157	3	20	75	30	23,000	18	0.15	0.016	0.004	400	1.E-04
Sand & Gravel	157 – 155	2	21	-	30	40,000	-	-	-	-	-	-

Note: Average ground water level at 179.0.

Table 4-5: Soil Properties for Design Profile 5 (Sta. 12+100W to 12+800W)

Material Description	Elevation, m	Thickness, m	Unit Weight, γ , kN/m ³	Shear Strength		Undrained Modulus of Elasticity, E, kPa	Moisture Content, W _N , %	Compressibility Characteristics				Hydraulic Conductivity, k _h , m/day
				Undrained, S _u , kPa	Friction Angle, ϕ °, °			C _c	C _r	C _{α}	P' _c , kPa	
Upper Granular	180 – 179.5	0.5	21		30	30,000						
Crust	179.5 – 177	2.5	21	75	30	30,000	20	0.16	0.018	0.005	500	6.E-04
Transitional Clay	177 – 175	2	21	75 – 68	30	23,000 – 20,000	19	0.15	0.017	0.004	500 – 400	6.E-04
Upper Silty Clay 1	175 – 164	11	20	68 – 37	30	20,000 – 11,000	23	0.19	0.021	0.005	400 – 195	1.E-04
Upper Silty Clay 2	164 – 160	4	20	37 – 45	30	11,000 – 14,000	18	0.15	0.016	0.004	195 – 235	1.E-04
Lower Clayey Silt 1	160 – 159	1	20	45 – 75	30	14,000 – 23,000	17	0.14	0.015	0.004	235 – 350	1.E-04
Lower Clayey Silt 2	159 – 153	6	20	75	30	23,000	22	0.18	0.020	0.005	350	1.E-04
Sand & Gravel	153 – 151	2	21		30	40,000						

Note: Average ground water level at 180.0.

It was found during the preliminary investigations (ref. R-24) 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 4-6). The average strength of the limestone is determined to be 85.5 MPa and is 'strong rock' based on the ISRM (1978, ref. R-32). Additionally, based on the coefficient of variation, enough tests have been performed to characterise the compressive strength.

Table 4-6: Summary of Intact Properties of Rock Core Samples

Item	Density (kg/m ³)	Unit Weight (kN/m ³)	UCS (MPa)
Number of Samples	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 a Hoek-Brown Constant (mi) of 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, ref. R-47).

4.5 Groundwater Conditions

Across the WEP project site, the groundwater levels in the silty clay stratum differ from those in the underlying lower granular deposit and bedrock, such that the magnitude and direction of the hydraulic gradients between the bedrock and the overburden deposits vary along the WEP project site. Thus, whereas the groundwater level is generally below the ground surface and the hydraulic gradient generally downward in the east part of the project, the interpreted conditions in west part suggest groundwater level close to the ground surface based on piezometers within the silty clay stratum, and artesian condition at piezometers in bedrock.

During the additional investigation, shallow and deep vibrating wire piezometers were installed in selected boreholes to measure the stabilized water levels within overburden and bedrock, respectively (Table 3-2).

The piezometric water levels within the overburden and the bedrock were estimated to be near elevations 179.0 and 180.7 (Table 4-8), respectively in the western part (Sta. 9+700W to 11+500W). These observations suggest artesian conditions and an upward gradient between the overburden and the bedrock. Artesian conditions observed in the silty clay stratum at in few locations (e.g., BH5-RW), may explain the presence of normally consolidated clay between Elevations 160 and 165. Water levels were generally near the ground surface and relatively deeper towards the east.

Perched groundwater table is generally present within the upper granular deposits. Patches of swampy areas and wet land are scattered in the western region of the project. During wet seasons the perched groundwater table rises to near the ground surface.

4.6 Subsurface Gases

The groundwater in the project area, especially within the lower granular deposit and bedrock, is known to contain dissolved hydrogen sulphide (H_2S) and methane (CH_4) gases that are liberated from the water on exposure to atmospheric pressure.

The H_2S gas can frequently be detected by odour at concentrations on the order of 0.5 ppm and can be corrosive at concentrations of about 2 ppm to 3 ppm in the groundwater. The gas was noted by odour during the drilling along this section of the Parkway (in Boreholes BH-152, BH-154, BH-160, BH01-RW, BH04-RW, B3-3 and B6-3, and CPT06-RW). 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. A summary of the results of these tests is provided in Table 4-7.

Table 4-7: Summary of Pumping Tests Data

Test #	Approximate Location	H_2S Gas Concentration, mg/L
TOW-1	Bridge B-11	< 0.02
TOW-2	North of Tunnel T-7	20.0
TOW-3	South of Tunnel T-4	7.9

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 water fluid in gassy soils, the immediate pore water pressure response (ΔU) to total stress changes can be very low. This phenomena leads to reduction in effective stress and hence shear strength (ref. R-29 and R-44). While no significant excavations below the original ground are anticipated in the high embankment segment of the Parkway between Sta. 10+030W and 12+290W, it is recommended that the design and construction methodologies should be developed in consideration of the potential encounter of these gases (ref. R-19).

Air quality and subgrade pore pressure monitoring should be carried out during construction. In general, it is recommended that equipment operating in confined spaces be selected to safely operate in a potentially gaseous environment.

Table 4-8: Summary of Measured Water Levels

Borehole	Surface El, m	Sensor El., m	Strata Type at Sensor Depth	Measured Water level	
				Date	El, m
BH2-RW	179.3	176.3	Silty Clay	July 9, 2011	177.5
				December 12, 2012	178.6
		166.5	Silty Clay	July 9, 2011	179.0
				December 12, 2012	184.7
		157.0	Limestone	July 9, 2011	180.7
				December 12, 2012	180.6
BH3-RW	178.6	175.55	Silty Clay	June 25, 2011	176.7
				December 5, 2012	178.1
		168.1	Silty Clay	June 25, 2011	178.2
				December 5, 2012	180.4
BH4-RW	178.3	170.7	Silty Clay	July 9, 2011	177.0
		164.9	Silty Clay	July 9, 2011	175.8
		155.6	Limestone	July 9, 2011	179.5
BH5-RW	182.5	174.9	Silty Clay	July 9, 2011	180.8
				November 27, 2012	180.7
		165.7	Silty Clay	July 9, 2011	182.9
				November 27, 2012	184.5
BH6-RW	180.8	174.3	Silty Clay	June 25, 2011	181.0
				December 10, 2012	178.4
		163.1	Silty Clay	June 25, 2011	180.7
				December 10, 2012	180.9
		148.8	Limestone	July 9, 2011	180.5
				December 10, 2012	181.8
BH B2-1	178.6	175.55	Silty Clay	July 9, 2011	176.7
				December 13, 2012	178.8
		167.9	Silty Clay	July 9, 2011	178.8
				December 13, 2012	182.6
		157.6	Limestone	July 9, 2011	180.0
				December 13, 2012	184.2
BH B3-1	178.9	175.9	Silty Clay	July 22, 2011	177.1
				December 13, 2012	182.1
		167.9	Silty Clay	July 22, 2011	178.4
				December 13, 2012	188.5
		157.6	Limestone	July 9, 2011	180.6
				December 13, 2012	182.3
BH B3-3	179.0	176.0	Silty Clay	August 22, 2011	178.4
				December 13, 2012	178.2
		166.8	Silty Clay	August 22, 2011	177.7
				December 13, 2012	177.7
		154.8	Limestone	August 22, 2011	180.3
				December 13, 2012	180.6
BH B4-1	180.8	177.8	Silty Clay	July 9, 2011	179.4
				November 9, 2012	179.8
		166.5	Silty Clay	July 9, 2011	180.5
				November 9, 2012	183.7
		150.9	Limestone	July 29, 2011	180.5
BH B6-1	180.2	177.3	Silty Clay	July 9, 2011	179.1
				December 10, 2012	179.8
		165.7	Silty Clay	July 9, 2011	177.3
				December 10, 2012	180.7
		151.2	Limestone	July 9, 2011	180.1
				December 10, 2012	180.2
BH B6-3	180.4	177.4	Silty Clay	July 9, 2011	179.7
				November 27, 2012	180.4
		167.8	Silty Clay	July 9, 2011	184.1
				November 27, 2012	183.4
		151.6	Silty Clay	July 9, 2011	181.1
				November 27, 2012	181.1

5 Geotechnical Design

5.1 Geotechnical Design Criteria

The geotechnical design complies with the requirements of the executable version of the Project Agreement Schedule 15-2 Part 2, Article 5 (PA). The most referred to design criteria are:

- The embankments are to be designed for a minimum factor of safety (FS) of 1.3.
- The magnitudes of maximum permissible differential settlement between Substantial Completion and Expiry Date at the bridge abutments and 20 m, 50 m, 75 m and 100 m distance from the bridge are 5 mm, 25 mm, 50 mm, 75 mm and 100 mm, respectively.
- High fill embankments will be constructed in stages that are suitable from economic, construction and technical considerations, ensuring the stability of the embankment during and after construction.

5.2 Design Configurations

The design of high embankment involves the following components:

- Highway 401 Embankment – from Sta. 10+030W to 12+290W,
- E. C. Row Expressway East Bound Lane (EBL) Embankment – from Sta.10+640E to 12+520E,
- E. C. Row Expressway EBL Embankment at Live Birthing Site (Sta 10+750W),
- Embankment Configuration at Utility Lines (BP Corridor and 2nd Street sewer line), and
- Settlement assessment and management for Matchette and Malden Road gas lines and existing E. C. Row Embankment.

The proposed design configurations for Highway 401 and E. C. Row Expressway EBL embankments are illustrated on Drawings G905 to G909⁸. Designs of approachway embankments and abutment backfill at Bridges B-2, B-3, B-4, B-5 and B-6 are beyond the scope of this report and have been addressed in detail in other reports (ref. R-3 to R-7)

The embankments for the WEP Parkway (Highway 401) and the E.C. Row Expressway will be built with compacted silty clay fill, which will be obtained from required excavations in the eastern part of the parkway. The design side slopes of the trapezoidal shaped embankments are generally 3H:1V, with benches incorporated in segments greater than 8 m in height. The design heights of these embankments above original ground surface vary from 0 to 11 m.

As shown earlier, the design and construction requirements for the high embankments are complex due to the soft consistency, limited duration of time available to achieve consolidation and strength gain in the clay deposit, space limitation (preventing slope flattening and surcharging for preloading) and settlement constraint. These conditions necessitated use of wick drains to expedite consolidation of the foundation

⁸ Embankment configuration for Highway 401 and E.C. Row Expressway East Bound Lane (EBL) were provided by HMM.

stratum and strength improvement, multi-stage construction and surcharge loading to minimize future long-term settlement as well as the use of expanded polystyrene (EPS). The embankment construction stages will also require surcharge (additional fill over and above the design outline of the embankment) to facilitate additional settlement and compensate, to the extent practically possible, the future long-term deformations of the embankment.

Perforated Vertical Drains (PVD) or wick drains (100 mm wide with 2 mm core thickness) are being used in a triangular pattern at spacing determined by time rate of consolidation and settlement calculations. Based on the results of consolidation/settlement and slope stability analyses 1.5 m and 2.0 m spacing was selected in consideration of the embankment height and ground conditions; where feasible, the spacing was increased under the embankment slope. In consideration of the artesian pressures in bedrock and the presence of gases in the bottom part of the silty clay stratum, the wick drain penetration was limited to about 2/3rd of the clayey silt to silty clay stratum (i.e., bottom of wick drains at about elevation 160-163 m, as indicated on the drawings).

The wick drain design is in accordance with the requirements of the OPSS 220, “Construction Specification for Wick Drain Installation”. Highlights of design requirements are given hereafter.

The wick drain design includes a minimum 0.3 m thick drainage blanket comprising well graded sand and gravel and separation fabric (geotextile) to prevent internal erosion. A second layer of sand and gravel (or geotextile) is required over the drainage blanket after the installation of PVD is complete.

5.3 Design Methodology

Based on the analyses carried out previously during the 30% design and current 90% design, the stability of the high embankments is governed by the undrained shear strength properties of the soft clayey silt to silty clay stratum, which will be mobilized during and following construction of the embankment in stages. High fill embankments will be constructed in stages that are suitable from economic, construction and technical considerations, ensuring the stability of the embankment during and after construction of each stage and in the long-term following construction.

The high embankment design involved stability analyses to verify the stability of embankment slopes and stress deformation analyses to assess stress distribution and settlements in substrata.

The slope stability analyses (limit equilibrium analyses) were carried out by the Morgenstern-Price method using the SLOPE/W software, Version 7.17, 2007. The soil parameters used for various analyses are shown in the relevant stability figure. The clay deposit was subdivided into layers according to the observed properties to facilitate the calculation of settlement, stress change and post-consolidation strength increase.

The vertical effective stress changes related to the loading stages and settlements were in general computed in general using the Settle3D software, Version 2.01⁹. For Second Stress sewer line the stress-deformation analysis was carried out using the SIGMA/W software Version 7.17 (see Section 6.4).

The stability and deformation analyses were carried out for five representative sections with variable subsurface soil conditions and embankment heights as shown on Figure 5-1 and indicated in Table 5-1.

Table 5-1: Selected Embankments Sections for Analysis

Analysis Section	Station	Applicable to Highway Segment	Soil Profile
1 (Highway 401)	10+050W	10+030W – 10+400W	1
2 (Highway 401)	10+600W	10+400W – 11+480W	2
3 (E.C. Row)	11+075E	10+640E – 11+520E	3
4 (Highway 401 and E.C. Row)	11+775W	11+480W – 12+290W, 11+520E – 12+080E	4
5 (E.C. Row)	12+250E	12+080E – 12+520E	5

Note: See Table 5-6 and Table 5-7 for relevant embankment segments.

The stability/settlement analyses for embankment involved the following steps:

- Step 1: Define design strength and compressibility properties for the 5 design sections based on Soil Property Profiles 1 and 5 (Table 4-1 to Table 4-5).
- Step 2: Determine the maximum height of fill (first stage) that can be placed over native soil and meets $FS > 1.3$ for global stability.
- Step 3: Estimate the undrained shear strength gain (ΔS_u) after completion of consolidation after 120 days of fill loading with a selected PVD (Prefabricated Vertical Drain) configuration.
- Step 4: Determine the maximum heights of the successive fill placement stages based on updated soil properties (to satisfy the minimum FS requirement for temporary slope).

Steps 3 and 4 were repeated until the design height of the embankment, including surcharge load of about 1 m of fill (where required), was reached.

- Step 5: The final (design) configuration of the embankments was checked for short-term / undrained and long-term stability / drained.
- Step 6: The immediate, primary and secondary consolidation for the embankment were estimated during construction, at the end of construction (3 yr) and for the operation and maintenance period (30 yr).

⁹ Other PVD properties assumed in modeling include: Ratio of diameter of smear zone to diameter of drain = 1.5, Ratio of undistributed to smear zone permeability = 2, discharge capacity = 8.6 m³/day.

5.4 High Embankments Design

5.4.1 Soil Property Profiles

The subsurface soil stratigraphy in the parkway on embankment segments comprises the following successive deposits:

- About 1 to 2 m thick surficial topsoil and granular layer;
- About 2 to 3 m thick desiccated clay crust;
- About 18 to 23 m thick deposit of soft to firm grey clayey silt to silty clay;
- About 1 to 2 m thick lower granular deposit (silt, sandy silt, silty sand and gravel till); and
- Limestone bedrock.

The soil unit that governs the stability of the embankment slopes is the soft to firm grey clayey silt to silty clay stratum. The undrained shear strength and compressibility characteristics of the grey silty clay deposit change significantly over the segment of the WEP on embankments.

In consideration of the clayey silt to silty clay strength and compressibility variation along the high embankments, distinct soil property profiles have been developed for five approximately 500 m long segments along the Highway 401 embankments. Soil properties for these five segments are shown in Figures 3-3 to 3-7 and Table 4-1 to Table 4-5.

5.4.2 Slope Stability Analyses

Slope stability analyses were carried out to simulate numerous loading scenarios required to achieve final embankment height of up to 11 m for the five analysis sections representing variable subsurface soil conditions and embankment heights. A number of embankment construction stages were considered to develop a loading sequence that would ensure adequate short-term stability during the successive loading stages. Short-term and long-term stability of the embankment with final bench and slope configuration was also checked. The analyses were carried out using Morgenstern-Price method and both circular and non-circular failure surfaces were tested.

The short-term loading condition was based on undrained shear strength parameters, which relates to the end of construction. The increase in the undrained strength (ΔS_u) of the clay deposit following excess pore pressure dissipation and consolidation of the clay strata under successive surcharge loads was calculated based on the net increase in the pre-consolidation pressure ($\Delta P'_c$) using the relationship $\Delta S_u = U \times 0.18 \Delta P'_c$, where U (%) is the degree of consolidation. The progress of settlement and the actual gain of strength of the silty clay deposit will be verified by instrument monitoring and in-situ testing at selected locations. To expedite and maximize the magnitude of strength gain for a given construction stage, the fill loading has to be maximized within the stability tolerance limits. In this regard, whereas the final slopes of the fill placement has been modelled at 3H:1V slope and a bench at 8 m height, temporary preloading surcharge side slopes at 2H:1V are considered.

The long-term loading condition was based on drained soil properties and steady-state pore water pressure conditions. The mounding of the phreatic surface within the embankment was considered to develop due to long-term infiltrations to about 1/4th of the embankment height above the original ground surface.

Significant results of the slope stability analyses are summarized in Table 5-2 and the selected stability result figures are included in Appendix D (Figures D-1 to D-21). The most significant conclusions drawn from the above slope stability analysis results are as follows:

- The embankments of all required heights (up to 11 m) and designed as discussed in this report with wick drains to expedite clay stratum consolidation, stage construction, additional temporary surcharge, and inclusion of lightweight fill, where required, have adequate margin of safety from both short-term and long-term steady state loading conditions during the proposed loading stages and in the final design configurations.
- Based on slope stability calculations, the existing soft grey clayey silt to silty clay stratum encountered west of Sta. 11+100W (area characterised by the weakest clay deposit in the WEP project) does not have sufficient strength to support embankments exceeding 6 m height with side slopes of 3H:1V. Therefore, suitable means of preloading and soil consolidation are necessary to improve the strength of the weak stratum adequately to allow embankment to be built safely and for construction to proceed in a timely manner in accordance with the project schedule.
- Expanded polystyrene (EPS) was considered at some locations (vicinity of Bridges B-1 and B-2) for embankments higher than 8.5 to 9.2 m, depending on the clay strength improvement that can be achieved.
- The temporary surcharge loading stage (i.e., the fill over and above the design embankment fill) is recommended to realise additional primary consolidation during construction and, thus, reduce the future post-construction settlement (due to the remaining primary consolidation and the long-term secondary consolidation). The stability calculations presented are based on 1 m thick temporary surcharge fill.

Table 5-2: Embankments Slope Stability Analysis Results

Analysis Section (Station)	Stage ID	Stage El / Height, m	Stage Slope	Stage Bench Width, m	EPS	Min. Calculated FS		Note
						Short- term	Long-term	
1 (10+050W)	1	185.0 / 6.0	2H:1V	-	w/o	1.2 (1.4)	-	-
	2	187.5 / 8.5	3H:1V	6 at El=185.0		1.2 (1.3)		-
	3	188.2 / 9.2		-		1.2 (1.3)		El=188.5, FS=1.2 (1.3)
	4a (Full Temp Surch.)	190.0 / 11.0		-		<u>1.1</u> (1.2)		See Note 1
	4b (Partial Temp Surch.)			14 at El=188.2		1.2 (1.3)		Partial surcharge and limited live
	5 (Final Config.)	189.0 / 10.0	-	-	w/o	1.2 (1.3)	-	EPS incorporated to reach final configuration
					with	1.4 (1.4)	1.8 (1.9)	
2 (10+600W)	1	185.0 / 6.0	2H:1V		w/o	1.2 (1.4)	-	-
	2	187.5 / 8.5	3H:1V	6 at El=185.0		1.3 (1.4)		-
	3 (Partial Temp Surch.)	189.0 / 10.0		-		1.2 (1.3)		See Note 4
	4 (Final Config)	188.0 / 9.0	-	-		1.4 (1.4)	1.9 (2.0)	-
3 (11+075E)	1	187.7 / 8.7	2H:1V	-	w/o	1.2 (1.4)	-	El=188.0, <u>1.1</u> (1.3)
	2 (Temp Surch.)	190.0 / 11.0		5 at El=187.7		1.2 (1.3)		-
	3 (Final Config.)	189.0 / 10.0	-	-		1.4 (1.5)	1.7 (1.8)	-
4 (11+775W)	1 (Temp Surch.)	189.0 / 8.0	2H:1V	-	w/o	1.5 (1.6)	-	-
	2 (Final Config.)	188.0 / 7.0	-	-		1.8 (1.9)	1.8 (1.9)	-
5 (12+225E)	1 (Temp Surch.)	189.0 / 9.0	2H:1V	-	w/o	1.3 (1.4)	-	-
	2 (Final Config.)	188.0 / 8.0	-	-		1.6 (1.7)	1.5 (1.6)	-

Notes:

- FS values inside parentheses correspond to circular failure surface searches. FS values outside parentheses (and illustrated in figures) are for composite ("optimized") failure surface searches. Underlined FS values are lower than the minimum required FS. These do not satisfy the design criteria for final embankment configurations. The factors of safety during stage loadings are sometimes slightly lower than 1.3 for optimized failure surfaces although they are greater than 1.3 for the circular failure surfaces. These values are considered acceptable for temporary slopes.
- EPS (Expanded Polystyrene)
- For backfill configuration at Bridges B-2, B-3, B-4, B-5 and B-6 refer see corresponding bridge detailed design reports (ref. R-3 to R-7).
- EPS was removed as higher levels of strength gain were measured after the first stage of surcharge.

5.4.3 Settlements

The earthfill embankment and the overlying pavement will experience settlement due to the following phenomena:

- Immediate deformation of subsurface soil strata;
- Primary consolidation of the subsurface soil strata;
- Secondary consolidation of the subsurface soil strata; and
- Compression and deformation of the embankment fill.

Immediate (“elastic”) Deformation: The magnitude of settlement due to immediate undrained deformation of the subsurface soils and the embankment fill was determined based on assumed linear elastic moduli of different strata. The calculated deformations corresponding to different heights for the five analysis sections described in Section 5.3 are summarized in Table 5-3.

Primary Consolidation: Most of the embankment settlement will be due to the primary consolidation of the subsurface soil strata, predominantly related to the grey silty clay stratum. Without drainage enhancement, primary consolidation of the grey silty clay deposit will take a long time to complete (about 10 years). With provision of wick drains installed at suitable spacing, significant part of the primary consolidation (e.g., about 90% consolidation) can be completed in about 60 to 90 days (for each loading stage) and the remaining 10% will be completed in the following 40 to 60 days (i.e., total elapsed time of about 4 to 5 months to complete the entire primary consolidation under a loading sequence).

Secondary Consolidation: The magnitude of settlement due to secondary consolidation of the grey silty clay stratum will be about 20% of the primary consolidation and most of it is expected to occur about 3 to 10 years following the completion of the loading. Although some secondary consolidation could occur simultaneously with primary consolidation, most of it will follow the primary consolidation.

Compression of Embankment Fill: Compression of the compacted embankment fill under its own weight is likely to be about 0.5 to 1% of the embankment height (depending on the placement moisture content and density), and is expected to be mostly completed simultaneously with the fill placement.

Settlement calculations were carried out using Settle3D, Version 2.01 software developed by Rocscience Inc. Settle3D calculates three-dimensional distribution of stresses due to surface loads. The settlements are computed considering one-dimensional strain distribution. Five models representing distinctly different embankment height and subsurface soil conditions were developed. The models simulated the soil compressibility and pre-consolidation characteristics as well as the wick drains. As the wick drains are designed to penetrate 2/3rd thickness of the silty clay to clayey silt stratum, the lower 1/3rd thickness of the stratum was modelled without wick drains.

(i) Primary Consolidation

Summary of settlement calculations for the five analysis sections are provided in Appendix E (Figure E-1 to E-5). In consideration of the distinct soil conditions along parkway-on-embankment, the settlement computations have been carried out separately for the five analysis sections which represent five embankment segments. For each loading stage, the settlement magnitudes were estimated by calculating the change in effective stress in the ground in comparison with the existing overburden pressure and the pre-consolidation pressure. Then the magnitude of settlement was estimated based on the applicable values of the compression index (C_c) and the recompression index (C_r) of the silty clay deposit.

The calculated settlements corresponding to different heights of the embankment for various segments of the embankments are summarized in Table 5-4.

(ii) Time Rate of Settlement

The time rate of primary consolidation and settlement was computed for embankments without and with the provision of PVD (wick drains) to expedite groundwater drainage. Without the wick drains, the elapsed time required to complete settlement corresponding to about 90% of the primary consolidation was estimated to vary from 5 to 10 years (possibly longer, depending on the prevalent hydraulic conductivity of the soils).

The time rate of consolidation analyses indicated that about 90 to 95% of the primary consolidation and the corresponding settlement for each loading stage could be completed in about 60 to 120 days in the presence of wick drains. The wick drains were installed at 1.5 to 2 m spacing depending on the location of the design section.

(iii) Secondary Consolidation

The magnitude of secondary settlement was estimated using the applicable values of the secondary compression index (C_α) of the silty clay deposit and are summarized in Table 5-4. It has been assumed that the secondary consolidation starts when 95% of primary consolidation has achieved.

Summary of total settlement magnitudes for different design segments are enlisted in Table 5-5. The above estimates show that post-construction secondary settlements (creep) can be as high as 5 cm for a 8 m high embankment and hence long-term maintenances are required.

Table 5-3: Summary of Embankment Settlements due to Elastic Compression of Subsurface Soil Strata

Stage	Analysis Section 1 (Sta. 10+050W)		Analysis Section 2 (Sta. 10+600W)		Analysis Section 3 (Sta. 11+075E)		Analysis Section 4 (Sta. 11+775W)		Analysis Section 5 (Sta. 12+250E)	
	Height, m	Elastic Deformation, cm	Height, m	Elastic Deformation, cm	Height, m	Elastic Deformation, cm	Height, m	Elastic Deformation, cm	Height, m	Elastic Deformation, cm
1	6	15	6	15	8.7	16	8	16	9	16
2	8.5	21	8.5	21	11	19	-	-	-	-
3	9.2	23	10	25	-	-	-	-	-	-
4	11	27	-	-	-	-	-	-	-	-

Table 5-4: Summary of Embankment Settlement due to Primary and Secondary Consolidations

Settlement at Analysis Section 1, cm (Sta. 10+050W)				Settlement at Analysis Section 2, cm (Sta. 10+600W)				Settlement at Analysis Section 3, cm (Sta. 11+075E)				Settlement at Analysis Section 4, cm (Sta. 11+775W)				Settlement at Analysis Section 5, cm (Sta. 12+225E)			
Height, m	Elapsed Time, day	Primary	Secondary	Height, m	Elapsed Time, day	Primary	Secondary	Height, m	Elapsed Time, day	Primary	Secondary	Height, m	Elapsed Time, day	Primary	Secondary	Height, m	Elapsed Time, day	Primary	Secondary
6	120	37	0	6	120	34	0	8.7	120	30	0	8	120	22	0	9	120	27	0
8.5	240	55	1	8.5	240	50	1	11	240	36	1	7	240	22	1	8	240	28	1
9.2	360	60	1	10	360	58	1	10	360	36	2								
11	480	69	2	9	480	58	2												
10	600	69	2																
10	3 yr	69	4	9	3 yr	58	3	10	3 yr	36	4	7	3 yr	22	5	8	3 yr	28	4
10	30 yr	69	9	9	30 yr	58	8	10	30 yr	36	7	7	30 yr	22	9	8	30 yr	28	9

Table 5-5: Summary of Total Estimated Settlements

Settlement Component (cm)		Analysis Section 1 (Sta. 10+050W)	Analysis Section 2 (Sta. 10+600W)	Analysis Section 3 (Sta. 11+075E)	Analysis Section 4 (Sta. 11+775W)	Analysis Section 5 (Sta. 12+225E)
Immediate Elastic, cm		27	25	19	16	16
Primary Consolidation, cm		69	58	36	22	28
Secondary Consolidation, cm	End of Construction	2	2	2	1	1
	3 year	4	3	4	5	4
	30 year	9	8	7	9	9
Total Settlement (30 year), cm		105	91	62	47	53

5.4.4 Embankment Design Configurations

The result of stability/settlement analyses were used to develop the design of the high embankments along Highway 401 and E.C. Row EBL. The design configurations of the embankments are described in Section 5.2. The recommended approach for constructing the embankments in different segments of the parkway is illustrated in profile view on Drawings G910 to G914 along Highway 401 and on Drawings G915 to G919 along E. C. Row Expressway East Bound lane.

Slope stability analyses carried out in Section 5.4 were used to determine the required staging configuration at each segment of the highway to safely raise the embankment to temporary surcharge levels. According to these studies, the design configuration along the two embankments can be divided into 16 segments. The recommended construction approaches for the embankments are summarized in Table 5-6 and Table 5-7.

As a result of partial temporary surcharge in the vicinity of Bridge B-2 EPS has to be incorporated within the embankment fill to achieve the required surcharge and minimize long-term settlements. EPS is also required to raise the embankments to final design levels near Bridge B-1.

Table 5-6: Highway 401 – Summary of Embankment Design Configurations

Embankment Segment	Length, m	Location, Station	Height, m	Surcharge Thickness, m	Number of Stages	Analysis Section	PVD spacing, m		EPS Required
							Under Core	Under Slope	
1	100	10+030W – 10+130W	11.0 – 8.5	1	5	1	1.5	2	Yes
2	100	10+130W – 10+230W	8.5 – 6.0	1	3	1	1.5	2	-
2a***	55	10+230W – 10+285W	± 6.0	1	2	1	2.5	2.5	-
3	115	10+285W – 10+400W	< 6.0	1	2	1	2	2	-
4	110	10+400W – 10+510W	6.0 – 8.5	1	3	2	1.5	2	-
5a	55	10+510W – 10+565W	8.5 – 9.0	1	4	2	1.5	2	-
5b	55	10+565W – 10+620W	9.0 – 10.0	1	4	2	1.5	2	Yes
BRIDGE B-2*	35	10+620W – 10+655W	-	-	-	-	-	-	-
5c	55	10+655W – 10+710W	10.0 – 9.0	1	4	2	1.5	2	Yes
5d	70	10+710W – 10+780W	9.0 – 8.5	1	4	2	1.5	2	-
6a	80	10+780W – 10+860W	8.5 – 6.0	1	3	2	1.5	2	-
6b	70	10+860W – 10+930W	6.0 – 4.0	0.8	3	2	1.5	2	-
7a	70	10+930W – 11+000W	4.0 – 3.0	0.5	2	2	NO	NO	-
7b	130	11+000W – 11+130W	< 3.0	0.0	2	2	NO	NO	-
7c	270	11+130W – 11+400W	3.0 – 4.0	0.5	2	2	NO	NO	-
7d	80	11+400W – 11+480W	4.0 – 6.0	0.8	2	2	NO	NO	-
8a	270	11+480W – 11+730W	6.0 – 8.0	1	2	4	2	2	-
BRIDGE B-4*	30	11+730W – 11+760W	-	-	-	-	-	-	-
8b	230	11+760W – 11+980W	8.0 – 6.0	1	2	4	2	2	-
9a**	70	11+980W – 12+050W	6.0 – 4.0	0.8	2	4	NO	NO	-
9b	110	12+050W – 12+160W	4.0 – 3.0	0.5	2	4	NO	NO	-
9c	130	11+160W – 12+290W	< 3.0	0	2	4	NO	NO	-

*: The stage loading requirements to be defined in consideration of bridge construction scheduling, which is beyond the scope of this report.

***: Refer to Section 6.4 for embankment configuration at 2nd street.

***: Refer to Section 6.1 for embankment configuration at BP corridor.

Table 5-7: E.C. Row Expressway East Bound Lane – Summary of Embankment Design Configurations

Embankment Segment	Length, m	Location, Station	Height, m	Surcharge Thickness, m	Number of Stages	Analysis Section	PVD spacing, m		EPS Required
							Under core	Slope	
1	50	10+720E – 10+770E	< 8.7	0.5	2	3	1.5	2	-
2a	175	10+770E – 10+945E	8.7 – 10.0	1	3	3	1.5	2	-
BRIDGE B-3*	150	10+945E – 11+095W	-	-	-	-	-	-	-
2b	45	11+095E – 11+140E	10.0 – 8.7	1	3	3	1.5	2	-
3	130	11+140E – 11+270E	8.7 – 5.5	1	2	3	1.5	5	-
4a	50	11+270E – 11+320E	5.5 – 4.0	0.8	2	3	NO	NO	-
4b	150	11+320E – 11+470E	± 4.0	0.5	2	3	NO	NO	-
4c	50	11+470E – 11+520E	4.0 – 5.5	0.8	2	3	NO	NO	-
5a	185	11+520E – 11+705E	5.5 – 8.0	1	2	4	2	2	-
BRIDGE B-5*	30	11+705E – 11+735E	-	-	-	-	-	-	-
5b	195	11+735E – 11+930E	8.0 – 6.0	1	2	4	2	2	-
6**	150	11+930E – 12+080E	6.0 – 4.5	0.8	2	4	NO	NO	-
7a	160	12+080E – 12+240E	6.0 – 9.0	1	2	5	2	2	-
BRIDGE B-6*	105	12+255E – 12+360E	-	-	-	-	-	-	-
7b	60	12+370E – 12+430E	9.0 – 6.0	1	2	5	2	2	-

*: The stage loading requirements to be defined in consideration of bridge construction scheduling, which is beyond the scope of this report.

**: Refer to Section 6.4 for embankment configuration at 2nd street.

5.5 Live Birthing Sites

5.5.1 General

Two environmentally sensitive Live Birthing Sites (LBS) have been identified along the proposed Highway 401 alignment, as shown in Figure 5-2. At Stations 10+750W and 11+095W (equivalent to Sta. 11+065E), referred to as LBS1 and LBS2, the environmentally sensitive areas fall within the footprint of the proposed embankment.

The alternative embankment configuration to accommodate LBS1 involves steepened south embankment slopes from 3H:1V to 2H:1V at LBS1. The design of Parkway at LBS2, which is in the vicinity of Bridge B-3 (E. C. Row EBL), involves high walls on both sides. The 2H:1V embankment configuration at LBS1 has been assessed from slope stability point of view, while the design Parkway at LBS2 is covered under the high walls design.

5.5.2 Slope Stability of LBS1

The calculated minimum FS against global instability for LBS1 were in excess of 1.3 and met the minimum requirements in the Project Agreement (PA) for short-term and long-term conditions, respectively (Table 5-8).

Table 5-8: LBS1 – Sta. 10+750W - Slope Stability Analysis Results

Embankment Stage	Stage El / Height, m	Stage Slope	Stage Bench With, m	Min. Calculated FS		Note
				Short-term	Long-term	
1	185.0 / 6.0	2H:1V	-	1.2 (1.4)	-	-
2 (Partial Temp Surcharge)	187.5 / 8.5	2H:1V	-	1.2 (1.4)		-
3 (Final Configuration)	186.5 / 7.5	2H:1V	-	1.3 (1.4)	1.3 (1.4)	-

Notes:

1. FS values inside parentheses correspond to circular failure surface searches.
2. FS values outside parentheses (and illustrated in figures) are for optimized (non-circular) failure surface searches.

Soil properties for LBS1 were based on strength profile 2. Slope stability figures for the final configuration of embankment are provided in Appendix D (Figures D-24 and D-25).

5.6 Stability of Temporary Preloading Fill at Bridge Abutments

The slope stability of the temporary preloading surcharge fill at bridge abutments have been checked and presented in AMEC, 2012 reports (ref. R-3 to R-7).

5.7 Settlements at Bridge Approachways

As indicated in Section 5.2, the PA design criteria requires that the pavement settlements expected to occur adjacent the bridge abutments between substantial completion and the expiry date (i.e., during the 30 years O&M phase) be limited to 5 mm at the abutment and gradually increase to 100 mm at 100 m distance from the abutment. To assess the effectiveness of 1 m surcharge fill over and above the design

fill height was analyzed at the Bridge B-2 to B-6 abutments, settlement analyses were carried out for two scenarios as follows:

1. Settlement for embankment with 1 m surcharge fill: Intermediate Elastic + 100% Primary + Secondary Consolidation during 3 years following surcharge placement (I+P+S_{3yrs})
2. Settlement for embankment without surcharge fill: Intermediate Elastic + 100% Primary + Secondary Consolidation during 30 years following construction (I+P+S_{30yrs})

The results of the settlement analyses, summarized on Table 5-9, show that the calculated (I+P+S_{3yrs}) with 1 m surcharge will be approximately equal to the calculated (I+P+S_{30yrs}) under design configuration loading. For example, the calculated (I+P+S_{3yrs}) for 9 m high embankment with 1 m surcharge fill and the calculated (I+P+S_{3yrs}) for 9 m design height of the embankment at Bridge B-2 are 875 mm and 879 mm, respectively. This suggests that minimum 1 m surcharge maintained for about 3 years before pavement construction will effectively eliminate future long-term settlement during O&M phase. Evidently, if the 1 m surcharge fill is applied for shorter duration, then the remnant secondary consolidated related settlement will continue during the post construction phase.

The proposed surcharge approach may be reviewed and refined based on experience gained during actual construction.

Table 5-9: Influence of Surcharge on Bridge Approachway Settlements

Bridge	Analysis Section	Location, Sta.	Embankment Height, m	Settlement, mm					
				Elastic	Primary	Secondary		Total	
						3 yr	30 yr	3 yr	30 yr
B-2	2	10+600W	9+1 (Surcharge)	247	582	46	121	875	-
			9	226	575	32	78	-	879
B-3	3	11+075E	10 +1 (Surcharge)	187	362	60	131	609	-
			10	178	357	38	75	-	610
B-4 & B-5	4	11+775W	7+1 (Surcharge)	160	225	62	129	447	-
			7	141	218	46	91		450
B-6	5	12+225E	8+1 (Surcharge)	165	302	54	120	521	-
			8	150	281	41	91	-	522

6 Impact on Utility Lines and Existing E.C. Row Embankment

Analyses were undertaken to assess the impact of the proposed embankments on the existing E.C. Row Expressway and the proposed realignments of the utility lines.

Settlement analyses were carried out to estimate both the immediate and long-term magnitudes of settlement resulting from the embankment fill placement. With the staged fill placement and provision of PVD mentioned earlier, most of the settlement due to primary consolidation would be completed in 3 to 4 months while the settlement due to secondary consolidation is expected to be completed in about 5 to 10 years thereafter. However, in areas where PVD cannot be installed, the elapsed time required to complete settlement corresponding to about 90% of the primary consolidation would vary from 5 to 10 years (possibly longer, depending on the prevalent hydraulic conductivity of the soils).

6.1 BP Pipelines Corridor – Sta. 10+250W

This BP line runs south-north under the proposed embankments for the EBR2, Highway 401 express lanes and the WBR2 (Figure 6-1). Settlements expected along the BP pipeline corridor due to the embankments and landscape stockpiles to be developed near the west end of the WEP project were estimated using Settle3D software.

The soil properties for various strata were estimated based on overall profiles developed for a 700 m long segment of the project between Sta. 9+700W and 10+400W (Soil Profile 1).

Due to the proximity and similarity of their finished grades, the embankments for Highway 401 and EBR2 have been modeled as a single embankment with 6 m height and 3H:1V side slopes. The estimated height of the WBR2 is approximately 3 m with side slopes of 3H:1V. In addition to Highway 401/EBR2 and WBR2, the landscaping berm located west of BP line was also simulated.

Figure 6-2 shows the settlement profile along the BP line. The estimated settlement magnitudes calculated using Settle3D are approximate, and the actual magnitudes could differ from these values by up to 35 to 50% (i.e., maximum long-term settlement of about 60 to 90 cm) under the highest part of Highway 401).

The original design of High Embankments over the BP corridor located approximately at Sta. 10+270W incorporated EPS (expanded polystyrene) within the embankment in order to reduce the magnitude of fill loading and the associated settlements within the area of the pipelines. This design was adopted in consideration of the difficulty and cost associated with PVD installation over the existing BP lines.

In April 2012, PIC requested AMEC to considering the use of normal soil fill in conjunction with perforated vertical and inclined wick drains (PVD and PID). In this regard, PIC initially requested an evaluation of the maximum spacing for the PVD associated with a 10 months preloading cycle for the 70 m wide area of the high embankment (Sta. 10+230W to Sta. 10+300W) over the BP line corridor. Based on the analysis results, PVD installed at 2.5 m spacing in a triangular pattern appeared to be suitable to achieve 90% primary consolidation in a 10 month loading duration. Considering the unusually wide

spacing between the drains, the actual progress of consolidation should be verified with field settlement monitoring, and contingencies (e.g., additional surcharge) should be considered if necessary (ref. R-8).

As the vertical PVDs cannot be installed in the vicinity of the BP line (i.e., within ~4.4 m distance from the BP corridor centreline), PIC proposed the use of PIDs to access the soil deposit lying within this 8.7 m wide corridor.

The time required to achieve 90 to 95% of primary consolidation under the BP corridor with the proposed PVD/PID configuration is similar to the time it will take to achieve same levels of consolidation with PVD (only) outside the corridor. Estimates show that the proposed PID (perforated inclined drain) configuration installed at 2.5 m spacing in a triangular pattern appear to be suitable to achieve 90 to 95% primary consolidation in a 10 month loading duration.

Considering the lack of experience with the proposed wick drains configuration (e.g., combination of PVDs and PIDs and the unusually wide spacing between them) in the Windsor-Essex area, the actual progress of consolidation should be verified with field settlement monitoring, and contingencies (e.g., additional surcharge) should be considered.

A typical section showing the required EPS configuration at the BP corridor is provided in Drawing G925.

6.2 Matchette Road Gas Line – Sta. 10+650W

The management of anticipated settlements along the gas main on Matchette Road is addressed in more details in AMEC, design report on Bridge B-2 (ref. R-3). In summary, the gas line existing under the current west shoulder of the road has been relocated along the center line of the road. To meet the timeline of the project, the height of the embankments abutting Matchette Road have been limited to 6 m, the balance to the final design grade will be covered using EPS.

6.3 Malden Road Gas Line – Sta. 11+700W

The influence of Highway 401 embankment and Bridges B-4 and B-5 abutments on ground settlements along the Malden Road centreline was estimated to assess the feasibility of temporary relocation of the existing high pressure gas line from its current location beneath the road shoulder to the centerline.

The soil properties for various strata were estimated based on profiles developed for a 700 m long segment of the project between Sta. 11+500W and 12+200W (Soil Profile 4).

The bridge approachways have been modeled as two 8.5 m high embankments with 3H:1V side slopes (Figure 6-3). Temporary buttresses with slopes at 1H:1V were assumed at the ends of the approachway embankments. The spacing between the buttresses was assumed 14 m at the toe.

Figure 6-4 shows the calculated settlement profile along the Malden Road centreline. As, illustrated, the calculated maximum total settlement along the Malden Road centerline could vary between 10 and 15 cm

at the centre of Highway 401 and reduce to less than 2 cm at about 60 m distance away from the center line.

6.4 Second Street Sewer Line

The Second Street intersection is an unopened access road, and the area will be subject to direct surcharge loads from future high embankments. The proposed sewer line runs parallel to the toe of embankment (12.5 offset from the toe and at 9.5 m depth) till it reaches Second Street at Sta. 12+000W, where it goes under the new construction of Highway 401 and E.C. Row Expressway East Bound Lane (ECR EBL) along the existing Second Street and connects to the active Sewer Line under the existing E. C. Row. The potential settlement of the sewer line parallel to the embankment and the necessity for use EPS to control the settlement across the high embankment (i.e., along the Second Street) were evaluated.

The soil properties for various strata were estimated based on overall profiles developed for a 700 m long segment of the project between Sta. 11+500W and 12+200W (Soil Profile 4).

The 401 highway and E C. Row Expressway embankments have been modeled as 8 m high embankments with 2H:1V side slopes (Figure 6-5).

Figure 6-6 shows the settlement profile at pipe elevation parallel to the embankment for options 1 and 2 at Sta. 12+200W. As illustrated, the maximum total settlement is 2 cm.

EPS was incorporated over the sewer line and was configured through trials to yield acceptable settlement at the sewer line level. The model made provision of drainage layer below the EPS and 1 m thick soil cover over it. Figure 6-7 shows the proposed EPS configuration to achieve manageable levels of settlements along the sewer line under the embankment. Settlement profiles are provided in Appendix E at the pipe and embankment final grade elevations. By provision of 6.0 m thick EPS (and drainage layer and 1 m thick soil cover) at the sewer location, long-term (30 yr) total settlement at pip level can be reduced to 3.02 cm (Figure E-6). As shown in Figure E-7, the post construction settlement (30yr estimate – EOC estimate) of the embankment segment over the sewer line (with EPS and without PVD's) is $5.1 - 0.4 = 4.7$ cm. The post-construction settlement of embankment built with clay fill and PVD's is $68.0 - 73.3 = 5.3$ cm. The above post-construction settlements meet the PA required relative settlements (100 mm settlement in 100 m distance).

Refer to Highway drawing package for EPS configuration at the sewer line.

6.5 Existing E.C. Row Expressway Embankment – Sta. 11+625W

The impact of the new construction on the existing E.C. Row Expressway was estimated in terms of immediate elastic and primary consolidation settlements.

Elastic stress distribution was used to calculate the embankment loading. The settlement profile was calculated based on soil elastic modulus (E) and compressibility characteristics (P'_c , C_r and C_c) of different strata which are presented in Figure 6-8. As, illustrated, the maximum immediate and primary settlement across the existing E.C. Row Embankment at Sta. 11+625W were estimated to be 5 and 25 cm, respectively.

7 Embankment Construction

7.1 General Comments and Recommendations

As mentioned earlier, the project at this time has progressed to near the completion of Stage I. The comments below were provided in the preliminary ADP design recommendations and they should be considered valid, where applicable, for the continuation of the project.

Foundation Preparation: The embankment footprint area will be cleared, grubbed and stripped. The extent of ground stripping will be determined based on site inspection after clearing and grubbing. Generally, whereas thin and firm topsoil may be left in place, all compressible peat/muskeg, wetland areas and other unsuitable material should be stripped and transported to designated areas. The Contractor should employ appropriate ground improvement approach within areas of unstable subgrade to facilitate constructability. Such treatment may involve suitable fill layer, geogrid sheet, a combination of the two, or other methods based on the ground conditions.

It is also recommended that suitable fill (e.g., clay obtained from required excavations in eastern sector of the WEP project) be placed to raise the prepared foundation surface to compensate for the sagging of the drainage blanket; the thickness of the fill should be approximately equal to the magnitude of anticipated settlement of the embankment. The compensatory fill should be trapezoidal shaped as per the anticipated settlement under the parkway embankment.

Wick Drains: As indicated earlier in Section 5.2, wick drains (100 mm wide with 2 mm core thickness) are required to expedite settlement and strength gain of the clay strata at selected segments of the high embankments. The wick drain layout is in a triangular pattern and at 1.5 m or 2.0 m spacing depending on the height of the embankment and the strength of the subsurface soil strata as indicated in Table 5-6 and Table 5-7.

Article 5.5(e) in the executed PA states that the design and construction of prefabricated vertical drains for high fill embankments should be in accordance with OPSS 220 – Construction Specification for Wick Drain Installation. OPSS 220 also provides the specifications for three components of the wick drain (namely, the core, the geotextile and the drain).

Drainage Blanket: As indicated in Section 5.2, a minimum 0.3 m thick drainage blanket of free draining sand and gravel fill is to be placed on the prepared ground to facilitate evacuation of the drainage water expelled out of the wick drains. Geotextile fabric (non-woven, Terrafix 300R, or equivalent) should be used as a separator sheet below the drainage blanket. Another geotextile fabric should be laid over the drainage blanket after completing wick drain installation.

The expelled water will be directed through a system of collector ditches along the embankment toe to collector sumps and then pumped out to a designated discharge location. Depending on the estimated ground settlement of the embankment segment, the characteristics of the blanket fill, and the ground and constructability conditions, the thickness of the drainage blanket may vary, but should not be less than 300 mm. A thin (approximately 100 to 150 mm thick) clean sand and gravel fill layer should be placed after wick drain installation to cover the drain stick-ups and the drainage blanket. Alternatively, a

geotextile fabric (non-woven, Terrafix 300R, or equivalent) may be used to cover the wick drain stick ups and facilitate the placement and compaction of the clay backfill material.

The granular blanket shall be placed according to the earth embankment requirements of OPSS 220 and compacted to a minimum 90% of its maximum dry density measured according to ASTM D6938. The granular blanket can comprise Granular A, Granular B, Type I or Type II material as per OPSS 1010, except that 100% shall pass the 37.5 mm sieve.

As indicated in Section 5.2, up to 1.0 m fill layer should be placed below the drainage blanket to compensate for the anticipated settlement of the drainage blanket and ensure positive drainage of expelled water to drainage system at embankment toe.

Expanded Polystyrene (EPS): Based on stability assessment of fill stages, the final 1 m thick surcharge layer cannot be placed over the entire width of the crest in design sections 1 and 2, which represent embankment configurations along Highway 401 between Sta. 10+030W and 10+130W (100 m) and from Sta. 10+575W to 10+700W (125 m).

EPS will also have to be incorporated within the embankment fill in final fill for Highway 401 embankment between Sta. 10+030W and 10+130W. The design to avoid EPS would require increased preloading by enlarging the footprint area of the fill.

EPS was also incorporated in the backfill behind Bridge B-2 abutments at Matchette Rd (Sta. 10+575W to 10+700W) as well as the high embankments sections over the Second Street gas line (Sta. 12+000W) where PVD were not installed.

See Drawing G926 for major construction requirements for the use of EPS. Alternative stabilization approaches for construction over soft clays may comprise reducing PVD spacing or incorporating a reinforced mat.

Embankment Fill: The material for embankment fill will be obtained from the required excavations in the eastern sectors of the WEP. The suitability of the fill material will be verified in terms of its gradation and plasticity characteristics and the in-situ moisture content. The fill material will be placed in maximum 300 mm thick loose lifts at w_{opt} to $w_{opt}+3\%$ moisture content and compacted to minimum 95% of the SPMDD¹⁰. The moisture content of the fill material should be modified, if required, by appropriate watering, or drainage and/or drying by stockpiling in wind rows, etc., to achieve the suitable placement water content.

Fill loading for each construction stage is to be maintained to achieve adequate degree of consolidation as per the design assumptions (Table 5-6 and Table 5-7).

The strength of the silty clay stratum will be determined by CPT and Nilcon vane testing following completion of consolidation and before proceeding with the next stage of fill placement. The CPT and Nilcon vane tests may be limited to the depth segment of the clay stratum where strength gain is expected

¹⁰ w_{opt} is the optimum water content determined by Standard Proctor Compaction Test and SPMDD is the Standard Proctor Maximum Dry Density.

to occur under the previously applied fill loading stage. No fill placement stage can be undertaken until the clay stratum is proven to have gained sufficient strength.

The fill material requirements to compensate for the embankment settlement should be based on the estimated magnitudes of long-term settlements, Table 7-1.

Temporary Additional Surcharge: The fill material for the temporary surcharge (about 1 m or thicker) can comprise any inorganic material. For the purposes of surcharging the ground, the extra fill does not have to meet any gradation and compaction requirements (i.e., it can be placed, spread and dozer compacted). The surcharge loading should be maintained for as long as possible to achieve maximum consolidation and settlement prior to pavement construction. In this regard, it is recommended that if feasible, the pavement construction over the embankments be delayed to 3 to 4 months before the operations and maintenance phase.

Table 7-1: Summary of Estimated Settlements

Settlement Component		Settlement, as % of Embankment Height (H)				
		Analysis Section 1 (Sta. 10+050W)	Analysis Section 2 (Sta. 10+600W)	Analysis Section 3 (Sta. 11+075E)	Analysis Section 4 (Sta. 11+775W)	Analysis Section 5 (Sta. 12+225E)
Immediate Elastic		2.7%	2.8%	1.9%	2.3%	2.0%
Fill Compression		2.0%	2.0%	2.0%	2.0%	2.0%
Primary Consolidation		6.9%	6.4%	3.6%	3.1%	3.5%
Secondary Consolidation	EOC	0.2%	0.2%	0.2%	0.1%	0.1%
	3 year	0.4%	0.3%	0.4%	0.7%	0.5%
	30 year	0.9%	0.9%	0.7%	1.3%	1.1%
Total (30 year)		12.5%	12.1%	8.2%	8.7%	8.8%

Drawings G920 to G922 show fill loading (including the proposed surcharge) at various cross sections along the high embankment. See Drawing G924 for major construction and instrumentation requirements for high embankments, as well as other relevant construction notes.

7.2 Optimizing Long-term Post-Construction Settlement

The settlement estimates can assist in the evaluation of the magnitude of surcharge preloading that will be required to compensate for the long-term post-construction settlement under the design embankment. As noted earlier, whereas the settlement due to short-term factors (i.e., primary consolidation and elastic deformation) is expected to be completed within 4 to 5 months following placement of the last fill loading (i.e., the temporary surcharge fill), the long-term secondary consolidation is likely to continue for another 3 to 10 years.

As noted in Section 5.4.3, the temporary surcharge fill has been incorporated in the embankment construction to realise additional primary consolidation during construction and, thus, reduce the future post-construction settlement (due to the remaining primary consolidation and the long-term secondary consolidation). It is therefore considered that maintaining the temporary surcharge until just before

pavement construction would result in improving the subsurface and embankment soils adequately and pre-empt the future settlements under the design loads from all primary and secondary processes. If the embankment monitoring suggests on-going settlement due to secondary consolidation, the following additional mitigation measures may be considered:

- Increasing the thickness of the temporary surcharge fill, which may have to be implemented in two stages; and/or
- Replacing part of the embankment fill adjacent the bridge structure with light-weight fill (the light-weight fill thickness can be tapered to control the differential settlements). This will regard the last loading stage as a surcharge pre-loading stage and a lowered embankment with EPS as the final configuration.

8 Instrumentation and Monitoring

As mentioned earlier in Section 3.3, 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 (ref. R-2).

The Contractor is responsible for planning, installation and maintenance of instrumentation as well as the completion of 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.

9 Limitations of Report

This report presents the subsurface soil and groundwater conditions inferred from geotechnical investigation and geotechnical design of the embankment 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.

10 Closure

The design for High Embankments was developed by Dr. Siavash Farhangi, P.Eng. under the direction of Dr. Narendra S. Verma, P.Eng. Dr. Dan Dimitriu, P.Eng. provided the senior review of the report. Mr. Matt Oldewening, P.Eng. managed the geotechnical investigation and Mr. Brian Lapos, P.Eng. is the project manager.

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Yours truly,

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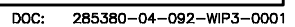
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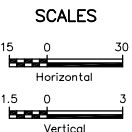
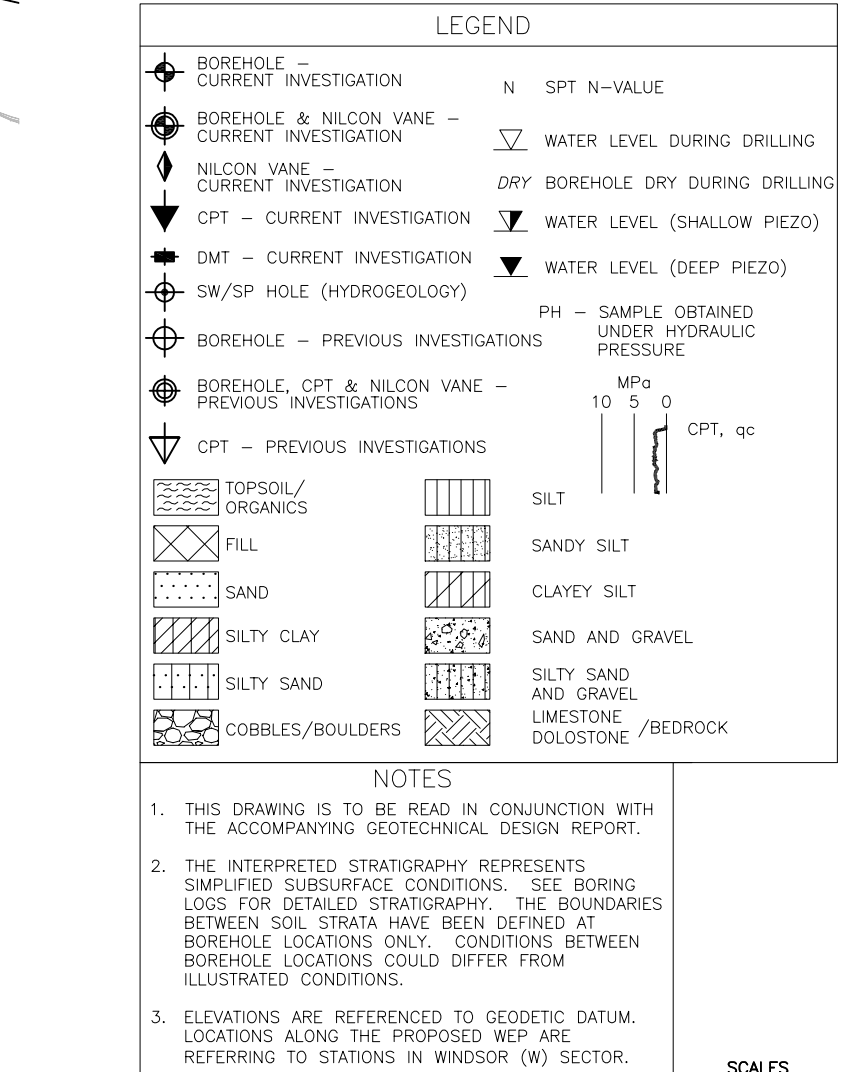
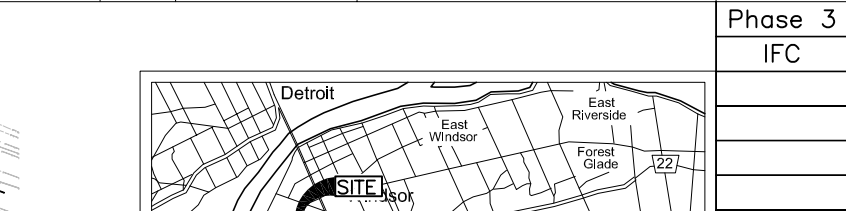
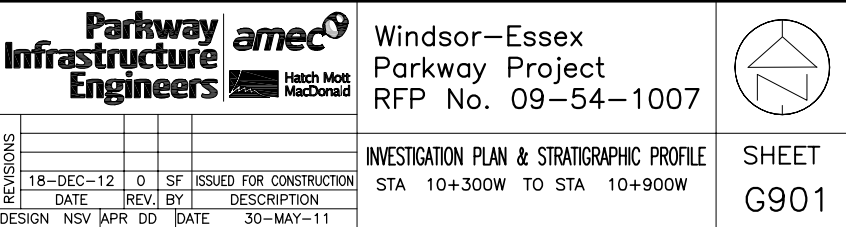
SHEET
G900

The key plan map shows the location of the Site in Windsor, Ontario, relative to Detroit, Michigan, and Tecumseh, Ontario. The Site is marked with a black dot and labeled 'SITE' in a black box. Major roads shown include I-19, I-401, and I-46. Local roads shown include Ojibway, Front Rd, Disputer Rd, Howard Ave, Walker Rd, and Manning Rd. The map also shows the Detroit River and the Windsor-Detroit border. A scale bar indicates a distance of 0 to 4 Km.

	BOREHOLE - CURRENT INVESTIGATION	N	SPT N-VALUE
	BOREHOLE & NILCON VANE - CURRENT INVESTIGATION		WATER LEVEL DURING DRILLING
	NILCON VANE - CURRENT INVESTIGATION	DRY	BOREHOLE DRY DURING DRILLING
	CPT - CURRENT INVESTIGATION		WATER LEVEL (SHALLOW PIEZO)
	DMT - CURRENT INVESTIGATION		WATER LEVEL (DEEP PIEZO)
	SW/SP HOLE (HYDROGEOLOGY)	PH	SAMPLE OBTAINED UNDER HYDRAULIC PRESSURE
	BOREHOLE - PREVIOUS INVESTIGATIONS		
	BOREHOLE, CPT & NILCON VANE - PREVIOUS INVESTIGATIONS		
	CPT - PREVIOUS INVESTIGATIONS		
	TOPSOIL/ ORGANICS		
	FILL		
	SAND		
	SILTY CLAY		
	SILTY SAND		
	COBBLES/BOULDERS		

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN REPORT.
2. THE INTERPRETED STRATIGRAPHY REPRESENTS SIMPLIFIED SUBSURFACE CONDITIONS. SEE BORING LOGS FOR DETAILED STRATIGRAPHY. 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. LOCATIONS ALONG THE PROPOSED WEP ARE REFERRING TO STATIONS IN WINDSOR (W) SECTOR.





SHEET
G902

IFC



SCALE

1 0 2 4K_N

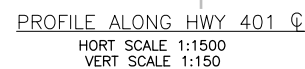


	BOREHOLE - CURRENT INVESTIGATION	N	SPT N-VALUE
	BOREHOLE & NILCON VANE - CURRENT INVESTIGATION		WATER LEVEL DURING DRILLING
	NILCON VANE - CURRENT INVESTIGATION	DRY	BOREHOLE DRY DURING DRILLING
	CPT - CURRENT INVESTIGATION		WATER LEVEL (SHALLOW PIEZO)
	DMT - CURRENT INVESTIGATION		WATER LEVEL (DEEP PIEZO)
	SW/SP HOLE (HYDROGEOLOGY)	PH	SAMPLE OBTAINED UNDER HYDRAULIC PRESSURE
	BOREHOLE - PREVIOUS INVESTIGATIONS		
	BOREHOLE, CPT & NILCON VANE - PREVIOUS INVESTIGATIONS	10	MPa
	CPT - PREVIOUS INVESTIGATIONS	5	0
	TOPSOIL/ ORGANICS		CPT, qc
	FILL		
	SAND		
	SILTY CLAY		
	SILTY SAND		
	COBBLES/BOULDERS		
			SILT
			SANDY SILT
			CLAYEY SILT
			SAND AND GRAVEL
			SILTY SAND AND GRAVEL
			LIMESTONE DOLOSTONE /BEDROCK

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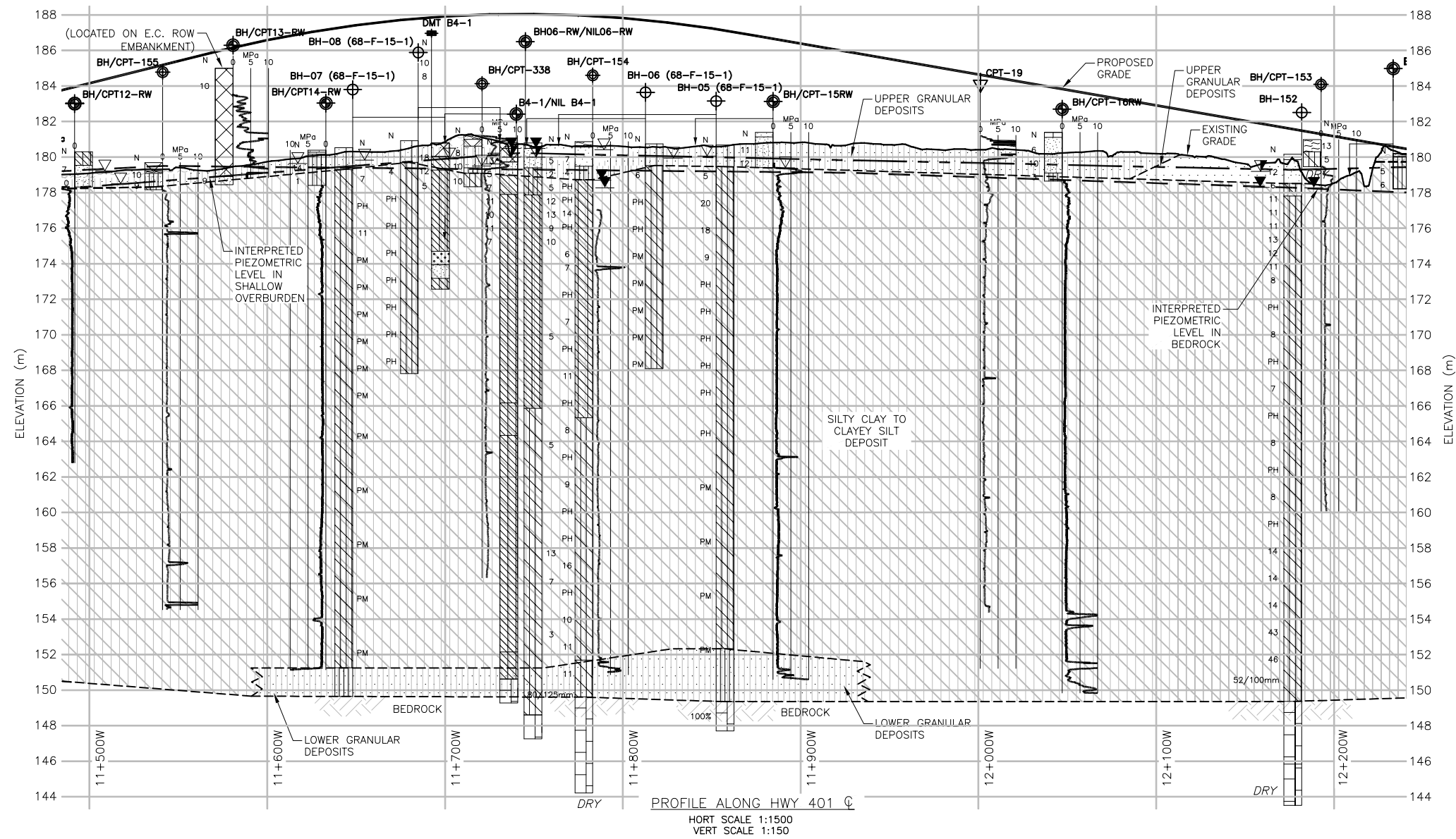
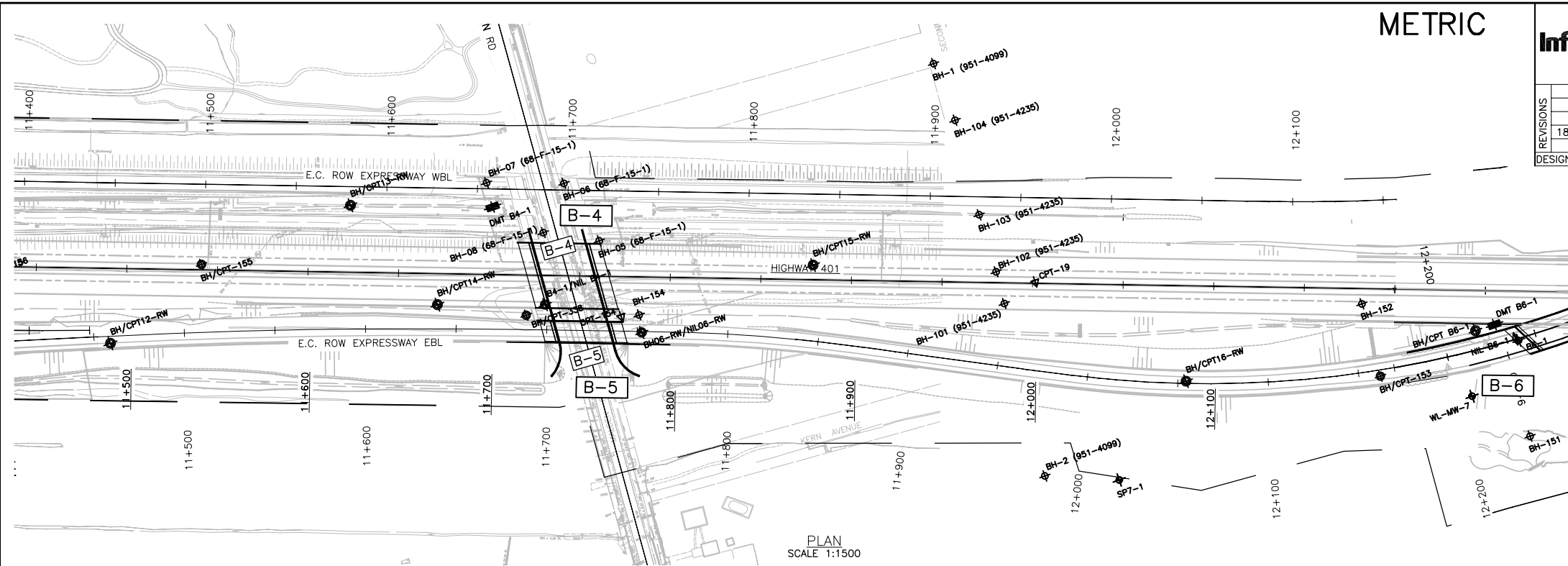
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Vertical



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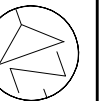


METRIC

Parkway Infrastructure Engineers		amec	
DESIGN		Hatch Mott MacDonald	
REVISIONS	18-DEC-12	0	SF
DATE	REV.	BY	DESCRIPTION
NSV	APR	DD	DATE
			30-MAY-11

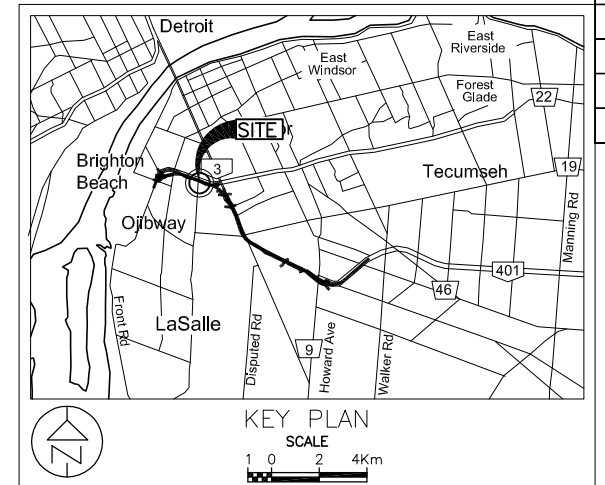
Windsor-Essex
Parkway Project
RFP No. 09-54-1007

INVESTIGATION PLAN & STRATIGRAPHIC PROFILE
STA 11+500W TO STA 12+200W



SHEET
G903

Phase 3
IFC



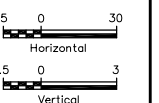
LEGEND

BOREHOLE - CURRENT INVESTIGATION	N SPT N-VALUE
BOREHOLE & NILCON VANE - CURRENT INVESTIGATION	WATER LEVEL DURING DRILLING
NILCON VANE - CURRENT INVESTIGATION	DRY BOREHOLE DRY DURING DRILLING
CPT - CURRENT INVESTIGATION	WATER LEVEL (SHALLOW PIEZO)
DMT - CURRENT INVESTIGATION	WATER LEVEL (DEEP PIEZO)
SW/SP HOLE (HYDROGEOLOGY)	PH - SAMPLE OBTAINED UNDER HYDRAULIC PRESSURE
BOREHOLE - PREVIOUS INVESTIGATIONS	
BOREHOLE, CPT & NILCON VANE - PREVIOUS INVESTIGATIONS	
CPT - PREVIOUS INVESTIGATIONS	
TOPSOIL/ ORGANICS	SILT
FILL	SANDY SILT
SAND	CLAYEY SILT
SILTY CLAY	SAND AND GRAVEL
SILTY SAND	SILTY SAND AND GRAVEL
COBBLES/BOULDERS	LIMESTONE /BEDROCK
	DOLOSTONE

NOTES

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SCALES



METRIC

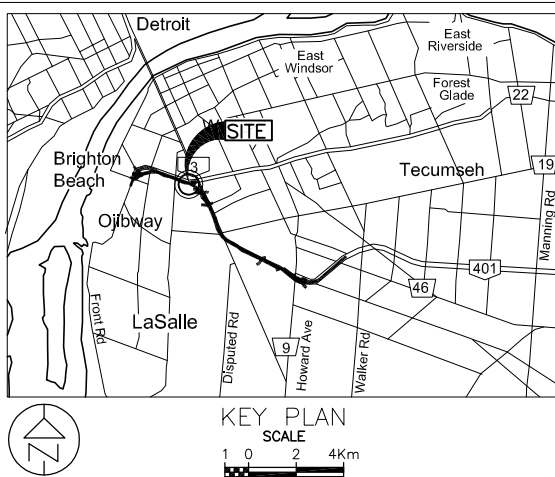


REVISIONS	DATE	REV.	BY	DESCRIPTION
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DESIGN	NSV	APR	DD	DATE 30-MAY-11

INVESTIGATION PLAN & STRATIGRAPHIC PROFILE
STA 12+100W TO STA 12+800W

SHEET
G904

Phase 3
IFC



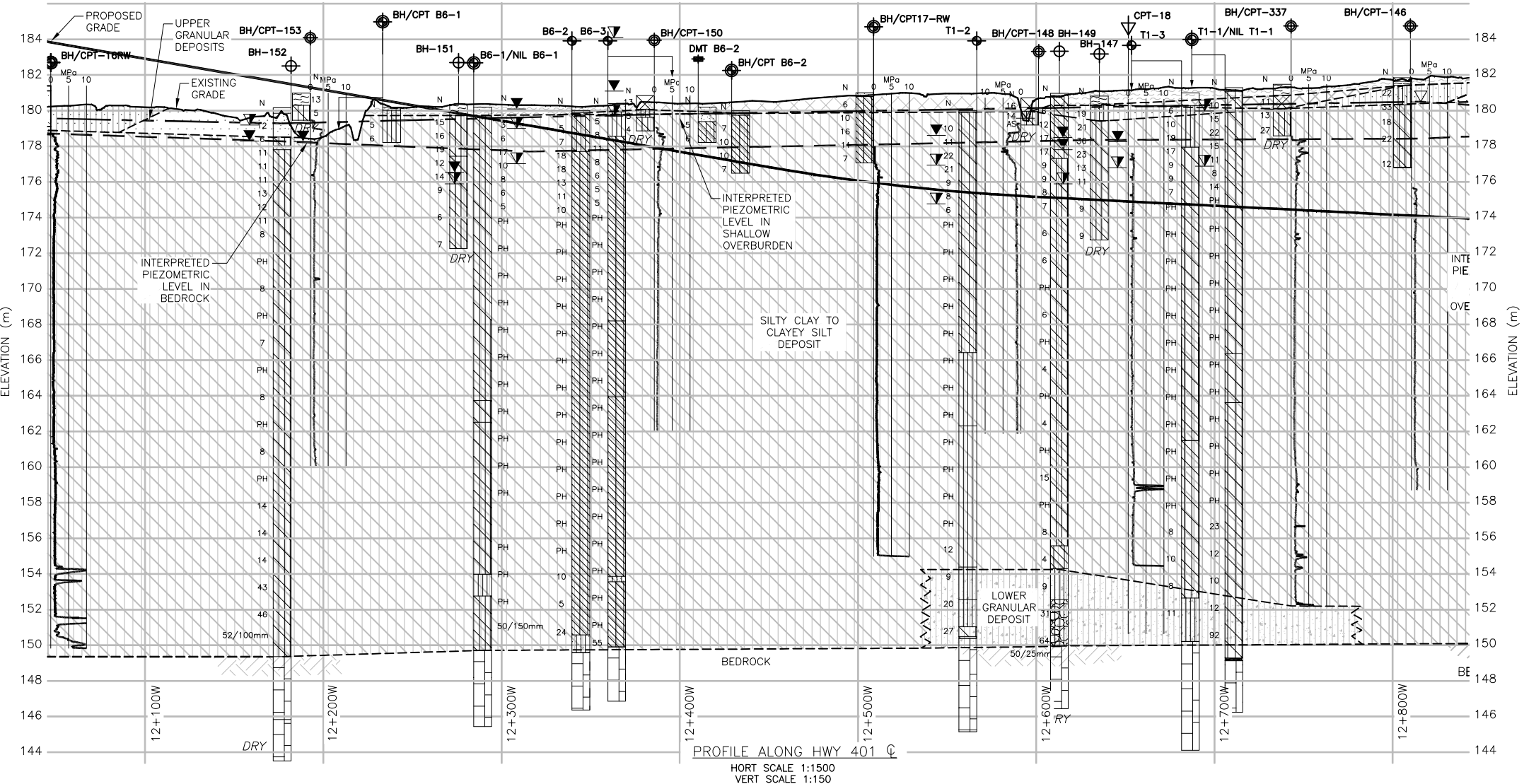
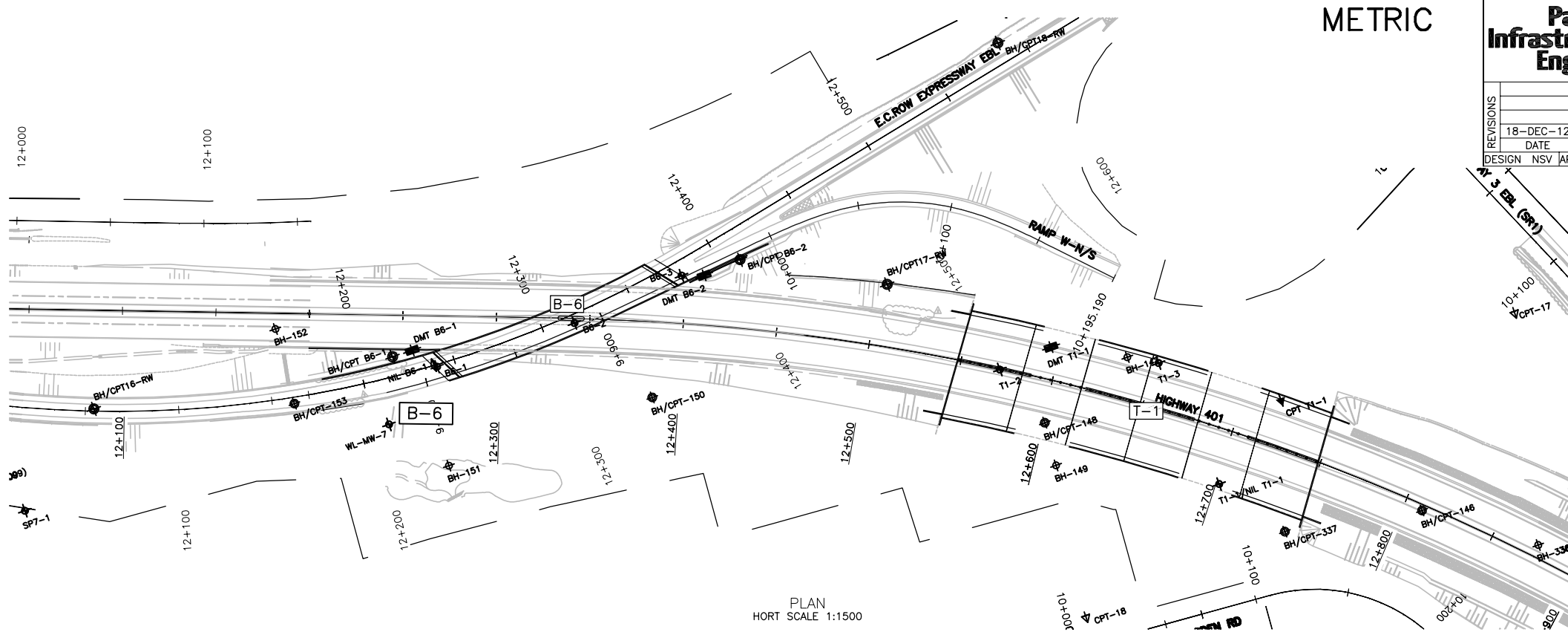
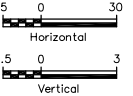
LEGEND

	BOREHOLE - CURRENT INVESTIGATION	N	SPT N-VALUE
	BOREHOLE & NILCON VANE - CURRENT INVESTIGATION		WATER LEVEL DURING DRILLING
	NILCON VANE - CURRENT INVESTIGATION		DRY BOREHOLE DRY DURING DRILLING
	CPT - CURRENT INVESTIGATION		WATER LEVEL (SHALLOW PIEZO)
	DMT - CURRENT INVESTIGATION		WATER LEVEL (DEEP PIEZO)
	SW/SP HOLE (HYDROGEOLOGY)		
	BOREHOLE - PREVIOUS INVESTIGATIONS		PH - SAMPLE OBTAINED UNDER HYDRAULIC PRESSURE
	BOREHOLE, CPT & NILCON VANE - PREVIOUS INVESTIGATIONS		
	CPT - PREVIOUS INVESTIGATIONS		
	TOPSOIL/ ORGANICS		SILT
	FILL		SANDY SILT
	SAND		CLAYEY SILT
	SILTY CLAY		SAND AND GRAVEL
	SILTY SAND		SILTY SAND AND GRAVEL
	COBBLES/BOULDERS		LIMESTONE /BEDROCK
			DOLOSTONE /BEDROCK

NOTES

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3. ELEVATIONS ARE REFERENCED TO GEODETIC DATUM. LOCATIONS ALONG THE PROPOSED WEP ARE REFERRING TO STATIONS IN WINDSOR (W) SECTOR.

