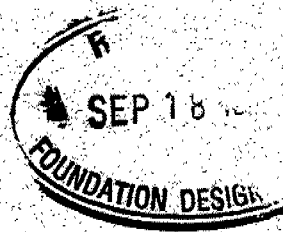


G.I.-30 SEPT. 1976

GEOCRES No. 40P16-15DIST. 33 REGION W.P. No. 244-97-00CONT. No. W. O. No. STR. SITE No. HWY. No. 10LOCATION Fairgrounds Shopping
Centre - OrangevilleNo of PAGES - Hwy to Reconstruction
=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



Jacques Whitford

Consulting Engineers
Environmental Scientists



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FIRST PROFESSIONAL MANAGEMENT INC.

**GEOTECHNICAL INVESTIGATION
EAST EMBANKMENT BETWEEN
STATION 11+600 AND 11+700
HIGHWAY 10/24 IMPROVEMENT
ORANGEVILLE, ONTARIO**

PROJECT NO. 10183



**Jacques Whitford
Environment Limited**

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September 17, 1998

First Professional Management Inc.
259 Yorkland Road
Suite 300
North York, Ontario
M2J 5B2

Project No. 10183

Attention: Mr. David Mills

**Re: Geotechnical Investigation
East Embankment Between Station 11+600 to 11+700
Highway 10/24 Improvement
Orangeville, Ontario**

Dear Mr. Mills:

1. Introduction

Jacques Whitford Environment Limited (JWEL) visited the above site on August 21, 1998 and visually examined the conditions on the east side of the embankment near Station 11+600 to 11+700. It was reported that the embankment in this area showed signs of settlement and some tension cracks have developed. As requested in the site meeting on August 27, 1998, we proceeded with the drilling of boreholes at the above noted area.

This report presents the findings during our site visit and the information revealed from the boreholes. Recommendations are also included for consideration by your office as well as MTO.

2. Background

Highway 10/24 in this area consists of a two lane highway near the intersection of Fifth Avenue. A second northbound lane was constructed in 1997 which generally involved in the reconstruction and paving over the old shoulder area. In 1998, the east side was widened to its present configuration to accommodate a centre median, two north bound lanes and a shoulder. This involved the removal of the existing embankment cover and placement of new fill to the east of the old embankment.



The roadwork and the embankment construction were carried out by Ambro Construction Ltd. (Ambro) and we understand that the quality control and inspection and testing work were also carried out by Ambro.

3. Fieldwork

The initial fieldwork program consists of excavating four test pits at the toe of the embankment and the drilling of three boreholes. However, during the excavation of the test pits, organic soil was noted under the embankment and therefore, the program was revised to include drilling of three sets of two boreholes (total of six), one at the theoretical 1:1 toe and one in the area of the old embankment toe.

In addition to the boreholes and test pits, six settlement plates were also installed to monitor the settlement of the embankment. The location of the boreholes, test pits and settlement plates are summarized in Table 1 and presented in Drawing A1.

4. Field Observations

During the site visit on August 21, 1998, the following conditions at the east embankment were noted:

- Tension cracks, just to the east of the pavement and parallel to the roadway are visible between approximate Stations 11+575 to 11+680 approximately;
- The grade stakes at Stations 11+625 and 11+664.5 is leaning away from the roadway;
- Surface erosion from the pavement to the new gravel fill area down the embankment is noted north of the new culvert area;
- Minor bulging of the slope was observed in the area where tension cracks are present;
- Manual probing using a steel rod indicated loose soil conditions to variable depths at the toe of the embankment;
- Soil below the toe of the embankment may contain organic (based on the soil sticking to the probe rod); and
- No other signs of distress was noted along the embankment.

5. Probable Reasons For the Observed Deficiencies

During the site meeting, we have indicated a number of probable cause of the observed settlement and cracking conditions at the east embankment. They are outlined below:

- Settlement due to inadequate compaction of the new fill;
- Settlement of the old fill under the embankment and the old embankment fill itself due to the loading from the new embankment fill;
- Presence of loose or organic soil beneath as well as outside the base of the embankment;
- Increase in stress over the old fill due to the lowering of the water level in the reservoir; and
- Differential settlement between the toe area and the embankment.

Accordingly, appropriate action to obtain more soil information by test pitting and boreholes were carried out. The information revealed from the test pits was presented in our letter dated August 31, 1998 and a copy is enclosed in Appendix A. The compaction reports provided by Armbro, enclosed in Appendix B, is also reviewed.

6. Subsoil Conditions

The subsoil at the borehole locations generally consists of a layer of sand to sand and gravel fill over peat, organic silt and native sand to sand and gravel. They are described below.

6.1 Sand to Sand And Gravel Fill

The embankment is generally constructed with the use of a sand with some gravel to a sand and gravel type granular soil. The moisture content of the granular fill is generally around 4 to 8 percent. The relative density, based on the N-values, is considered to be loose to compact. This layer is present in all boreholes.

6.2 Peat

Black, predominantly fibrous with numerous larger roots to pieces of wood and granular pockets, was found in all the boreholes except BH A. The peat is moist, mostly fibrous with granular zones and contained numerous roots with some pieces of wood. The thickness of this layer ranges from 0.1 to 2.8 m. and the moisture contents are in the range of 115 to 287 percent.

6.3 Organic Silt

27
A layer of very loose, brown organic silt was found to underlain the fill or peat in all boreholes except BH C1. The silt contains sand and clayey pockets and is soft in consistency. The moisture content ranges from 42 to 156 percent.

6.4 Sand to Sand and Gravel

The native soil underlying the fill and organic soils at this site is a sand to sand and gravel deposit. The sand is generally fine to medium with medium to coarse layers. The relative density of this soil is considered to be compact to dense based on the N-values. The sand to sand and gravel is saturated with moisture content ranging from 10 to 15 percent.

7. Settlement Monitoring Results

Settlement plates (SP) were installed on August 28, 1998 at the locations shown on Drawing A1 for the purpose of monitoring the settlement of the embankment. The settlement is expected to occurred from the start of the construction in summer of 1997 and prior to the installation of the settlement plates. As a result, the total settlement of the embankment could not be determined.

The monitoring is therefore, limited to the settlements occurred since the commencement of the monitoring. For the period between September 2 and 16, 1998, a maximum total settlement of 22 mm was noted at Plate No. A2. The results for the settlement monitoring are illustrated in Figures 1 to 3 inclusive.

The result suggested that the bulk of the settlement has been completed and the present reading is most likely represent the secondary consolidation end for the peat and organic silt soil layers. The slow rate of settlement will likely continue for some time before stabilizing. When the additional fill is placed in this area to complete the final construction, more settlement is anticipated. The monitoring of the settlement should therefore be continued until there is a stabilizing trend in the readings.

8. Discussion and Conclusion

Based on the subsoil conditions revealed from the boreholes, the cause of the observed settlement and cracking were predominantly caused by the settlement of the peat and organic silt underlying the widened embankment. It appeared that during the original construction, the organic silt and small amount of peat were also not totally removed in some areas. Our previous boreholes, located just east of the cable guardrail, did not show any significant peat or organic soil which could be an indication that the organic soil did not extend much west of the shoulder area.

In the widening area, neither the peat nor the organic silt were totally sub-excavated during the recent construction. It is conceivable that during the original construction the embankment was allowed to settle prior to the final paving work and therefore, the performance of the pavement at this time did not reflect the settlements normally associated with the presence of organic soils.

The compaction report provided by Armbro indicated that the granular fill in the embankment all achieved a minimum of 95 percent compaction. Based on the borehole information, the relative density of the sand appeared to be variable, with N-values ranging from 3 to 38. This suggested that some of the fill, in particularly the area close to the existing embankment (benching zone), are not particularly well compacted.

Based on the current borehole information, the base of the peat is near Elevation 408.3 to 409.6 m which is approximately 2.4 to 3.9 m below the reservoir. The base of the organic silt is near Elevation 406.7 m which is up to 5.5 m below the toe of the slope.

In order to totally remove the organic soils from the area, the excavation would undermine the existing roadway and therefore will have to be shored. In addition, the proposed depth of excavation would also be up to 5 m below the water level in the reservoir which is not possible without carrying out positive de-watering. To sub-excavate the organic soils, the side slope on the existing reservoir side would cause substantial disturbance to the wet land. Based on the above difficulties, sub-excavation would be very costly as the use of shoring and positive dewatering are required.

In view of the presence of the peat, slope stability analyses were carried out to determine the minimum factor of safety for the finished embankment. Since tension cracks occurred at the shoulder location, it is assumed that the failure circle would pass through this point. Using some typical parameters for the various soil types, (ϕ of 35° for the granular fill and peat, 28° for the organic silt, and 45° for the native sand and gravel), the overall minimum factor of safety, at the Borehole A and A1 section, is 1.38. It is our opinion, therefore, that the finished embankment should be stable. The results of the stability analyses are presented in Appendix C.

With the addition of the fill to the finished grade, more settlement will take place and may continue for months. It is worth noting that the proposed edge of pavement in the area lies just to the west of the tension cracks noted in the area. In other words, the settled area would be at or just outside the pavement area and in the proposed shoulder. Maintenance of the area, can therefore be accomplished by simply grading the area, place additional granular material and carry out surface compaction.

9. Recommendations

Based on the available soil information and the above reasoning, we would recommend the following actions for the proposed construction:

- Level the granular in the area and proof-roll the area with conventional compaction equipment;
- Place additional granular fill up to 150 mm above the finished grade and compacted to the required compaction effort or 100 percent Standard Proctor Maximum Dry Density;
- Continue the monitoring of the settlement in the area using the settlement plates installed;
- Delay the paving of the base course asphalt as long as possible or until the settlement plates showed little to no movements;
- Repair the granular shoulder as needed over the winter and spring;
- Repair the base asphalt if required in 1999;
- If settlement has been completed, place the surface asphalt in the summer or fall of 1999.

