



**FEASIBILITY FOUNDATION INVESTIGATION AND DESIGN  
REPORT 2 – GEOGRAPHICAL TOWNSHIP OF RALEIGH  
for  
HIGHWAY 401 – CHATHAM-KENT  
FROM 0.9 KM EAST OF ESSEX COUNTY ROAD 42  
EASTERLY 66.1 KM TO THE ELGIN COUNTY BOUNDARY  
AGREEMENT NUMBER 3004-E-0001  
GWP NO. 80-00-00  
for  
MCCORMICK RANKIN CORPORATION**

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**Feasibility Foundation Investigation and Design  
Report 2 – Geographical Township of Raleigh**

for  
Highway 401 – Chatham-Kent  
From 0.9 Km East of Essex County Road 42  
Easterly 66.1 Km to the Elgin County Boundary  
Agreement Number 3004-E-0001  
GWP No. 80-00-00

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**1. INTRODUCTION**

This report presents the results of the foundation feasibility study carried out for the proposed widening of the Highway 401 section through the Geographical Township of Raleigh, County of Kent. The study is being carried out for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

MTO plans to widen the Highway 401 section extending from 0.9 km east of Essex County Road 42 easterly 66.1 km to the Elgin County Boundary from four to six lanes. Feasibility studies are required for the foundations of the existing bridge structures and structural culverts (span larger than 3.0 m) between the study limits. The freeway section traverses five geographical townships and the reporting was separated into five reports designated as follows:

- Report 1 – Geographical Township of Tilbury East/North
- Report 2 – Geographical Township of Raleigh
- Report 3 – Geographical Township of Harwich
- Report 4 – Geographical Township of Howard
- Report 5 – Geographical Township of Orford

This report concerns the Highway 401 section through the Geographical Township of Raleigh which extends between the geographical boundaries of the Townships of Tilbury East and Harwich on the west and east, respectively for some 15.9 km. A key map for this section of the Highway 401 is highlighted in Figure 2-1.

Within the limits of Raleigh Township, there are five underpass bridge structures, including the underpass for one interchange, eight bridges and two structural culverts that are described in the following section.





All dimensions in this report are provided in metres except where indicated.

## 2. SITE DESCRIPTION

The Highway 401 through the Geographical Township of Raleigh is currently a four-lane freeway.

The following table lists the MTO site numbers, locations and types of structures and structural culverts along this section of Highway 401.

**LIST OF STRUCTURES**

Structure Name	Site No.	Station (*)	Type
Merlin Road Underpass	13-191	~10+032	4-span steel girder structure
Deary Drain Culvert	13-400-C	10+765.65	Conc. Open Footing (4.27 by 1.83 by 53.3)
Drake Road Underpass	13-262	~14+216	4-span Prestressed Conc. Beams structure
Government Drain No. 2 Bridge EBL	13-152/1	~14+387	Concrete Rigid Frame
Government Drain No. 2 Bridge WBL	13-152/2	~14+387	Concrete Rigid Frame
Dillon Road Underpass	13-292	~18+060	4-span Prestressed Conc. Beams structure
Government Drain No. 3 Bridge EBL	13-227/1	~18+100	Concrete Rigid Frame
Government Drain No. 3 Bridge WBL	13-227/2	~18+100	Concrete Rigid Frame
Raleigh Plains Drain Bridge EBL	13-228/1	~20+050	Concrete Rigid Frame
Raleigh Plains Drain Bridge WBL	13-228/2	~20+050	Concrete Rigid Frame
Flook & Hinton Drain Bridge EBL	13-229/1	~21+450	Concrete Rigid Frame
Flook & Hinton Drain Bridge WBL	13-229/2	~21+450	Concrete Rigid Frame
Bloomfield Road Underpass	13-241	21+877.4	4-span steel girder interchange structure
Culvert Site 13-401	13-401-C	25+253.7	Conc. Open Footing (5.30 by 3.66 by 73.8)
Kent County Road No.10 Underpass	13-235	25+917.5	4-span steel girder structure

Notes: Culvert sizes taken from RFP documents as Span by Width by Length in metres.

(\*) – The chainage refers to Raleigh Township. All chainages should be considered approximate.



The typical topography abutting the highway corridor within the Geographical Township of Raleigh is typically flat or shows a gentle undulation. In general, the highway grades rise gradually to the east with an approximate maximum relief of 3.1 m, between the Tilbury East and Harwich Township boundaries (elevation 179.8 at Merlin Road and elevation 182.9 at Kent County Road No. 10) based on inferred pavement surface elevations at the underpass locations.

The main land use is agricultural and the typical vegetation beyond the highway corridor comprises mostly of farming crops. Isolated stands of trees are also present along the highway corridor and some of the drainage ditches. The roadside ditches are typically covered with grasses. Scattered farm residences and facilities are located near Highway 401. Commercial properties are located north of Highway 401 on Bloomfield Road.

Steel towers from a Hydro corridor border the south shoulder of Highway 401 from about Sta. 18+400 (about 340 m east of the Dillon Road underpass) to the east boundary of Harwich Township for about 7.5 km.

Natural drainage of the lands located along the highway is generally poor. The highway crosses several creeks and man-made drains that were constructed to enhance the natural drainage of the farmland and lower the perched groundwater that is typically encountered at depths close the ground surface along this section of the highway corridor.

The MTO design frost depth for the Geographical Township of Raleigh is 1.2 m.

### **3. INVESTIGATION PROCEDURES**

The foundation feasibility analysis for this report was based primarily on a review of existing data and literature. The data comprised five geological maps and literature, three physiographic maps, twenty-one previous MTO construction contract documents and foundation investigation reports and three groundwater data documents, including 66 water well records. Other sources of documents were also used such as mosaics of aerial photographs, base maps and topographic maps and one Aggregate Resources Inventory Report. Table 2-1 provides a list of the reference documents reviewed for this study.



A large number of the reference documents were in poor condition prior to scanning by MTO. The inferred data referred in this report was double-checked where possible. Chainages are approximate unless clearly provided on the reference documents. The majority of elevations and dimensions were converted to the metric system from imperial units. All dimensions and elevations provided in this report should be verified during detail design.

A summary of the stratigraphy encountered in the water wells is provided on the attached Table 2-2 and details of the measured groundwater levels and encountered bedrock levels in the wells were included on the attached Site Plans, Drawings 2-1 to 2-5.

A site reconnaissance visit was also carried out at each of the bridge structures and culverts. Representative photographs showing relevant natural features and geomorphology are included in Appendix A.

Subsurface field explorations were not carried out for this report. Copies of the previous records of boreholes and associated location plans relevant to the existing structures that were available at the time of the investigation were included in Appendix B.

#### **4. LITERATURE REVIEW**

##### **4.1 Inferred Subsurface Conditions**

The reviewed geological and physiographic maps and literature indicated that Highway 401 through the Geographical Township of Raleigh was constructed over the St. Clair Clay Plain deposits which occur over the western area of Kent County and extend over the Essex and Lambton Counties to the west and north, respectively. The St. Clair Clay Plain consists of a flat and relatively deep deposit of typically very stiff clayey silt and silty clay till deposits.

The bedrock underlying the Highway 401 alignment through the Geographical Township of Raleigh comprises mostly of the black bituminous shale containing locally grey shale of the Kettle Point Formation.

For the structures where previous reports were not prepared or were not available, the subsurface conditions were assumed to be similar to those encountered or inferred for the adjacent structures.

[illegible]



### SUMMARIZED INFERRED/ASSUMED SUBSURFACE CONDITIONS

Structure Name	Soil Cover Levels (*)		Bedrock (**)		Groundwater (***)	
	Clayey Silt, Silty Clay (Till)	Silt, Sand	Depth (m)	Elev.	Depth (m)	Elev.
Raleigh Plains Drain Bridge EBL	Very stiff to 6.0 m depth; stiff below. Termination Depths: 9.8 to 12.8 m (elev. 166.0 to 169.1)	—	20.4 to 25.6	156.2 to 161.5	Perched: Not Recorded Regional: 2.5 to 15.3	Perched: Not Recorded Regional: 164.7 to 179.3
Raleigh Plains Drain Bridge WBL						
Flook & Hinton Drain Bridge EBL	Stiff to very stiff. Depths: 19.8 to 20.3 m (elev. 158.9 to 159.9)	—	19.8 to 21.7	158.3 to 159.9	Perched: 2.4 Regional: 5.8 to 7.6	Perched: 177.6 Regional: 172.4 to 173.1
Flook & Hinton Drain Bridge WBL						
Bloomfield Road Underpass	Stiff to very stiff. Termination Depths: 5.8 to 20.6 m (elev. 159.2 to 173.9)	—	20.6 to 21.7	158.3 to 159.2	Perched: Not Recorded Regional: 5.6 to 7.6	Perched: Not Recorded Regional: 172.4 to 174.0
Culvert Site 13-401	Very stiff to hard. Depths: 10.2 to 11.7 m (elev. 169.7 to 171.2)	Dense/very dense sand/sand till. Termination Depths: 11.0 to 15.5 m (elev. 165.9 to 170.8)	> 24.4 to >38.1	<144.6 to <158.6	Perched: Not Recorded Regional: 3.7 to 20.7	Perched: Not Recorded Regional: 162.0 to 179.0
Kent County Road No.10 Underpass						

Notes: (\*) From borehole data. Levels indicated are inferred depths and elevations of the bottom of the soil units. Topsoil and fill units were disregarded.

(\*\*) From records of boreholes and water wells.

(\*\*\*) Groundwater levels were based on records of boreholes and water wells (circa 1950 to 1970).

Depths of topsoil and fill encountered during previous subsurface investigations were disregarded because present conditions will likely differ from those recorded. The records of some of the boreholes indicated the emanation of natural gas during the drilling.

The typical soil stratigraphy encountered in the previous investigations at all of the structure sites comprises cohesive deposits of silty clay, clayey silt till/silty clay till. These cohesive soils extend to a discontinuous layer of sand encountered at depths of 22.9 m at the Merlin Road underpass and 10.2 to 11.7 m at the Kent County Road No.10 underpass. At the remaining structure sites, it is inferred that the cohesive deposits extend beyond the termination depths of the boreholes



(minimum depth of 5.3 m at the Drake Road underpass) and to the underlying bedrock at several sites (Dillon Road Underpass/Government Drain No. 3 at 23.5 m; Flook & Hinton Drain Bridges at 19.8 to 20.3 m; Bloomfield Road underpass at 20.6 m depths).

The discontinuous sandy deposits encountered at the Merlin Road underpass extend to the bedrock at depths of 28.1 and 28.2 m, elevation 150.3. At the Kent County Road No. 10 underpass, the sand extends beyond the 11.0 to 15.5 m termination depth of the boreholes.

Based on borehole and well records, the bedrock underlying the Highway 401 sites was typically encountered or inferred at variable depths ranging between 19.8 and deeper than 38.1 m. The bedrock surface was found at a variable range of levels from lower than elevation 144.6 to 161.5.

Perched groundwater was found or inferred at depths ranging from 0.3 to 2.4 m depths (and near the surface at creek crossing sites) in the boreholes and well records. The regional groundwater was found or inferred between 2.5 and 20.7 m depths. The present groundwater conditions may vary from those recorded during the geotechnical investigations and well drilling in the 1950 to 1970s.

#### **4.2 Inferred Structure Foundations**

Based on the construction drawings reviewed, the foundations of the abutments and piers of the underpass structures were founded on spread footings and/or 323 mm O.D. concrete-filled steel tube piles driven to relatively low design capacities of 222 and 312 kN. The abutments of the Dillon Road Underpass structure were founded on No. 14 timber piles driven to a design capacity of 133 kN. The following table summarizes the foundation type and founding levels that were indicated for the spread footings and driven piles.



### BRIDGE STRUCTURE - EXISTING FOUNDATIONS

Structure	Abutments			Piers		
	Type	Elevation		Type	Elevation	
		Top Footing / Pile Cap	Bottom Footing / Pile Tip		Top Footing / Pile Cap	Bottom Footing / Pile Tip
Merlin Road Underpass	Spread Footings	176.8	175.9	Spread Footings	176.8	175.9
Drake Road Underpass	Piles (222 kN)	182.6	175.3	Spread Footings	177.4	176.5
Government Drain No. 2 Bridge EBL and WBL	Spread Footings	174.7	173.8	N/A	N/A	N/A
Dillon Road Underpass	Piles (133 kN)	183.6	169.9	Spread Footings	178.5	177.6
Government Drain No. 3 Bridge EBL and WBL	Spread Footings	173.4	172.5	N/A	N/A	N/A
Raleigh Plains Drain Bridge EBL and WBL	Spread Footings	175.6	174.7	N/A	N/A	N/A
Flook & Hinton Drain Bridge EBL and WBL	Spread Footings	176.2	175.4	N/A	N/A	N/A
Bloomfield Road Underpass	Piles (312 kN)	184.4	170.7	Piles (312 kN)	179.2	170.1
Kent County Road No.10 Underpass	Piles (312 kN)	186.7	173.7	Spread Footings	181.1	179.9

Note: Elevations were taken from reference contract drawings for top of spread footings, bottom of pile caps and pile tips. Pile capacities indicated in brackets were also taken from construction drawings.

The construction of the spread footing foundation for the Government Drain No. 2, Raleigh Plains and Flook & Hinton Drain Bridges involved the installation of sheet pile walls, according to their respective contract drawings. The sheet piles extended along the front (channel side) of the abutment footings and retaining wall between the abutments.

The culverts over 3 m span being assessed are of the concrete frame open footing type. It is inferred that the culvert footings were founded on the native clayey deposits about 1.2 m below grade for frost protection.



## **5. SITE RECONNAISSANCE**

The site reconnaissance of the structures within this geographical township was carried out on January 26 and 27 and June 28, 2006. Fifty relevant photographs of the structure and culvert sites are presented in Appendix A for reference. The following notes were compiled.

- In general, the site visits confirmed that the structures and culverts are located on generally flat to gently undulating terrain of the St. Clair Clay Plain (photographs 2-1 to 2-3, 2-5, 2-7, 2-9 to 2-13, 2-17 to 2-20, 2-22, 2-23, 2-31, 2-37, 2-39, 2-41 to 2-43, 2-45 to 2-48 and 2-50).
- The visual inspection of the underpass structure foundations did not reveal signs of distress such as settlements or other distortion (photographs 2-1, 2-3, 2-9, 2-18, 2-35 and 2-45).
- The roadside ditches and median were typically covered with grass. Wet ground occurs locally at toe of embankment slopes and in the roadside ditches at the underpass structure and culvert locations (photographs 2-12, 2-19, 2-38, 2-42, 2-46, 2-48 and 2-50).
- It was judged that the underpass approach embankments and interchange ramps are currently stable and without visible settlements. No major signs of distress such as erosion or sliding of the bridge approach embankments were noted (photographs 2-2, 2-5, 2-6, 2-17, 2-19, 2-20, 2-21, 2-40 and 2-47).
- A rabbit burrow that was noted beside a dead rabbit on the east side of the north approach embankment to the Kent County Road No. 10 indicates potential future hazard due to settlement or weakening of the pavement support (photograph 2-49).
- Localized surficial erosion of the north foreslope and concrete revetment at the Bloomfield Road underpass was noted (photograph 2-36).
- The concrete revetment of the embankment foreslopes of the underpasses at Merlin Road, Drake Road and Dillon Road were partially or fully replaced with rockfill cover.





- The channels at the inlet/outlet of the culverts and under bridges were locally narrowed by soils eroding or sloughing off the earth banks (photographs 2-26, 2-33 and 2-44).
- Channel bank erosion and erosion control measures using rockfill cover were noted at several sites (photographs 2-7, 2-8, 2-24 to 2-30 and 2-32).
- A system of water flow control is being used in the roadside ditches to contain run-off waters in the drain channel (photographs 2-7 and 2-27).
- Significant water flow was noted from the weep holes of the drain bridge abutments (photographs 2-14, 2-26 and 2-28).
- Swampy ground was not noted within or near the structures or culverts within the alignment. However, some areas were wet possibly due to poor drainage on the relatively flat terrain (photographs 2-37, 2-38, 2-46 and 2-50).
- The exit and on-ramps of the Bloomington Road interchange were constructed over terrain that is typically flat and free of swampy soils (photographs 2-38, 2-41 and 2-42).
- Drainage ditches were constructed 40 m to the west of the north approach embankments of Merlin Road and 161 and 40 m to the east of Drake Road and Dillon Road underpasses respectively (photographs 2-2, 2-12 and 2-22).
- Other smaller culverts were installed adjacent and under the approach embankments of the Kent County Road No. 10 underpass (photographs 2-46 and 2-48).
- Hydro towers are located along the south of Highway 401 from the east of Government Drain No. 3 (photograph 2-23) easterly through the Bloomfield and Kent County Road No. 10 underpass (photographs 2-34, 2-39, 2-41 to 2-43, 2-46 and 2-50).
- Lines of hydro poles are located immediately west of the Merlin Road, Dillon Road and Kent County Road No. 10 underpasses and east of the Bloomfield Road Underpass (photograph 2-2, 2-5, 2-20, 2-35, 2-37 and 2-47).



## **6. DISCUSSION AND RECOMMENDATIONS**

### **6.1 General**

The MTO is currently planning to widen Highway 401 through the County of Kent from four to six lanes of traffic. This report pertains to the section through the Geographical Township of Raleigh. It is understood that the two widening alternatives being currently considered essentially comprise the following:

Alternative 1 – Adding one lane to the inside of the westbound and eastbound lanes

Alternative 2 – Adding one lane to the outside of the westbound and eastbound lanes

It is envisaged that Alternative 1 will require filling of the median ditch and construction of a barrier along the centreline of the median. Existing culvert and underpass structures would not require foundation modifications.

At the Bloomfield Road interchange, it is planned to replace the existing Bloomfield Road underpass with a wider structure to accommodate additional Bloomfield Road and interchange ramp lanes. The existing ramps are to be removed and replaced by Parclo A configuration interchange ramps. Furthermore, the 7<sup>th</sup> Line West access to the interchange will be closed and a future Business Park Road is considered to provide full access to Bloomfield Road to/from Bloomfield Business Park.

Extension of the existing Flook & Hinton WBL bridge to accommodate the future N-W ramp lane and a new bridge at the Flook & Hinton EBL bridge to accommodate the future W-N/S ramp lane of the interchange at Bloomfield Road are also proposed. The Government Drain No. 2 and No. 3 bridges, Raleigh Plain Drain Bridges and Flook & Hinton Drain Bridges will require widening to the inside.