SCALES



METRIC



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

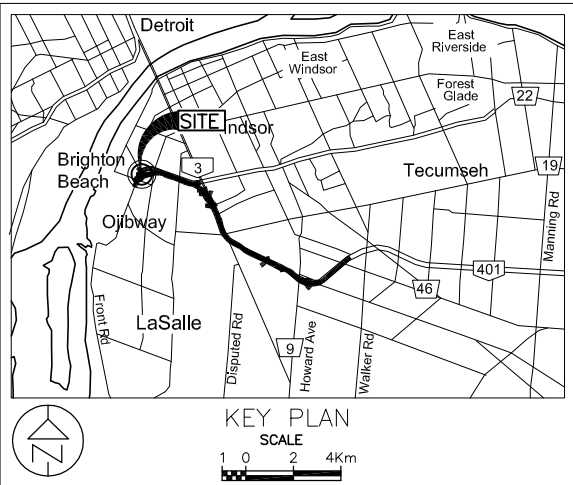
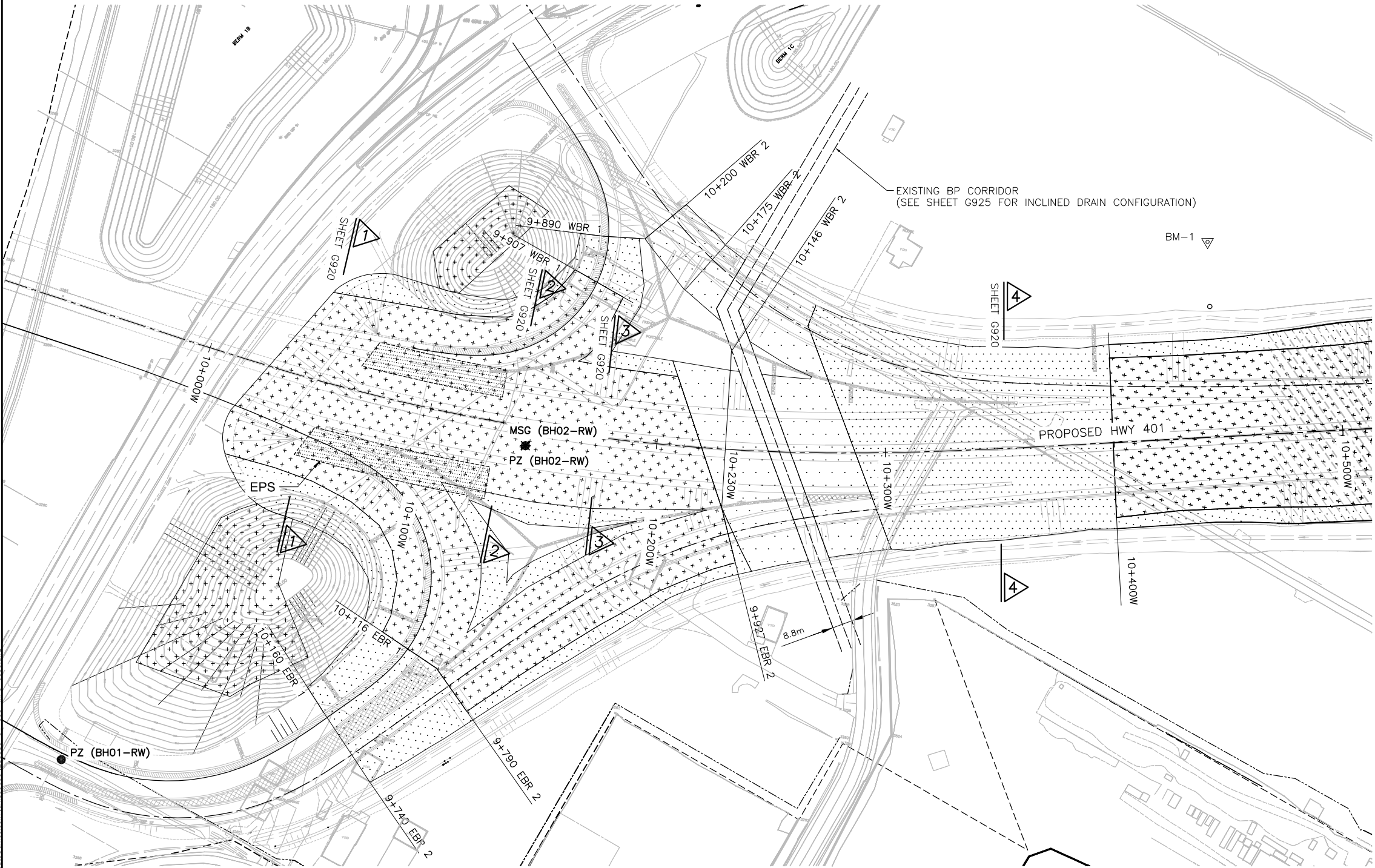


REVISIONS			
DATE	REV.	BY	DESCRIPTION
18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
DESIGN	NSV	APR DD	DATE 30-JUN-11

EMBAKMENT DESIGN PLAN
STA 10+030W TO STA 10+500W

SHEET
G905

Phase 3
IFC



LEGEND

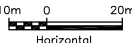
- PVD INSTALLED AT 1.5m SPACING
- PVD INSTALLED AT 2.0m SPACING
- PVD INSTALLED AT 2.5m SPACING
- LIVE BIRTHING SITE
- EXCLUSION BOUNDARIES
- SNAKE FENCE (AS-BUILT)
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PLAN FOR HWY 401 AND E.C. ROW EMBANKMENTS BETWEEN STA 10+030W TO 10+500W. REFER TO GEOTECHNICAL INSTRUMENTATION AND MONITORING PLAN (DOC: 285380-04-118-001) FOR DETAILED MONITORING PROGRAM.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.

SEGMENT ID	①	②	②A	③	④
HEIGHT	11–8.5m	8.5–6m	6m	6m	6–8.5m
CONSTRUCTION STAGES	5 STAGES	3 STAGES	2 STAGES (10 MONTHS)	2 STAGES	3 STAGES
CORE/SLOPE PVD SPACING, c/c	1.5m/2.0m	1.5m/2.0m	2.5m	2.0m	1.5m/2.0m
SURCHARGE THICKNESS	1m	1m	1m	1m	1m
EPS REQUIRED	12x2 + 14x2 m ³ /m	NO	NO	NO	NO

SCALE



METRIC



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

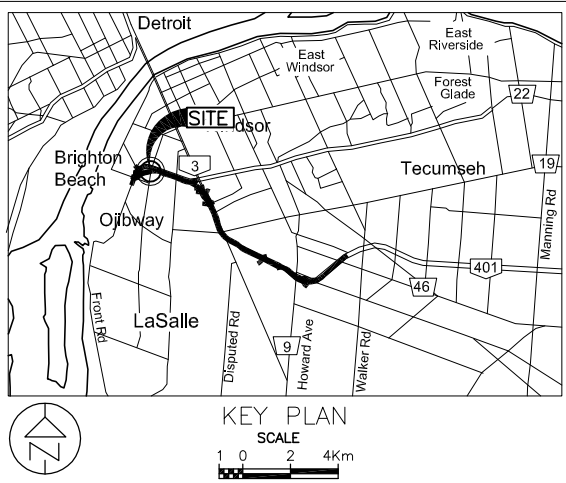


REVISIONS			
DATE	REV.	BY	DESCRIPTION
18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
DESIGN	NSV	APR DD	DATE

EMBAKMENT DESIGN PLAN
STA 10+500W TO STA 11+000W

SHEET
G906

Phase 3
IFC



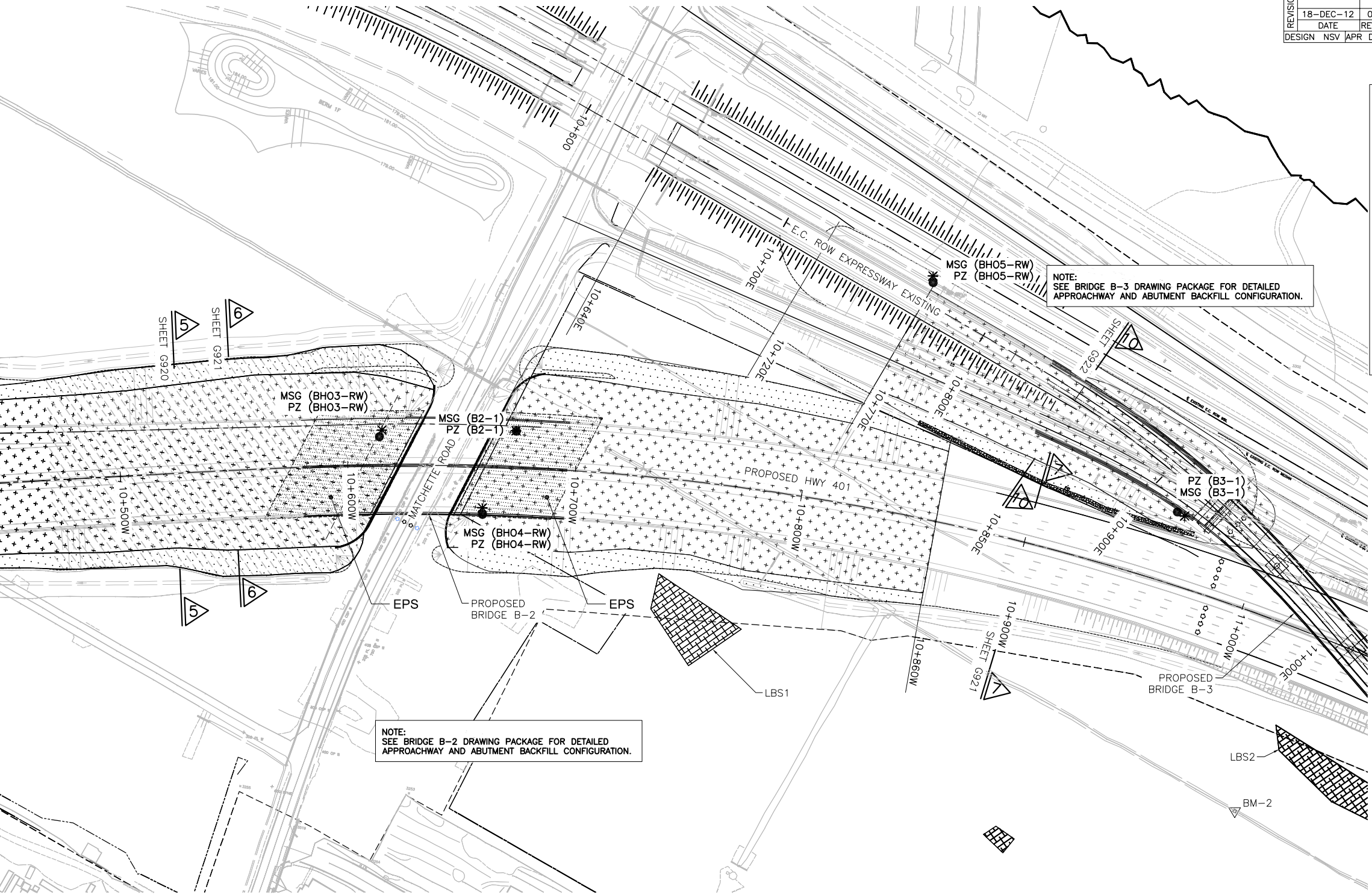
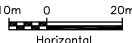
LEGEND

- PVD INSTALLED AT 1.5m SPACING
- PVD INSTALLED AT 2.0m SPACING
- LIVE BIRTHING SITE
- EXCLUSION BOUNDARIES
- SNAKE FENCE (AS-BUILT)
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

NOTES

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SCALE



HWY 401 EMBANKMENT		⑤		⑥		⑦	
SEGMENT ID		8.5–10m		8.5–6m		6m	
HEIGHT		4 STAGES		3 STAGES		2 STAGES	
CONSTRUCTION STAGES		1.5m/2.0m		1.5m/2.0m		NO	
CORE/SLOPE PVD SPACING, c/c		1m		1m	0.8m	0.5m	0m
SURCHARGE THICKNESS		SEE B-2 DRAWING PACKAGE FOR EPS CONFIGURATION		NO		NO	
EPS REQUIRED							

REALIGNED E.C. ROW EBL EMBANKMENT		①		②	
SEGMENT ID		<8.7m		8.7–11m	
HEIGHT		2 STAGES		3 STAGES	
CONSTRUCTION STAGES		NO		1.5m/2.0m	
CORE/SLOPE PVD SPACING, c/c		0.5m		1m	
SURCHARGE THICKNESS		NO		NO	
EPS REQUIRED					

METRIC



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

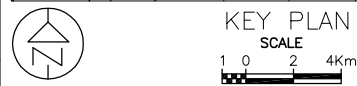
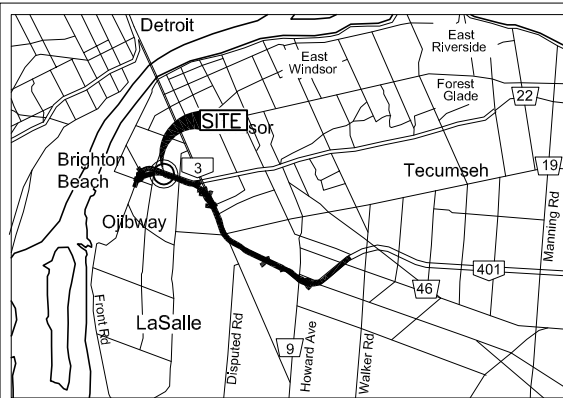


REVISIONS			
DATE	REV.	BY	DESCRIPTION
18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
DESIGN	NSV	APR DD	DATE 30-JUN-11

EMBANKMENT DESIGN PLAN
STA 11+000W TO STA 11+500W

SHEET
G907

Phase 3
IFC

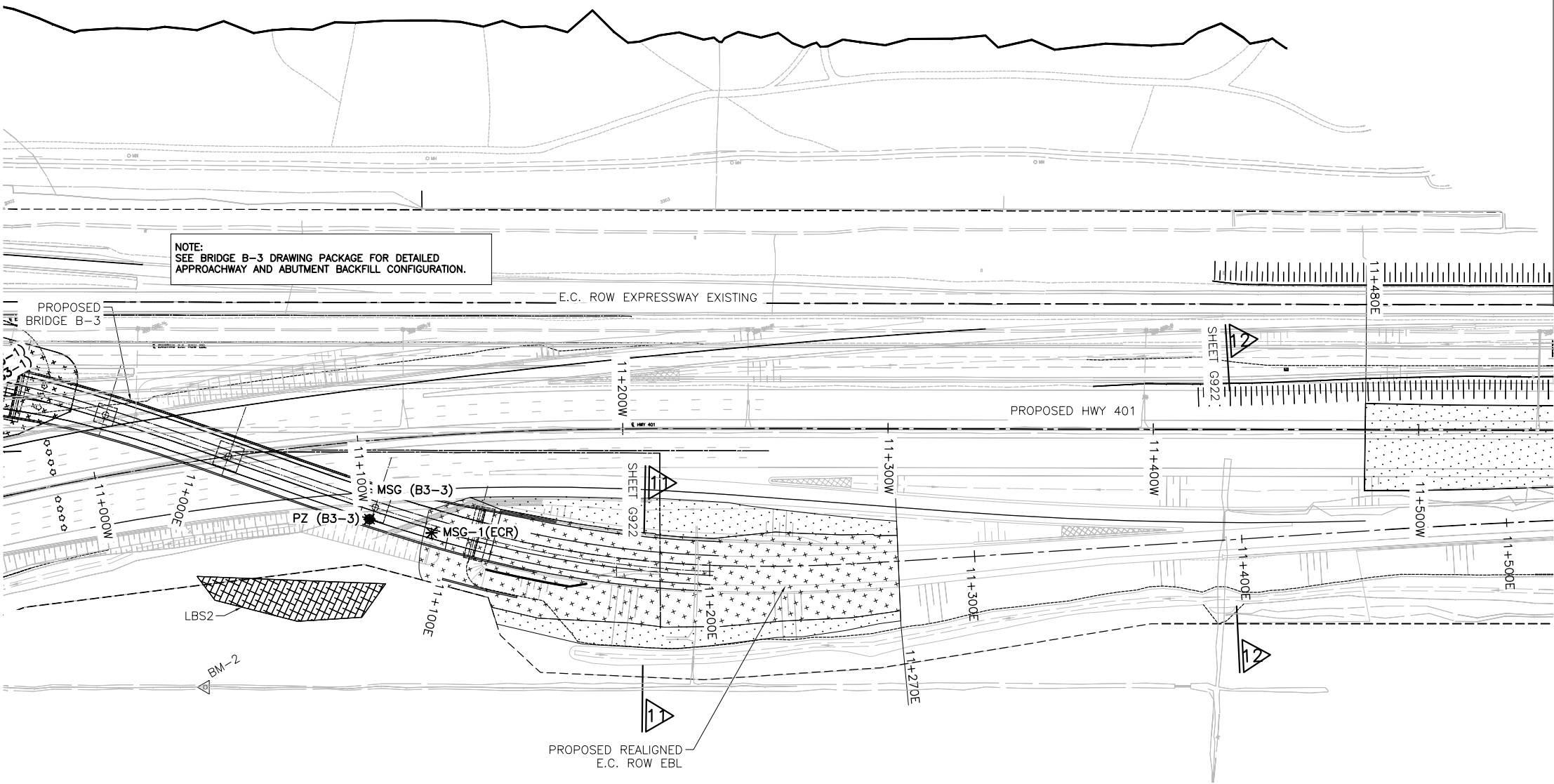


LEGEND

- PVD INSTALLED AT 1.5m SPACING
- PVD INSTALLED AT 2.0m SPACING
- LIVE BIRTHING SITE
- EXCLUSION BOUNDARIES
- SNAKE FENCE (AS-BUILT)
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

NOTES

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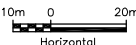
HWY 401
EMBANKMENT

SEGMENT ID	⑦		⑧	
HEIGHT	6m		6-8m	
CONSTRUCTION STAGES	2 STAGES		2 STAGES	
CORE/SLOPE PVD SPACING, c/c	NO		2m	
SURCHARGE THICKNESS	0.5m		1m	
EPS REQUIRED	NO		NO	

REALIGNED E.C. ROW EBL

SEGMENT ID	②	③	④	⑤
HEIGHT	8.7-11m	8.7-5.5m	<5.5m	
CONSTRUCTION STAGES	3 STAGES	2 STAGES	2 STAGES	
CORE/SLOPE PVD SPACING, c/c	1.5m/2.0m	1.5m/2.0m	NO	
SURCHARGE THICKNESS	1m	1m	0.5m	
EPS REQUIRED	NO	NO	NO	

SCALE



METRIC



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

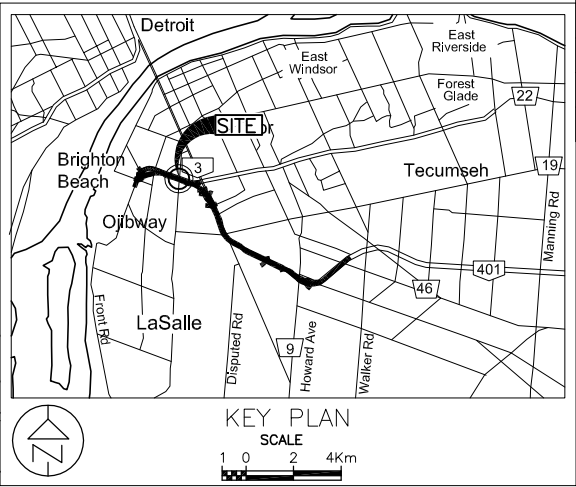
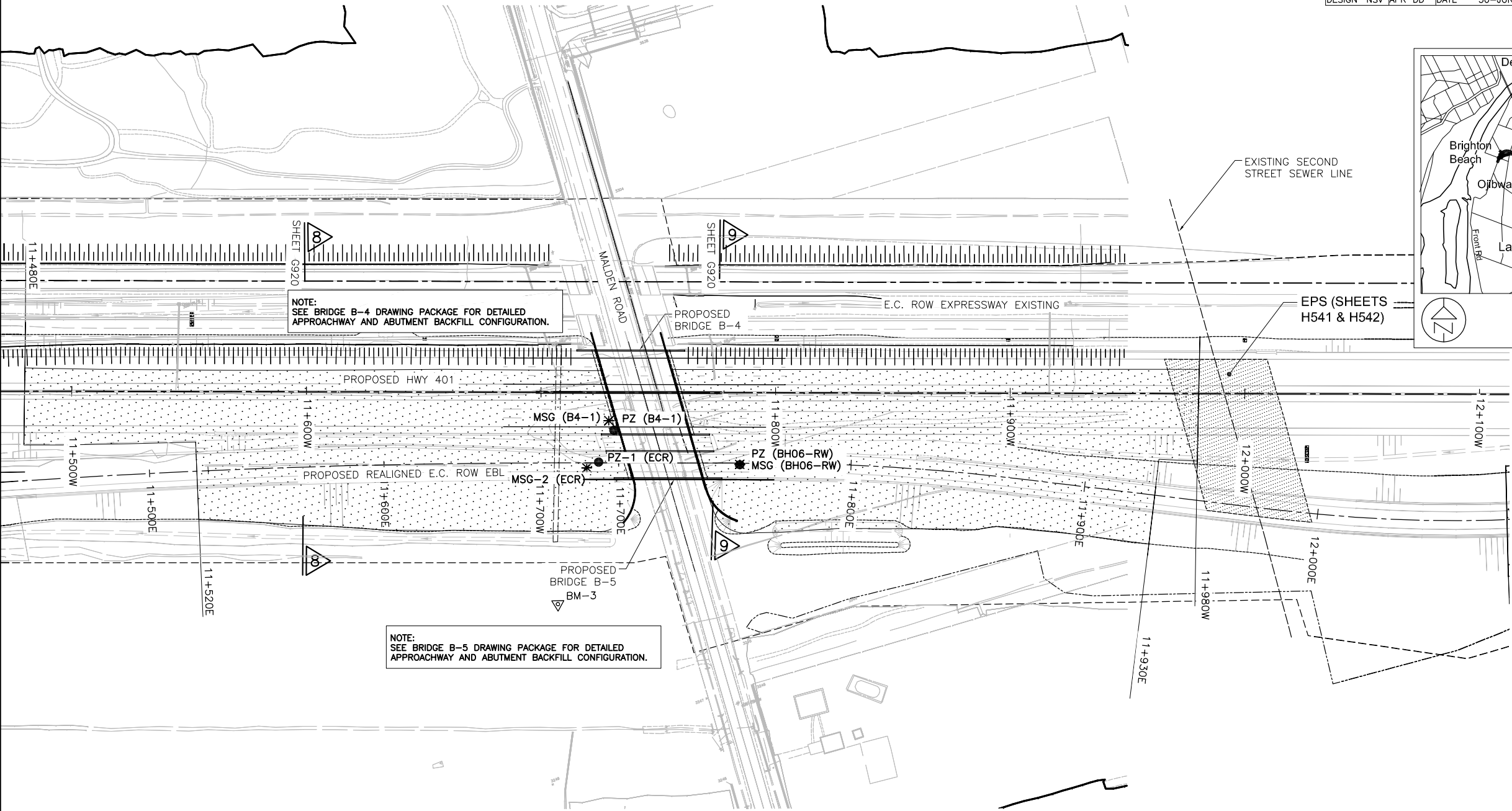


REVISIONS			
18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
DATE	REV.	BY	DESCRIPTION
DESIGN	NSV	APR DD	DATE 30-JUN-11

EMBANKMENT DESIGN PLAN
STA 11+500W TO STA 12+100W

SHEET
G908

Phase 3
IFC



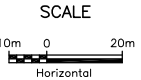
LEGEND

- PVD INSTALLED AT 1.5m SPACING
- PVD INSTALLED AT 2.0m SPACING
- LIVE BIRTHING SITE
- EXCLUSION BOUNDARIES
- SNAKE FENCE (AS-BUILT)
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PLAN FOR HWY 401 AND E.C. ROW EMBANKMENTS BETWEEN STA 11+500W TO 12+100W. REFER TO GEOTECHNICAL INSTRUMENTATION AND MONITORING PLAN (DOC: 285380-04-118-001) FOR DETAILED MONITORING PROGRAM.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.

HWY 401 EMBANKMENT	SEGMENT ID	⑧	⑨
	HEIGHT	6-8m	4-3m
	CONSTRUCTION STAGES	2 STAGES	2 STAGES
	CORE/SLOPE PVD SPACING, c/c	2m	NO
	SURCHARGE THICKNESS	1m	0.5m
REALIGNED E.C. ROW EBL EMBANKMENT	SEGMENT ID	⑤	⑥
	HEIGHT	5.5-8m	<6 m
	CONSTRUCTION STAGES	2 STAGES	2 STAGES
	CORE/SLOPE PVD SPACING, c/c	2.0m	NO
	SURCHARGE THICKNESS	1m	0.8m



METRIC



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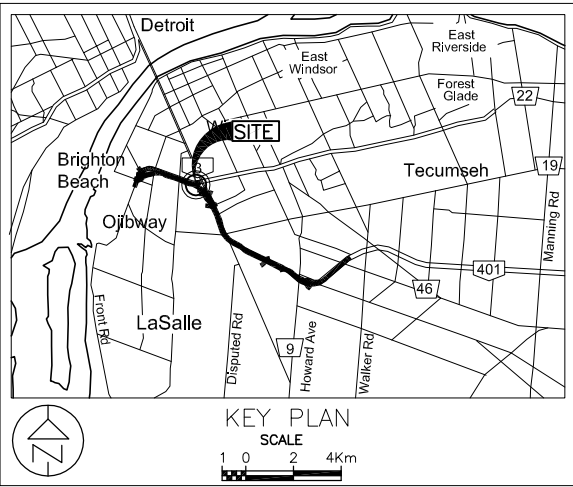


REVISIONS			
18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
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DESIGN	NSV	APR DD	DATE 30-JUN-11

EMBANKMENT DESIGN PLAN
STA 12+100W TO STA 12+600W

SHEET
G909

Phase 3
IFC



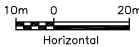
LEGEND

- PVD INSTALLED AT 1.5m SPACING
- PVD INSTALLED AT 2.0m SPACING
- LIVE BIRTHING SITE
- EXCLUSION BOUNDARIES
- SNAKE FENCE (AS-BUILT)
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

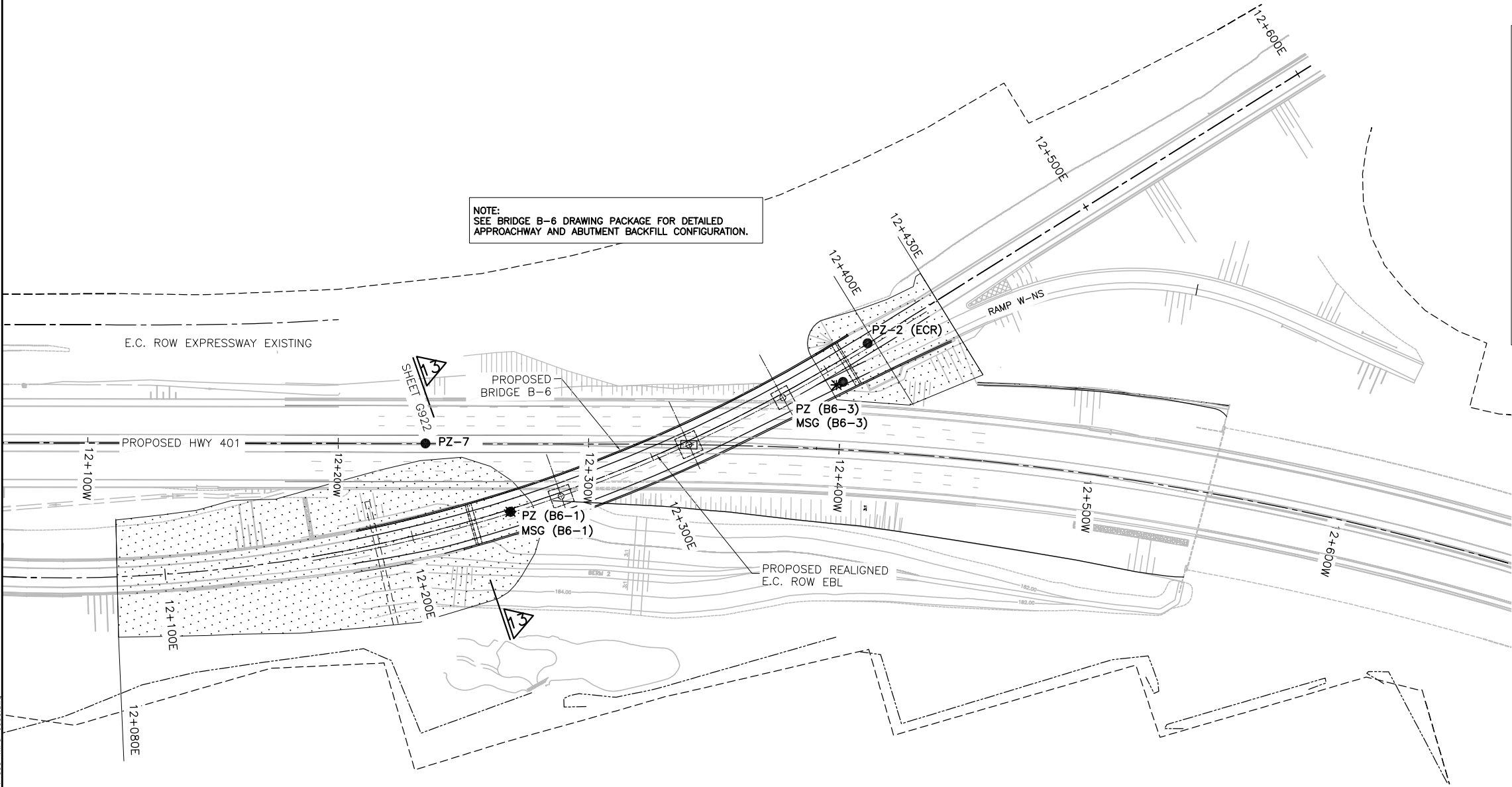
NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PLAN FOR HWY 401 AND E.C. ROW EMBANKMENTS BETWEEN STA 12+100W TO 12+600W. REFER TO GEOTECHNICAL INSTRUMENTATION AND MONITORING PLAN (DOC: 285380-04-118-001) FOR DETAILED MONITORING PROGRAM.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.

SCALE



NOTE:
SEE BRIDGE B-6 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.



HWY 401
EMBANKMENT

SEGMENT ID	⑨	
HEIGHT	4–3m	<3m
CONSTRUCTION STAGES	2 STAGES	
CORE/SLOPE PVD SPACING, c/c	NO	12+160W
SURCHARGE THICKNESS	0.5m	0m
EPS REQUIRED	NO	12+290W

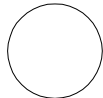
REALIGNED E.C. ROW EBL
EMBANKMENT

SEGMENT ID	⑦	
HEIGHT	6–9m	
CONSTRUCTION STAGES	2 STAGES	
CORE/SLOPE PVD SPACING, c/c	2.0m	
SURCHARGE THICKNESS	1m	
EPS REQUIRED	NO	

METRIC



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



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HWY 401 EMBANKMENT DESIGN PROFILE

SHEET

G910

STA 10+030W TO STA 10+400W

Phase 3

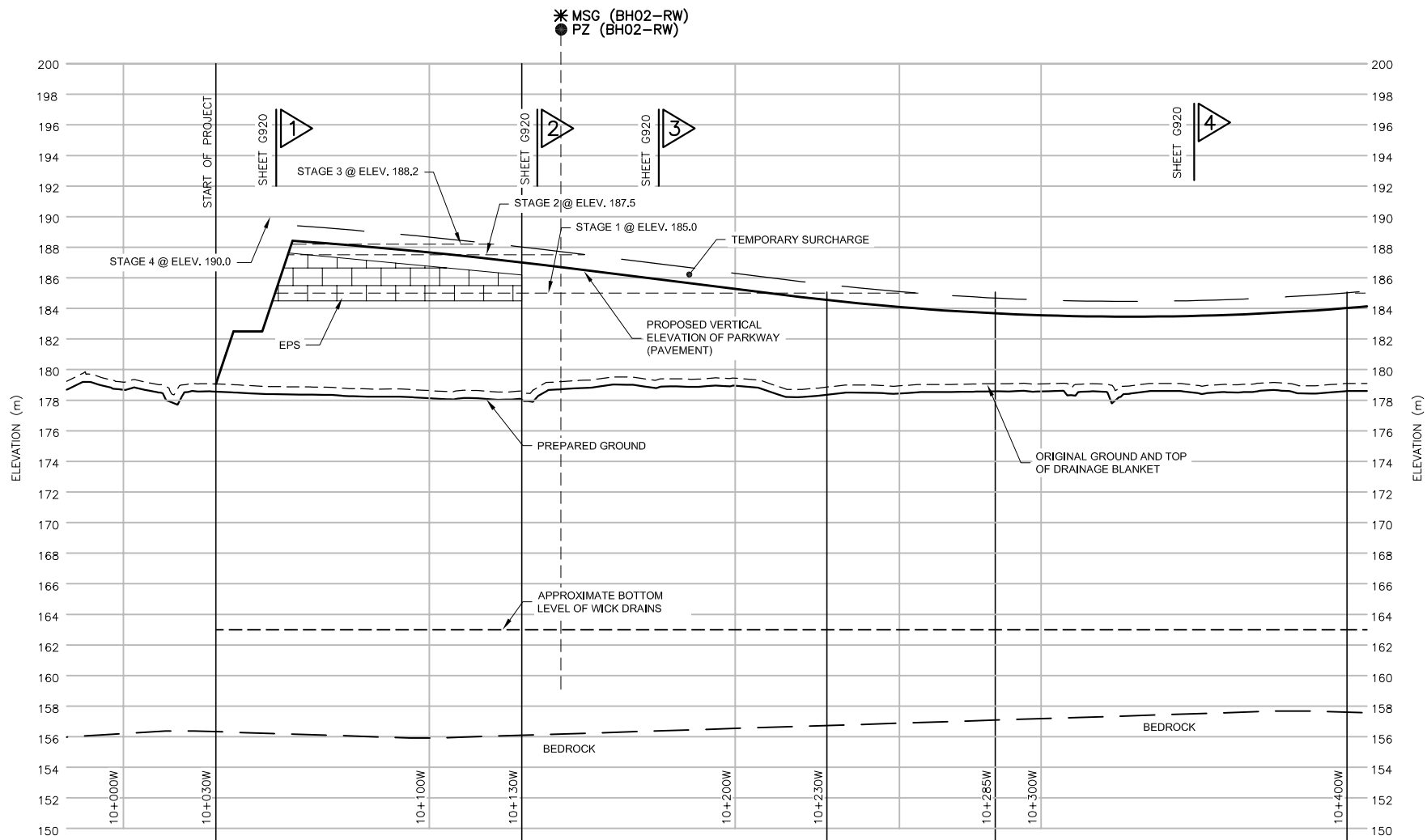
IFC

LEGEND

- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

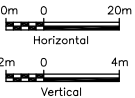
NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR HIGHWAY 401 EMBANKMENT BETWEEN STA. 10+030W TO 10+400W.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- SEE SHEET G925 FOR WICK DRAIN CONFIGURATION AT BP CORRIDOR.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.



SEGMENT ID	①	②	BP CORRIDOR (NOTE 4)	②A	③
HEIGHT ABOVE ORIGINAL GROUND SURFACE	8.5–11m	6–8.5m		6m	6m
CONSTRUCTION STAGES	5 STAGES	3 STAGES		2 STAGES (10 MONTHS)	2 STAGES
CORE/SLOPE PVD SPACING, c/c	1.5m/2m	1.5m/2m		2.5m	2m
TEMPORARY SURCHARGE THICKNESS	1m	1m		1m	1m
EPS REQUIRED	12x2+14x2 m³/m	NO		NO	NO
PVD BOTTOM ELEVATION	163.0m	163.0m		163.0m	163.0m

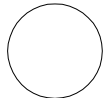
SCALES



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	DATE	REV.	BY	DESCRIPTION
DESIGN	NSV	APR	DD	DATE 30-JUN-11

HWY 401 EMBANKMENT DESIGN PROFILE

STA 10+400W TO STA 10+800W

SHEET

G911

Phase 3

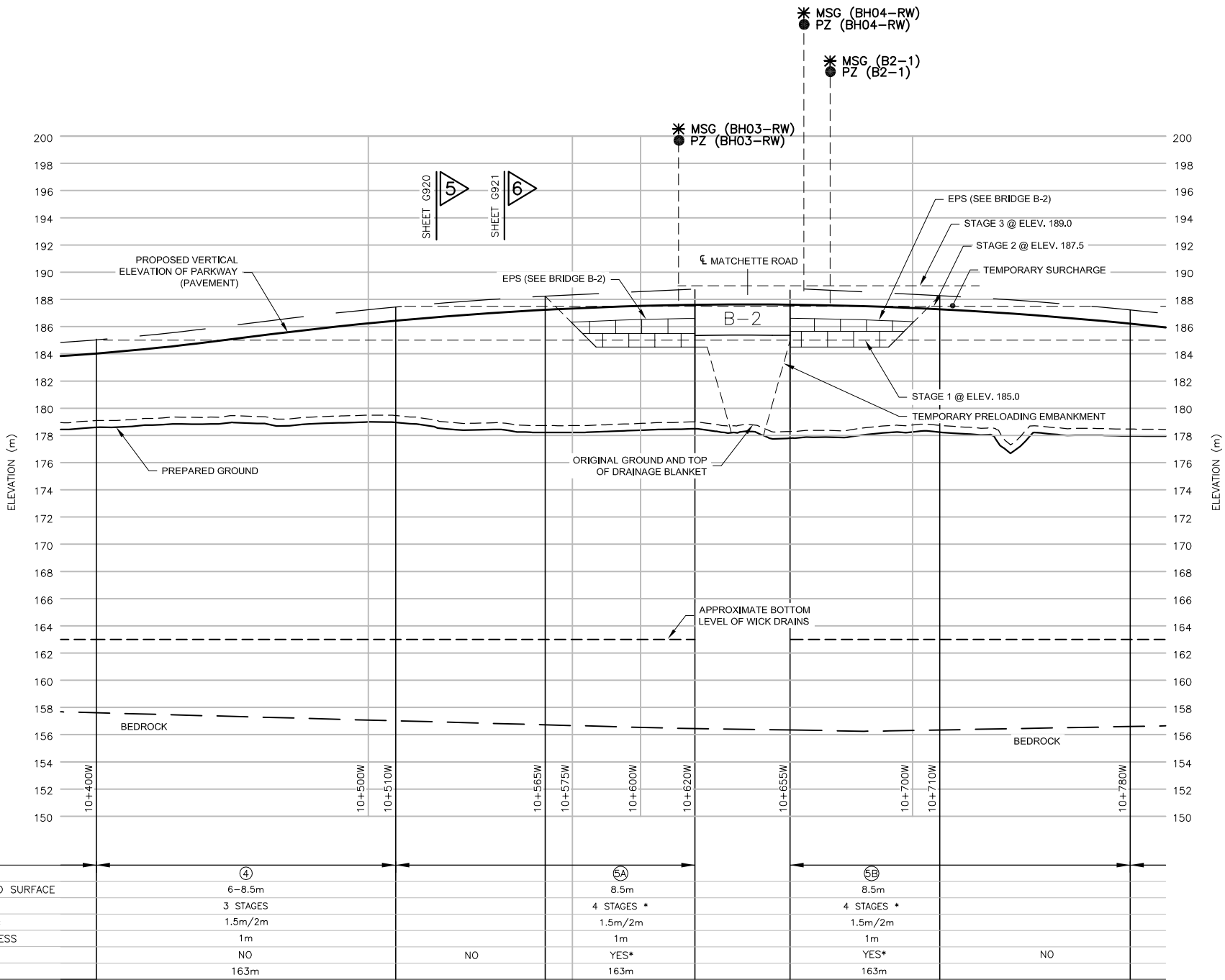
IFC

LEGEND

- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

NOTES

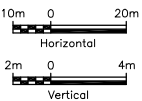
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR HIGHWAY 401 EMBANKMENT BETWEEN STA. 10+400W TO 10+800W.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.



* SEE BRIDGE B-2 DRAWING PACKAGE FOR DETAILS

NOTES:
SEE SHEET G925 FOR EMBANKMENT SURCHARGE
CONFIGURATION AT BRIDGE B-2 LOCATION.

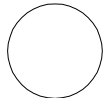
SCALES



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HWY 401 EMBANKMENT DESIGN PROFILE

STA 10+800W TO STA 11+300W

SHEET

G912

Phase 3

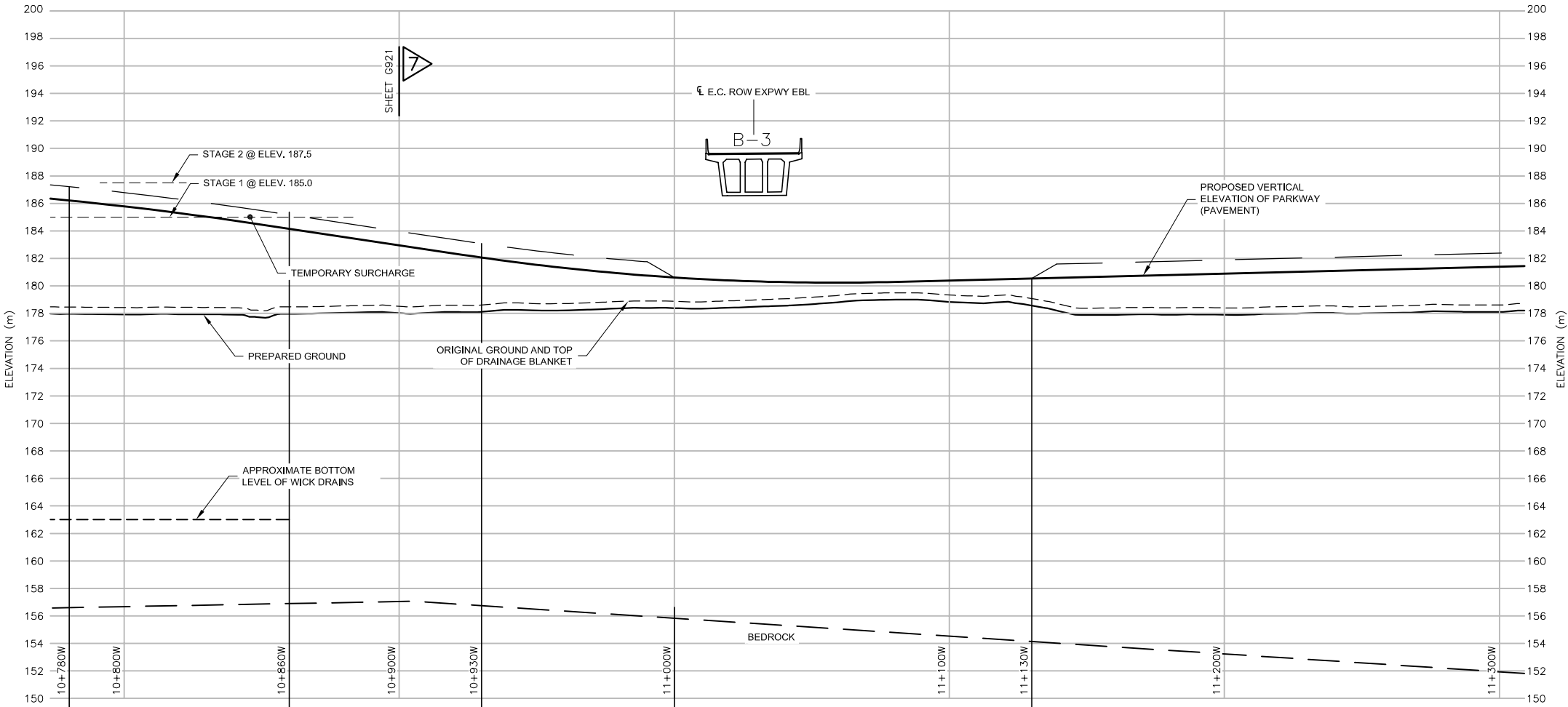
IFC

LEGEND

- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

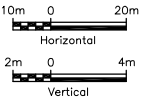
NOTES

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- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR HIGHWAY 401 EMBANKMENT BETWEEN STA. 10+800W TO 11+300W.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.



SEGMENT ID	⑥			⑦		
HEIGHT ABOVE ORIGINAL GROUND SURFACE	6–8.5m			<2m		
CONSTRUCTION STAGES	3 STAGES			2 STAGES		
CORE/SLOPE PVD SPACING, c/c	1.5m/2m			NO PVD		
TEMPORARY SURCHARGE THICKNESS	1m			0m		
EPS REQUIRED	NO			NO		
PVD BOTTOM ELEVATION	163m			NO PVD		

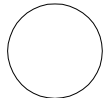
SCALES



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DESIGN	NSV	APR	DD	DATE 30-JUN-11

HWY 401 EMBANKMENT DESIGN PROFILE

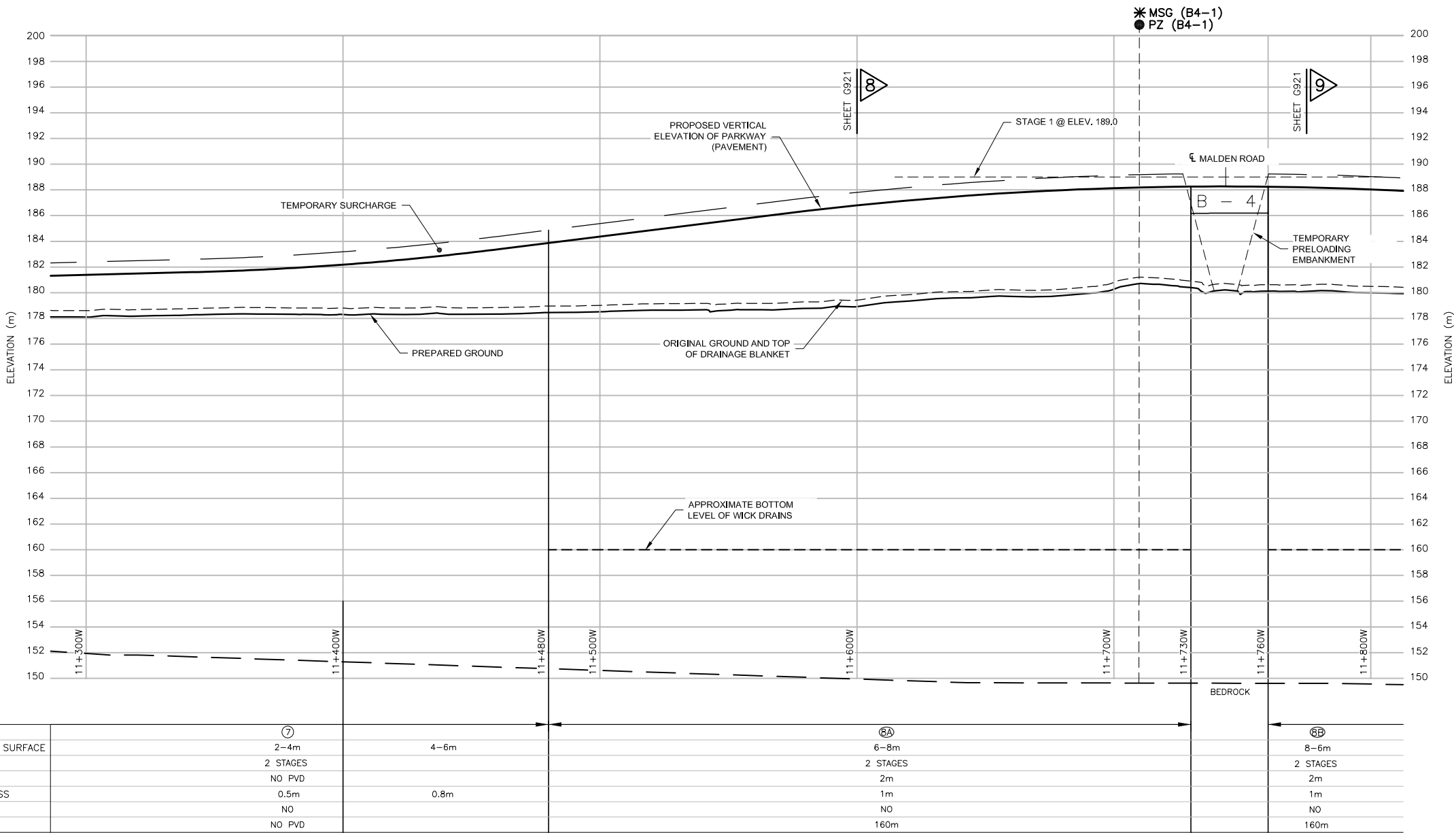
SHEET

G913

STA 11+300W TO STA 11+800W

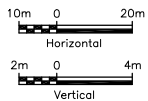
Phase 3

IFC



NOTE:
SEE BRIDGE B-4 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.

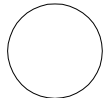
SCALES



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DESIGN	NSV	APR	DD	DATE 30-JUN-11

HWY 401 EMBANKMENT DESIGN PROFILE

STA 11+800W TO STA 12+300W

SHEET

G914

Phase 3

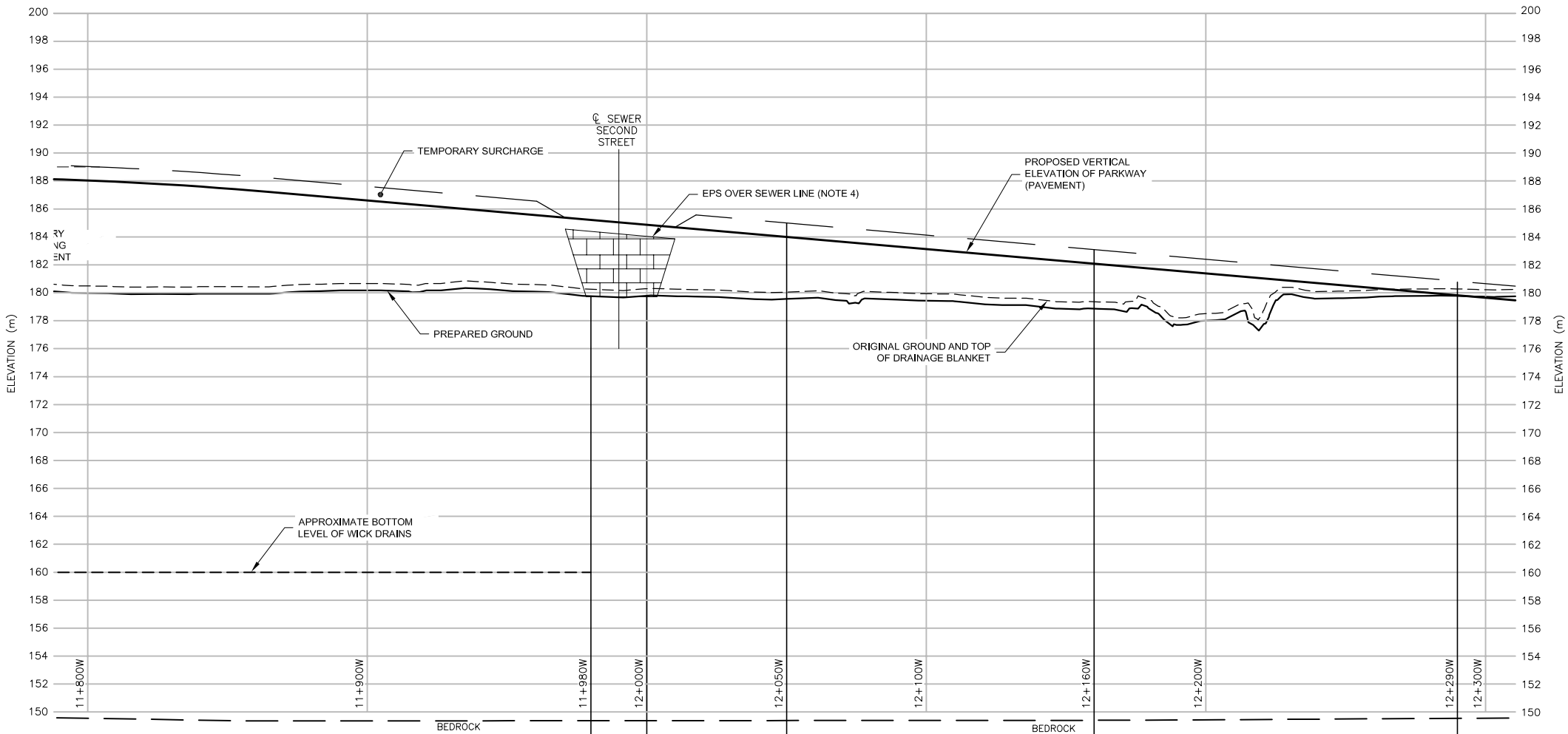
IFC

LEGEND

- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

NOTES

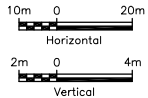
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR HIGHWAY 401 EMBANKMENT BETWEEN STA. 11+800W TO 12+300W.
- SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- SEE SHEETS H541 & H542 FOR EMBANKMENT CONFIGURATION AT SECOND STREET SEWER LINE.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.

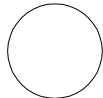


SEGMENT ID	⑧	⑨
HEIGHT ABOVE ORIGINAL GROUND SURFACE	8–6m	4–3m
CONSTRUCTION STAGES	2 STAGES	2 STAGES
CORE/SLOPE PVD SPACING, c/c	2m	NO PVD
TEMPORARY SURCHARGE THICKNESS	1m *	0.5m
EPS REQUIRED	NO	NO
PVD BOTTOM ELEVATION	160m	NO PVD

* SURCHARGE BEYOND EPS AREA

SCALES





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DESIGN	NSV	APR DD	DATE 30-JUN-11

EC ROW EBL EMBANKMENT DESIGN PROFILE

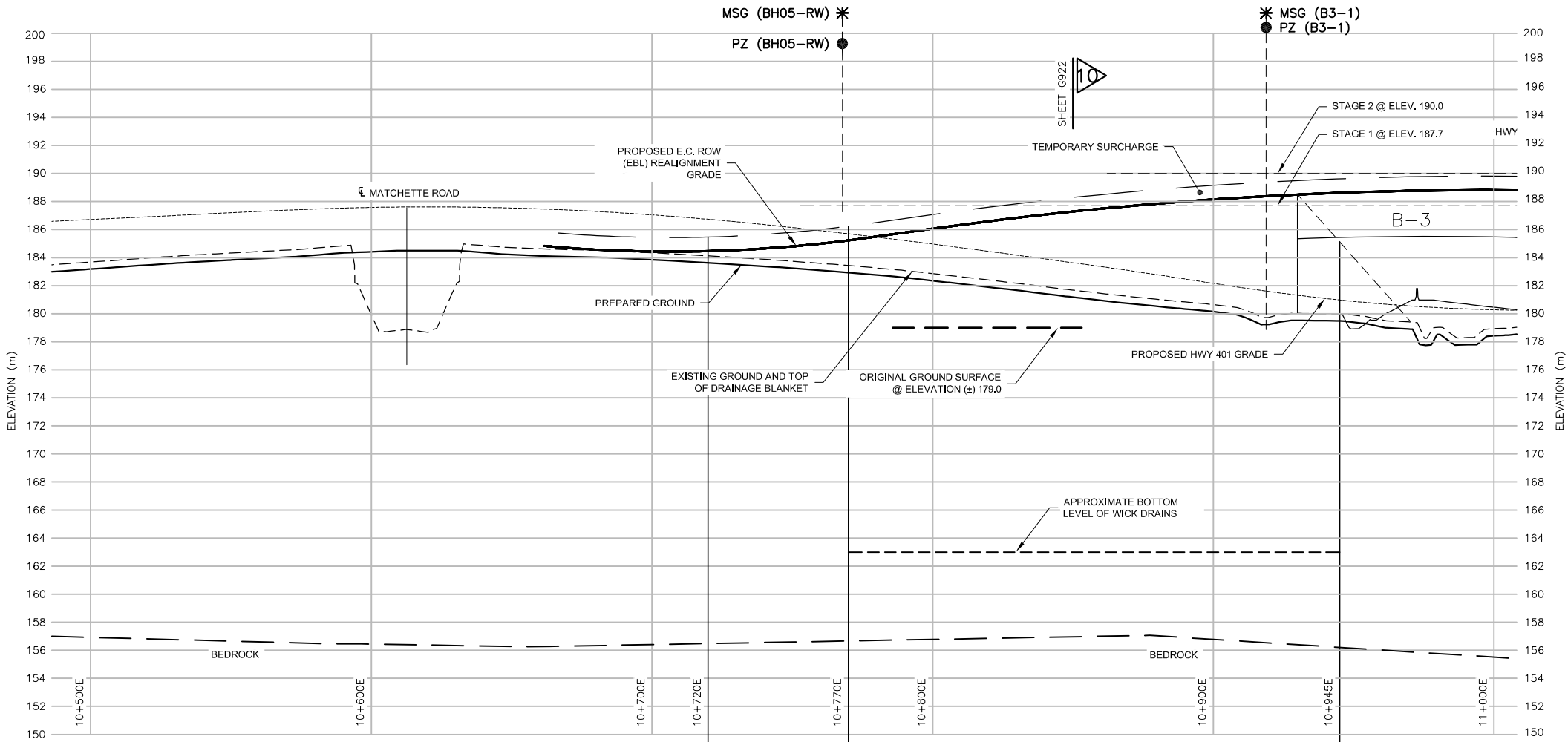
SHEET

G915

STA 10+500E TO STA 11+000E

Phase 3

IFC



LEGEND

- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

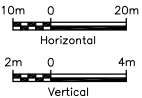
NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR E.C. ROW EBL EMBANKMENT BETWEEN STA. 10+500E TO 11+000E.
- SEE SHEET G924 FOR GENERAL NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.

SEGMENT ID	
HEIGHT ABOVE ORIGINAL GROUND SURFACE	
CONSTRUCTION STAGES	
CORE/SLOPE PVD SPACING, c/c	
TEMPORARY SURCHARGE THICKNESS	
EPS REQUIRED	
PVD BOTTOM ELEVATION	

NOTE:
SEE BRIDGE B-3 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.

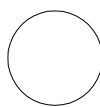
SCALES



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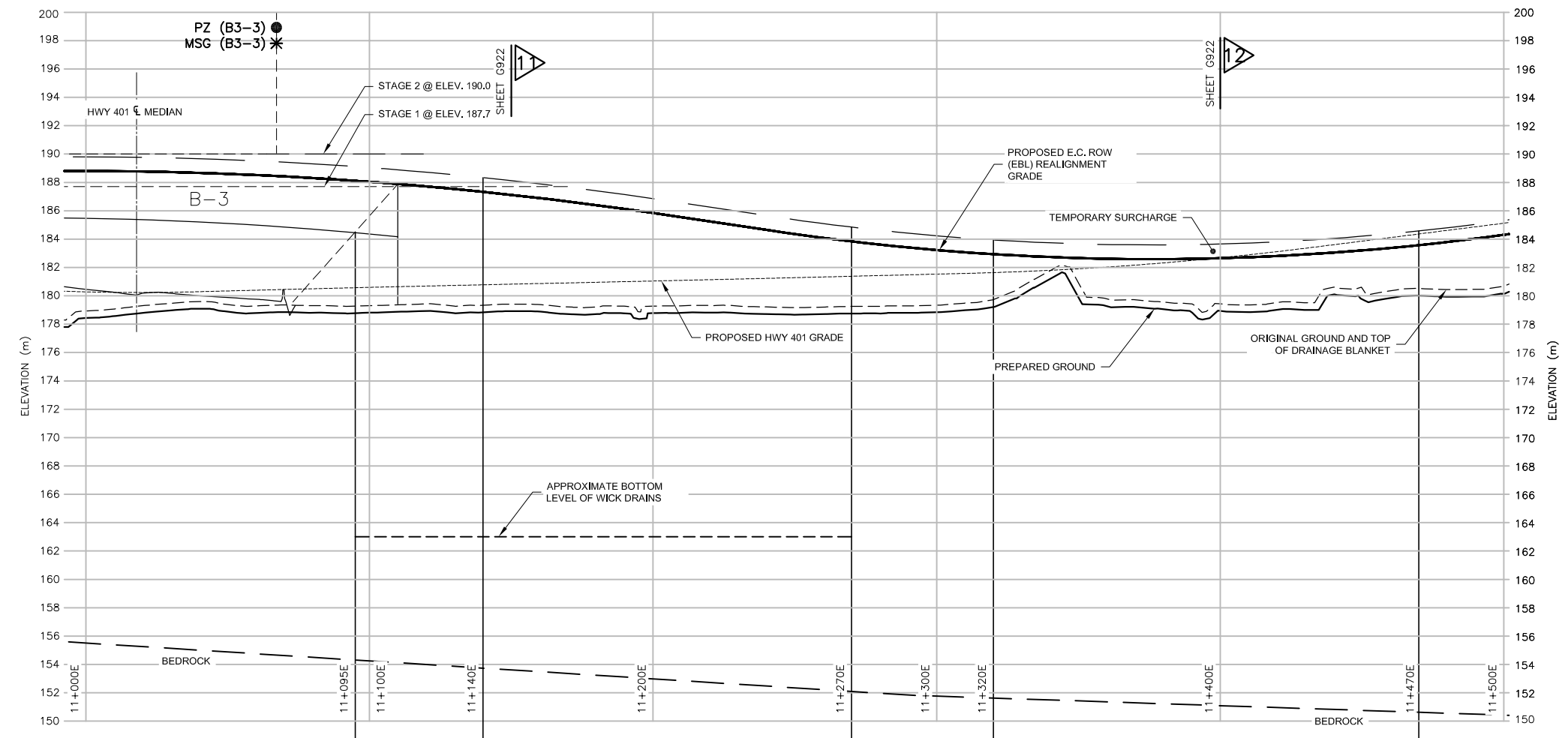


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EC ROW EBL EMBANKMENT DESIGN PROFILE
STA 11+000E TO STA 11+500E

SHEET
G916

Phase 3
IFC



LEGEND

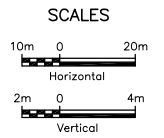
- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

NOTES

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- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR E.C. ROW EBL EMBANKMENT BETWEEN STA. 11+000E TO 11+500E.
- SEE SHEET G924 FOR GENERAL NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.

SEGMENT ID	②B	③	④
HEIGHT ABOVE ORIGINAL GROUND SURFACE	10–8.7m	8.7–5.5m	+/-4m
CONSTRUCTION STAGES	3 STAGES	2 STAGES	2 STAGES
CORE/SLOPE PVD SPACING, c/c	1.5m/2m	1.5m/2m	NO PVD
TEMPORARY SURCHARGE THICKNESS	1m	1m	0.5m
EPS REQUIRED	NO	NO	NO
PVD BOTTOM ELEVATION	163m	163m	NO PVD

NOTE:
SEE BRIDGE B-3 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.



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EC ROW EBL EMBANKMENT DESIGN PROFILE

STA 11+500E TO STA 12+000E



SHEET

G917

Phase 3

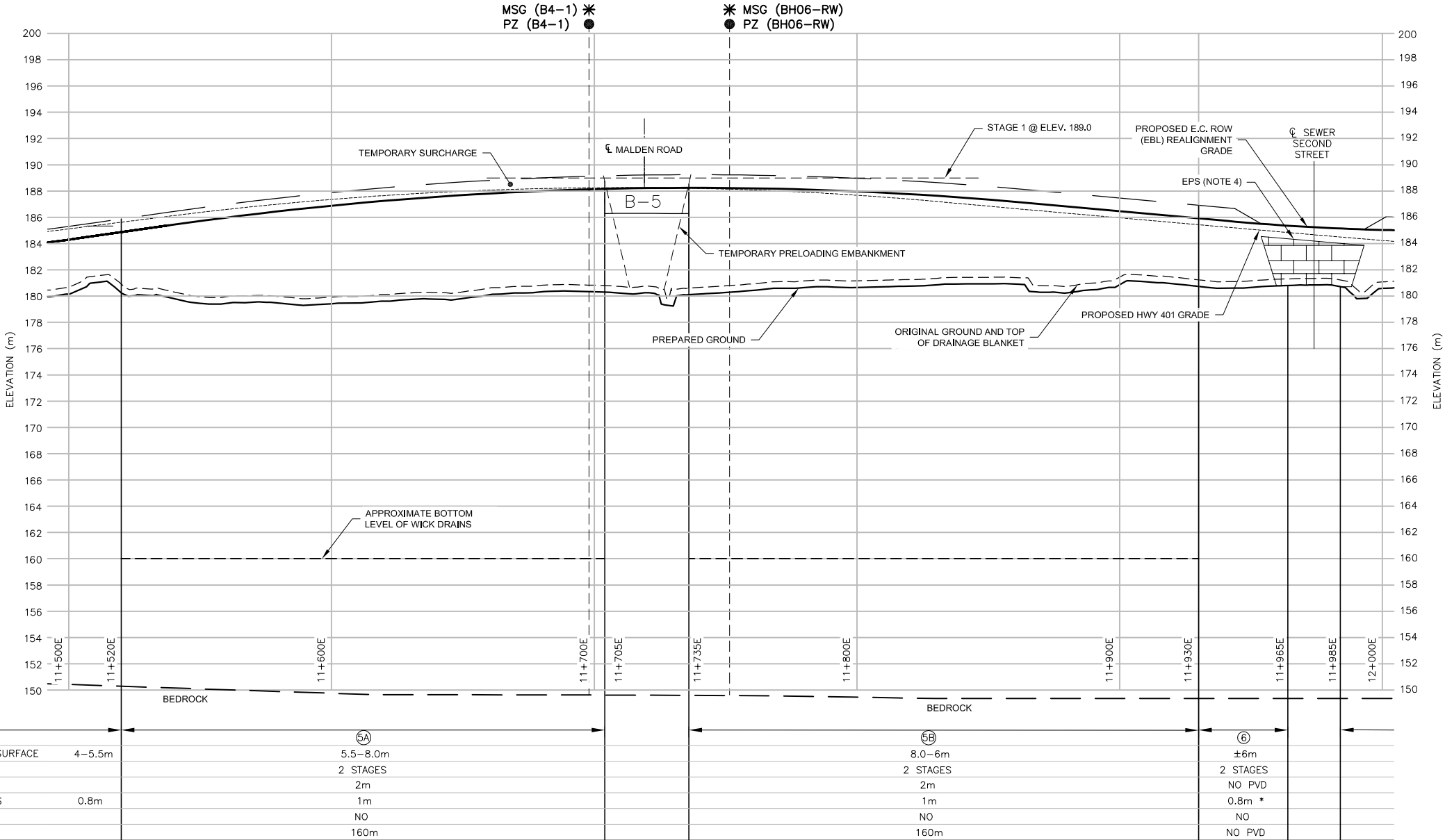
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LEGEND

- * MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- ▽ BM PERMANENT SURVEYING BENCHMARK

NOTES

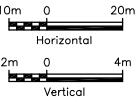
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR E.C. ROW EBL EMBANKMENT BETWEEN STA. 11+500E TO 12+000E.
- SEE SHEET G924 FOR GENERAL NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- SEE SHEETS H541 & H542 FOR EMBANKMENT CONFIGURATION AT SECOND STREET SEWER LINE.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.



* SURCHARGE BEYOND EPS AREA

NOTE:
SEE BRIDGE B-5 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.

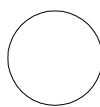
SCALES



METRIC



Windsor–Essex
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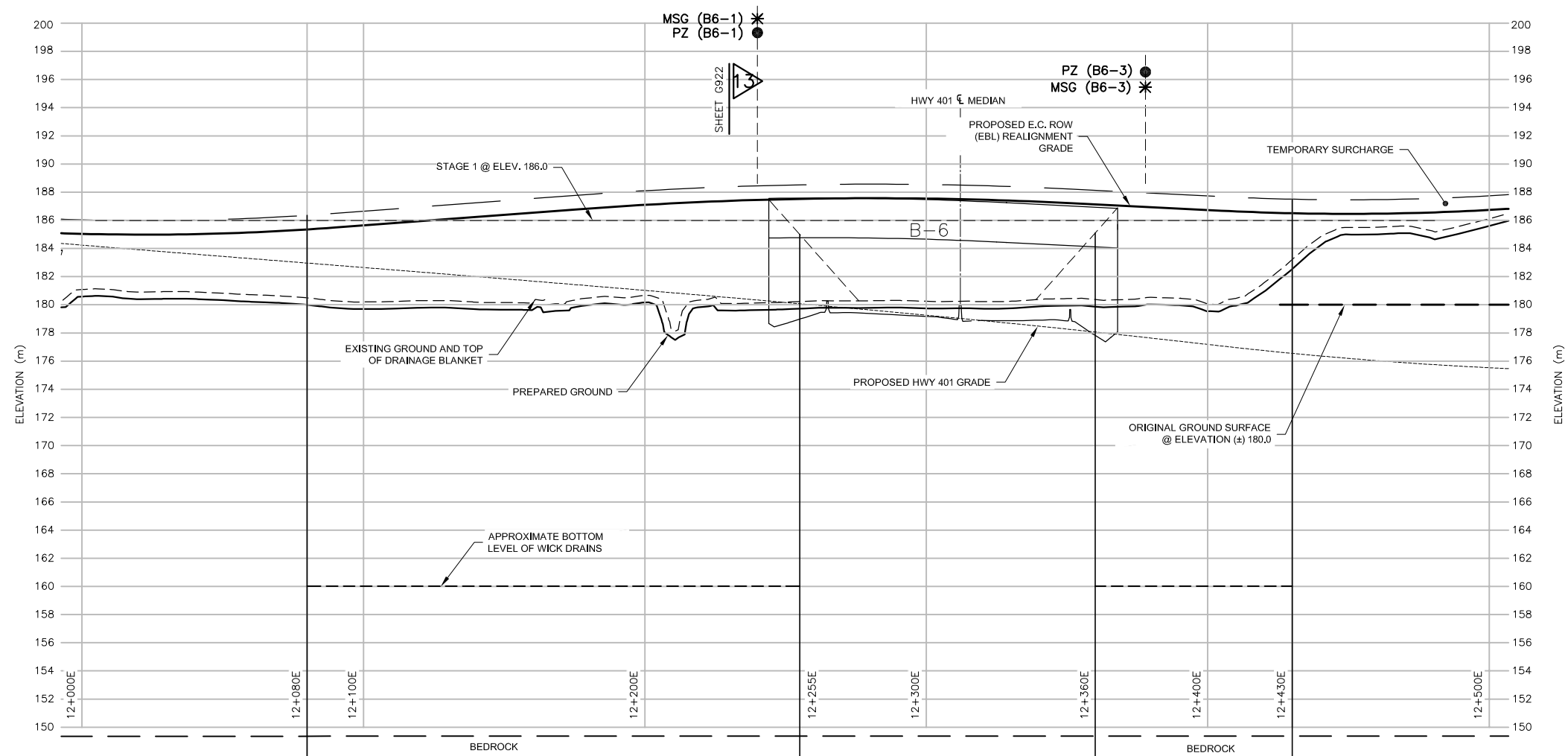


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18-DEC-12	0	SF	ISSUED FOR CONSTRUCTION
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DESIGN NSV APR DD	DATE	30-JUN-11	

EC ROW EBL EMBANKMENT DESIGN PROFILE
STA 12+000E TO STA 12+500E

SHEET
G918

Phase 3
IFC



LEGEND

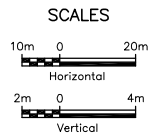
- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

NOTES

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- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR E.C. ROW EBL EMBANKMENT BETWEEN STA. 12+000E TO 12+500E.
- SEE SHEET G924 FOR GENERAL NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.