If the above action is acceptable to the developer, general contractor, designer consultant and MTO, the general contractor, being the builder as well as the quality control agency, must be fully responsible for the maintenance and condition of the embankment as well as the performance of the roadway upon completion. An extended warranty for the roadway acceptable to your office and MTO, is recommended.



Page 7
Mr. David Mills
September 17, 1998

We trust that the above information is satisfactory for your consideration and action. Should you have any queries, please do not hesitate to contact this office.

Yours truly,

Jacques Whitford Environment Limited

David Wong, P. Eng.

Stephen S. M. Cheng, P. Eng.

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	Mr. Dennis G. Regan MTO	(1)	Fax: 519-873-4600
	Mr. Eric Magni MTO	(1)	Fax: 519-873-4403

SSMC/ssmc/P:\10xxx\10183\Settlement_problem.dot

Geotechnical Investigation, Highway 10/24 (Between Stn. 11+600 & 11+700)

Project No. 10183



Tables

Table 1: Borehole, Test Pits and Settlement Plate Locations

No.	Station	Location Description
Settlement Plates		
A1	11+614	Located approximately m from C/L of Highway 10
A2	11+614	Located approximately m from C/L of Highway 10
B1	11+651	Located approximately m from C/L of Highway 10
B2	11+651	Located approximately m from C/L of Highway 10
C1	11+683	Located approximately m from C/L of Highway 10
C2	11+683	Located approximately m from C/L of Highway 10
Boreholes		
A	11+613	On the widened shoulder area
A1	11+613	On slope near the toe of the theoretical 1:1 line
B	11+650	On the widened shoulder area
B1	11+650	On slope near the toe of the theoretical 1:1 line
C	11+682	On the widened shoulder area
C1	11+682	On slope near the toe of the theoretical 1:1 line
Test Pits		
1	11+581	At base of existing embankment
2	11+600	At base of existing embankment
3	11+655	At base of existing embankment
4	11+690	At base of existing embankment