Construction of Alternative 2 will likely require the modification of the existing underpass and bridge structures or alternatively the construction of new structures. One option for modification of the existing underpass structures is to cut into the existing approach embankment foreslopes (in front of the abutments) and construct permanent vertical retaining wall for abutment support. Widening to the outside will also require alterations to the Bloomington Road interchange ramps and the extension of culverts. The alternatives for the construction of new underpass structures comprise constructing on the same alignment or on new alignment to the west or east of the existing structures.

The following sections of this report provide comments for planning purposes and an overview of the advantages and disadvantages, costs and risks/consequences of each alternate configuration from a foundation perspective.

#### 6.1.1 Structure Foundations

As indicated previously, it is envisaged that the widening alternative comprising the addition of traffic lanes to the inside will not require new foundations or modifications to existing foundation. The alternative of widening to the outside of the existing lanes will likely require new construction or alteration of the existing structures in view of their currently narrow four-span configuration. It is noted that the structures may also require replacement or widening due to a separate possible requirement to increase their current number of traffic lanes over Highway 401.

Based on the available data, the following foundation levels and geotechnical resistances for shallow and deep foundations are anticipated.

#### **PRELIMINARY REFERENCE FOUNDING LEVELS AND GEOTECHNICAL RESISTANCES <sup>(1)</sup>**

Structure site	Shallow Foundations <sup>(2)</sup>				Deep Foundations <sup>(3)</sup>			
	Founding Levels <sup>(4)</sup>		Geotechnical Resistance		Founding Levels		Geotechnical Resistance <sup>(5)</sup>	
	Depth (m)	Elev.	ULS (kPa)	SLS (kPa)	Depth (m)	Elev.	ULS (kN)	SLS (kN)
Merlin Road Underpass	3.9	175.9	350	200	28	149	2,000	N/A
Drake Road Underpass	3.5	176.5	350	200	24 to 34	146 to 159	2,000	N/A



**PRELIMINARY REFERENCE FOUNDING LEVELS AND GEOTECHNICAL RESISTANCES <sup>(1)</sup>**

Structure site	Shallow Foundations <sup>(2)</sup>				Deep Foundations <sup>(3)</sup>			
	Founding Levels <sup>(4)</sup>		Geotechnical Resistance		Founding Levels		Geotechnical Resistance <sup>(5)</sup>	
	Depth (m)	Elev.	ULS (kPa)	SLS (kPa)	Depth (m)	Elev.	ULS (kN)	SLS (kN)
Government Drain No. 2 Bridge EBL and WBL	1.0	173.8	350	200	24 to 34	146 to 159	2,000	N/A
Dillon Road Underpass	5.1	177.6	350	200	21 to 24	154 to 161	2,000	N/A
Government Drain No. 3 Bridge EBL and WBL	2.5	172.5	350	200	21 to 24	154 to 161	2,000	N/A
Raleigh Plains Drain Bridge EBL and WBL	0.9	174.7	250	150	20 to 26	156 to 161	2,000	N/A
Flook & Hinton Drain Bridge EBL and WBL	0.8	175.4	250	150	20 to 22	158 to 160	2,000	N/A
Bloomfield Road Underpass	-	-	-	-	21 to 22	158 to 159	2,000	N/A
Kent County Road No.10 Underpass	3.0	179.9	350	200	38	144	2,000	N/A

Notes: <sup>(1)</sup> Geotechnical resistances are to be confirmed during detailed design. Factored resistance at ULS used in the table.

<sup>(2)</sup> Abutments founded below the 1.2 m foundation frost depth on engineered fill may be designed for 900 kPa ULS and 350 kPa SLS for a granular pad thickness  $\geq 2.0$  m

<sup>(3)</sup> Driven pile tips assumed to be established on the bedrock underlying the sites.

<sup>(4)</sup> Footing founding levels should match those of existing footings for widening alternatives and assumed to be minimum 1.5 m wide. Depths refer to inferred top of highway pavement levels at the underpasses or base of channel at drain bridges. Spread footings are not recommended at the Bloomfield Road Underpass site.

<sup>(5)</sup> Resistance for HP 310x110 piles. SLS resistance is not applicable to piles driven to refusal on unyielding bedrock.

Subject to structural analyses, existing underpass structure foundations may be reused for new structures constructed on the same alignment (such as, the centre pier foundations). The installation of new steel H-piles will be required for construction of new integral or semi-integral bridge abutments in addition to the other design items specific to these abutment types.



Spread footings are not recommended at the Bloomfield Road Underpass site because of the inferred local soil conditions and the existing structure only incorporated driven pile foundations.

Extensions of the bridge abutments at the drain bridge locations will require excavations below the respective channel beds. These excavations will likely need to be stabilized with sheet pile walls.

Where culvert extensions are required, it is envisaged that the extensions may be founded on the native typically stiff to hard silty clay/clayey silt/silty clay till that are inferred to exist at the founding subgrade level of the existing culverts. The extensions may be founded on the native soils and designed for preliminary geotechnical resistances of 300 kPa at ULS (factored) and 150 kPa at SLS.

#### 6.1.2 Embankment Stability

For the widening alternative comprising the addition of traffic lanes on the inside of the highway, the placement of fill on the existing median is not envisaged to cause slope instability problems.

The alternative of widening the highway to the outside the existing underpass structures will likely require replacement of the existing structures. Any new underpass structures built to the west or east of the existing alignments will require the construction of new approach embankments comprising about 6 to 7 m high fills at the abutments or widening of the existing embankments. It is envisaged that these embankments, if required, would comprise of earth fill, because rock fill is not readily available in the area of the project. The embankment subgrade typically comprises very stiff clayey silt/silty clay till. The soils are typically wet containing a relatively high perched groundwater condition.



No signs of distress such as erosion, major sloughing or sliding were noted on the existing underpass structure approach embankments. Based on the condition of these existing earth embankments, it is considered that the earth slopes will be stable at the standard earth slope configurations of 2H:1V. If rockfill is used, the stable slope configuration would be 1.25H:1V.

In general, it is considered that the existing native soils are capable of withstanding the additional loading of the new earth embankments or embankment widening, if required. The short and long-term slope stability of approach embankments on each site should be investigated during detail design.

The widening of the embankments is not expected to cause stability problems at the location of the culvert and bridge extensions in view of the relatively low additional fills (estimated 2 to 3 m high) that would be required. The faces of the inlet and outlet channels of the culverts should be cut at 3H:1V slopes to minimize erosion or sloughing of the existing sandy subgrade at the ditch line.

#### 6.1.3 Embankment Settlement

It is estimated that the settlements of new embankments constructed separately from the existing fills are expected to be significant, and in the order of 50 to 70 mm at the location of the highest fills behind the abutments. Most of the settlements are expected to occur during construction because most of the native cohesive soils are heavily preconsolidated.

Where the embankments are widened the estimated magnitude of settlements is about half those indicated for separate embankments.

The requirement for management control of the settlements should be considered during detail design. Construction of new embankments in advance of installation of new piles would minimize post-construction effects such as potential drag down forces on piles for new or widened foundations.



Settlements of the stiff to hard clayey silt/silty clay till subgrade soils at the culvert or bridge extension sites under the anticipated 2 to 3 m high new embankment platform widenings are considered to be negligible and be completed during construction. Cambers are not considered a requirement to be incorporated during construction of extensions of these culverts.

#### 6.1.4 Construction Considerations

The construction of the alternative to widen to the inside is considered to be straightforward from a foundation point of view since new underpass structures or widening of the embankment of the existing would not be required. Widening of the bridges over the drains will be required for both alternatives. Widening of the drain bridges to the inside will likely require temporary shoring for the installation of new pile caps or new footings. Widening to the outside option will be more complex, requiring the widening of structures drain bridges and embankments, as well as new or modified underpass structures, including removal of the approach embankment foreslopes and construction of permanent vertical retaining walls.

It is envisaged that the new underpass structures for the alternative comprising of the widening to the outside would be two-span. Where the access to the existing underpass structures is temporarily closed during construction of the new structures, the installation of the new pier and abutment foundations is expected to be straightforward at all underpass structures. The construction of new structures on the same alignment while maintaining through traffic on the existing structures will require temporary shoring of the approach embankment fills (on longitudinal directions). This may be required for interchanges such as at Bloomington Road.

Excavations for the installation of new pier foundations or footing foundations for abutments on native soils will require control of the perched groundwater in particular within the silty soils encountered locally near the ground surface. Road protection as outlined in the SP 105S19 will likely be needed for the excavations required for new piers and abutment foundations. The performance level of the protection systems should be determined during detail design.

In addition, the widening or realignment of the approach embankments to the west of Merlin Road and to the east of the Dillon Road and Kent County Road No. 10 underpass structures will likely



require the realignment and/or extension of the existing drainage ditches and concrete culverts that cross the highway and the sideroads.

The existing foundations may be widened to accommodate new or wider structures (if structurally feasible). Where these existing foundations bear on driven pipe piles, the new piles should extend to the bedrock surface to prevent differential settlements. It is recommended that the need for pre-augering of the soil cover prior to the installation of new driven pipe piles be assessed at the detail design stage on a site specific basis. The depth of the pre-augering should be determined during detail design and consider that the existing low capacity pipe piles are installed at about 5 to 13 m depths below road surface levels (elevations 170 to 175) and the underlying bedrock surface is inferred at 21 to 38 m depths (elevations 161 to 145), that is about 9 to 29 m deeper than the existing pile tips. This pre-augering will avoid/minimize lateral forces and drag-down loads on the existing piles due to displacement of soil surrounding the existing piles. These effects may be mitigated by using steel H-piles instead of pipe piles for the foundation widenings. For widening of the existing foundations with deep foundations, the existing structure should be monitored during pile driving to bedrock.

#### 6.1.5 Advantages and Disadvantages of Alternate Configurations

In view of the foregoing considerations the following table summarizes the advantages and disadvantages and inferred risks/consequences of each of the alternate configurations from a foundation perspective. This preliminary analysis is based on the currently planned widening of Highway 401 from four to six lanes. Other facets of the project that may need to be considered, such as future widening to eight lanes and the condition of existing underpass structures are to be addressed by others.





### ADVANTAGES AND DISADVANTAGES – BRIDGE STRUCTURES

Structure Name	Widening to Inside		Widening to Outside (*)			
	Advantages	Disadvantages	New Structure on Existing Alignment		New Structure on New Alignment	
			Advantages	Disadvantages	Advantages	Disadvantages
Merlin Road Underpass	Use of existing structure and approach embankment. Least costly and little disruption to local traffic.	None	Use of existing embankment. Possible reuse of existing foundations	New structure required. Shoring existing approach embankments or closing traffic on bridge needed.	None	New structure and approach embankments required. Drain bridge west of underpass needs relocation.
Drake Road Underpass	Use of existing structure and approach embankment. Least costly and little disruption to local traffic.	None	Use of existing embankment. Possible reuse of existing foundations	New structure required. Shoring existing approach embankment or closing traffic on bridge needed.	None	New structure and approach embankments required.
Dillon Road Underpass	Use of existing structures and approach embankment. Least costly and little disruption to highway traffic.	None	Use of existing embankment. Possible reuse of existing foundations	New structure required. Shoring existing approach embankments or closing traffic on bridge needed.	None	New structure and approach embankments required. Drain bridge east of underpass needs relocation.
Bloomfield Road Underpass	Use of existing structure and approach embankment. Least costly and little disruption to local traffic.	None	Use of existing embankment. Possible reuse of existing foundations	New structure required. Shoring existing approach embankments or closing traffic on bridge needed.	None	New structure and approach embankments required.



### ADVANTAGES AND DISADVANTAGES – BRIDGE STRUCTURES

Structure Name	Widening to Inside		Widening to Outside (*)			
	Advantages	Disadvantages	New Structure on Existing Alignment		New Structure on New Alignment	
			Advantages	Disadvantages	Advantages	Disadvantages
Kent County Road No.10 Underpass	Use of existing structure and approach embankment. Least costly and little disruption to local traffic.	None	Use of existing embankment. Possible reuse of existing foundations	New structure required. Shoring existing approach embankments or closing traffic on bridge needed.	None	New structure and approach embankments required. Culverts east, north and south of underpass need relocation or extension.

Notes: (\*) Assumes widening to the outside will require a new underpass structure or modifications to the existing underpass structure, including removal of the approach embankment foreslope and construction of permanent vertical retaining walls.

### ADVANTAGES AND DISADVANTAGES – DRAIN BRIDGES

Structure Name	Widening to Inside (*)		Widening to Outside (*)	
	Advantages	Disadvantages	Advantages	Disadvantages
Government Drain No. 2 Bridge EBL and WBL	Widening uses existing median embankments. Additional sheet piles not required. Least costly.	Temporary shoring required to construct foundations for bridge widening	None	Additional sheet piles required. Widening of existing embankment required. Temporary shoring required to construct foundations for bridge widening.
Government Drain No. 3 Bridge EBL and WBL	Widening uses existing median embankments. Least costly.	Temporary shoring required to construct foundations for bridge widening	None	Widening of existing embankments required. Temporary shoring required to construct foundations for bridge widening.
Raleigh Plains Drain Bridge EBL and WBL	Widening uses existing median embankments. Additional sheet piles not required. Least costly.	Temporary shoring required to construct foundations for bridge widening	None	Additional sheet piles required. Widening of existing embankment required. Temporary shoring required to construct foundations for bridge widening.



### ADVANTAGES AND DISADVANTAGES – DRAIN BRIDGES

Structure Name	Widening to Inside (*)		Widening to Outside (*)	
	Advantages	Disadvantages	Advantages	Disadvantages
Flook & Hinton Drain Bridge EBL and WBL	Widening uses existing median embankments. Additional sheet piles not required. Least costly.	Temporary shoring required to construct foundations for bridge widening	None	Additional sheet piles required. Widening of existing embankment required. Temporary shoring required to construct foundations for bridge widening.

Notes: (\*) Assumes widening to the inside or outside will maintain existing highway alignment at drain bridges.

Sheet piling was not used at the Government Drain No. 3 Bridges.

### ADVANTAGES AND DISADVANTAGES – CULVERTS

Structure Name	Widening to Inside		Widening to Outside	
	Advantages	Disadvantages	Advantages	Disadvantages
Deary Drain Culvert	Culvert extensions not required	None	None	Culvert extensions required
Culvert Site 13-401	Culvert extensions not required	None	None	Culvert extensions required

Note: Use of centre section of culvert is subject to structural verification.

Since widening to the inside will not require extensions of the culverts this option will be considered less costly than the widening to outside alternative. Roadway protection maybe required for either alternative.

In general, widening to the inside for this section of the Highway 401 will involve the least risk since shoring of the approach embankments, construction of new embankments and bridges or widening of existing embankment will not be required or will be minimized when compared with the widening to the outside option.

## 6.2 Preferred Alternative Considerations

From the foundation point of view, the preferred alternative to widen Highway 401 from four to six lanes of traffic is to widen to the inside (previously designated Alternative 1, adding traffic lanes on



the median of the existing lanes). The selected alternative depended on additional considerations, such as the potential future widening to eight traffic lanes that were addressed by others.

The preferred option for the highway widening will require the replacement of the structure at the Bloomfield Road interchange and provision of Parclo A interchange ramps to replace the existing ramps. Copies of the preferred option plans provided by MRC are appended to this report as Drawings P2-1 to P2-5.

Shoring of the existing road and Bloomfield Road approach embankments will be required for the preferred alternative if the road will remain open to traffic during construction.

From the foundation point of view the preferred alternative will also require the extension of the Flook & Hinton Drain EB and WB bridges at approximate Sta. 21+450, including additional sheet piles and widening of the existing embankment, to accommodate future Highway 401 EBL and WBL in the median, and N-W and W-N/S ramps to the outside.

The construction of the Preferred Alternative is considered to be feasible from the foundations standpoint.

### **6.3 Foundation Investigation Areas For Detail Design**

The Preferred Alternative of widening Highway 401 from four to six lanes by adding traffic lanes to the inside would not require foundation investigations at the underpass and culvert structures through the Geographical Township of Raleigh, unless these structures require widening or replacement due to other considerations.

Foundation investigations will be required at the Bloomfield underpass to accommodate the realigned future Bloomfield Road and ramp lanes. In addition, extending the Flook & Hinton Drain Bridges also require foundation investigations to accommodate the new ramp for the modified Bloomfield Road interchange.



Widening of the other existing underpasses and drain bridges to the inside will also require foundation investigations.

For the Preferred Alternative, the foundation investigations for new structures that would be required for detailed design of the Highway 401 widening are listed on the following tables.

#### FOUNDATION INVESTIGATION AREAS – STRUCTURES

Stations (*)	Proposed Works	Existing Data (**)
~14+387	Government Drain No. 2 Bridge EBL	4 boreholes to depths from 7.9 to 9.8 m
~14+387	Government Drain No. 2 Bridge WBL	
~18+100	Government Drain No. 3 Bridge EBL	9 boreholes to depths from 8.2 to 23.5 m
~18+100	Government Drain No. 3 Bridge WBL	
~20+050	Raleigh Plains Drain Bridge EBL	3 boreholes to depths from 9.8 to 12.8 m
~20+050	Raleigh Plains Drain Bridge WBL	
~21+450	Flook & Hinton Drain Bridge EBL	4 boreholes to depths from 19.8 to 20.3 m
~21+450	Flook & Hinton Drain Bridge WBL	
21+877.4	Bloomfield Road Underpass	7 boreholes to depths from 5.8 to 20.6 m

Notes: (\*) Stations are approximate.  
(\*\*) Relevant data from previous foundation investigation reports.  
Refer to Table 2-1 for list of reference documents.

#### FOUNDATION INVESTIGATION AREAS –CULVERTS

Stations (*)	Proposed Works	Existing Data
10+765.65	Deary Drain Culvert	Data not available
25+253.7	Culvert Site 13-401	Data not available

Notes: (\*) Stations provided in the RFP documents.



## 7. CLOSURE

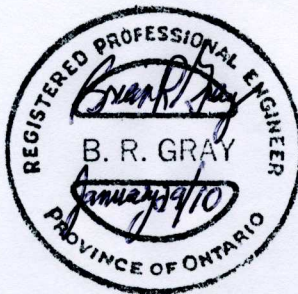
This report was prepared by Mr. C. M. P. Nascimento, P. Eng. Senior Project Engineer and reviewed by Mr. B. R. Gray, M. Eng., P. Eng, MTO Designated Contact.

Yours very truly

Peto MacCallum Ltd.