SEGMENT ID	⑥	⑦A	⑦B
HEIGHT ABOVE ORIGINAL GROUND SURFACE	4.5–6m	6–9m	6–9m
CONSTRUCTION STAGES	2 STAGES	2 STAGES	2 STAGES
CORE/SLOPE PVD SPACING, c/c	NO PVD	2m	2m
TEMPORARY SURCHARGE THICKNESS	0.8m	1m	1m
EPS REQUIRED	NO	NO	NO
PVD BOTTOM ELEVATION	NO PVD	160m	160m

NOTE:
SEE BRIDGE B-6 DRAWING PACKAGE FOR DETAILED
APPROACHWAY AND ABUTMENT BACKFILL CONFIGURATION.

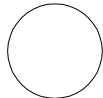


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METRIC



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



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EC ROW EBL EMBANKMENT DESIGN PROFILE

SHEET

G919

STA 12+500E TO STA 12+700E

Phase 3

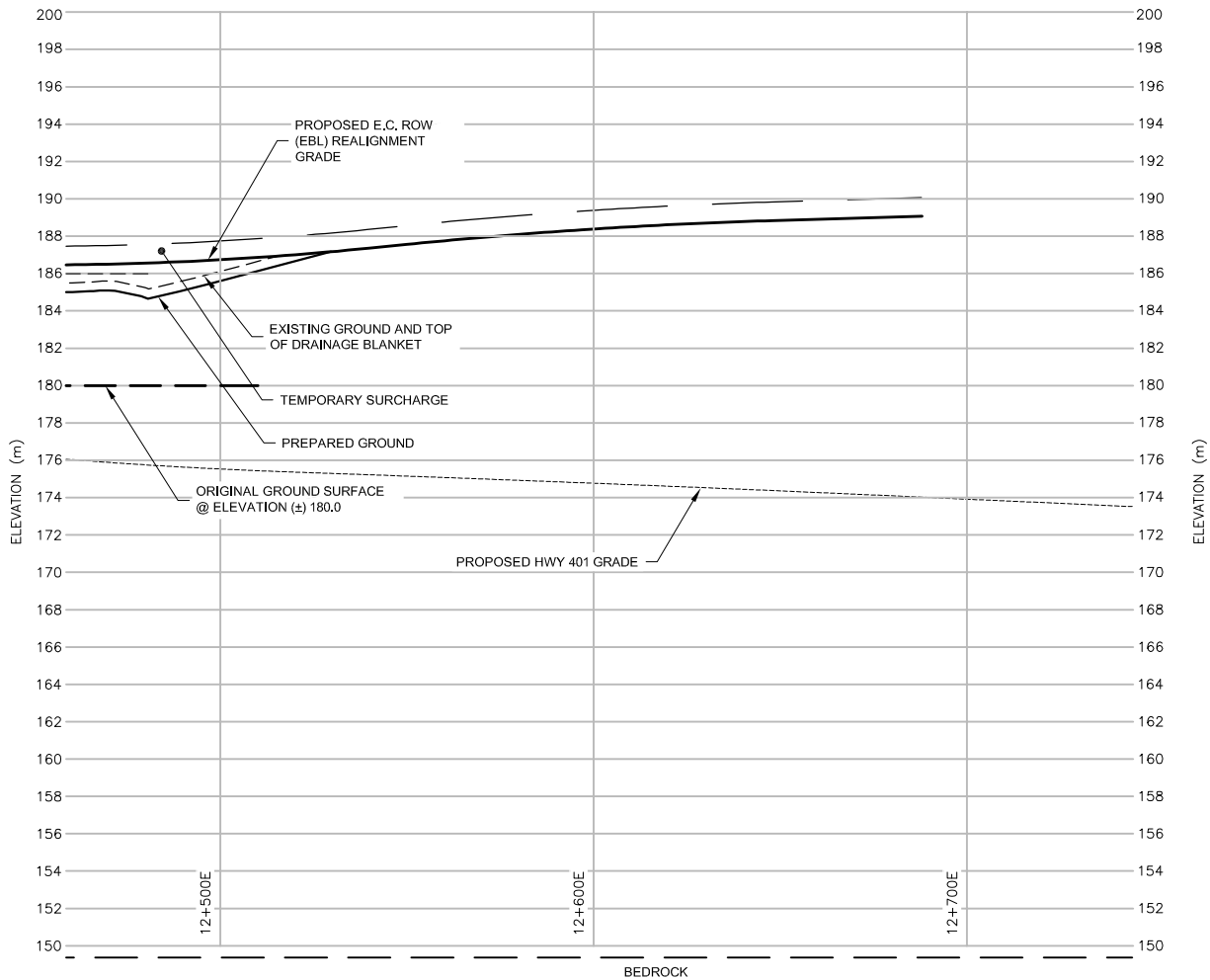
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LEGEND

- MSG MAGNETIC RING SETTLEMENT GAUGE
- PZ VW PIEZOMETER
- BM PERMANENT SURVEYING BENCHMARK

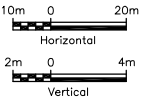
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- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
- THIS DRAWING ILLUSTRATES PROPOSED WICK DRAIN DESIGN PROFILE FOR E.C. ROW EBL EMBANKMENT BETWEEN STA. 12+500E TO 12+700E.
- SEE SHEET G924 FOR GENERAL NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION DETAILS.
- FOR BACKFILL CONFIGURATION BEHIND BRIDGE ABUTMENTS, SEE THE RELEVANT BRIDGE DESIGN REPORT.
- SEE NOTES 2 AND 3 ON SHEET G900 FOR SOIL STRATIGRAPHY AND ELEVATION DATUM.



SEGMENT ID
HEIGHT ABOVE ORIGINAL GROUND SURFACE
CONSTRUCTION STAGES
CORE/SLOPE PVD SPACING, c/c
TEMPORARY SURCHARGE THICKNESS
EPS REQUIRED
PVD BOTTOM ELEVATION

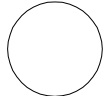
SCALES



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HWY 401-EMBANKMENT DESIGN SECTIONS

SHEET

STA 10+050W TO STA 10+525W

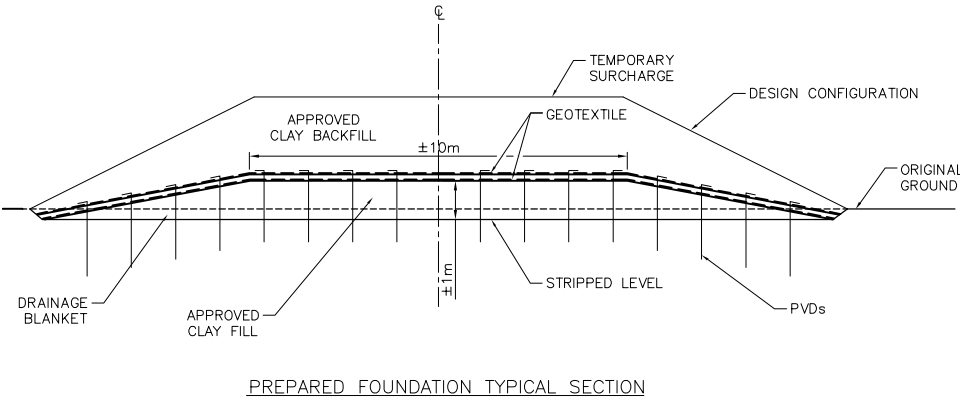
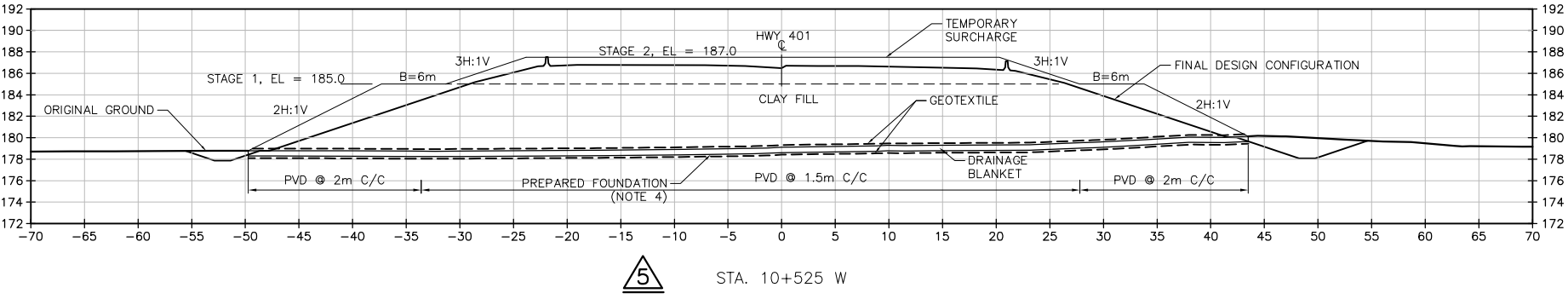
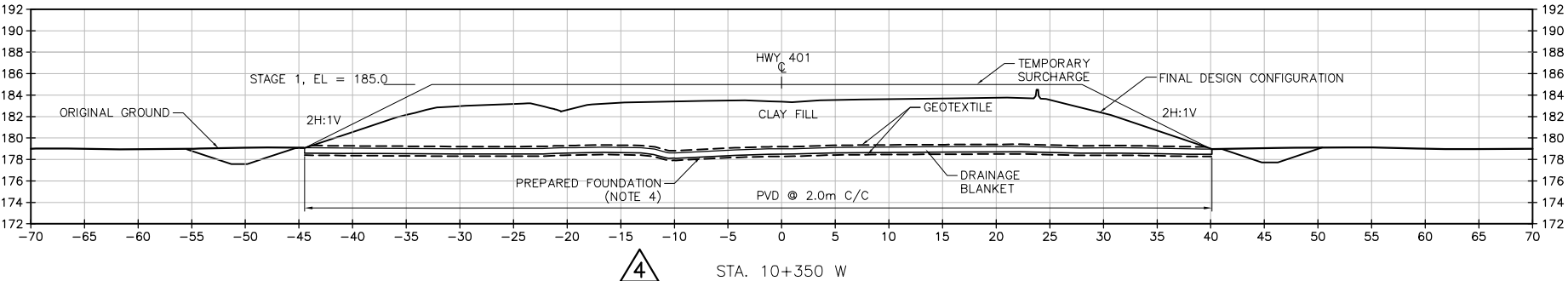
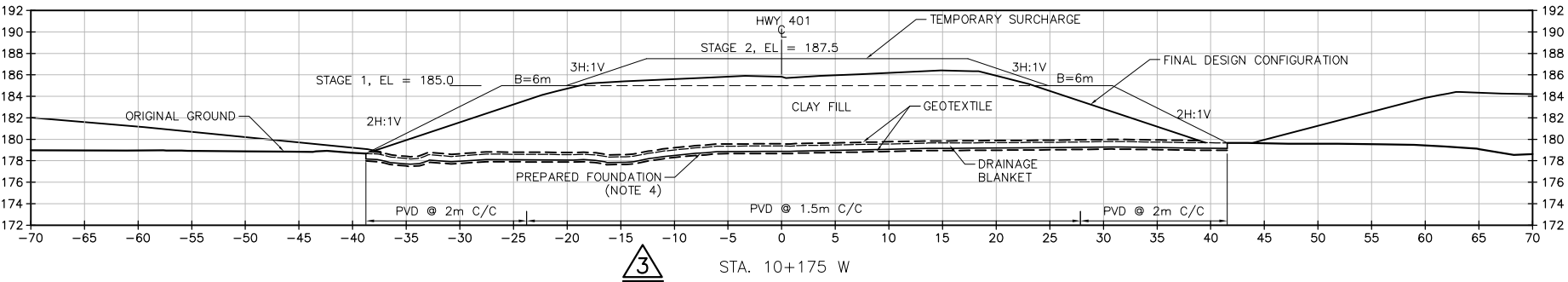
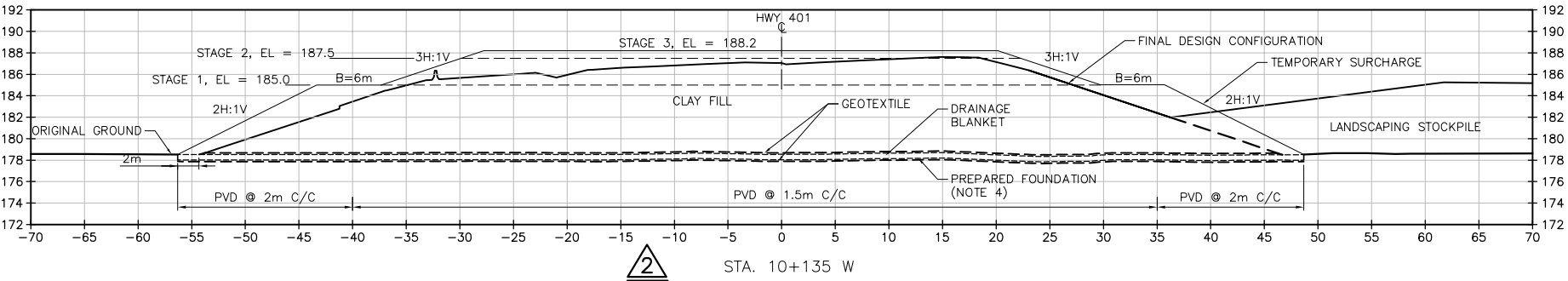
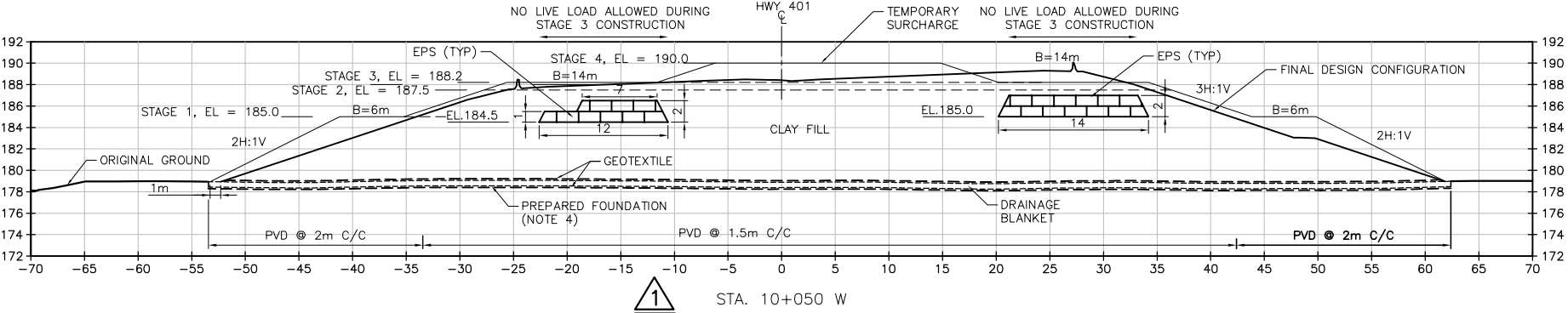
G920

Phase 3

IFC

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
2. THIS DRAWING ILLUSTRATES PROPOSED DESIGN SECTIONS 1 TO 5 FOR HWY 401 BETWEEN STA. 10+050W TO 10+525W.
3. THE EMBANKMENT IS TO BE BUILT IN STAGES AS SHOWN.
4. FOUNDATION PREPARATION INCLUDES GRUBBING AND STRIPPING FOLLOWED BY BUILDING UP THE GROUND WITH APPROVED CLAYFILL IN A DOME SHAPE, IN ORDER TO COMPENSATE FOR ANTICIPATED SETTLEMENT AND ENSURE POSITIVE DRAINAGE OF WATER EXPELLED THROUGH PVDs. THE MINIMUM RECOMMENDED HEIGHT OF THE DOME AT THE CENTER OF EMBANKMENT IS ±1m OR GREATER THAN THE EXPECTED LONGTERM SETTLEMENT AS SHOWN IN TYPICAL SECTION.
5. SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION REQUIREMENTS.



SCALE 1:300



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HWY-401 EMBANKMENT DESIGN SECTIONS

STA 10+600W TO STA 11+775W

SHEET

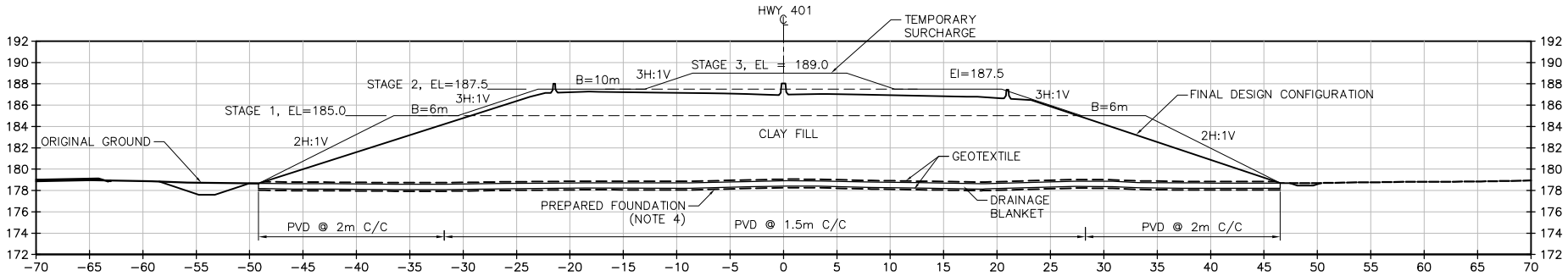
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Phase 3

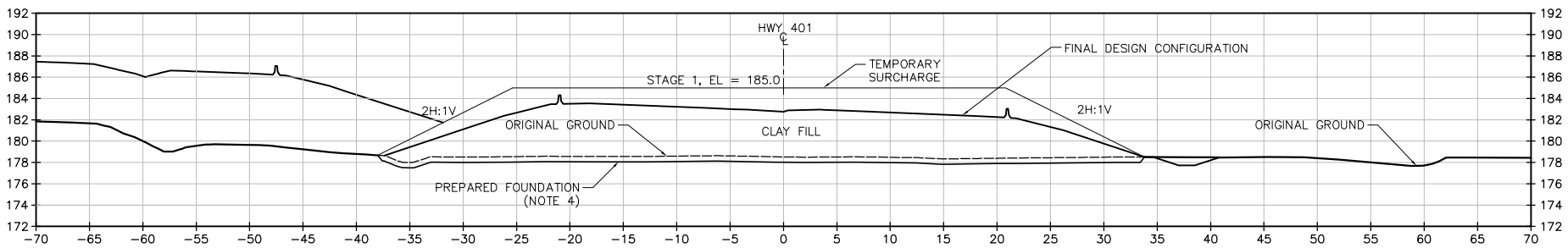
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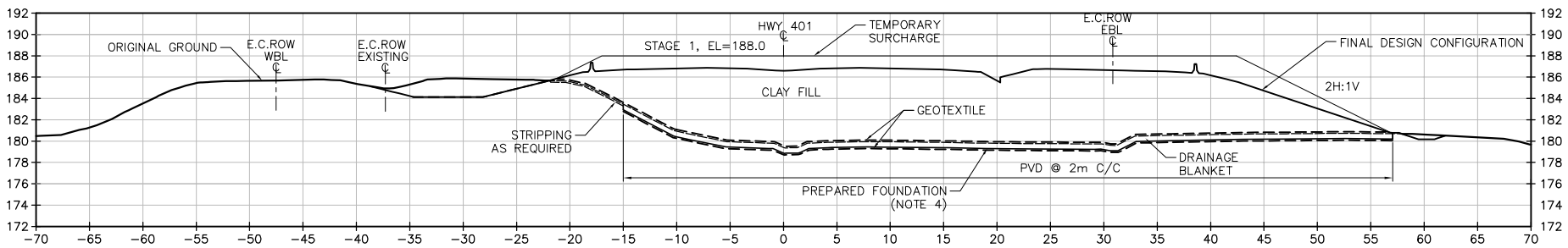
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2. THIS DRAWING ILLUSTRATES PROPOSED DESIGN SECTIONS 6 TO 9 FOR HWY 401 BETWEEN STA. 10+600W TO 11+775W.
3. THE EMBANKMENT IS TO BE BUILT IN STAGES AS SHOWN.
4. FOUNDATION PREPARATION INCLUDES GRUBBING AND STRIPPING FOLLOWED BY BUILDING UP THE GROUND WITH APPROVED CLAYFILL IN A DOME SHAPE, IN ORDER TO COMPENSATE FOR ANTICIPATED SETTLEMENT AND ENSURE POSITIVE DRAINAGE OF WATER EXPELLED THROUGH PVDs. THE MINIMUM RECOMMENDED HEIGHT OF THE DOME AT THE CENTER OF EMBANKMENT IS $\pm 1\text{m}$ OR GREATER THAN THE EXPECTED LONGTERM SETTLEMENT AS SHOWN IN TYPICAL SECTION.
5. SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION REQUIREMENTS.



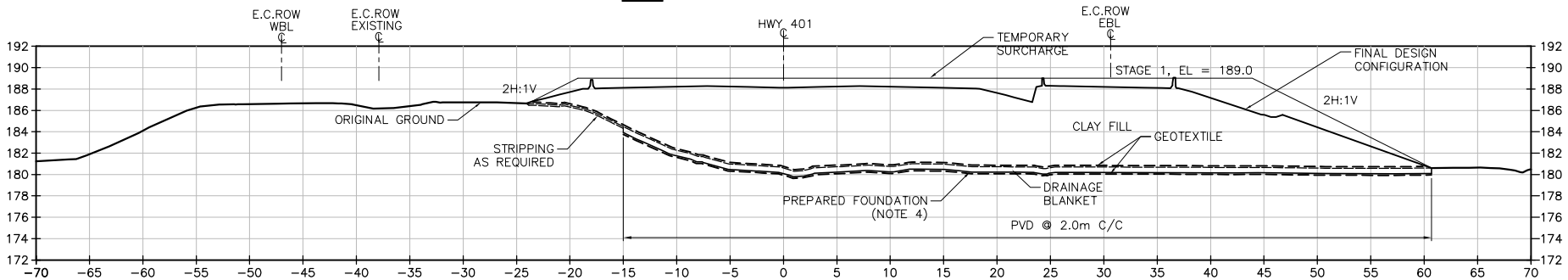
6 STA. 10+550 W



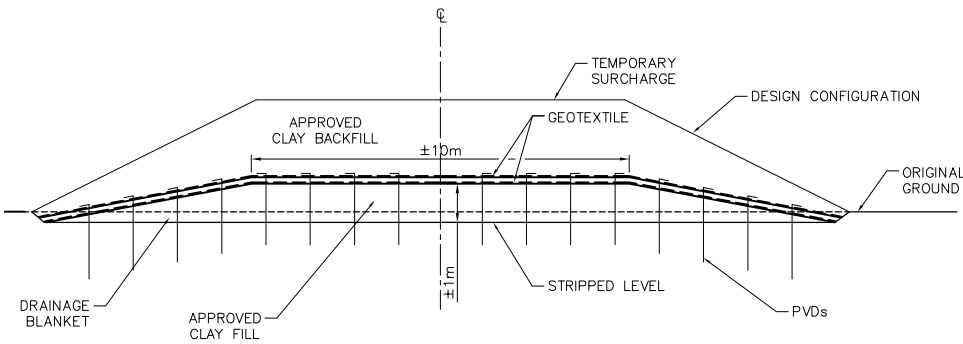
7 STA. 10+900 W



8 STA. 11+600 W



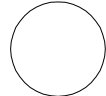
9 STA. 11+775 W



PREPARED FOUNDATION TYPICAL SECTION

SCALE 1:300





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EC ROW EBL-EMBANKMENT DESIGN SECTIONS

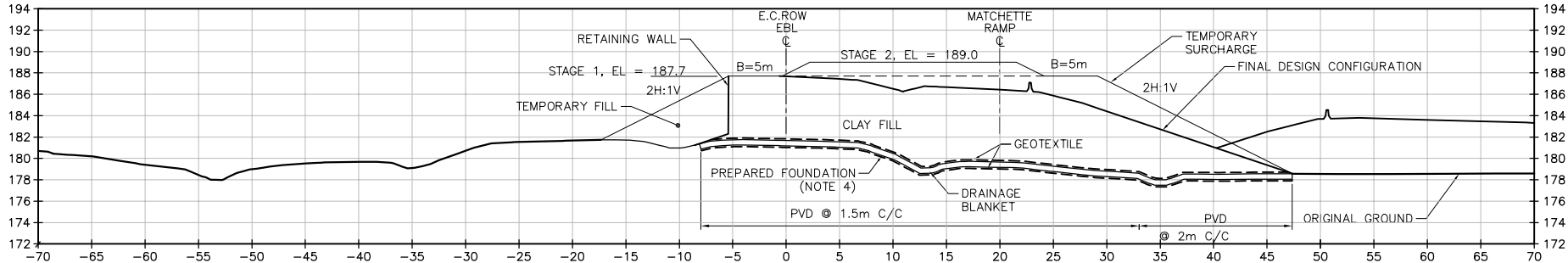
STA 10+850E TO STA 12+225E

SHEET

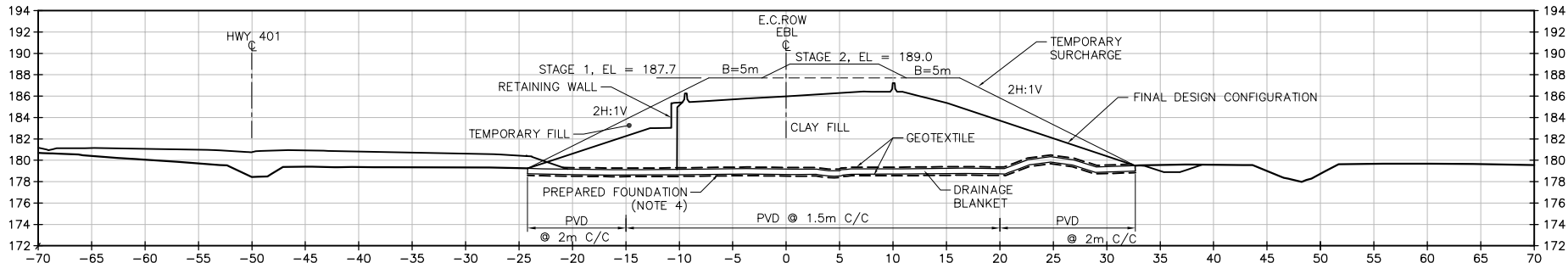
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Phase 3

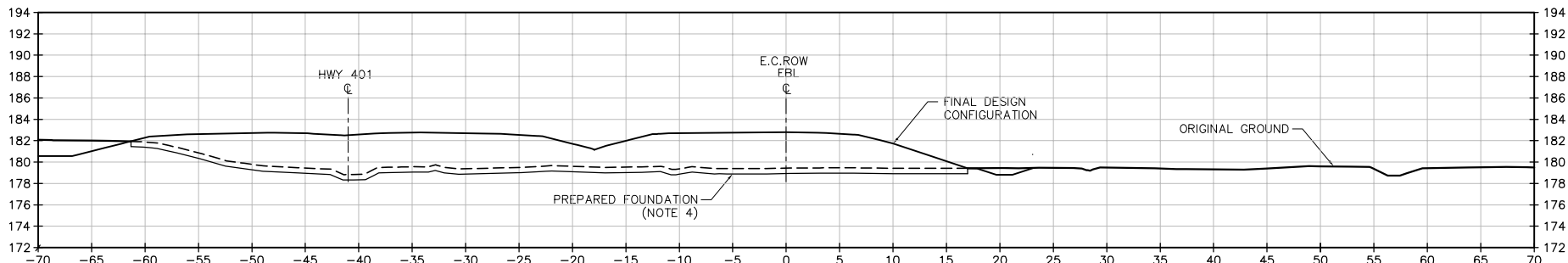
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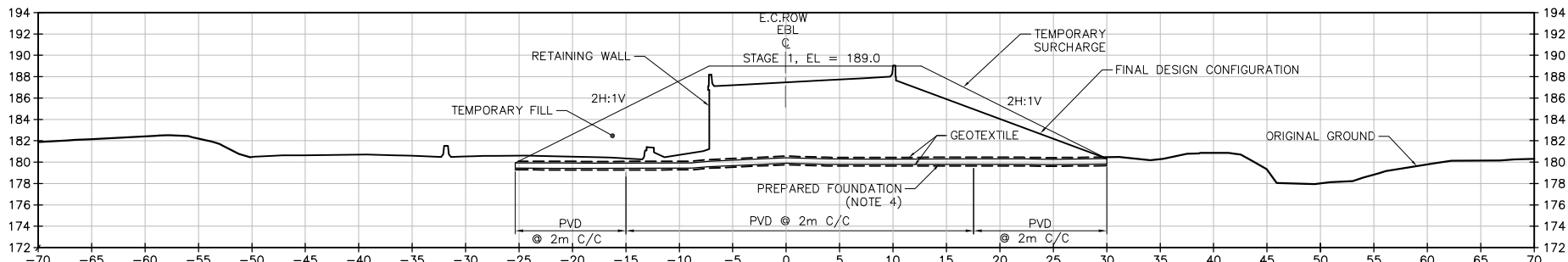
E.C. ROW EBL 10+850



E.C. ROW EBL 11+175



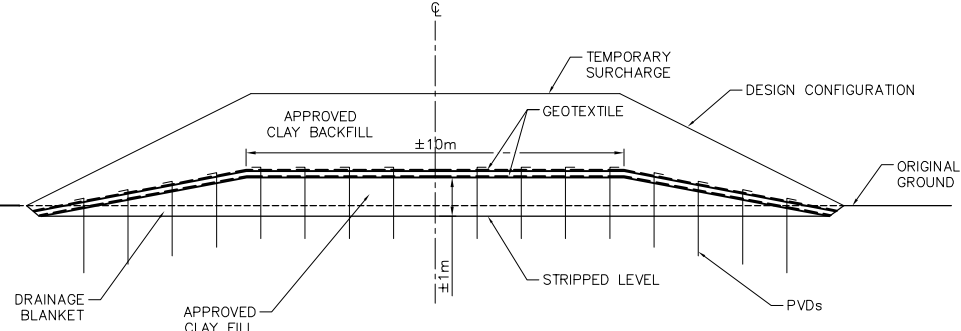
E.C. ROW EBL 11+400



E.C. ROW EBL 12+225

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
2. THIS DRAWING ILLUSTRATES PROPOSED DESIGN SECTIONS 10 TO 13 FOR E.C. ROW EBL BETWEEN STA. 10+850E TO 12+225E.
3. THE EMBANKMENT IS TO BE BUILT IN STAGES AS SHOWN.
4. FOUNDATION PREPARATION INCLUDES GRUBBING AND STRIPPING FOLLOWED BY BUILDING UP THE GROUND WITH APPROVED CLAYFILL IN A DOME SHAPE, IN ORDER TO COMPENSATE FOR ANTICIPATED SETTLEMENT AND ENSURE POSITIVE DRAINAGE OF WATER EXPELLED THROUGH PVDs. THE MINIMUM RECOMMENDED HEIGHT OF THE DOME AT THE CENTER OF EMBANKMENT IS $\pm 1\text{m}$ OR GREATER THAN THE EXPECTED LONGTERM SETTLEMENT AS SHOWN IN TYPICAL SECTION.
5. SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION REQUIREMENTS.




PREPARED FOUNDATION TYPICAL SECTION

SCALE 1:300



Parkway Infrastructure Engineers | **amec**
Hatch MacDonell



SHEET
G925

IFC

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- VERTICAL DRAIN
- 30deg (2H:1V) DRAIN
- ◇ 45deg (1H:1V) DRAIN



1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONSTRUCTION NOTES AND GEOTECHNICAL DESIGN REPORT.
2. THIS DRAWING ILLUSTRATES PROPOSED DESIGN CONFIGURATION FOR EMBANKMENT SEGMENTS BUILT OVER BP CORRIDOR AND BRIDGE B-2 ABUTMENT.
3. SEE SHEET G924 FOR NOTES ON EMBANKMENT CONSTRUCTION AND INSTRUMENTATION REQUIREMENTS.

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CONSTRUCTION NOTES – EXPANDED POLYSTYRENE FILL

1.0 GENERAL REQUIREMENTS

- 1.1.THE REQUIREMENTS ON THIS DRAWING RELATE TO THE CONSTRUCTION OF THE EXPANDED POLYSTYRENE (EPS) FILL WITHIN BACKFILL AT THE STRUCTURES AND HIGH EMBANKMENTS TO BE BUILT ALONG THE WINDSOR–ESSEX PARKWAY (WEP) PROJECT AS ILLUSTRATED ON THE DRAWINGS. THE REQUIREMENTS GIVEN HEREFTER ARE THE PRINCIPAL REQUIREMENTS. FOR DETAILED REQUIREMENTS, THE CONTRACTOR SHOULD REFER TO MTO MATERIAL SPECIFICATION REQUIREMENTS STATED IN NSSP EXPANDEDPOLYSTYRENEREQUIREMENT.DOC.
- 1.2.THESE CONSTRUCTION NOTES ARE TO READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN DRAWINGS AND REPORT.
- 1.3.THE CONSTRUCTION WORKS SHALL BE EXECUTED IN ACCORDANCE WITH THE GEOTECHNICAL DESIGN ILLUSTRATED ON THE ACCOMPANYING DRAWINGS, THE SUPPLIER SPECIFICATIONS AND THE REQUIREMENTS SPECIFIED IN THE FOLLOWING STANDARDS, SPECIFICATIONS AND PUBLICATIONS:

- MTO NSSP EXPANDED POLYSTYRENE REQUIREMENT
- CAN/ULC–S701–11 THERMAL INSULATION, POLYSTYRENE BOARDS AND PIPE COVERING
- ASTM D1621 COMPRESSIVE PROPERTIES OF RIGID CELLULAR PLASTICS
- ASTM C203 BREAKING LOAD AND FLEXURAL PROPERTIES OF BLOCK TYPE THERMAL INSULATION
- ASTM C177 STEADY STATE HEAT FLUX MEASUREMENTS AND THERMAL TRANSMISSION PROPERTIES BY MEANS OF THE HEAT FLOW APPARATUS
- ASTM D2842 WATER ABSORPTION BY RIGID CELLULAR PLASTICS
- ASTM D2863 MEASURING THE MINIMUM OXYGEN CONTENT
- ASTM D2126 RESPONSE OF RIGID CELLULAR PLASTICS TO THERMAL AND HUMID AGING
- ASTM D6817 STANDARD SPECIFICATION FOR RIGID CELLULAR POLYSTYRENE GEOFOAM
- OPSS 201 CLEARING, CLOSE CUT CLEARING, GRUBBING, REMOVAL OF SURFACE AND PILES BOULDERS
- OPSS 212 BORROW
- OPSS 501 COMPACTION
- OPSS 518 DEWATERING
- OPSS 904 CONSTRUCTION SPECIFICATION FOR CONCRETE STRUCTURES
- OPSS 905 CONSTRUCTION SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE
- OPSS 1010 AGGREGATES – GRANULAR A, B, M, AND SELECTED SUBGRADE MATERIAL
- OPSS 1440 MATERIAL SPECIFICATION FOR STEEL REINFORCEMENT FOR CONCRETE
- OPSS 1605 EXPANDED EXTRUDED POLYSTYRENE PAVEMENT INSULATION
- OPSS 1860 GEOTEXTILES
- NCHRP REPORT 529 GEOFOAM APPLICATIONS IN HIGHWAY EMBANKMENTS
- CAN/ULC–S102.2–10–EN BURNING CHARACTERISTICS

- 1.4 IF THERE IS ANY CONFLICT BETWEEN THE REQUIREMENTS GIVEN ON THIS DRAWING AND THE STANDARDS AND SPECIFICATIONS DOCUMENTS LISTED IN SECTION 1.3, THE DESIGNER SHOULD BE CONSULTED FOR CLARIFICATION AND RECOMMENDATION.
- 1.5 IN THE FOLLOWING CONSTRUCTION NOTES, THE CONTRACTOR MEANS PIC AND ITS SUB–CONTRACTORS, THE SUPPLIER MEANS THE MANUFACTURER AND PROPRIETARY SUPPLIER OF THE EPS, THE ENGINEER MEANS THE GEOTECHNICAL SITE ENGINEER, AND THE DESIGNER MEANS THE GEOTECHNICAL DESIGNER OF THE PROJECT.

2.0 SITE PREPARATION

- 2.1 CLEAR AND GRUB SITE AND REMOVE ANY SUBGRADE MATERIAL UNSUITABLE FOR EPS BLOCK PLACEMENT AS PER TECHNICAL SPECIFICATIONS FOR CLEARING, GRUBBING AND STRIPPING (OPSS 201).
- 2.2 DEWATERING: THERE SHALL BE NO STANDING WATER OR ACCUMULATED SNOW OR ICE ON THE SUBGRADE WITHIN THE AREA WHERE EPS BLOCKS ARE PLACED. EPS BLOCKS SHALL NOT BE PLACED ON A FROZEN SUBGRADE (OPSS 518).
- 2.3 PLACE GRANULAR LEVELLING PAD AS PER DRAWINGS BUT NOT LESS THAN 150 mm THICK CONSISTING OF GRANULAR 'A' OR GRANULAR 'B' MATERIAL WITH GRADATION AND PHYSICAL REQUIREMENTS AS SPECIFIED IN OPSS 1010. WHERE LEVELLING PAD IS THICKER THAN 100 mm, THE PAD SHALL BE COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY.
- 2.4 EPS SHALL NOT BE FOUNDED DIRECTLY ON EXISTING ASPHALT PAVEMENT. THE CONSTRUCTOR SHALL REMOVE EXISTING PAVEMENT IN ADDITION TO ANY MATERIAL CONTAINING HYDROCARBONS AND REPLACE WITH CLEAN GRANULAR MATERIAL. WHERE AN EPS EMBANKMENT IS FOUNDED ABOVE A PRE–EXISTING SUBSURFACE PAVEMENT LAYER THERE SHALL BE MINIMUM 200 mm OF FREE DRAINING LEVELING COURSE BELOW THE EPS BLOCKS.

3.0 MATERIALS

- 3.1 THE CONTRACTOR SHALL SUBMIT INFORMATION ON THE EPS MATERIAL, MANUFACTURER, PHYSICAL AND MECHANICAL PROPERTIES OF THE MATERIAL, AND AGING AND DURABILITY CHARACTERISTICS AS PER THE MTO–NSSP REQUIREMENTS.
- 3.2 THE CONTRACTOR SHALL PROVIDE CERTIFICATE OF COMPLIANCE OF PHYSICAL AND MECHANICAL PROPERTIES AND THE IDENTIFICATION OF THE LABORATORY ACCREDITED BY THE STANDARDS COUNCIL OF CANADA TO TEST THE EPS. THE PHYSICAL AND MECHANICAL PROPERTIES INCLUDE GEOMETRY, NOMINAL DENSITY, COMPRESSIVE STRENGTH, FLEXURAL STRENGTH, THERMAL RESISTANCE, DIMENSIONAL STABILITY, FLAMMABILITY AND WATER ABSORPTION.
- 3.3 THE PRODUCT SHALL BE SUITABLY MARKED TO IDENTIFY ITS TYPE, NUMBER AND THE MANUFACTURER’S NAME OR TRADEMARK.
- 3.4 EPS BLOCKS SHALL MEET ASTM D6817 STANDARD SPECIFICATION FOR RIGID CELLULAR POLYSTYRENE GEOFOAM AS PER THE FOLLOWING:

ASTM DESIGNATION	DENSITY, kg/m ³	COMPRESSIVE RESISTANCE, kPa		MAXIMUM WATER ABSORPTION, %
		AT 1% DEFORMATION	AT 5% DEFORMATION	
EPS 22	22	50	115	4
EPS 24	24	65	140	3
EPS 29	29	75	170	2

- 3.5 TESTING OF EPS SAMPLES SHALL BE UNDERTAKEN ACCORDING TO ASTM D1621 (PROCEDURE A). FOR EACH EPS GRADE PRODUCED BY THE SUPPLIER, A MINIMUM OF ONE SAMPLE SHALL BE TESTED PER 500 m³ FOR THE FIRST 2000 m³. A MINIMUM OF ONE SAMPLE PER 2000 m³ SHALL BE TESTED THEREAFTER.
- 3.6 THE CONTRACTOR SHALL SUBMIT THE METHOD OF DELIVERY, STORAGE, HANDLING AND PROTECTION FROM DAMAGE BY WEATHER, TRAFFIC, CONSTRUCTION STAGING AND OTHER CAUSES AS PER THE RIGID EXPANDED POLYSTYRENE MANUFACTURER’S REQUIREMENTS.
- 3.7 THE CONTRACTOR SHALL PROTECT THE EXPANDED POLYSTYRENE FROM EXPOSURE TO SUNLIGHT TO AVOID ULTRAVIOLET DEGRADATION AS PER MANUFACTURER’S RECOMMENDATION. PROTECTION OF MATERIALS AND WORKS FROM DAMAGE BY WEATHER, TRAFFIC, CONSTRUCTION STAGING, FIRE OR VANDALISM AND OTHER CAUSES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
- 3.8 CONCRETE AND CONCRETE MATERIALS SHALL CONFORM TO OPSS 1350 WITH THE FOLLOWING EXCEPTIONS AND/OR ADDITIONS: CLASS OF CONCRETE 36 MPa AT 28 DAYS, COARSE AGGREGATE 19 mm NOMINAL MAXIMUM SIZE, AIR CONTENT 7% ± 1.5%, AND MAXIMUM SLUMP 60 mm. THE STEEL REINFORCEMENT SHALL CONFORM TO THE REQUIREMENT OF OPSS 1440 AND SHALL BE PLACED IN ACCORDANCE WITH OPSS 905.

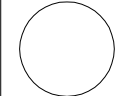
4.0 CONSTRUCTION

- 4.1 THE CONTRACTOR SHALL SUBMIT FULL DETAILS OF THE METHOD OF FOUNDATION EXCAVATION AND PREPARATION, CONSTRUCTION OF LEVELLING PAD, METHOD OF PLACEMENT OF THE EPS BLOCKS, AND THE METHODS OF PLACEMENT OF MINIMUM 125 mm THICK REINFORCED CONCRETE BASE PAD, SUBBASE MATERIAL AND SIDE SLOPE COVER.
- 4.2 FOUNDATION EXCAVATION SHALL BE CARRIED OUT TO THE DESIGN ELEVATION SHOWN ON THE DRAWINGS. ANY SOFTENED, LOOSENED OR DELETERIOUS MATERIALS AT THE FOUNDATION FOOTING ELEVATION SHALL BE SUBEXCAVATED AND REPLACED WITH GRANULAR 'A' OR GRANULAR 'B' MATERIAL.
- 4.3 PLACE, LEVEL AND COMPLETE A LAYER OF GRANULAR 'A' OR GRANULAR 'B' MATERIAL IN ACCORDANCE WITH OPSS 501 TO WITHIN ±30 mm OF THE DESIGN ELEVATION. THE LEVELLING PAD SHALL NOT DEVIATE BY MORE THAN 10 mm AT ANY PLACE ON A 3 m STRAIGHT EDGE OVER THE LIMITS OF THE BOTTOM COURSE OF BLOCKS. THE LEVELLING PAD SHALL NOT BE PLACED ON FROZEN GROUND.
- 4.4 THE EPS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER’S INSTRUCTIONS AND GOOD CONSTRUCTION PRACTICE. THE INDIVIDUALLY MARKED BLOCKS SHALL BE PLACED ON THE PREPARED LEVELLING PAD. THE TOP SURFACE OF THE FIRST LAYER OF BLOCKS IS TO BE SET PLANE AND LEVEL. LOCAL TRIMMING OF THE BLOCKS MAY BE NECESSARY. SUBSEQUENT SUCCESSIVE LAYERS SHALL BE ORIENTED WITH THE LONG AXIS OF BLOCKS POSITIONED AT 90° TO THE PREVIOUS LAYER IN ORDER TO AVOID CONTINUOUS JOINTS. BLOCK JOINTS SHALL BE OFFSET AND STAGGERED BETWEEN LAYERS AS ILLUSTRATED ON THE DRAWINGS OR RECOMMENDED BY THE SUPPLIER.
- 4.5 SLOPING END ADJUSTMENTS AT THE ABUTMENTS SHALL BE ACCOMPLISHED BY LEVELLING TERRACES IN THE SUBSOIL IN ACCORDANCE WITH THE BLOCK THICKNESS.

METRIC

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RFP No. 09–54–1007



EMBANKMENT DESIGN
CONSTRUCTION NOTES
EXPANDED POLYSTYRENE

SHEET
G926

Phase 3

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- 4.6 TEMPORARY BALLAST SHALL BE PROVIDED AS NECESSARY TO PREVENT MOVEMENT OF EXPANDED POLYSTYRENE BOTH IN STORAGE AND AS PLACED DUE TO WINDY CONDITIONS. TIMBER FASTENERS OR EQUIVALENT SHALL BE USED AS NECESSARY.
- 4.7 THE EXPANDED POLYSTYRENE FILL/EMBANKMENTS SHALL BE PROTECTED FROM ACCIDENTAL IGNITION DUE TO WELDING, SMOKING, GRINDING OR CUTTING TOOLS, ETC. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PREVENT IGNITION OF THE EXPANDED POLYSTYRENE.
- 4.8 THE EXPANDED POLYSTYRENE SHALL BE PROTECTED FROM ORGANIC SOLVENTS AND OTHER AGGRESSIVE, HARMFUL CHEMICALS DURING CONSTRUCTION. THE PROPOSED METHOD OF PROTECTION DURING CONSTRUCTION SHALL BE SUBMITTED TO THE CONTRACTOR’S QUALITY VERIFICATION ENGINEER FOR REVIEW AND TO THE CONTRACT ADMINISTRATOR FOR INFORMATION PURPOSES.
- 4.9 EXPOSED BLOCKS SHALL BE COVERED IMMEDIATELY TO AVOID POSSIBLE BURROWING BY ANIMALS.
- 4.10 INDIVIDUALLY MARKED BLOCKS SHALL BE FABRICATED AND PLACED TO ENSURE THE TOP SURFACE MATCHES THE ELEVATION AND CROSSFALL SHOWN ON THE DRAWINGS.
- 4.11 THE TOP SURFACE AND SIDE SURFACES OF THE EXPANDED POLYSTYRENE SHALL BE COVERED WITH 10 MIL POLYETHYLENE SHEETING EXTENDING ONTO ADJACENT WORK AT THE LONGITUDINAL ENDS OF THE EMBANKMENT/ABUTMENTS. ALL JOINTS SHALL BE LAPPED A MINIMUM 300 mm TO PROVIDE A FULLY SEALED ENCLOSURE. THE JOINTS IN THE LONGITUDINAL AND TRANSVERSE DIRECTIONS SHALL BE ARRANGED TO OVERLAP THE BLOCKS IN THE LOWER LAYER OF THE EPS.
- 4.12 THE CONTRACTOR SHALL INSTALL THE CONCRETE PAD COVER AS DESCRIBED IN SECTIONS 3.8 AND 4.1 ABOVE. THE STEEL REINFORCEMENT SHALL BE PLACED IN ACCORDANCE WITH OPSS 905. THE TOP OF THE EPS SHOULD BE SLOTTED TO PREVENT RELATIVE DISPLACEMENT BETWEEN THE EPS AND CONCRETE PAD.
- 4.13 THE CONTRACTOR SHALL SUBMIT DETAILS OF THE SEQUENCE AND METHOD OF INSTALLATION TO THE ENGINEER FOR REVIEW AT LEAST 3 WEEKS PRIOR TO THE INSTALLATION OF THE EPS. THE SUBMITTAL SHALL SATISFY ALL SPECIFICATIONS.
- 4.14 TRAFFIC: EQUIPMENT OTHER THAN RUBBER–TIRE SAWING EQUIPMENT SHALL NOT BE PERMITTED ON THE CONCRETE UNTIL IT HAS ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 2 MPa. A LIFT OF GRANULAR NO LESS THAN 600 mm IN THICKNESS SHALL BE PLACED ON THE CONCRETE PAD BEFORE TRAFFIC IS PERMITTED. EQUIPMENT SHALL BE LIMITED IN WEIGHT AND SIZE AND RESTRICTED IN OPERATION TO AVOID DAMAGING THE EPS AS PER THE SUPPLIER’S REQUIREMENT.

5.0 DRAINAGE

- 5.1 TOP SURFACE OF EPS BLOCKS SHALL BE STEPPED OR SLOPED TO MATCH SUPER ELEVATION OR CROSSFALL. DRAINAGE CHANNELS COMPRISING 19 mm CLEAR CRUSH STONE WRAPPED WITH NON–WOVEN GEOTEXTILE (AMOCO 4545 OR APPROVED EQUIV.) SHALL BE PROVIDED UNLESS REQUIRED OTHERWISE BY THE DESIGNER OR NOTED ON THE DESIGN DRAWINGS. SUBDRAINS SHALL BE PERFORATED PVC DRAIN PIPE WITHIN 19 mm CLEAR CRUSH BEDDING WRAPPED IN NON–WOVEN GEOTEXTILE AS PER DESIGN DRAWINGS.
- 5.2 APPROPRIATE DRAINAGE SHALL BE PROVIDED IN EPS EMBANKMENT/FILL FOUNDATION TO ENSURE EFFECTIVE DRAINAGE AND PREVENT PRESENCE OF STANDING WATER OR ACCUMULATED SNOW OR ICE ON THE SUBGRADE WITHIN THE AREA WHERE EPS BLOCKS ARE PLACED.

6.0 USE

- 6.1 THIS DRAWING PROVIDES CONSTRUCTION REQUIREMENTS FOR GEOTECHNICAL ASPECTS OF BACKFILLING AT HIGH EMBANKMENTS.

Figures

Figure 3-1: Field Vane Correction Factor vs. Plasticity Index Derived from Embankment Failures

(Ladd & DeGroot, 2004)

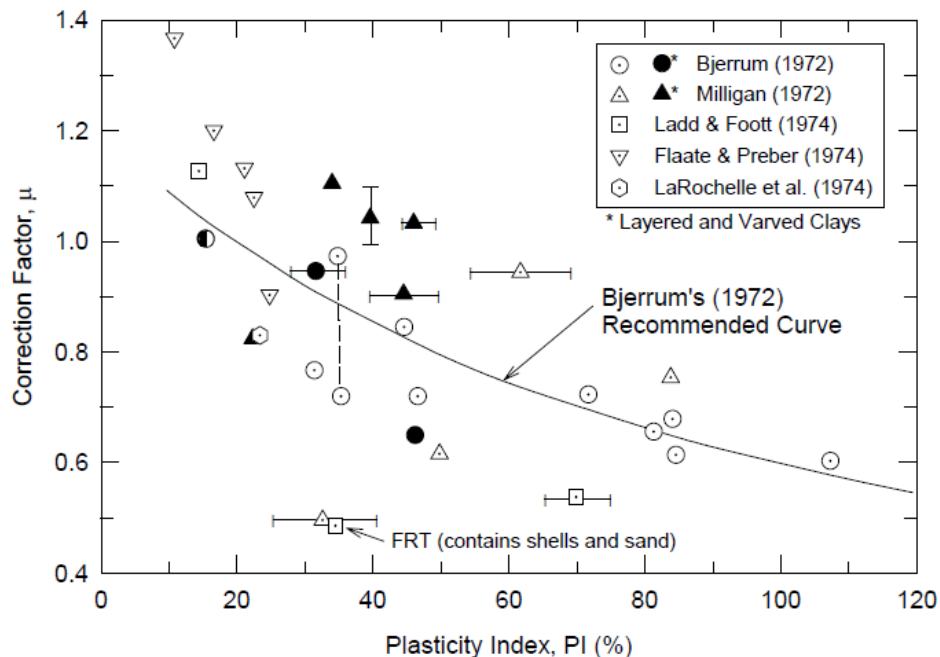
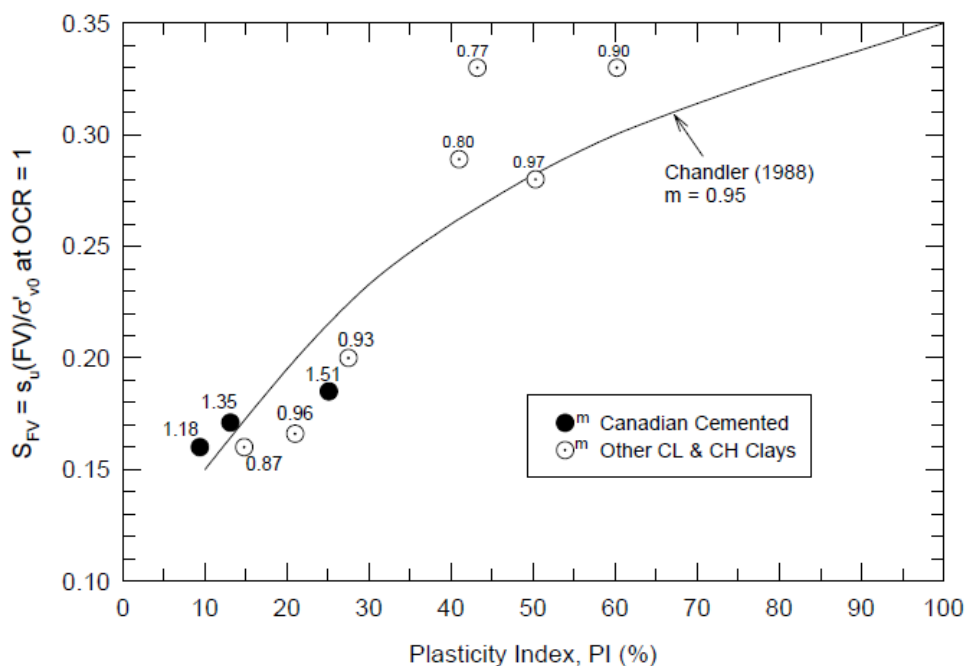
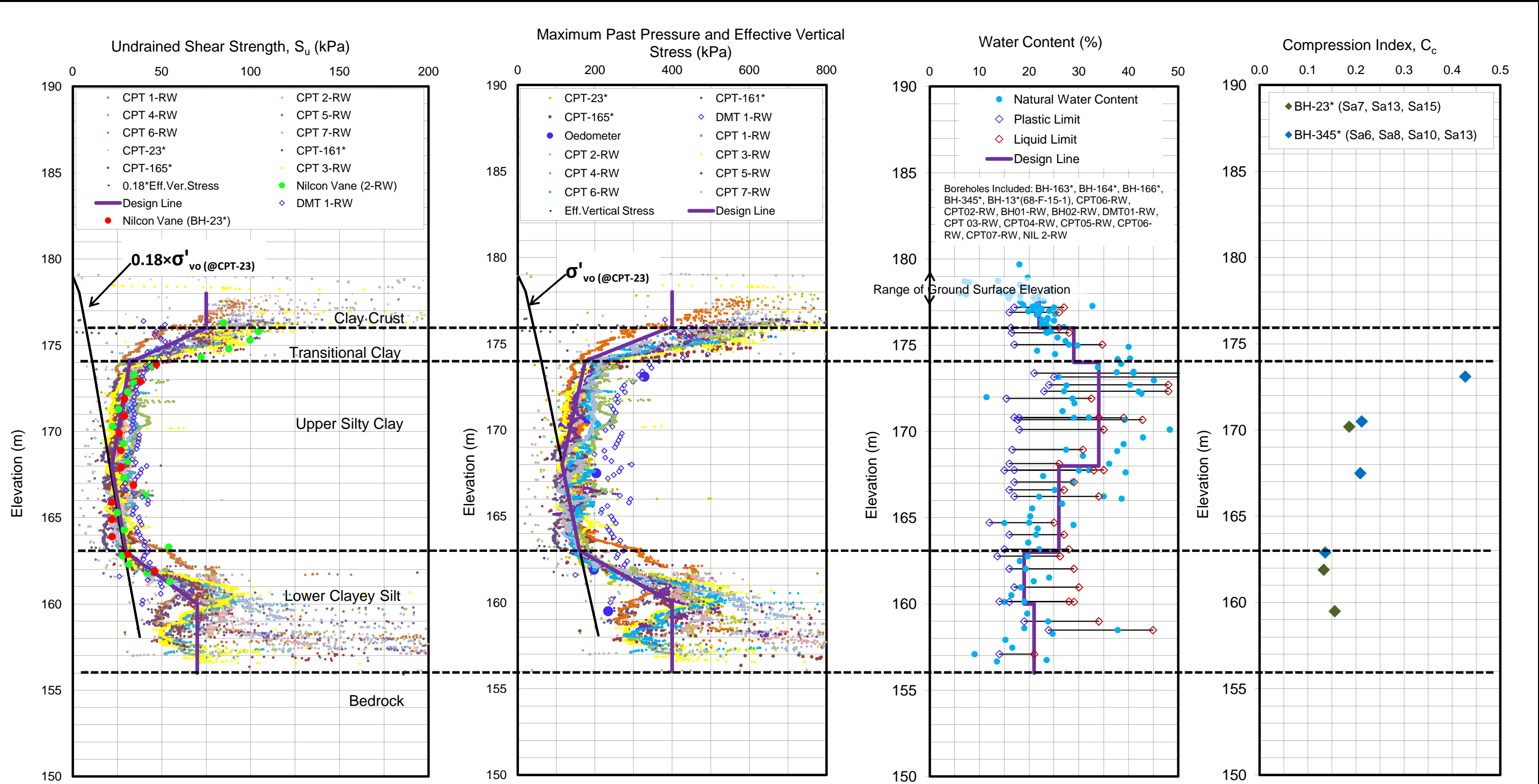


Figure 3-2: Field Vane Undrained Strength Ratio at OCR=1 vs. PI for Homogeneous Clays

(Ladd & DeGroot, 2004)





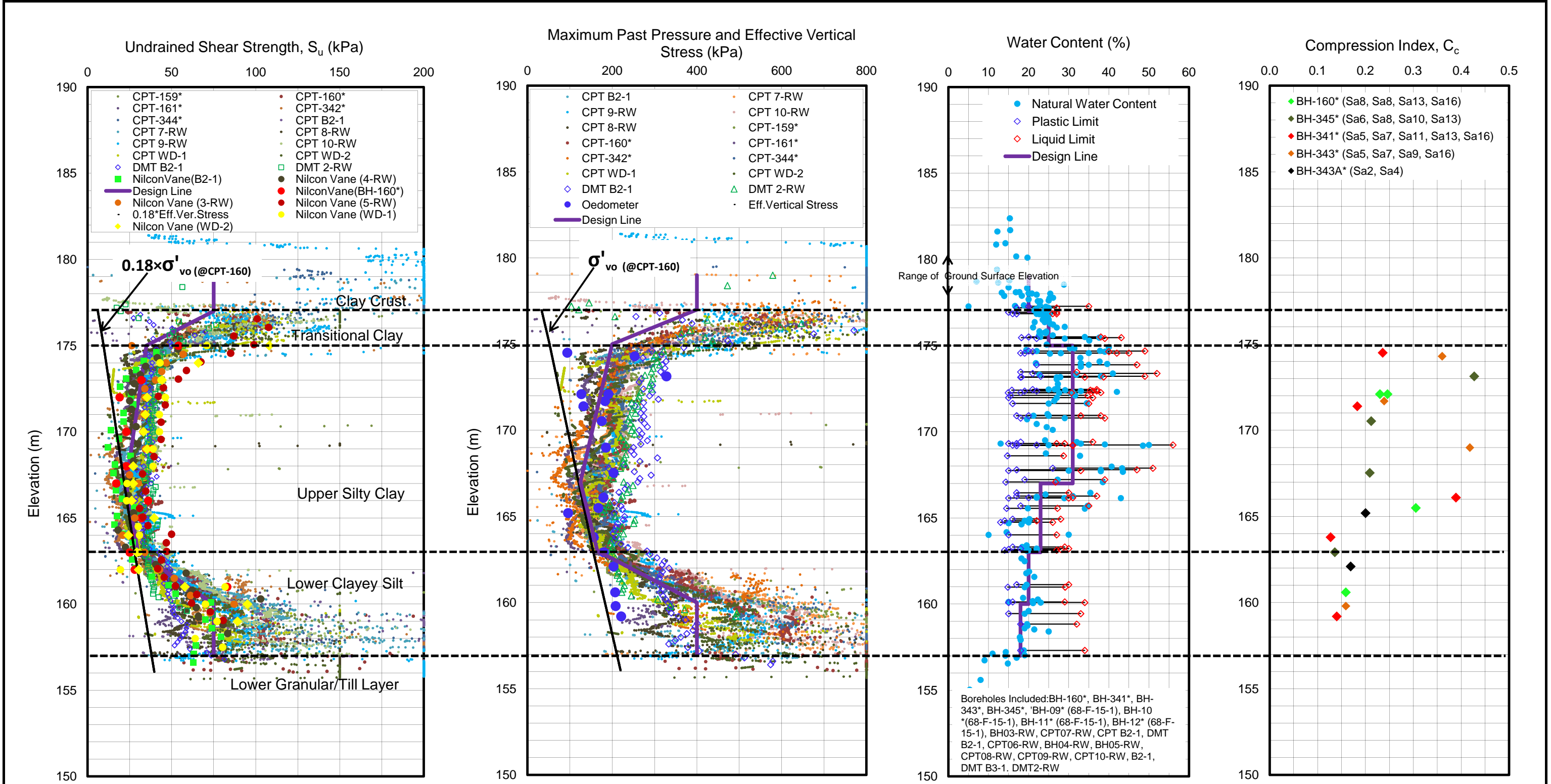
Notes:

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, $OCR = [(S_u / \sigma'_{vo}) / S]^{1/m}$.

* From previous investigations.

<div>amec Earth & Environmental</div> <div>CLIENT : <div>PARKWAY</div></div>	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES STA. 9+700W TO 10+400W				
	DATE: Nov 2011	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: 3-3	REV. B




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, $OCR = [(S_u / \sigma'_v) / S]^{1/m}$.

* From previous investigations.



Earth & Enviromental

CLIENT :

  

PROJECT:
WINDSOR ESSEX PARKWAY

TITLE:
**SOIL PROPERTIES PROFILES
STA.10+300W TO 10+900W**

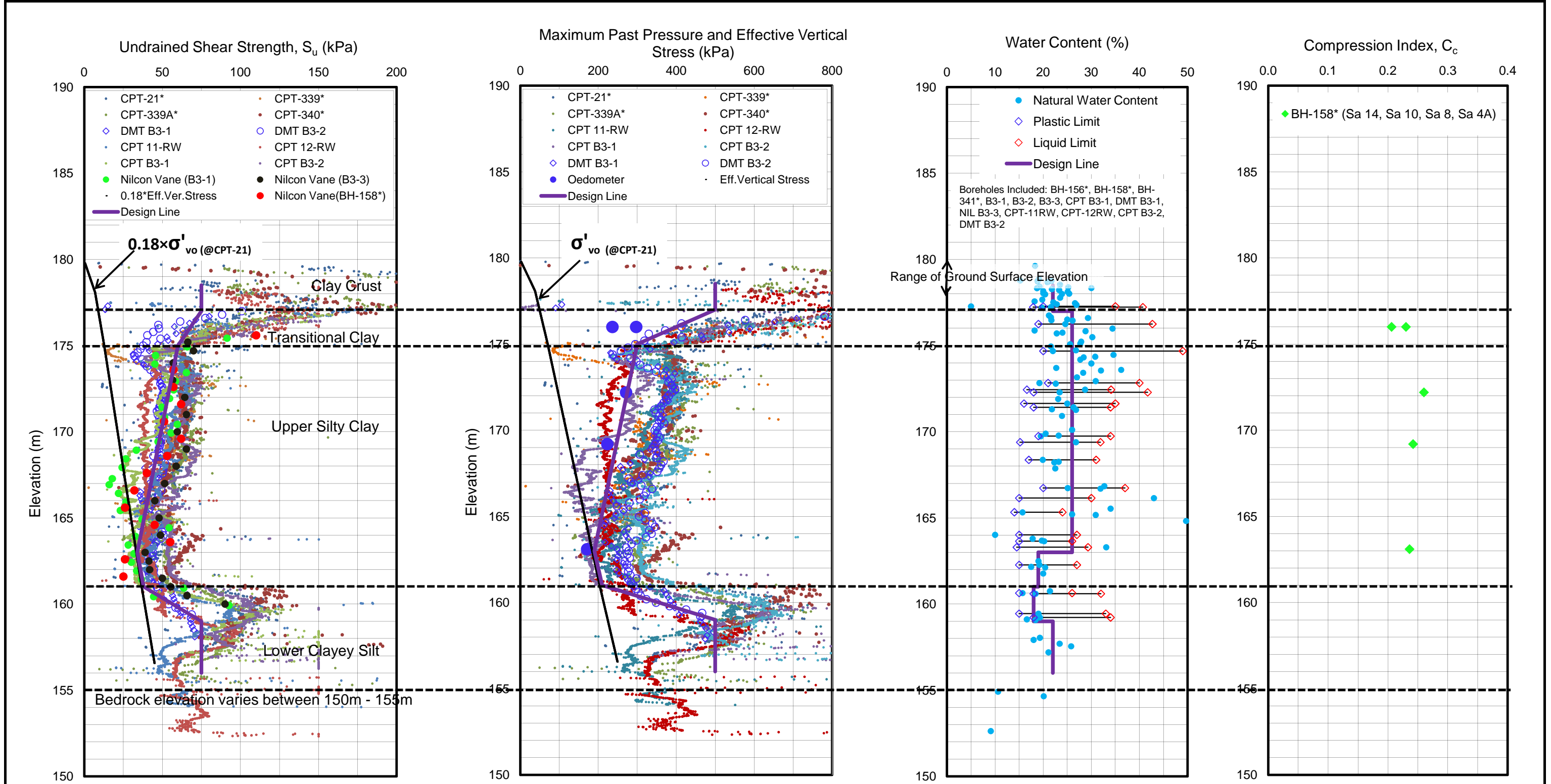
DATE:
Nov 2011

JOB NO.:
SW8801.1002

CAD FILE:

FIGURE NO.:
3-4

REV.
B



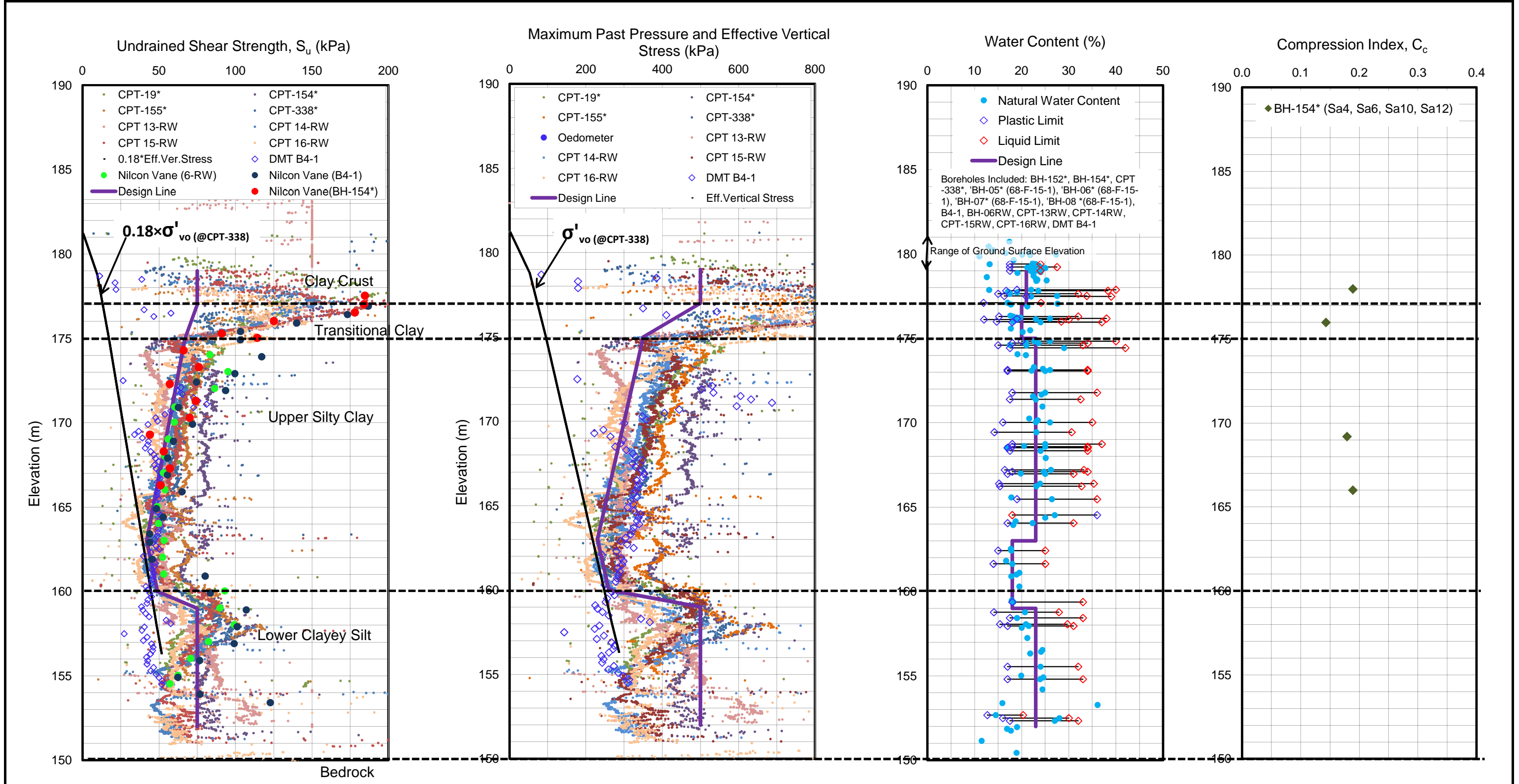
Notes:

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, $OCR = [(S_u / \sigma'_{vo}) / S]^{1/m}$.

* From previous investigations.

<div>amec Earth & Environmental</div> <div>CLIENT : <div>PARKWAY INFRASTRUCTURE CONSTRUCTORS acciona DRAGADOS FLUOR</div></div>	PROJECT: WINDSOR ESSEX PARKWAY			
	TITLE: SOIL PROPERTIES PROFILES STA.10+900W TO 11+500W			
	DATE: Nov 2011	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: 3-5 REV. B








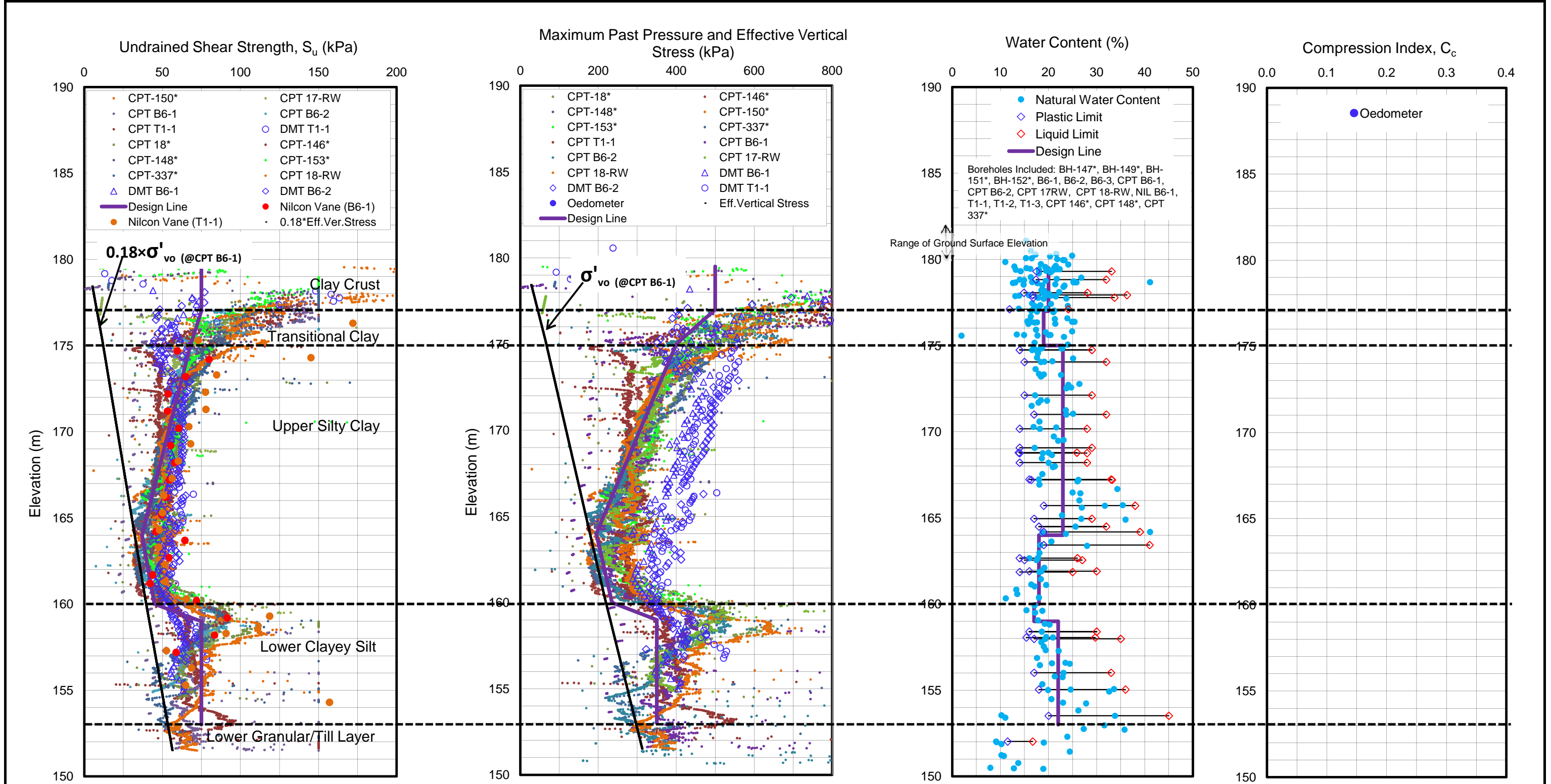
Notes:

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, $OCR = [(S_u / \sigma'_{vo}) / S]^{1/m}$.

* From previous investigations.

<div> Earth & Enviromental</div>	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES STA.11+500W TO 12+200W				
	DATE: Nov 2011	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: 3-6	REV. B
CLIENT : <div></div>					



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, $OCR = [(S_u / \sigma'_{vo}) / S]^3$.

* From previous investigations.