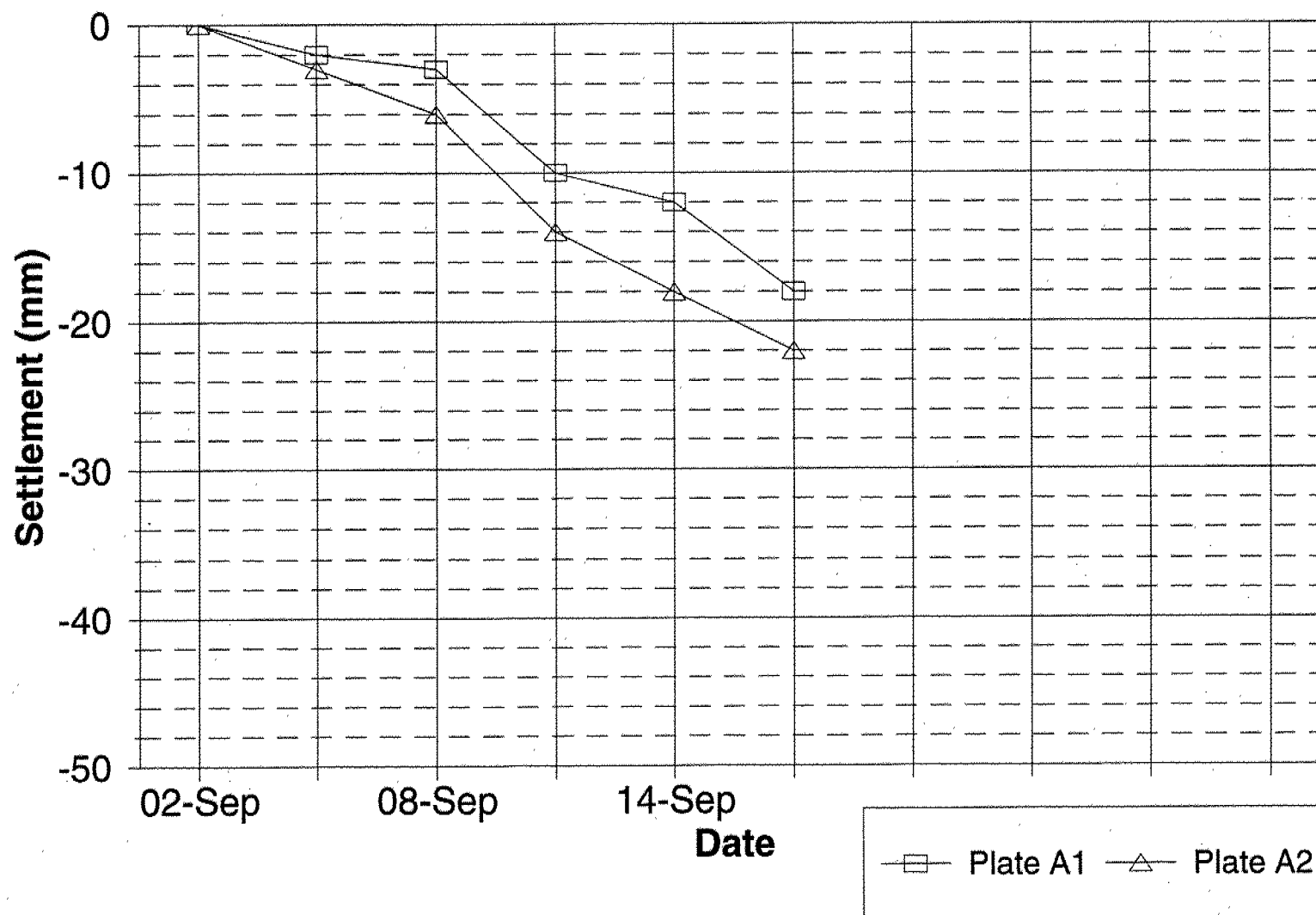
Figures



Environnement Canada / Environment Canada



Figure 1: Settlement Monitoring Settlement Plates A1 & A2



**Figure 2: Settlement Monitoring
Settlement Plates B1 & B2**

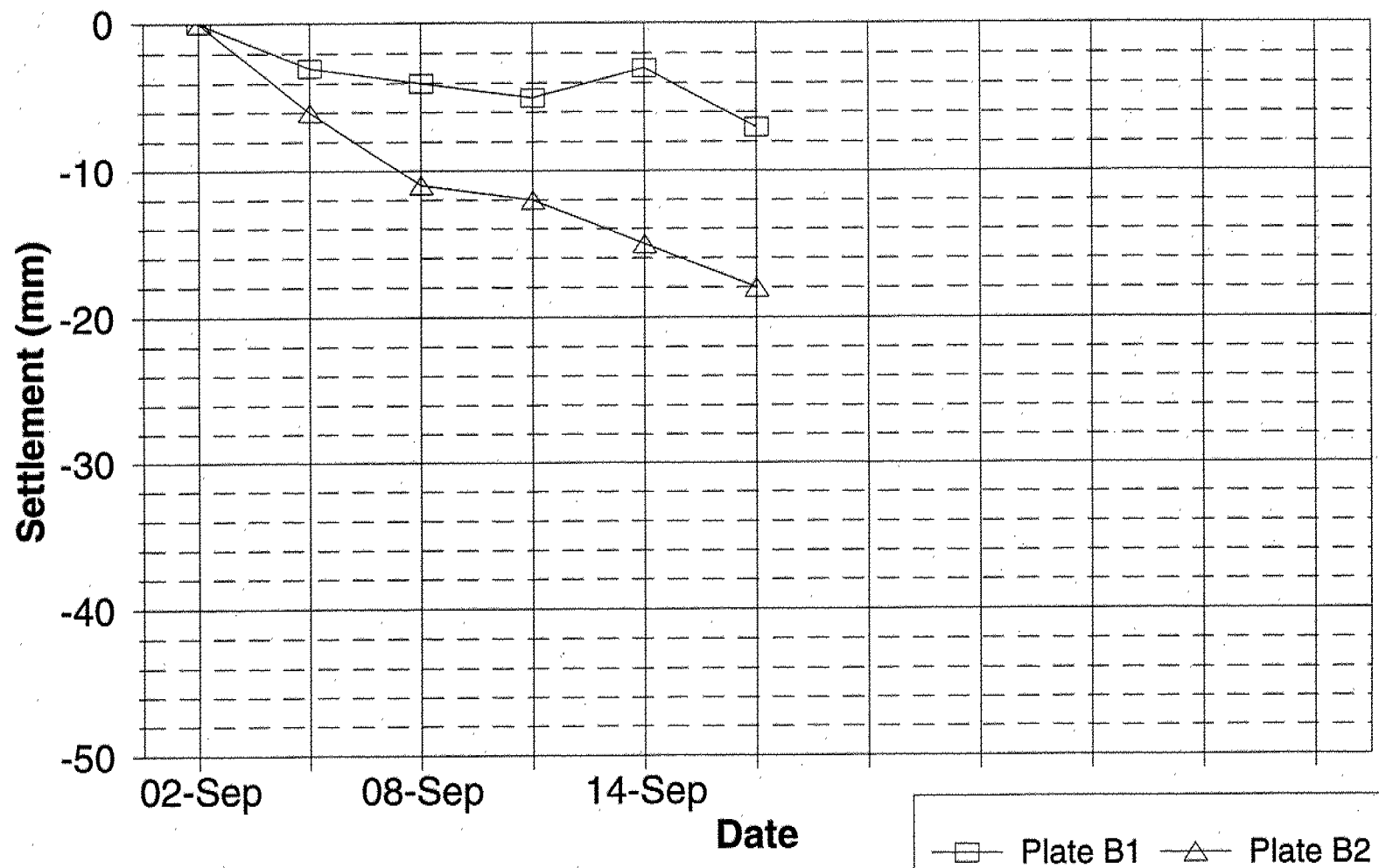
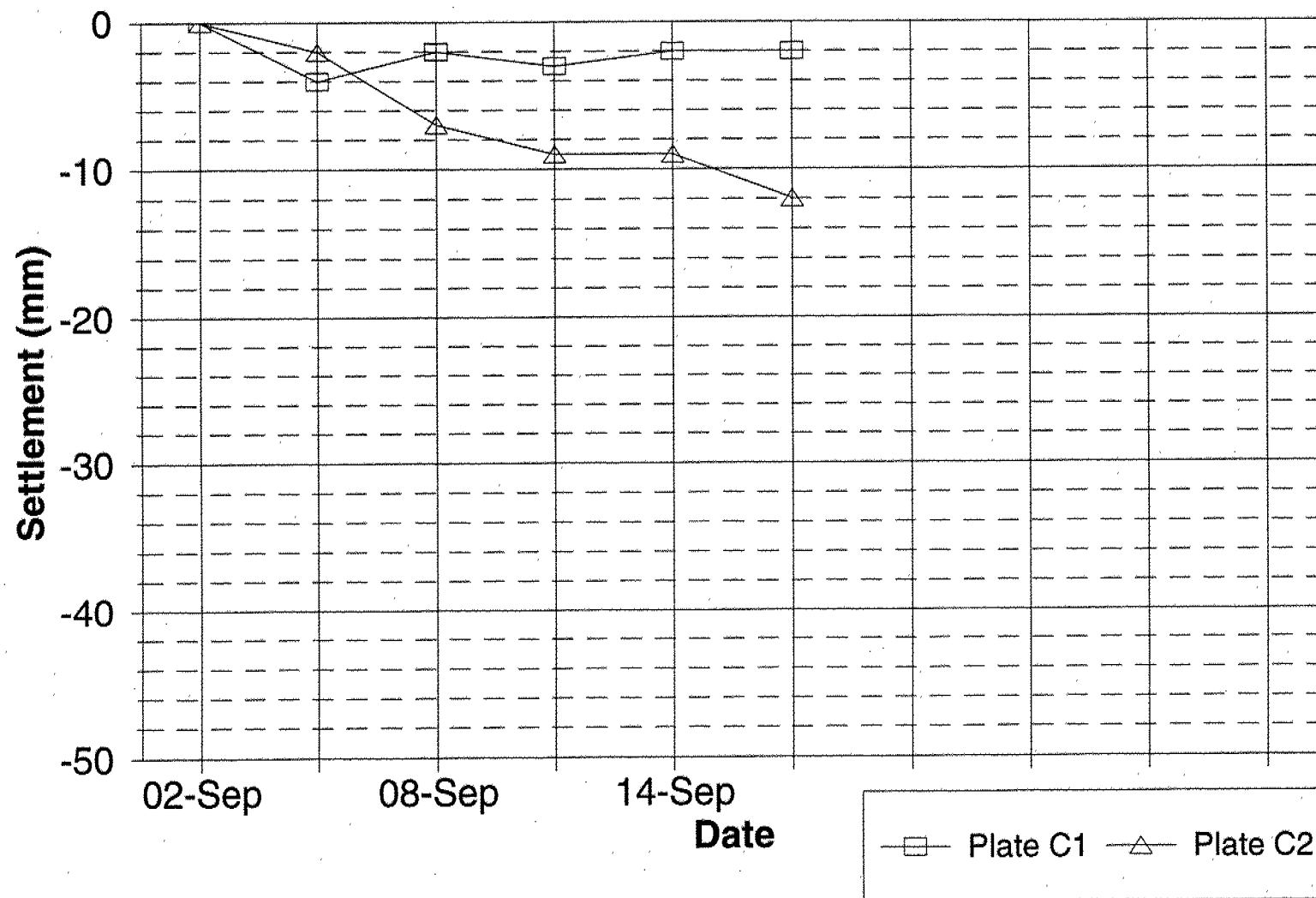
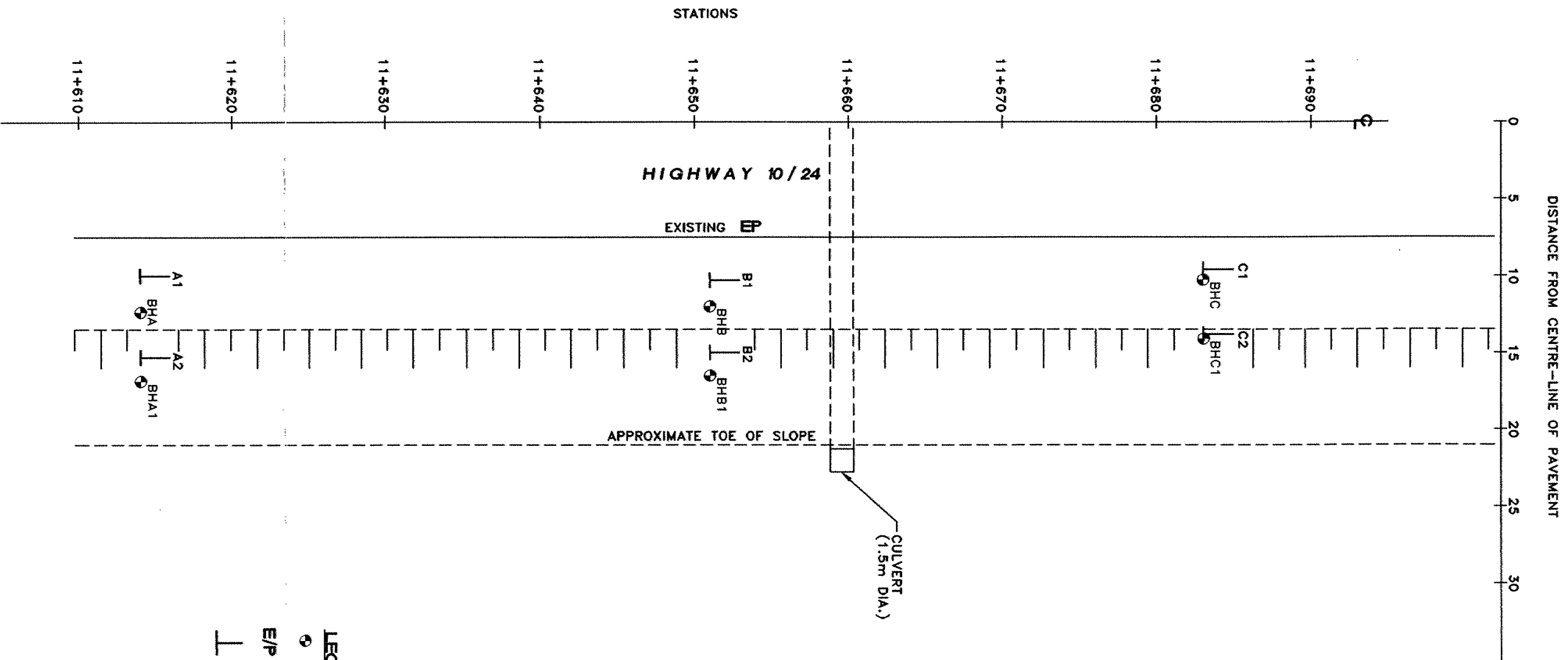


Figure 3: Settlement Monitoring
Settlement Plates C1 & C2



Drawings



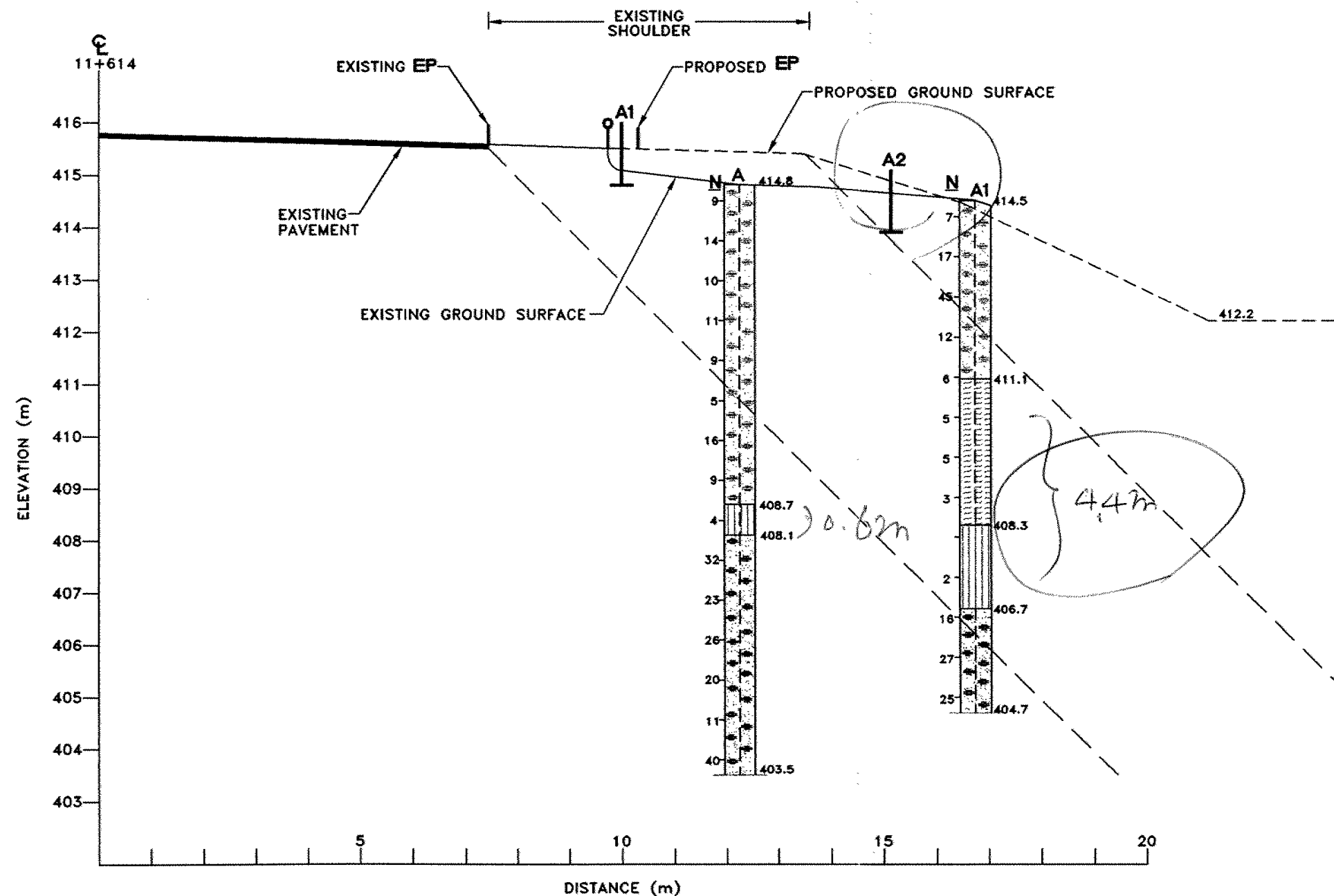
- LEGEND**
- BOREHOLE
 - E/P EDGE OF PAVEMENT
 - └ SETTLEMENT PLATES