Carlos M.P. Nascimento, P.Eng.  
Senior Project Engineer



Brian R. Gray, MEng, P.Eng.  
MTO Designated Contact

CN-cn:mi



**TABLE 2-1**  
**LIST OF REFERENCE DOCUMENTS**  
**(TOWNSHIP OF RALEIGH)**

**A. Geological Maps**

- Geological Map of the Province of Ontario, Map No. 1958B Ontario, Department of Mines, Compiled 1958. Scale 1:1,267,200.
- Quaternary Geology of Ontario, Southern Sheet, Map 2556 from Ontario Ministry of Northern Development and Mines, Compiled 1991. Scale 1:1,000,000.
- Drift - Thickness Contours, Kent County, Preliminary Map 52-4A, Prepared by J.F. Caley and B.V. Sanford, 1951, Published 1952 by Department of Mines and Technical Surveys of the Geological Survey of Canada.
- Bedrock Contours, Kent County, Preliminary Map 52-4B, Prepared by J.F. Caley and B.V. Sanford, 1951, Published 1952 by Department of Mines and Technical Surveys of the Geological Survey of Canada.
- Ontario Geological Map, Map No. 2196 from Ontario Department of Mines and Northern Affairs, Compiled 1970. Scale 1:1,013,760 (1 inch = 16 miles).

**B. Physiographic Maps**

- Soil Map of the County of Kent, Soil Survey Report No. 3, Published by the Experimental Farms Branch, Ottawa, 1936, Scale 1/2 inch = 1 mile.
- Physiography of Southern Ontario Map P.2715 Ontario Geological Survey, 1984. Scale 1:600,000.
- Physiography of the Southwestern Portion of Southern Ontario, Map 2225 Ontario Department of Mines and Northern Affairs, Ontario Research Foundation, Published 1972, Scale 1:253,440 (1 inch = 4 miles).

**C. MTO Reports and Drawings**

- (1) Foundation Investigation Report for Government Drain No. 1 Bridge at Highway 2, North of Highway 401, WP 89-67-00, dated December 1974, Geocres No. 40J8-36.
- (2) Contract Drawings for Merlin Road Underpass at Highway 401 prepared by Morrison, Hershfield, Millman & Huggins Ltd. WP 69-59, dated September 28, 1960.
- (3) Foundation Investigation Report for Highway 401, Line 'C'; and Drainage Canal (Government Drain No. 1) and Realigned County Road (Merlin Road) prepared May 1959, WP 10-59 and 69-59, Geocres No. 40J8-7.





- (4) Contract Drawing for Drake Road Underpass at Highway 401, WP 81-59, dated November 1967.
- (5) Foundation Investigation Report for Proposed Crossing of Highway 401 and Drake Road, File No. 67-F-202 prepared by Dominion Soil Investigation Limited dated June 5, 1967, WP 81-59, Geocres No. 40J8-31.
- (6) Additional Borings for Revised Drake Road Underpass, W.J. No. 67-F-51, WP 81-59, dated June 20, 1967, Geocres No. 40J8-30.
- (7) Contract Drawings for Raleigh Township Bridge No. 12 (Government Drain No. 2 Bridges), WP 11-59 dated September 1959.
- (8) Foundation Investigation Report for Highway 401, Line 'C' and Drainage Ditch Crossing Lot 7, Concession 6 (Government Drain No. 2), WP 11-59, dated May 8, 1959, Geocres No. 40J8-4.
- (9) Contract Drawings for Dillon Road Underpass at Highway 401, WP 299-60, dated January 1967.
- (10) Foundation Investigation Report for Highway 401, Line 'C' and Jeannette Creek and Gravel Road Proposed Crossing (Government Drain No. 3 Bridges and Dillon Road Underpass), Lots 12 and 13, Concession 7; Township of Raleigh, WP 12-59, W.J.F-59-61, dated July 1959, Geocres No. 40J8-11.
- (11) Contract Drawings for Raleigh Township Bridge No. 9 (Government Drain No. 3 Bridges), WP 12-59, dated October 1959.
- (12) Contract Drawings for Raleigh Township Bridge No. 7 (Raleigh Plains Drain Bridges), WP 13-59, dated November 6, 1959.
- (13) Foundation Investigation Report for Highway 401, Line 'A' and Jeannette Creek Crossing Lots 15 and 16, Concession VII (Raleigh Plains Drain Bridges), WP 13-59, W.J.F-59-14, dated May 6, 1959, Geocres No. 40J8-8.
- (14) Contract Drawings for Raleigh Township Bridge No. 6 (Flook & Hinton Drain Bridges), WP 14-59, dated January 8, 1960.
- (15) Foundation Investigation Report for Jeannette Creek & Highway 401, Line 'A' Crossing Raleigh Township Lot 18, Concession 7 (Flook & Hinton Drain Bridges), WP 14-59, W.J.F-59-34, Geocres No. 40J8-9.
- (16) Contract Drawings for Bloomfield Road Interchange Underpass, WP 297-59, dated October/November 1960.
- (17) Foundation Investigation Report for proposed underpass structure of Highway 401 at County Road 27 (Bloomfield Road Underpass), Project No. J419 prepared by



William A. Trow & Associates Ltd., WP 297-59, dated October 2, 1959, Geocres No. 40J8-19.

- (18) Contract Drawings for Kent County Road No. 10 Underpass at Highway 401, WP 56-59, dated June 1961.
- (19) Foundation Investigation Report for Highway 401 underpass at Kent County Road No. 10, WP 56-59 prepared by E.M. Peto Associates Ltd. dated December 17, 1959, Geocres No. 40J8-16.
- (20) Contract Drawings for Hot Mix Paving, Contract No. 78-55 from east of interchange No. 8 Tilbury North (Essex County Road 42) easterly to west of Bloomfield Road, WP 51-77-01, dated February 9, 1978 (General data only - no additional soil data).
- (21) Contract Drawing for Hot Mix Paving, Contract No. 97-43, from 0.7 km east of Highway 2 easterly to 0.8 km west of County Road 27 (Bloomfield Road), WP 600-93-01 and 600-93-00, dated April 18, 1997 (General data only - no additional soil data).

#### **D. Ground Water Data**

- Water Well Records for Ontario (Kent-Lambton) 1946-1974, Ministry of the Environment, Water Resources Bulletin 2-20 Ground Water Series Published 1977.
- Ground Water Probability, County of Kent, Water Resources Map 3117-1, Ontario Resources Commission 1970. Scale 1:100,000.
- Southern Ontario Drainage Basins, Map 3002-2, Ministry of the Environment, Water Quantity Management Branch, 1973, Scale 1:500,000.
- Essex-Chatham-Kent Groundwater Management Study, Ministry of Environment, [http://www.ene.gov.on.ca/envision/water/groundwater/essex\\_chatham\\_kent/index.htm](http://www.ene.gov.on.ca/envision/water/groundwater/essex_chatham_kent/index.htm). Last modified on October 21, 2008.

#### **E. Other Sources**

- Air Photo Mapping of existing conditions provided by MTO – digital files.
- Chatham – Kent Base Mapping and Mosaic provided by MTO and MRC – digital files.
- Topographic Map of Ontario, Chatham Sheet, Geographic Section of Department of National Defence 1913, Reprinted 1940. Scale: 1 inch = 1 mile.
- Aggregate Resources Inventory of Raleigh and Harwich Townships, Kent County, Southern Ontario published by the Ministry of Northern Development and Mines, Ontario Geological Survey Aggregates Resources Inventory Paper No. 126, dated 1991.



**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
4	1	178.4	09/54	Dry	-	Clay 6.1; hard pan 24.4; boulder 25.9	>25.9	<152.5
4	2	177.2	09/55	Dry	-	Yellow clay 3.1; blue clay 28.1; shale 28.4	28.1	149.1
4	2	178.4	09/55	Dry	-	Yellow clay 3.1; blue clay 28.1; shale 28.4	28.1	150.3
4	3	177.8	05/73	Dry	-	Blue clay 18.6; clay sand gravel 22.9; black sand gravel 24.7; grey shale 25.0	24.7	153.1
4	3	178.4	07/63	2.4	176.0	Yellow clay 3.7; blue clay 22.9	>22.9	<155.5
4	3	177.2	05/54	6.1	171.1	Blue clay 9.2; gravel 9.8; clay 21.0; gravel 21.7; gravel clay 26.8; clay sand 27.8; shale 29.3	27.8	149.4
4	3	178.4	05/54	3.7	174.7	Blue clay 21.7; sand gravel 23.8	>23.8	<154.6
5	3	178.4	08/50	Dry	-	Yellow clay 7.6; sand 24.7; gravel 26.8	>26.8	<151.6
5	3	177.2	08/50	Dry	-	Yellow clay 7.6; sand 23.5; gravel 25.6	>25.6	<151.6
5	4	177.2	09/50	4.6	172.6	Clay 19.5; sand muck 22.9; sand gravel 24.4	>24.4	<152.8
5	4	177.2	05/48	Not Recorded	Not Recorded	Clay 12.8; hard pan 20.7; sand 21.0; shale 21.4	21.0	156.2
5	5	178.1	09/73	19.8	158.3	Clay 23.8; silty sand 24.1; gravel 24.4; black shale 25.6	24.4	153.7
6	5	183.0	03/61	4.3	178.7	Clay 23.4; sand 24.4	>24.4	<158.6
6	5	178.4	02/61	Dry	-	Clay 24.7; rock 28.1	24.7	153.7
6	5	183.0	02/61	4.9	178.1	Clay 23.5; sand 23.8	>23.8	<159.2
6	6	178.4	01/73	6.1	172.3	Clay 18.3; hard pan 25.6; shale 26.2	25.6	152.8



**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
6	6	183.0	03/53	4.6	178.4	Clay 11.6; sand 12.2; muck 25.3; sand 26.8; shale 27.1	26.8	156.2
6	7	183.0	06/61	3.7	179.3	Clay 11.3; gravel sand 11.9; clay stones 23.5; clay sand 23.8; sand 24.1; shale 24.4	24.1	158.9
6	10	183.0	05/60	5.2	177.8	Clay 22.6; sand 22.9; rock 23.1	22.9	160.1
7	7	180.0	10/52	5.5	174.5	Clay 25.3; sand gravel 28.4	>28.4	<151.6
7	7	180.0	06/68	6.1	173.9	Clay 4.9; blue clay 16.2; sand 18.0; blue clay 25.6	>25.6	<154.4
7	7	179.6	08/54	6.1	173.5	Clay 4.9; blue clay 16.2; sand 18.0; blue clay 25.3; rock 25.6	25.3	154.3
7	7	180.0	12/69	8.5	171.5	Yellow clay 4.8; blue clay 25.6; sand 26.5	>26.5	<153.5
7	7	180.0	08/54	Dry	-	Clay 3.1; blue muck 15.3; sand 16.5; blue muck 28.1; rock 28.7; shale 29.0	28.1	151.9
7	7	180.0	05/49	9.2	170.8	Clay 27.5; sand 32.9; gravel 33.9	>33.9	<146.1
7	7	180.0	08/54	Dry	-	Clay 3.1; blue muck 14.3; sand 16.5; blue muck 25.6; rock 26.2; shale 26.5	25.6	154.4
7	8	183.0	05/53	Dry	-	Yellow clay 4.8; blue clay 22.9; sand 24.4	>24.4	<158.6
7	8	180.0	05/53	5.5	174.5	Yellow clay 4.3; blue clay 22.6; sand 23.2	>23.2	<156.8



**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
7	10	180.0	05/59	Dry	-	Yellow clay 3.1; blue muck 29.0; sand 30.5; brown shale 31.7; shale 33.6	30.5	149.5
7	10	181.5	09/67	3.1	178.4	Clay 1.9; clay sand 4.6; clay stones 14.3; gravel shale 14.9; black shale 15.9	14.9	166.6
7	11	179.0	05/66	Dry	-	Yellow clay 3.1; blue muck 21.0; shale 24.7	21.0	158.0
7	11	179.0	08/66	4.3	174.7	Yellow clay 4.9; blue clay stones 20.7; sand 22.0	>22	<157.0
7	11	179.3	05/66	Dry	-	Yellow clay 3.1; blue muck 21.5; shale 22.9	21.5	157.8
7	11	179.0	07/66	Dry	-	Yellow clay 4.9; blue clay stones 22.0; sand 22.6; shale 22.8; black shale 29.3	22.6	156.4
7	11	180.0	06/57	-	-	Clay 22.6; sand 23.2; shale 25.9	23.2	156.8
7	11	180.0	06/64	3.7	176.3	Yellow clay 3.1; blue muck 12.2; sand 13.4; grey muck 19.2; sand gravel 19.8; grey rock 20.1	19.8	160.2
7	12	180.0	09/51	6.4	173.6	Yellow clay 10.4; blue clay 20.7; sand 21.7; rock 22.0	21.7	158.3
7	12	179.3	09/51	Dry	-	Yellow clay 11.0; blue clay 21.0; sand 22.0; rock 22.9; shale 26.2	22.0	157.3
7	13	180.0	04/64	Dry	-	Clay 3.1; blue muck 15.3; grey muck 20.1; black shale 22.2	20.1	159.9
7	14	180.0	09/48	4.3	175.7	Sand 3.4; clay 15.0; gravel 16.0; clay 20.7; gravel 21.0; shale 22.0	21.0	159.0
7	16	180.0	05/64	9.2	170.8	Brown clay 1.8; blue clay 20.4; blue shale 20.7	20.4	159.6
7	16	180.0	09/63	2.5	177.5	Sand 3.1; blue muck 18.3; gravel 21.0	>21.0	<159.0



**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
7	16	180.0	05/63	15.3	164.7	Clay 21.3; gravel 22.0; black shale 22.9	22.0	158.0
7	16	183.0	05/63	Dry	-	Clay 3.5; clay gravel 22.0; black shale 22.9	22.0	161.0
7	17	180.0	10/56	Dry	-	Sand 2.5; blue muck 19.5; sand gravel 20.7; rock shale 22.0	20.7	159.3
7	17	180.0	08/63	2.5	177.5	Sand 3.1; blue muck 20.5; sand 21.3; black rock 23.5	21.3	158.7
7	17	180.0	12/63	Dry	-	Sand 3.1; blue muck 18.3; sand gravel 21.0; shale 24.4	21.0	159.0
7	17	183.0	11/63	Dry	-	Sand 3.1; blue muck 18.9; sand gravel 21.5; shale 24.7	21.5	161.5
7	17	180.0	10/56	Dry	-	Sand 2.5; blue muck 19.5; sand gravel 20.7; rock shale 22.0	20.7	159.3
7	18	180.0	01/63	Dry	-	Clay 4.3; clay gravel 16.2; sand 18.0; clay gravel 23.2; gravel 23.8; shale 24.7	23.8	156.2
7	18	180.0	01/63	4.3	175.7	Sand 1.2; blue clay 6.2; clay gravel 16.2; sand 18.0; clay gravel 23.2; gravel 23.8; shale 24.7	23.8	156.2
7	18	183.0	01/63	5.2	177.8	Sand 2.4; clay 14.3; clay gravel 21.3; gravel 22.6; hard pan 22.9; black shale 23.8	22.9	160.1
7	18	180.0	01/63	Dry	-	Blue clay 5.2; clay gravel 14.0; sand 17.1; blue clay 23.2; black shale 24.4	23.2	156.8
7	18	180.0	01/63	4.9	175.1	Clay 4.6; clay gravel 22.6; gravel 23.2; black shale 24.4	23.2	156.8



**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
8	23	181.5	09/68	3.1	178.4	Clay sand 6.0; clay 11.6; gravel 12.0; clay 12.2	>12.2	<169.3
8	23	182.7	11/64	9.5	173.2	Clay 9.8; sand 12.2	>12.2	<170.5
8	23	182.7	12/63	Dry	-	Clay 3.7; clay stones 28.9	>28.9	<153.7
8	23	182.7	12/63	6.1	176.6	Clay 3.7; clay stones 11.3; sand silt 12.2	>12.2	<170.5
8	25	182.7	10/71	9.2	173.5	Clay 1.2; clay sand 10.7; rock 11.0; clay stones 30.5; gravel 32.0; sand 33.0	>33.0	<149.7
8	25	182.7	06/63	5.5	177.2	Sand 6.1; blue muck 12.2; sand 28.4	>28.4	<154.3
8	25	182.7	09/55	3.7	179.0	Clay 35.1; gravel 36.5	>36.5	<146.2
8	25	182.7	11/64	9.2	173.5	Clay 21.4; gravel stones 27.5	>27.5	<155.2
8	25	183.0	03/70	11.0	172.0	Clay 5.5; clay sand 6.5; clay stones 28.7; sand gravel 29.0	>29.0	<154.0
8	25	183.0	10/69	6.1	176.9	Clay 23.8; gravel sand 24.4	>24.4	<158.6
8	25	181.5	09/70	18.3	163.2	Clay 3.7; sand 4.9; clay 18.3; gravel clay 18.9; clay stones 23.8; sand gravel 25.3; gravel 25.6	>25.6	<155.9
8	25	182.7	09/68	20.7	162.0	Sand 1.6; clay 12.8; gravel 13.4; clay 25.0; sand gravel 26.2; black clay 26.8	>26.8	<155.9
8	25	182.7	08/68	9.2	173.5	Clay stones 26.8; sand silt 27.5	>27.5	<155.2
8	25	182.7	06/71	6.4	176.3	Clay stones 15.9; sand gravel 19.5; clay stones 24.4; gravel 25.9; sand stones 26.8	>26.8	<155.9
8	25	182.7	07/53	Dry	-	Clay 3.1; clay gravel 38.1; shale 76.2	38.1	144.6
8	25	182.7	08/53	Dry	-	Clay 3.1; clay gravel 38.1	>38.1	<144.6