<div> Earth & Enviromental</div>	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES STA.12+100W TO 12+800W				
	DATE: Nov 2011	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: 3-7	REV. B
CLIENT : <div>   </div>					

Figure 4-1: Compressibility Parameters at WEP

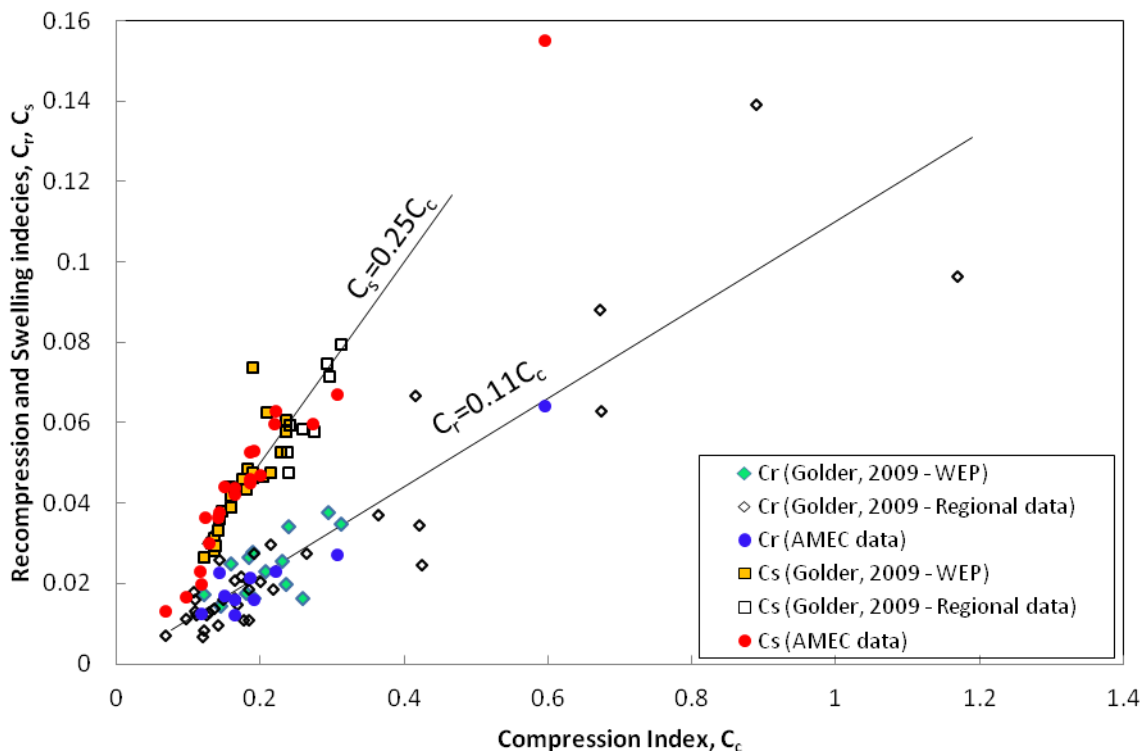
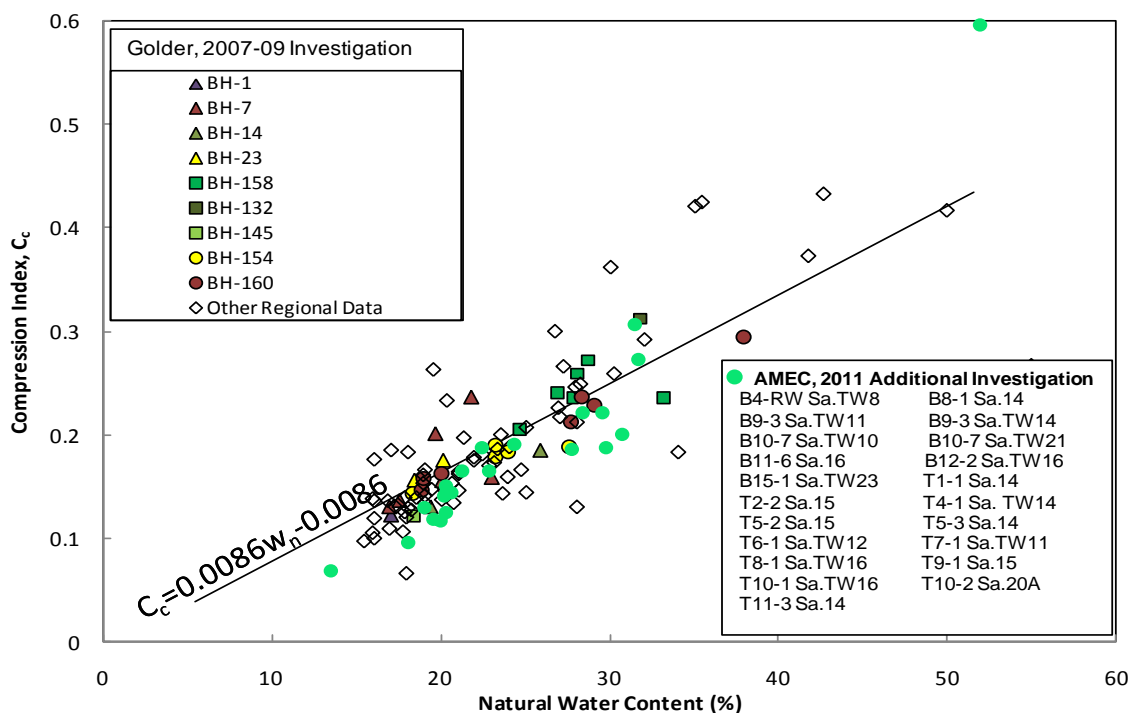


Figure 4-2: C_α versus C_c Relationship at WEP

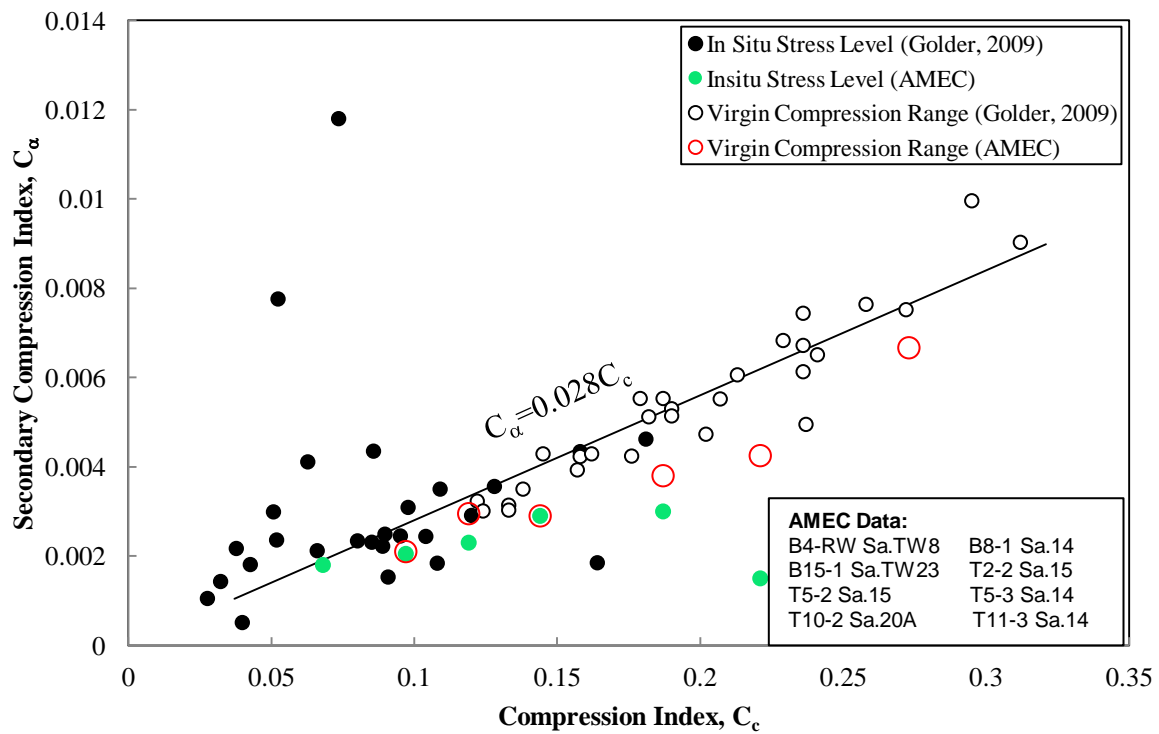


Figure 4-3: Effective Friction Angle (ϕ') for Silty Clay to Clayey Silt Stratum at WEP

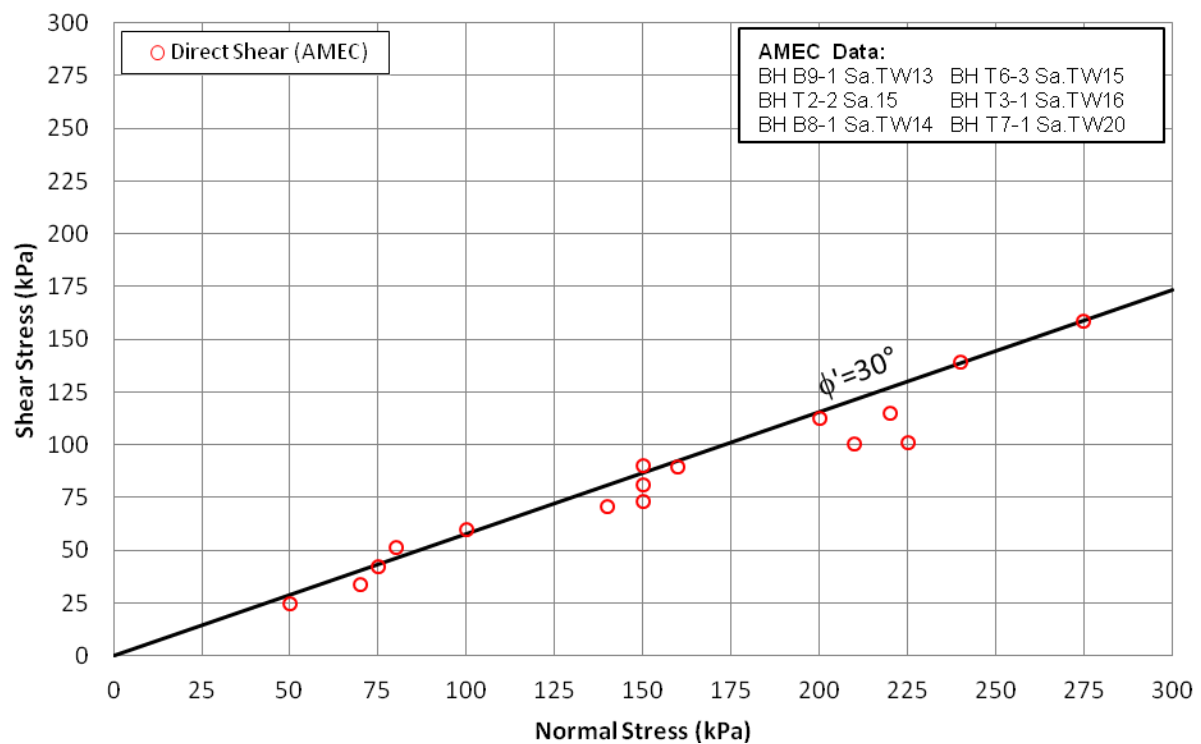
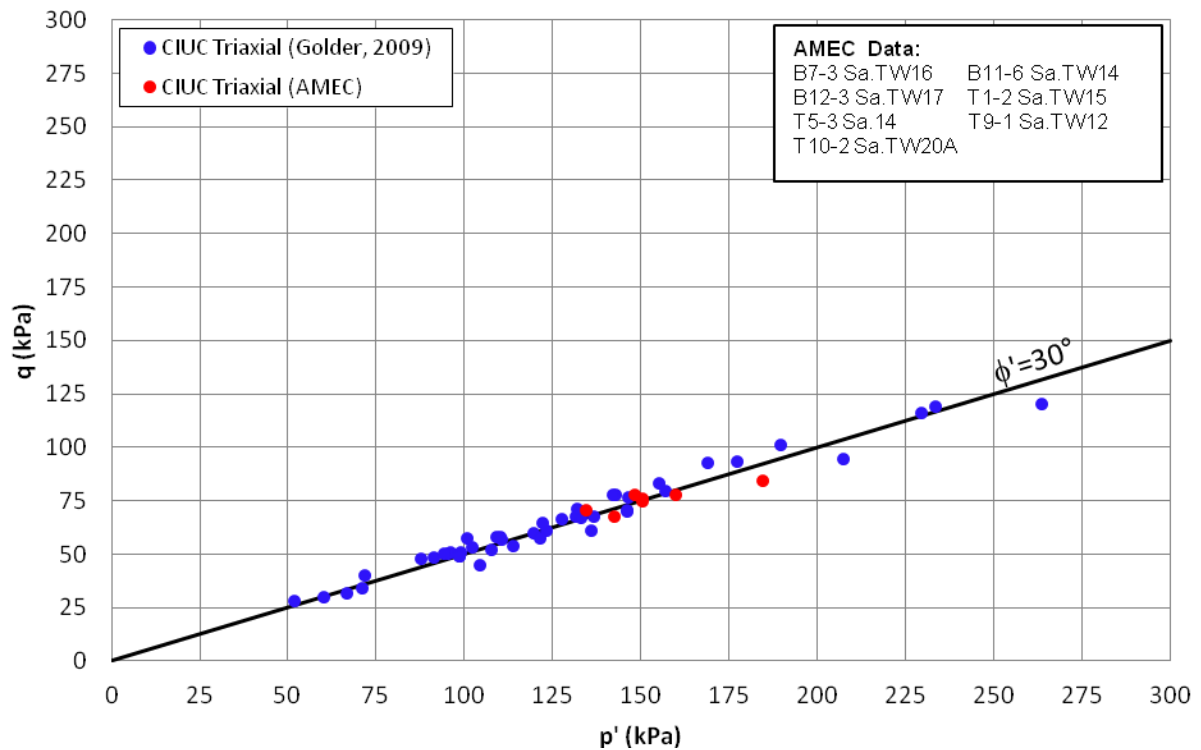


Figure 4-4: Relationship between $\sin \phi'$ and Plasticity Index for Normally Consolidated Soils (Kenney, 1959)

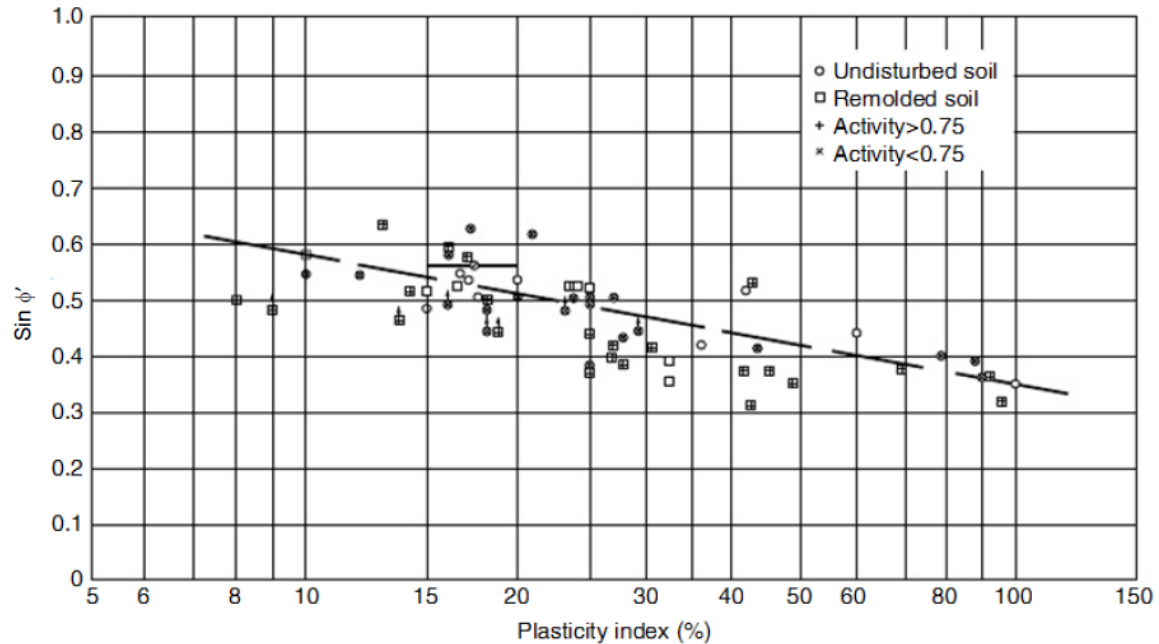
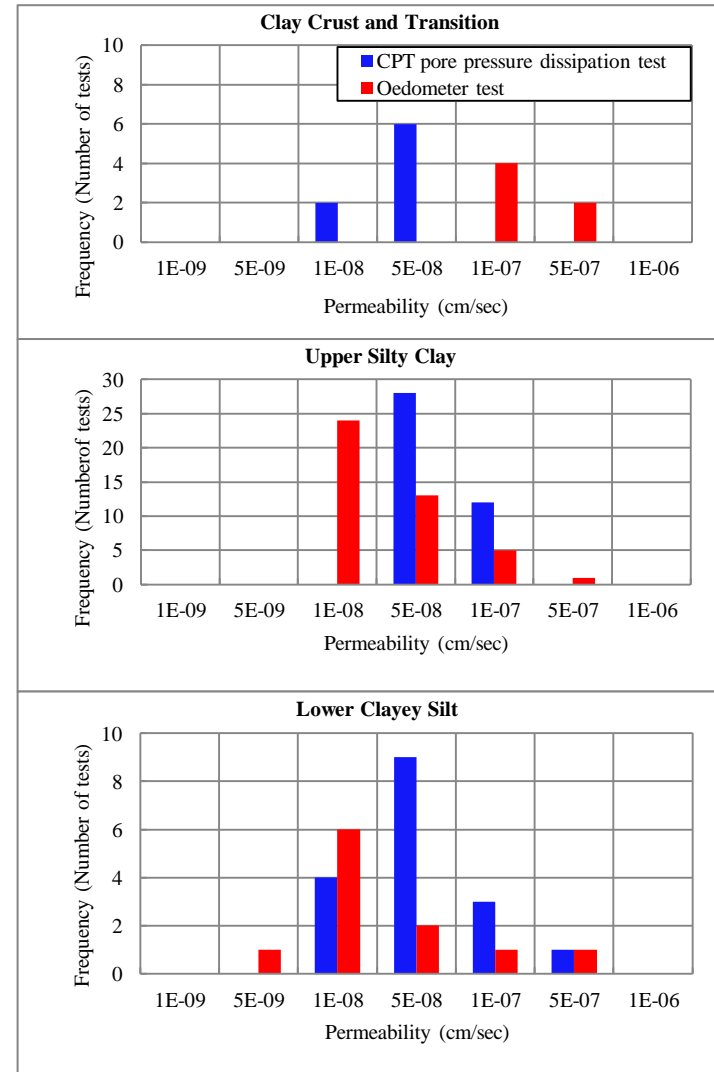
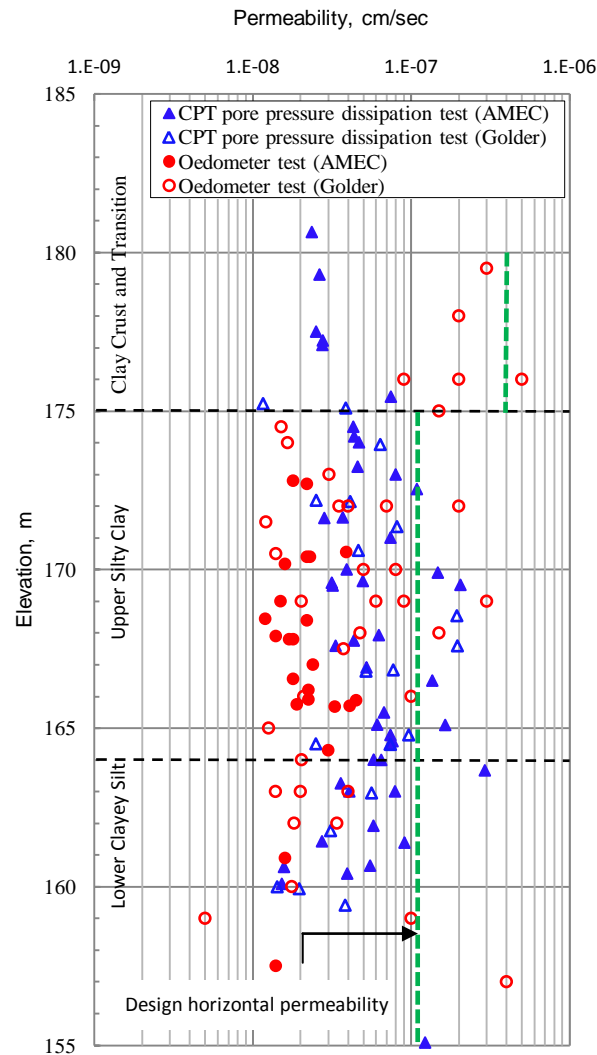
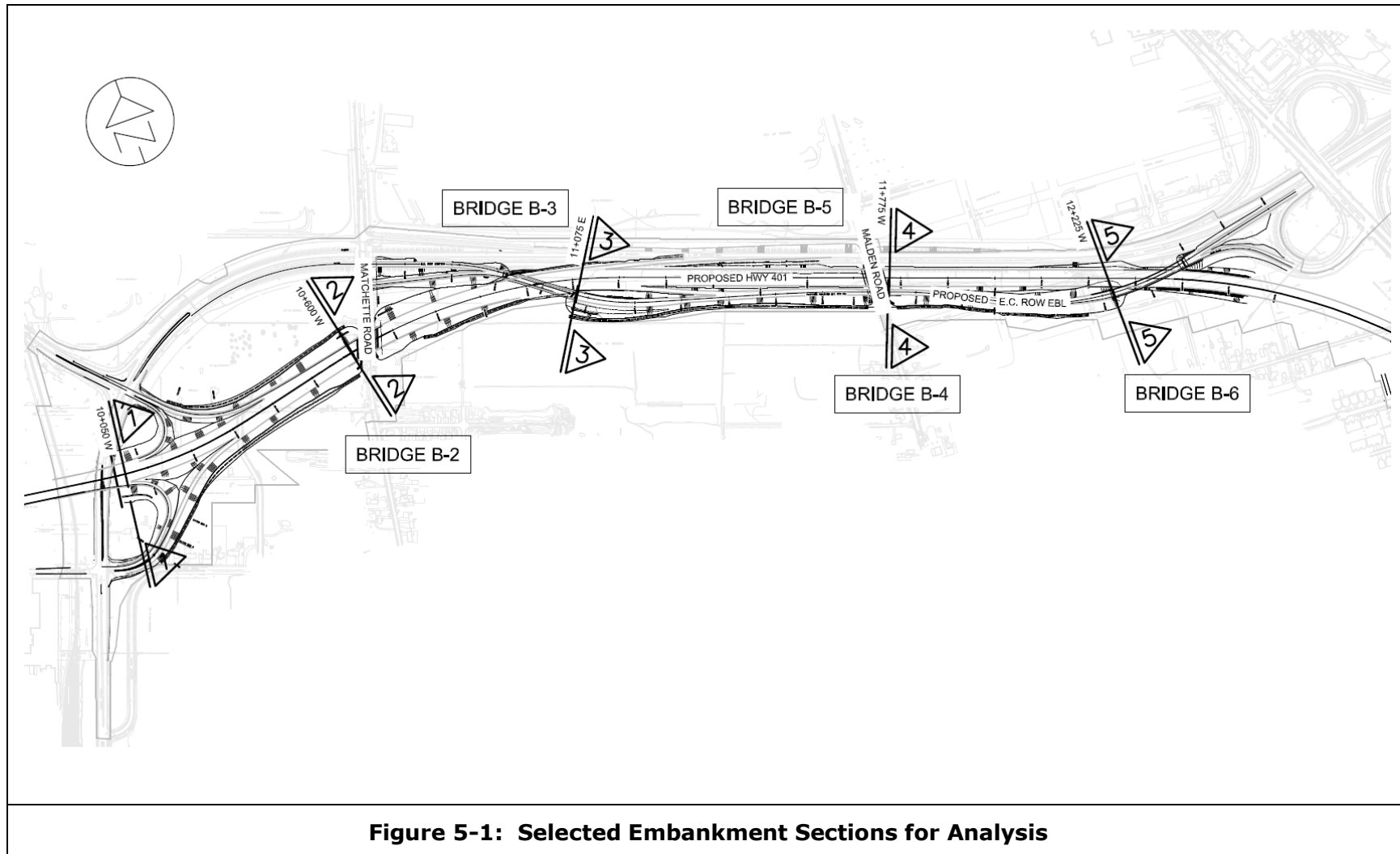


Figure 4-5: Inferred Clay Stratum Permeability from CPT Pore Pressure Dissipation and Oedometer Tests





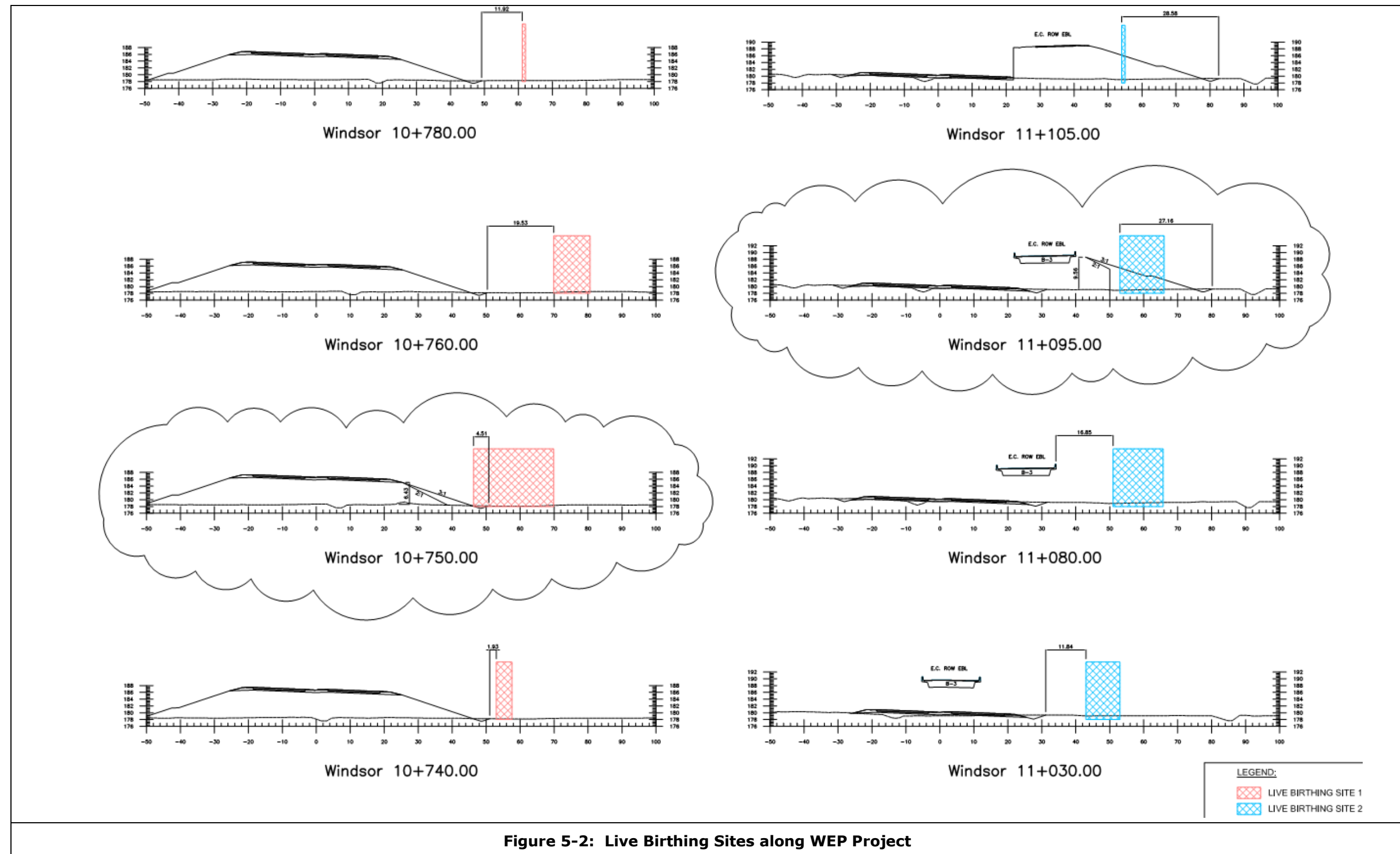
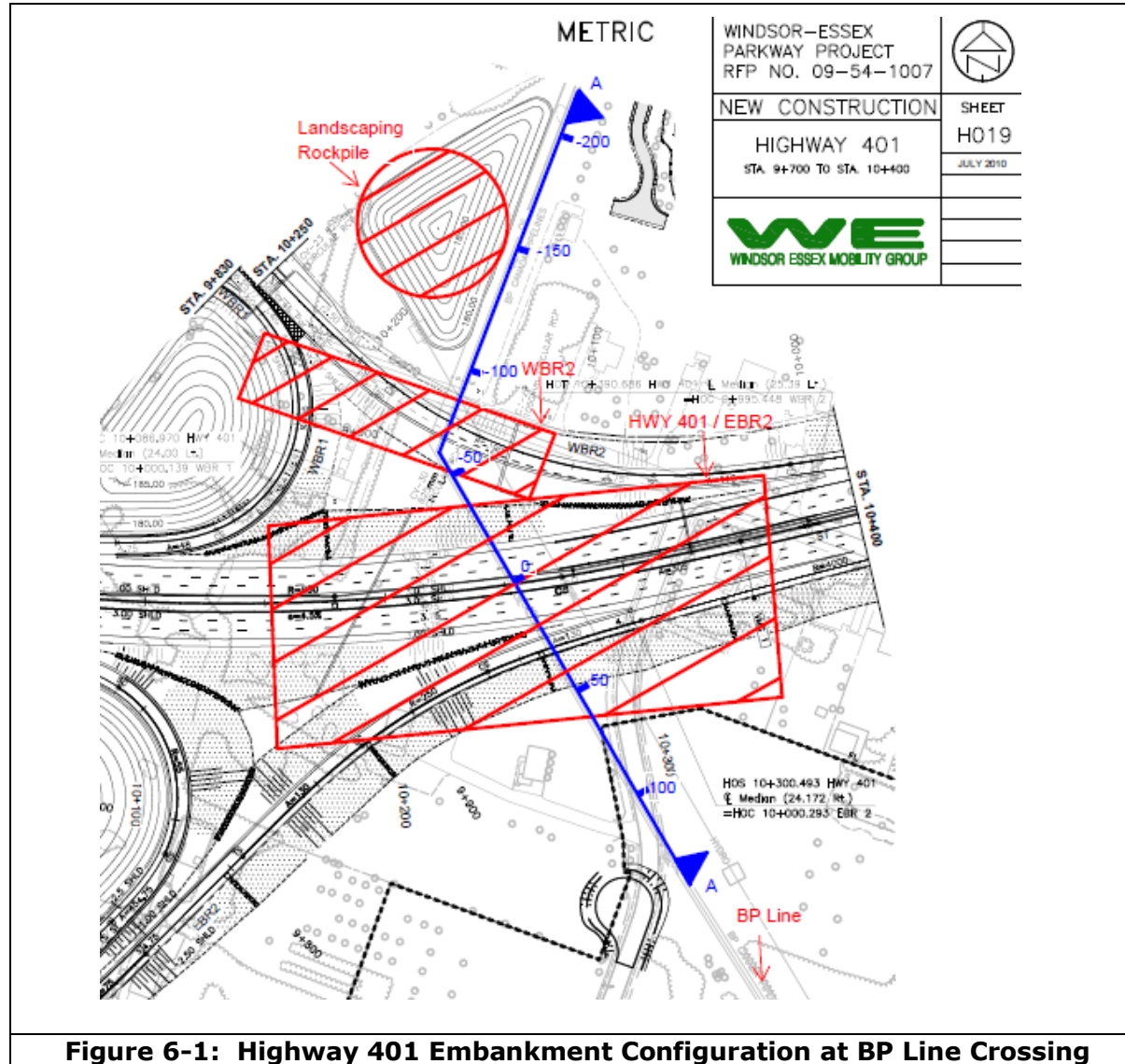


Figure 5-2: Live Birthing Sites along WEP Project



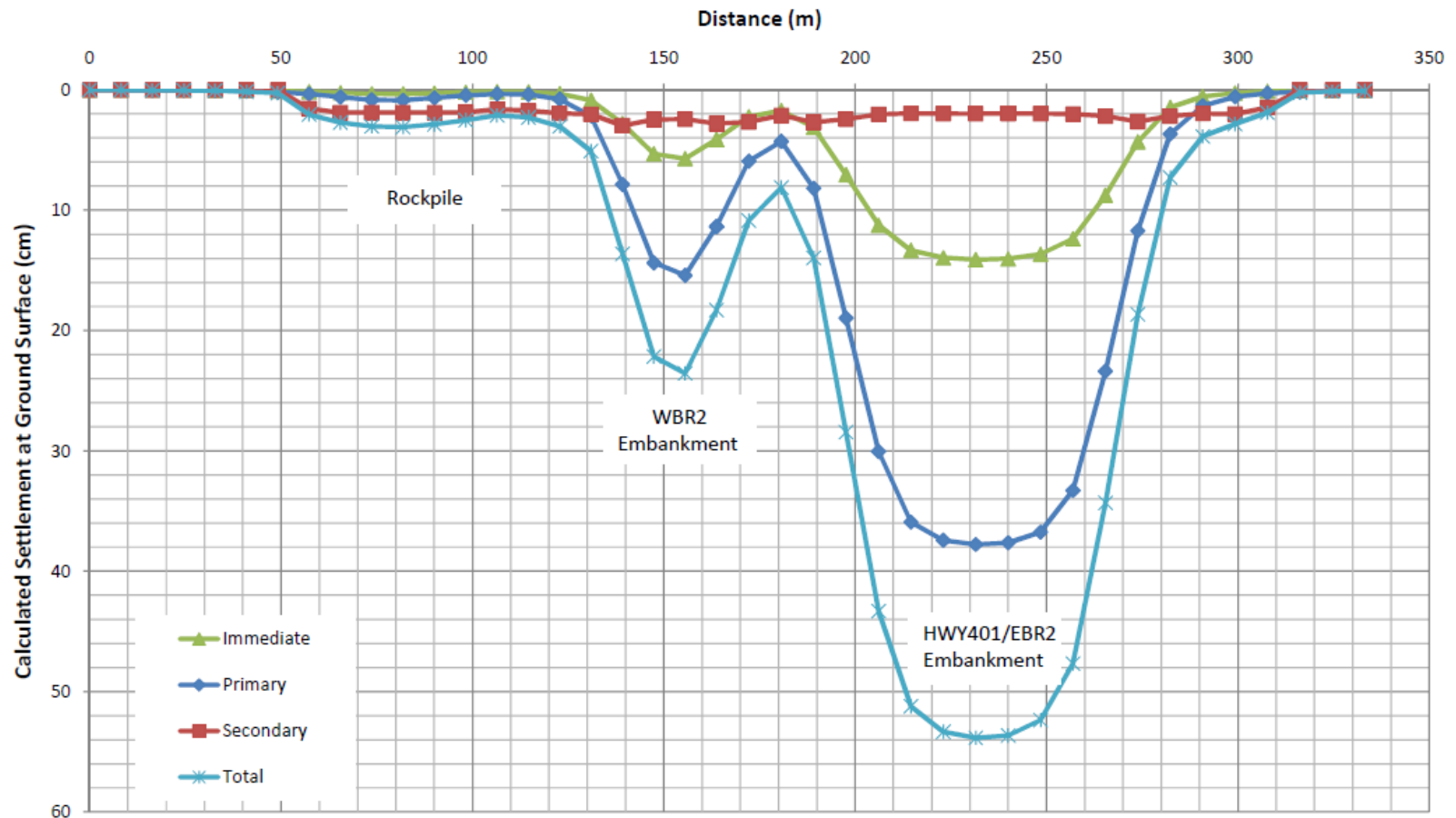


Figure 6-2: Settlement Profile along BP Line under Embankment

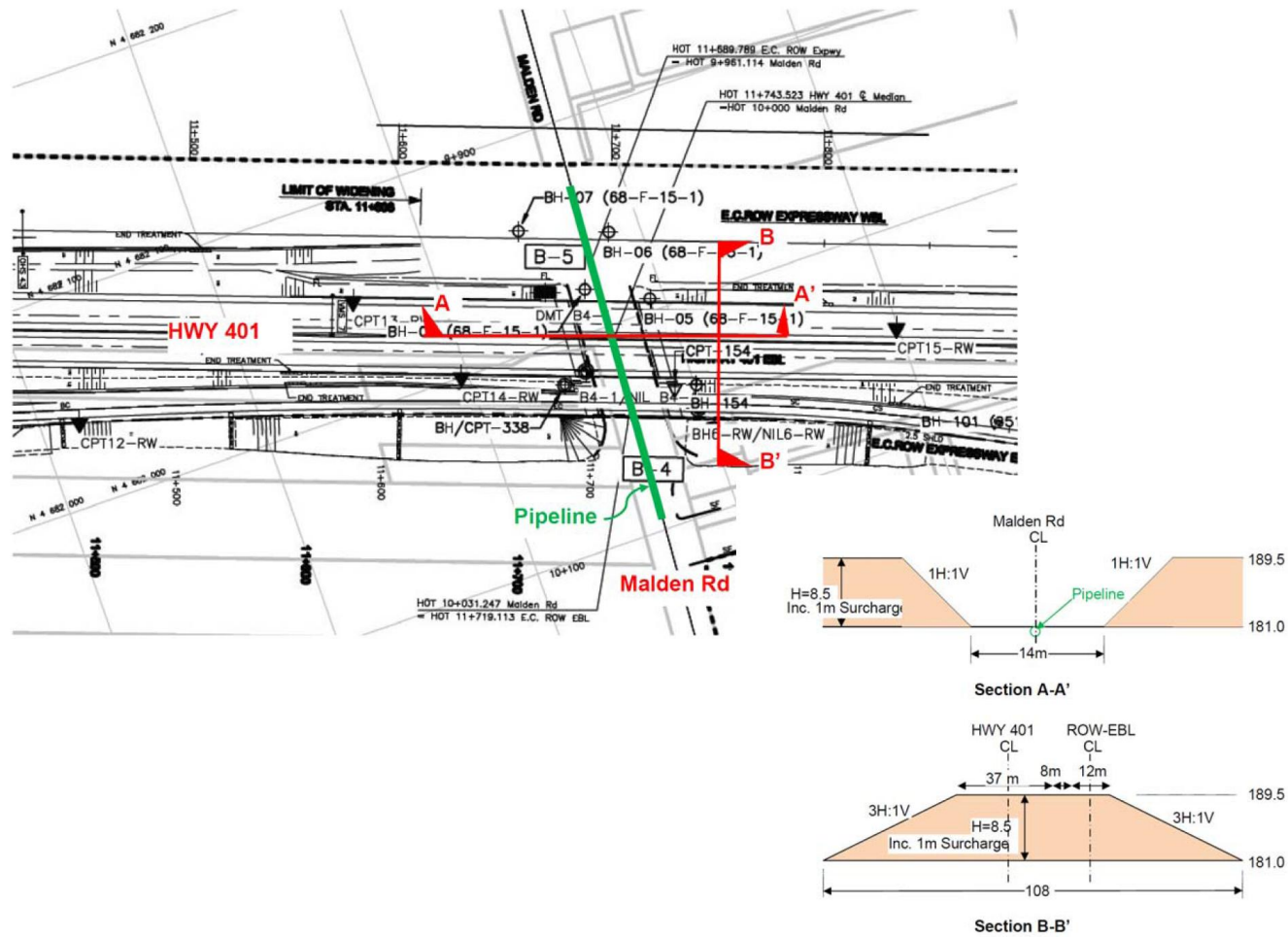
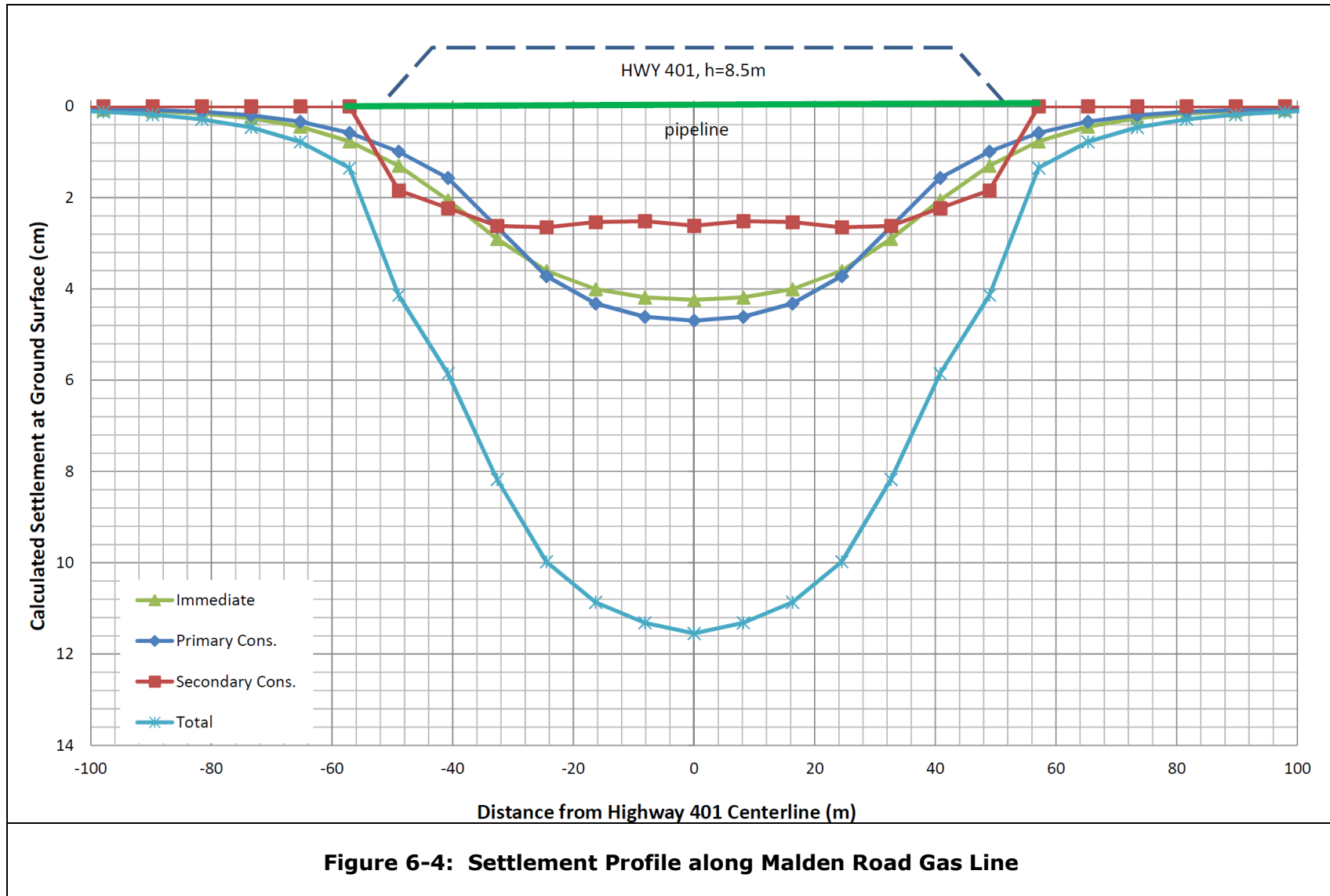


Figure 6-3: High Embankment and Gas Pipeline Configuration at Malden Road

Project: Windsor-Essex Parkway
Document: Geotechnical Investigation and Design Report – High Embankments
 (Sta. 10+030W to Sta. 12+290W)
Doc No.: 285380-04-119-0003 (Geocres No. 40J6-44)

Date: December / 2012
Rev: 0
Page No.: Figure 16 of 21



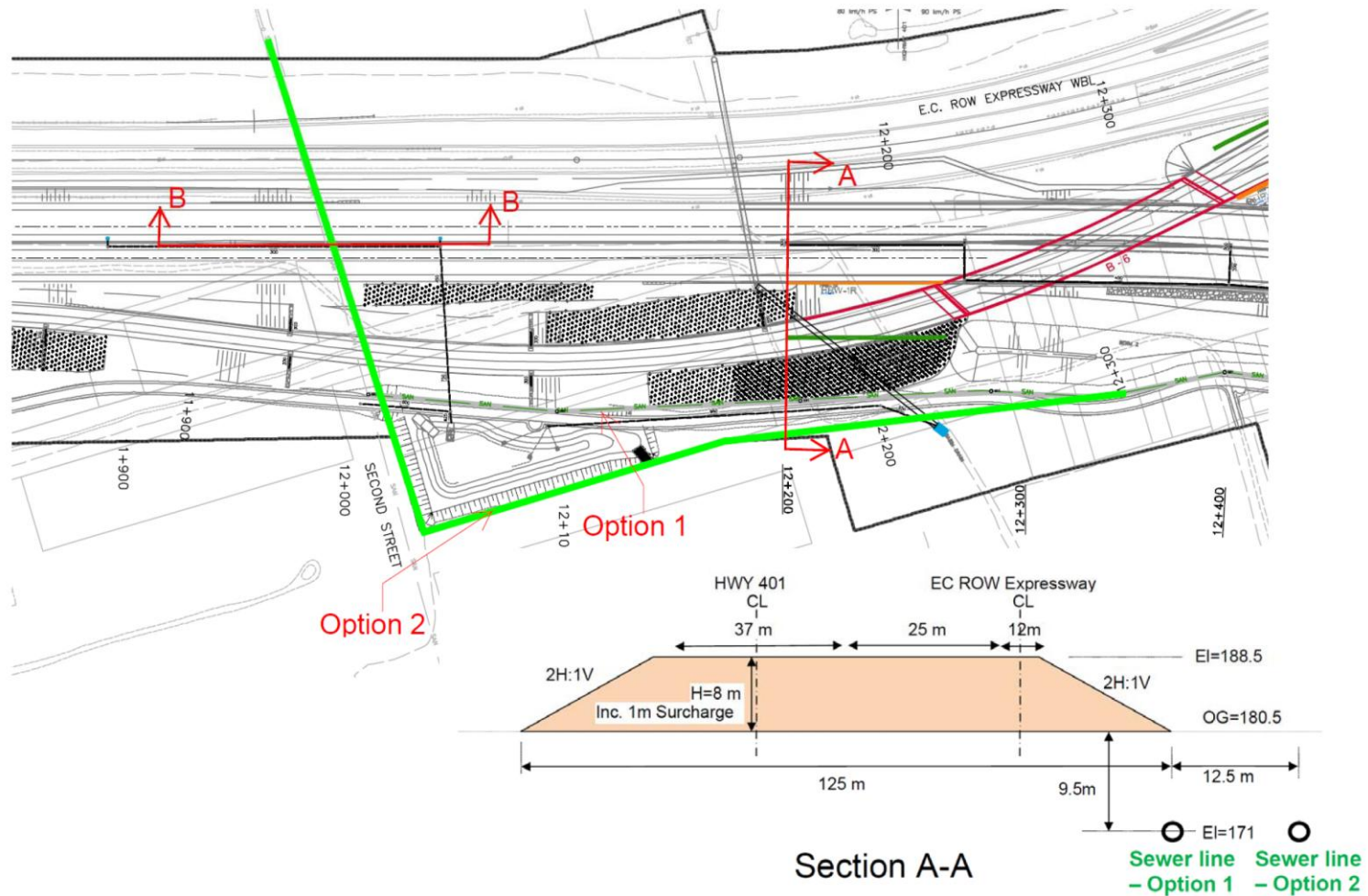


Figure 6-5: High Embankment Configuration and Sewer Line Segment at Second Street

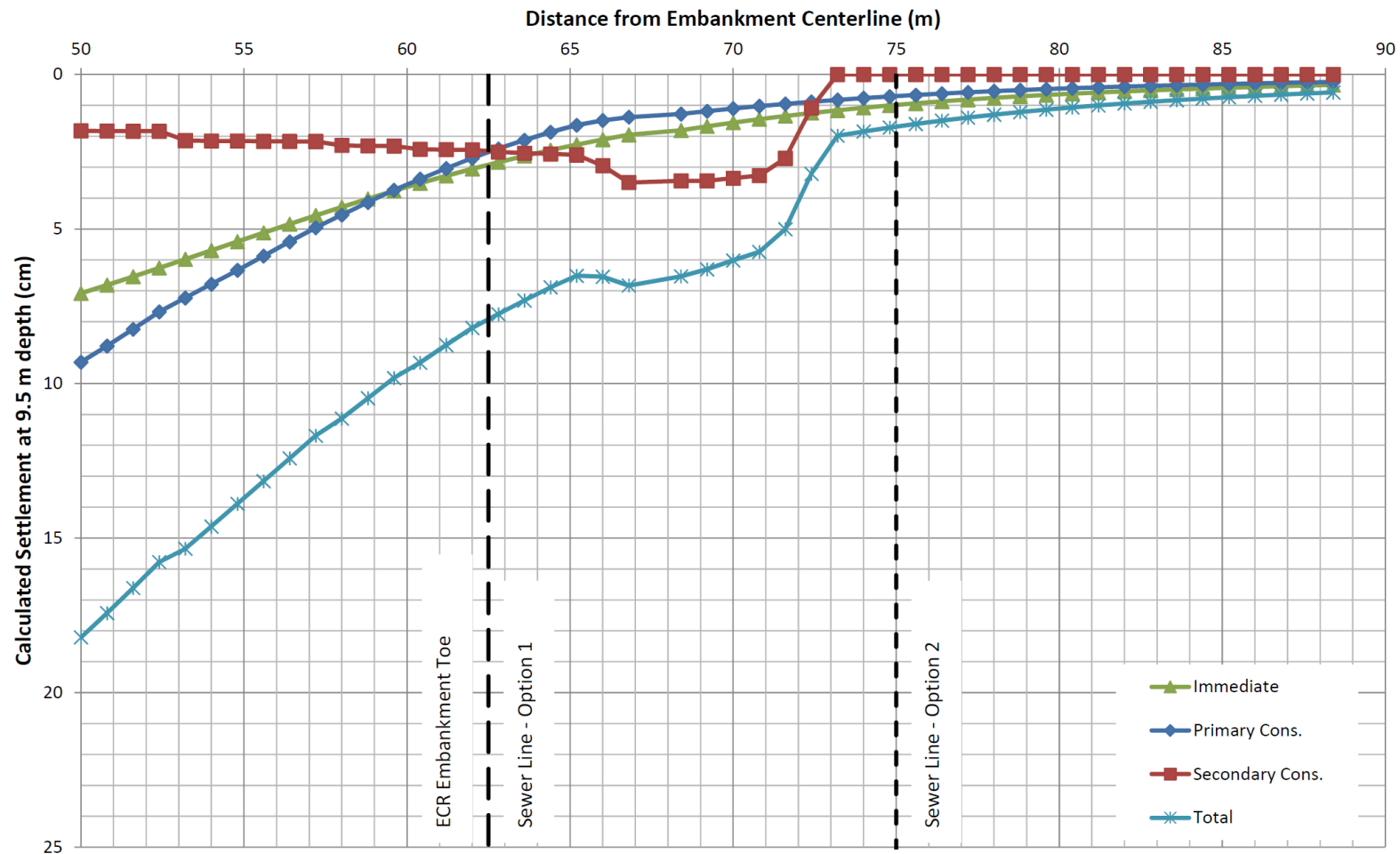


Figure 6-6: Settlement Profile at Sewer Line Options 1 and 2 Located Parallel to Embankment Toe (Sta. 12+200W)

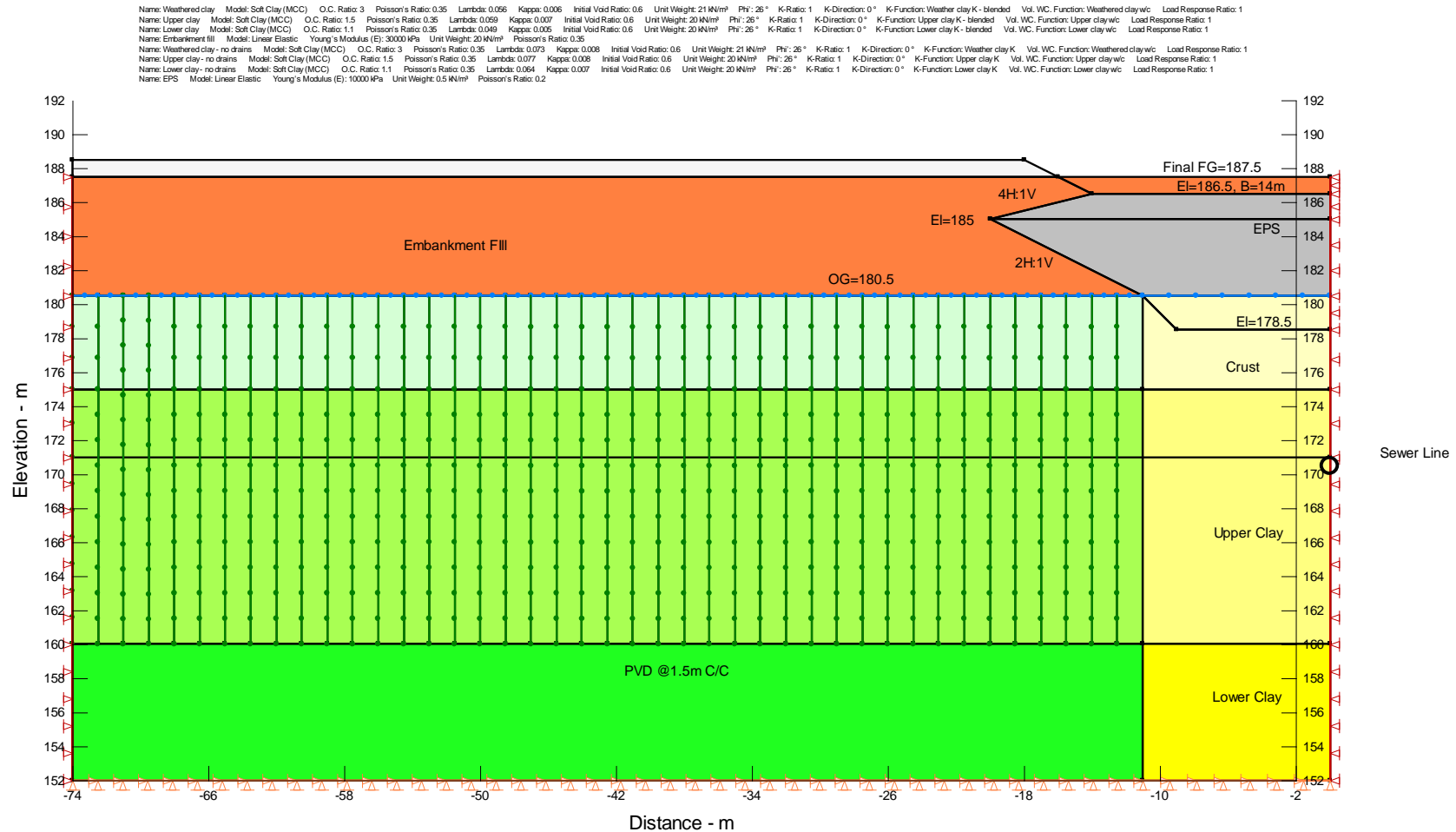


Figure 6-7: EPS Configuration at Sewer Line under Highway Embankment at Second Street

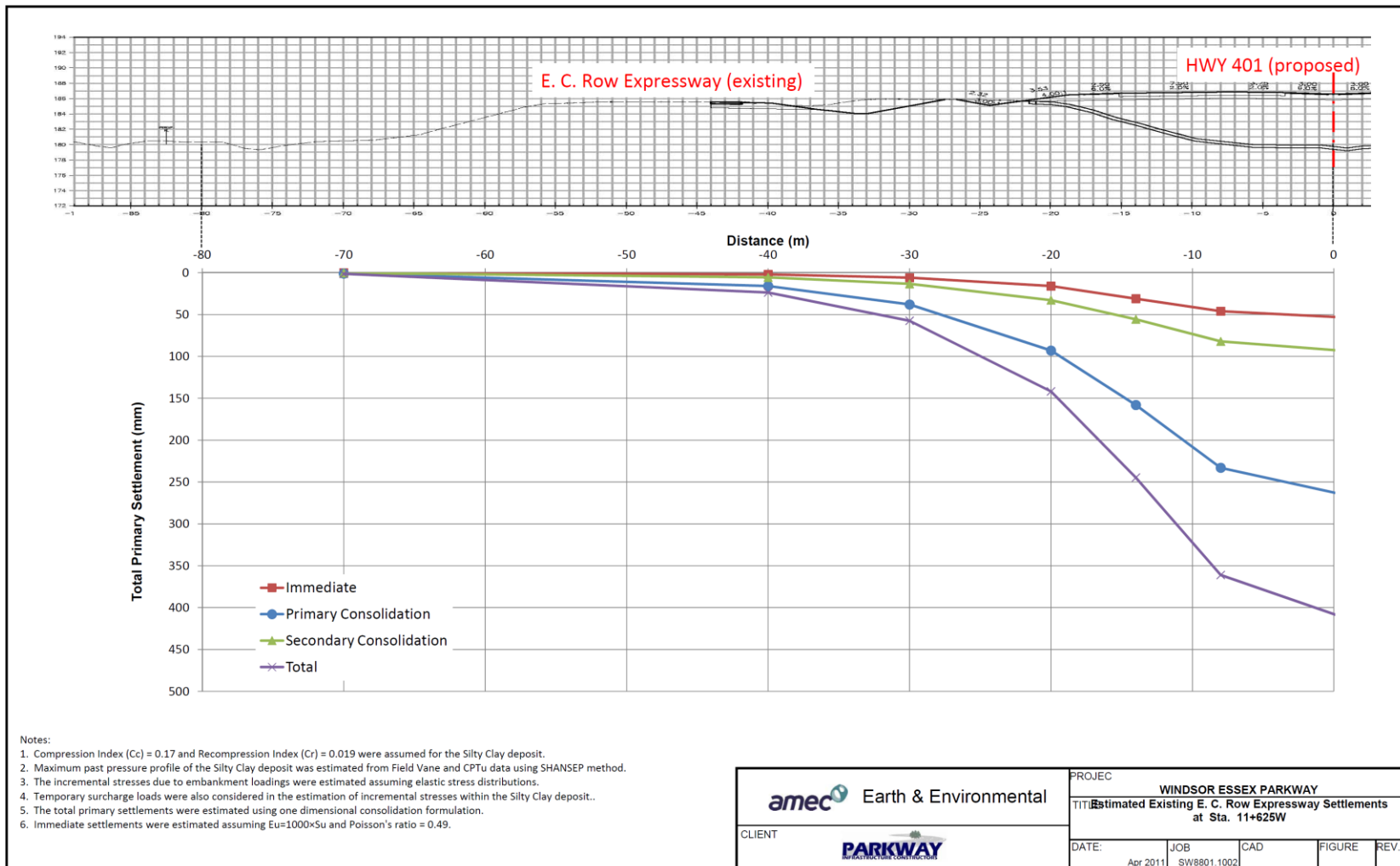


Figure 6-8: Settlement Profile Across Existing E.C. Row Embankment

Appendix A Borehole, CPT and DMT logs from Additional Geotechnical Investigation

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*):

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

Consistency of Cohesive Soils	Undrained Shear Strength kPa
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.

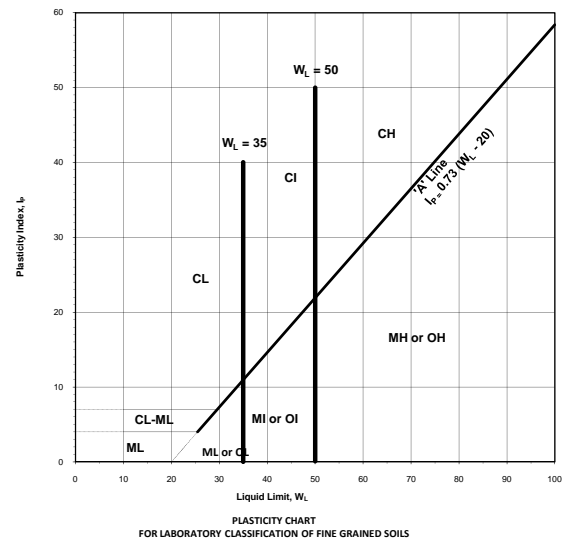
MTC SOIL CLASSIFICATION
Based on MTC Soil Classification Manual



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.	$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3			
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH STONE INTERMEDIATE SIZES MISSING	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES					
		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.	$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3	
		LIQUID LIMIT LESS THAN 35 AND 50	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)					GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE AND CHARACTER OF PLASTICITY, AMOUNT AND MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESIS.
NONE			QUICK	NONE	ML	INORGANIC SILTS & SANDY SILTS OR SLIGHTLY PLASTICITY, ROCK FLOUR				
MEDIUM TO HIGH			NONE TO VERY SLOW	MEDIUM	CL	SILTY CLAYS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS				
SLIGHT TO MEDIUM			SLOW	SLIGHT	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS				
LIQUID LIMIT BETWEEN 35 AND 50		NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	MI	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS				FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED AND REMOLDED STATES, MOISTURE & DRAINAGE CONDITION.
		HIGH	NONE	MEDIUM TO HIGH	CI	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY				
		SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OI	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY				
		SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMEACOUS FINE SANDY SILTS, ELASTIC SILTS				
LIQUID LIMIT GREATER THAN 50		HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS				
		MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY				
		HIGH ORGANIC SOILS				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
SAND	FINE	26.5 mm	4.75 mm		
		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

www.amec.com

**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 BH02-RW

1 OF 2

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682135.3, E328621.4 ORIGINATED BY TR
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 5 Jun 11 - 5 Jun 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE	W _P	W	W _L		
179.3	Fill Surface							20 40 60 80 100					kN/m ³	GR SA SI CL
0.0	FILL Mottled clayey organics Some sand, trace gravel						179							
177.8			1	SS	6		178							
1.5	SILTY SAND And inclusions of black sand Compact Stiff Brown		2	SS	12	▽								
177.0	Moist to saturated		3A, B	SS	5		177							
176.8	SAND and GRAVEL , Wet													
2.5	SILT and CLAY Varved (Variable thickness) Soft Grey		4	SS	3		176							
			5	SS	3									
174.9							175							
4.4	SILTY CLAY Some pink clay nodules Grey -Some sand, trace gravel		6	SS	2									
			7	SS	WOH		174							
			8	TW	PH		173	×					51.0	-vibrating wire piezometer (VWP) installed in adjacent boring at (4682135N, 328621E) near bedrock surface. Shallow and mid-depth VWP's installed in adjacent boring used for Nilcon Vane test at (4682137N, 328621E); Spider Magnets (MG) installed in adjacent boring at (4682139N, 328620E) -MG and VWP #P3 installed at 3.04m below fill surface
			VT					2.9						
			9	TW	PH		172	+						
							171							
			10	TW	PH		170						48.3	-sampler advanced under weight of hammer and rods
			VT					2.2						
			11	TW	PH		169	+						
							168							
167.1							167	×						
12.2	CLAYEY SILT Trace sand, trace gravel Silty sand pockets Soft to firm Grey		12	TW	PH			2.2						-MG installed at 9.0m below fill surface
			VT				166	+						-no recovery on first attempt; sample disturbed
			13	TW	PH									
							165							

Continued Next Page

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No BH03-RW

1 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682240.3, E329081.1 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 9 May 11 - 11 May 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	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 _P	W	W _L				
178.9	Ground Surface						20	40	60	80	100	10	20	30	kN/m ³	GR SA SI CL		
0.0	FILL Silty clay, some sand, trace gravel, topsoil Brown															-inclinometer casing installed in sampled borehole. Spider Magnets (MG) installed in adjacent boring at (N4682241.3, E329080.1) drilled without sampling. Vibrating wire piezometers (VWP) installed in adjacent boring at (N4682239.3, E329082.1) -no sample recovery with split spoon -MG installed at elevation 176.5m -VWP #P3 installed at elevation 175.9m -end of drilling May 9; restart May 10		
177.5	FINE SAND and SILT Laminated Very loose Mottled brown and grey		1	SS	4												17.3	
176.8			2	SS	4													19.4
2.1	CLAYEY SILT laminated, varved Firm Grey		3	SS	5													
			4	SS	7											17.2		
175.2	SILTY CLAY Pink clay nodules, trace sand and gravel Soft Grey		5	SS	3												17.2	
3.7			6	TW	PH													17.2
			7	TW	PH													
			8	TW	PH											17.2		
																	17.2	
																		17.2
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METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

3 OF 3

METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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RECORD OF BOREHOLE No BH04-RW

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682217.2, E329130.8 ORIGINATED BY DG
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 13 Jun 11 - 14 Jun 11 CHECKED BY MSO

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)									
						○ UNCONFINED ● POCKET PEN.			+ FIELD VANE × LAB VANE	20	40	60	80						100	10
	July 9, 2011 Water level measured in Piezometer VWP #P22 at elevation 179.3m on July 22, 2011 Water level measured in Piezometer VWP #P22 at elevation 179.1m on August 23, 2011						148													
							147													
							146													
							145													
							144													
							143													
							142													
							141													
							140													
							139													
							138													
							137													
							136													
							135													
							134													

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RECORD OF BOREHOLE No BH05-RW

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682348.8, E329308.8 ORIGINATED BY TR
 DIST HWY WEP BOREHOLE TYPE CME 850 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 13 Jun 11 - 13 Jun 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
								<div><div><div></div><div></div><div></div><div></div><div></div></div><div>20 40 60 80 100</div></div> <div>○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE</div>									
	June 25, 2011: EL. 180.8m July 9, 2011: EL. 179.9m July 22, 2011: EL. 178.7m Piezometric Levels in VWP #P17: June 25, 2011: EL. 182.9m July 9, 2011: EL. 182.3m July 22, 2011: EL. 181.9m						152										
							151										
							150										
							149										
							148										
							147										
							146										
							145										
							144										
							143										
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							139										
							138										

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No BH06-RW

1 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681950.3, E330198.8 ORIGINATED BY SD
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 13 Jun 11 - 14 Jun 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		W _P	W	W _L			
								○ UNCONFINED + FIELD VANE	WATER CONTENT (%)						
							● POCKET PEN. × LAB VANE								
180.8	Ground Surface							20 40 60 80 100							
0.0	Black TOPSOIL														
180.5	Brown FINE SAND														
0.3	Some silt Wet, loose		1	SS	5		180								
179.4	Grey CLAYEY SILT														
1.4	Very soft, wet		2	SS	2		179								
			3	SS	5		178								
	Firm														
	Grey Some sand, trace gravel -Trace pink inclusions Stiff, moist		4	SS	12		177								
			5	SS	13		176								
			6	SS	9		175								
			7	SS	10		174								
			8	TW	PH		173								
				VT			172								
	Firm to stiff, wet		9	TW	PH		171								
							170								
			10	TW	PH		169								
				VT			168								
			11	SS	5		167								
							166								
169.2	Grey SILTY CLAY														
11.6	Some sand Firm to stiff		12	TW	PH										
				VT											
			13	TW	PH										

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B3-1

1 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682267.8, E329431.6 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 14 Jun 11 - 14 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE										
								20 40 60 80 100											
178.9	Ground Surface																		
0.0	Mixed FILL Sand and gravel, clayey silt with topsoil organics near surface																		
178.3																			
0.6	SILTY CLAY Weathered Trace sand, trace gravel Soft to Stiff Mottled brown and grey -Fissures and wet sand seams -Soft wet seam		1	SS	3														
			2	SS	4														
			3	SS	8														
			4	SS	6														
			5	SS	4														
			6	SS	3														
			7	SS	3														
	-Sand laminations (approx. 25mm thick)		8	TW	PH														
			VT																
			9	SS	PH														
			VT																
			10	TW	PH														
			11	TW	PH														
			VT																
			12	TW	PH														
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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	+ FIELD VANE							● POCKET PEN.	× LAB VANE	
							20	40	60	80	100							
							20	40	60	80	100							
														</				

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

RECORD OF BOREHOLE No B3-1

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682267.8, E329431.6 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 14 Jun 11 - 14 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE												
	Water level measured in Piezometer VWP #P21 at elevation 180.6m on July 22, 2011 Water level measured in Piezometer VWP #P21 at elevation 180.6m on August 25, 2011						148													
							147													
							146													
							145													
							144													
							143													
							142													
							141													
							140													
							139													
							138													
							137													
							136													
							135													
							134													

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B3-2

1 OF 2

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682224.9, E329491.10 ORIGINATED BY BS
DIST HWY WEP BOREHOLE TYPE CME 850 - 150mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 25 Jun 11 - 26 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED + FIELD VANE											
								● POCKET PEN. × LAB VANE											
178.9	Ground Surface					20	40	60	80	100	10	20	30						
178.0	TOPSOIL					20	40	60	80	100									
0.2	SILTY CLAY Soft to stiff Mottled brown and grey -Some organics -Trace sand, trace gravel Grey -Some sand, trace gravel Moist -Grey-pink with black clay inclusions						178									19.7	2 14 34 50		
			1	SS	3														
			2	SS	6														
			3	SS	8														
			4	SS	3														
			5	SS	3														
			6	SS	3														
			7	SS	2														
			8	TW	PH														
				VT															
			9	TW	PH														
				VT															
			10	TW	PH														
	VT																		
11	TW	PH																	
	VT																		
															18.8				
12	TW	PH																	
	VT																		
13	TW	PH																	

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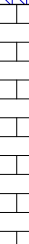

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RECORD OF BOREHOLE No B3-2

2 OF 2

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682224.9, E329491.10 ORIGINATED BY BS
DIST HWY WEP BOREHOLE TYPE CME 850 - 150mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 25 Jun 11 - 26 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)					
								○ UNCONFINED		+ FIELD VANE											
								● POCKET PEN.		× LAB VANE											
							20	40	60	80	100										
163.7	SILTY CLAY (continued)																				
15.2	CLAYEY SILT Some sand, trace gravel Stiff Grey -Trace sand, trace gravel, trace cobbles (inferred)			14	TW	PH	163										20.8	3 25 40 32 -continued drilling by wash boring with casing at about 15.5 m below ground surface			
				VT																	
				15	SS	PH															
				16	TW	PH															
																		20.7	5 18 40 37 -no retrieval with shelby tube; sample retrieved by pushing split spoon		
VT																					
159.1	SILT Some clay, some fine sand, some silty clay seams Compact Grey			17	TW	PH	159														
158.0				CLAYEY SILT Stiff Grey				18	SS	15	158										
20.9																					
156.0	LIMESTONE Fine grained Fossiliferous, petroliferous, laminated Fractured at location between 22.9m and 23.0m Brown			19	RC		156											-Split Spoon refusal at 22.9m RQD = 66.7% TCR = 67% SCR = 44%			
22.9																					
				20	RC			155													
153.6	END OF BOREHOLE No groundwater observed during auger drilling						154												RQD = 100% TCR = 100% SCR = 88%		
25.3																					
																	</				

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B3-3

1 OF 2

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682180.9, E329559 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 850 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 20 Jun 11 - 22 Jun 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		W _P	W	W _L		
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE	WATER CONTENT (%)					
						20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL		
179.0	Ground Surface													
0.0	TOPSOIL													
178.7														
0.3	FINE SAND													
178.2	Poorly graded													
0.8	Some silt, some clay													
	Brown		1	SS	4		178							
	CLAYEY SILT													
177.6	Trace to some sand													
1.4	Mottled brown and grey		2	SS	10		177							
	CLAYEY SILT													
	Trace to some sand													
	Stiff to firm													
	Brown		3	SS	13		176							
	Grey													
	-Some sand, trace gravel													
	-Trace fissures													
			4	SS	5		175							
	-Trace sand													
			5	SS	5		174							
	-Trace pink clay nodules below approx. 4m													
			6	SS	4		173							
			7	SS	3		172							
			8	SS	PH		171							
			VT				170							
	-Some sand, trace gravel		9	TW	PH		169							
			10	TW	PH		168							
			VT				167							
			11	TW	PH		166							
	Moist													
			12	TW	PH		165							
			VT											
			13	TW	PH									

Continued Next Page

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B3-3

2 OF 2

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682180.9, E329559 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 850 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 20 Jun 11 - 22 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE						
	CLAYEY SILT (continued)		14	TW	PH										
				VT					1.4						-continued drilling by wash boring with casing at about 15.5 m below ground surface
			15	TW	PH			×							4 23 45 28
			16	TW	PH										
				VT											
			17	TW	PH										
	-Trace cobbles														
			18	SS	5										
156.1															
22.9	SAND and GRAVEL Fine to Coarse Dense to very dense Grey and black		19	SS	32										-VWP #P3 installed at 24.2m below ground surface -no recovery with shelby tube; sample retrieved by driving split spoon
	-Trace limestone fragments		20	SS	52										
153.7															
125.5	LIMESTONE Fine grained Grey		21	RC											
152.7	Fossiliferous, fine grained, with oil stains Grey														
120.5	LIMESTONE Fine Grained, fossiliferous Grey														
26.5															
152.2	LIMESTONE Fine Grained, laminated Grey														
26.8															
	END OF BOREHOLE														
	No groundwater observed during auger drilling														
	Water level measured in Piezometer VWP #P1 at elevation 178.4m on August 22, 2011														
	Water level measured in Piezometer VWP #P2 at elevation 177.7m on August 22, 2011														
	Water level measured in Piezometer VWP #P3 at elevation 180.3m on August 22, 2011														

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B4-1

1 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681982.4, E330153.5 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 9 Jun 11 - 11 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE					
180.8	Fill Surface												kN/m ³	GR SA SI CL
0.0	Heterogeneous FILL Including sand, silt, clay, topsoil, and gravel													
179.7			1A, B	SS	13									
1.1	Brown-Grey FINE SAND Trace to some silt													
179.0	Saturated Loose		2A, B	SS	5									
1.8	Grey CLAY													
	Grey SILT		3	SS	7									
178.1	Laminated, saturated Loose, firm													
2.7	Grey CLAYEY SILT Stiff -Soft, wet clay seams and hairline sand/silt seams to approx. 4.5m		4	SS	11									-VWP #P3 installed at 3.05m below surface
			5	SS	10									-SM installed at 4.01m below surface
			6	SS	11									
	Firm		7	SS	7									
			8	TW	PH								20.4	1 13 45 41
			9	TW	PH									
			10	TW	PH								20.1	
							</							

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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

RECORD OF BOREHOLE No B4-1

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681982.4, E330153.5 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 9 Jun 11 - 11 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED	+	FIELD VANE										
								● POCKET PEN.	×	LAB VANE										
150.6							20	40	60	80	100									
30.2	Grey Colour LIMESTONE Medium to Coarse Grained Laminated, stylolites present, fractures present at location		24	RC												-VWP #P31 installed at 29.9m below ground surface -slightly artesian groundwater condition at bedrock interface ROD = 78% TCR = 92% SCR = 79%				
			25	RC																
149.3																				
31.5	END OF BOREHOLE																			
	Piezometric Levels in VWP #P3: June 25, 2011: EL. 179.3m July 9, 2011: EL. 179.4m July 22, 2011: EL. 179.2m						149													
	Piezometric Levels in VWP #P12: June 25, 2011: EL. 179.5m July 9, 2011: EL. 181.3m July 22, 2011: EL. 180.5m						148													
	Piezometric Levels in VWP #P31: July 29, 2011: EL. 180.5m July 22, 2011: EL. 180.5m						147													
							146													
							145													
							144													
							143													
							142													
							141													
							140													
							139													
							138													
							137													
							136													