BOREHOLE LOCATION PLAN

Job No:	10183	Dwg. No:	A1
Date:	98/09/17	Dwn. by:	PC
		Appd:	DW



**Jacques
Whitford**



NOTE: AS BUILT CROSS-SECTION
NOT UNIFIED.

0 1 2 3 4 5m
SCALE 1:100

CROSS SECTION SHOWING BOREHOLE A AND A1 LOCATION AND SUBSOIL STRATIGRAPHY
STATION No. 11 + 614
HIGHWAY 10/24, ORANGEVILLE, ONTARIO

Job No:

10183

Dwg. No:

1

Date:

98/09/15

Dwn. by:

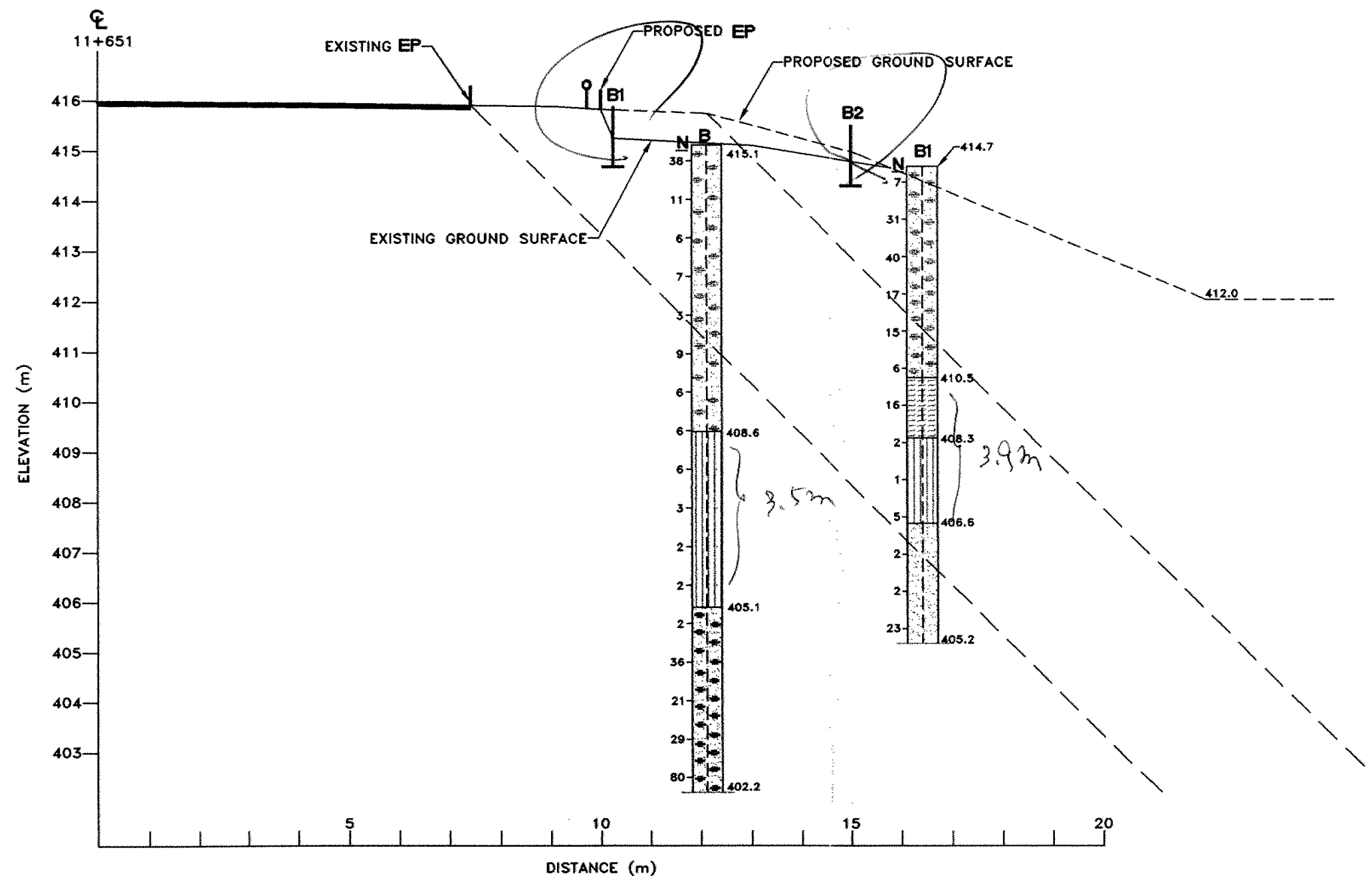
PC

Appd:

DW

JW Jacques Whitford

10183-3

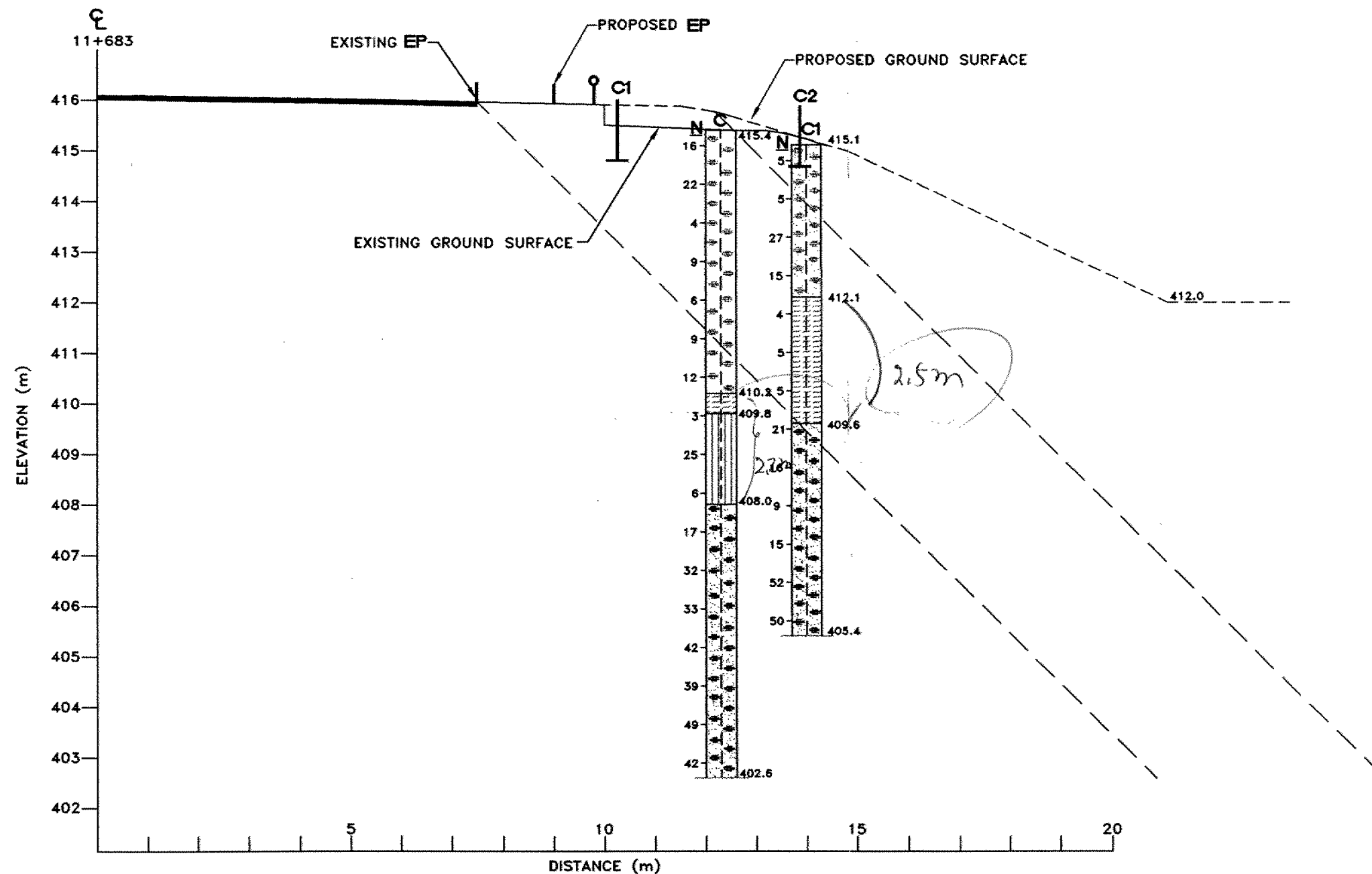


NOTE: AS BUILT CROSS-SECTION
NOT UNIFIED.