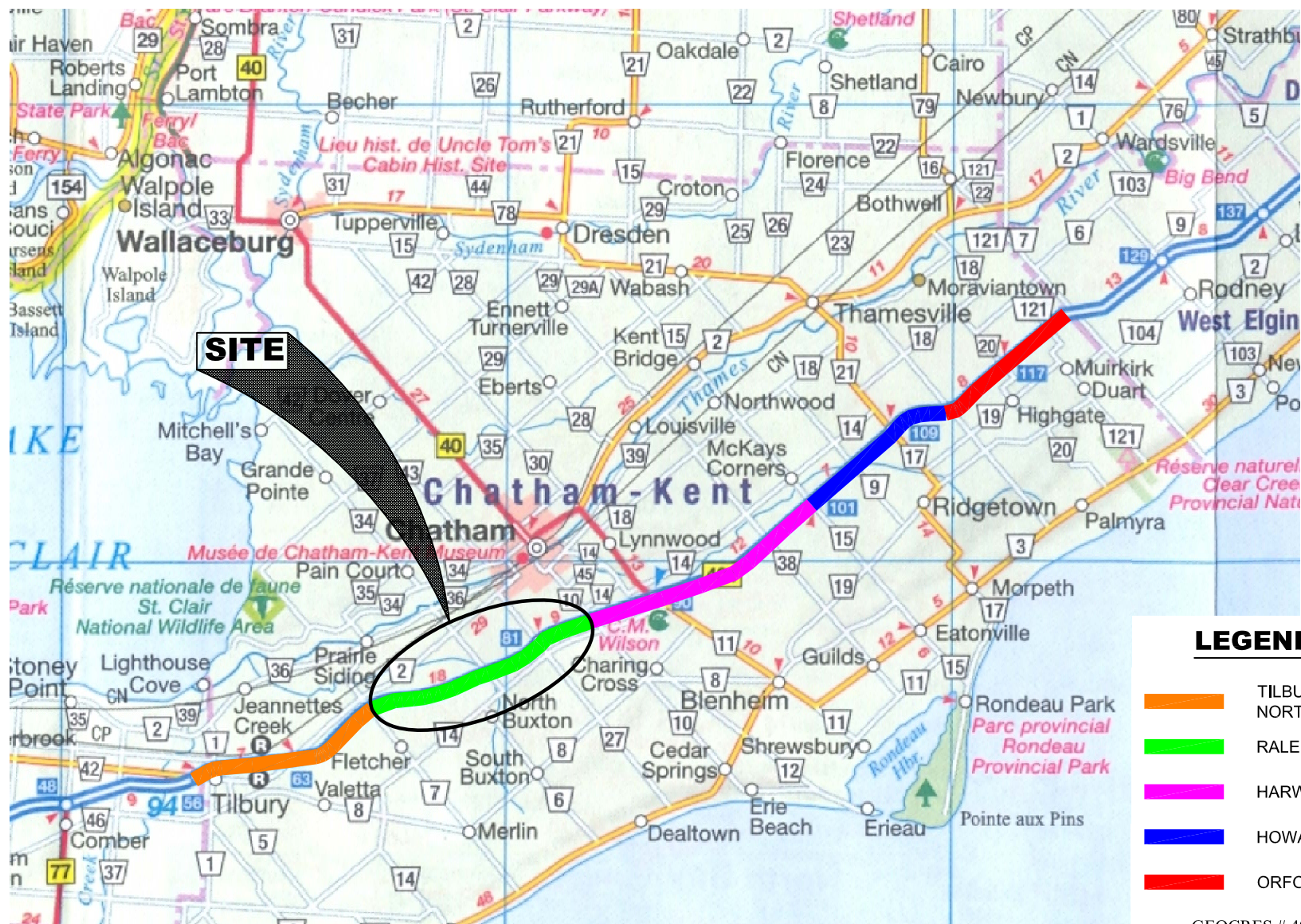


**TABLE 2-2**  
**WATER WELL RECORDS SUMMARY**  
**TOWNSHIP OF RALEIGH**

CONCESSION NO.	LOT NO.	GROUND ELEV. (m)	DATE DRILLED	STATIC WATER		STRATIGRAPHY DESCRIPTION (SOIL AND DEPTH TO BOTTOM OF UNIT)	BEDROCK	
				DEPTH (m)	ELEV. (m)		DEPTH (m)	ELEV. (m)
A	14	181.8	08/67	3.7	178.1	Clay 2.2; clay stones 20.7; gravel 21.0; shale 21.4	21.0	160.8
A	15	181.5	04/70	3.1	178.4	Clay 11.0; hard pan 15.3; clay 18.9; gravel 19.2; hard pan 20.1	>20.1	<161.4
A	16	178.4	02/74	6.1	172.3	Clay sand 19.8; clay sand rock 20.7	20.7	157.7
A	16	181.8	07/60	Dry	-	Clay 3.1; blue muck 12.2; sand 12.5; blue muck 25.0; sand 25.6; rock 28.7	25.6	156.2
A	16	181.8	08/60	2.5	179.3	Clay 15.3; blue muck 24.4; gravel shale 24.7	24.4	157.4
A	17	181.8	06/65	2.7	179.1	Clay sand 3.1; clay 12.2; sand 13.3; clay stones 21.0; gravel 21.4; black shale 22.3	21.4	160.4
A	18	180.0	10/63	2.4	177.6	Sand 3.1; clay 12.2; muck 20.7; black shale 21.0	20.7	159.3
A	19	180.0	08/62	7.6	172.4	Sand 3.1; blue muck 20.7; sand 21.7; shale 22.0	21.7	158.3

**NOTE:**

1. Data taken from MOE Water Well Records for Ontario (Kent-Lambton) 1946-1974, Water Resources Bulletin 2-20 Groundwater Series.



# LEGEND:

- TILBURY EAST / NORTH TWP
- RALEIGH TWP
- HARWICH TWP
- HOWARD TWP
- ORFORD TWP

GEOCRES # 40J8-47

## REPORT # 2 - RALEIGH TOWNSHIP

**FEASIBILITY FOUNDATION INVESTIGATION DESIGN REPORTS  
HIGHWAY 401 WIDENING - CHATHAM - KENT  
GWP 80-00-00**

## KEY MAP



**MCCORMICK RANKIN  
CORPORATION**

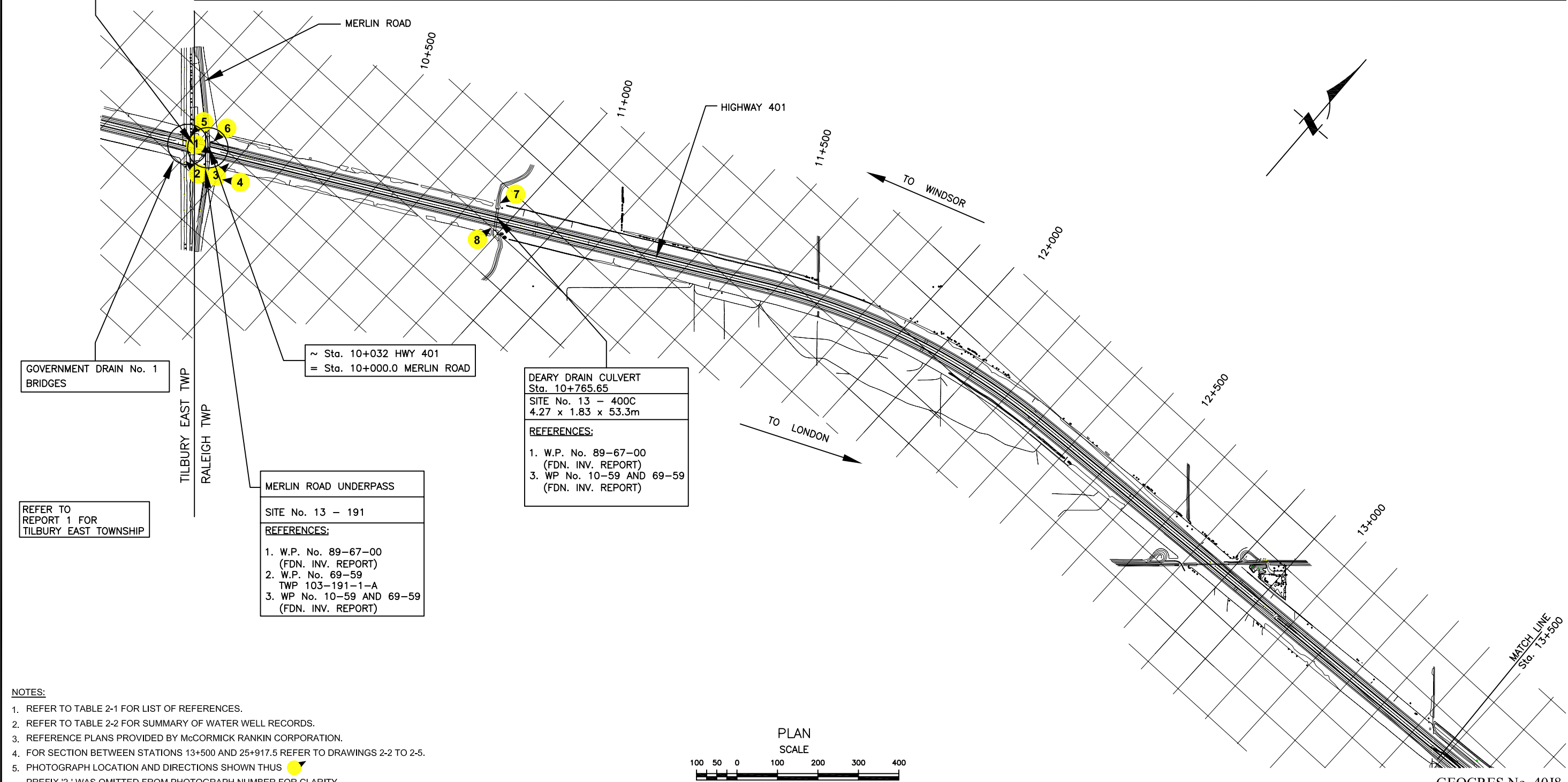



**Peto MacCallum Ltd.**  
CONSULTING ENGINEERS

DRAWN: <b>N.A.</b>	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED: <b>C.N.</b>	<b>JAN. 2010</b>	<b>1 : 400,000</b>	<b>05TF060</b>	<b>2-1</b>
APPROVED: <b>B.R.G.</b>				



	SUMMARY OF WATER WELL RECORDS							CONCESSION 6 LOT 6
	CONCESSION 4 LOT 1	CONCESSION 4 LOT 2	CONCESSION 4 LOT 3	CONCESSION 5 LOT 3	CONCESSION 5 LOT 4	CONCESSION 5 LOT 5	CONCESSION 6 LOT 5	
	GROUNDWATER DEPTH: ONE DRY WELL	GROUNDWATER DEPTH: TWO DRY WELLS	GROUNDWATER DEPTH: 2.4 to 6.1m EL. 171.1 to 176.0 ONE DRY WELL	GROUNDWATER DEPTH: TWO DRY WELLS	GROUNDWATER DEPTH: 4.6m EL. 172.6	GROUNDWATER DEPTH: 19.8m EL. 158.3	GROUNDWATER DEPTH: 4.3 to 4.9m EL. 178.1 to 178.7 ONE DRY WELL	
Sta. 20+977.6 TILBURY EAST TWP Sta. 10+000.0 RALEIGH TWP	BEDROCK DEPTH >25.9m EL. <152.5	BEDROCK DEPTH 28.1m EL. 149.1 to 150.3	BEDROCK DEPTH >22.9 to 27.8m EL. 149.4 to <155.5	BEDROCK DEPTH EL. <151.6	BEDROCK DEPTH 21.0 to >24.4m EL. <152.8 to 156.2	BEDROCK DEPTH 24.4m EL. 153.7	BEDROCK DEPTH >23.8 to 24.7m EL. 153.7 to <159.2	REFER TO DRAWING 2-2 FOR GROUNDWATER AND BEDROCK DETAILS

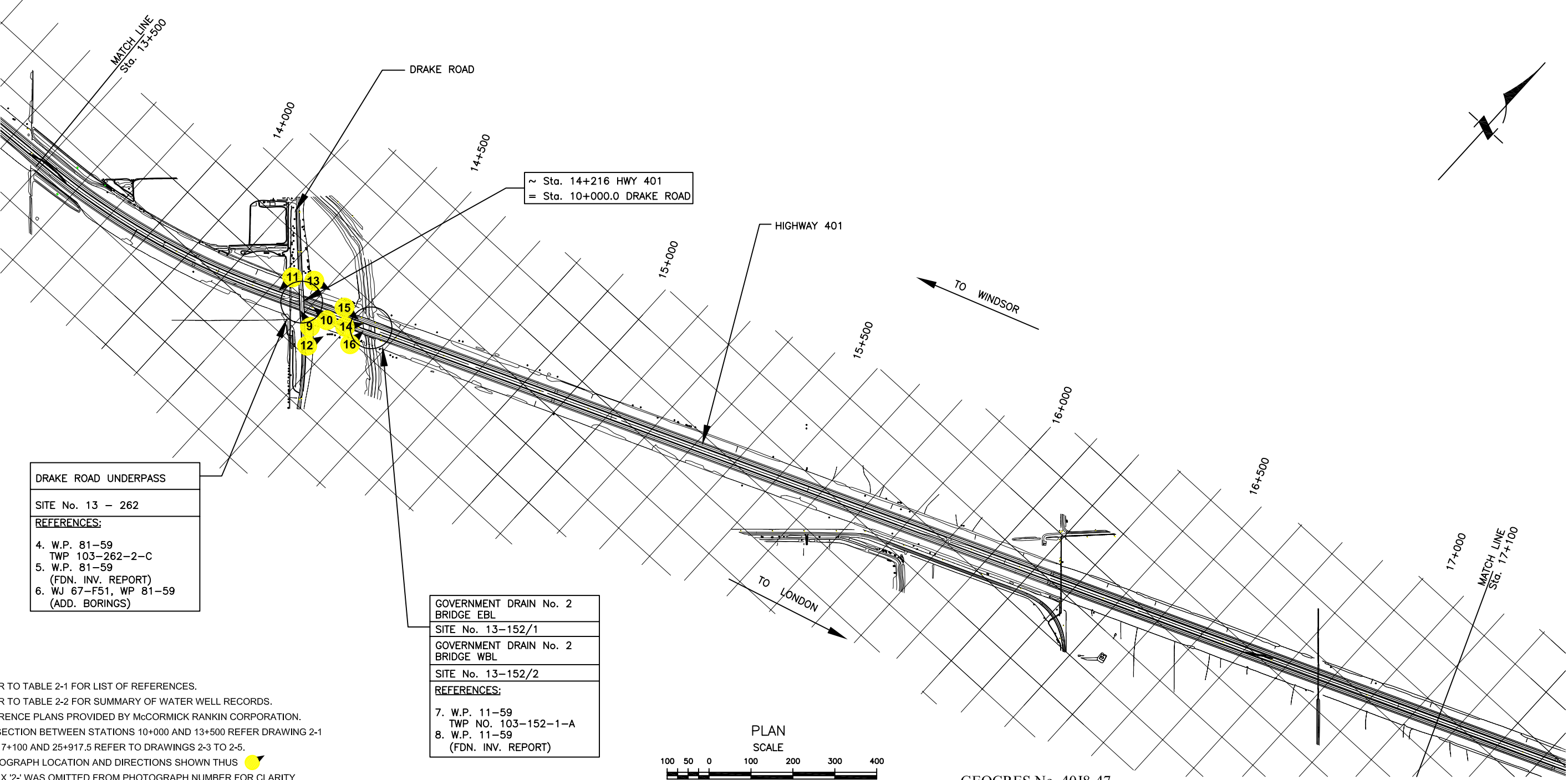



- NOTES:
- 1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  - 2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  - 3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  - 4. FOR SECTION BETWEEN STATIONS 13+500 AND 25+917.5 REFER TO DRAWINGS 2-2 TO 2-5.
  - 5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS  PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.

GEOCRES No. 40J8-47

<i>METRIC</i> DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES	 <b>Ontario</b>  <b>McCORMICK RANKIN CORPORATION</b> A member of  <b>MMM GROUP</b>	 <b>Peto MacCallum Ltd.</b> CONSULTING ENGINEERS	CONT No GWP No 80-00-00 <b>HIGHWAY 401</b> WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN	 <b>DRAWING</b> 2-1
		DATE <b>JANUARY 2010</b> CHECKED BY: <b>C.N.</b>	DRAWN BY: <b>N.A.</b> APPROVED BY: <b>B.R.G.</b>	

SUMMARY OF WATER WELL RECORDS								
CONCESSION 6 LOT 6	CONCESSION 6 LOT 7	CONCESSION 7 LOT 7	CONCESSION 7 LOT 8	CONCESSION 7 LOT 9	CONCESSION 6 LOT 10	CONCESSION 7 LOT 10	CONCESSION 7 LOT 11	
GROUNDWATER DEPTH 4.6 to 6.1m EL. 172.3 to 178.4	GROUNDWATER DEPTH 3.7m EL. 179.3	GROUNDWATER DEPTH 5.5 to 9.2m EL. 170.8 to 174.5 TWO DRY WELLS	GROUNDWATER DEPTH 5.5m EL. 174.5 ONE DRY WELL	NO DATA FOUND	GROUNDWATER DEPTH 5.2m EL. 177.8	GROUNDWATER DEPTH 3.1m EL. 178.4 ONE DRY WELL	GROUNDWATER DEPTH 3.7 to 4.3m EL. 174.7 - 176.3 THREE DRY WELLS	
BEDROCK DEPTH 25.6 to 26.8m EL. 152.8 to 156.2	BEDROCK DEPTH 24.1m EL. 158.9	BEDROCK DEPTH >25.3 to 33.9m EL. <146.1 to <154.4	BEDROCK DEPTH >23.2 to >24.4m EL. <156.8 to <158.6	NO DATA FOUND	BEDROCK DEPTH 22.9m EL. 160.1	BEDROCK DEPTH 14.9 to 30.5m EL. 149.5 to 166.6	BEDROCK DEPTH 19.8 to 23.2m EL. 156.4 to 160.2	



- NOTES:
- REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  - REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  - REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  - FOR SECTION BETWEEN STATIONS 10+000 AND 13+500 REFER DRAWING 2-1 AND 17+100 AND 25+917.5 REFER TO DRAWINGS 2-3 TO 2-5.
  - PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS  PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.

METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES



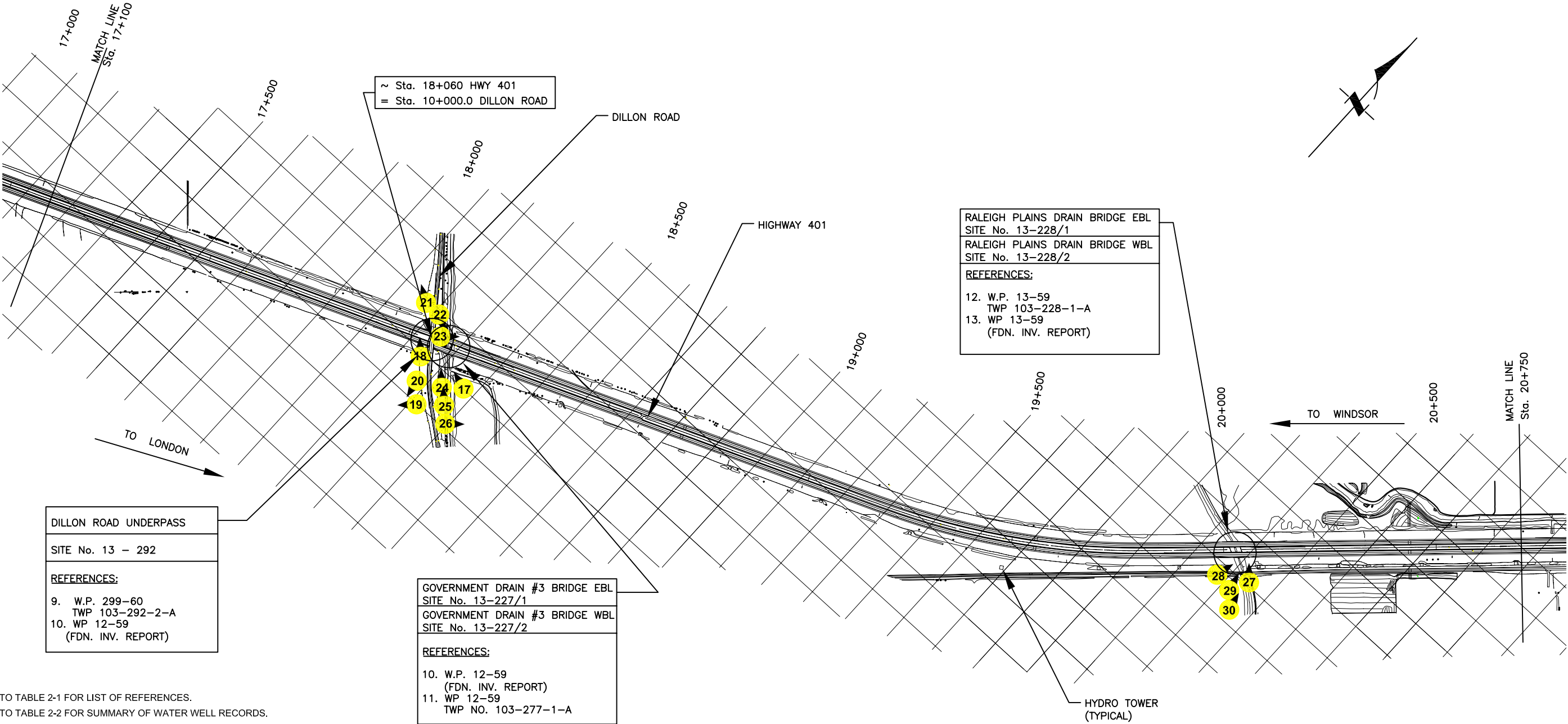
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CHECKED BY:	C.N.	APPROVED BY:	B.R.G.

CONT No  
GWP No 80-00-00

HIGHWAY 401  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN

DRAWING  
2-2

SUMMARY OF WATER WELL RECORDS								
CONCESSION 7 LOT 11	CONCESSION 7 LOT 12	CONCESSION 7 LOT 13	CONCESSION 7 LOT 14	CONCESSION A LOT 14	CONCESSION A LOT 15	CONCESSION 7 LOT 16	CONCESSION A LOT 16	CONCESSION 7 LOT 17
REFER DRAWING 2-2 FOR GROUNDWATER AND BEDROCK DETAILS	GROUNDWATER DEPTH 6.4m EL. 173.6 ONE DRY WELL	NO DATA FOUND  ONE DRY WELL	GROUNDWATER DEPTH 4.3m EL. 175.7	GROUNDWATER DEPTH 3.7m EL. 178.1	GROUNDWATER DEPTH 3.1m EL. 178.4	GROUNDWATER DEPTH 2.5 to 15.3m EL. 164.7 to 177.5 ONE DRY WELL	GROUNDWATER DEPTH 2.5 to 6.1m EL. 172.3 to 179.3 ONE DRY WELL	GROUNDWATER DEPTH 2.5m EL. 177.5 FOUR DRY WELLS
	BEDROCK DEPTH 21.7 to 22.0m EL. 157.3 to 158.3	BEDROCK DEPTH 20.1m EL. 159.9	BEDROCK DEPTH 21.0m EL. 159.0	BEDROCK DEPTH 21.0m EL. 160.8	BEDROCK DEPTH >20.1m EL. <161.4	BEDROCK DEPTH 20.4 to 22.0m EL. 158.0 to 160.1	BEDROCK DEPTH 20.7 to 25.6m EL. 156.2 to 157.7	BEDROCK DEPTH 20.7 to 21.5m EL. 158.7 to 161.5



DILLON ROAD UNDERPASS  
SITE No. 13 - 292  
  
REFERENCES:  
9. W.P. 299-60  
TWP 103-292-2-A  
10. WP 12-59  
(FDN. INV. REPORT)

GOVERNMENT DRAIN #3 BRIDGE EBL  
SITE No. 13-227/1  
GOVERNMENT DRAIN #3 BRIDGE WBL  
SITE No. 13-227/2  
  
REFERENCES:  
10. W.P. 12-59  
(FDN. INV. REPORT)  
11. WP 12-59  
TWP NO. 103-277-1-A

RALEIGH PLAINS DRAIN BRIDGE EBL  
SITE No. 13-228/1  
RALEIGH PLAINS DRAIN BRIDGE WBL  
SITE No. 13-228/2  
  
REFERENCES:  
12. W.P. 13-59  
TWP 103-228-1-A  
13. WP 13-59  
(FDN. INV. REPORT)

- NOTES:
1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  4. FOR SECTION BETWEEN STATIONS 10+000 AND 17+100 REFER DRAWING 2-1 AND 2-2 AND 20+750 AND 25+917.5 REFER TO DRAWINGS 2-4 AND 2-5.
  5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.

GEOCRES No. 40J8-47

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

McCORMICK RANKIN CORPORATION  
A member of MMM GROUP

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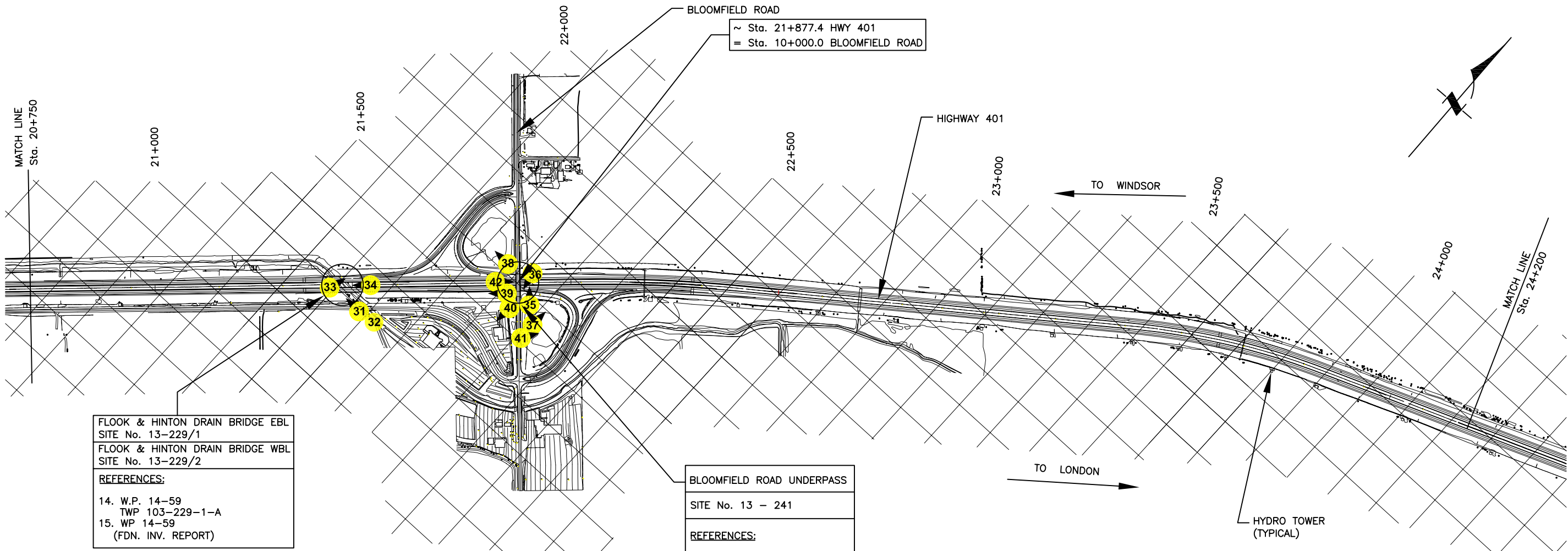
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CHECKED BY:	C.N.	APPROVED BY:	B.R.G.

CONT No  
GWP No 80-00-00  
  
HIGHWAY 401  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN

DRAWING  
2-3



SUMMARY OF WATER WELL RECORDS								
CONCESSION A LOT 17	CONCESSION 7 LOT 18	CONCESSION A LOT 18	CONCESSION 7 LOT 19	CONCESSION A LOT 19	CONCESSION A LOT 20	CONCESSION A LOT 21	CONCESSION A LOT 22	CONCESSION 8 LOT 23
GROUNDWATER DEPTH 2.7m EL. 179.1	GROUNDWATER DEPTH 4.3 to 5.2m EL. 175.1 to 177.8 TWO DRY WELLS	GROUNDWATER DEPTH 2.4m EL. 177.6	NO DATA FOUND	GROUNDWATER DEPTH 7.6m EL. 172.4	NO DATA FOUND	NO DATA FOUND	NO DATA FOUND	GROUNDWATER DEPTH 3.1 to 9.5m EL. 173.2 to 178.4 1 DRY WELL
BEDROCK DEPTH 21.4m EL. 160.4	BEDROCK DEPTH 22.9 to 23.8m EL. 156.2 to 160.1	BEDROCK DEPTH 20.7m EL. 159.3	NO DATA FOUND	BEDROCK DEPTH 21.7m EL. 158.3	NO DATA FOUND	NO DATA FOUND	NO DATA FOUND	BEDROCK DEPTH >12.2 to >28.9m EL. <153.7 to <170.5



- NOTES:
- REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  - REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  - REFERENCE PLANS PROVIDED BY MCCORMICK RANKIN CORPORATION.
  - FOR SECTION BETWEEN STATIONS 10+000 AND 20+750 REFER DRAWINGS 2-1 TO 2-3 AND 24+200 AND 25+917.5 REFER TO DRAWING 2-5.
  - PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.



GEOCRES No. 40J8-47

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

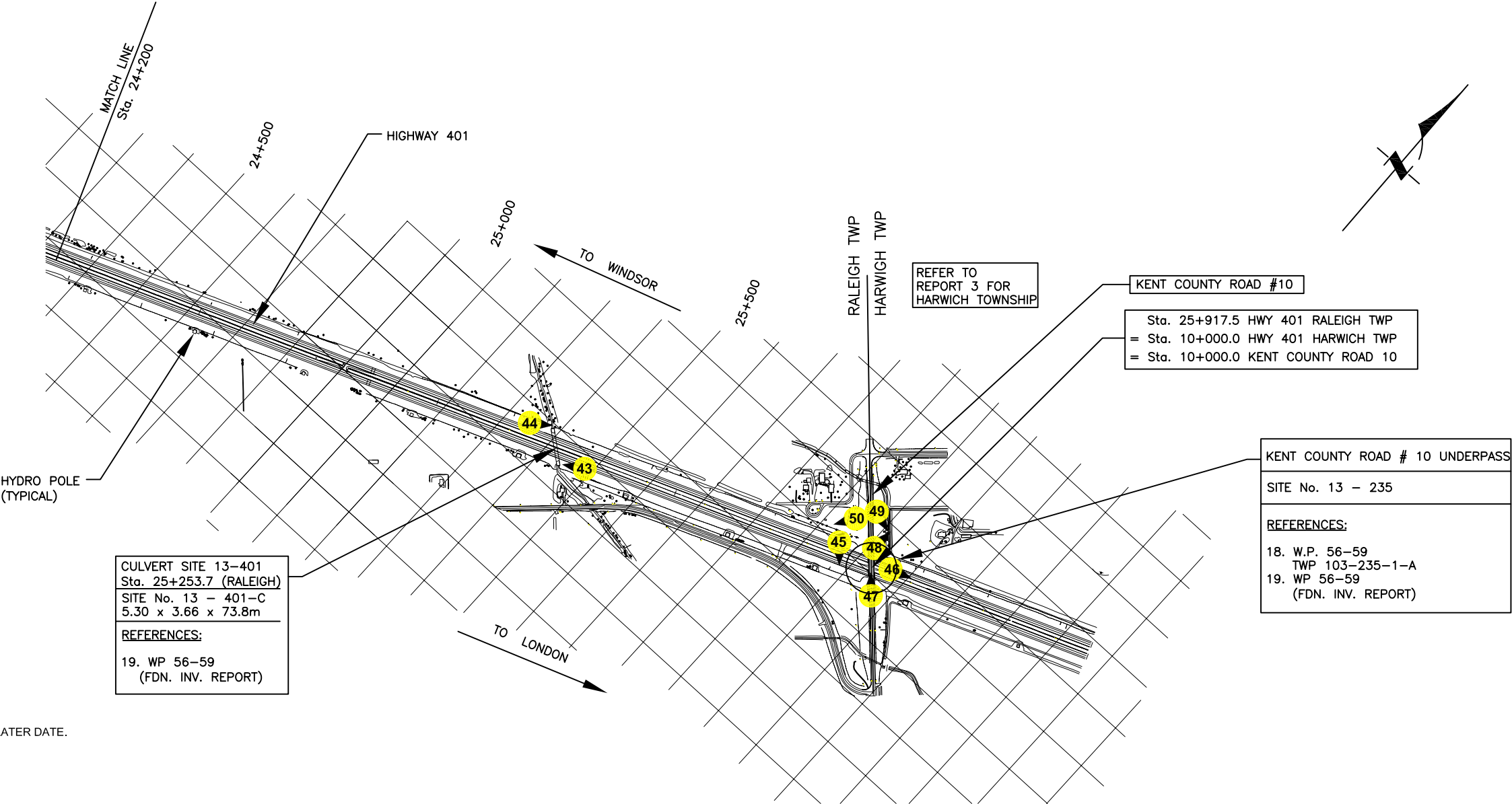


DATE **JANUARY 2010**  
CHECKED BY: **C.N.**  
DRAWN BY: **N.A.**  
APPROVED BY: **B.R.G.**

CONT No  
GWP No 80-00-00  
HIGHWAY 401  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN



SUMMARY OF WATER WELL RECORDS		
CONCESSION 8 LOT 23	CONCESSION 8 LOT 24	CONCESSION 8 LOT 25
REFER DRAWING 2-4 FOR GROUNDWATER AND BEDROCK DETAILS	NO DATA FOUND	GROUNDWATER DEPTH 3.7 to 20.7m EL. 162.0 to 179.0 TWO DRY WELLS
	NO DATA FOUND	BEDROCK DEPTH >24.4 to >38.1m EL. <144.6 to <158.6



PREDRAFT NOTE: PHOTOGRAPHS 2-43 AND 2-44 WILL BE PROVIDED AT A LATER DATE.

- NOTES:
- REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  - REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  - REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  - FOR SECTION BETWEEN STATIONS 10+000 AND 24+200 REFER DRAWINGS 2-1 TO 2-4
  - PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.

GEOCRES No. 40J8-47

METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

McCORMICK RANKIN CORPORATION

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CONSULTING ENGINEERS

DATE **JANUARY 2010**

CHECKED BY: **C.N.**

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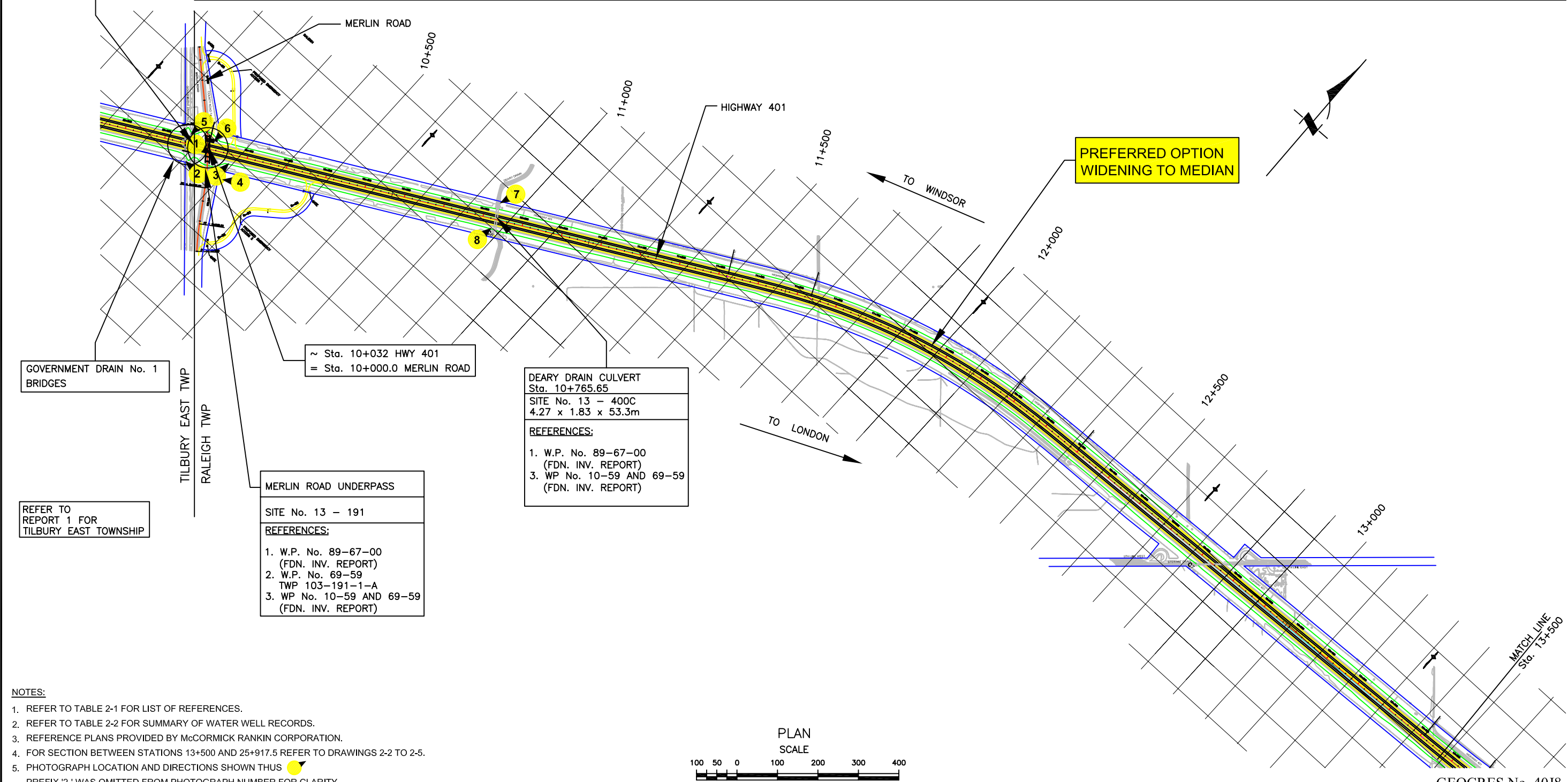
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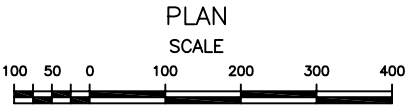
**HIGHWAY 401**  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN

DRAWING  
2-5

Sta. 20+977.6 TILBURY EAST TWP Sta. 10+000.0 RALEIGH TWP	SUMMARY OF WATER WELL RECORDS							REFER TO DRAWING 2-2 FOR GROUNDWATER AND BEDROCK DETAILS
	CONCESSION 4 LOT 1	CONCESSION 4 LOT 2	CONCESSION 4 LOT 3	CONCESSION 5 LOT 3	CONCESSION 5 LOT 4	CONCESSION 5 LOT 5	CONCESSION 6 LOT 5	
	GROUNDWATER DEPTH: ONE DRY WELL	GROUNDWATER DEPTH: TWO DRY WELLS	GROUNDWATER DEPTH: 2.4 to 6.1m EL. 171.1 to 176.0 ONE DRY WELL	GROUNDWATER DEPTH: TWO DRY WELLS	GROUNDWATER DEPTH: 4.6m EL. 172.6	GROUNDWATER DEPTH: 19.8m EL. 158.3	GROUNDWATER DEPTH: 4.3 to 4.9m EL. 178.1 to 178.7 ONE DRY WELL	
	BEDROCK DEPTH >25.9m EL. <152.5	BEDROCK DEPTH 28.1m EL. 149.1 to 150.3	BEDROCK DEPTH >22.9 to 27.8m EL. 149.4 to <155.5	BEDROCK DEPTH EL. <151.6	BEDROCK DEPTH 21.0 to >24.4m EL. <152.8 to 156.2	BEDROCK DEPTH 24.4m EL. 153.7	BEDROCK DEPTH >23.8 to 24.7m EL. 153.7 to <159.2	



- NOTES:
1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  4. FOR SECTION BETWEEN STATIONS 13+500 AND 25+917.5 REFER TO DRAWINGS 2-2 TO 2-5.
  5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS  PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.