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

METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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

RECORD OF BOREHOLE No B6-1

2 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681786.8, E330654.4 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 18 Jun 11 - 21 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		
						20	40	60	80	100							
	CLAYEY SILT Some sand, trace gravel (continued)																
			14	TW	PH												
163.7																	
16.5	SILTY CLAY Some sand, trace gravel Pink-grey																
			15	TW	PH												
162.5																	
17.7	CLAYEY SILT Some sand, trace gravel Grey																
			16	TW	PH												
			17	TW	PH												
			18	TW	PH												
			19	SS													
			20	TW	PH												

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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

RECORD OF BOREHOLE No B6-2

1 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681784.6, E330731.4 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 28 Jun 11 - 29 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE									
180.1	Ground Surface																	
0.0	TOPSOIL																	
179.7																		
0.4	CLAYEY SILT Some sand, trace gravel Firm to very stiff Mottled brown and grey		1	SS	5													
	Brown		2	SS	7													
	Brown to Grey		3	SS	18													
177.2																		
2.9	CLAYEY SILT Some sand, trace gravel Trace pink clay nodules Stiff to very stiff Grey		4	SS	18													
			5	SS	13													
			6	SS	11													
			7	SS	10													
	-Occasional oxidation		8	TW	PH													
				VT														
			9	TW	PH													
			10	TW	PH													
				VT														
			11	TW	PH													
			12	TW	PH													
				VT														
	-Trace sand		13	TW	PH													
165.5																		
14.6																		

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B6-2

2 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681784.6, E330731.4 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 28 Jun 11 - 29 Jun 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)							
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE								
							20 40 60 80 100	20 40 60 80 100	10 20 30								
	SILTY CLAY Firm Grey (continued)		14	TW	PH			×					○				
					VT												
163.6	CLAYEY SILT Firm Grey		15	SS	PH								○				
16.5																	
	Interbedded Sand and Fine Gravel Layers at elevation 161.8 m		16	TW	PH				×								
					VT												
			17	TW	PH								○				
			18	SS	PH								○				
			19	SS	PH								○				
	-Some sand, trace gravel		20	SS	PH								○				
			21	SS	10								○				
	-Trace to some sand	22	SS	5								○					
150.7	SANDY SILT Some gravel, trace cobbles Grey	23A, B	SS	24								○					
29.4																	

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF BOREHOLE No B6-2

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681784.6, E330731.4 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 28 Jun 11 - 29 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)					
								<div><div>○ UNCONFINED</div><div>● POCKET PEN.</div></div>	<div><div>+ FIELD VANE</div><div>× LAB VANE</div></div>													
								<div>20406080100</div>	<div>20406080100</div>													
149.7							150									RQD = 55% TCR = 88% SCR = 67% Rock Core = 122.7 MPa						
30.4	LIMESTONE Fine Grained Partially crystallized, laminated Fractured between 30.4m and 30.7m Fracture running parallel to the core Grey to brown		24	RC			149															
148.2			25	RC			148										RQD = 67% TCR = 88% SCR = 88% -could not recover sample in sleeve many mechanical breaks due to spinning in NQ casing					
31.9	LIMESTONE Fine to Medium Grained Porous, laminated Fractured between 33.4m and 33.5m Fracture running parallel to the core Brown						147															
146.5	END OF BOREHOLE No groundwater observed during auger drilling						146															
33.6							145															
							144															
							143															
							142															
							141															
							140															
							139															
							138															
							137															
						136																

METRIC

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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

RECORD OF BOREHOLE No NIL02-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682137.1, E328620.8 ORIGINATED BY TR
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 6 Jun 11 - 6 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE									
179.3	Fill Surface						20	40	60	80	100						
0.0	FILL Silty clay, trace organics Mottled Brown																
			</														

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

RECORD OF BOREHOLE No NIL B3-3

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682184.0, E329556.0 ORIGINATED BY SD
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 4 Jun 11 - 5 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE									
179.0	Ground Surface																			
0.0	TOPSOIL																			
178.7	Black																			
0.3	SILT																			
	Trace clay																			
	Loose		1	SS	5															
	Mottled brown and grey																			
	Moist																			
177.3			2	SS	11															
1.7	SILTY CLAY																			
	Some sand, trace gravel																			
	Stiff																			
	Brown-grey		3	SS	15															
	Damp to moist																			
	Grey																			
	-Trace sand		4	SS	7															
	Moist to wet																			
175.5	END OF SAMPLED BOREHOLE																			
3.5	(Continued with Nilcon Vane to refusal)																			
	Borehole dry on completion																			
							175													
							174													
							173													
							172													
							171													
							170													
							169													
							168													
							167													
							166													
							165													





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

RECORD OF BOREHOLE No NIL B6-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681787.7, E330654 ORIGINATED BY SD
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 10 Jul 11 - 10 Jul 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		W _p W W _L WATER CONTENT (%)				GR	SA	SI	CL
180.1	Ground Surface							20 40 60 80 100									
180.0	TOPSOIL						180										
0.2	FINE SAND Some Silt Brown																
179.4	CLAYEY SILT Brown Moist to wet		1	SS	5		179										
0.8																	
178.6	CLAYEY SILT Some sand, trace gravel Stiff Mottled brown and grey Grey Some sand and gravel		2	SS	10		178										
1.5																	
	Some pink inclusions		4	SS	12		177										
	Moist to wet		5	SS	12		176										
175.1	END OF BOREHOLE (continued with Nilcon Vane to refusal)		6	SS	8												
5.0	Borehole dry on completion						175										
							174										
							173										
							172										
							171										
							170										
							169										
							168										
							167										
							166										

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RECORD OF BOREHOLE No CPT01-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682083, E328470 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 3 Jun 11 - 3 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE								
						● POCKET PEN.	× LAB VANE	WATER CONTENT (%)									
180.5	Ground Surface						20	40	60	80	100	10	20	30			
180.4	TOPSOIL																
180.1	SAND Poorly Graded Trace silt Very loose Brown		1	SS	3	▽	180						○				
178.9	SAND Well Graded Trace gravel Compact Brown		2	SS	13		179							○			
178.2	CLAYEY SILT Trace sand, interbedded silt lenses Firm Grey		3	SS	6		178							○			
177.7	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)						177										
177.7							176										
							175										
							174										
							173										
							172										
							171										
							170										
							169										
							168										
							167										
							166										

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

1 OF 1

METRIC

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ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

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

RECORD OF BOREHOLE No CPT04-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682361.5, E328676.9 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 4 Jun 11 - 4 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE	20	40	60	80						100			
									20	40	60	80						100	10	20	30
178.6	Road Shoulder Surface																				
178.6	LIMESTONE Crushed Grey																				
	SAND and GRAVEL Medium-Coarse Trace silt Compact Brown		1	SS	15									○							
177.1	SILT Some clay, trace sand, interbedded silt lenses Firm Grey														○						
176.6			2	SS	7																
2.0	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)																				
							176														
							175														
							174														
							173														
							172														
							171														
							170														
							169														
							168														
							167														
							166														
							165														
							164														

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

RECORD OF BOREHOLE No CPT06-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682136.9, E328777.8 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 75 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 7 May 11 - 7 May 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE									
178.9	Pavement Surface																GR SA SI CL			
178.0	200mm CONCRETE																-artesian groundwater condition and strong N2S odour when CPT withdrawn after test			
0.2																				
178.4	FILL																			
0.5	Crushed limestone Silty sand and gravel Grey		1	SS	15															
177.5	SAND, Well graded																			
1.4	Some gravel, saturated																			
177.2	Compact		2	SS	15															
1.7	Brown																			
	SANDY SILT																			
	Brown																			
	CLAYEY SILT		3	SS	4															
	Trace sand																			
	Firm																			
	Grey																			
	Soft		4	SS	3															
175.4	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)																			
3.5																				

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

RECORD OF BOREHOLE No CPT07-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682201.8, E328892.2 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 75 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 7 May 11 - 7 May 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE							
						● POCKET PEN.	× LAB VANE	WATER CONTENT (%)								
179.1	Ground Surface						20	40	60	80	100	10	20	30		
179.0	200mm Sandy TOPSOIL															
178.0	Black SAND Poorly Graded (fine) Some silt, trace gravel Loose Brown		1	SS	5											
177.7	CLAY and SILT Firm Grey		2	SS	7											
177.0	-Alternately laminated, trace fine sand		3	SS	5											
175.6	CLAYEY SILT, Trace fine sand Firm Grey		4	SS	5											
3.5	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)															

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

RECORD OF BOREHOLE No CPT08-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682230.8, E329255.3 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 18 Jun 11 - 18 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE						● POCKET PEN.	×	LAB VANE
178.4	Ground Surface																	
0.0	TOPSOIL																	
178.1																		
0.3	SAND Poorly graded (Fine) Compact Brown-grey -Trace silt		1	SS	10													
176.9																		
1.5	CLAYEY SILT Trace to some sand Firm Brown-grey		2	SS	6													
176.4																		
2.0	END OF SAMPLED BOREHOLE (Continued with CPT to refusal) Borehole dry on completion																	
							176											
							175											
							174											
							173											
							172											
							171											
							170											
							169											
							168											
							167											
							166											
							165											
							164											

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

RECORD OF BOREHOLE No CPT09-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682361.8, E329272 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 9 Jun 11 - 9 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	● POCKET PEN.	+ FIELD VANE	× LAB VANE								
183.1	Ground Surface																		
182.9	<div><div><div>FILL</div><div>Topsoil</div><div>Brown and Black</div><div>FILL</div><div>Silty Clay</div><div>Some topsoil, some sand, trace gravel, trace refuse</div></div></div>																		
0.2			1	SS	3														
			2	SS	6														
181.1	END OF SAMPLED BOREHOLE (Continue with CPT to refusal)																		
2.0																			
							181												
							180												
							179												
							178												
							177												
							176												
							175												
							174												
							173												
							172												
							171												
							170												
							169												



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

RECORD OF BOREHOLE No CPT11-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682100.4, E329713.3 ORIGINATED BY TR
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 6 Jun 11 - 6 Jun 11 CHECKED BY MSO

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)							
179.1	Ground Surface																	
0.0	TOPSOIL Trace roots/rootlets						179											
178.3																		
0.8	SILTY CLAY Trace rootlets, trace pockets of grey clayey silt		1	SS	5		178											
177.9	Firm																	
1.2	Mottled brown and grey END OF SAMPLED BOREHOLE (Continued with CPT to refusal) Borehole dry on completion																	
							177											
							176											
							175											
							174											
							173											
							172											
							171											
							170											
							169											
							168											
							167											
							166											
							165											




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RECORD OF BOREHOLE No CPT12-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682041.3, E329919.9 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 7 Jun 11 - 7 Jun 11 CHECKED BY MSO

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa																	
180.4	Ground Surface					○ UNCONFINED			+	FIELD VANE													
						● POCKET PEN.			×	LAB VANE													
0.0	Brown to Grey FILL Silty Clay Some rootlets, trace topsoil						180																
179.6							179																
0.8	Brown SAND Poorly Graded Trace silt Compact		1	SS	7		179																
178.4			2	SS	10																		
2.0	END OF SAMPLED BOREHOLE (Continue with CPT to refusal)						178																
							177																
							176																
							175																
							174																
							173																
							172																
							171																
							170																
							169																
							168																
							167																
							166																

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

RECORD OF BOREHOLE No CPT13-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682069.5, E330070.1 ORIGINATED BY TR
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 11 Jun 11 - 11 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE							
								20 40 60 80 100									10 20 30	
185.1	Fill Surface																	
0.0	FILL Alternating layers of brown Silty Clay Some sand, trace gravel And grey Silty Clay, some sand, trace gravel																	
183.9			1	SS	10													
1.2	Continued with CPT to 6.1m																	

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

RECORD OF BOREHOLE No CPT14-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682001.9, E330097.3 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 7 Jun 11 - 7 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE									
180.4	Ground Surface					▽	180											
0.0	TOPSOIL																	
180.0	SAND Poorly Graded (Fine) Brown Trace silt, moist																	
0.4																		
179.6	CLAYEY SILT Trace sand Very soft Grey		1	SS	14		179											
0.8																		
178.4	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)		2	SS	1													
2.0							178											
							177											
							176											
							175											
							174											
							173											
							172											
							171											
							170											
							169											
							168											
							167											
							166											

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RECORD OF BOREHOLE No CPT15-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681954.3, E330300.3 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 8 Jun 11 - 8 Jun 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/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL
181.5	Ground Surface							20	40	60	80	100						
0.0	250mm TOPSOIL						181											
181.2	SAND, Poorly Graded Trace silt Compact Brown		1	SS	11													
0.3																		
	Saturated		2	SS	12		180											
179.5	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)																	
2.0																		
							179											
							178											
							177											
							176											
							175											
							174											
							173											
							172											
							171											
							170											
							169											
							168											
							167											

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

RECORD OF BOREHOLE No CPT16-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681826, E330473.6 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 17 Jun 11 - 17 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE								
								● POCKET PEN.	× LAB VANE								
180.7	Ground Surface						20	40	60	80	100						
0.0	FILL																
180.4	Crushed Limestone																
0.3	Sand and gravel																
	Grey																
	FILL																
	Poorly graded sand		1	SS	6												
	Trace to come silt, some organics, pieces of wood and glass shards																
179.2	Brown-black																
1.5	Fine SAND		2	SS	10												
	Poorly graded																
	Compact																
178.4	Brown to grey																
2.3	CLAYEY SILT		3	SS	3												
178.0	Trace sand																
2.7	Soft Grey																
	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)																
	Borehole dry during drilling on June 16, 2011																

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

RECORD OF BOREHOLE No CPT17-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681749, E330896.1 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 75 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 16 Jun 11 - 16 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m³	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									
180.8	Ground Surface						20	40	60	80	100							
0.0																		
180.4																		
180.2																		
0.6																		
	</																	

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

RECORD OF BOREHOLE No CPT18-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681851.3, E330994.5 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 21 Jun 11 - 21 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	● POCKET PEN.	+ FIELD VANE	× LAB VANE							
187.3	Ground Surface																	
187.0	TOPSOIL																	
0.2	FILL Silty clay, some sand, trace gravel Brown to grey																	
			1	SS	12													
	Grey		2	SS	12													
185.3	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)																	
2.0																		
	Borehole dry during drilling on June 21, 2011																	
							185											
							184											
							183											
							182											
							181											
							180											
							179											
							178											
							177											
							176											
							175											
							174											
							173											

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

RECORD OF BOREHOLE No CPT B2-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682211.4, E329077.4 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE Track Mounted Drill - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 9 May 11 - 9 May 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
								○ UNCONFINED	+	FIELD VANE											
								● POCKET PEN.	×	LAB VANE											
178.8	Ground Surface						20	40	60	80	100										
0.0	FILL Silty clay with sand, trace gravel, trace topsoil																				
178.0	FILL Silty sand mixed with topsoil, trace concrete pieces		1	SS	14																
177.4	SILT And Fine SAND Varved Loose Grey		2	SS	6																
176.1	CLAYEY SILT Varved Firm Grey		3	SS	5																
175.3	END OF SAMPLED BOREHOLE (Continued with CPT to refusal) Borehole dry on completion		4	SS	7																
3.5																					
							175														
							174														
							173														
							172														
							171														
							170														
							169														
							168														
							167														
							166														
							165														
							164														




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

RECORD OF BOREHOLE No CPT B3-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682270.6, E329419.6 ORIGINATED BY TA
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 10 Jun 11 - 10 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE												
179.0	Ground Surface							20	40	60	80	100								
0.0	TOPSOIL																			
178.4	SANDY SILT Fine Loose Brown		1	SS	3		178													
0.6	-Some clay		2	SS	2															
177.0	END OF SAMPLED BOREHOLE (Continued with CPT to refusal)						177													
2.0	Borehole dry on completion																			
							176													
							175													
							174													
							173													
							172													
							171													
							170													
							169													
							168													
							167													
							166													
							165													




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

RECORD OF BOREHOLE No CPT B3-2

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682176.2, E329573 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 850 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 20 Jun 11 - 20 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE									
179.1	Ground Surface							20	40	60	80	100	10	20	30			
0.0	TOPSOIL																	
178.7																		
0.4	SAND																	
178.3	Poorly graded Trace silt Brown																	
0.8	SILTY CLAY Some sand, trace gravel Mottled brown and grey Brown -Trace fissures		1	SS	3													
177.1																		
2.0	END OF SAMPLED BOREHOLE (continued with CPT to refusal)																	
	Borehole dry on completion																	

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RECORD OF BOREHOLE No CPT B6-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681799.7, E330633.6 ORIGINATED BY TA
DIST HWY WEP BOREHOLE TYPE CME 75 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 16 Jun 11 - 16 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE	● POCKET PEN.	×					
180.2	Ground Surface						20	40	60	80	100						
180.0	TOPSOIL																
0.2	CLAYEY SILT Trace to some sand Firm Brown Varved -Interbedded sand lenses		1	SS	5												
178.2	-Trace rootlets		2	SS	6												
2.0	END OF SAMPLED BOREHOLE (Continued with CPT to refusal) Borehole dry on completion																
							178										
							177										
							176										
							175										
							174										
							173										
							172										
							171										
							170										
							169										
							168										
							167										
							166										

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

METRIC

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

RECORD OF BOREHOLE No DMT01-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682162.2, E328674 ORIGINATED BY LC
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 8 Jun 11 - 8 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+	FIELD VANE	×						LAB VANE	
178.6	Ground Surface						20	40	60	80	100							
178.0	TOPSOIL						20	40	60	80	100							
0.2	Brown-Grey FINE SAND Trace silt, trace clay Very loose, wet		1	SS	2	▽								○				
177.1																		
1.5	Grey SILTY CLAY Laminated, trace sand Firm		2	SS	6										○			
176.6	END OF SAMPLED BOREHOLE (Continue with DMT to refusal)																	
2.0																		
							176											
							175											
							174											
							173											
							172											
							171											
							170											
							169											
							168											
							167											
							166											
							165											
							164											

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

RECORD OF BOREHOLE No DMT02-RW

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682330.9, E329357.7 ORIGINATED BY LC
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 20 Jun 11 - 20 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE												
								● POCKET PEN. × LAB VANE												
181.6	Fill Surface																			
180.4	<div><div>FILL</div><div>Silty Sand and Gravel Some grass, some topsoil</div><div>Mottled Brown-Grey</div><div>FILL</div><div>Silty Clay Trace topsoil</div></div>																			
0.2																				
			1	SS	5															
			2	SS	12															
179.6	END OF SAMPLED BOREHOLE (Continue with DMT to refusal)																			
2.0																				
							179													
							178													
							177													
							176													
							175													
							174													
							173													
							172													
							171													
							170													
							169													
							168													
							167													

RECORD OF BOREHOLE No DMT B2-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682249.9, E329090.6 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 12 May 11 - 12 May 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE	×						LAB VANE		
178.8	Ground Surface						20	40	60	80	100								
0.0	FILL Mixed sand, silt and topsoil Trace gravel, some construction debris																		
			1	SS	10														
177.1	CLAYEY SILT With wet fissures, sand seams (possible FILL) Soft to firm Brown-grey		2,A,B	SS	5														
1.7																			
176.8	END OF SAMPLED BOREHOLE (Continued with DMT to refusal)																		
2.0	Borehole dry on completion																		

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

RECORD OF BOREHOLE No DMT B3-1

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682286.4, E329420.5 ORIGINATED BY LC
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 19 Jun 11 - 19 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED + FIELD VANE ● POCKET PEN. × LAB VANE								
179.5	Fill Surface						20	40	60	80	100					
179.0	FILL Silty sand and gravel															
0.2	FILL Silty clay, some topsoil		1	SS	8								○			
178.0																
1.5	SILTY CLAY Weathered and thin, wet sand/silt seams		2	SS	4									○		
177.5	Brown-grey															
2.0	END OF SAMPLED BOREHOLE (Continued with DMT)															
	Borehole dry on completion															
							177									
							176									
							175									
							174									
							173									
							172									
							171									
							170									
							169									
							168									
							167									
							166									
							165									

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

RECORD OF BOREHOLE No DMT B3-2

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4682177.6, E329571.6 ORIGINATED BY LC
DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 22 Jun 11 - 22 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE							● POCKET PEN.	× LAB VANE	
179.2	Ground Surface																	
0.0	TOPSOIL																	
178.9	Sandy with roots																	
0.3	FINE SAND																	
178.3	Trace silt and roots																	
	Brown																	
0.9	CLAYEY SILT/SILTY CLAY		1A, B	SS	2													
178.0	With numerous hairline sand/silt seams																	
1.2	Mottled brown and grey																	
	SILTY CLAY		2	SS	11													
177.2	Fissured, varved with 4" silt lens																	
2.0	Grey																	
	END OF BOREHOLE																	
	(Continued with DMT to refusal)																	
	Borehole dry on completion																	
	</																	

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

METRIC

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

RECORD OF BOREHOLE No DMT B6-2

1 OF 1

METRIC

W.P. RFP No. 09-54-1007 LOCATION N4681785.9, E330805.3 ORIGINATED BY LC
 DIST HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS
 DATUM Geodetic DATE 17 Jun 11 - 17 Jun 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
180.3	Ground Surface															
0.0	TOPSOIL															
179.9	Sandy, large roots															
0.4	FINE SAND															
179.5	Loose Brown Wet															
0.8	CLAYEY SILT		1A, B	SS	5											
	And hairline, horizontal fine sand/silt seams															
	Firm		2	SS	6											
178.3	Mottled brown and grey															
2.0	END OF SAMPLED BOREHOLE (Continued with DMT to refusal)															
	Borehole dry on completion															
							178									
							177									
							176									
							175									
							174									
							173									
							172									
							171									
							170									
							169									
							168									
							167									
							166									

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 11/12/12

RECORD OF CONE PENETRATION TEST CPT 01-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/3/2011 - 6/3/2011

SHEET 1 OF 2

LOCATION N4682083; E328470

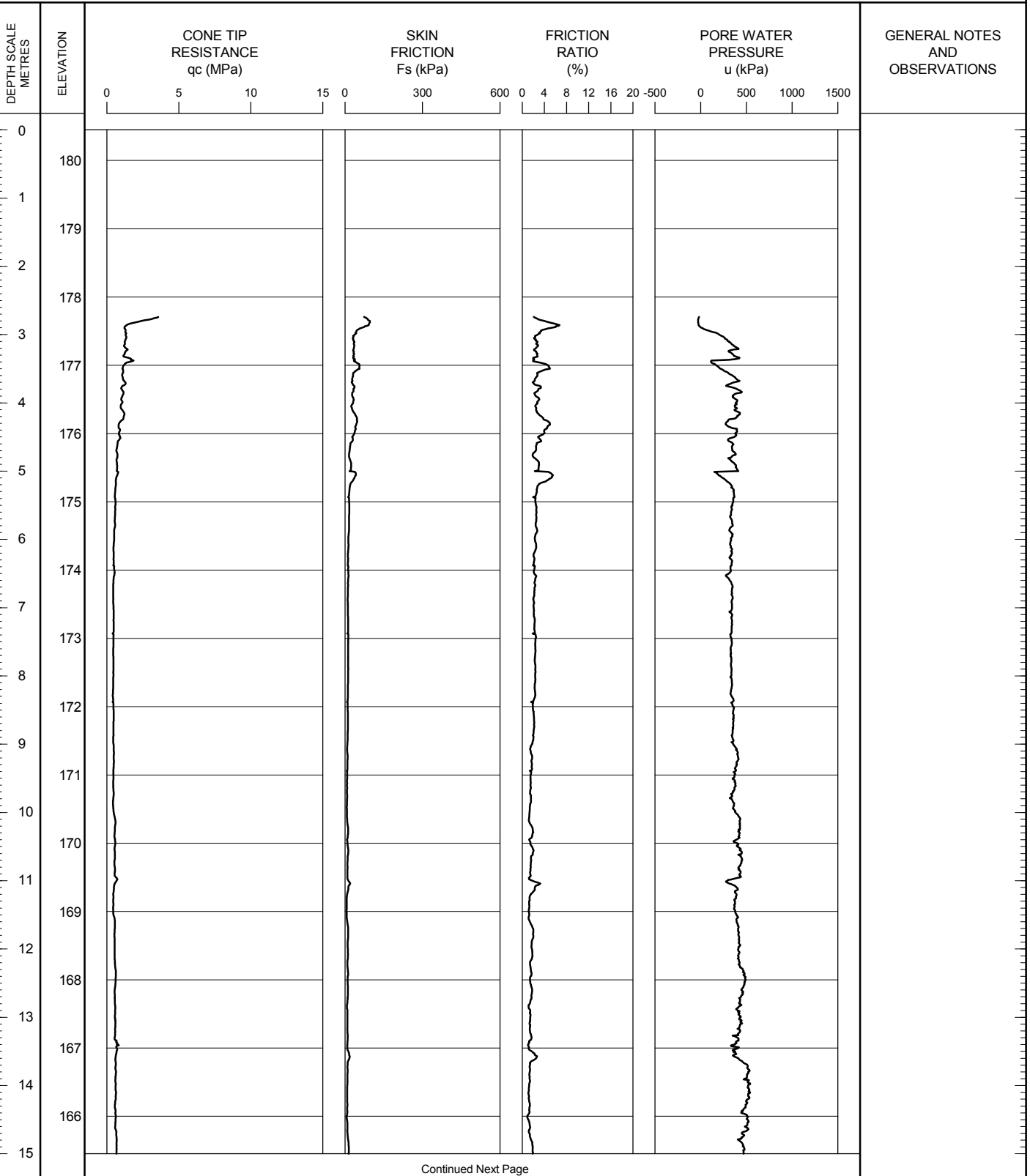
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5

PREDRILL DEPTH: 2.7

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 01-RW

METRIC

PROJECT Windsor-Essex Parkway

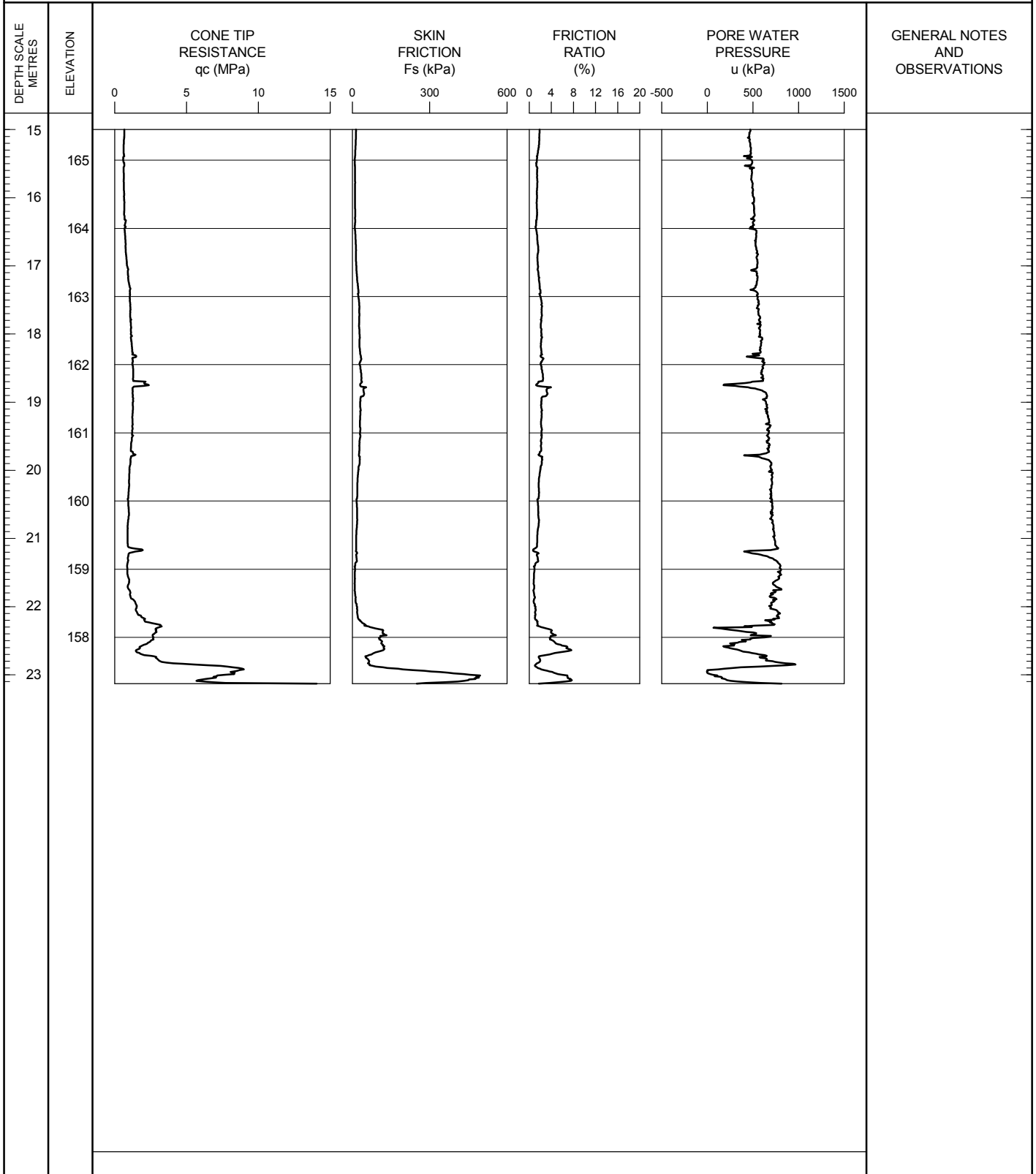
TEST DATE 6/3/2011 - 6/3/2011

SHEET 2 OF 2

LOCATION N4682083; E328470

DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5 PREDRILL DEPTH: 2.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 02-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/9/2011 - 6/9/2011

SHEET 1 OF 2

LOCATION N4682384.8; E328543.2

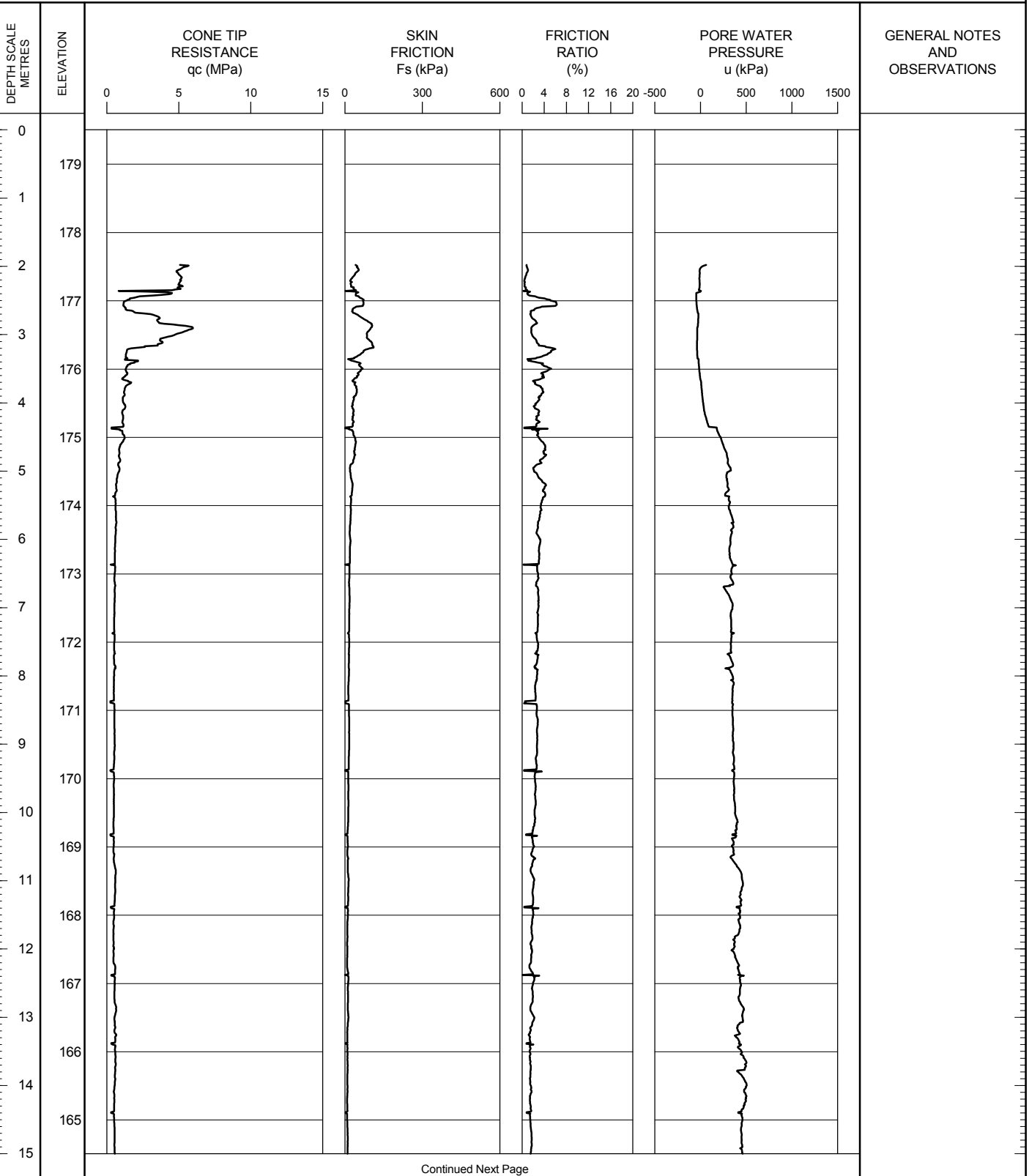
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.5

PREDRILL DEPTH: 2

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 02-RW

METRIC

PROJECT Windsor-Essex Parkway

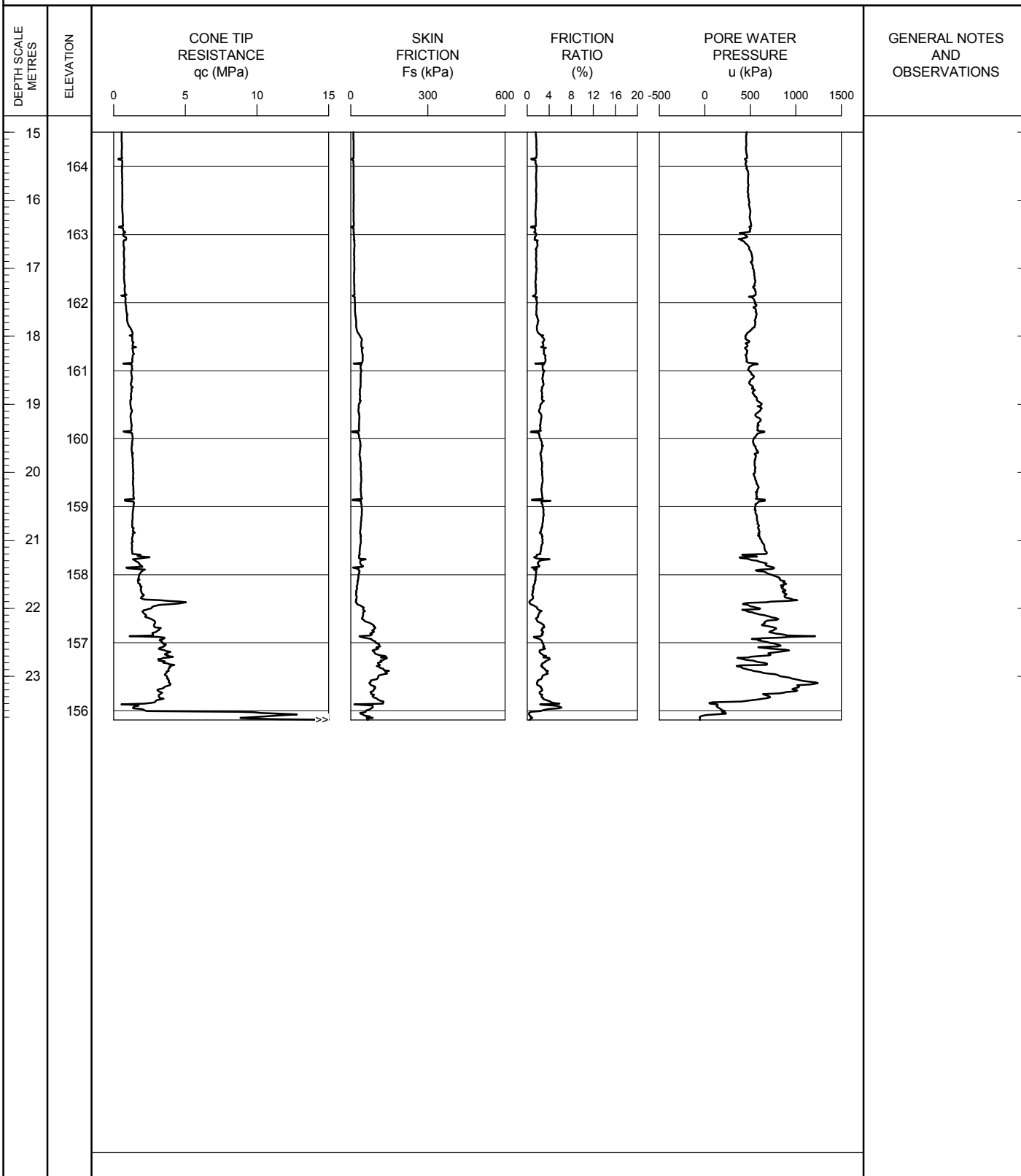
TEST DATE 6/9/2011 - 6/9/2011

SHEET 2 OF 2

LOCATION N4682384.8; E328543.2

DATUM Geodetic

GROUND SURFACE ELEVATION: 179.5 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 03-RW

METRIC

PROJECT Windsor-Essex Parkway

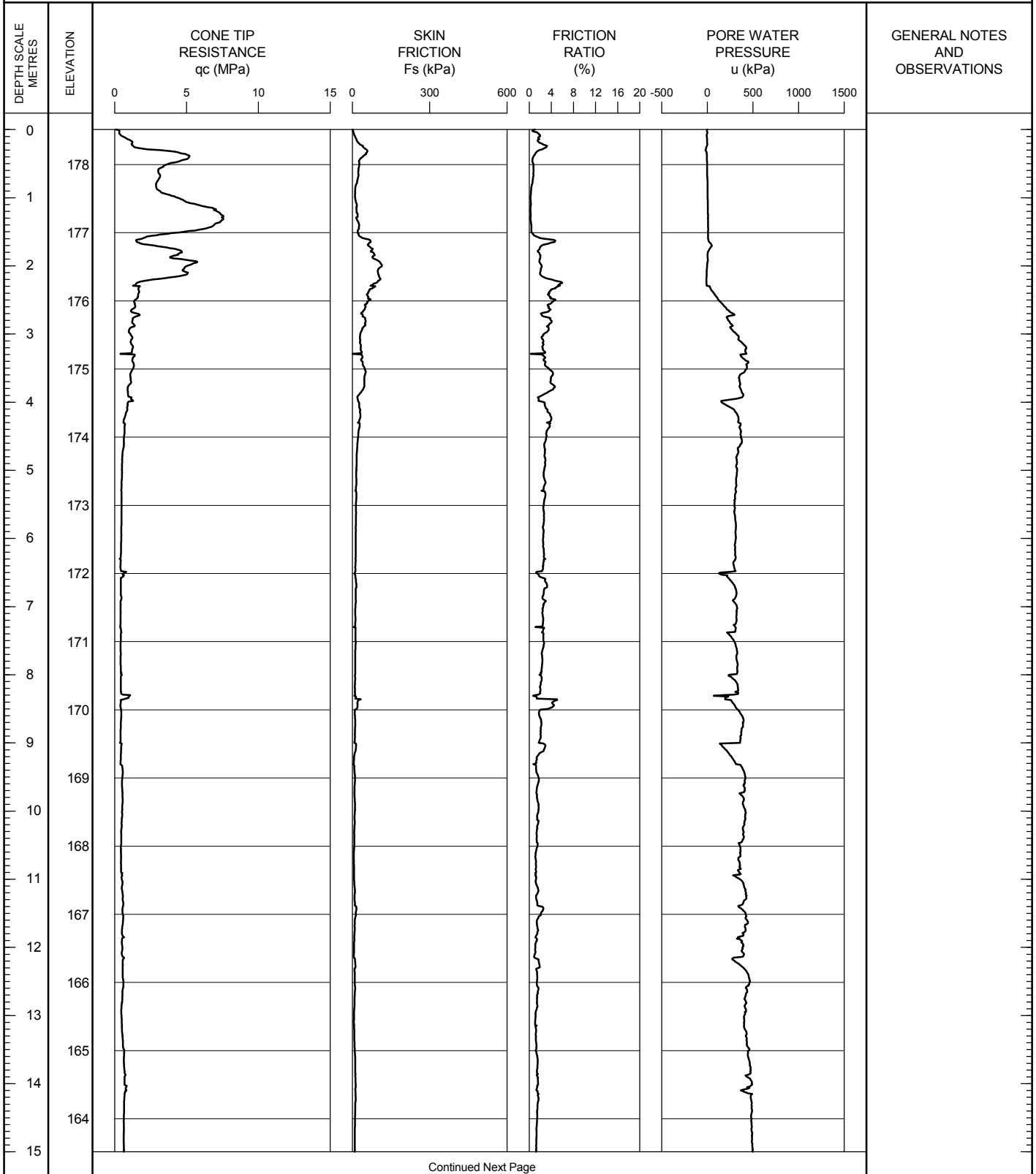
TEST DATE 6/2/2011 - 6/2/2011

SHEET 1 OF 2

LOCATION N4682024.7; E328600.5

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.5 PREDRILL DEPTH: 0 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 03-RW

METRIC

PROJECT Windsor-Essex Parkway

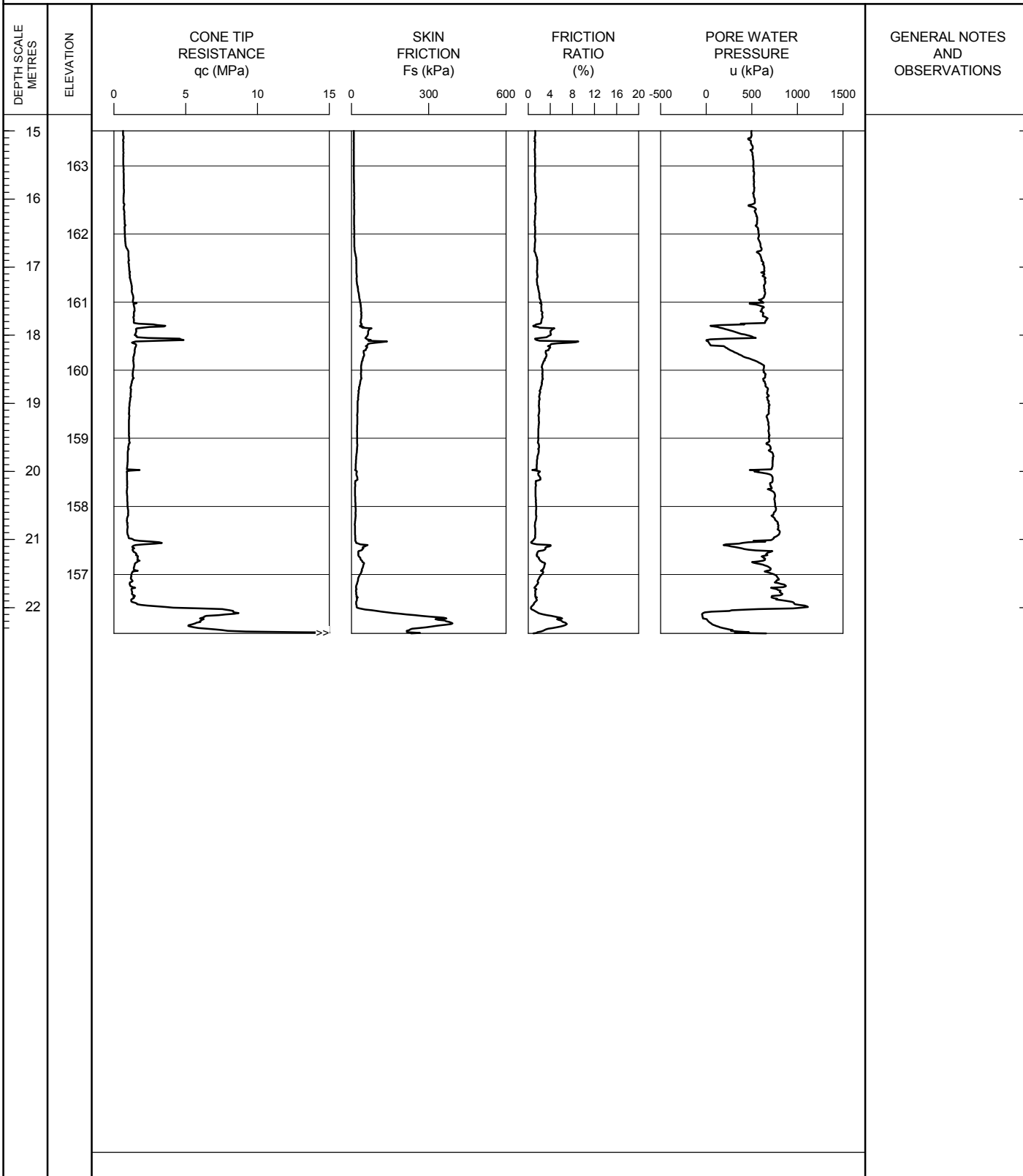
TEST DATE 6/2/2011 - 6/2/2011

SHEET 2 OF 2

LOCATION N4682024.7; E328600.5

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.5 PREDRILL DEPTH: 0 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



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

OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 04-RW

METRIC

PROJECT Windsor-Essex Parkway

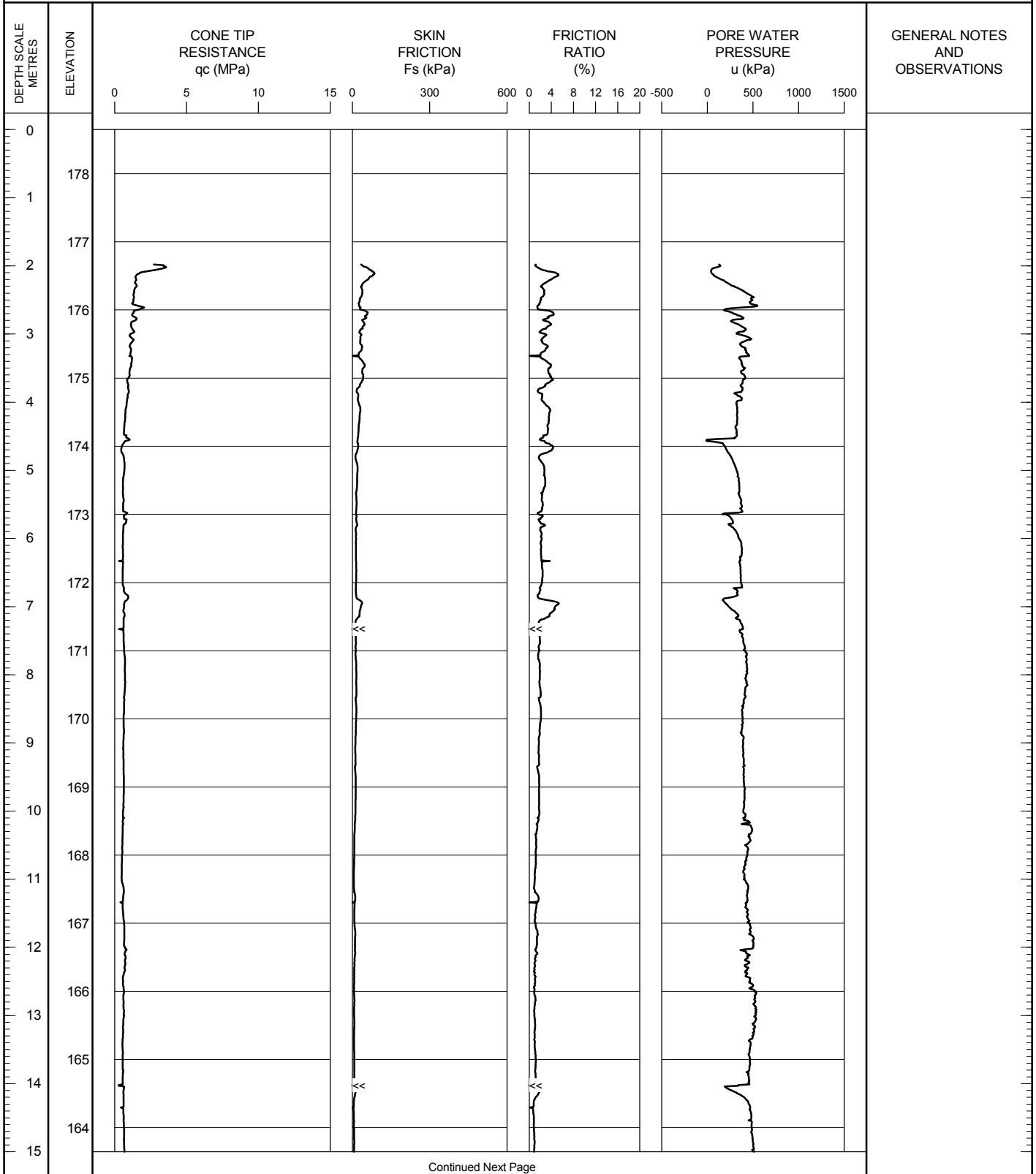
TEST DATE 6/4/2011 - 6/4/2011

SHEET 1 OF 2

LOCATION N4682361.5; E328676.9

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.6 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 04-RW

METRIC

PROJECT Windsor-Essex Parkway

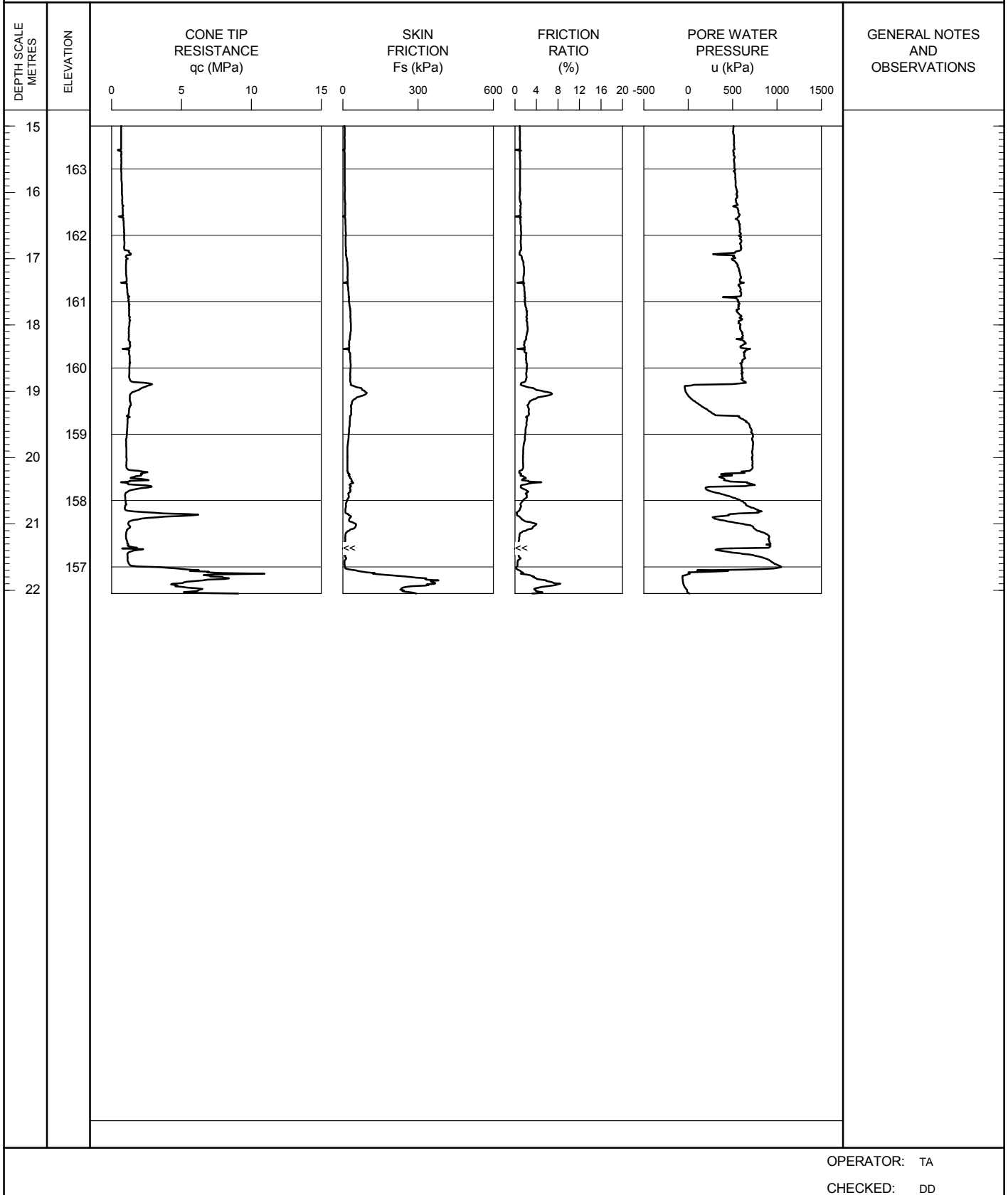
TEST DATE 6/4/2011 - 6/4/2011

SHEET 2 OF 2

LOCATION N4682361.5; E328676.9

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.6 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 05-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/3/2011 - 6/3/2011

SHEET 1 OF 2

LOCATION N4682240.2; E328674.2

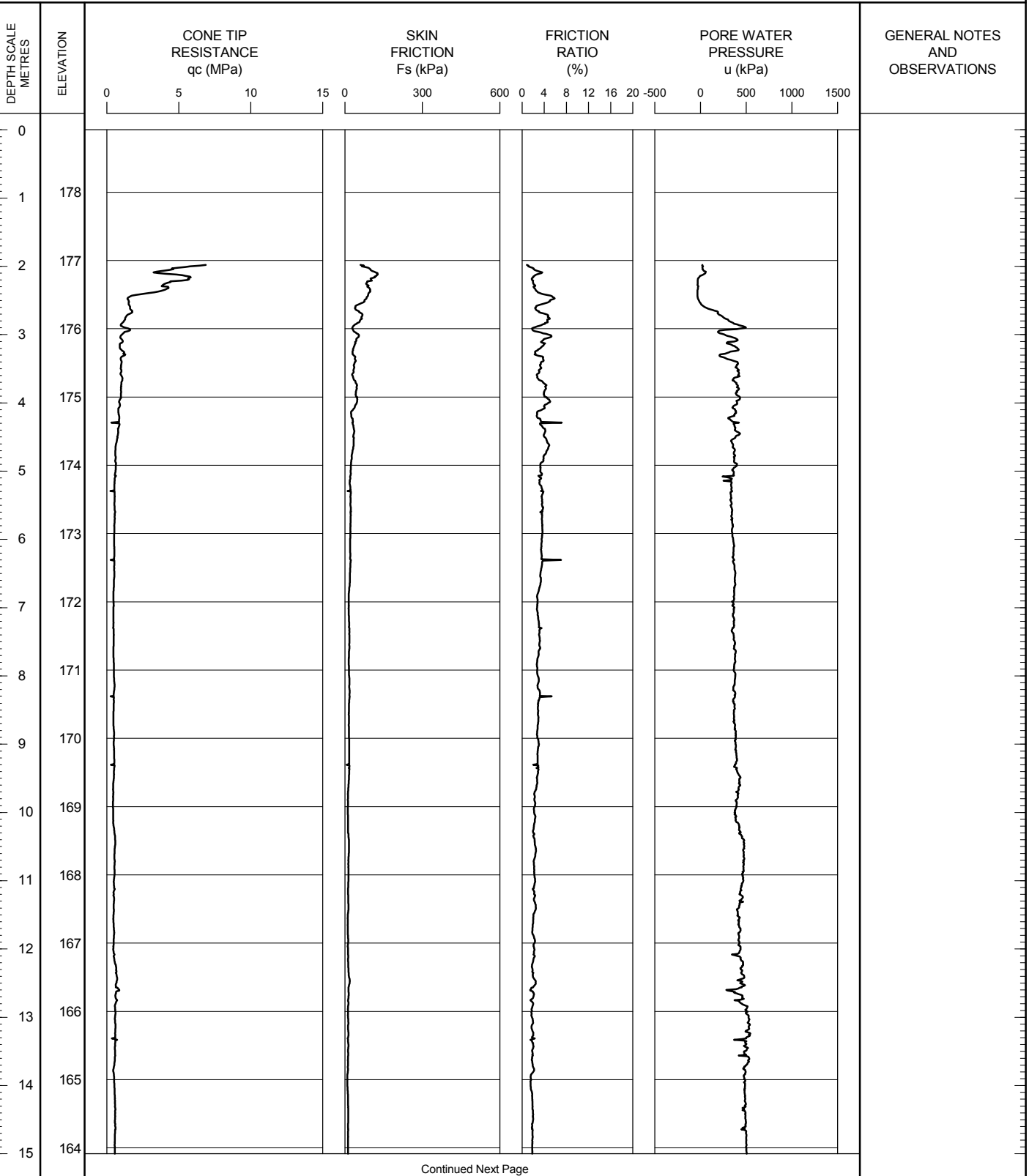
DATUM Geodetic

GROUND SURFACE ELEVATION: 178.9

PREDRILL DEPTH: 2

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 05-RW

METRIC

PROJECT Windsor-Essex Parkway

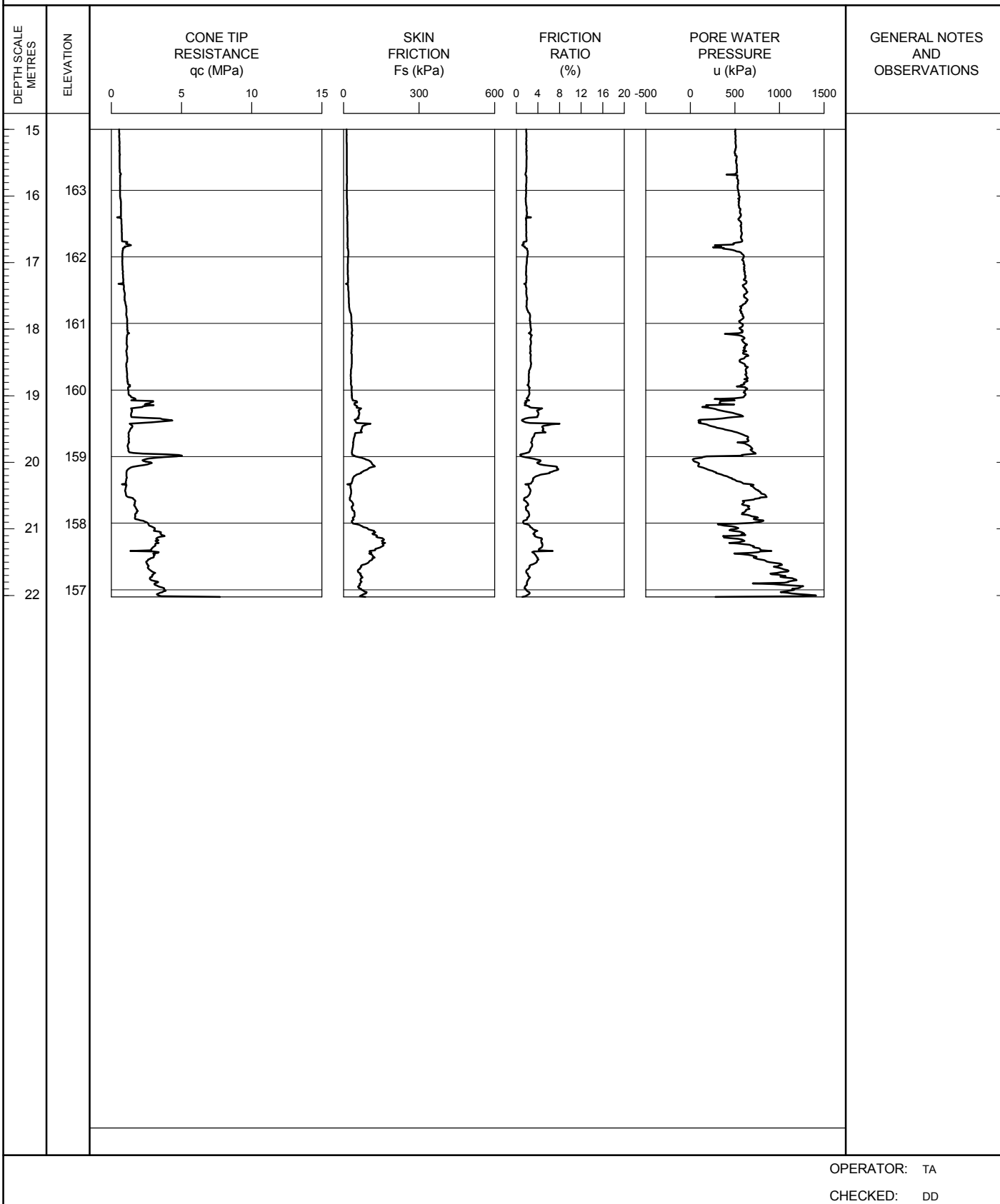
TEST DATE 6/3/2011 - 6/3/2011

SHEET 2 OF 2

LOCATION N4682240.2; E328674.2

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.9 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 06-RW

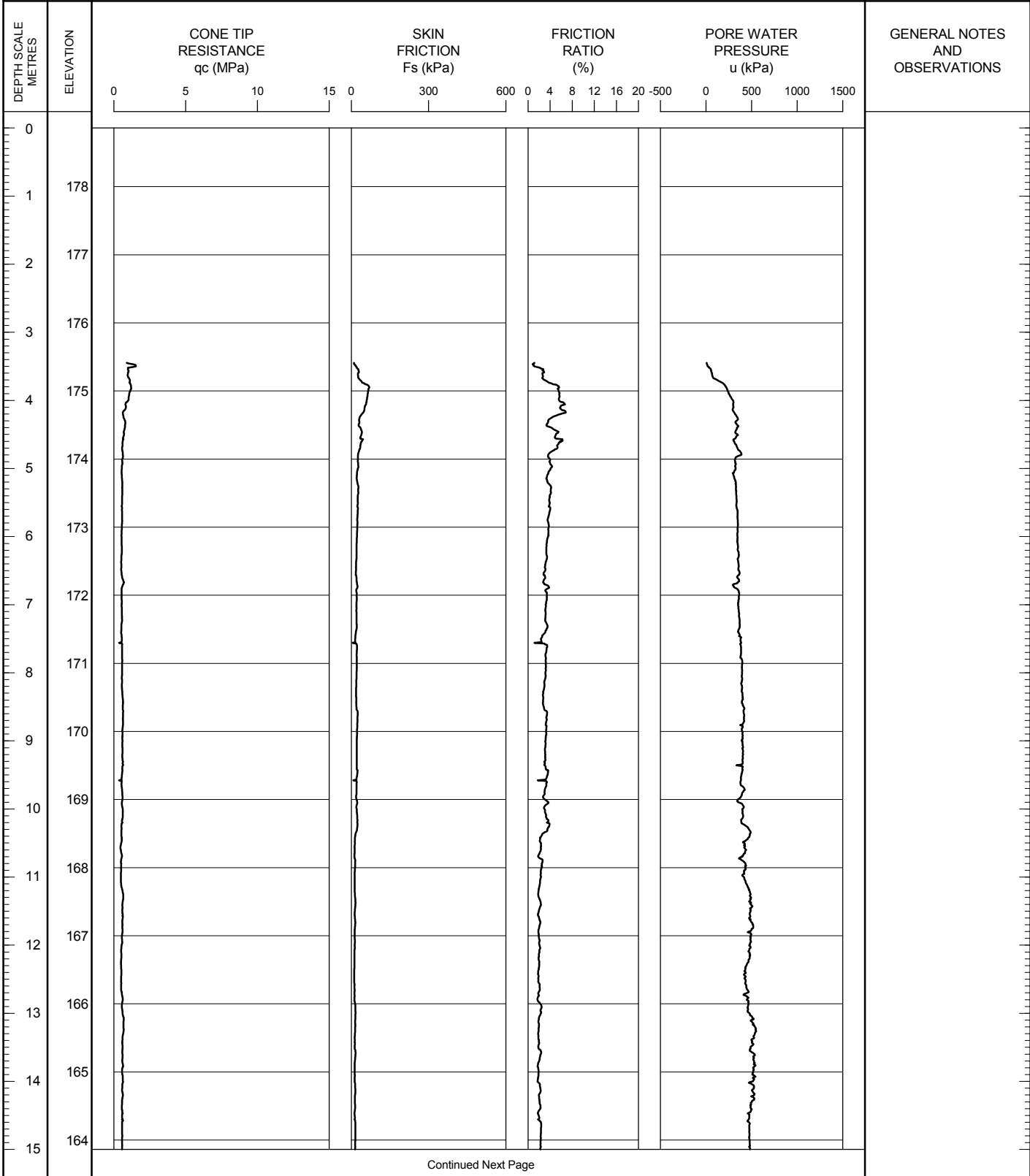
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682136.9; E328777.8

TEST DATE 5/7/2011 - 5/7/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 178.9 PREDRILL DEPTH: 3.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEF CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 06-RW

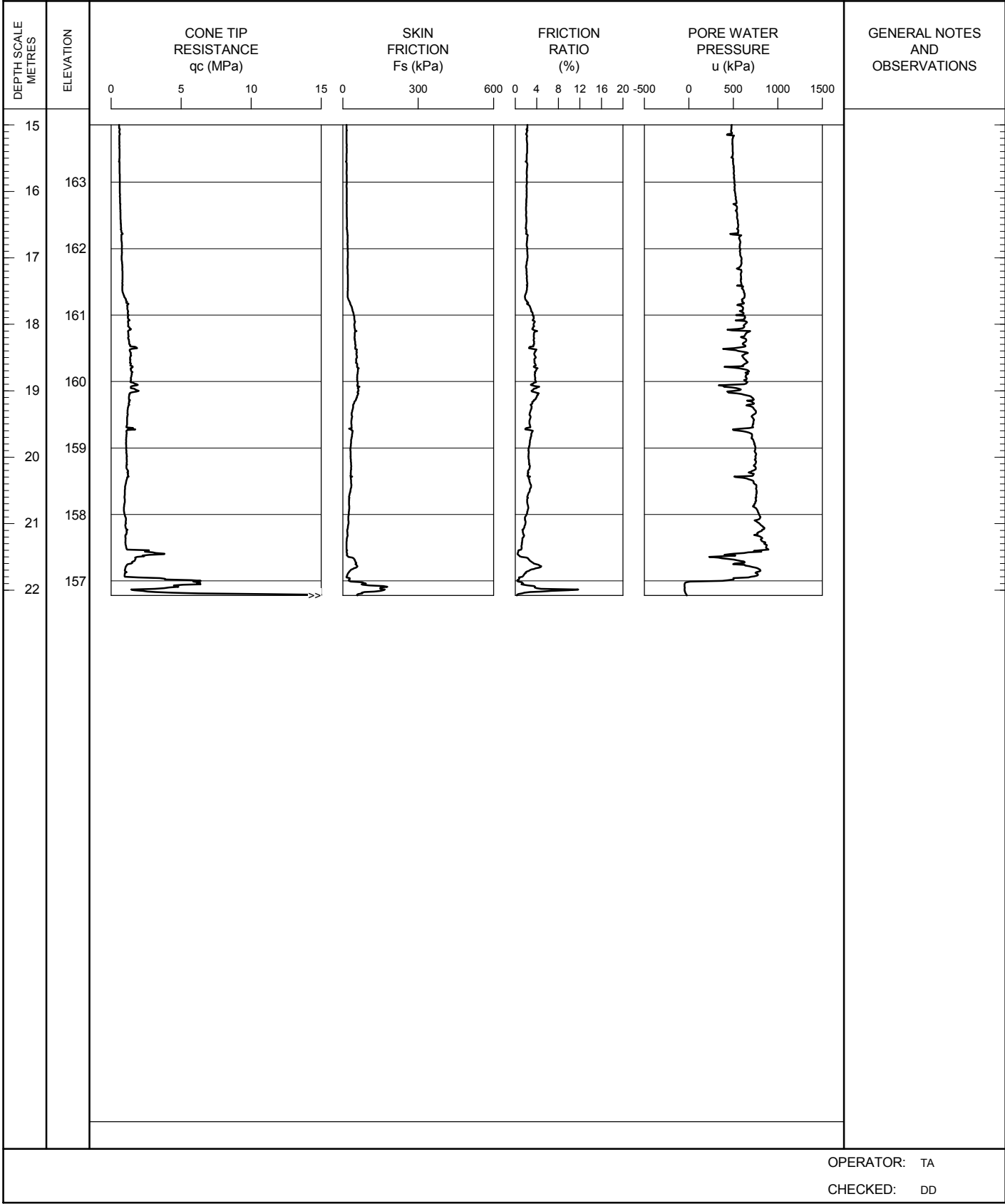
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682136.9; E328777.8

TEST DATE 5/7/2011 - 5/7/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 178.9 PREDRILL DEPTH: 3.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 07-RW

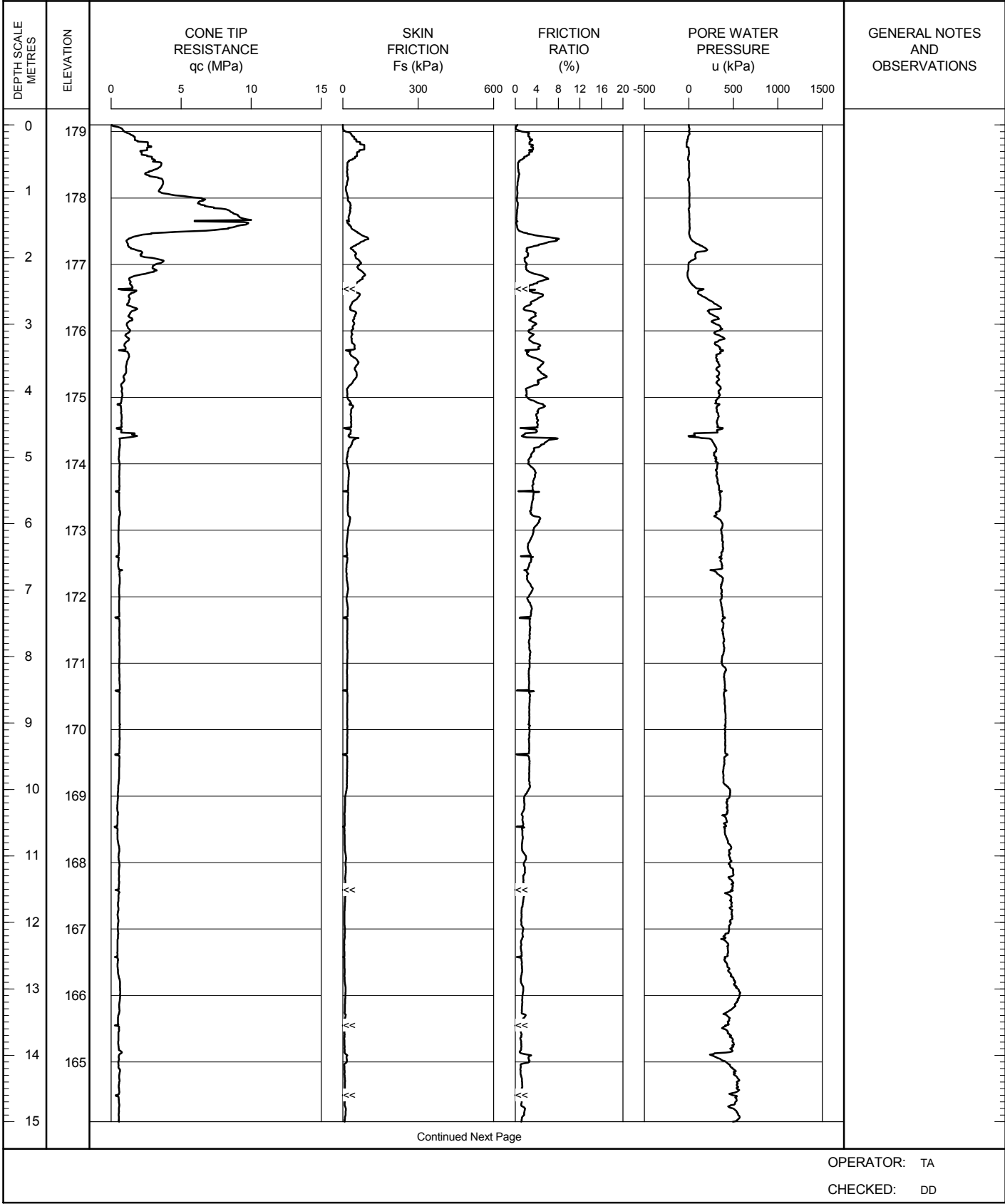
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682201.8; E328892.2

TEST DATE 5/8/2011 - 5/8/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1 PREDRILL DEPTH: 0 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEF CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 07-RW

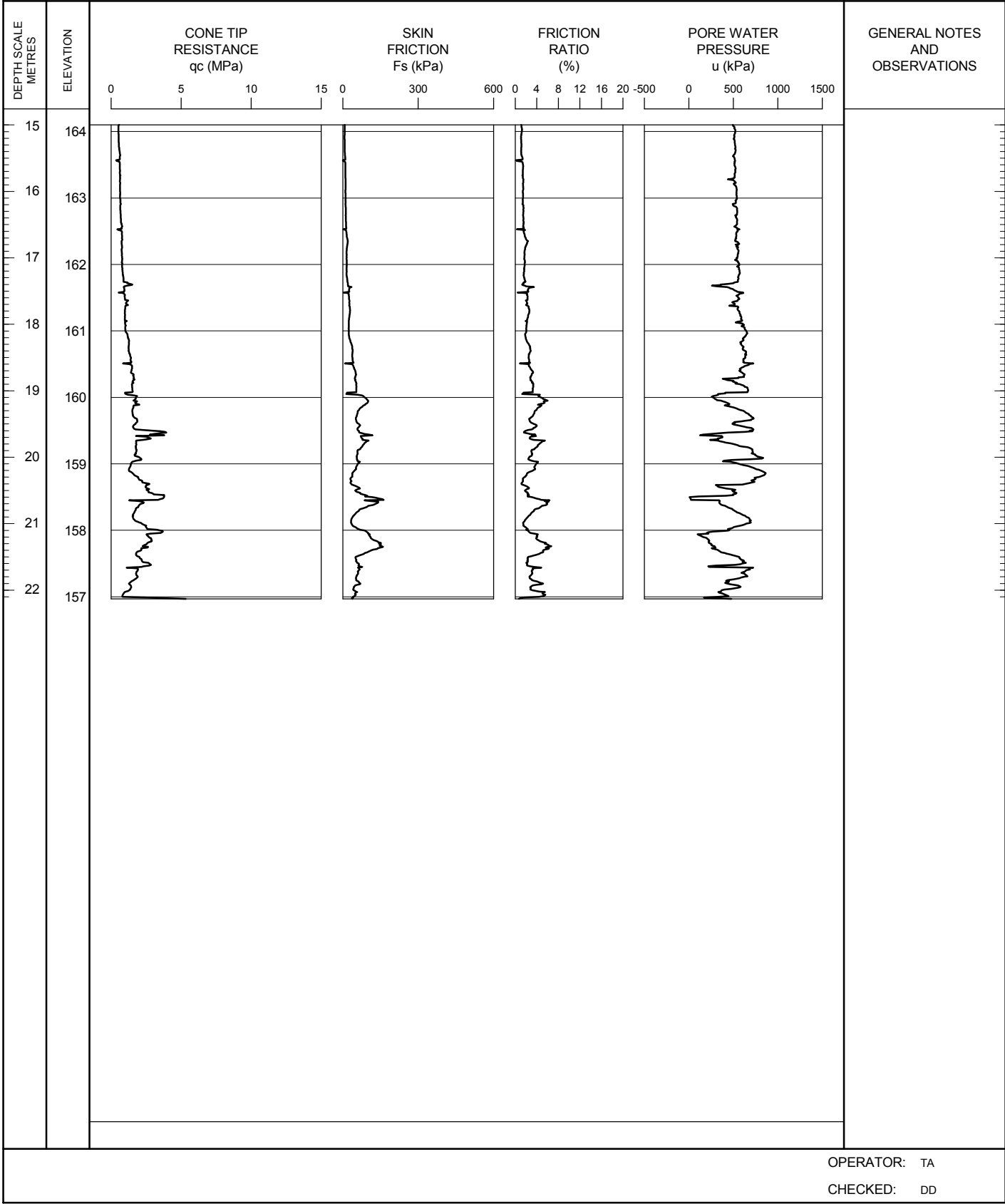
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682201.8; E328892.2