CROSS SECTION SHOWING BOREHOLE B AND B1 LOCATION AND SUBSOIL STRATIGRAPHY
STATION No. 11 + 651
HIGHWAY 10/24, ORANGEVILLE, ONTARIO

Job No:	10183	Dwg. No:	2
Date:	98/09/15	Dwn. by:	PC
		Appd:	DW

JWA Jacques Whitford



NOTE: AS BUILT CROSS-SECTION
NOT UNIFIED

0 1 2 3 4 5m
SCALE 1:100

CROSS SECTION SHOWING BOREHOLE C AND C1 LOCATION AND SUBSOIL STRATIGRAPHY
STATION No. 11 + 683
HIGHWAY 10/24, ORANGEVILLE, ONTARIO

Job No:	10183	Dwg. No:	3
Date:	98/09/15	Dwn. by:	PC
		Appd:	DW

W Jacques Whitford

10183-5

Borehole Logs

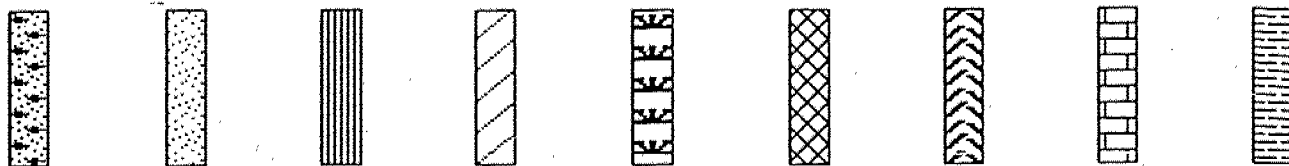


Environmental Protection Agency



SYMBOLS AND TERMS USED ON THE BOREHOLE AND TEST PIT RECORDS

STRATA PLOT



Gravel & Sand Sand Silt Clay Peat/Topsoil (Organic Silt) Fill Igneous Bedrock Limestone Bedrock Metamorphic Bedrock

SOIL DESCRIPTION

Terminology used for describing soil strata based upon the proportion of individual particle sizes present:

Trace, or occasional	less than 10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. silt and sand)	35-50%

The standard terminology to describe cohesionless soils includes the relative density, as determined by laboratory test or by the Standard Penetration Test 'N'-value: the number of blows of 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler one foot (305mm) into the soil.

Relative Density	'N' Value	Relative Density %
Very Loose	< 4	< 15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	> 50	> 85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by in-situ tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength		'N' Value
	kips/sq.ft.	kPa	
Very Soft	< 0.25	< 12.5	< 2
Soft	0.25-0.5	12.5-25	2-4
Firm	0.5-1.0	25-50	4-8
Stiff	1.0-2.0	50-100	8-15
Very Stiff	2.0-4.0	100-200	15-30
Hard	> 4.0	> 200	> 30

SYMBOLS AND TERMS USED ON THE BOREHOLE AND TEST PIT RECORDS

ROCK DESCRIPTION

The description of bedrock is based on the rock quality designation (RQD).

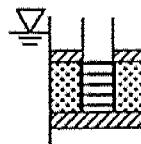
The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. In most cases RQD is run on NXL core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from normal in-situ fractures.

RQD	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured.

WATER LEVEL MEASUREMENT



Open Borehole



Piezometer or Standpipe

SAMPLES

SS.... Split spoon sample (obtained by performing the standard penetration test)	BS.... Bulk sample
AS.... Auger sample	WS.... Wash sample
ST.... Shelby tube or thin wall tube	RC.... Rock core AXT, BXL, etc.... Rock core samples obtained with the use of standard diamond drilling bits.
PS.... Piston sample	
LS.... Sample submitted for Laboratory Analysis	
GS.... Grab Sample	

VAPOUR CONCENTRATIONS

▲.... ppm
●.... % LEL

1% LEL is the equivalent of 110 ppm based on a hexane calibration

BOREHOLE RECORD

BHA

CLIENT First Professional Management Inc.

PROJECT No. 10183

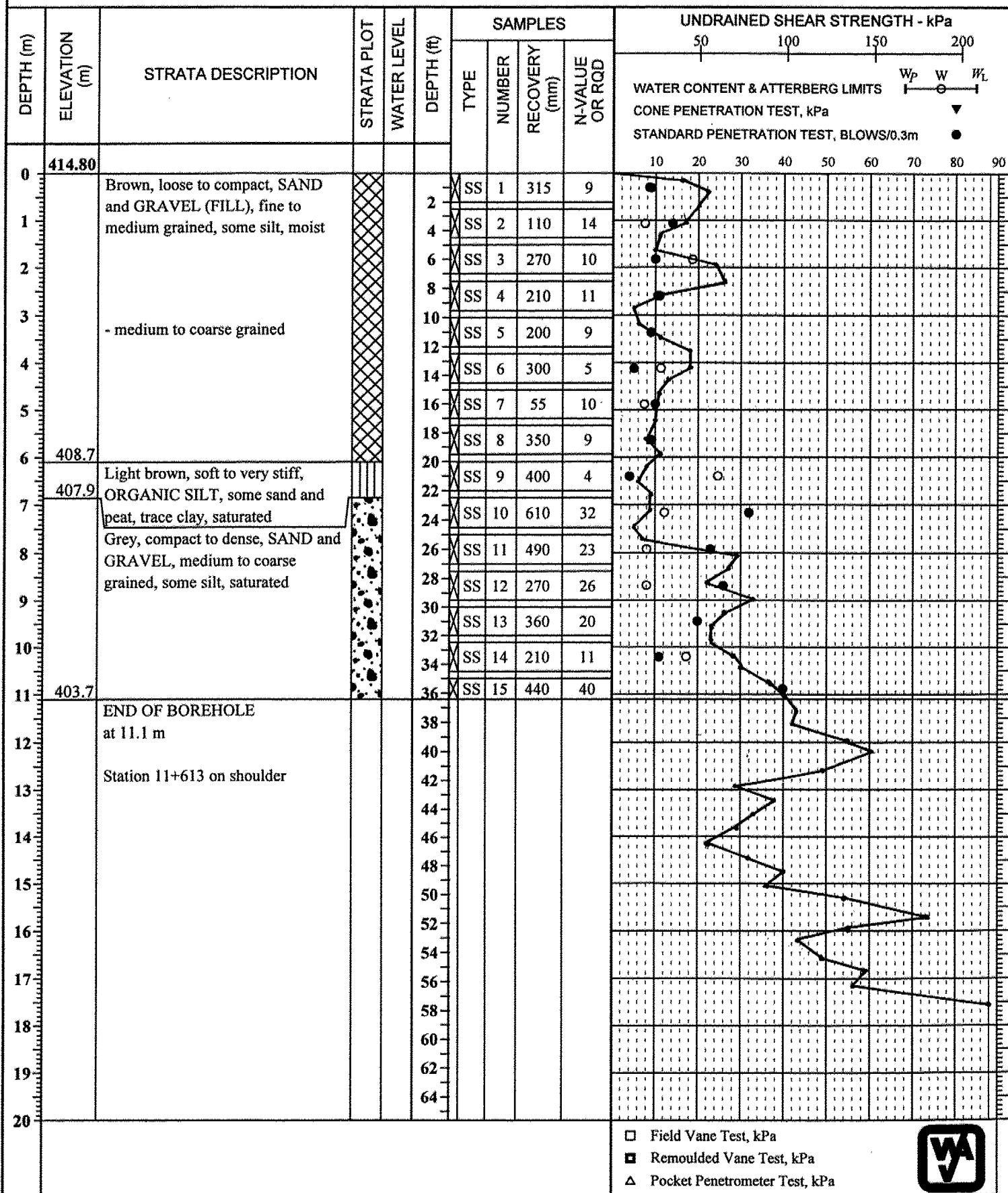
LOCATION Highway 10/24, Orangeville, Ontario

DATUM Geodetic

DATES: BORING 98/09/09

WATER LEVEL ---

TPC ELEV. ---





BOREHOLE RECORD

BHB

CLIENT First Professional Management Inc.