GEOCRES No. 40J8-47

METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

PREFERRED OPTION



Ontario



McCORMICK RANKIN CORPORATION

A member of  MMM GROUP



Peto MacCallum Ltd.

CONSULTING ENGINEERS

DATE **JANUARY 2010**

CHECKED BY: **C.N.**

DRAWN BY: **N.A.**

APPROVED BY: **B.R.G.**

CONT No  
GWP No **80-00-00**

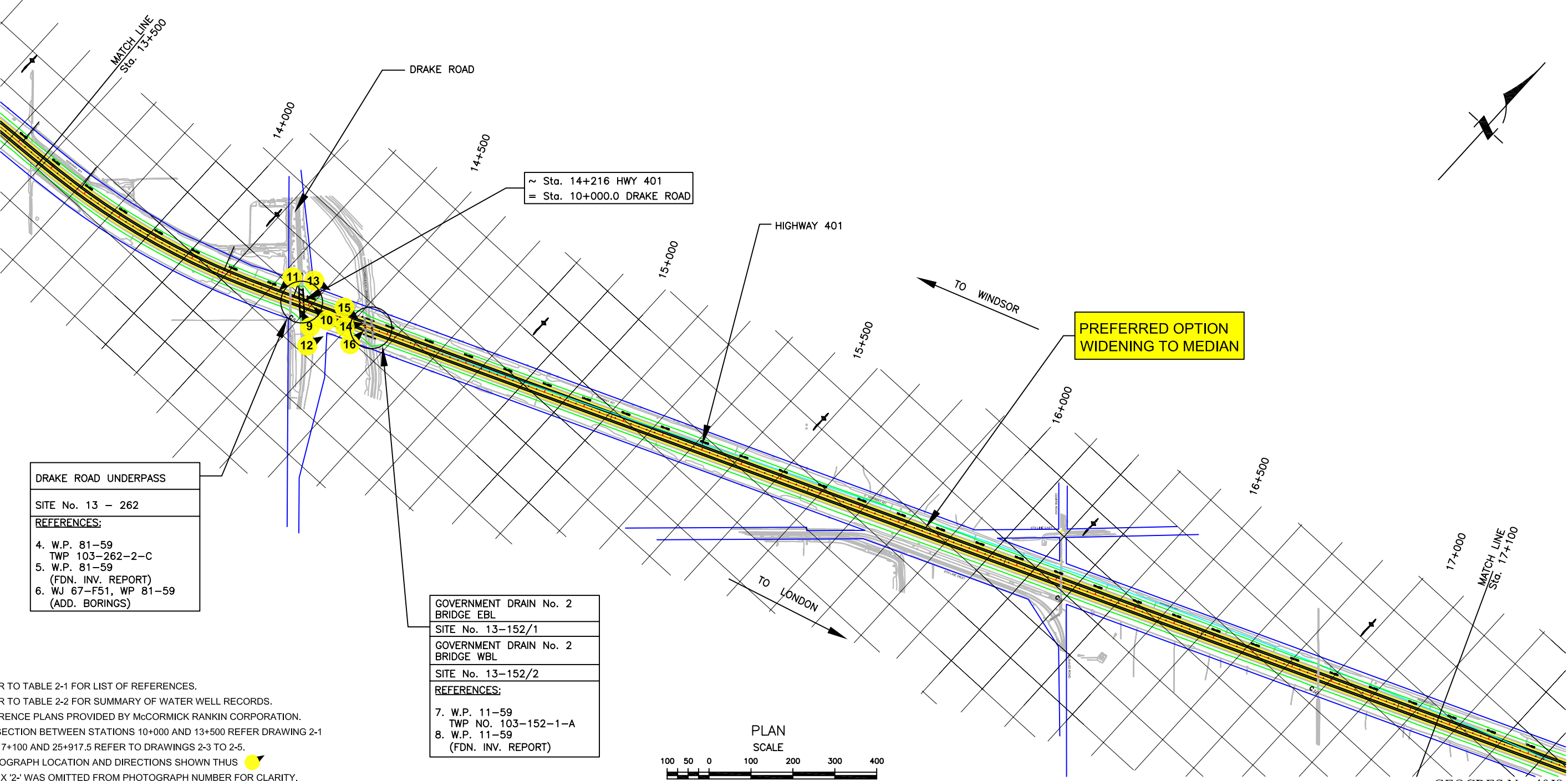
HIGHWAY 401  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN




DRAWING  
**P2-1**



SUMMARY OF WATER WELL RECORDS								
CONCESSION 6 LOT 6	CONCESSION 6 LOT 7	CONCESSION 7 LOT 7	CONCESSION 7 LOT 8	CONCESSION 7 LOT 9	CONCESSION 6 LOT 10	CONCESSION 7 LOT 10	CONCESSION 7 LOT 11	
GROUNDWATER DEPTH 4.6 to 6.1m EL. 172.3 to 178.4	GROUNDWATER DEPTH 3.7m EL. 179.3	GROUNDWATER DEPTH 5.5 to 9.2m EL. 170.8 to 174.5 TWO DRY WELLS	GROUNDWATER DEPTH 5.5m EL. 174.5 ONE DRY WELL	NO DATA FOUND	GROUNDWATER DEPTH 5.2m EL. 177.8	GROUNDWATER DEPTH 3.1m EL. 178.4 ONE DRY WELL	GROUNDWATER DEPTH 3.7 to 4.3m EL. 174.7 - 176.3 THREE DRY WELLS	
BEDROCK DEPTH 25.6 to 26.8m EL. 152.8 to 156.2	BEDROCK DEPTH 24.1m EL. 158.9	BEDROCK DEPTH >25.3 to 33.9m EL. <146.1 to <154.4	BEDROCK DEPTH >23.2 to >24.4m EL. <156.8 to <158.6	NO DATA FOUND	BEDROCK DEPTH 22.9m EL. 160.1	BEDROCK DEPTH 14.9 to 30.5m EL. 149.5 to 166.6	BEDROCK DEPTH 19.8 to 23.2m EL. 156.4 to 160.2	



- NOTES:
1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  4. FOR SECTION BETWEEN STATIONS 10+000 AND 13+500 REFER DRAWING 2-1 AND 17+100 AND 25+917.5 REFER TO DRAWINGS 2-3 TO 2-5.
  5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS  PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.

GOVERNMENT DRAIN No. 2 BRIDGE EBL
SITE No. 13-152/1
GOVERNMENT DRAIN No. 2 BRIDGE WBL
SITE No. 13-152/2
REFERENCES:
7. W.P. 11-59 TWP NO. 103-152-1-A
8. W.P. 11-59 (FDN. INV. REPORT)

DRAKE ROAD UNDERPASS
SITE No. 13 - 262
REFERENCES:
4. W.P. 81-59 TWP 103-262-2-C
5. W.P. 81-59 (FDN. INV. REPORT)
6. WJ 67-F51, WP 81-59 (ADD. BORINGS)

PREFERRED OPTION

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

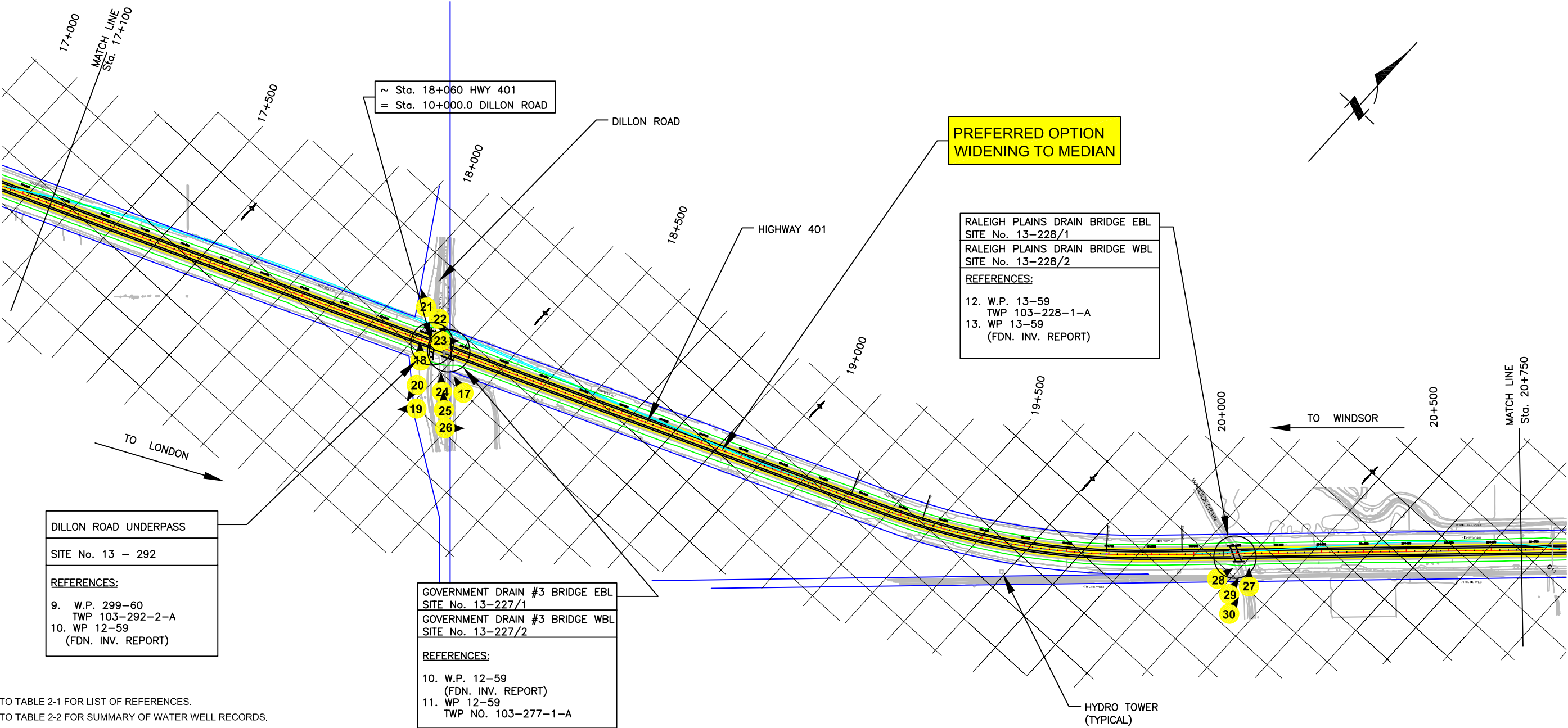


DATE	JANUARY 2010	DRAWN BY:	N.A.
CHECKED BY:	C.N.	APPROVED BY:	B.R.G.

CONT No	GWP No 80-00-00
HIGHWAY 401 WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN	

DRAWING  
P2-2

SUMMARY OF WATER WELL RECORDS								
CONCESSION 7 LOT 11	CONCESSION 7 LOT 12	CONCESSION 7 LOT 13	CONCESSION 7 LOT 14	CONCESSION A LOT 14	CONCESSION A LOT 15	CONCESSION 7 LOT 16	CONCESSION A LOT 16	CONCESSION 7 LOT 17
REFER DRAWING 2-2 FOR GROUNDWATER AND BEDROCK DETAILS	GROUNDWATER DEPTH 6.4m EL. 173.6 ONE DRY WELL	NO DATA FOUND ONE DRY WELL	GROUNDWATER DEPTH 4.3m EL. 175.7	GROUNDWATER DEPTH 3.7m EL. 178.1	GROUNDWATER DEPTH 3.1m EL. 178.4	GROUNDWATER DEPTH 2.5 to 15.3m EL. 164.7 to 177.5 ONE DRY WELL	GROUNDWATER DEPTH 2.5 to 6.1m EL. 172.3 to 179.3 ONE DRY WELL	GROUNDWATER DEPTH 2.5m EL. 177.5 FOUR DRY WELLS
	BEDROCK DEPTH 21.7 to 22.0m EL. 157.3 to 158.3	BEDROCK DEPTH 20.1m EL. 159.9	BEDROCK DEPTH 21.0m EL. 159.0	BEDROCK DEPTH 21.0m EL. 160.8	BEDROCK DEPTH >20.1m EL. <161.4	BEDROCK DEPTH 20.4 to 22.0m EL. 158.0 to 160.1	BEDROCK DEPTH 20.7 to 25.6m EL. 156.2 to 157.7	BEDROCK DEPTH 20.7 to 21.5m EL. 158.7 to 161.5



DILLON ROAD UNDERPASS  
SITE No. 13 - 292  
REFERENCES:  
9. W.P. 299-60  
TWP 103-292-2-A  
10. WP 12-59  
(FDN. INV. REPORT)

GOVERNMENT DRAIN #3 BRIDGE EBL  
SITE No. 13-227/1  
GOVERNMENT DRAIN #3 BRIDGE WBL  
SITE No. 13-227/2  
REFERENCES:  
10. W.P. 12-59  
(FDN. INV. REPORT)  
11. WP 12-59  
TWP NO. 103-277-1-A

RALEIGH PLAINS DRAIN BRIDGE EBL  
SITE No. 13-228/1  
RALEIGH PLAINS DRAIN BRIDGE WBL  
SITE No. 13-228/2  
REFERENCES:  
12. W.P. 13-59  
TWP 103-228-1-A  
13. WP 13-59  
(FDN. INV. REPORT)

- NOTES:
1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  4. FOR SECTION BETWEEN STATIONS 10+000 AND 17+100 REFER DRAWING 2-1 AND 2-2 AND 20+750 AND 25+917.5 REFER TO DRAWINGS 2-4 AND 2-5.
  5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.