TEST DATE 5/8/2011 - 5/8/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1 PREDRILL DEPTH: 0 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 08-RW

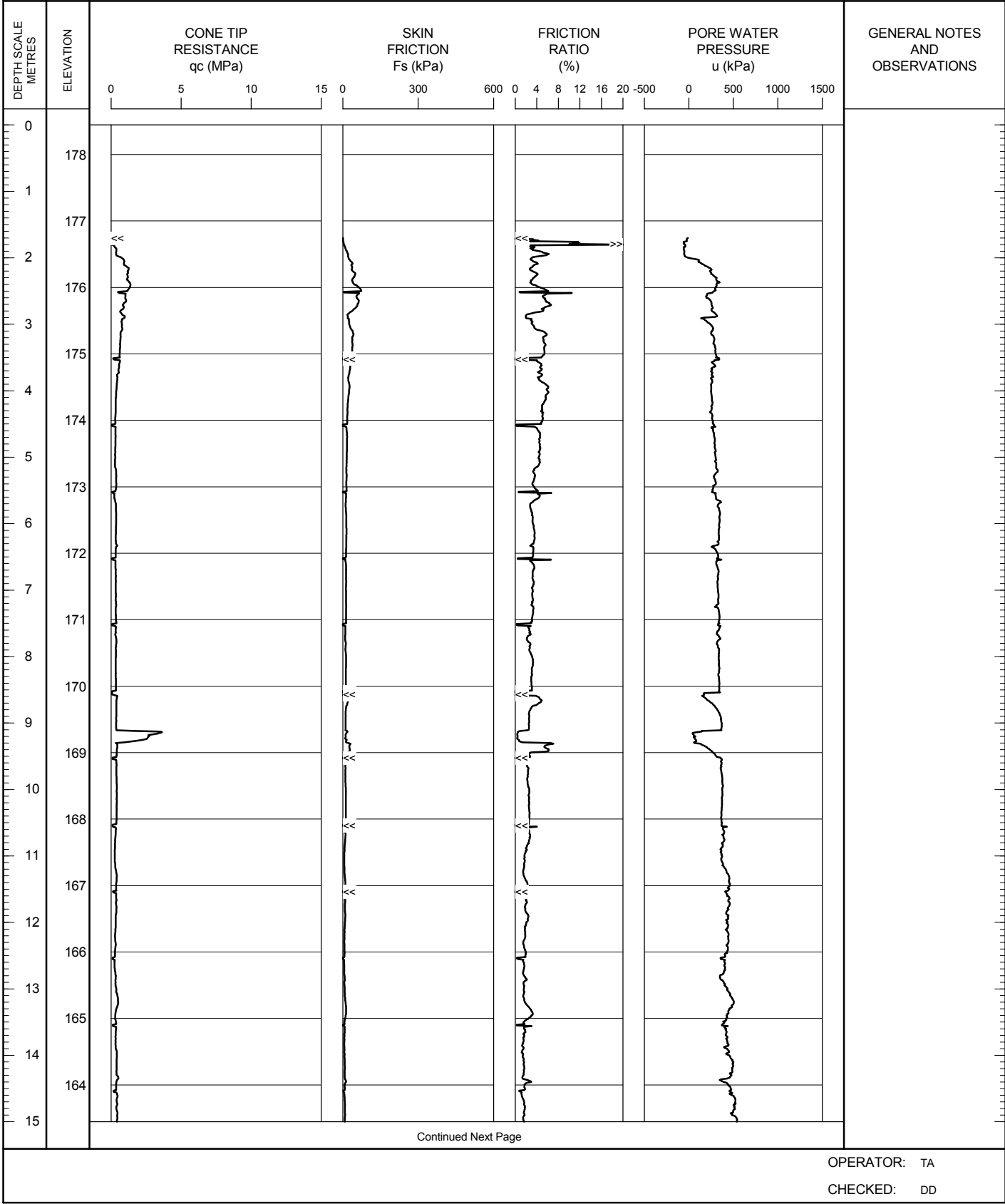
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682230.8; E329255.3

TEST DATE 6/19/2011 - 6/19/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 178.4 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 08-RW

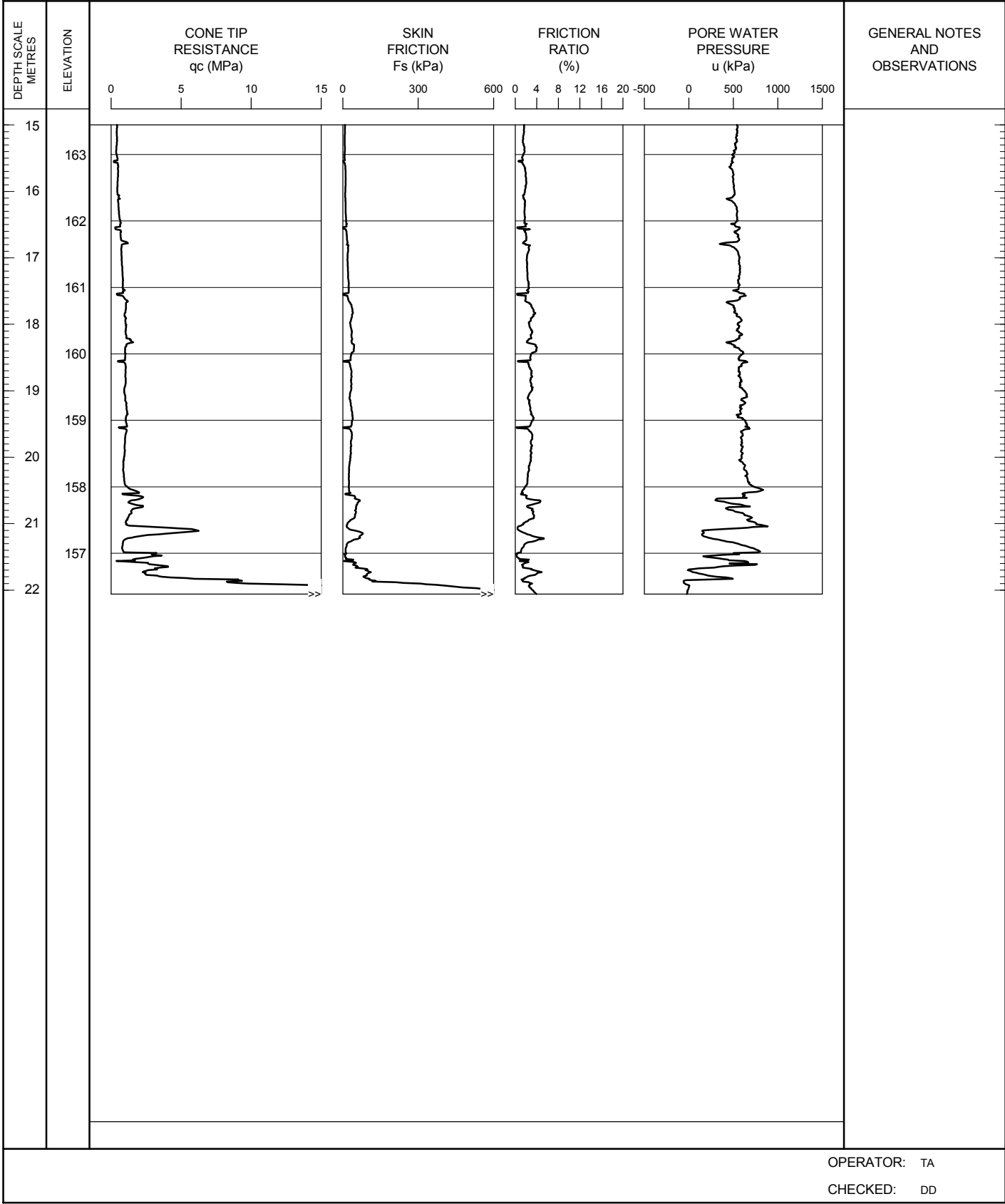
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682230.8; E329255.3

TEST DATE 6/19/2011 - 6/19/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 178.4 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 09-RW

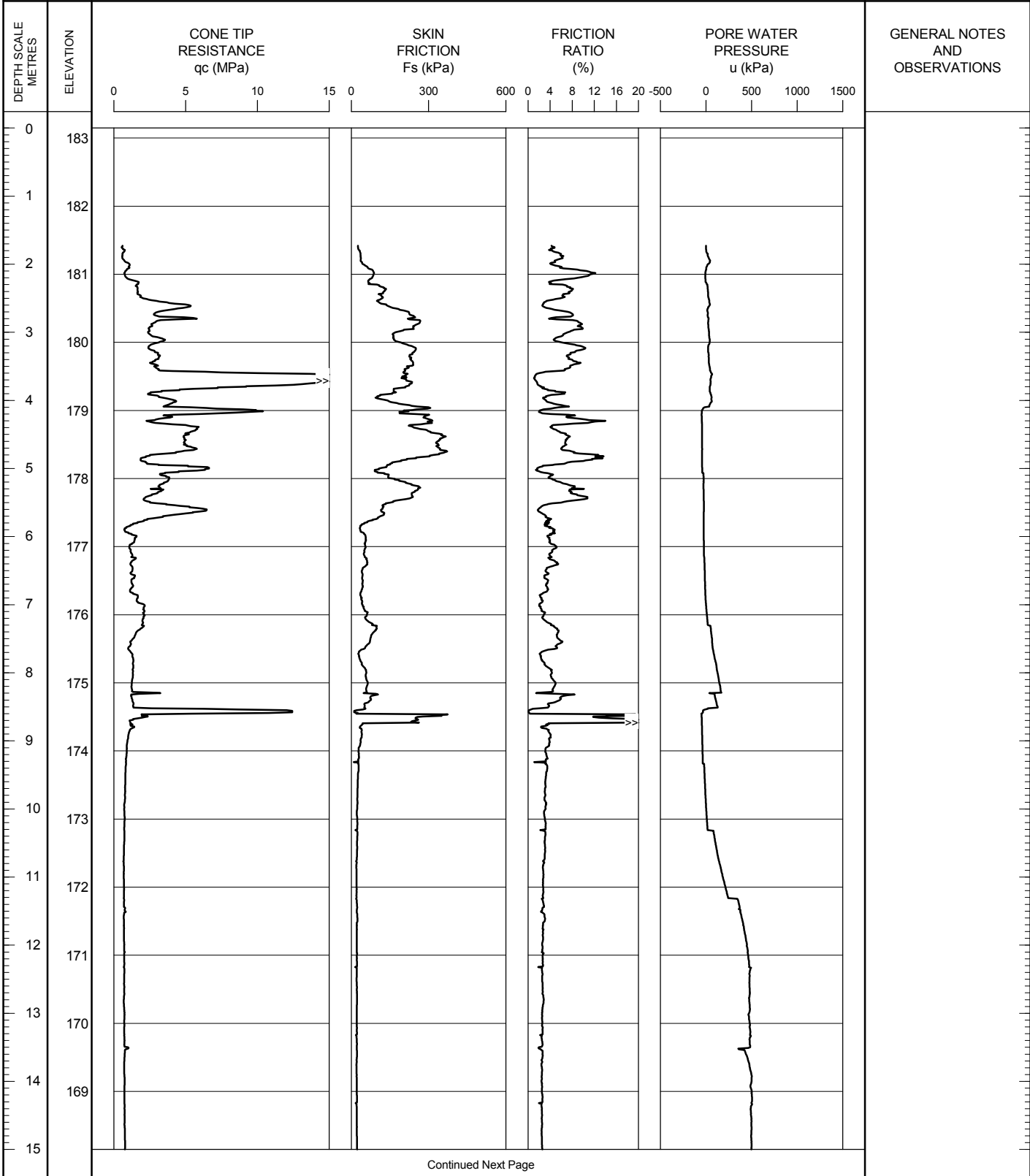
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682361.8; E329272

TEST DATE 6/9/2011 - 6/9/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 183.1 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 09-RW

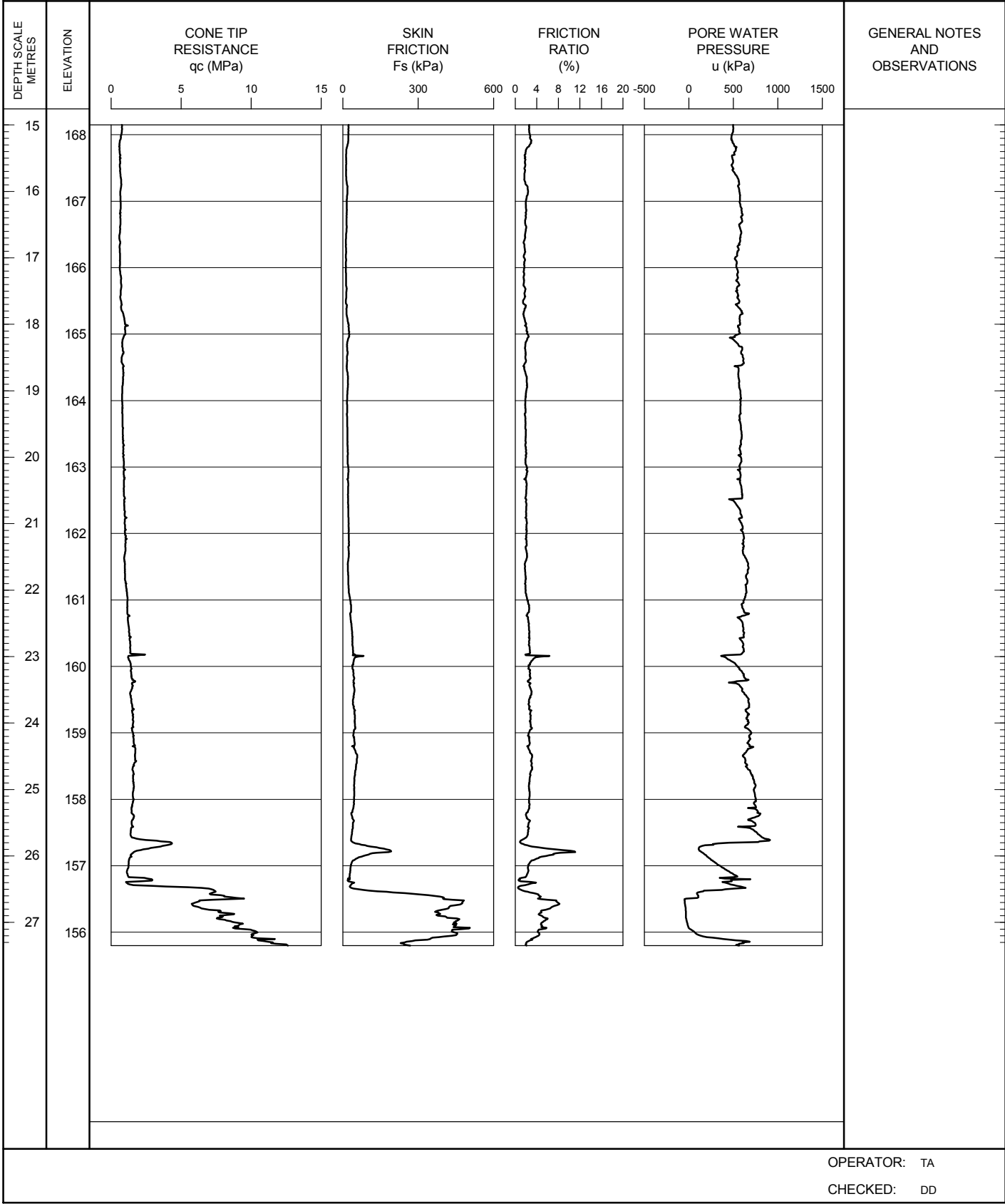
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682361.8; E329272

TEST DATE 6/9/2011 - 6/9/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 183.1 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 10-RW

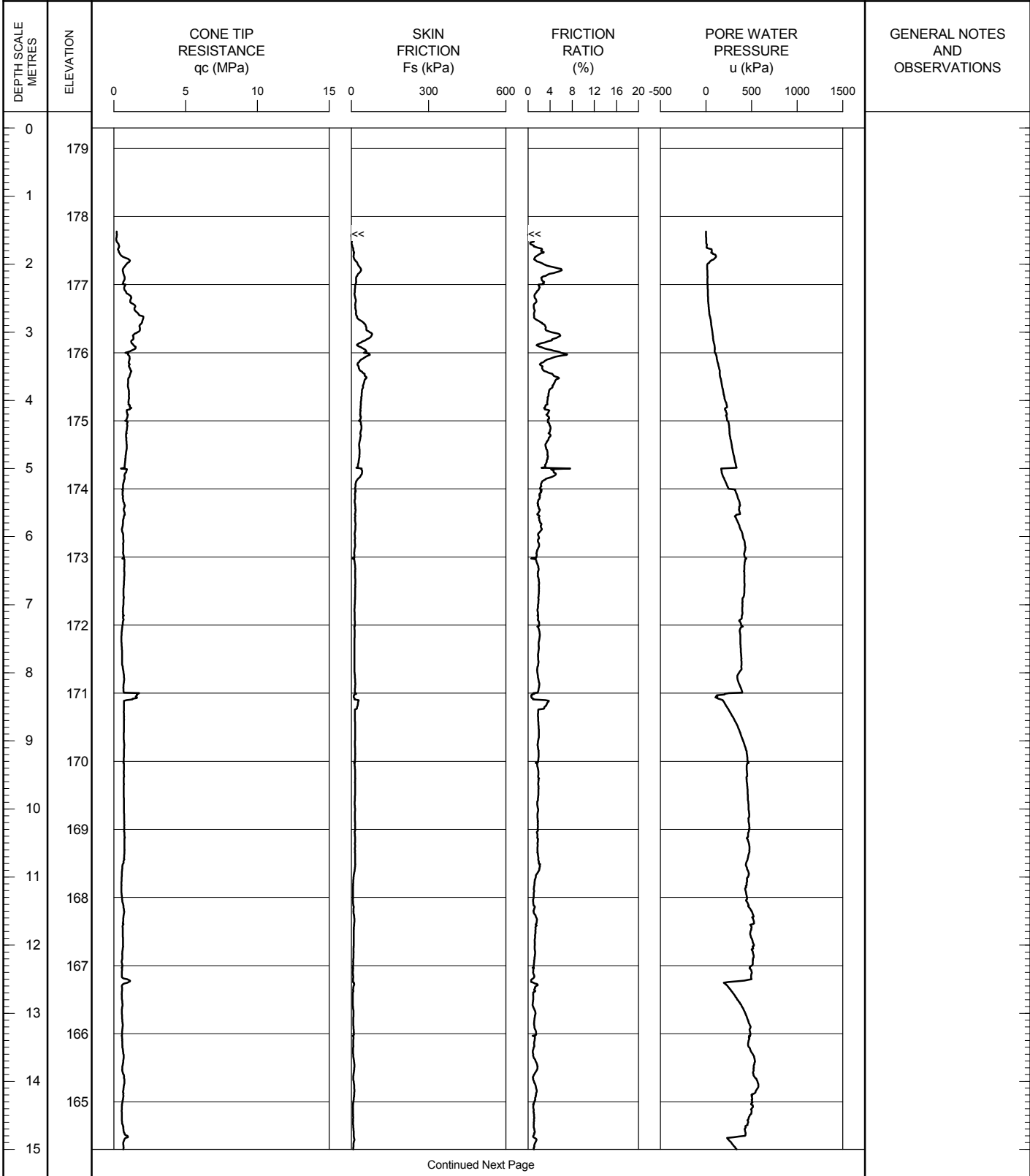
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682295.7; E329387.8

TEST DATE 6/10/2011 - 6/10/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.3 PREDRILL DEPTH: 1.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEP CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 10-RW

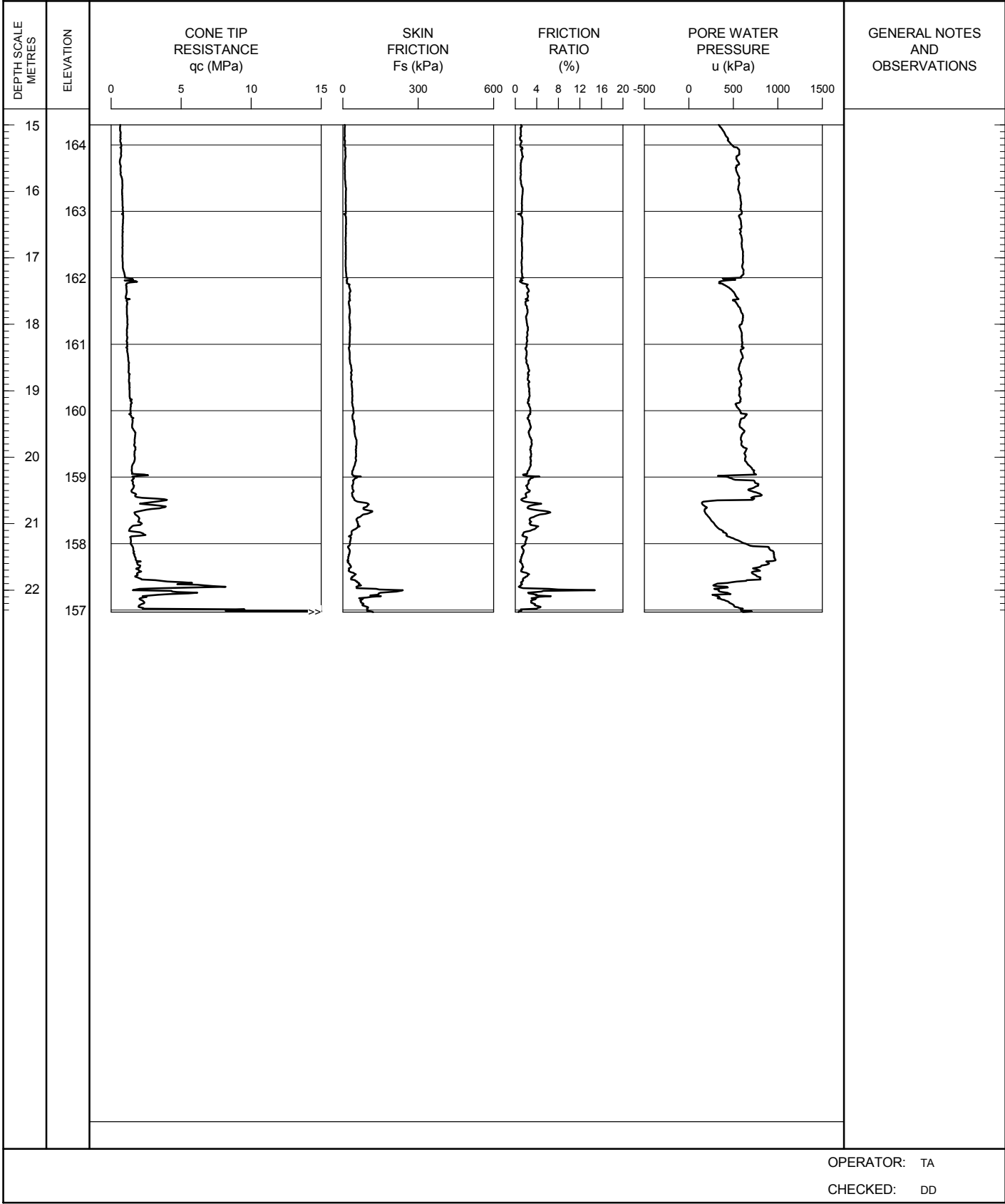
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682295.7; E329387.8

TEST DATE 6/10/2011 - 6/10/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.3 PREDRILL DEPTH: 1.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 11-RW

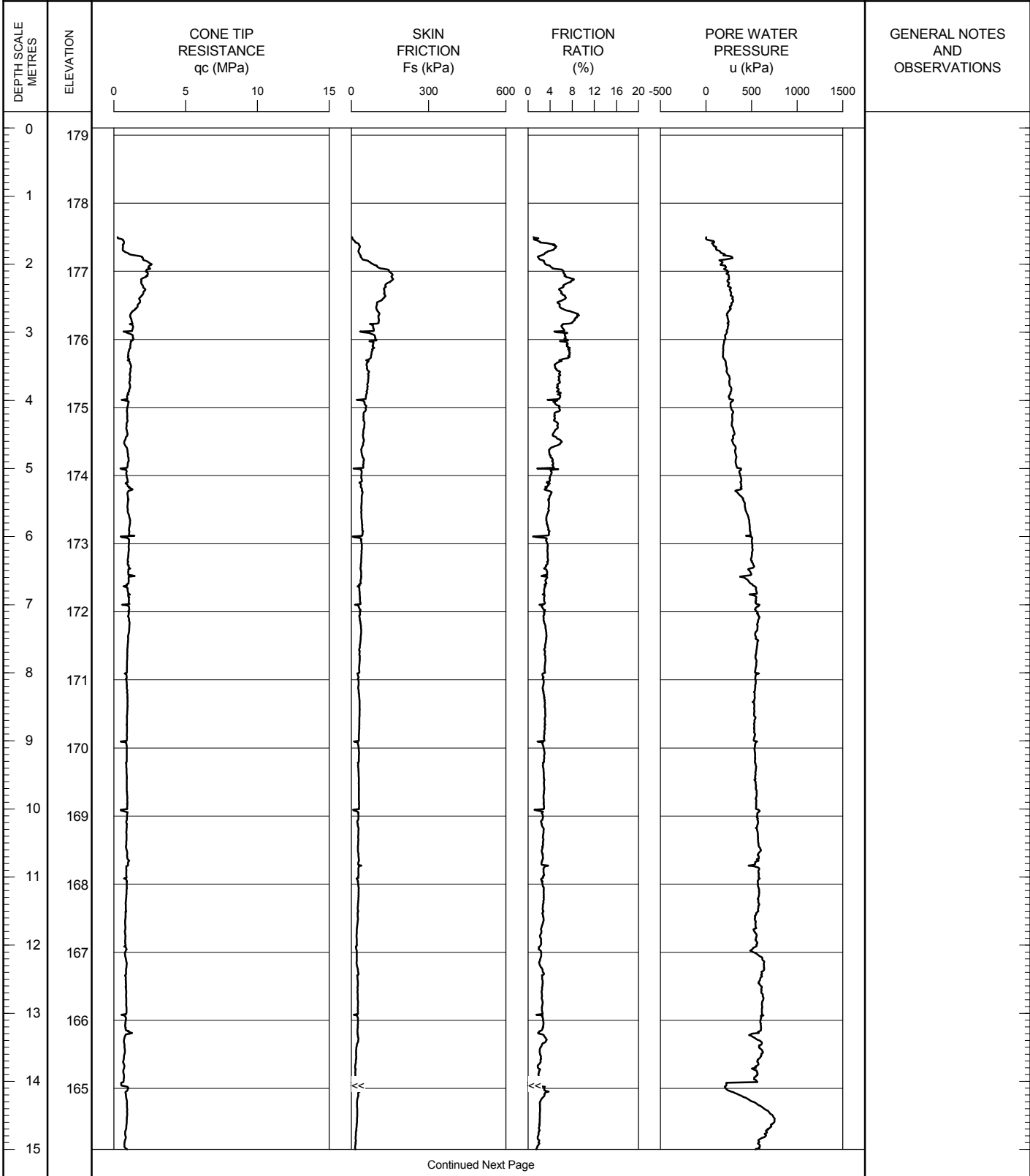
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682100.4; E329713.3

TEST DATE 6/6/2011 - 6/6/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1 PREDRILL DEPTH: 1.6 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 11-RW

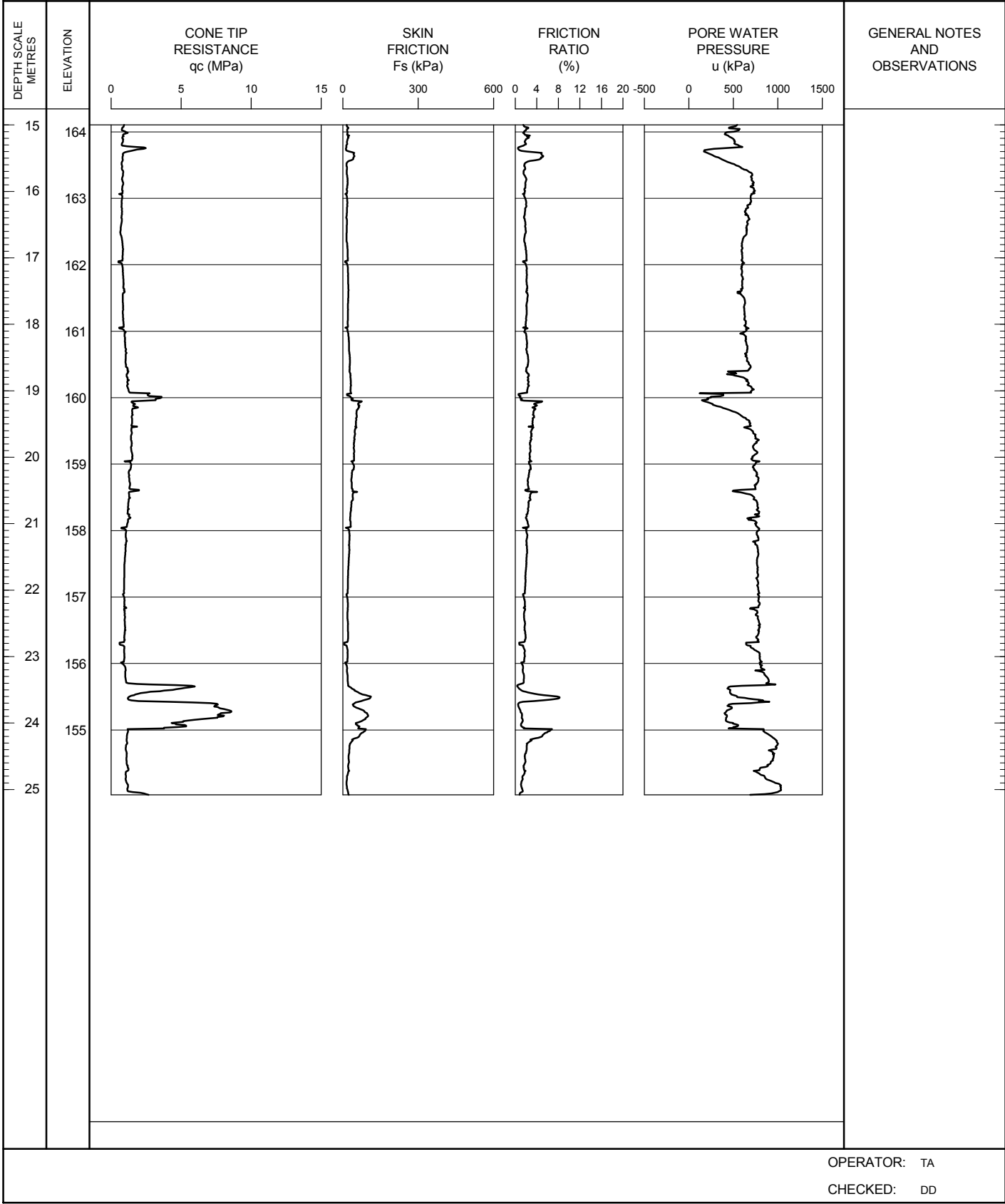
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682100.4; E329713.3

TEST DATE 6/6/2011 - 6/6/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1 PREDRILL DEPTH: 1.6 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 12-RW

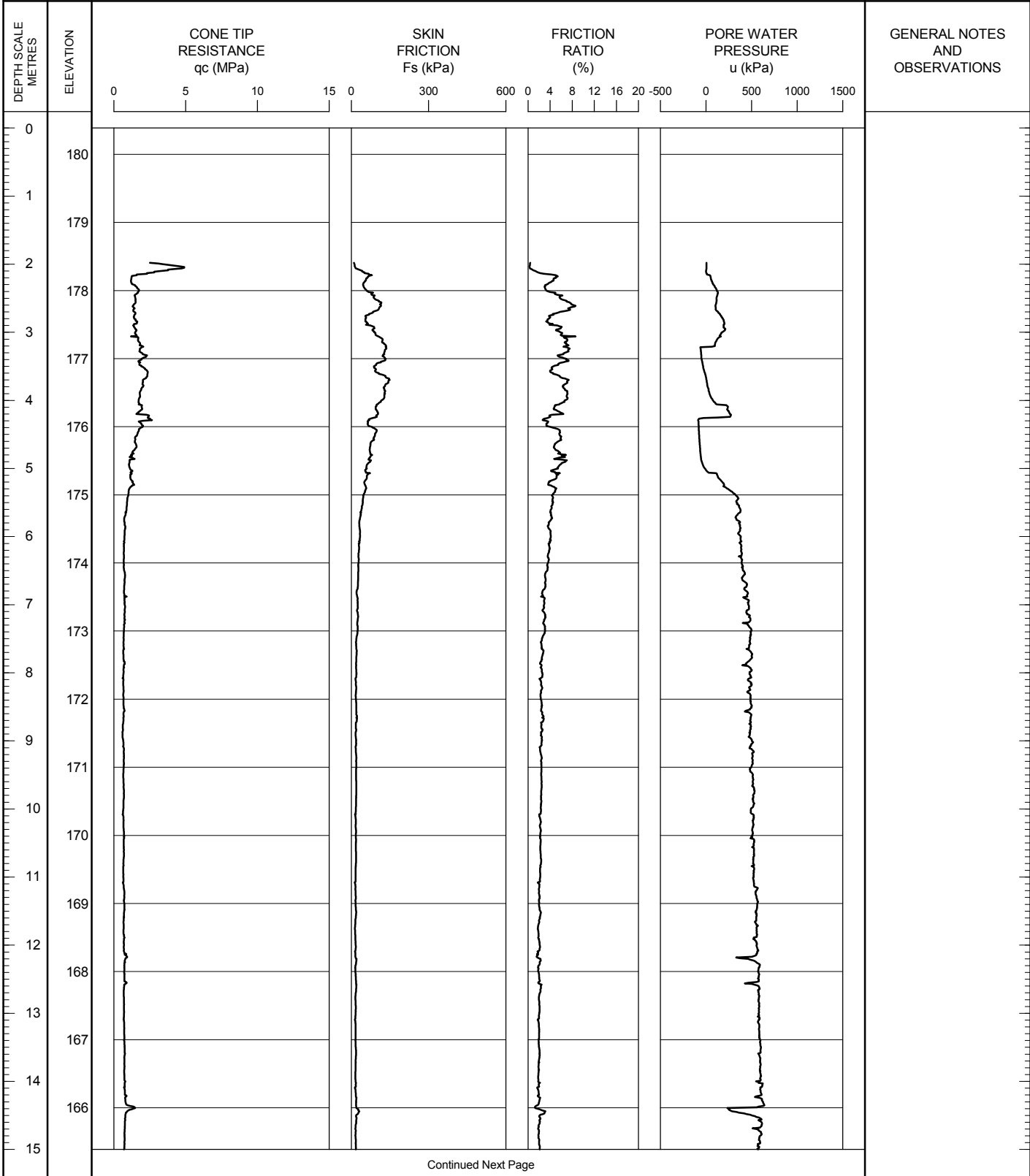
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682041.3; E329919.9

TEST DATE 6/7/2011 - 6/7/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.4 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 12-RW

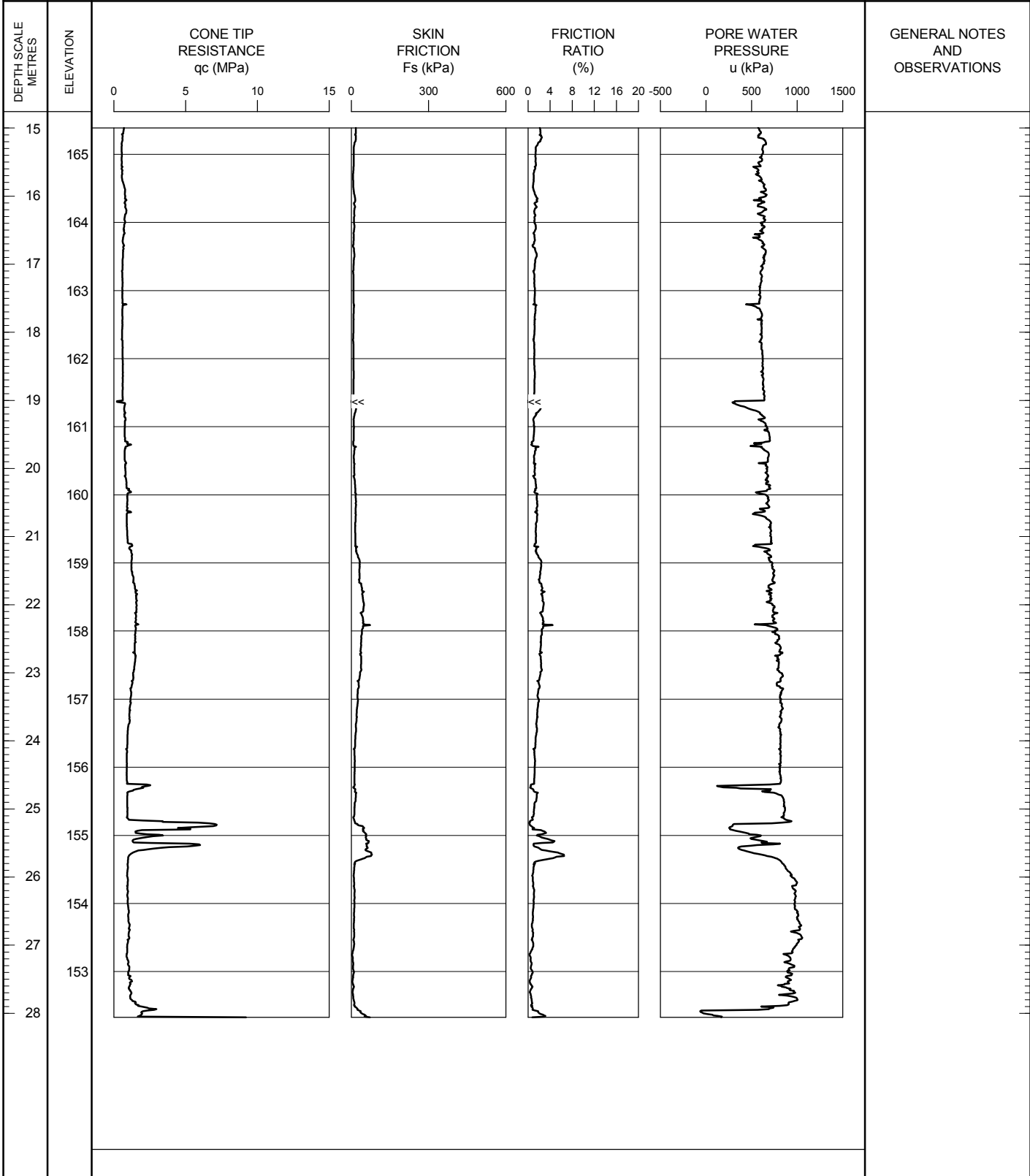
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682041.3; E329919.9

TEST DATE 6/7/2011 - 6/7/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.4 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 13-RW

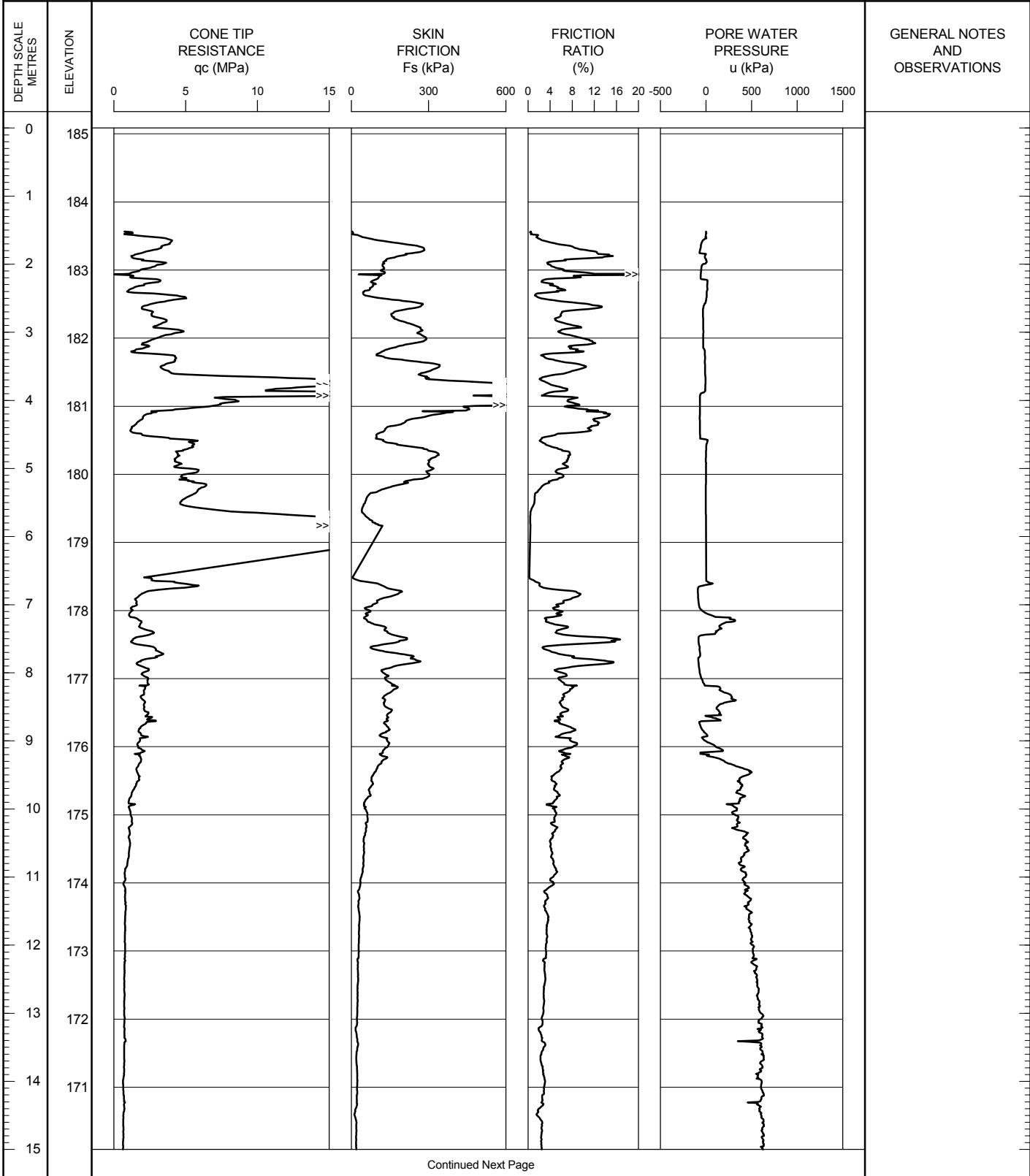
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682069.5; E330070.1

TEST DATE 6/8/2011 - 6/11/2011

SHEET 1 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 185.1 PREDRILL DEPTH: 1.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 13-RW

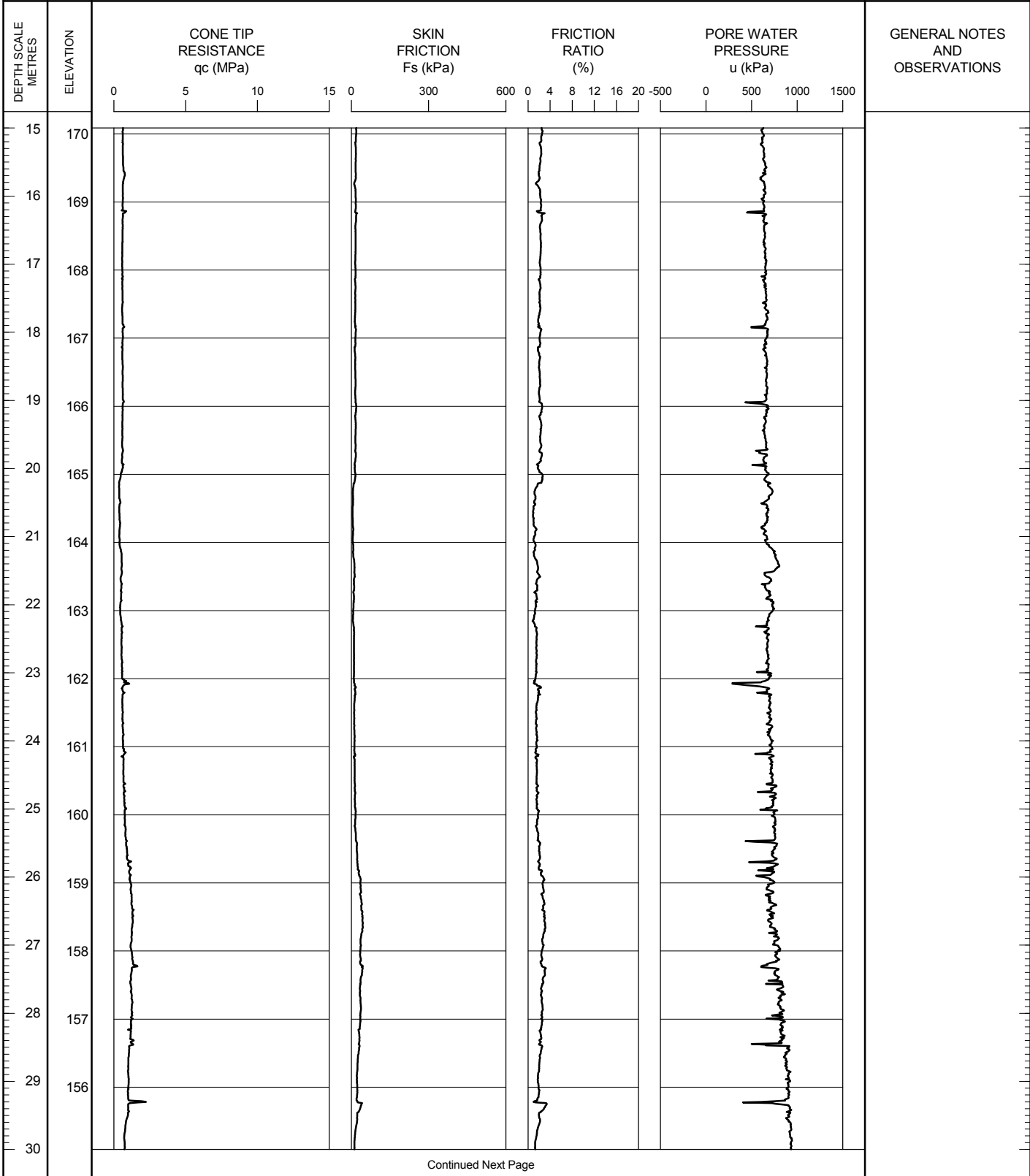
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682069.5; E330070.1

TEST DATE 6/8/2011 - 6/11/2011

SHEET 2 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 185.1 PREDRILL DEPTH: 1.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 13-RW

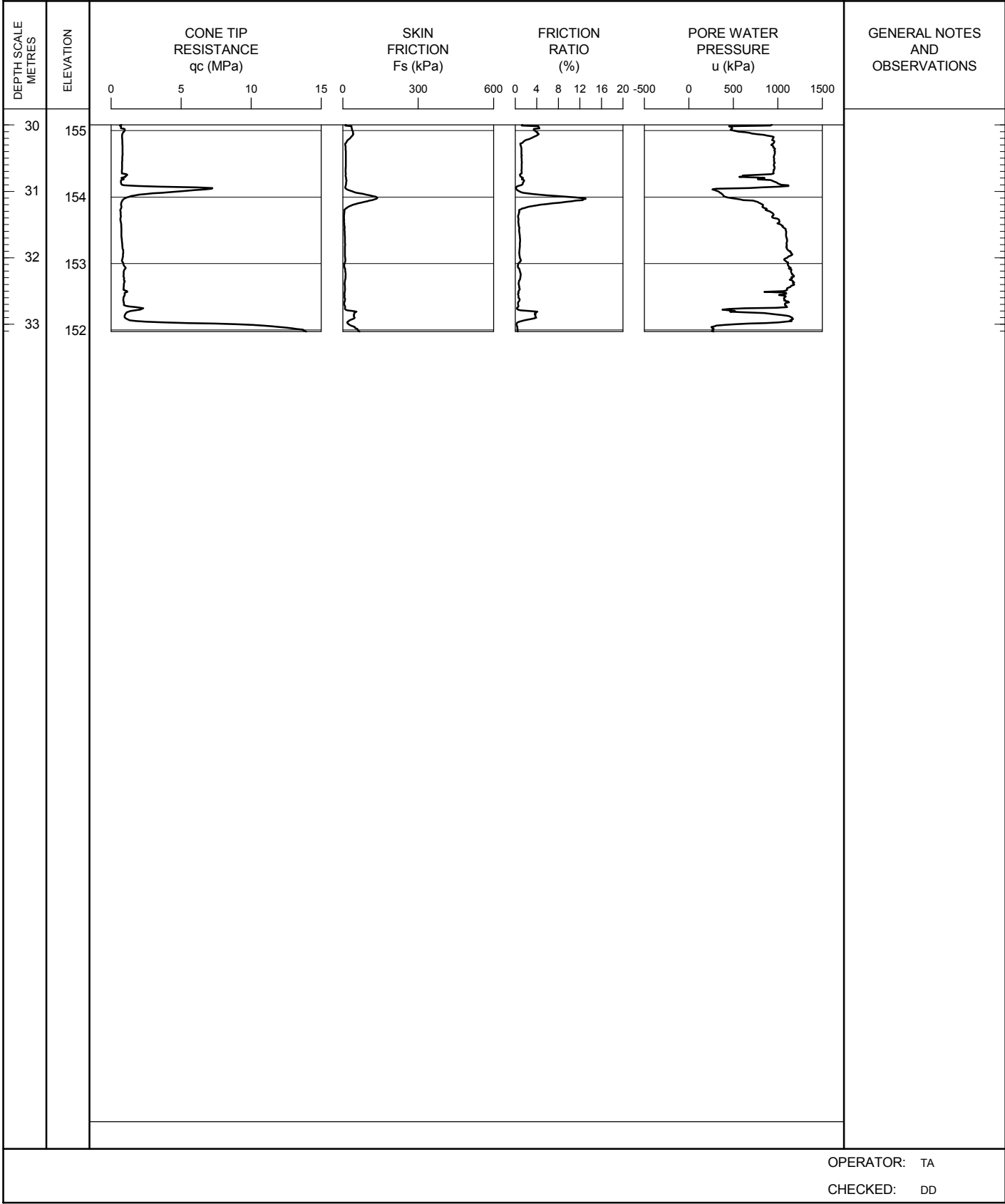
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682069.5; E330070.1

TEST DATE 6/8/2011 - 6/11/2011

SHEET 3 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 185.1 PREDRILL DEPTH: 1.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 14-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/7/2011 - 6/7/2011

SHEET 1 OF 2

LOCATION N4682001.9; E330097.3

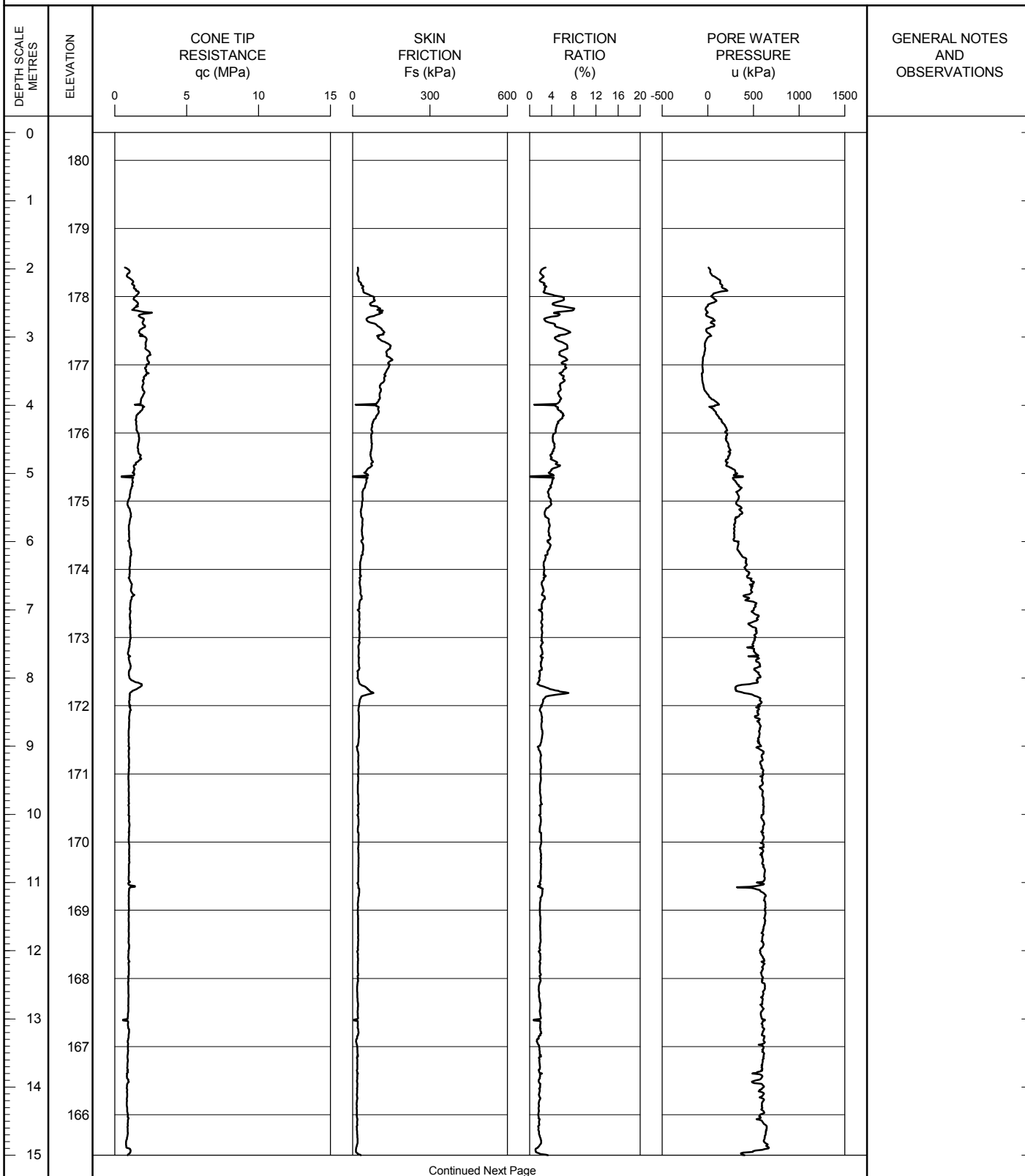
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.4

PREDRILL DEPTH: 2

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 14-RW

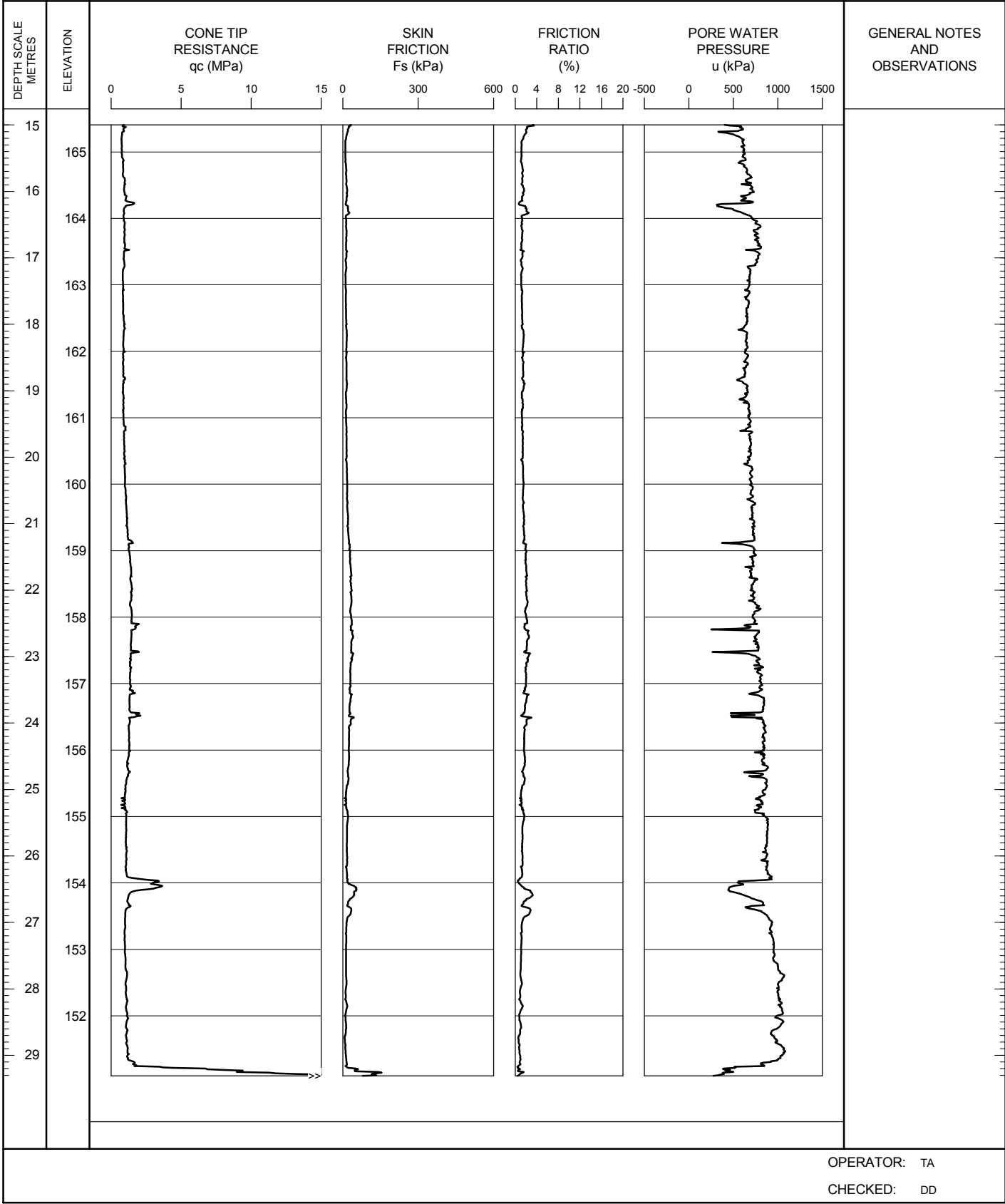
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4682001.9; E330097.3

TEST DATE 6/7/2011 - 6/7/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.4 PREDRILL DEPTH: 2 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 15-RW

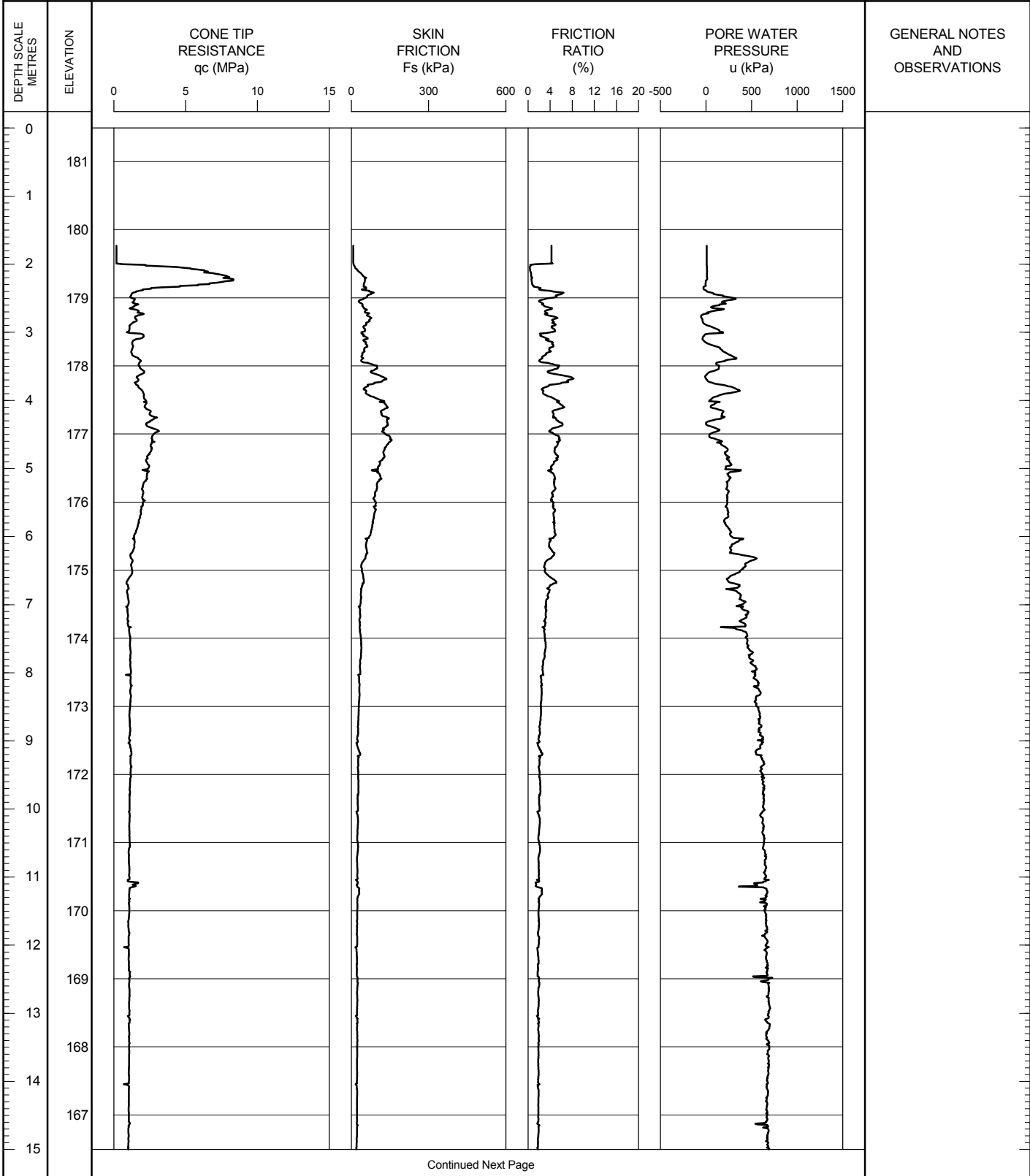
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681954.3; E330300.3

TEST DATE 6/8/2011 - 6/8/2011

SHEET 1 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 181.5 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 15-RW

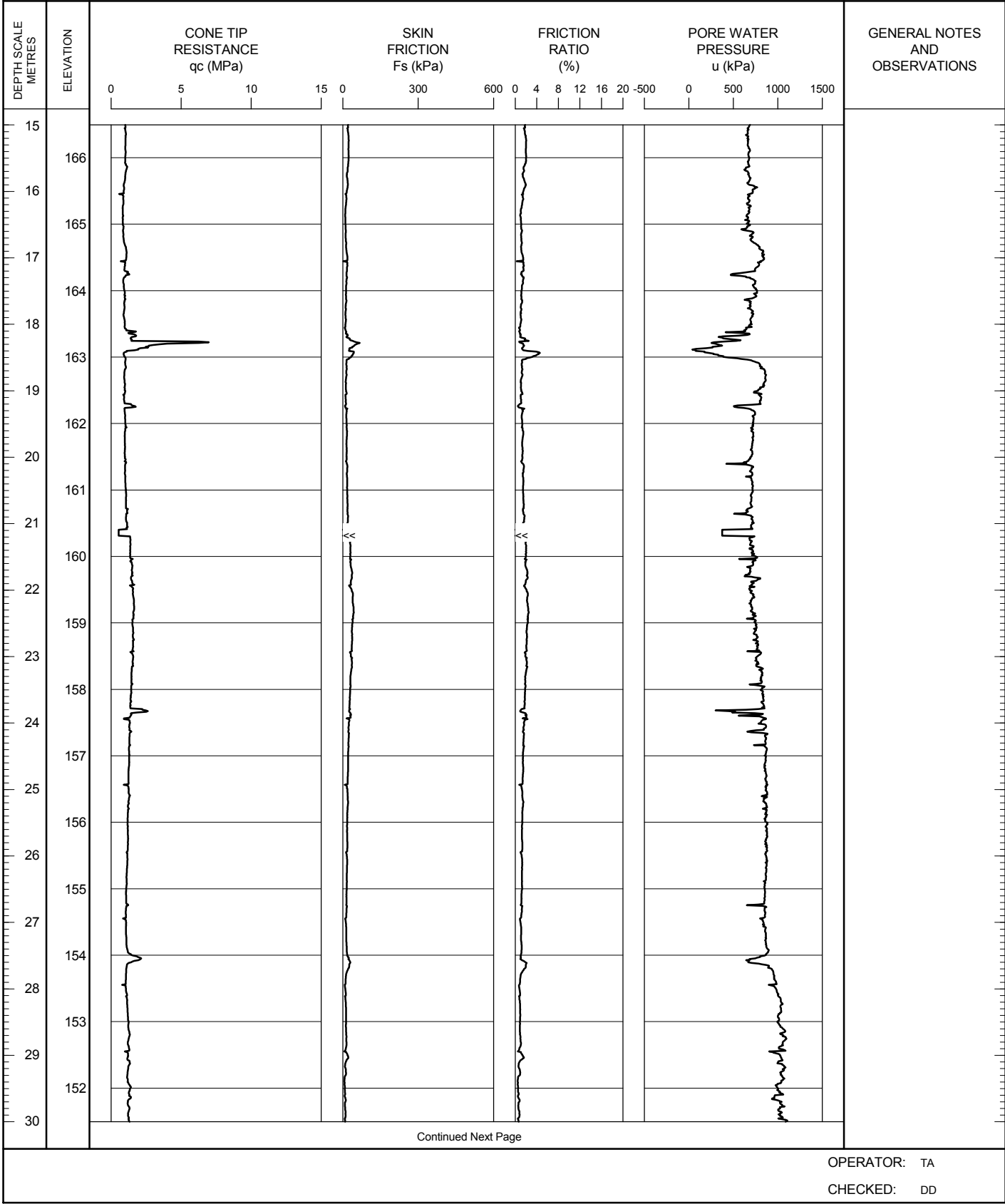
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681954.3; E330300.3

TEST DATE 6/8/2011 - 6/8/2011

SHEET 2 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 181.5 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



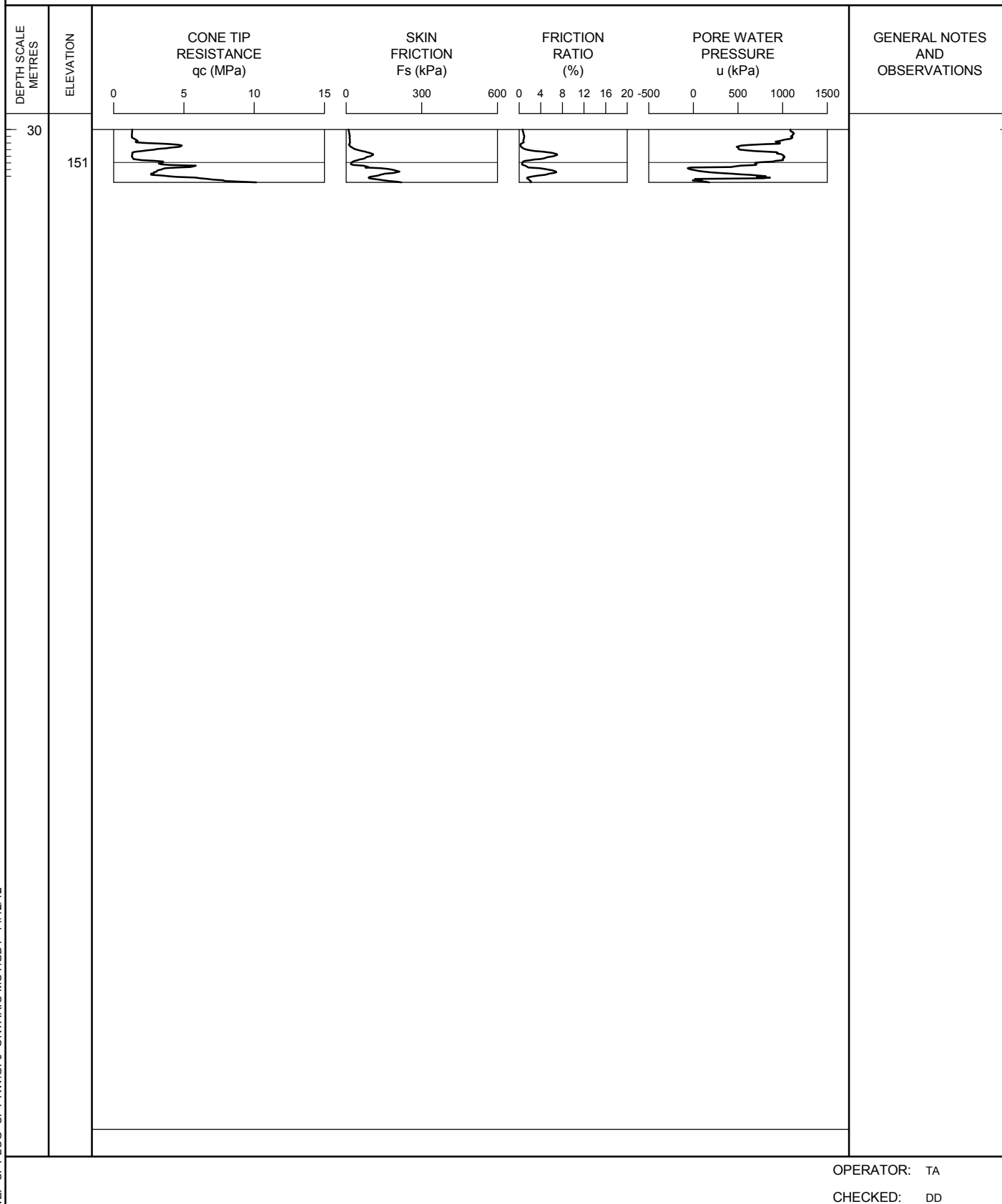
WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

METRIC

SHEET 3 OF 3

DATUM Geodetic

GROUND SURFACE ELEVATION: 181.5 PREDRILL DEPTH: 1.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 16-RW

METRIC

PROJECT Windsor-Essex Parkway

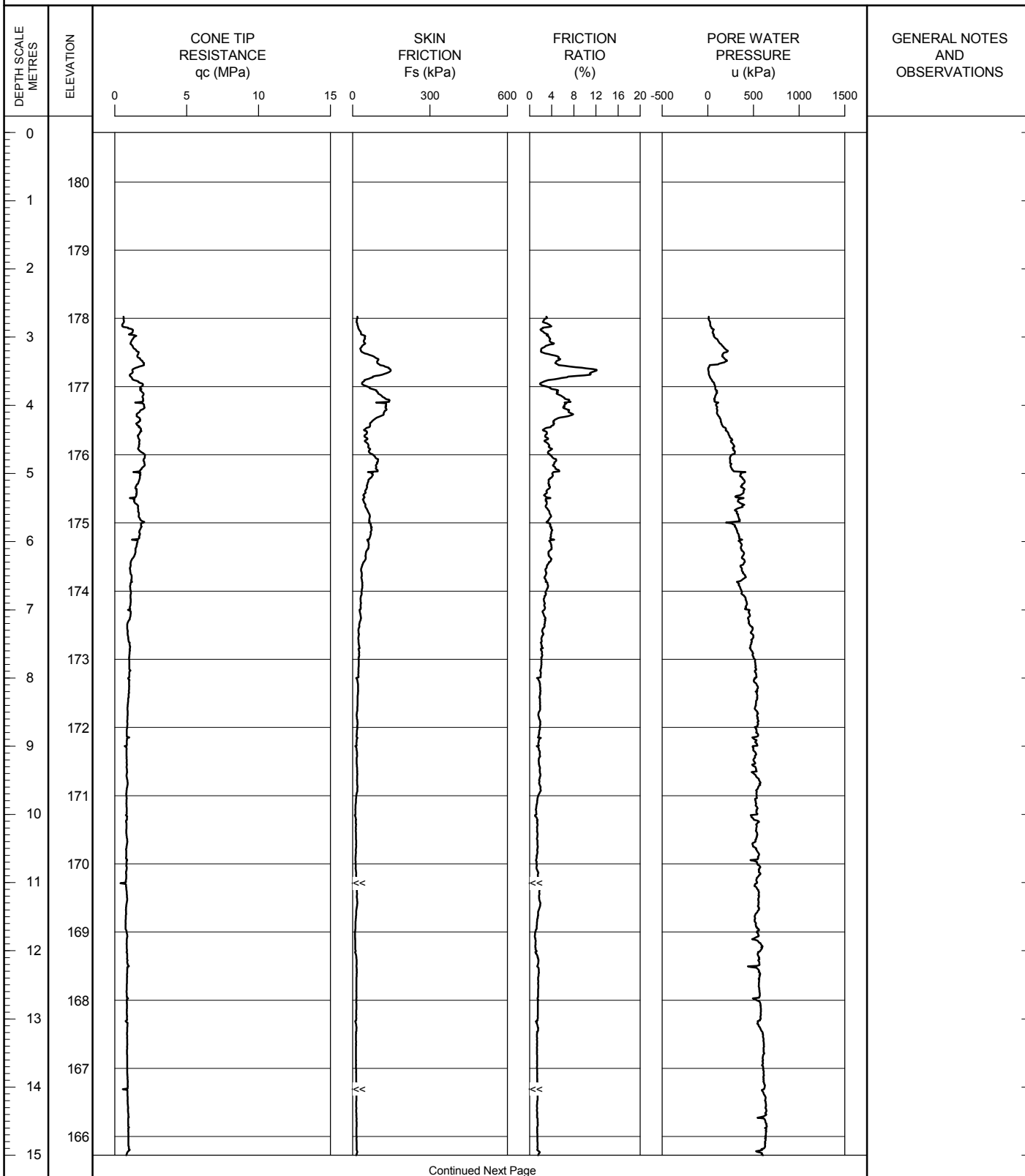
TEST DATE 6/17/2011 - 6/17/2011

SHEET 1 OF 3

LOCATION N4681826.0; E330473.6

DATUM Geodetic

GROUND SURFACE ELEVATION: 180.7 PREDRILL DEPTH: 2.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 16-RW

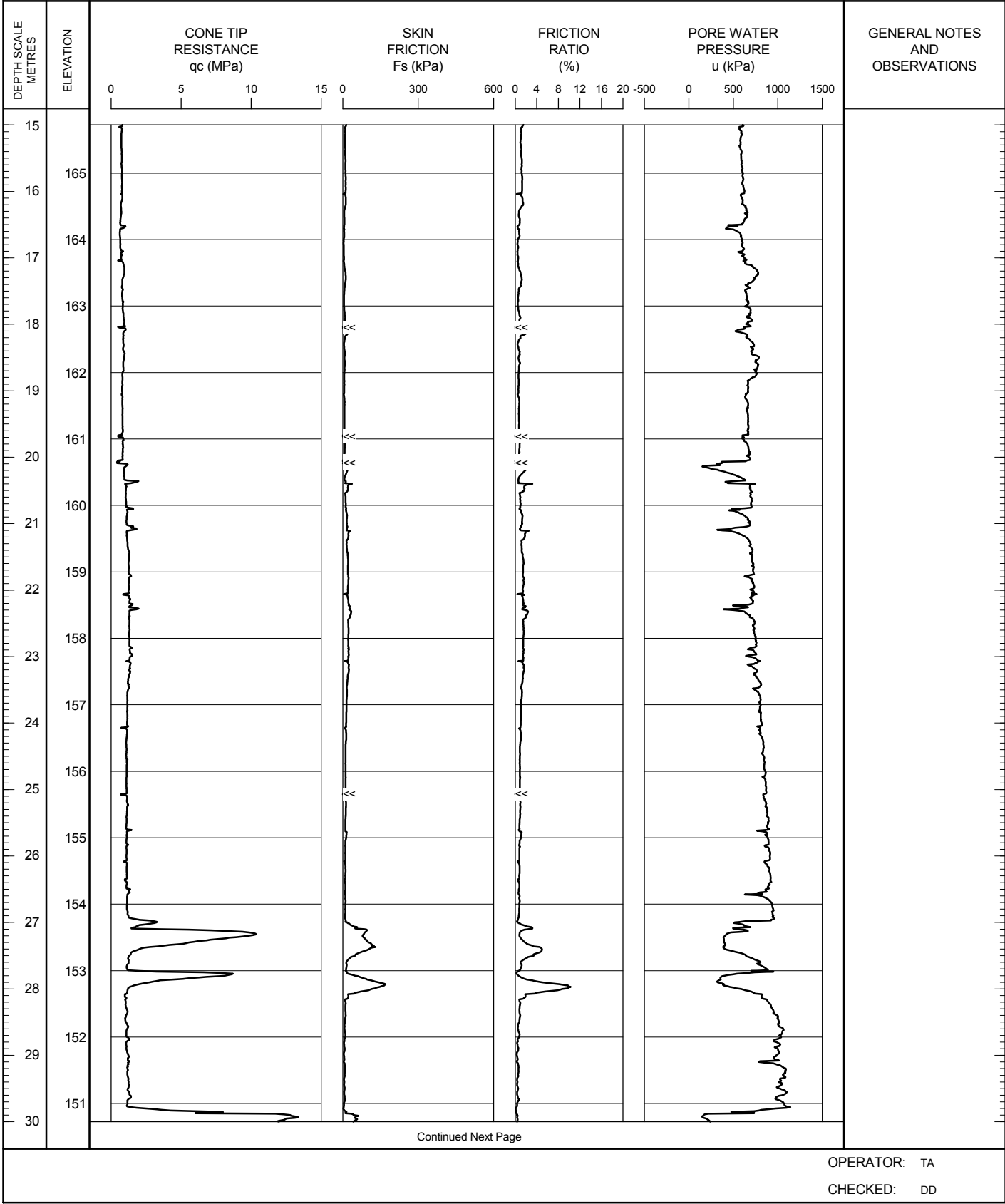
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681826.0; E330473.6