PROJECT No. 10183

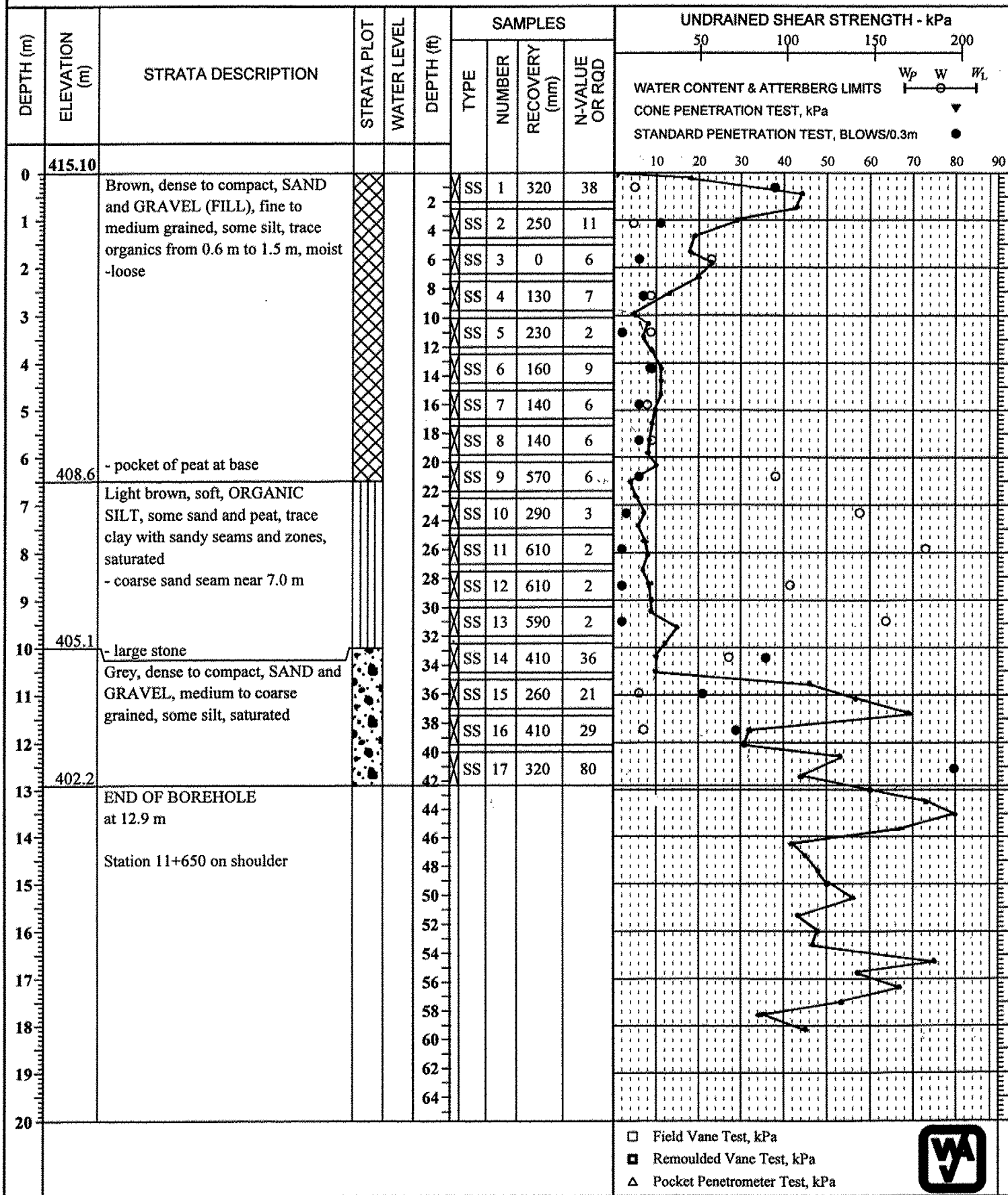
LOCATION Highway 10/24, Orangeville, Ontario

DATUM Geodetic

DATES: BORING 98/09/09

WATER LEVEL ---

TPC ELEV. ---



BOREHOLE RECORD

BHB1

CLIENT First Professional Management Inc.PROJECT No. 10183LOCATION Highway 10/24, Orangeville, OntarioDATUM GeodeticDATES: BORING 98/09/09WATER LEVEL ---TPC ELEV. ---

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH - kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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BOREHOLE RECORD

BHC

CLIENT First Professional Management Inc.

PROJECT No. 10183

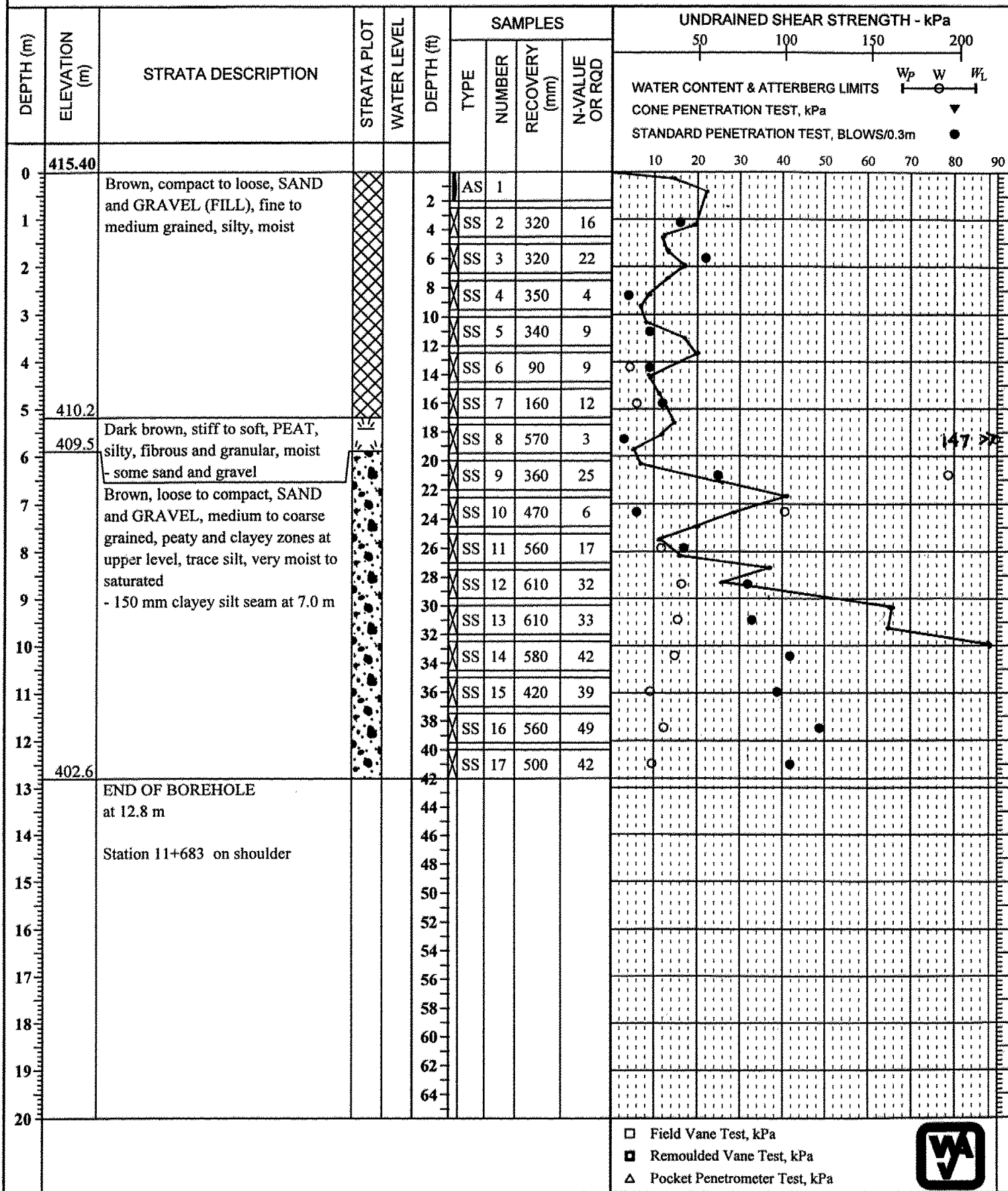
LOCATION Highway 10/24, Orangeville, Ontario

DATUM Geodetic

DATES: BORING 98/09/09

WATER LEVEL ---

TPC ELEV. ---



JACQUES WHITFORD
ENVIRONMENT LIMITED

BOREHOLE RECORD

BHC1

CLIENT First Professional Management Inc.

PROJECT No. 10183

LOCATION Highway 10/24, Orangeville, Ontario

DATUM Geodetic

DATES: BORING 98/09/09

WATER LEVEL ---

TPC ELEV. ---

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL	DEPTH (ft)	SAMPLES				UNDRAINED SHEAR STRENGTH - kPa											
						TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD	50	100	150	200								
0	415.10	Brown, loose to compact, SAND and GRAVEL (FILL), fine to medium grained, silty, fibrous and granular, moist			2	SS	1	350	5												
1	4				SS	2	390	5													
2	6				SS	3	590	27													
3	8				SS	4	320	15													
4	412.1	Dark brown, firm to very stiff, PEAT, silty, fibrous and granular, moist			10	SS	5	390	4												
5	12				SS	6	440	5													
6	14				SS	7	300	5													
7	16				SS	8	440	21													
8	409.6	Grey, compact, SAND and GRAVEL, medium to coarse grained, trace silt, moist - piece of stone at 6.5 m - 300 mm organic silt layer at 7.3 m - fine to medium grained, with coarse to medium grained sand seams at 8.0 m			20	SS	9	610	16												
9	22				SS	10	570	9													
10	24				SS	11	610	15													
11	26				SS	12	610	52													
12	405.4	END OF BOREHOLE at 9.7 m			28	SS	13	560	50												
13	30																				
14	32																				
15	34																				
16		Station 11+683 on slope			36																
17	38																				
18	40																				
19	42																				
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	50																				
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	60																				
	62																				
	64																				

☐ Field Vane Test, kPa

☒ Remoulded Vane Test, kPa

☐ Pocket Penetrometer Test, kPa

Appendix A Test Pit Report





**Jacques Whitford
Environment Limited**

Consulting Engineers
Environmental Scientists
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Goose Bay, LAB
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Toronto, ON
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Calgary, AB
Lethbridge, AB
Vancouver, BC
Freeport, ME
Winslow, ME
Portsmouth, NH
West Topsham, VT
Port of Spain, Trinidad
Mexico, DF
Moscow, Russia
Buenos Aires, Argentina

Project No. 10183

August 31, 1998

Mr. David Mills

First Professional Management Inc.
259 Yorklan Road
Suite 300
North York, Ontario
M2J 5B2

Dear Mr. Mills:

**Re: Test Pits Near Station 11+660
Highway 10/24 Improvement
Orangeville, Ontario**

Further to the directions given in the site meeting on August 27, 1998, Armbró supplied a backhoe and carried out test pits at the toe of the east embankment slope in the area between approximately Stations 11+ 570 to 11+ 700. A total of four test pits were planned. However, due to the proximity of open water from the reservoir to the toe of the slope near Station 11+690 areas, the contractor did not proceed with the test pit excavation at this location.