GEOCRES No. 40J8-47

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

PREFERRED OPTION

Ontario  
 McCORMICK RANKIN CORPORATION  
A member of MMM GROUP

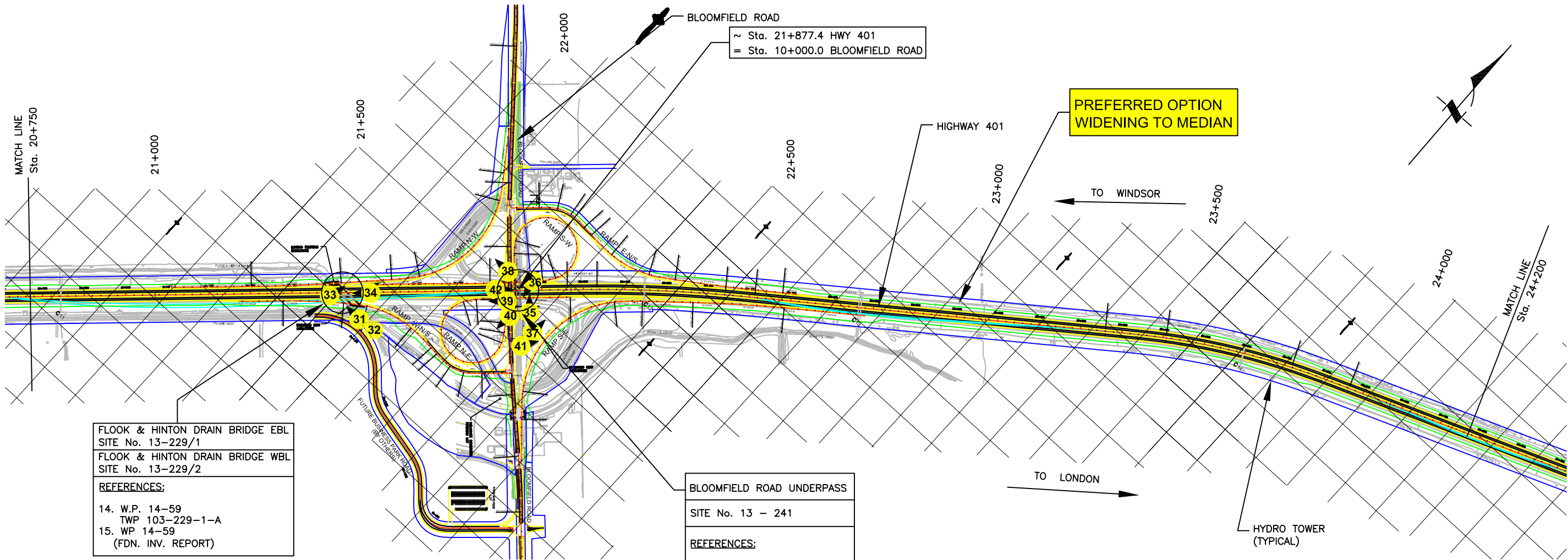
Peto MacCallum Ltd.  
CONSULTING ENGINEERS  
DATE **JANUARY 2010**  
CHECKED BY: **C.N.**  
DRAWN BY: **N.A.**  
APPROVED BY: **B.R.G.**

CONT No  
GWP No 80-00-00  
HIGHWAY 401  
WIDENING THROUGH KENT COUNTY  
RALEIGH TOWNSHIP SECTION  
SITE PLAN

DRAWING  
P2-3



SUMMARY OF WATER WELL RECORDS								
CONCESSION A LOT 17	CONCESSION 7 LOT 18	CONCESSION A LOT 18	CONCESSION 7 LOT 19	CONCESSION A LOT 19	CONCESSION A LOT 20	CONCESSION A LOT 21	CONCESSION A LOT 22	CONCESSION 8 LOT 23
GROUNDWATER DEPTH 2.7m EL. 179.1	GROUNDWATER DEPTH 4.3 to 5.2m EL. 175.1 to 177.8 TWO DRY WELLS	GROUNDWATER DEPTH 2.4m EL. 177.6	NO DATA FOUND	GROUNDWATER DEPTH 7.6m EL. 172.4	NO DATA FOUND	NO DATA FOUND	NO DATA FOUND	GROUNDWATER DEPTH 3.1 to 9.5m EL. 173.2 to 178.4 1 DRY WELL
BEDROCK DEPTH 21.4m EL. 160.4	BEDROCK DEPTH 22.9 to 23.8m EL. 156.2 to 160.1	BEDROCK DEPTH 20.7m EL. 159.3	NO DATA FOUND	BEDROCK DEPTH 21.7m EL. 158.3	NO DATA FOUND	NO DATA FOUND	NO DATA FOUND	BEDROCK DEPTH >12.2 to >28.9m EL. <153.7 to <170.5



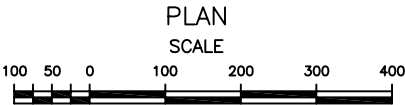
FLOOK & HINTON DRAIN BRIDGE EBL  
SITE No. 13-229/1  
FLOOK & HINTON DRAIN BRIDGE WBL  
SITE No. 13-229/2

REFERENCES:  
14. W.P. 14-59  
TWP 103-229-1-A  
15. WP 14-59  
(FDN. INV. REPORT)

BLOOMFIELD ROAD UNDERPASS  
SITE No. 13 - 241

REFERENCES:  
16. W.P. 297-59  
TWP 103-241-1-A  
17. WP 297-59  
(FDN. INV. REPORT)

- NOTES:
1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  3. REFERENCE PLANS PROVIDED BY MCCORMICK RANKIN CORPORATION.
  4. FOR SECTION BETWEEN STATIONS 10+000 AND 20+750 REFER DRAWINGS 2-1 TO 2-3 AND 24+200 AND 25+917.5 REFER TO DRAWING 2-5.
  5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.



GEOCRES No. 40J8-47

METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

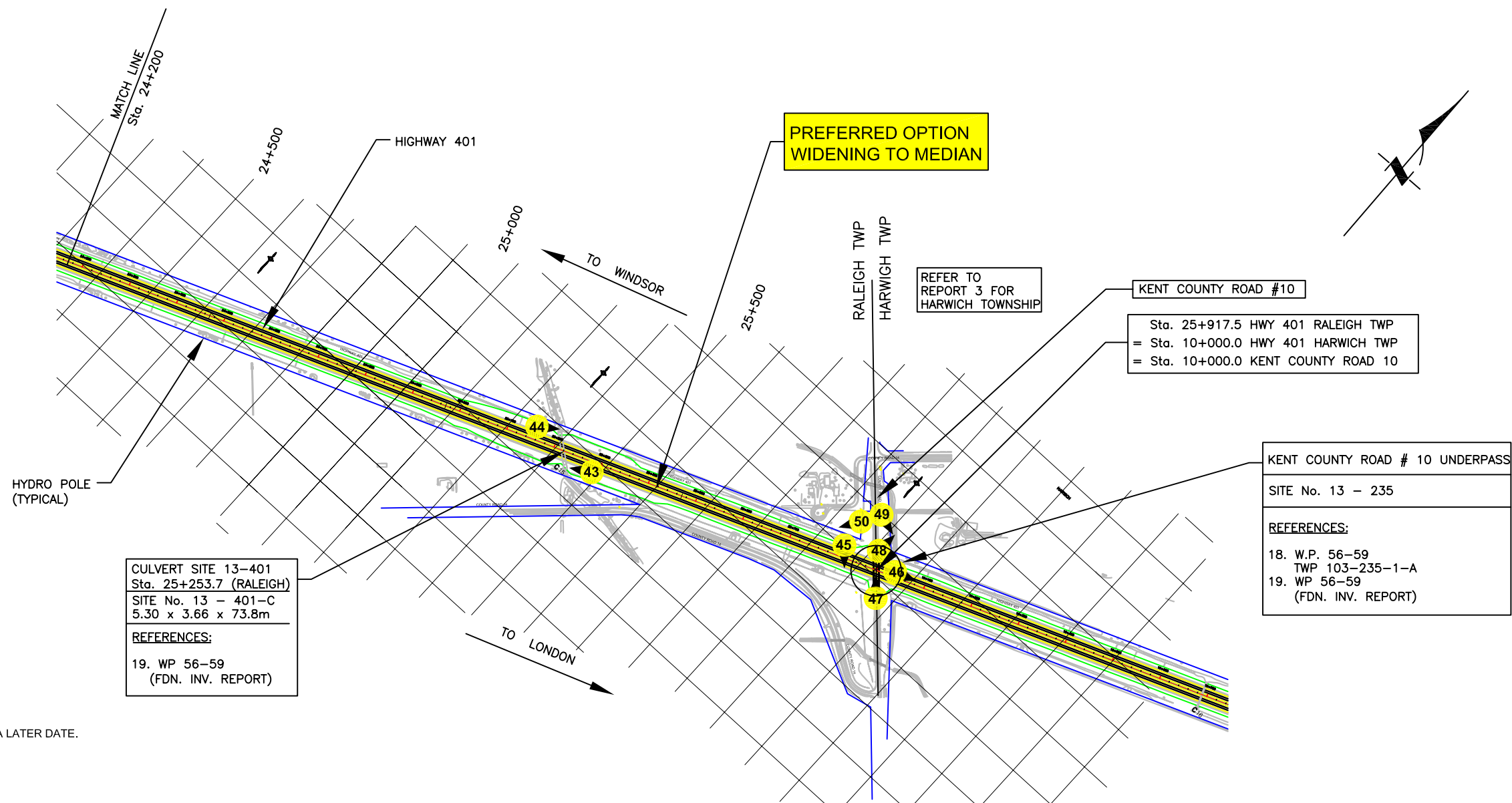
PREFERRED OPTION




DATE <b>JANUARY 2010</b>		DRAWN BY: <b>N.A.</b>	
CHECKED BY: <b>C.N.</b>		APPROVED BY: <b>B.R.G.</b>	

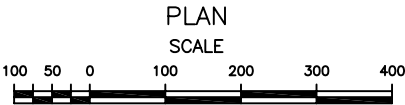
CONT No GWP No 80-00-00	
HIGHWAY 401 WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN	
DRAWING P2-4	

SUMMARY OF WATER WELL RECORDS		
CONCESSION 8 LOT 23	CONCESSION 8 LOT 24	CONCESSION 8 LOT 25
REFER DRAWING 2-4 FOR GROUNDWATER AND BEDROCK DETAILS	NO DATA FOUND	GROUNDWATER DEPTH 3.7 to 20.7m EL. 162.0 to 179.0 TWO DRY WELLS
	NO DATA FOUND	BEDROCK DEPTH >24.4 to >38.1m EL. <144.6 to <158.6



PREDRAFT NOTE: PHOTOGRAPHS 2-43 AND 2-44 WILL BE PROVIDED AT A LATER DATE.

- NOTES:
- 1. REFER TO TABLE 2-1 FOR LIST OF REFERENCES.
  - 2. REFER TO TABLE 2-2 FOR SUMMARY OF WATER WELL RECORDS.
  - 3. REFERENCE PLANS PROVIDED BY McCORMICK RANKIN CORPORATION.
  - 4. FOR SECTION BETWEEN STATIONS 10+000 AND 24+200 REFER DRAWINGS 2-1 TO 2-4
  - 5. PHOTOGRAPH LOCATION AND DIRECTIONS SHOWN THUS  PREFIX '2-' WAS OMITTED FROM PHOTOGRAPH NUMBER FOR CLARITY.



GEOCRES No. 40J8-47

<p>METRIC</p> <p>DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES</p>	<p>PREFERRED OPTION</p>	<div><p>Ontario</p><div><p>McCORMICK RANKIN CORPORATION</p><p>A member of  MMM GROUP</p></div></div>	<div><p>Peto MacCallum Ltd.</p><p>CONSULTING ENGINEERS</p></div> <table><tr><td>DATE</td><td>JANUARY 2010</td><td>DRAWN BY:</td><td>N.A.</td></tr><tr><td>CHECKED BY:</td><td>C.N.</td><td>APPROVED BY:</td><td>B.R.G.</td></tr></table>	DATE	JANUARY 2010	DRAWN BY:	N.A.	CHECKED BY:	C.N.	APPROVED BY:	B.R.G.	<table><tr><td>CONT No</td><td>GWP No</td></tr><tr><td>80-00-00</td><td>80-00-00</td></tr><tr><td colspan="2">HIGHWAY 401 WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN</td></tr></table>	CONT No	GWP No	80-00-00	80-00-00	HIGHWAY 401 WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN		<div></div> <p>DRAWING P2-5</p>
DATE	JANUARY 2010	DRAWN BY:	N.A.																
CHECKED BY:	C.N.	APPROVED BY:	B.R.G.																
CONT No	GWP No																		
80-00-00	80-00-00																		
HIGHWAY 401 WIDENING THROUGH KENT COUNTY RALEIGH TOWNSHIP SECTION SITE PLAN																			



## **APPENDIX A**

### Site Photographs 2-1 to 2-50

Photographs 2-1 to 2-6	– Merlin Road Underpass
Photographs 2-7, 2-8	– Deary Drain Culvert
Photographs 2-9 to 2-12	– Drake Road Underpass
Photographs 2-13 to 2-16	– Government Drain No. 2 Bridge EBL and WBL
Photographs 2-17 to 2-22	– Dillon Road Underpass
Photographs 2-23 to 2-26	– Government Drain No. 3 Bridge EBL and WBL
Photographs 2-27 to 2-30	– Raleigh Plains Drain Bridge EBL and WBL
Photographs 2-31 to 2-34	– Flook & Hinton Drain Bridge EBL and WBL
Photographs 2-35 to 2-42	– Bloomfield Road Underpass
Photographs 2-43, 2-44	– Culvert Site 13-401
Photographs 2-45 to 2-50	– Kent County Road No.10 Underpass



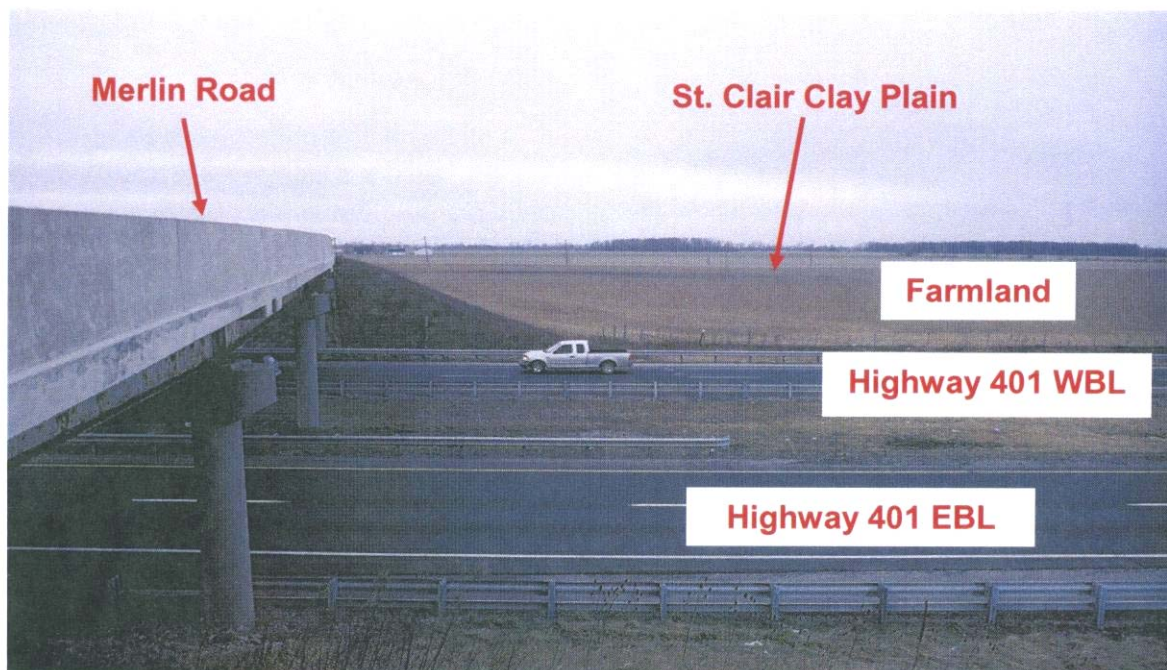


**PHOTOGRAPH 2-1:** Merlin Road Underpass. Looking east at Merlin Road Underpass from south roadside ditch of Highway 401. Note flat terrain in the distance beyond structure. (January 27, 2006)



**PHOTOGRAPH 2-2:** Merlin Road Underpass. Looking northwesterly from southwest corner of structure. Note flat terrain, farmland use and Government Drain No.1 about 40 m to the west. Small commuter parking north of north approach embankment. (January 27, 2006)



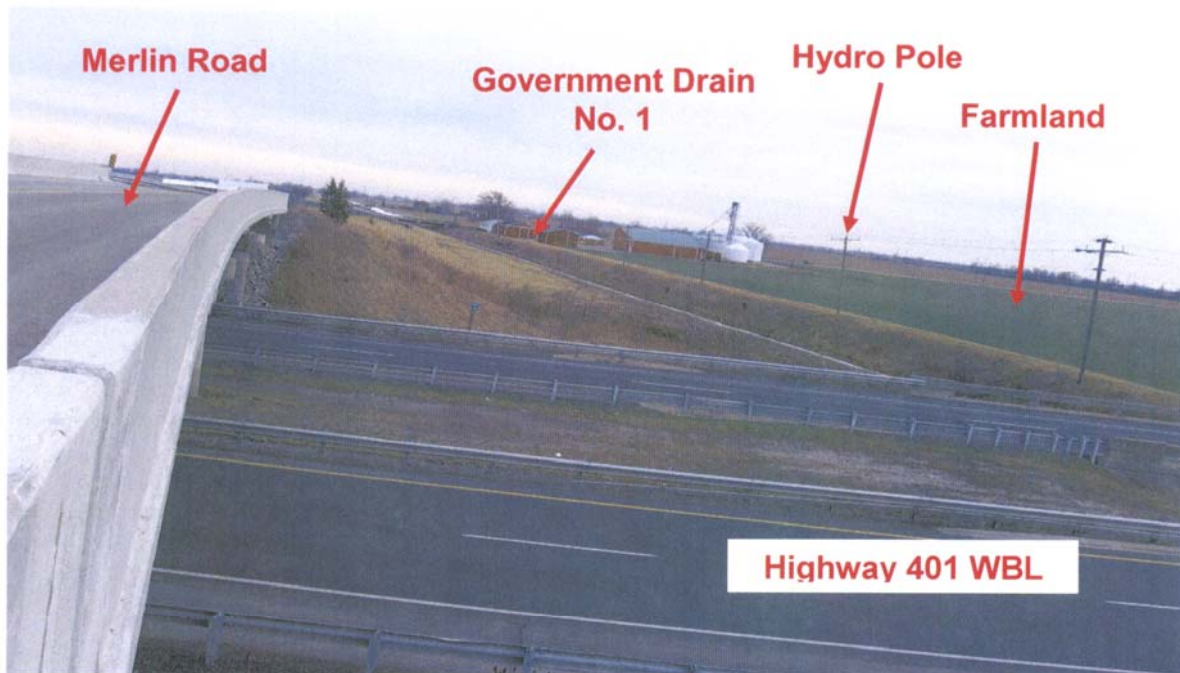


**PHOTOGRAPH 2-3:** Merlin Road Underpass. Looking northeasterly from the east of the south approach embankment. Note flat terrain (St. Clair Clay Plain) and farmland use. (January 27, 2006)



**PHOTOGRAPH 2-4:** Merlin Road Underpass. Looking west at revetment of south foreslope of structure. Note old concrete revetment partially replaced with crushed rockfill. (January 27, 2006)



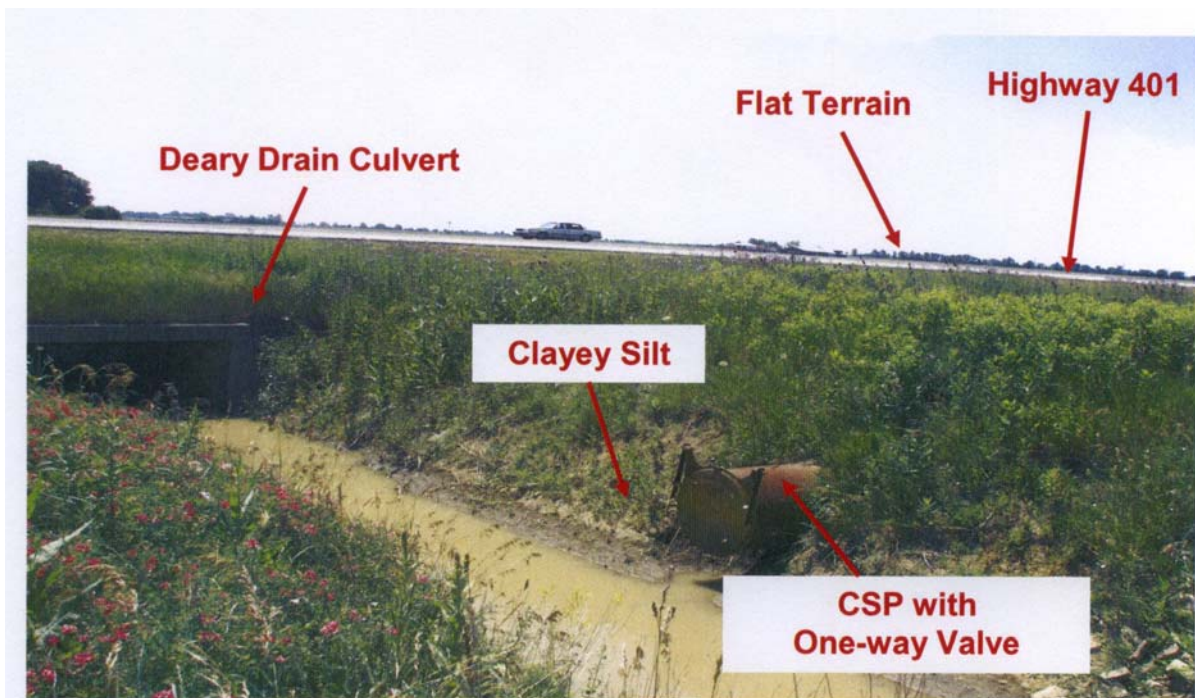


**PHOTOGRAPH 2-5:** Merlin Road Underpass. Looking southwesterly from northwest corner of Merlin bridge structure. Note flat terrain, Government Drain No. 1, farmland and residence. (January 27, 2006)