TEST DATE 6/17/2011 - 6/17/2011

SHEET 2 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.7 PREDRILL DEPTH: 2.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 16-RW

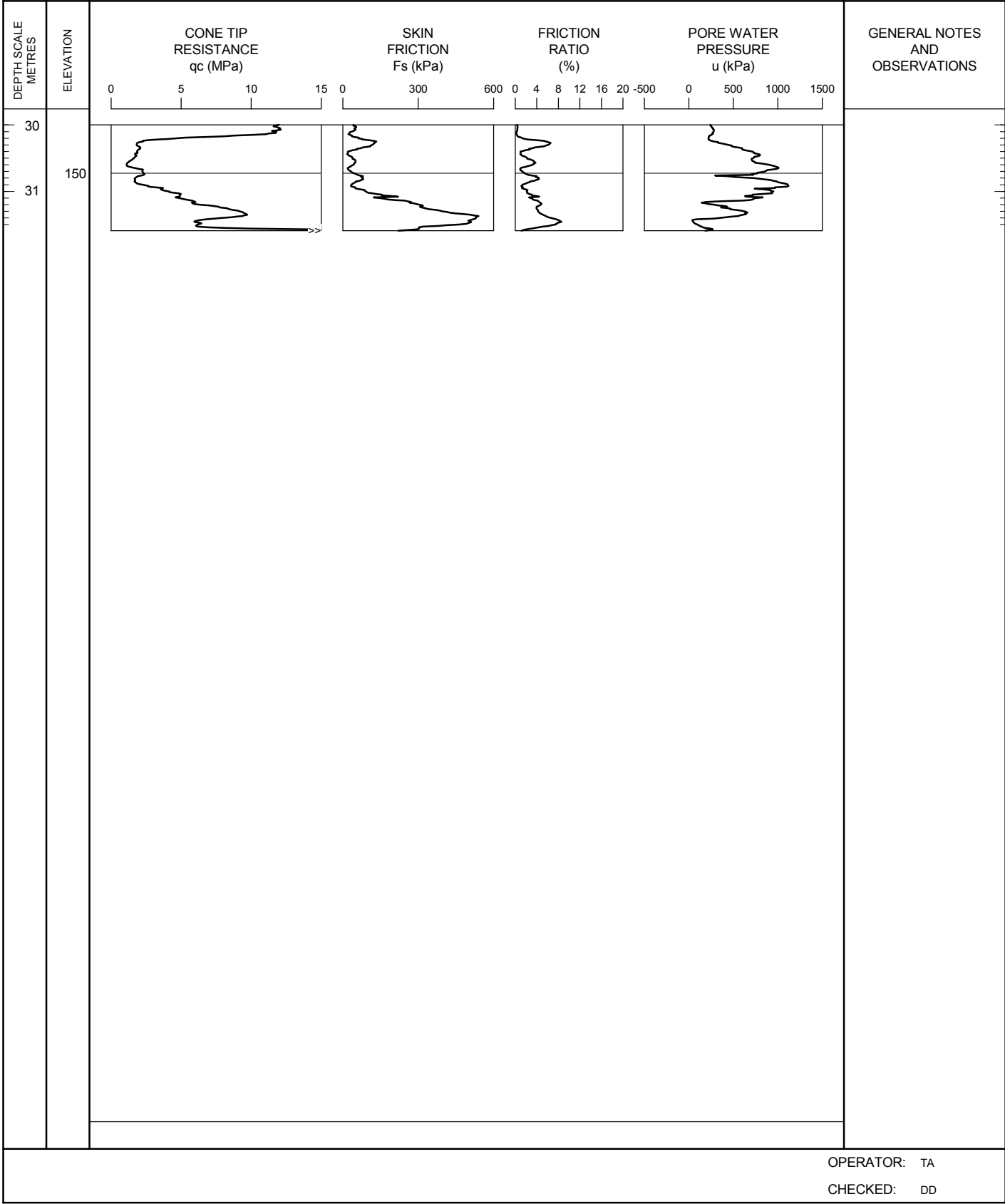
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681826.0; E330473.6

TEST DATE 6/17/2011 - 6/17/2011

SHEET 3 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.7 PREDRILL DEPTH: 2.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT 17-RW

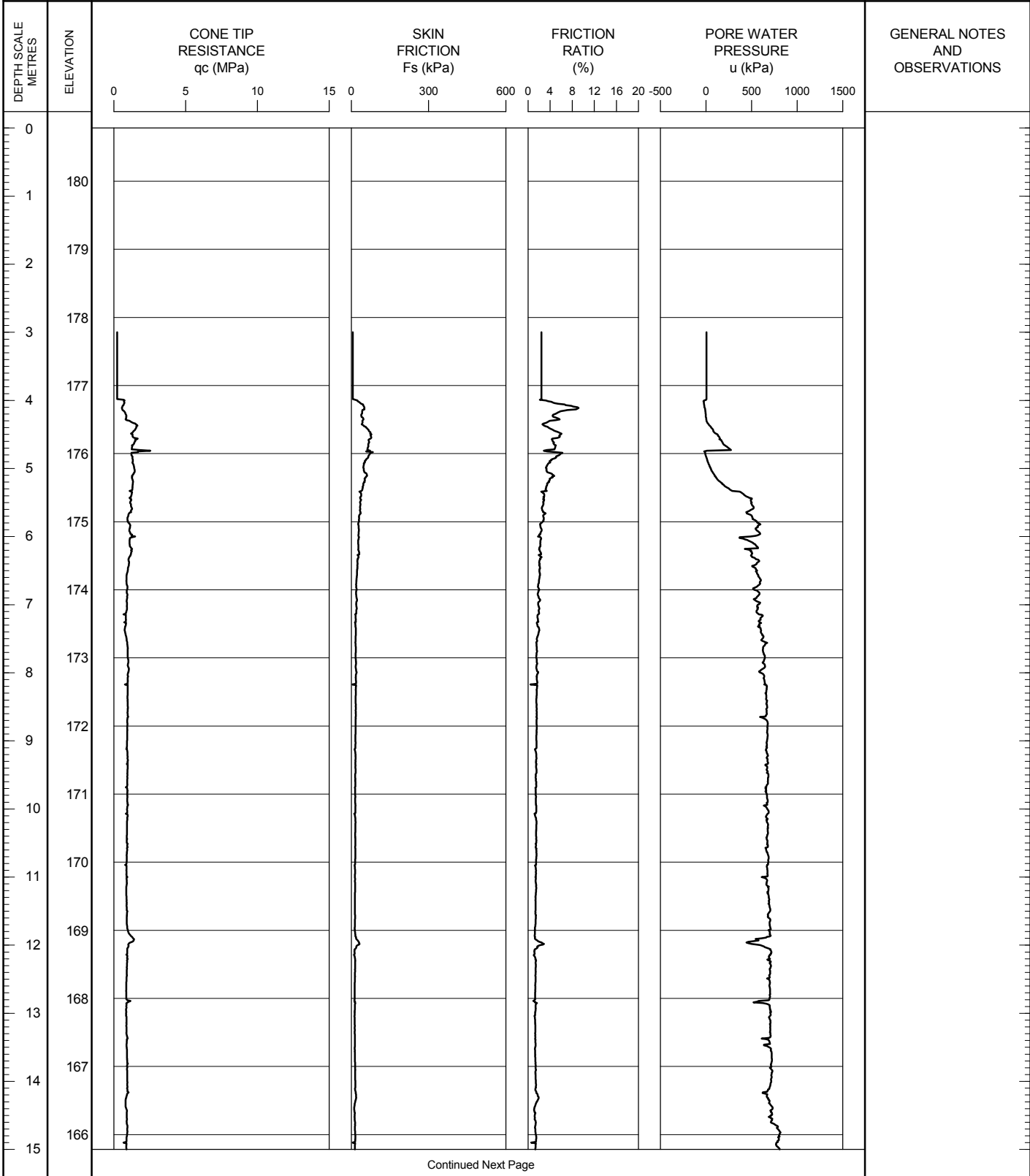
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681749; E330896.1

TEST DATE 6/16/2011 - 6/16/2011

SHEET 1 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.8 PREDRILL DEPTH: 3 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEP CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 17-RW

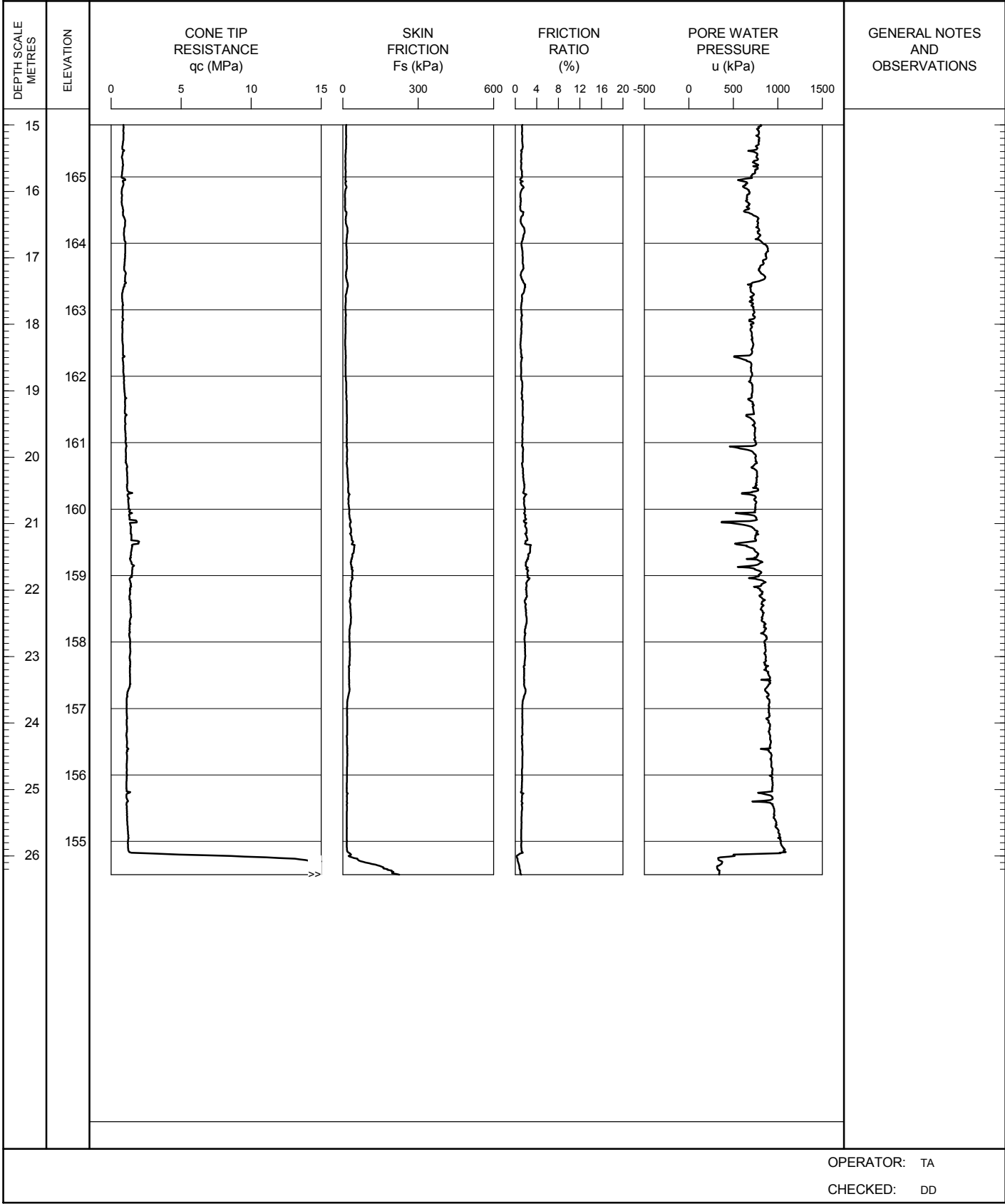
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681749; E330896.1

TEST DATE 6/16/2011 - 6/16/2011

SHEET 2 OF 2
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.8 PREDRILL DEPTH: 3 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT 18-RW

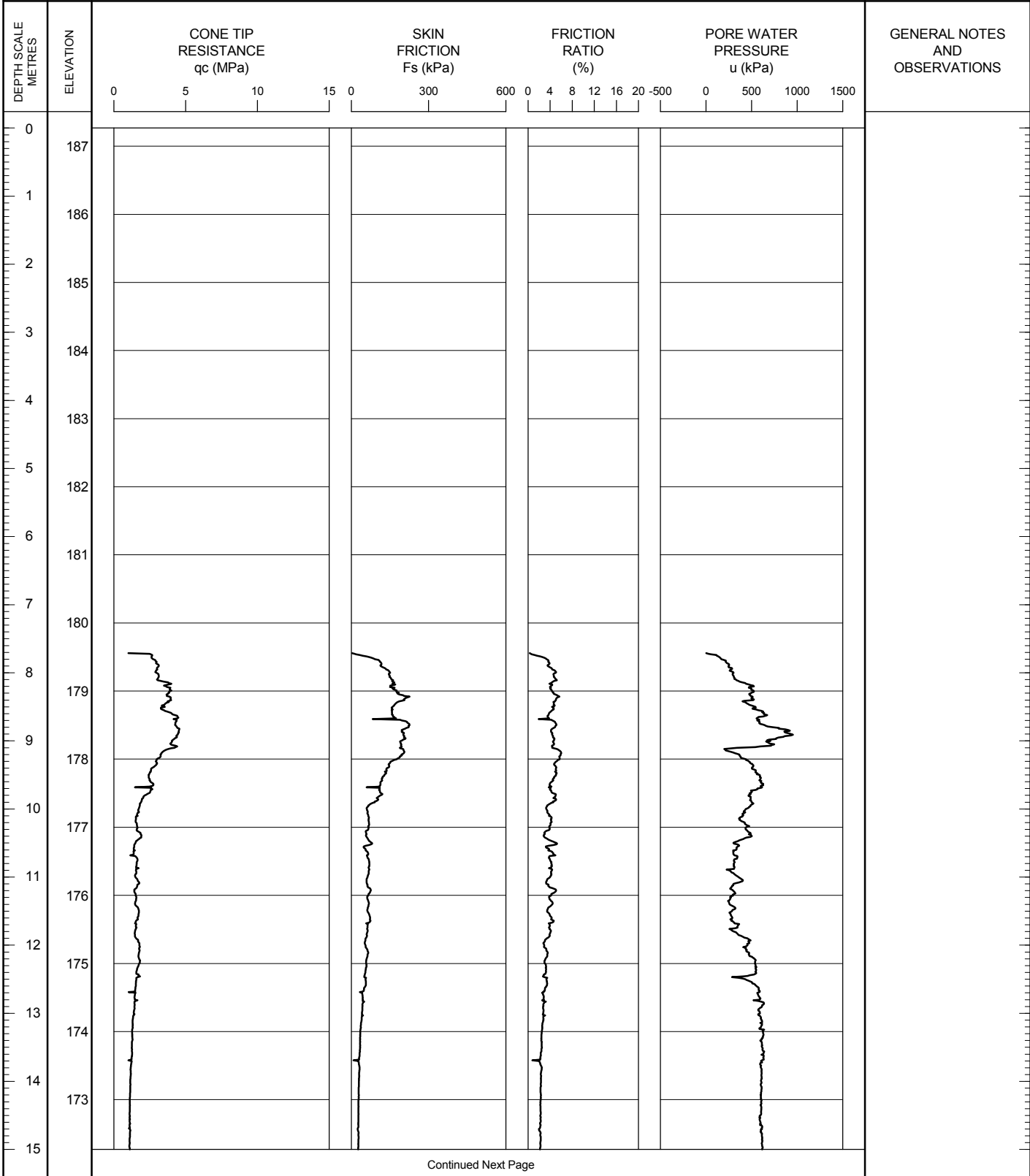
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681851.3; E330994.5

TEST DATE 6/21/2011 - 6/21/2011

SHEET 1 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 187.3 PREDRILL DEPTH: 7.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEP CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 18-RW

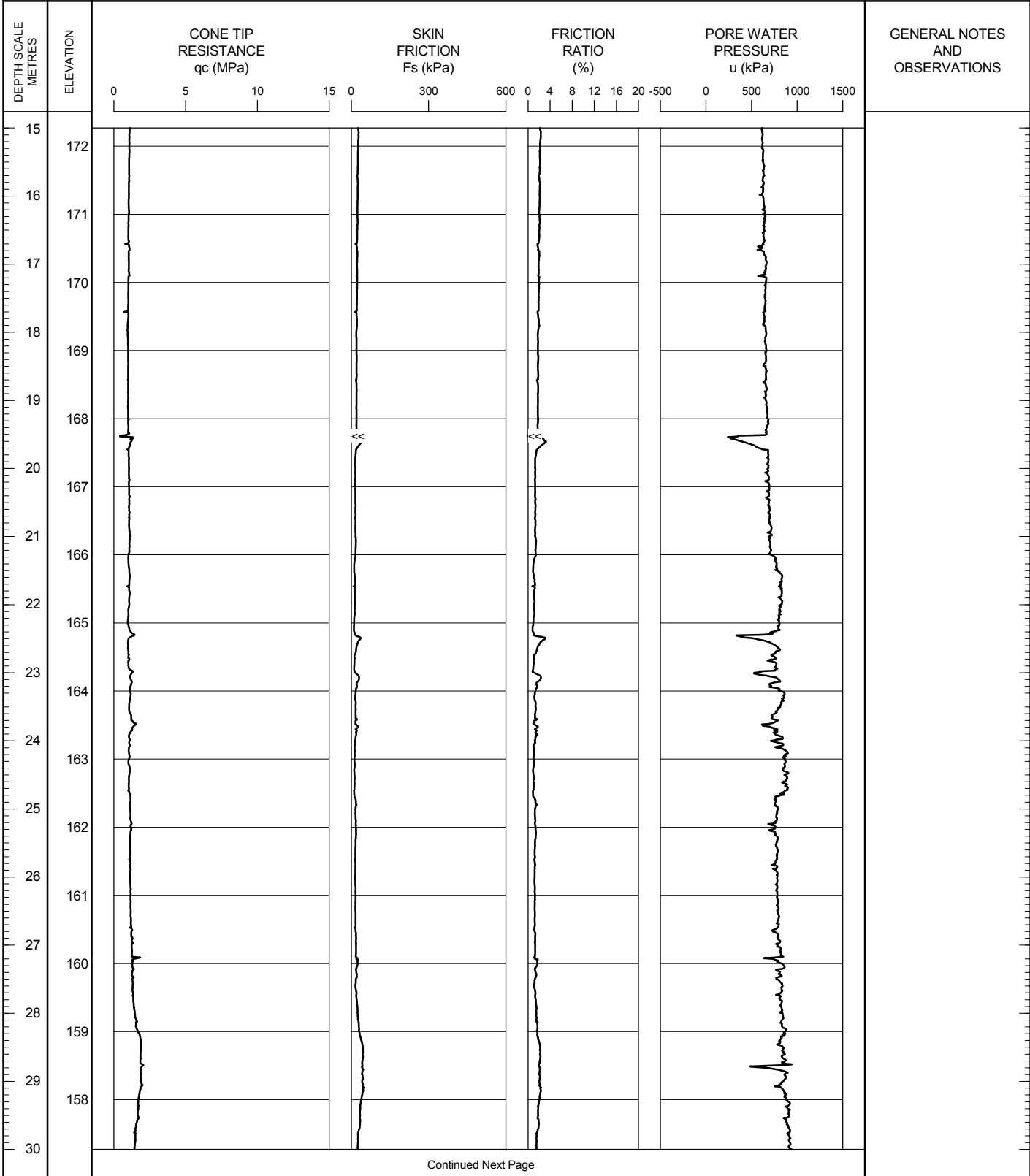
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681851.3; E330994.5

TEST DATE 6/21/2011 - 6/21/2011

SHEET 2 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 187.3 PREDRILL DEPTH: 7.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



Continued Next Page

OPERATOR: TA
CHECKED: DD

WEF CPT LOG CPT-RW/GPJ ONTARIO MOT.GDT 14/12/12

RECORD OF CONE PENETRATION TEST CPT 18-RW

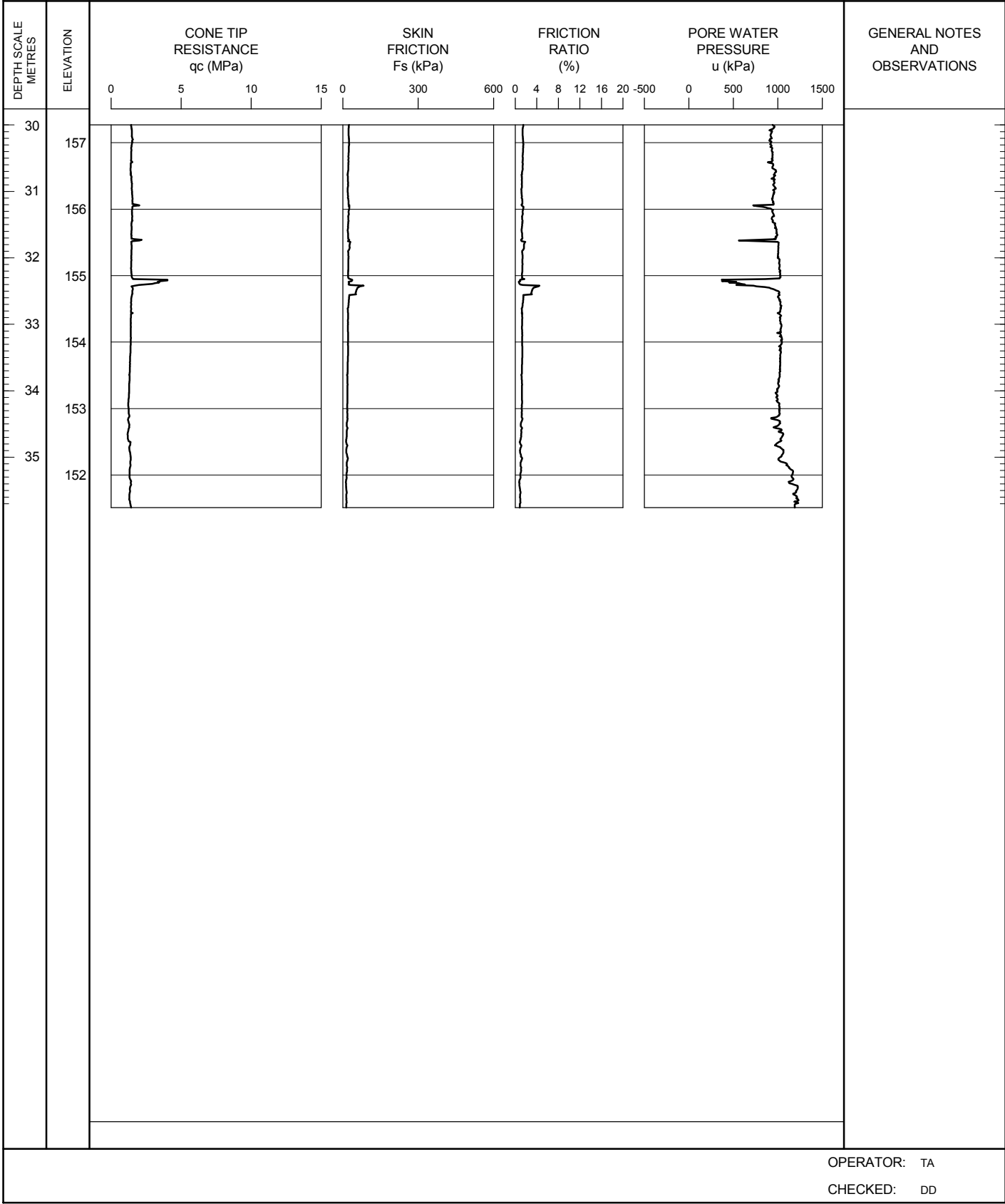
METRIC

PROJECT Windsor-Essex Parkway
LOCATION N4681851.3; E330994.5

TEST DATE 6/21/2011 - 6/21/2011

SHEET 3 OF 3
DATUM Geodetic

GROUND SURFACE ELEVATION: 187.3 PREDRILL DEPTH: 7.7 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA
CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B2-1

METRIC

PROJECT Windsor-Essex Parkway

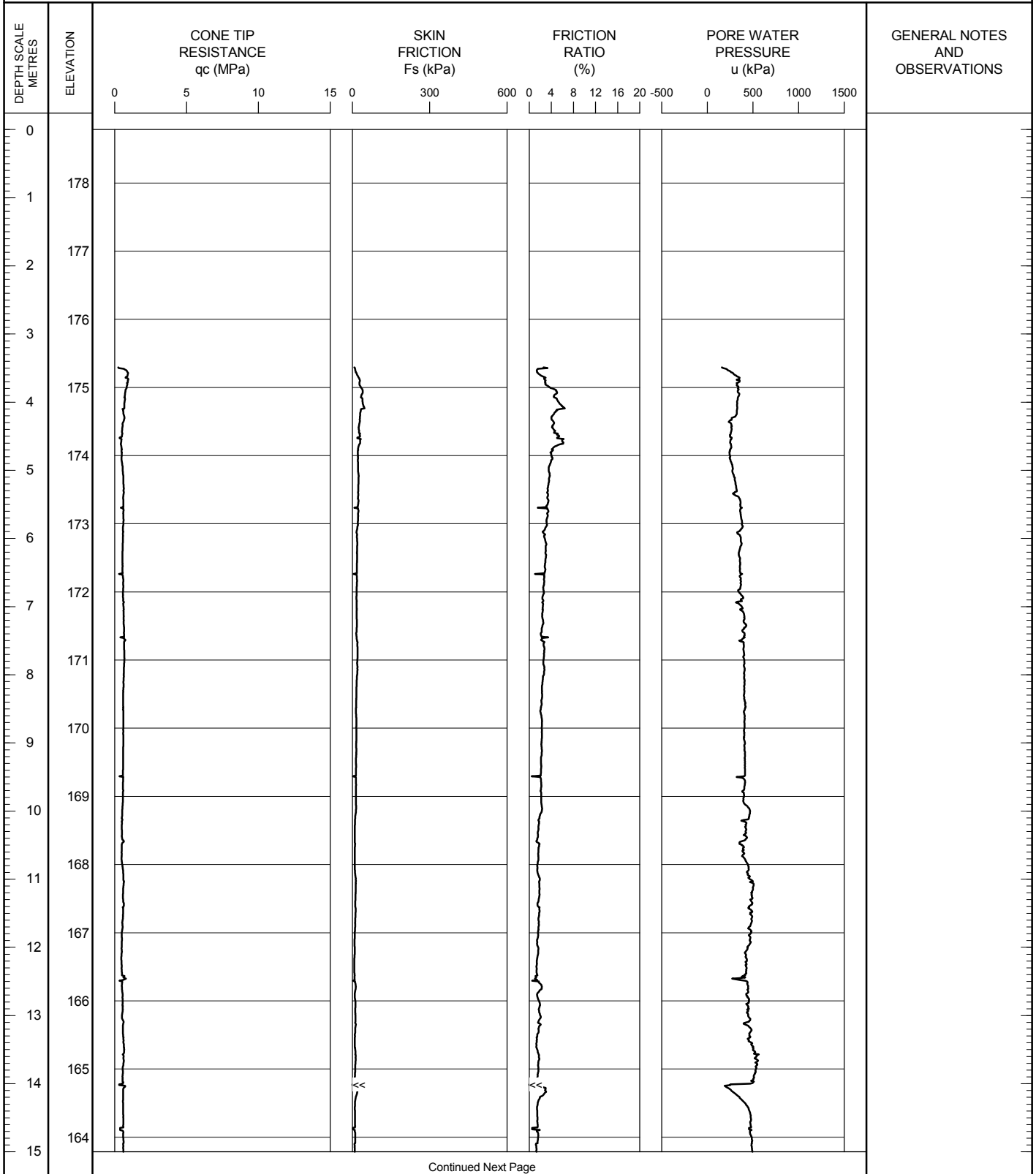
TEST DATE 5/9/2011 - 5/9/2011

SHEET 1 OF 2

LOCATION N4682211.4; E329077.4

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.8 PREDRILL DEPTH: 3.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B2-1

METRIC

PROJECT Windsor-Essex Parkway

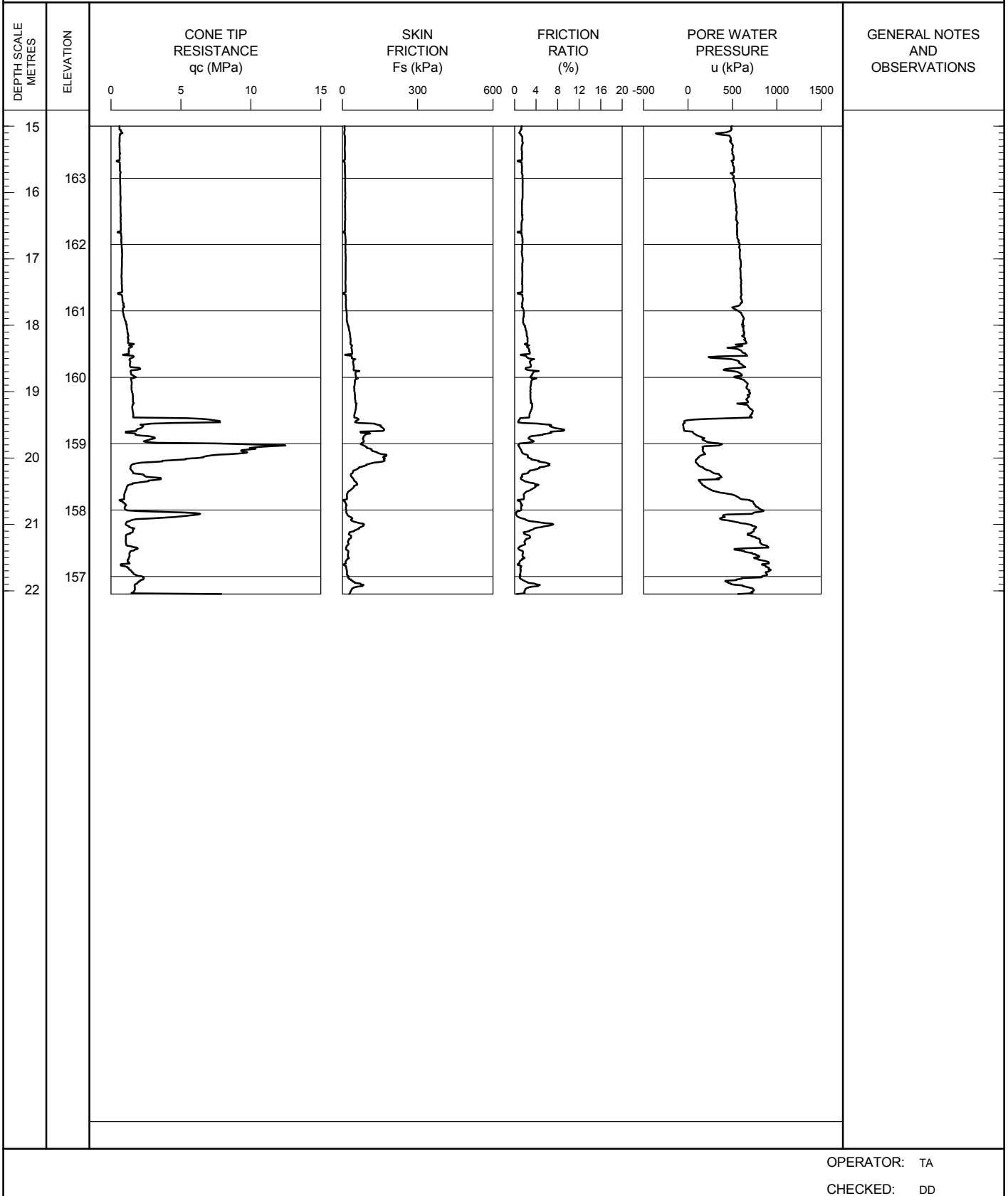
TEST DATE 5/9/2011 - 5/9/2011

SHEET 2 OF 2

LOCATION N4682211.4; E329077.4

DATUM Geodetic

GROUND SURFACE ELEVATION: 178.8 PREDRILL DEPTH: 3.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT B3-1

METRIC

PROJECT Windsor-Essex Parkway

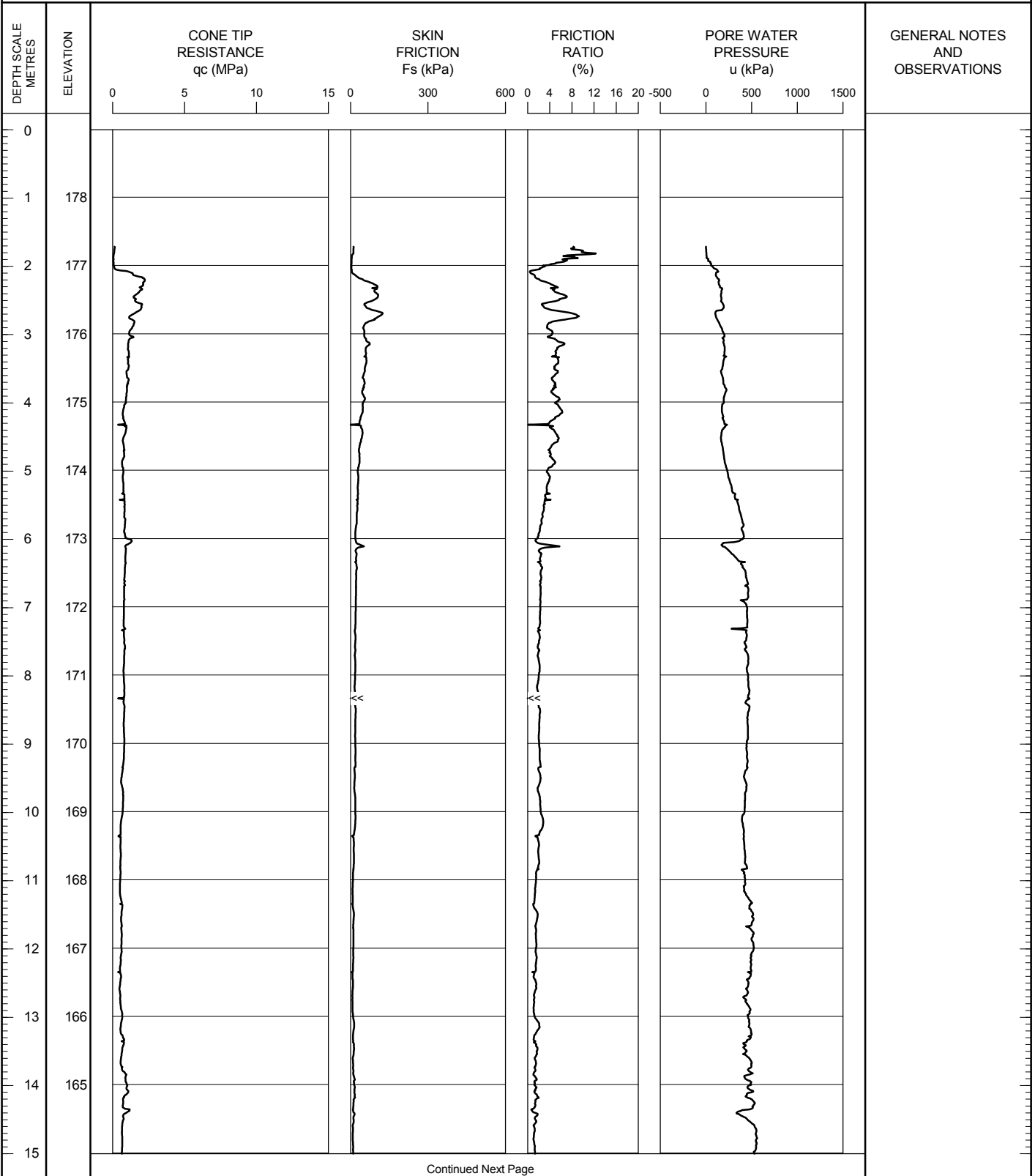
TEST DATE 6/10/2011 - 6/10/2011

SHEET 1 OF 2

LOCATION N4682270.6; E329419.6

DATUM Geodetic

GROUND SURFACE ELEVATION: 179.0 PREDRILL DEPTH: 1.6 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B3-1

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/10/2011 - 6/10/2011

SHEET 2 OF 2

LOCATION N4682270.6; E329419.6

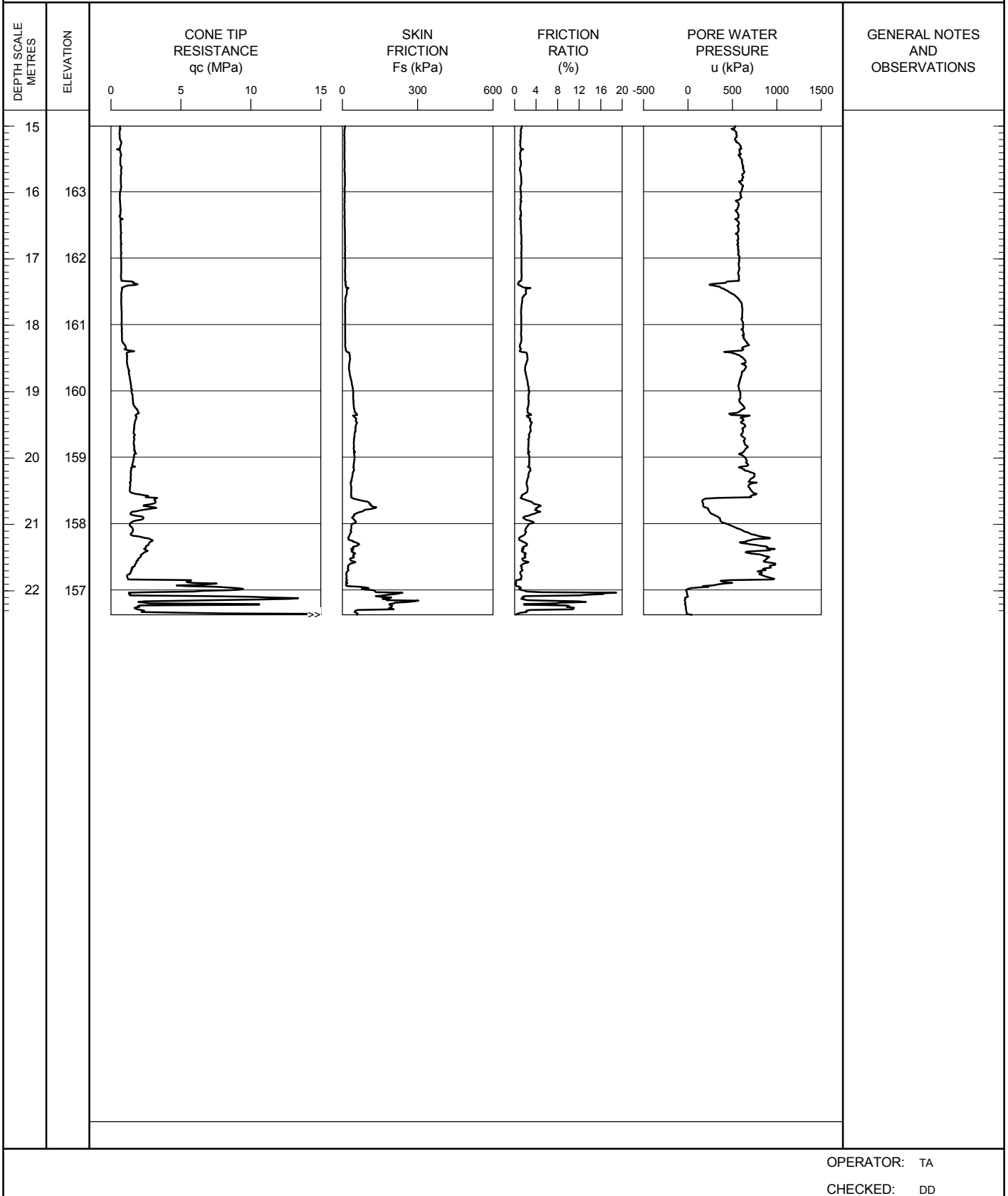
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.0

PREDRILL DEPTH: 1.6

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



RECORD OF CONE PENETRATION TEST CPT B3-2

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/20/2011 - 6/20/2011

SHEET 1 OF 2

LOCATION N4682176.2; E329573

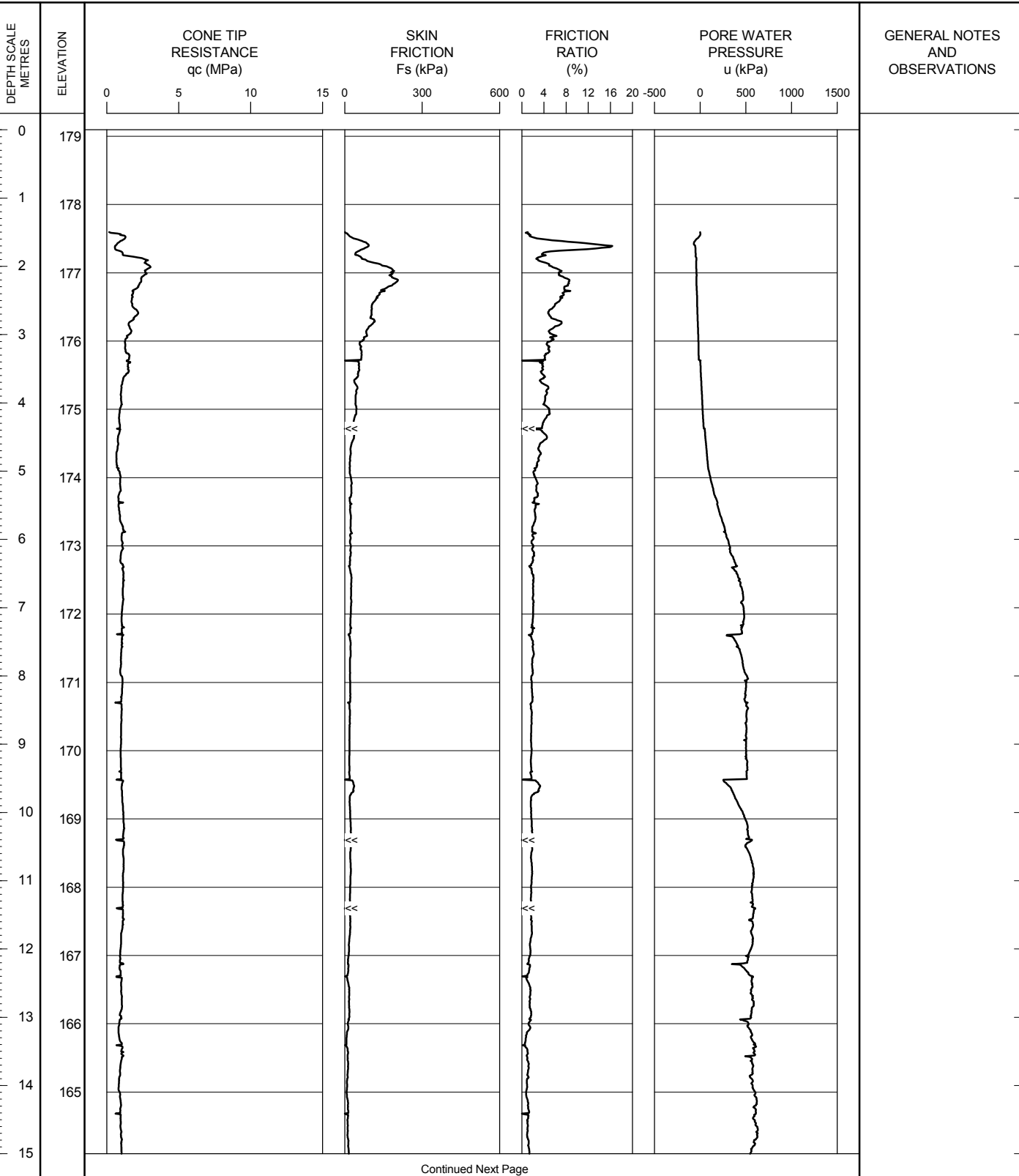
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1

PREDRILL DEPTH: 1.5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B3-2

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/20/2011 - 6/20/2011

SHEET 2 OF 2

LOCATION N4682176.2; E329573

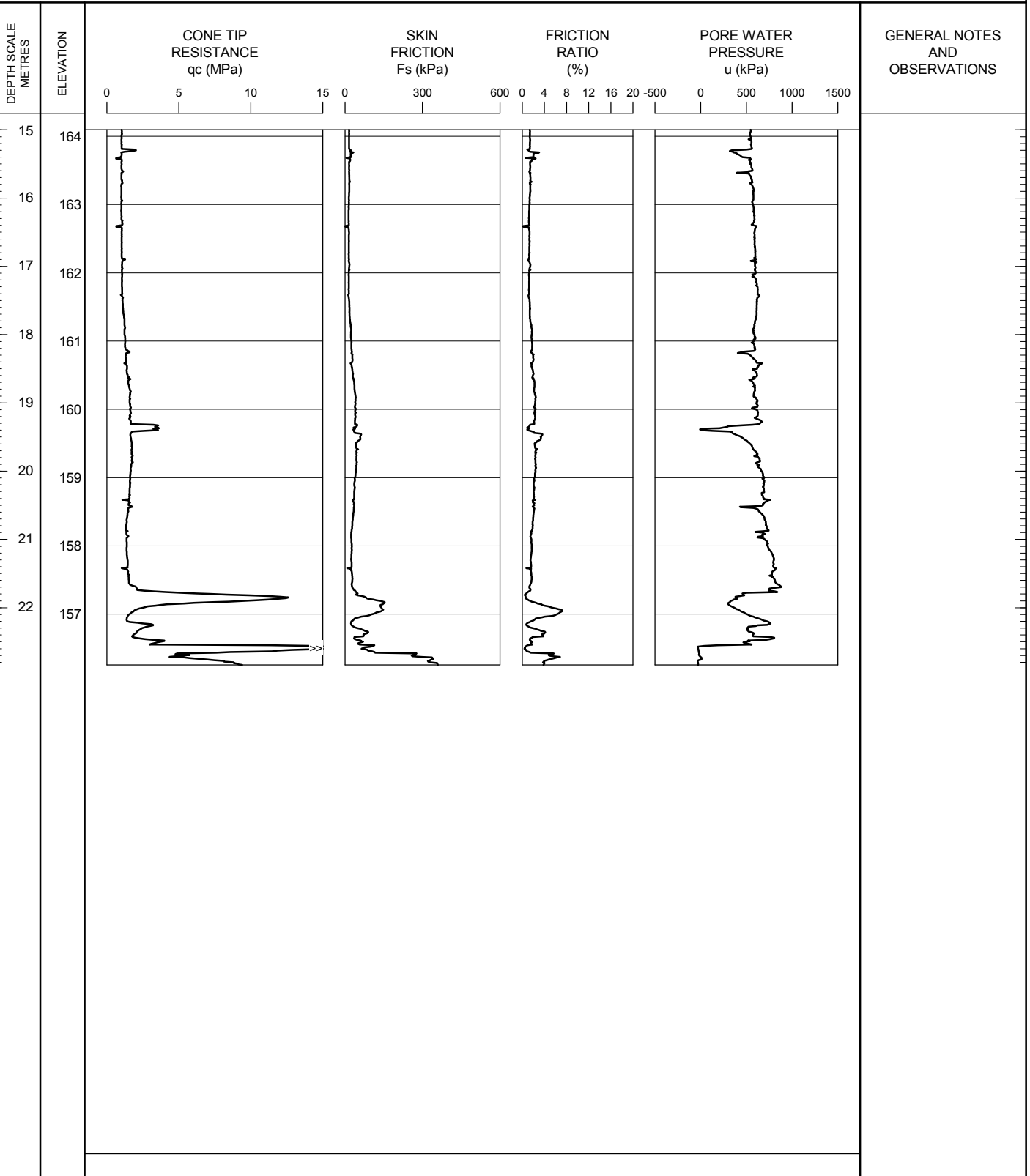
DATUM Geodetic

GROUND SURFACE ELEVATION: 179.1

PREDRILL DEPTH: 1.5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B6-1

METRIC

PROJECT Windsor-Essex Parkway

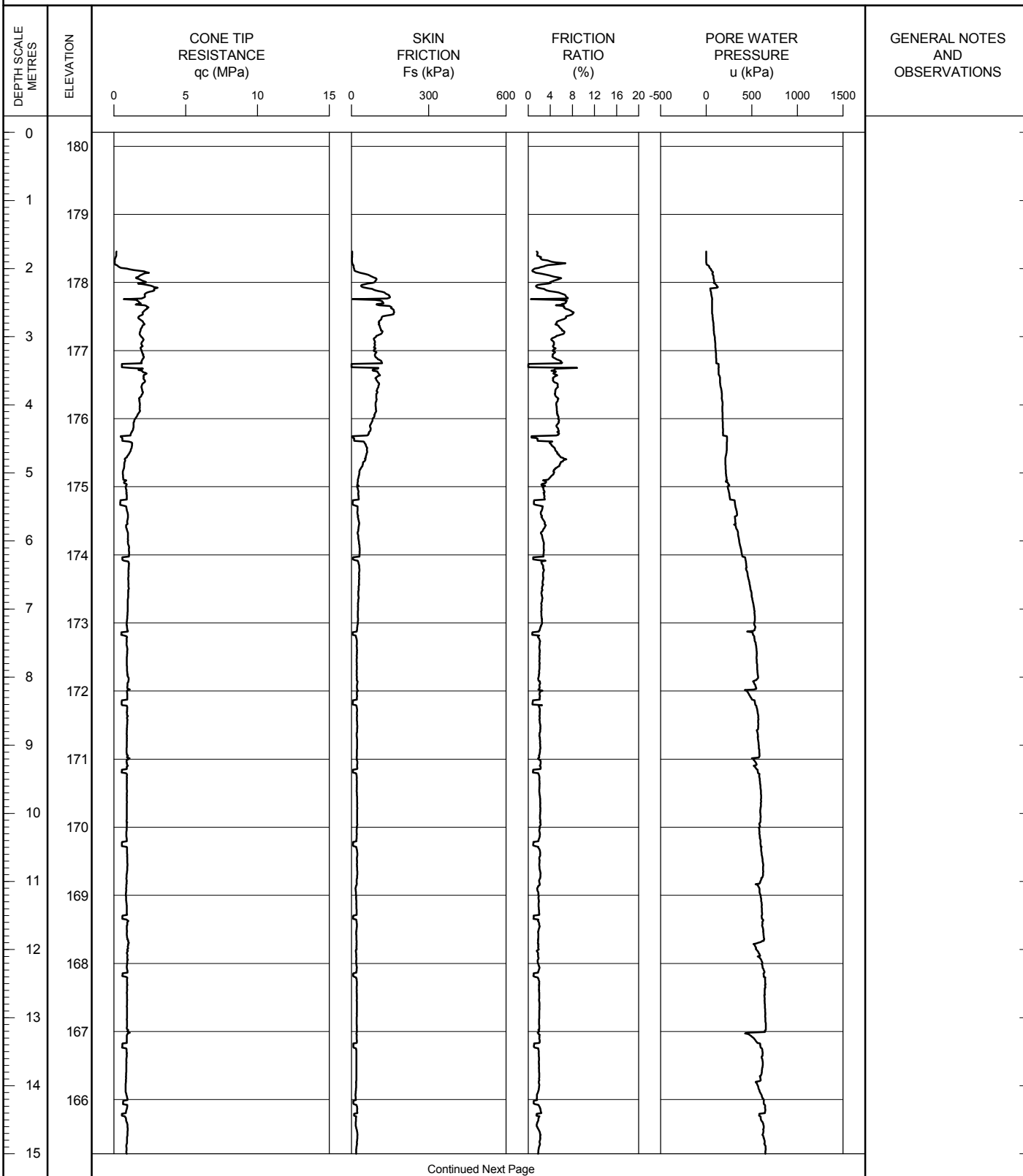
TEST DATE 6/10/2011 - 6/10/2011

SHEET 1 OF 2

LOCATION N4681799.7; E330633.6

DATUM Geodetic

GROUND SURFACE ELEVATION: 180.2 PREDRILL DEPTH: 1.8 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG BRIDGE CPTS.GPJ ONTARIO MOT GDT 14/12/12

OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B6-1

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/10/2011 - 6/10/2011

SHEET 2 OF 2

LOCATION N4681799.7; E330633.6

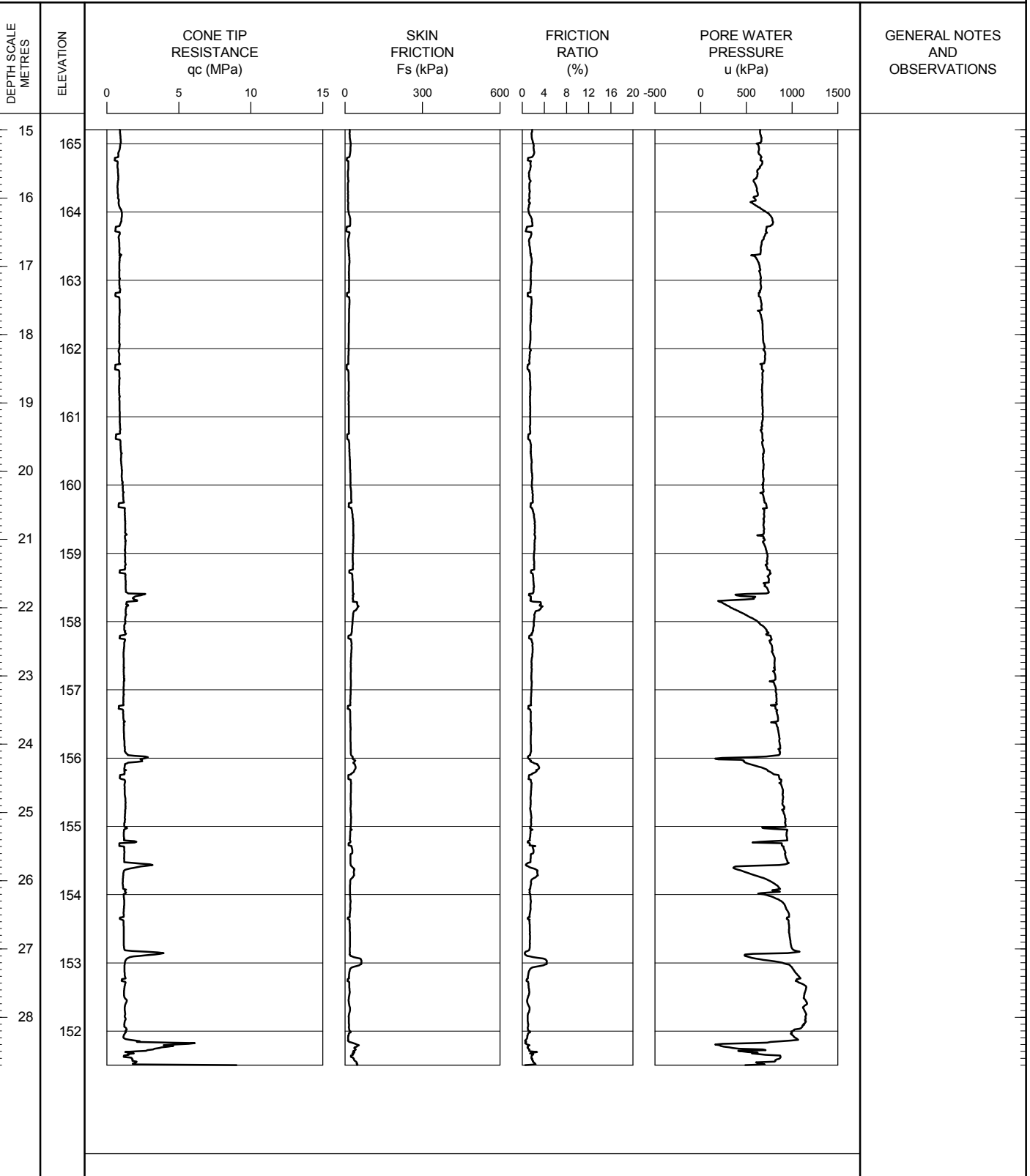
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.2

PREDRILL DEPTH: 1.8

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B6-2

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/20/2011 - 6/20/2011

SHEET 1 OF 3

LOCATION N4681787.4; E330826.2

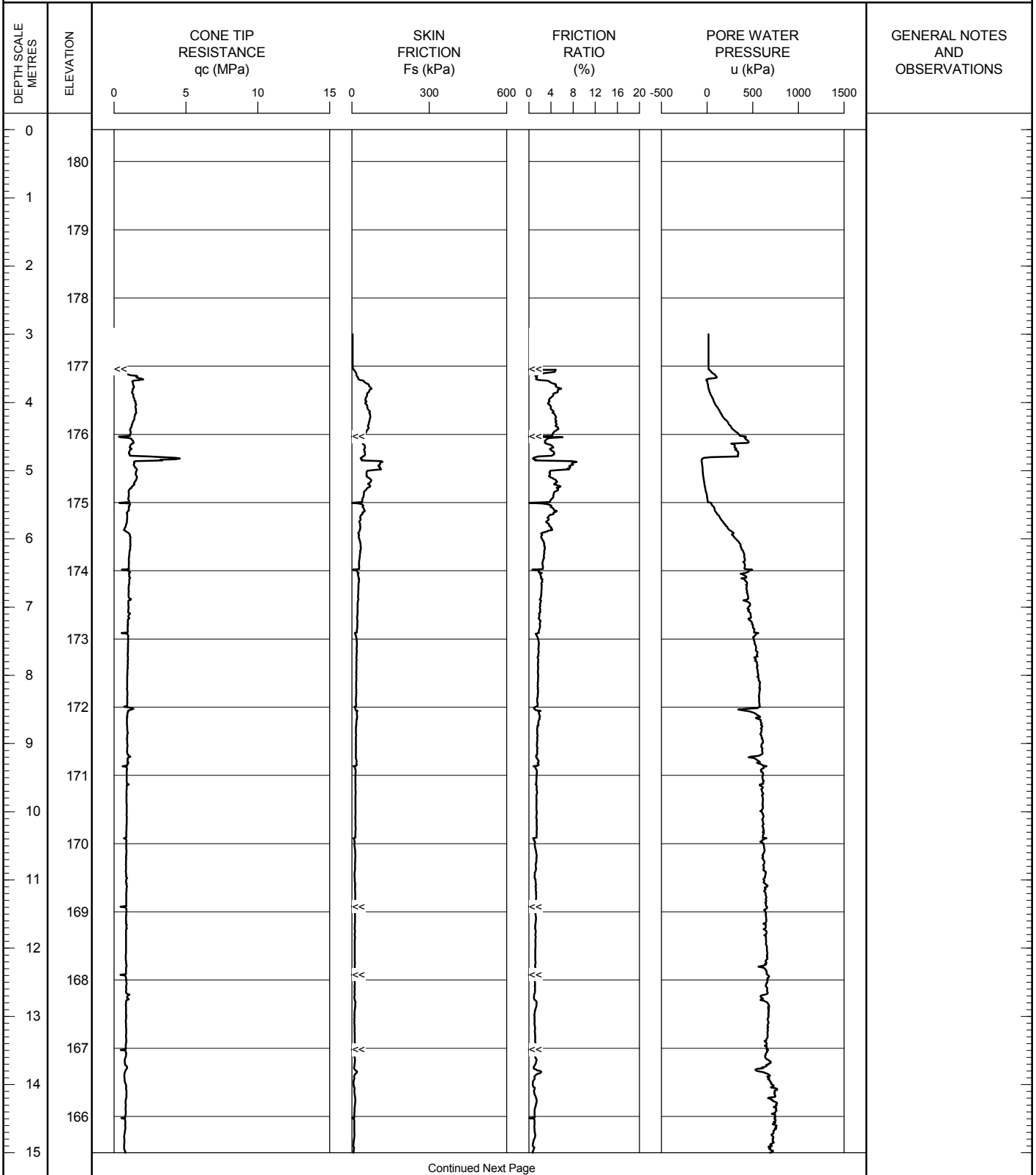
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5

PREDRILL DEPTH: 3.5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

RECORD OF CONE PENETRATION TEST CPT B6-2

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 6/20/2011 - 6/20/2011

SHEET 2 OF 3

LOCATION N4681787.4; E330826.2

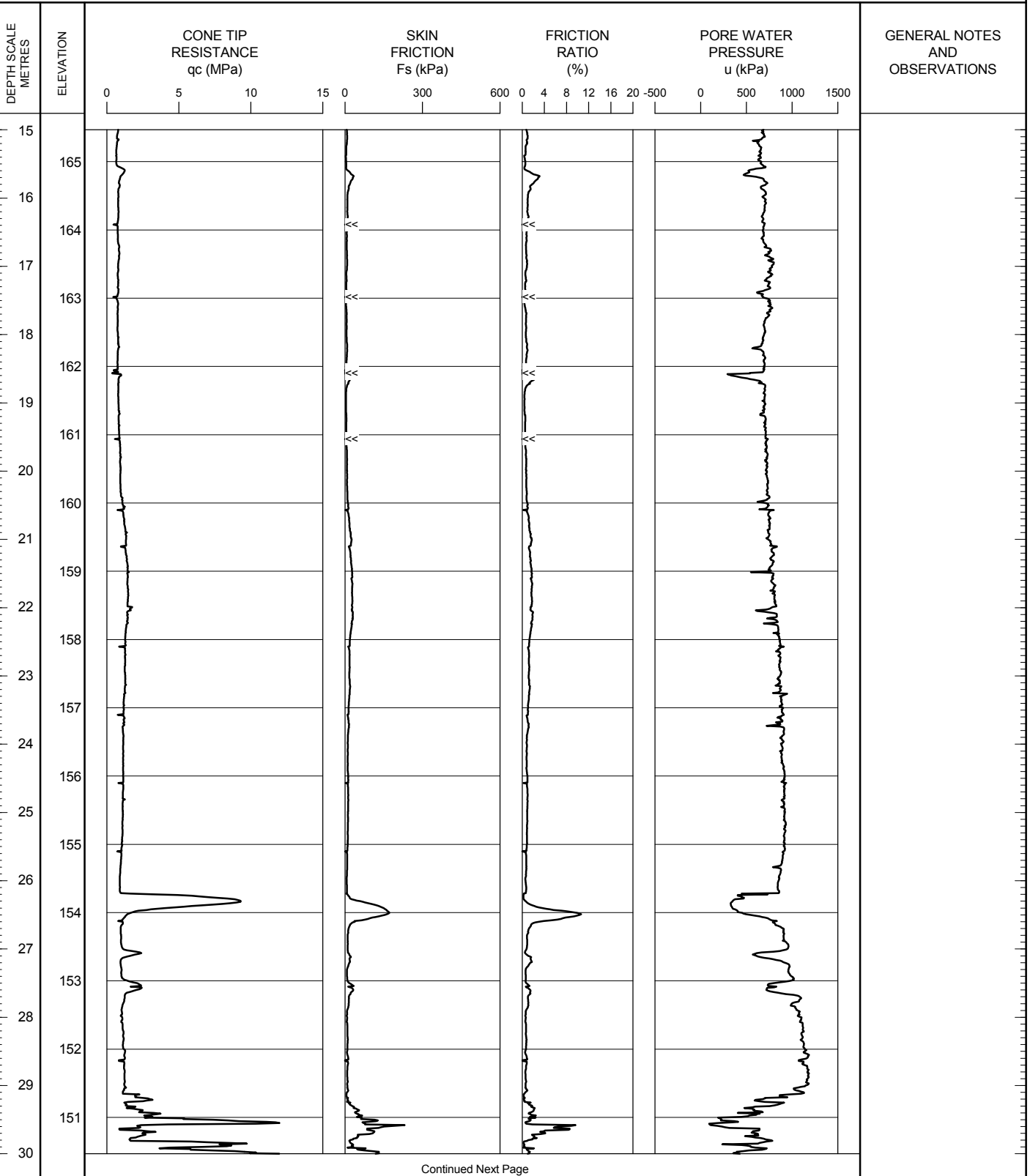
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5

PREDRILL DEPTH: 3.5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

METRIC

SHEET 3 OF 3

DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5 PREDRILL DEPTH: 3.5 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0