A total of three test pits were undertaken. The test pit excavation started from the silt fence line and proceeded up and into the existing slope. The observations noted in the test pits area are summarized in Table 1. The elevations shown in the table are based on using the elevation at the toe of the embankment from the cross-sections in the immediate vicinity shown on the drawings prepared by Greer Galloway Group as a reference. The Elevations should therefore, be considered as an approximation only.

In summary, organic soil was noted below the embankment fill in all three test pits. The base of the organic soil could not be established due to the depth encountered and the sides of the excavation became unstable. The depth will be established by boreholes which are scheduled to commence on September 1, 1998. It should be noted that at Test Pit 3 (Station 11+655), a thin layer of white sand (0.3 m \pm) was noted near the base of the toe. However, organic soil was noted to underlie this sand layer.



Page 2
Mr. David Mills
August 31, 1998

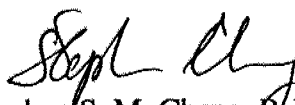
Based on the information obtained from the test pits, the following are recommended.

- Due to the presence of thick organic soil near the toe of the slope which extended into the embankment, no additional granular fill should be added until a clearer picture of the soil conditions in the area is known;
- In order to obtain the subsoil conditions in the area, three sets of boreholes, one each near the crest and part way down the east embankment at the three settlement plates locations should be drilled (to verify the presence as well as thickness of the organic soil); and
- Monitor the settlement of the embankment over a period of time.

We trust that the above interim information is satisfactory for your consideration and action. Should you have any queries, please do not hesitate to contact this office.

Yours truly,

Jacques Whitford Environment Limited


Stephen S. M. Cheng, P. Eng.
Manager, Geotechnical Division

Distribution:	Addressee	(1)	Fax: 416-493-2744
	Mr. Brad Kalus – The Greer Galloway Group Inc.	(1)	Fax: 705-743-9592
	Mr. Dennis G. Regan MTO	(1)	Fax: 519-649-3182
	Mr. Eric Magni MTO	(1)	Fax: 519-649-3108



Table 1: Observations in Test Pits

Test Pit No.	Approximate Station	Observations
1	11+581	West face of test pit at approximately 13.3 m from the C/L of the existing roadway. Organic soil was noted at the west face of the test pit below ~ Elevation 412.4 m to the termination near ~ Elevation 410.1 m (~2.4 m below the toe of slope). Native soil not encountered at the base of test pit. No Settlement plates installed in this area.
2	11+600	West face of test pit at approximately 16.3 m from C/L of roadway. Organic soil was noted at the west face of the test pit below ~ Elevation 411.7 m to the termination near ~ Elevation 410.1 m. (~2.2 m below the toe of slope). Native soil was not encountered at the base of the test pit.. Settlement Plates A1 (at existing cable guardrail) and A2 (at present top of slope) installed in this area.
3	11+655	West face of test pit at approximately 16.1 m from C/L of existing roadway. Organic soil inter-bedded with sand was noted at the west face of the test pit below ~ Elevation 410.7 m to the termination near ~ Elevation 409.7 m (~2.6 m below the toe of slope). Native soil was not encountered at the base of the test pit. Settlement Plates B1 (at existing cable guardrail) and B2 (at present top of slope) installed in this area.
4	11+690	Test pit not advanced due to proximity to the reservoir's open water. Settlement Plates C1 (at existing cable guardrail) and C2 (at present top of slope) installed in this area.

Note: Elevation are approximate and are based on the toe elevation noted on the cross-sections provided by Greer Galloway for the closest Stations in the vicinity of the test pits.



Appendix B

Armbro's Compaction Reports



Faxsimile Transmission

To: Steve Chang

Company: Jacques Whitford & Associates

Fax # 905-479-9326

From: John Krasko

Fax #905-451-9827 Phone 905-451-0690

Date: August 25, 1998

pages

6

Subject : Hwy 10/24 QA /QC

Message :

Steve,

Attached are the following test strip reports for the Highway 10/24 widening @ Orangeville.

Yours Truly ,

Armbro Construction Limited

John Krasko

John Krasko, Estimator / Project Manager



Ambro Materials Engineering

Daily Field Summary

Date:

27/05/98

Contract No.:

Job No.:

548

Job Name:

Location:

HWY 10 & 29 (ORANGEVILLE)
HWY 10 E/S & W/S

Type Of Material Tested:

☒
☐
☐
☐

Subgrade

Trench Backfill

Engineered Fill

Other

☐
☐

Granular Subbase

Granular Base

☐
☐

Binder Asphalt

Surface Asphalt

Material Type:

Opt M/C %

Density (kg/m³)

EST

LAB

	Material Type	Opt M/C %	Density (kg/m ³)	EST	LAB
A	PIT RUN GRAN 'B'		1932	<input checked="" type="checkbox"/>	<input type="checkbox"/>
B	NATURAL 'B'	8.3	2152	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Specified and In-Situ Compaction (%)

Proctor Method

☒
☐

Standard

Modified

Material A

Material B

Specified

Achieved

Q index

95	95+
95	95+

Weather:

Compaction Equipment:

SUNNY 28°C

LARGE SMOOTH DRUM

☒
☐

Preliminary Report Left on site with

Sample(s) obtained for laboratory analysis/ no. of samples:

SHAWN

Comments:

A CONTROL STRIP WAS USED TO ESTIMATE
PIT RUN GRAN 'B' @ 1935 AROUND 8-9%
MOISTURE CONTENT.
NATURAL 'B' MATERIAL WAS GRANULAR
SHOULDER VERY BONY

Corrective Actions:

Technician:

M. BERRY

Pg. 1 of 1



Armco Materials Engineering

Daily Field Summary

Date: 28/05/98
Contract No.: _____
Job No.: 548

Job Name: HWY 10 & 29 ORANGETHUR
Location: HWY 10 E/S & W/S

Type Of Material Tested:

<input checked="" type="checkbox"/> Subgrade	<input checked="" type="checkbox"/> Granular Subbase	<input type="checkbox"/> Binder Asphalt
<input type="checkbox"/> Trench Backfill	<input type="checkbox"/> Granular Base	<input type="checkbox"/> Surface Asphalt
<input type="checkbox"/> Engineered Fill		
<input type="checkbox"/> Other		

Material Type: _____ Opt W/C % _____ Density (kg/m³) _____

A	<u>PIT RUN GRAN 'B'</u>	<u>1932</u>	<input checked="" type="checkbox"/> EST	<input type="checkbox"/> LAB
B	<u>GRAN 'B' (SANDY)</u>	<u>2048</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C	<u>GRAN 'B' (DARKER MATERIAL)</u>	<u>2141</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Proctor Method _____

<input checked="" type="checkbox"/> Standard	Material A	Specified	Achieved	Q index
<input type="checkbox"/> Modified	Material B	<u>95</u>	<u>95 +</u>	
	" C	<u>100</u>	<u>100 +</u>	

Weather: SUNNY, SOME OVERCAST 28°C
Compaction Equipment: LARGE SMOOTH DRUM

☒ Preliminary Report Left on site with SHAWN
☐ Sample(s) obtained for laboratory analysis/ no. of samples: _____

Comments:

GRAN 'B' MATERIAL WAS ESTIMATED BY MEANS
OF TEST STRIP.
DARKER MATERIAL HAD LESS SAND & HIGHER DENSITY
@ 2141
LIGHTER MATERIAL SANDY @ 2048
GRAN 'B' WAS PLACED IN 2 LIFTS, RESULTS ARE FROM
THE 1ST LIFT. (11+140 -> 11+500)

Corrective Actions:

Technician: M. BENY



ARM BRO MATERIALS ENGINEERING COMPACTION TEST RESULTS

Job No.:

#548

Job Name:

HWY 10 (ORANGEVILLE)

Job Location:

HWY 10 E/S F/W/S

Date:

27/05/98

Test No.	Test Location	Material Type	Proctor / Moisture	% Moisture	Wet Density	Dry Density	% Compaction
1	10 + 653 10.0 m RT. @ SUBGRADE	PT. RUN 'B'	1932	7.8	2088	1935	100
2	11 + 181 15.6 m LT. @ SUBGRADE	NATIVE 'B'	2152 8.3	3.6	2240	2162	101
3	11 + 260 12.0 m LT. @ SUBGRADE	"	"	6.2	2258	2127	99
4	11 + 300 11.0 m LT. @ SUBGRADE	"	"	3.7	2187	2109	98
5	11 + 345 8.5 m LT. @ SUBGRADE	"	"	4.8	2218	2115	98
6	11 + 455 10.0 m LT. @ SUBGRADE	"	"	2.7	2273	2214	103
7	11 + 555 13.0 m LT. 1.5 BELOW O/G	"	"	8.4	2253	2078	97
8	11 + 622 14.0 m RT. 1.5 BELOW O/G	PT. RUN 'B'	1932	6.1	2053	1935	100
9	11 + 700 12.0 m RT. 2.4 m BELOW O/G	NATIVE 'B'	2152 8.3	6.0	2261	2133	99
10	11 + 595 11.0 m RT. 1.5 m BELOW O/G	"	"	6.2	2233	2103	98

MS
DS513.7
2946

Page 1 of 1



ARMRO MATERIALS ENGINEERING COMPACTION TEST RESULTS

Job No.:

Job Location:

548

HWY 10 E/S

(FILL)

Job Name: HWY 10 E 24 ORANGEVILLE

Date:

20/05/98

PIT RUN
"B"

Test No.	Test Location	Material Type	Proctor / Moisture	% Moisture	Wet Density	Dry Density	% Compaction
1	11 + 632 13.0 m RT. 1.3 BELOW E/PAV.	1932		7.9	2118	1963	102
2	11 + 593 12.0 m RT. 0.8 m BELOW EX/PAV.	"	"	5.6	1969	1864	96
3	11 + 685 11.0 m RT. 1.8 m BELOW EX/PAV	"	"	5.5	2057	1950	101
4	11 + 508 12.0 m RT. @ SUBGRADE	"	"	6.6	2045	1918	99
5	11 + 558 14.0 m RT. @ SUBGRADE	"	"	4.2	2069	1986	103
6	11 + 611 11.0 m RT. @ SUBGRADE	"	"	5.8	2075	1962	102
7	11 + 675 10.0 m RT @ SUBGRADE	"	"	6.4	2022	1901	98

MS
DS

514.0
2967



ARMBRO MATERIALS ENGINEERING
COMPACTION TEST RESULTS

Job No.:

548

Job Name:

HWY 10 & 24

Job Location:

HWY 10 & 24
W/S GRAN 'B' 1ST LIFT.

Date:

28/05/98

Test No.	Test Location	Material Type	Proctor / Moisture	% Moisture	Wet Density	Dry Density	% Compaction
1	11 + 492 11.0m LT. 1ST LIFT	GRAN - B	2141	6.9	2297	2145	100
2	11 + 420 10.0m LT. 1ST LIFT	"	2048	5.4	2182	2061	100
3	11 + 341 9.0m LT. 1ST LIFT	"	2141	8.6	2324	2139	100
4	11 + 288 12.0m LT. 1ST LIFT	"	2048	5.6	2216	2099	100
5	11 + 237 7.0m LT. 1ST LIFT	"	2141	6.5	2287	2147	100
6	11 + 160 14.5m LT. 1ST LIFT	"	2048 2048	4.9	2170	2068	100

MS
DS

514.0
2967



Faxsimile Transmission

To: Steve Chang

Company: Jacques Whitford & Associates

Fax # 905-479-9326

From: John Krasko

Fax #905-451-9827 Phone 905-451-0690

Date: August 25, 1998

pages 6

Subject : Hwy 10/24 QA /QC

Message :

Steve,

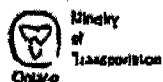
Attached are the QA/QC reports for the Highway 10/24 widening @ Orangeville.

Yours Truly ,

Armbro Construction Limited

John Krasko

John Krasko, Estimator / Project Manager



FIELD COMPACTION REPORT - NUCLEAR GAUGE No. _____

PROCTOR DATA or CONTROL STRIP

CONTRACT No. _____
HWY. No. 10
REGION _____

TYPE OF MATERIAL GRANULAR B
SOURCE LOCKER GRAVEL

③ MDD -
OMC -

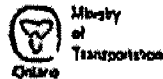
TARGET DENSITY
⑤ - 2120 @ 7.1

REFERENCE STANDARD READINGS ▶					③ MOISTURE -					⑤ DENSITY -					DATE: SEP 30 17				
TEST No		PLACEMENT			STATION	OFFSET	MOISTURE				DENSITY				% COMPACTION				
LOT	SUB LOT	CULVERT & STRUCTURES PIPES & SEWERS	GRADE	OTHER			③ COUNT PER MINUTE	RATIO $\frac{C}{A}$	WATER CONTENT		⑤ COUNT PER MINUTE	RATIO $\frac{D}{B}$	⑥ WET DENSITY $1/m^3 [pcf]$	DRY DENSITY $1/m^3 [pcf]$ F-E	SUB LOT $\frac{F-E}{G} \times 100$	LOT MEAN \bar{X}	LOT RANGE R	ACCEPTED	REJECTED
									④ $\frac{E}{F-E} \times 100$ $1/m^3 [pcf]$	IN % $\frac{E}{F-E} \times 100$									
1	1				11+225	1.0							2065	97.4	98.2				
	2				+250	1.5							2092	98.7					
	3				+275	2.0							2094	98.8					
	4				+300	1.0							2070	97.6					
2	1				+325	1.5							2085	98.3	98.5				
	2				+350	2.0							2090	98.6					
	3				+375	1.5							2082	98.2					
	4				+400	1.0							2095	98.8					
3	1				+425	1.5							2050	96.7	97.5				
	2				+450	1.5							2068	97.5					
	3				+475	1.0							2070	98.6					
	4				+500	2.0							2072	97.7					
4	1				+525	2.0							2092	98.7	98.3				
	2				+550	2.5							2080	98.1					
	3				+575	1.5							2086	98.3					
	4				+600	2.0							2081	98.1					

Rejected areas shall be further compacted. Retested areas should be indicated with the letter 'R', using the original lot number.

REMARKS: _____

PRALASH KANDASAM
TECHNICIAN



TYPE OF MATERIAL GRANULAR B
SOURCE LOKER GRAVEL

FIELD COMPACTION REPORT - NUCLEAR GAUGE No. _____
PROCTOR DATA or CONTROL STRIP
(G) MOD - _____ TARGET DENSITY
OMC - _____ (G) - 2120 @ 7.1

CONTRACT No. _____
HWY. No. 10
REGION _____

REFERENCE STANDARD READINGS					(A) MOISTURE -					(B) DENSITY -					DATE: SEP				
TEST No		PLACEMENT			STATION	OFFSET	MOISTURE			DENSITY				% COMPACTION					
LOT	SUB LOT	CULVERT & STRUCTURES PIPES & SEWERS	GRADE	OTHER			(C) COUNT PER MINUTE	RATIO $\frac{C}{A}$	WATER CONTENT		(D) COUNT PER MINUTE	RATIO $\frac{D}{B}$	(F) WET DENSITY $1/m^3(pcf)$	DRY DENSITY $1/m^3(pcf)$	SUB LOT MEAN \bar{X}	LOT RANGE R	ACCEPTED	REJECTED	
									(E) $1/m^3(pcf)$	IN % $\frac{E}{F-E} \times 100$									(F) WET DENSITY $1/m^3(pcf)$
5	1				+625	2.0						2062	97.3	97.2					
	2				+650	2.5						2060	97.2						
	3				+675	1.5						2056	97.0						
	4				+700	1.0						2070	97.6						
6	1				+710	2.5						2092	98.6	98.4					
	2				+725	2.0						2085	98.3						
	3																		
	4																		
	1																		
	2																		
	3																		
	4																		
	1																		
	2																		
	3																		
	4																		

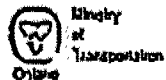
Rejected areas shall be further compacted. Retested areas should be indicated with the letter 'R', using the original lot number.

REMARKS: _____

Prakash KANDASAMU
TECHNICIAN

COPIES TO WHITE - REGIONAL QUALITY ASSURANCE CANARY - CONTRACTOR PINK - PROJECT SUPERVISOR GOLDEN ROD - CONSTRUCTION SUPERVISOR/ORIGINATOR
PH-EC-9 05-04

24 BELOW



FIELD COMPACTION REPORT - NUCLEAR GAUGE No. _____

CONTRACT No. _____

PROCTOR DATA or CONTROL STRIP

HWY. No. _____

TYPE OF MATERIAL GRAVULAR B

③ MOD -

TARGET DENSITY

REGION _____

SOURCE LOKER GRAVEL

OMC -

⑥ - 2120 @ 7.1

REFERENCE STANDARD READINGS ▶						③ MOISTURE -				⑥ DENSITY -				DATE: <u>SEP 30 17</u>						
TEST No		PLACEMENT				STATION	OFFSET	MOISTURE				DENSITY				% COMPACTION				
LOT	SUB LOT	CULVERT & STRUCTURES	PIPES & SEWERS	GRADE	OTHER			③ COUNT PER MINUTE	RATIO $\frac{C}{A}$	WATER CONTENT		④ COUNT PER MINUTE	RATIO $\frac{D}{B}$	⑥ WET DENSITY $1/m^3(pcf)$	DRY DENSITY $1/m^3(pcf)$ $f-E$	SUB LOT $\frac{f-E}{G} \times 100$	LOT MEAN \bar{X}	LOT RANGE R	ACCEPTED	REJECTED
										⑤	IN % $\frac{E}{F-E} \times 100$									
1	1					11+500	1.5						2052	96.8	96.9					
	2					+ 525	2.0						2064	97.3						
	3					+ 550	3.0						2050	96.7						
	4																			
2	1					+575	3.0						2061	97.2	97.3					
	2					+600	1.5						2059	97.1						
	3					+625	1.0						2072	97.7						
	4																			
	1																			
	2																			
	3																			
	4																			
	1																			
	2																			
	3																			
	4																			

Rejected areas shall be further compacted. Retested areas should be indicated with the letter 'R', using the original lot number.

REMARKS: _____

PraCASH Kandasami
TECHNICIAN

COPIES TO WHITE - REGIONAL QUALITY ASSURANCE CANARY - CONTRACTOR PINK - PROJECT SUPERVISOR GOLDEN ROD - CONSTRUCTION SUPERVISOR/ORIGINATOR
PH-CC-1 05-04

Job No.:
Job Location:

Job Name: FIRST PROFESSIONAL DEVELOPMENT
Date: 25/05/98

MS
DS

25 / 05 / 1598

[illegible]

Appendix C

Stability Analysis Result