RECORD OF NILCON VANE TEST NIL 02-RW

Project : Windsor-Essex Parkway

Test Date: 6/6/2011

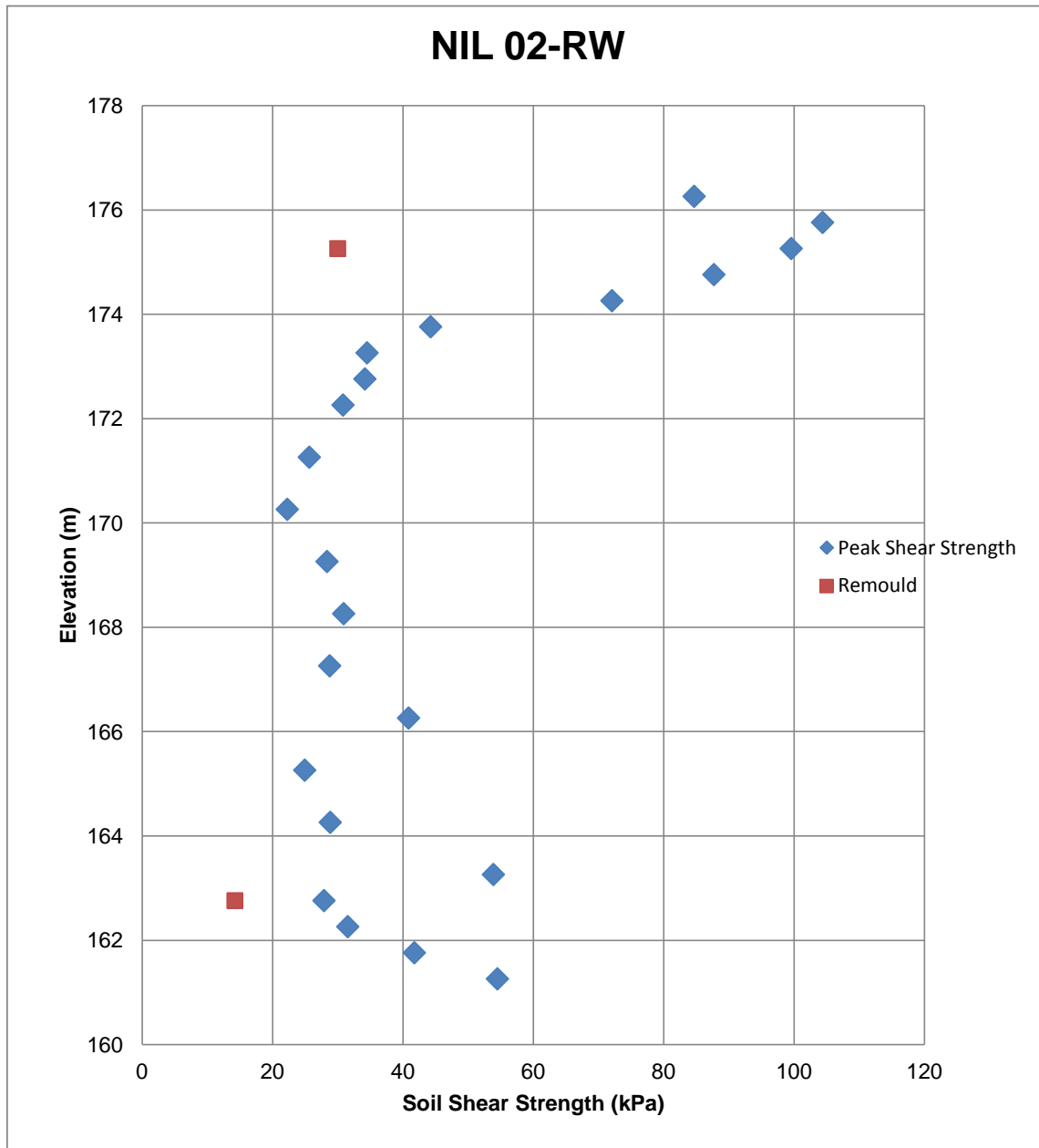
Sheet 1 of 1

Location: N4682137.1; E328620.8

Predrill Depth : 1.5 m

Datum Geodetic

Ground Surface Elevation: 179.3 m



Operator: TR

Checked: DD

RECORD OF NILCON VANE TEST NIL 03-RW

Project : Windsor-Essex Parkway

Test Date: 6/21/2011

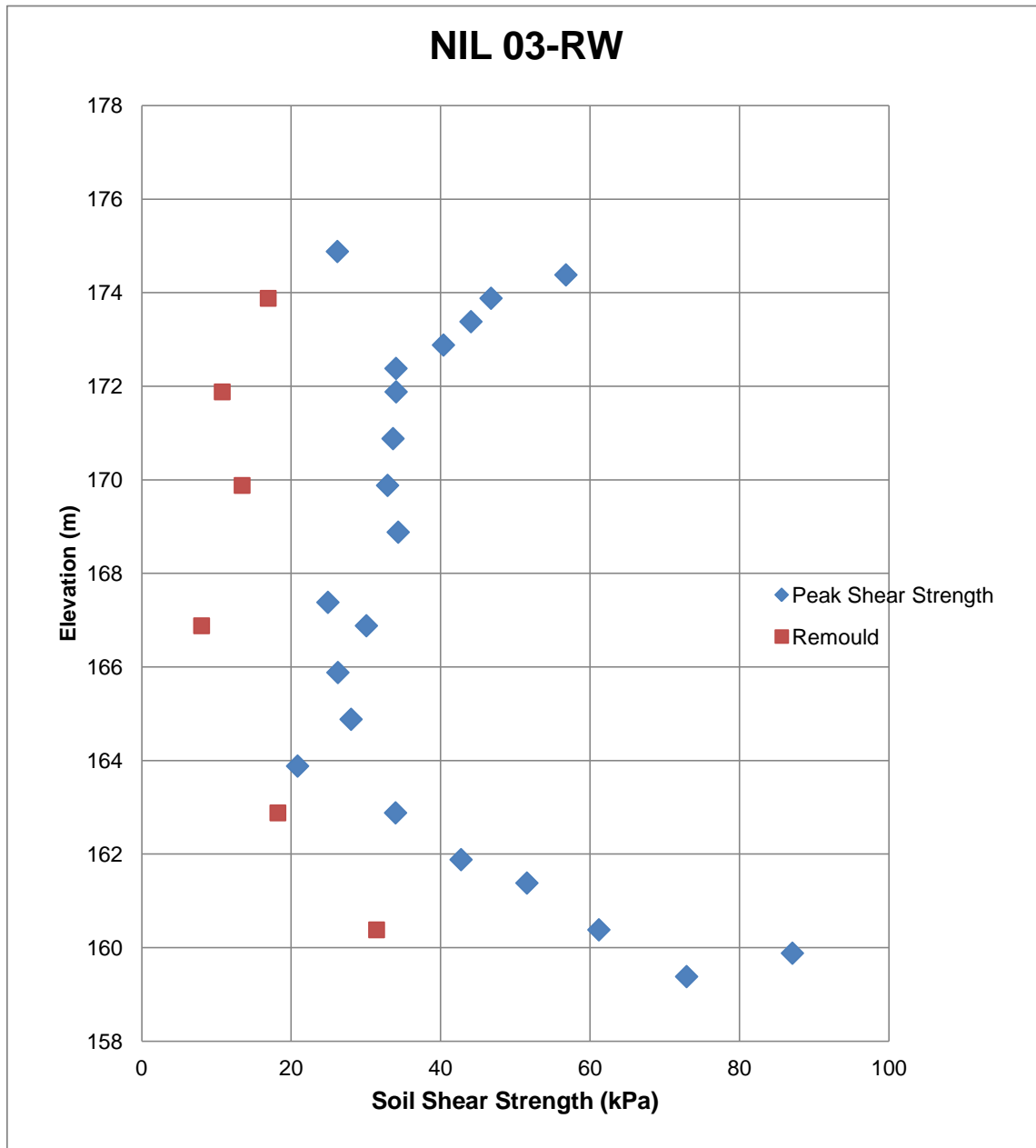
Sheet 1 of 1

Location: N4682240.3; E329078.1

Predrill Depth : 4.0 m

Datum Geodetic

Ground Surface Elevation: 178.9 m



Operator: NB

Checked: DD

RECORD OF NILCON VANE TEST NIL 04-RW

Project : Windsor-Essex Parkway

Test Date: 6/23/2011

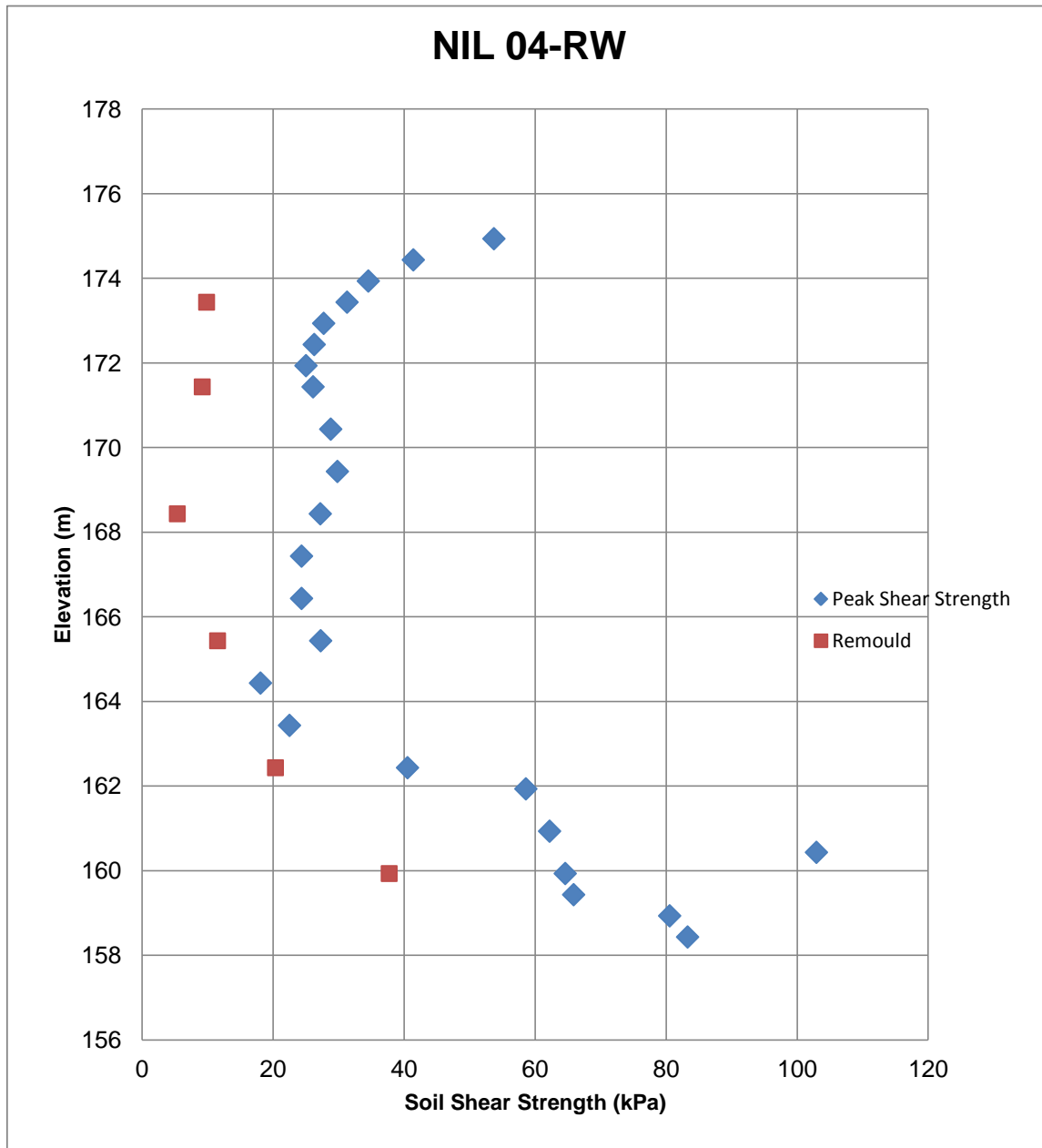
Sheet 1 of 1

Location: N4682220.0; E329128.1

Predrill Depth : 3.5 m

Datum Geodetic

Ground Surface Elevation: 178.4 m



Operator: NB

Checked: DD

RECORD OF NILCON VANE TEST NIL 05-RW

Project : Windsor-Essex Parkway

Test Date: 6/19/2011

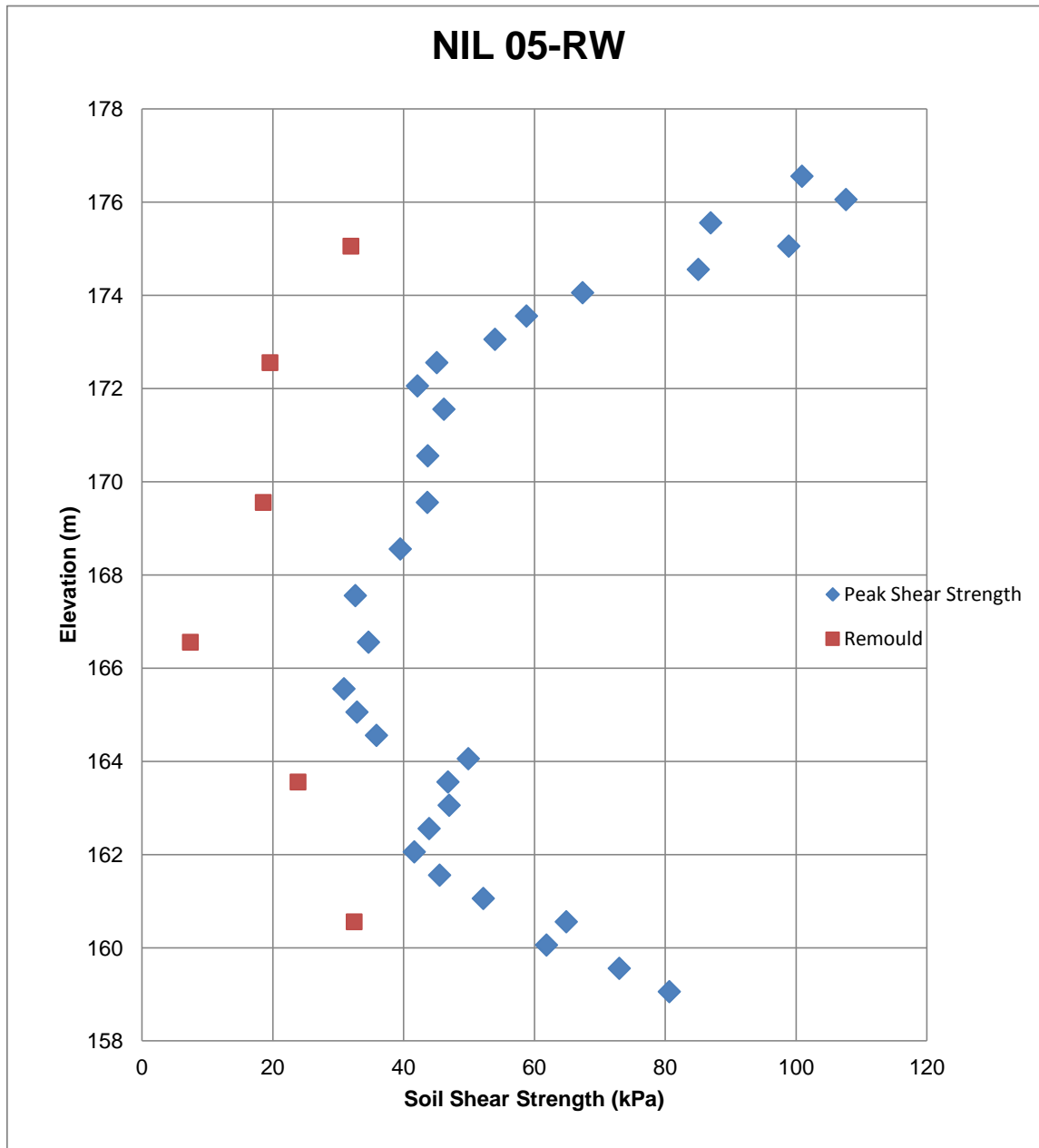
Sheet 1 of 1

Location: N4682349.2; E329307.6

Predrill Depth : 6.0 m

Datum Geodetic

Ground Surface Elevation: 182.6 m



Operator: NB

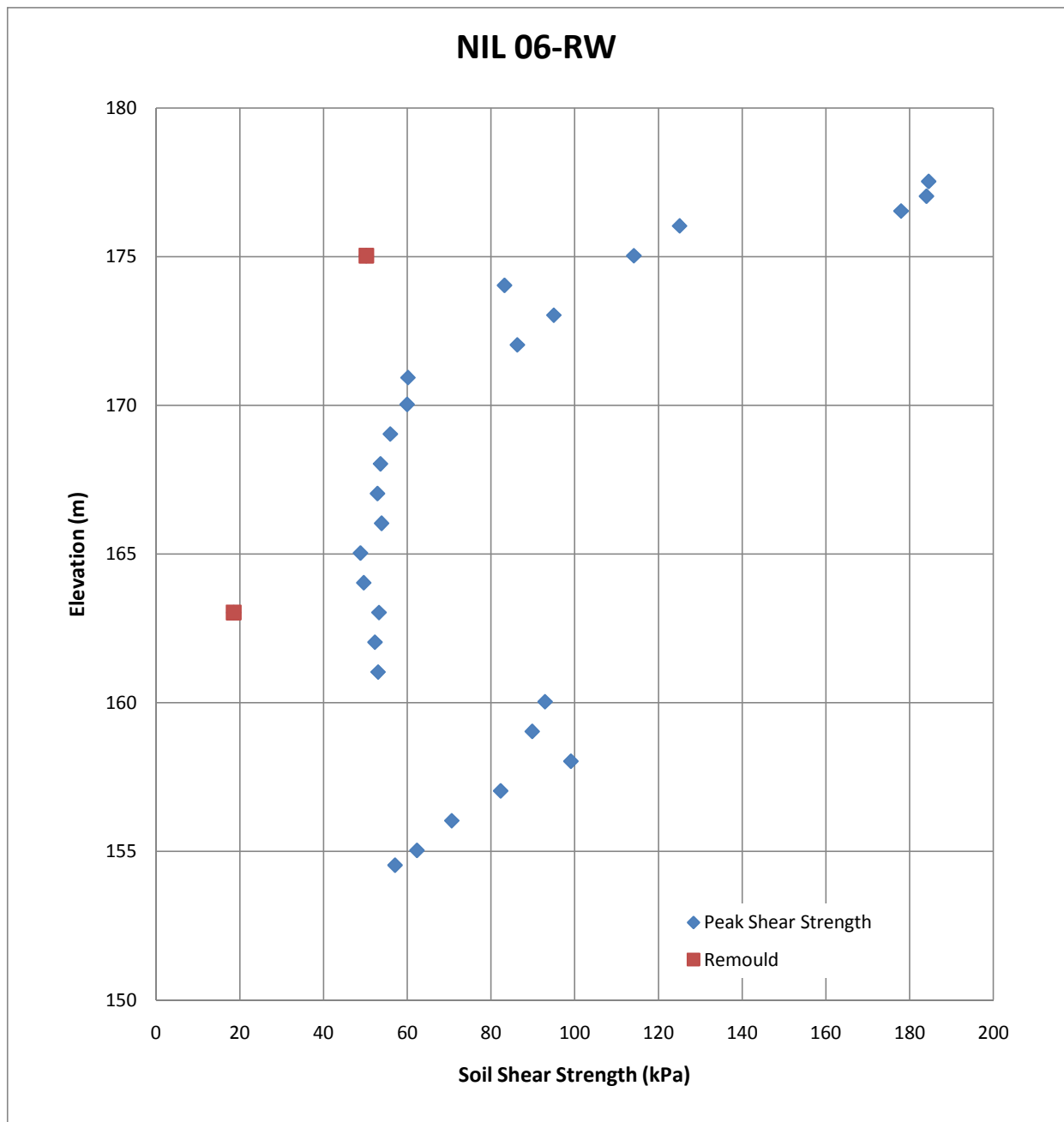
Checked: DD

RECORD OF NILCON VANE TEST NIL 06-RW

Project : Windsor-Essex Parkway
 Location: 4681948.0 N; 330200.9 E
 Ground Surface Elevation: 181.0 m

Test Date: 6/27/2011
 Predrill Depth : 3.0 m

Sheet 1 of 1
 Datum Geodetic



Operator: SD

Checked: DD

RECORD OF NILCON VANE TEST NIL B2-1

Project : Windsor-Essex Parkway

Test Date: 6/20/2011

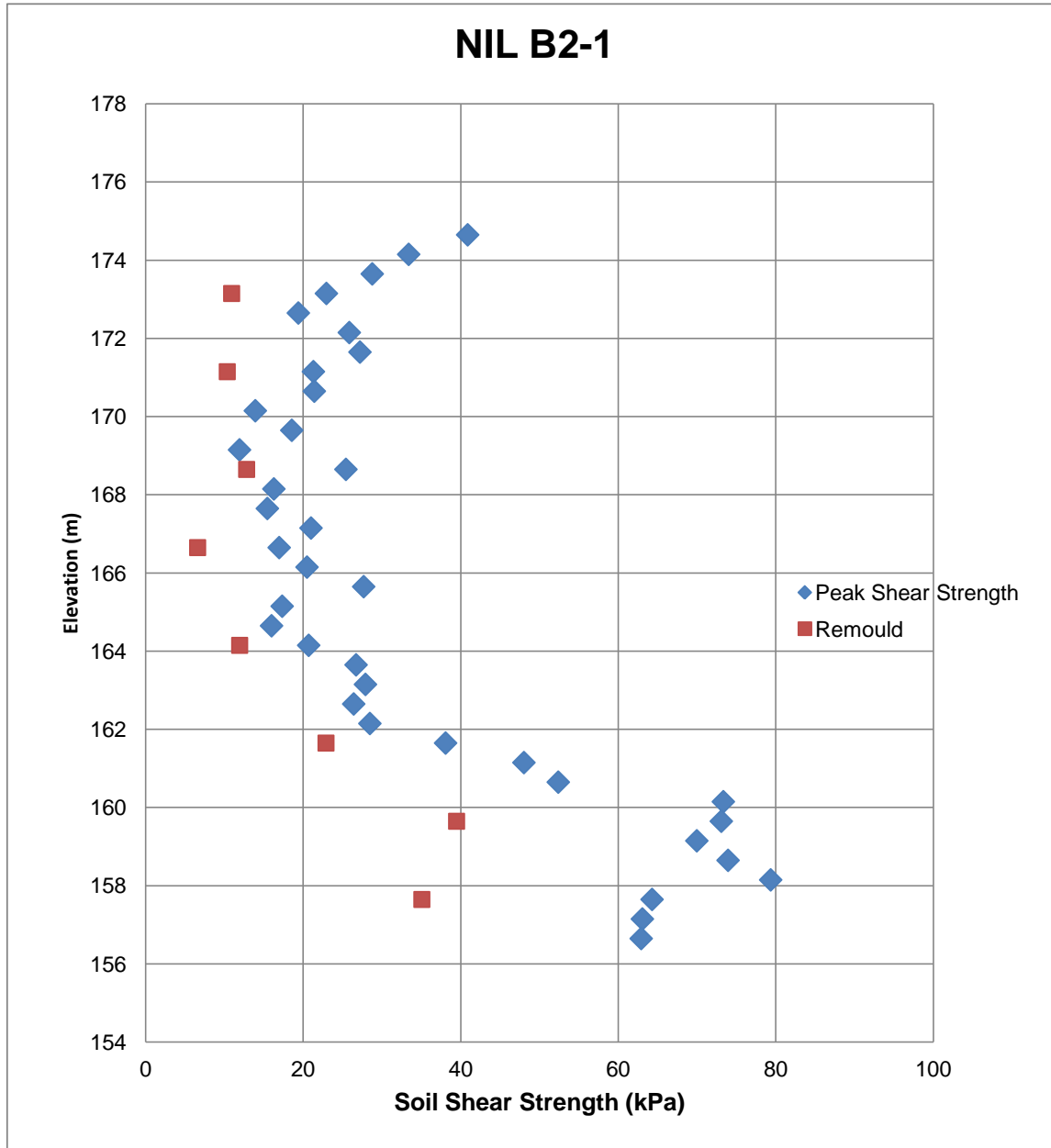
Sheet 1 of 1

Location: N4682253.0; E329139.6

Predrill Depth : 4.0 m

Datum Geodetic

Ground Surface Elevation: 178.6 m



Operator: NB

Checked: DD

RECORD OF NILCON VANE TEST NIL B3-1

Project : Windsor-Essex Parkway

Test Date: 6/17/2011

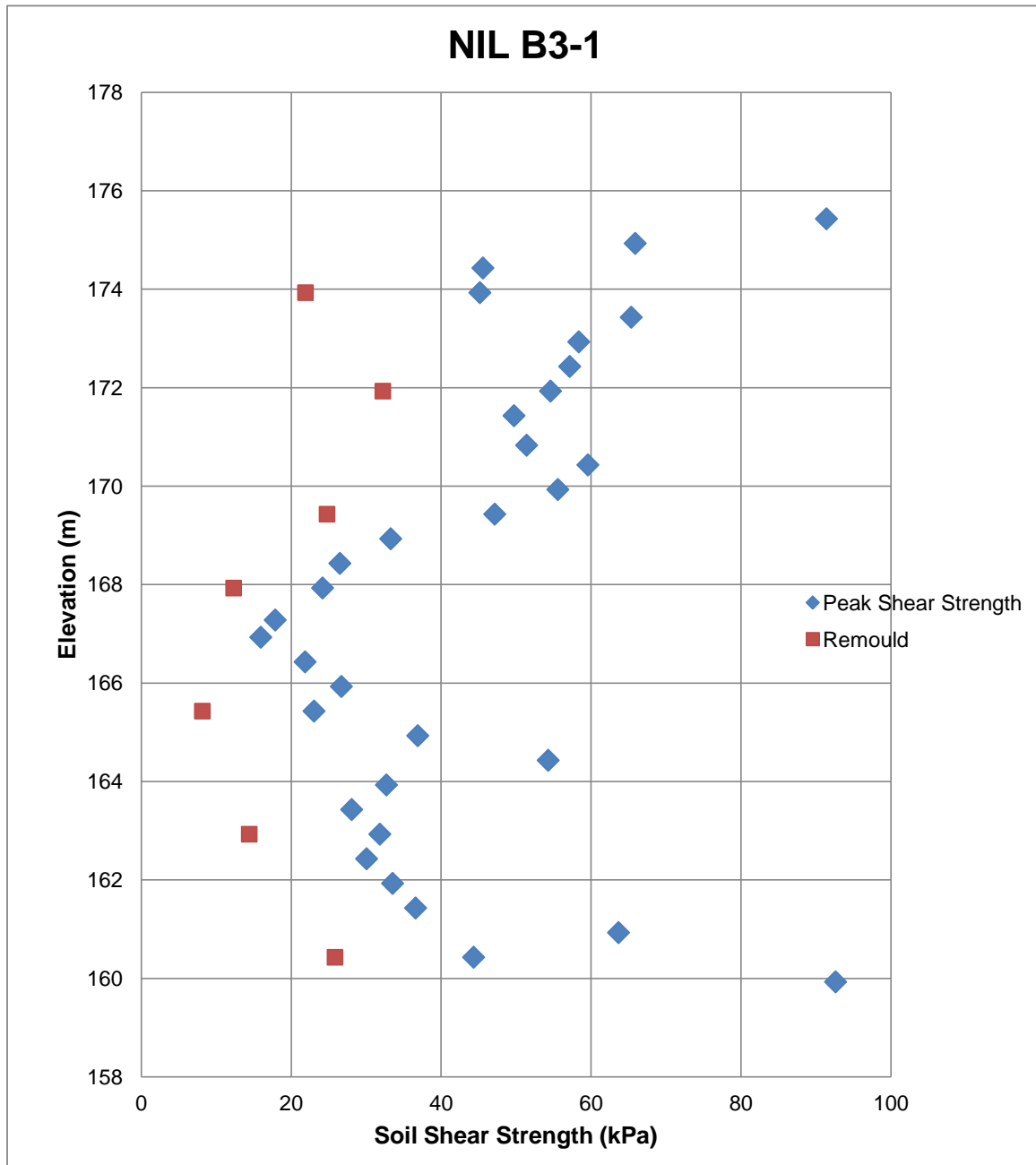
Sheet 1 of 1

Location: N4682266.3; E329436.2

Predrill Depth : 3.5 m

Datum Geodetic

Ground Surface Elevation: 178.9 m



Operator: NB

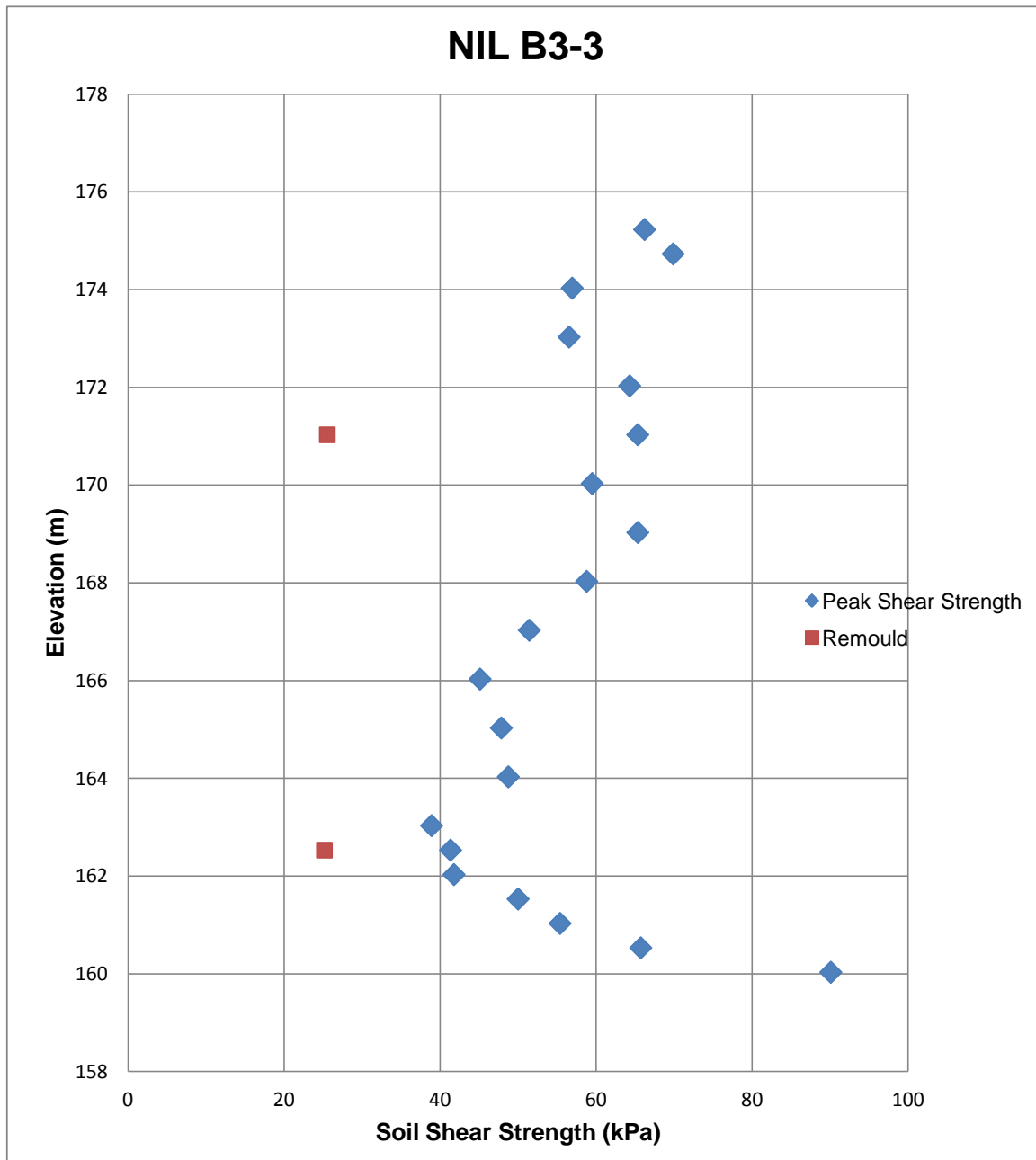
Checked: DD

RECORD OF NILCON VANE TEST NIL B3-3

Project : Windsor-Essex Parkway
 Location: N4682184.0; E329556.0
 Ground Surface Elevation: 179.0 m

Test Date: 6/4/2011 - 6/5/2011
 Predrill Depth : 3.5 m

Sheet 1 of 1
 Datum Geodetic



Operator: SD

Checked: DD

RECORD OF NILCON VANE TEST NIL B4-1

Project : Windsor-Essex Parkway

Test Date: 6/26/2011 - 6/27/2011

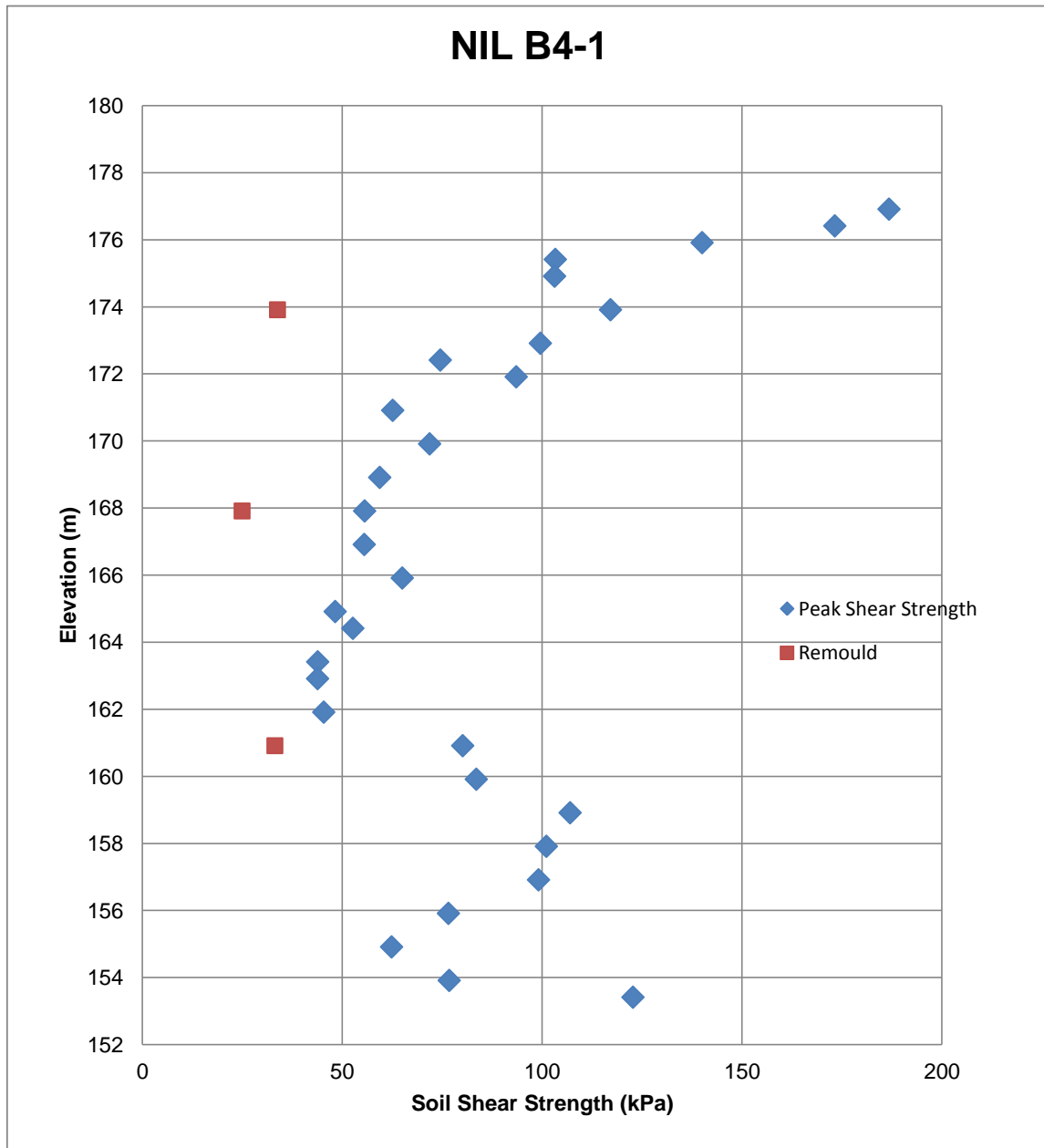
Sheet 1 of 1

Location: N4681982.5; E330151.6

Predrill Depth : 3.5 m

Datum Geodetic

Ground Surface Elevation: 180.9 m



Operator: SD

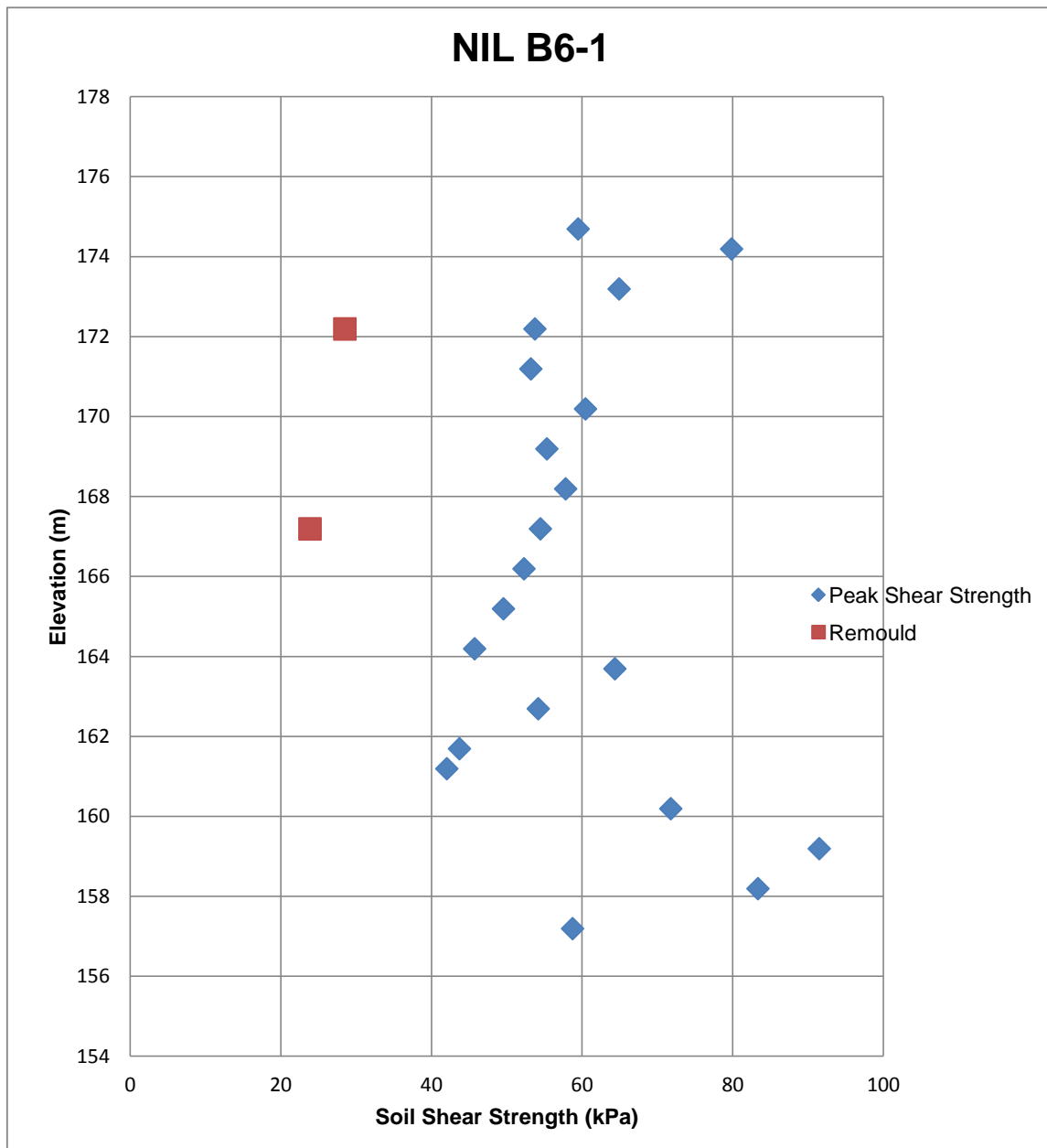
Checked: DD

RECORD OF NILCON VANE TEST NIL B6-1

Project : Windsor-Essex Parkway
 Location: N4681786.8; E330654.4
 Ground Surface Elevation: 180.2 m

Test Date: 7/10/2001
 Predrill Depth : 5.0 m

Sheet 1 of 1
 Datum Geodetic



Operator: SD

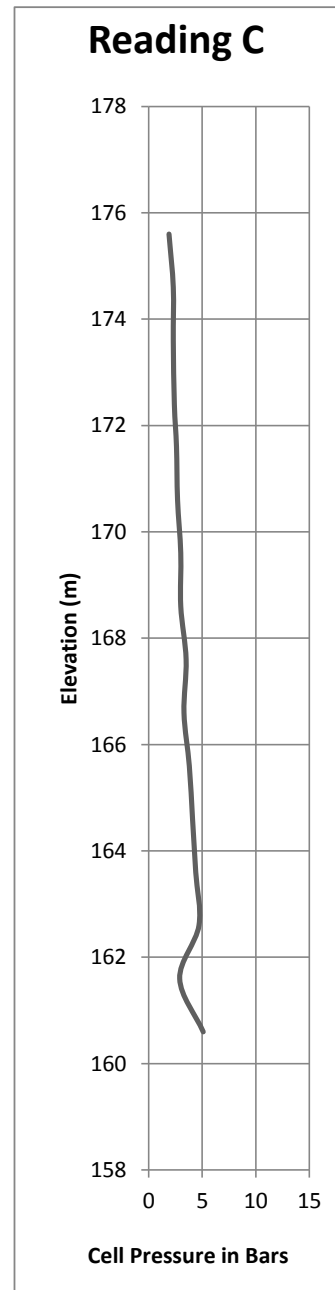
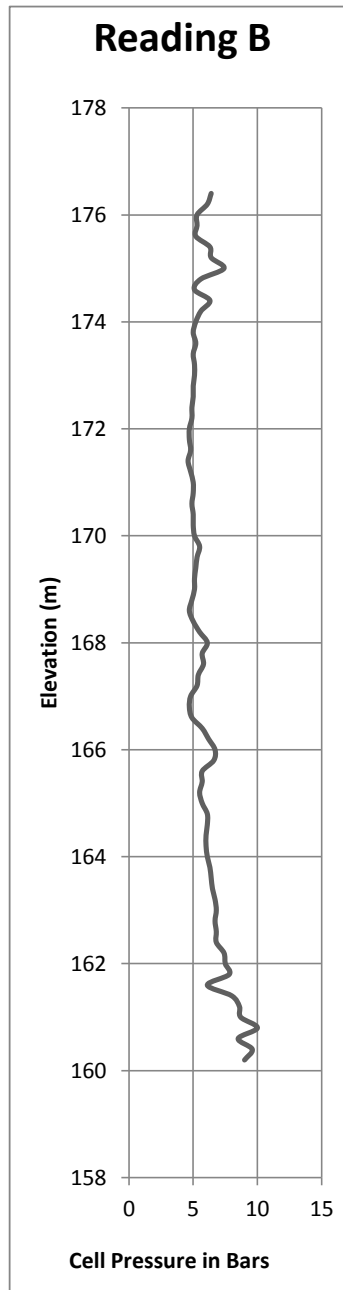
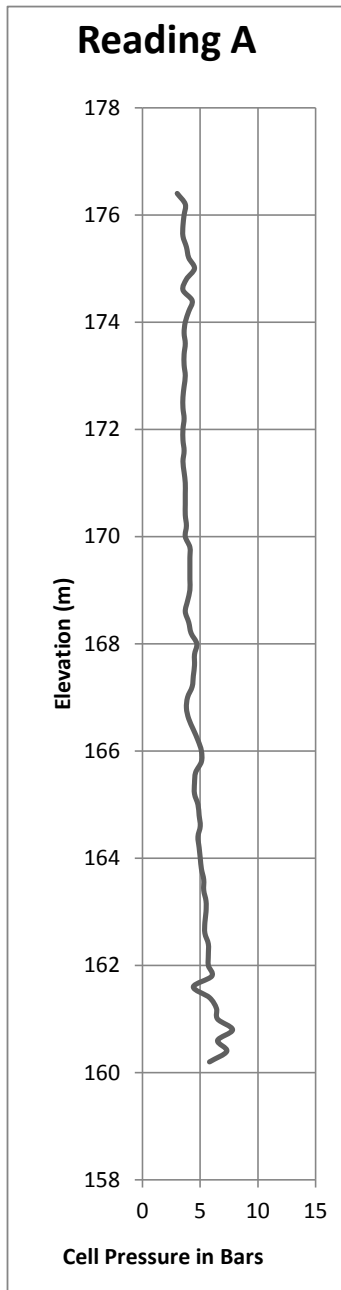
Checked: DD

RECORD OF DILATOMETER TEST DMT 01-RW

Project : Windsor-Essex Parkway
Location: N 4682162.2; E 328674.0
Ground Surface Elevation : 178.6

Test Date: 6/8/2011
Predrill Depth : 2.0 m
Delta A: 0.19 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.28 Bar



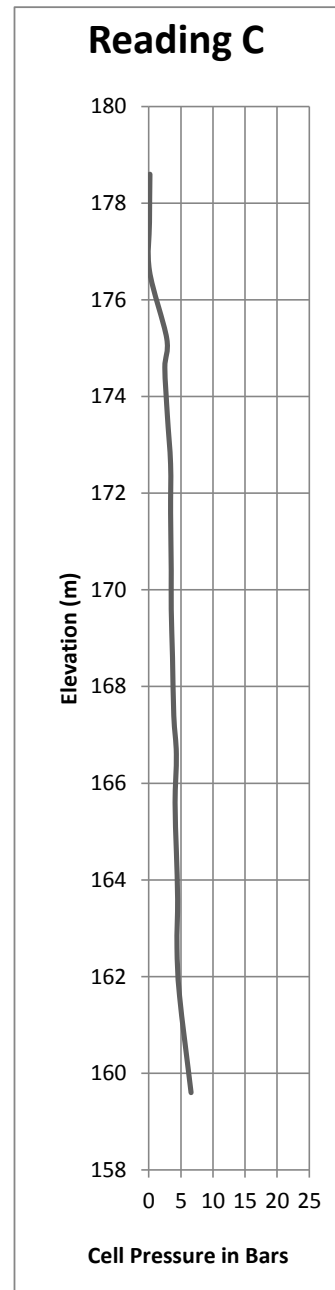
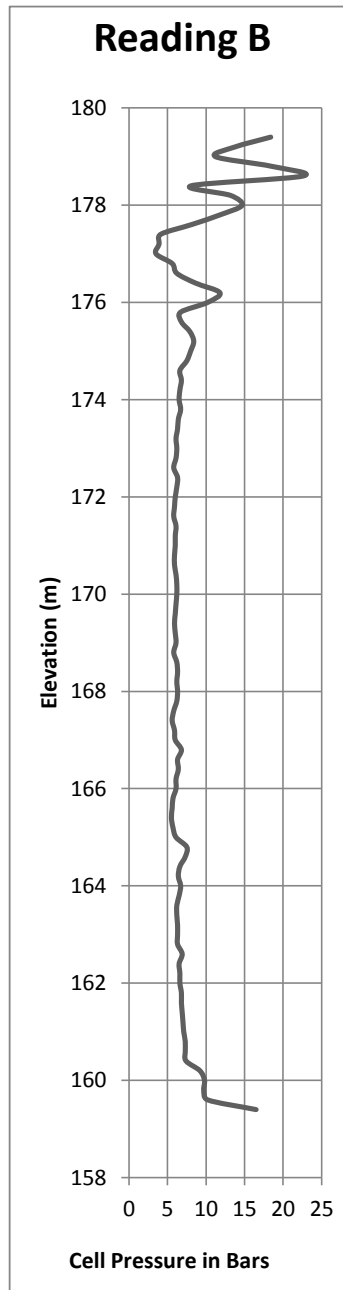
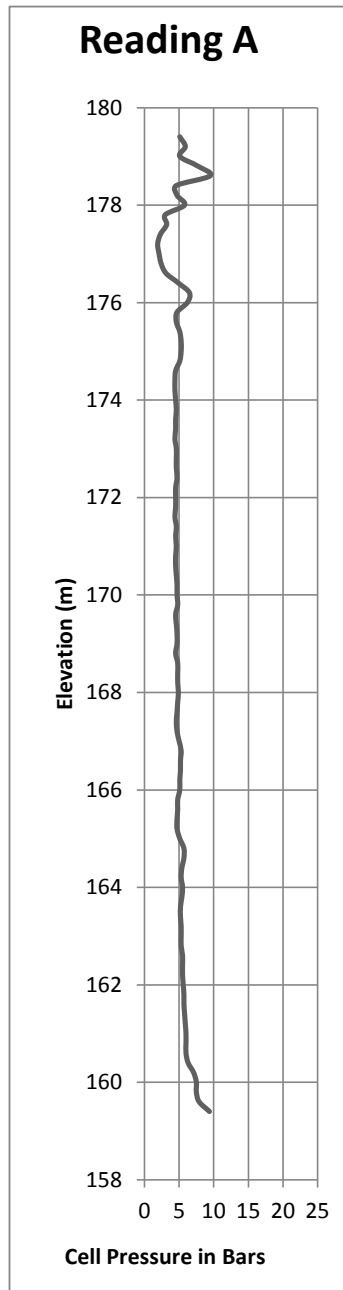
Operator: LC
Checked: DD

RECORD OF DILATOMETER TEST DMT 02-RW

Project : Windsor-Essex Parkway
Location: N 4682330.9; E 329357.7
Ground Surface Elevation : 181.6

Test Date: 6/20/2011
Predrill Depth : 2.0 m
Delta A: 0.19 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.23 Bar



Operator: LC

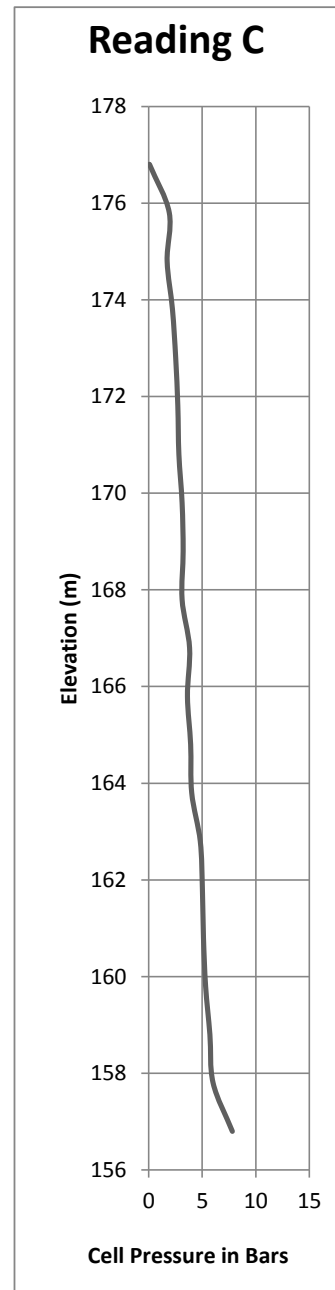
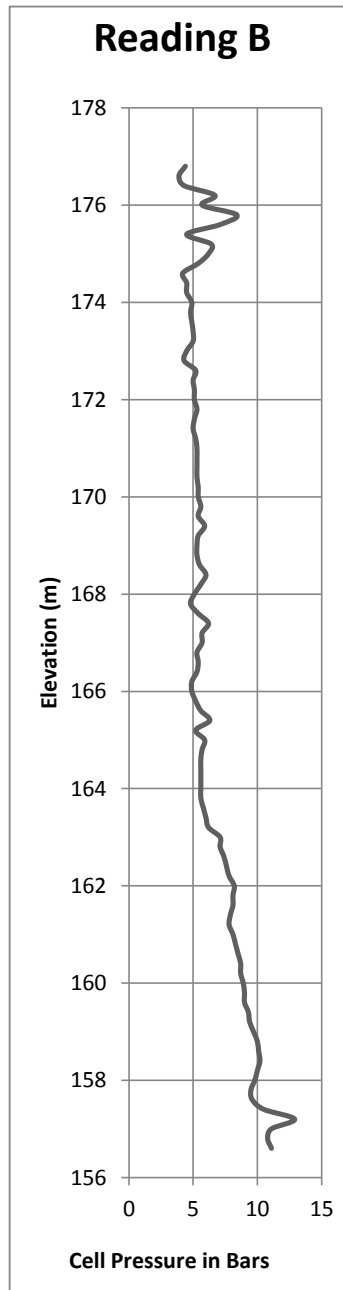
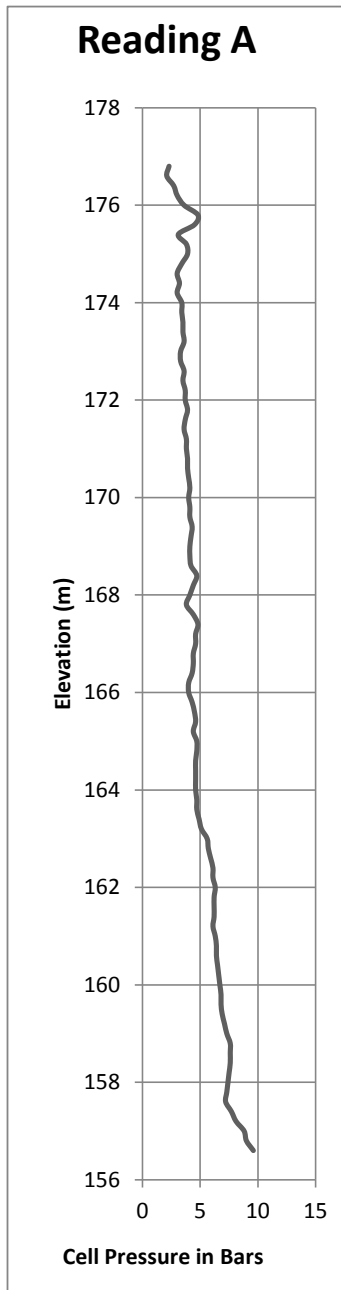
Checked: DD

RECORD OF DILATOMETER TEST DMT B2-1

Project : Windsor-Essex Parkway
Location: N 4682249.9; E 329090.6
Ground Surface Elevation : 178.8

Test Date: 5/12/2011
Predrill Depth : 1.98 m
Delta A: 0.19 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.32 Bar



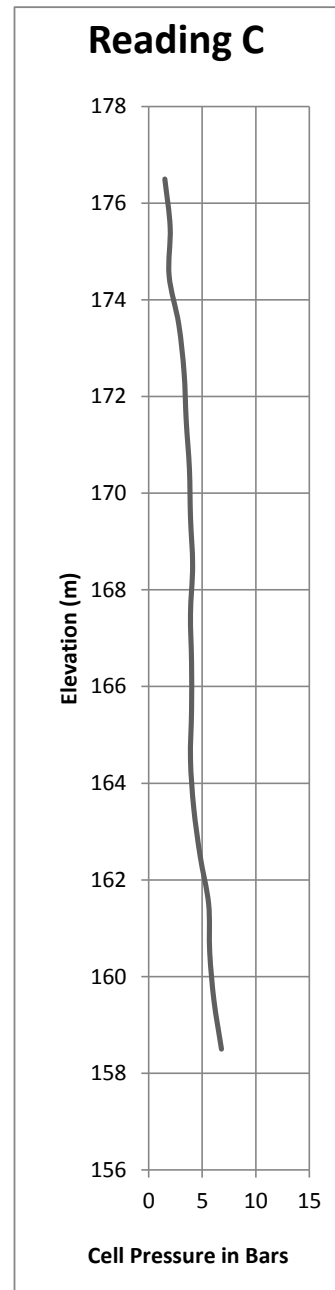
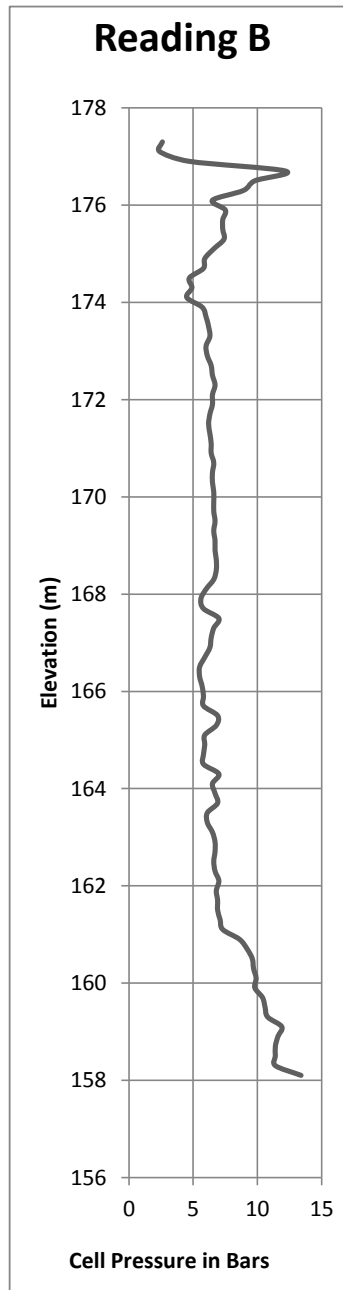
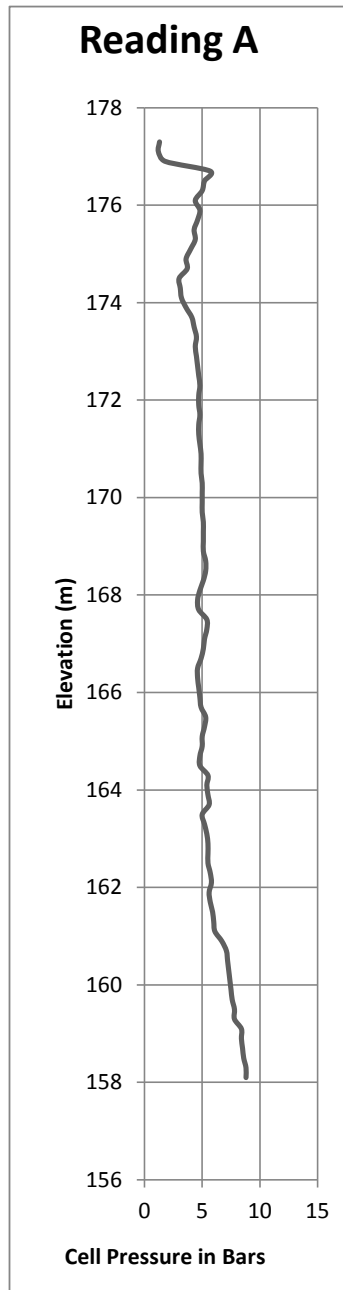
Operator: LC
Checked: DD

RECORD OF DILATOMETER TEST DMT B3-1

Project : Windsor-Essex Parkway
Location: N 4682286.4; E 329420.5
Ground Surface Elevation : 179.5

Test Date: 6/19/2011
Predrill Depth : 2.0 m
Delta A: 0.20 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.25 Bar



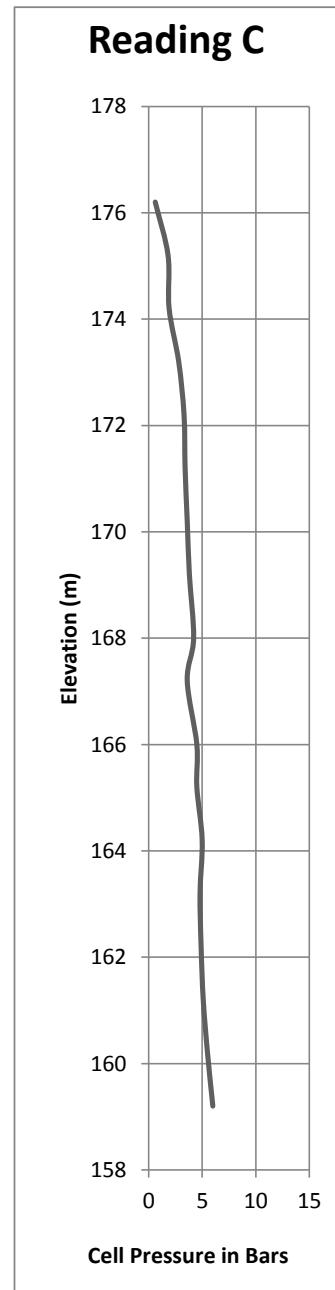
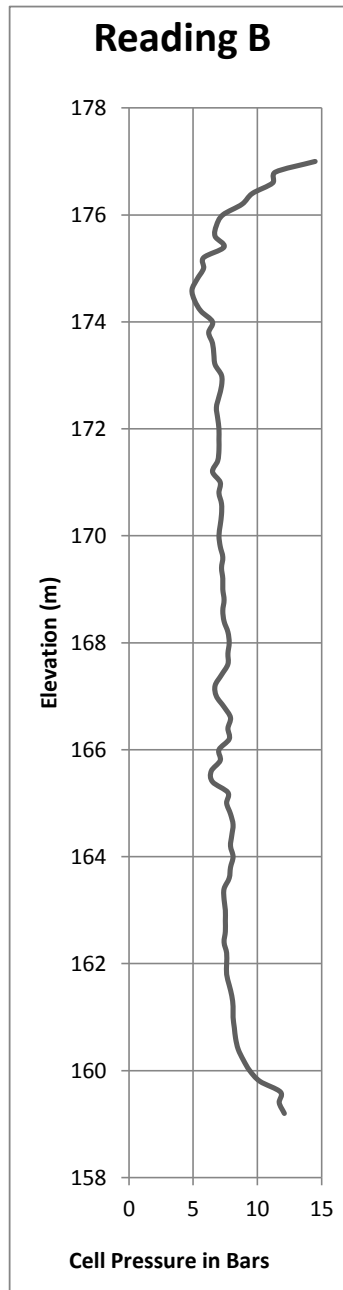
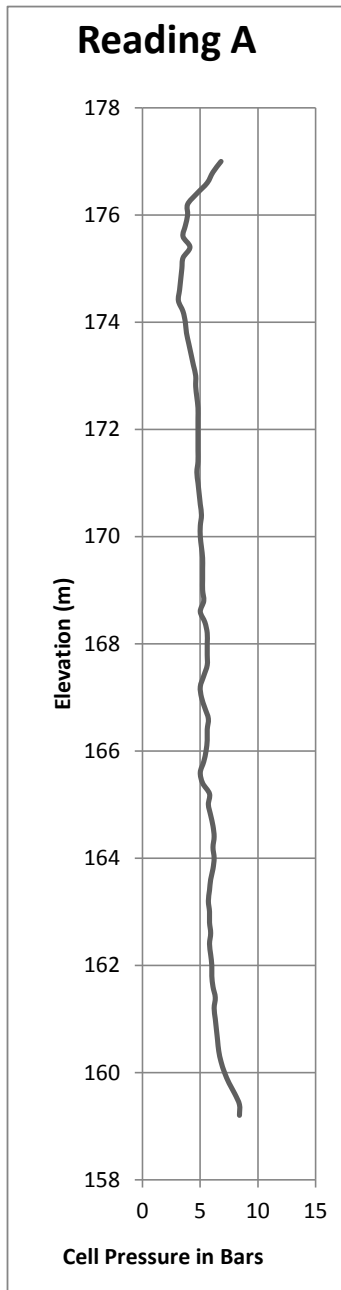
Operator: LC
Checked: DD

RECORD OF DILATOMETER TEST DMT B3-2

Project : Windsor-Essex Parkway
Location: N 4682177.6; E 329571.6
Ground Surface Elevation : 179.2

Test Date: 6/23/2011
Predrill Depth : 2.0 m
Delta A: 0.20 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.48 Bar



Operator: LC
Checked: DD

RECORD OF DILATOMETER TEST DMT B4-1 SHALLOW

Project : Windsor-Essex Parkway
Location: N 4682042.8; E 330143.9

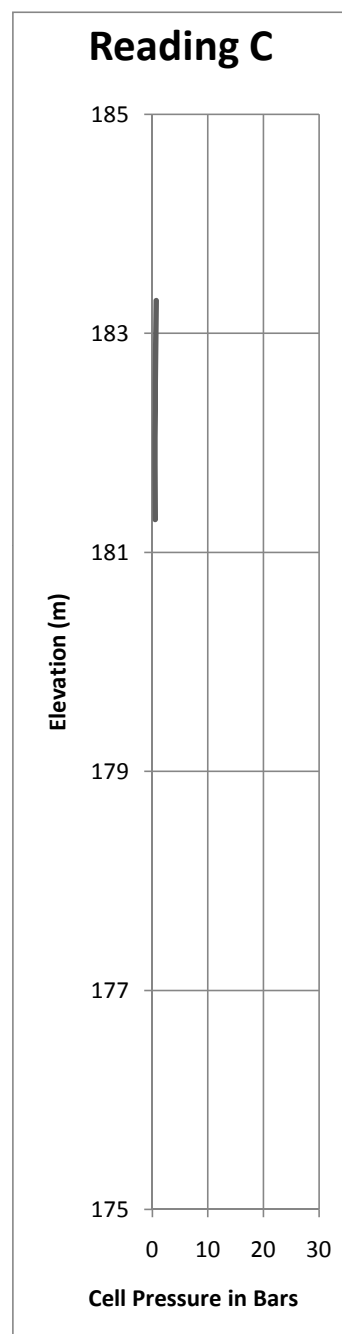
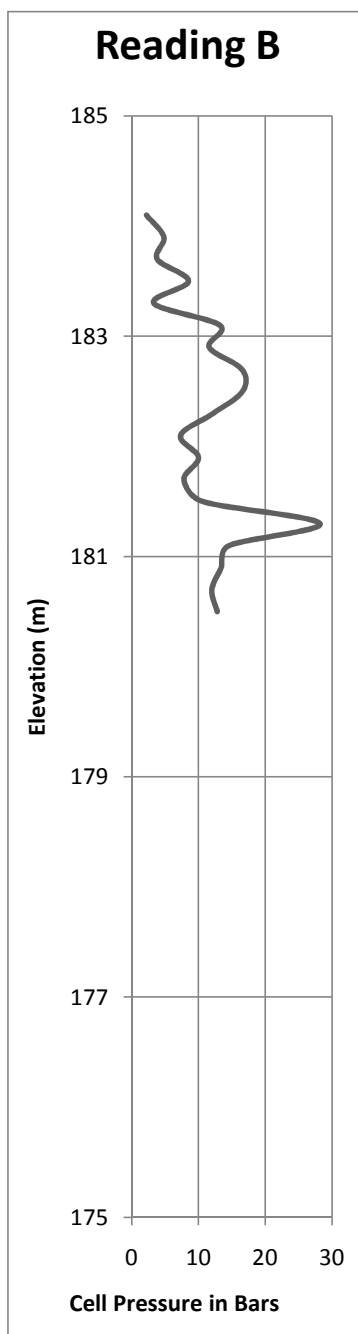
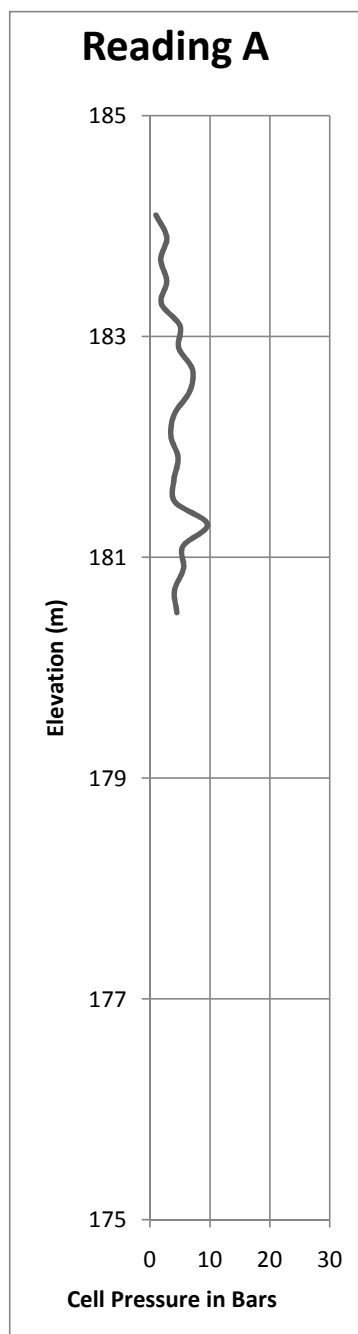
Test Date: 6/22/2011
Predrill Depth : 2.0 m

Sheet 1 of 1
Datum Geodetic

Ground Surface Elevation : 186.3

Delta A: 0.21 Bar

Delta B: 0.28 Bar



Note DMT refusal at elevation 180.3 m. Redrilled to elevation 178.1 m.
Continued with DMT to elevation 160.1 m

Operator: LC

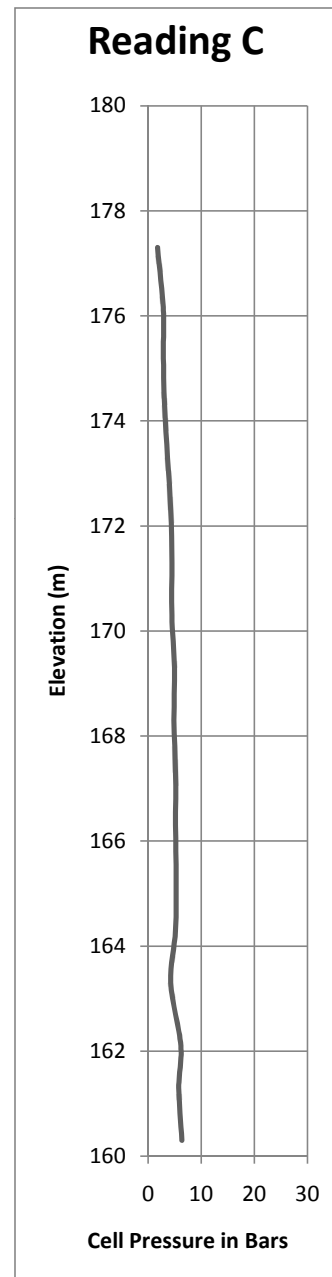
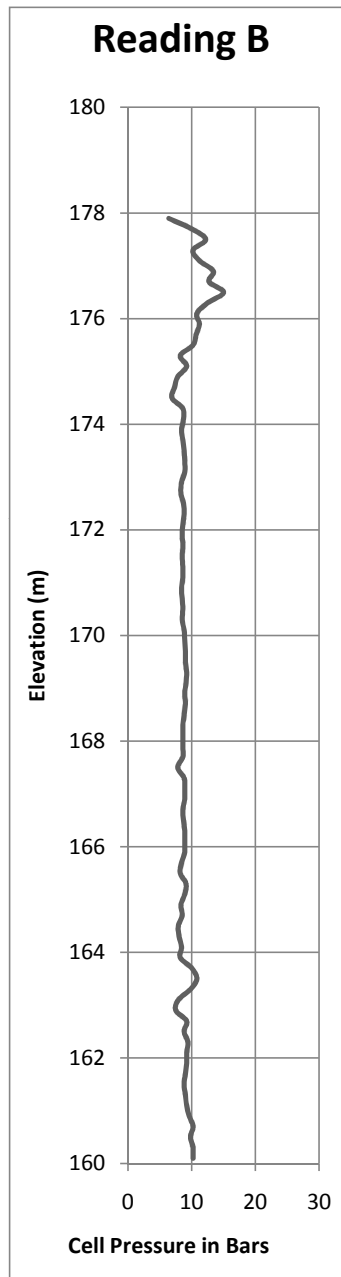
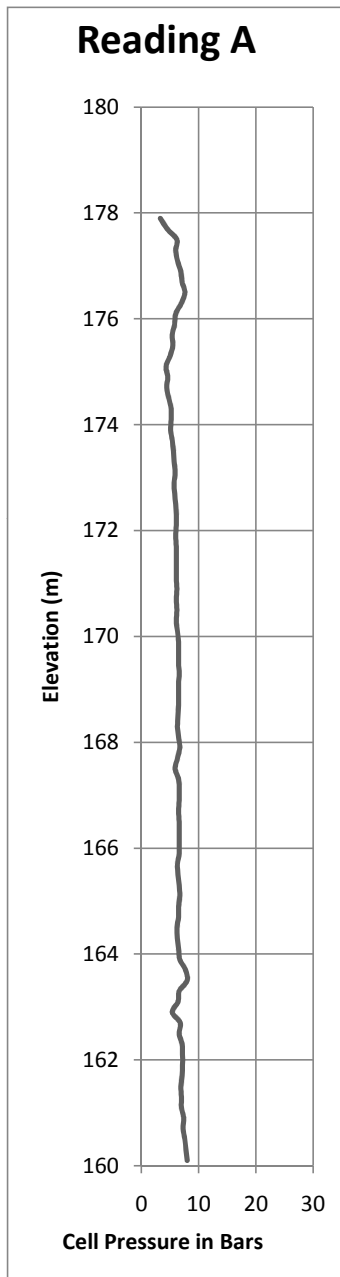
Checked: DD

RECORD OF DILATOMETER TEST DMT B4-1 DEEP

Project : Windsor-Essex Parkway
Location: N 4682042.8; E 330143.9
Ground Surface Elevation : 186.3

Test Date: 6/22/2011
Predrill Depth : 8.2 m
Delta A: 0.19 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.52 Bar



Note Restarted DMT at elevation 172.5m.

Operator: LC

Checked: DD

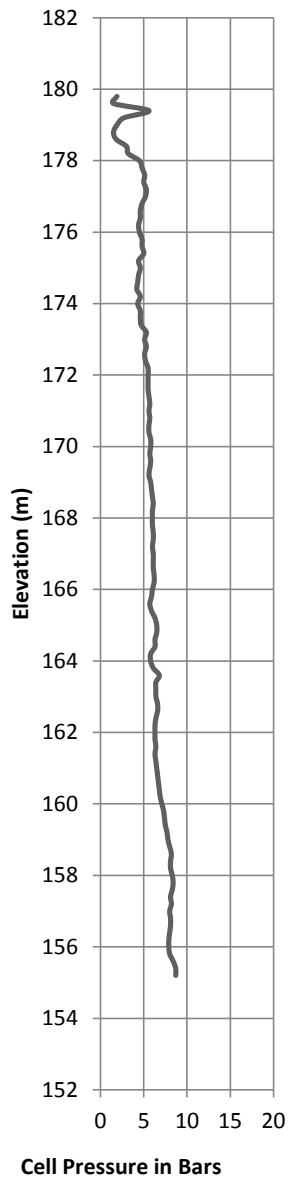
RECORD OF DILATOMETER TEST DMT B6-1

Project : Windsor-Essex Parkway
Location: N 4681799.4; E 330644.6
Ground Surface Elevation : 180.0

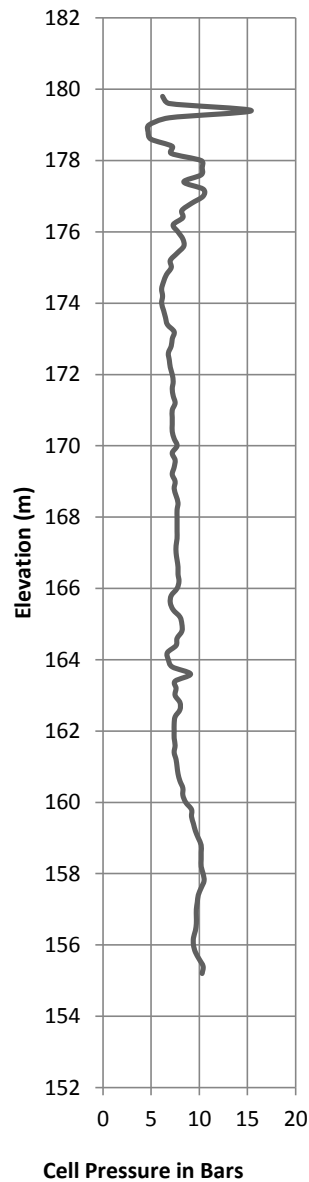
Test Date: 7/8/2011
Predrill Depth : 0.2 m
Delta A: 0.18 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.25 Bar

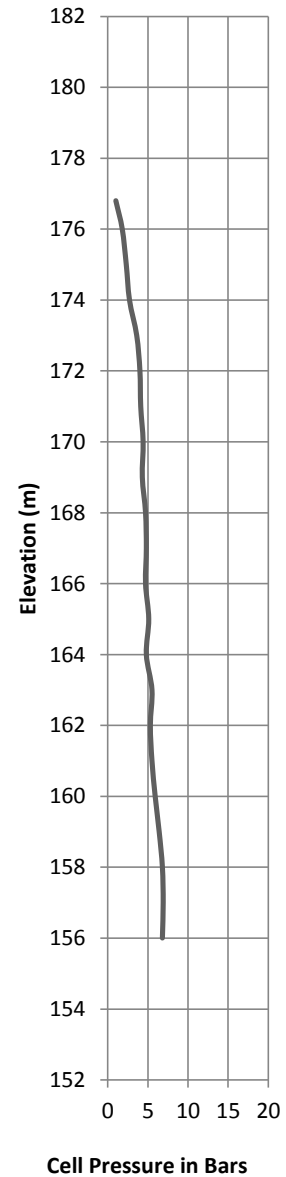
Reading A



Reading B



Reading C



Operator: LC

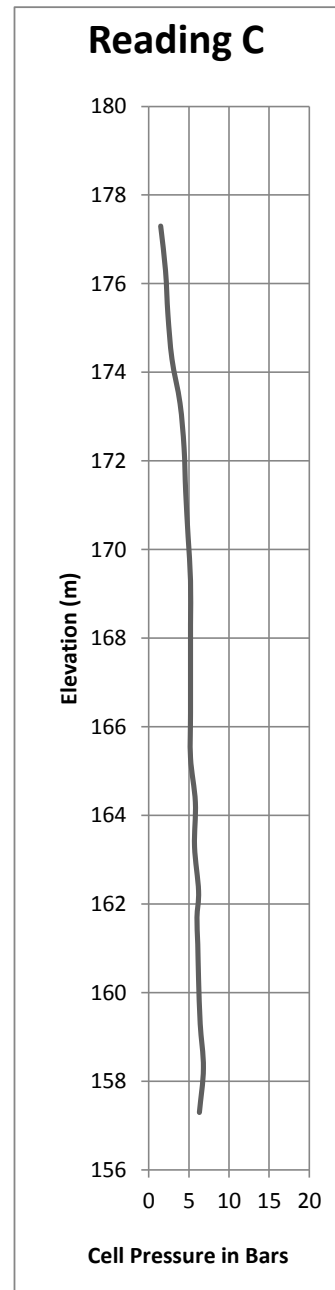
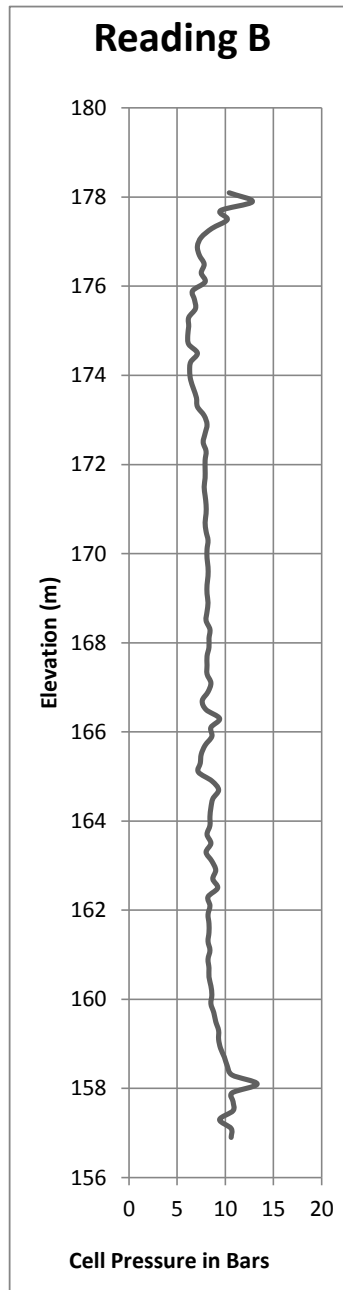
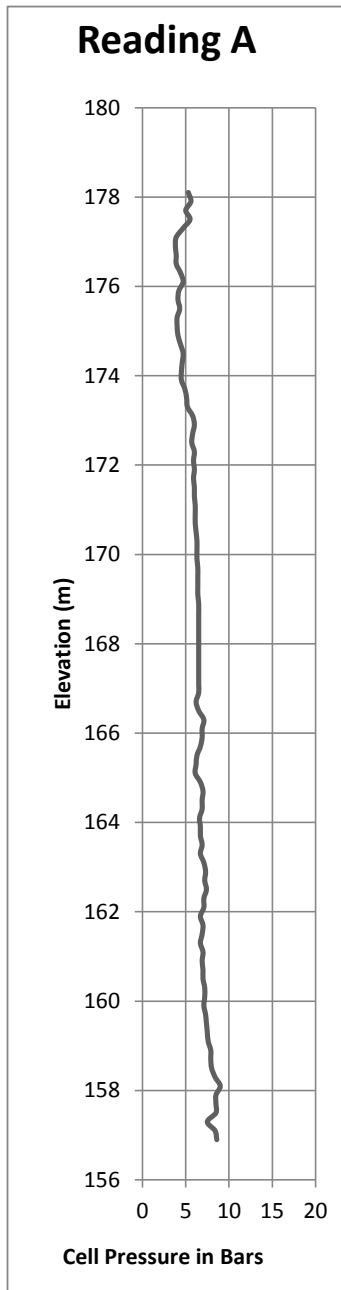
Checked: DD

RECORD OF DILATOMETER TEST DMT B6-2

Project : Windsor-Essex Parkway
Location: N 4681785.9; E 330805.3
Ground Surface Elevation : 180.3

Test Date: 7/17/2011
Predrill Depth : 2.0 m
Delta A: 0.20 Bar

Sheet 1 of 1
Datum Geodetic
Delta B: 0.26 Bar



Operator: LC
Checked: DD

Appendix B Borehole Logs from Previous Investigations

Project: Windsor-Essex Parkway
Document: Geotechnical Investigation and Design Report – High Embankments
(Sta. 10+030W to Sta. 12+290W)
Doc No.: 285380-04-119-0003 (Geocres No. 40J6-44)

Date: December / 2012
Rev: 0
Page No.: Appendix B

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY _____ AMS

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S. + Field Vane o Unconfined	WATER CONTENT % 10 20 30					
592.8	Ground Level												
0.0	Silty sand												
588.8			1	SS	5								
4.0			2	SS	20								
			3	SS	18								
			4	SS	9								
			5	TW	PH								
	Clayey silt		6	TW	PH								
	some sand		7	TW	PH								
	trace of gravel.		8	TW	PH								
			9	TW	PH								
	Firm to very stiff.		10	TW	PH								
			11	TW	PM								
			12	TW	PM								
			13	TW	PM								
			14	TW	PM								
499.8													
93.0	Sandy silt												
	Some gravel												
490.0	Very dense.												
102.8	Limestone		15	AXT	Rec.								
484.6	Bedrock			Rc	100%								
108.2	End of Borehole												

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

OB 68-E-15 LOCATION Co-ords. 101,015 N; 55,440 E. ORIGINATED BY AMS
W.P. 260-66-6 BORING DATE Feb. 23, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cont. flight auger (bombardier) CHECKED BY AMS

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	W.P.	W.L.		
593.0	Ground Level															
0.0	Silty sand.					590										590.5
4.0	Clayey silt some sand trace of gravel. Firm.		1	SS	6											
			2	TW	PH											
			3	TW	PH	580									124	1 11 38 50
			4	TW	PM											
			5	TW	PM	570									127	
			6	TW	PM											
			7	TW	PM	560										
			8	TW	PM											
551.5																3 17 45 35
41.5	End of Borehole															

20
15-5 % strain at failure
10