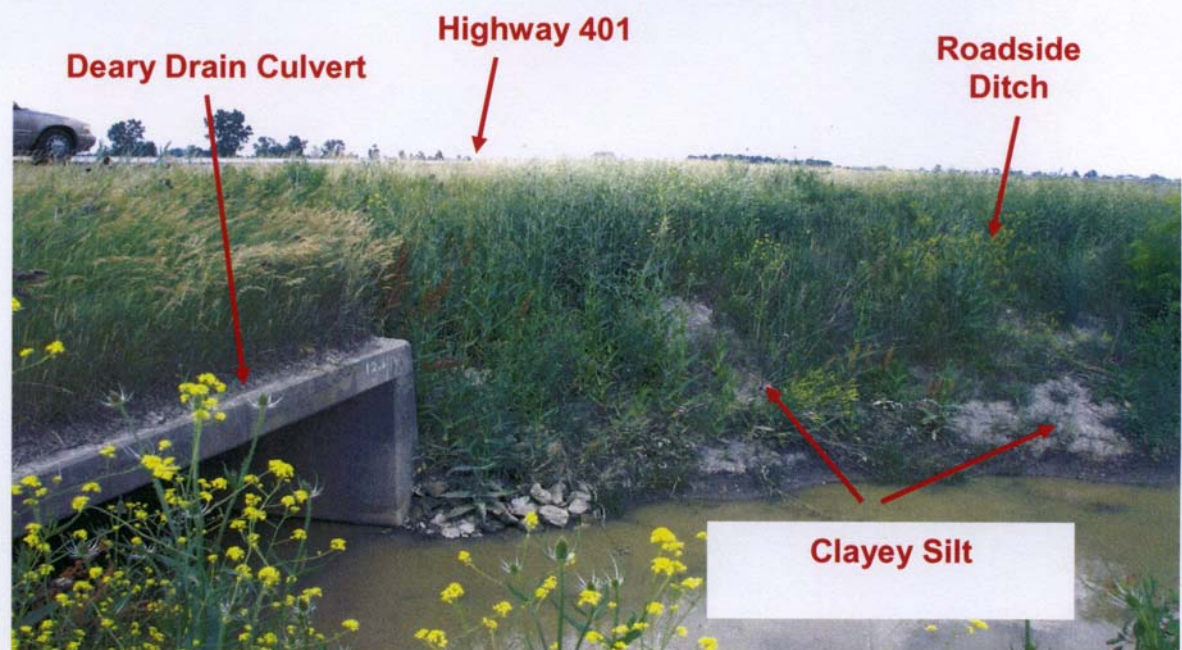


**PHOTOGRAPH 2-6:** Merlin Road Underpass. Looking southerly from northeast end of approach embankment of Merlin Road Underpass. Note good condition of slope. (January 27, 2006)





**PHOTOGRAPH 2-7:** Deary Drain Culvert. Looking southwesterly from north of Highway 401, east bank of drain channel. Note flat terrain beyond Highway 401, clayey silt type soil in bank of channel, CSP culvert with one-way valve for water flow control. (June 28, 2006)



**PHOTOGRAPH 2-8:** Deary Drain Culvert. Looking northeasterly at south end of culvert from west bank of drain channel. Note well vegetated roadside ditch, locally exposed native clayey silt type soil in east bank and murky water indicating erosion. (June 28, 2006)





**PHOTOGRAPH 2-9:** Drake Road Underpass. Looking north from south shoulder of Highway 401 at south pier. Note flat terrain beyond approach embankment, Government Drain No. 2 at tree line in the background and rockfill cover on north foreslope. (January 27, 2006)

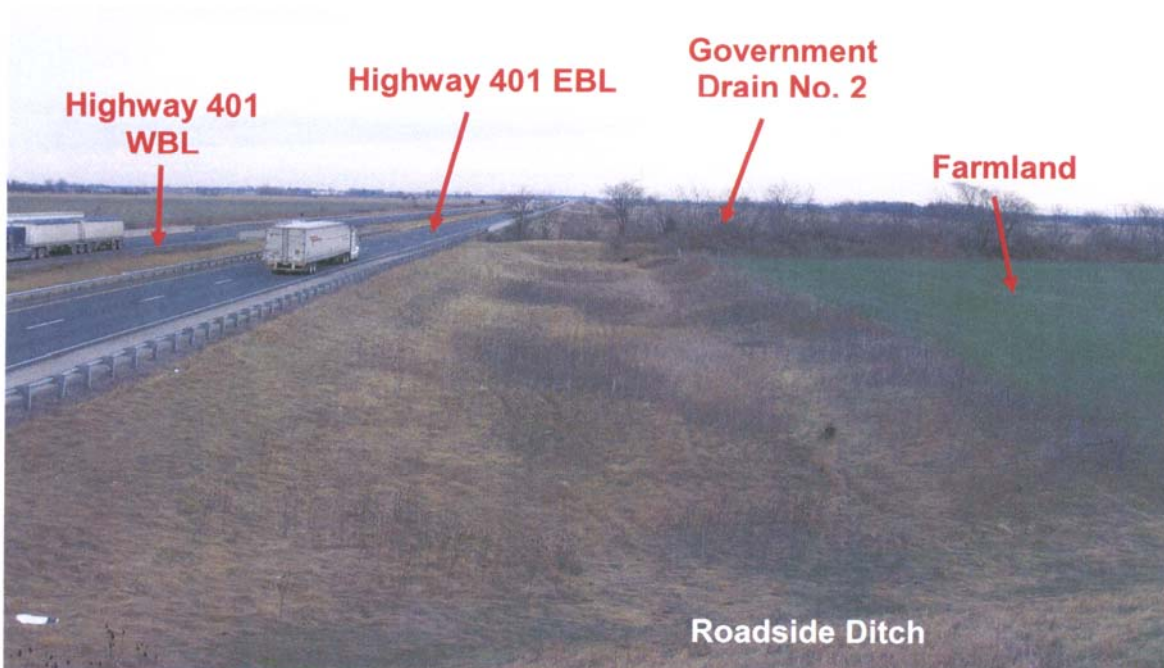


**PHOTOGRAPH 2-10:** Drake Road Underpass. Looking west across foreslope of south pier. Note flat terrain in distance and rockfill covering embankment foreslope. (January 27, 2006)

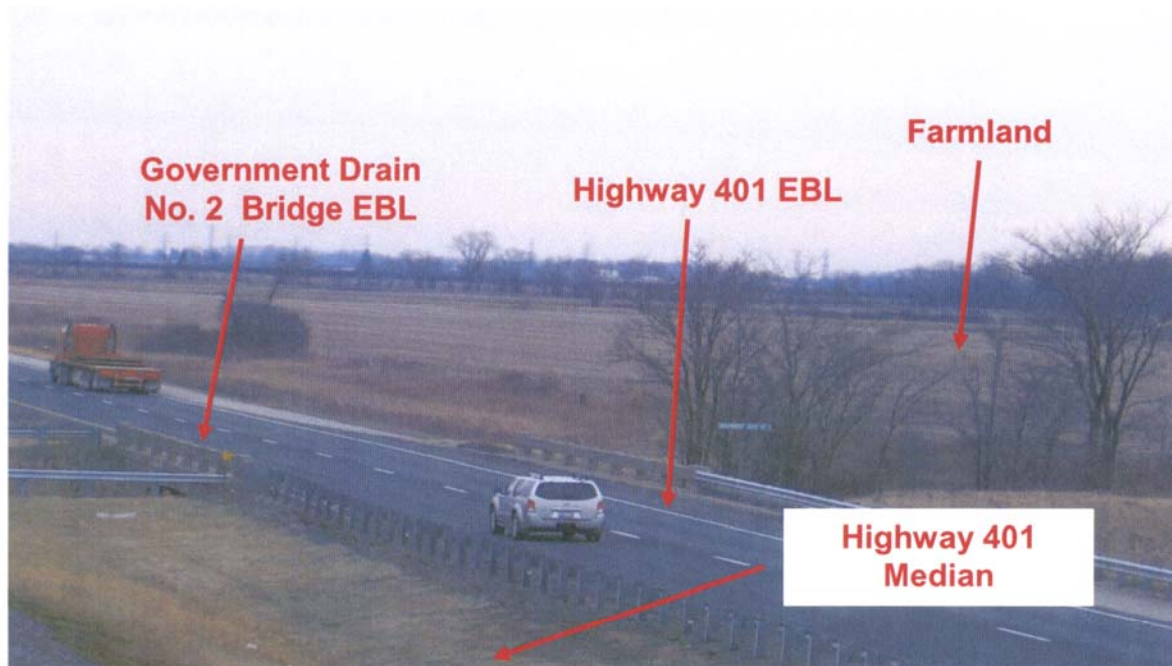




**PHOTOGRAPH 2-11:** Drake Road Underpass. Looking southwesterly from northwest corner of deck of structure. Note farmland in middle of photograph, drainage ditch along west toe of slope of south approach embankment, typically flat terrain. (January 27, 2006)



**PHOTOGRAPH 2-12:** Drake Road Underpass. Looking east from east side of south approach embankment. Note flat terrain, farmland use, wide and flat roadside ditches and Government Drain No. 2 located 161 m easterly at tree line. (January 27, 2006)

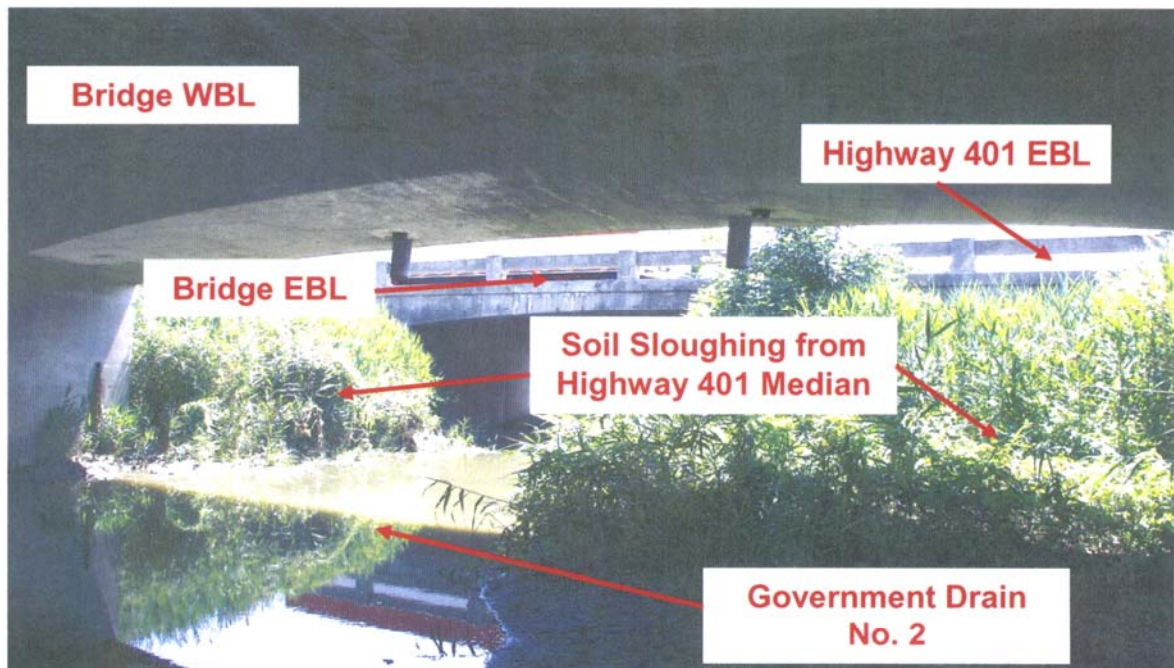


**PHOTOGRAPH 2-13:** Government Drain No. 2 Bridge EBL. Zoom view of EBL bridge over the Government Drain No. 2 from north embankment of Drake Road Underpass. Note flat terrain and farmland use. (January 27, 2006)

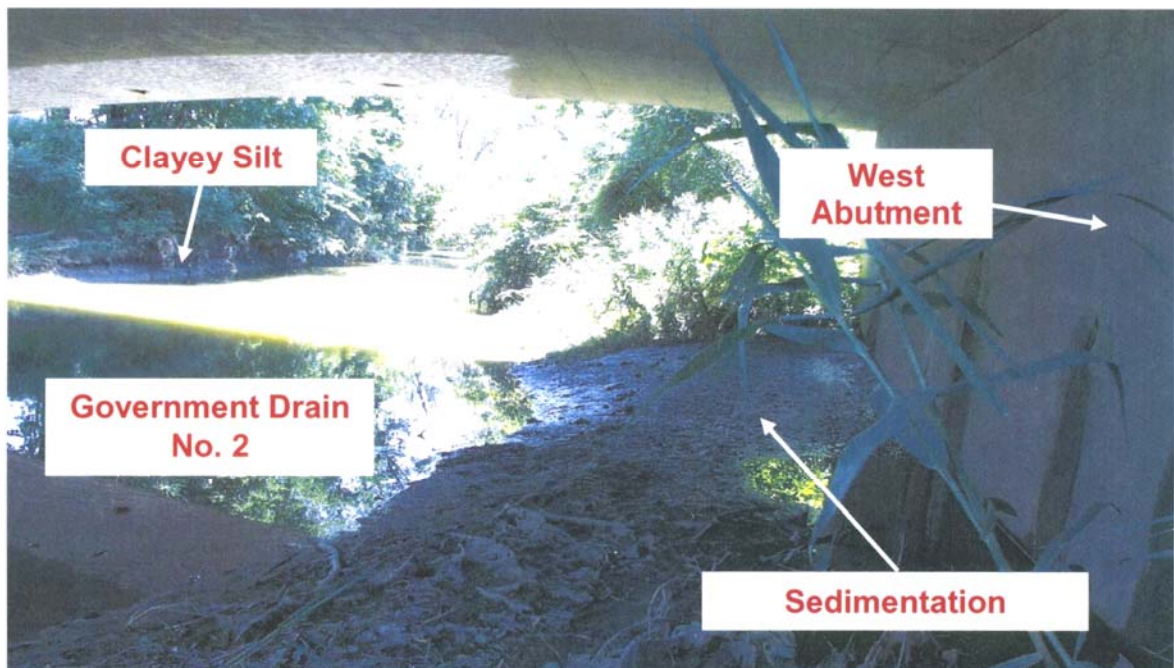


**PHOTOGRAPH 2-14:** Government Drain No. 2 Bridges. Looking northeasterly from base of median at west bank of channel. View under Government Drain No. 2 WBL. Note narrowed channel due to sloughing of fill soil and water flow through weephole. (June 28, 2006)



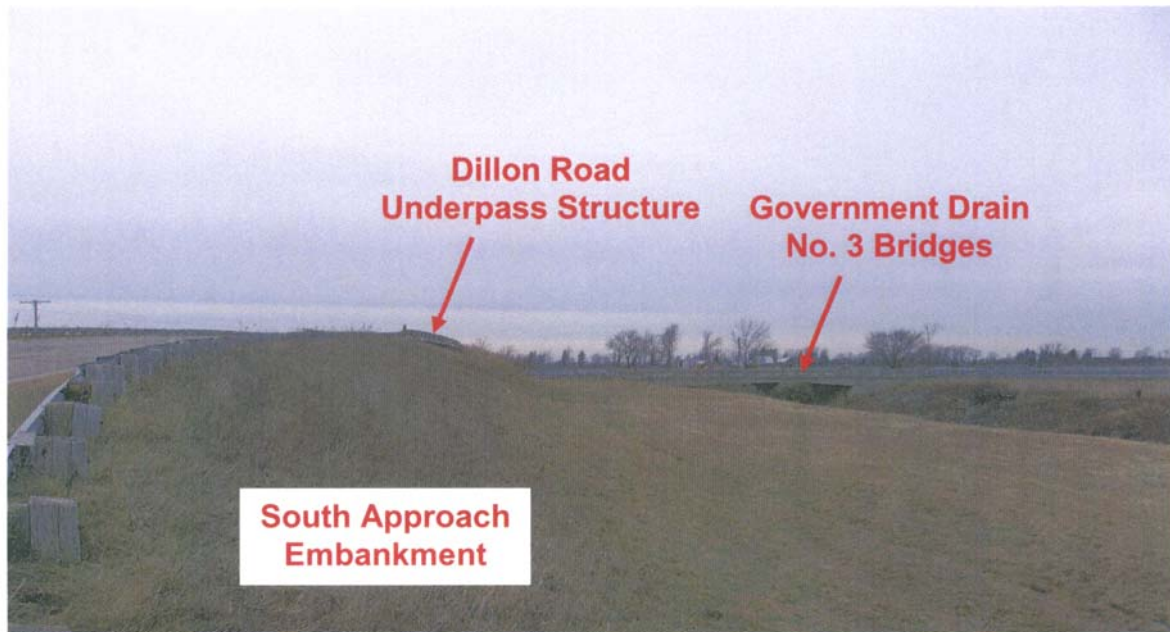


**PHOTOGRAPH 2-15:** Government Drain No. 2 Bridges. Looking southeasterly from north end of base of west abutment of WBL bridge. Note well vegetated median of Highway 401, narrowed channel due to soil sloughing, EBL bridge in background. (June 28, 2006)

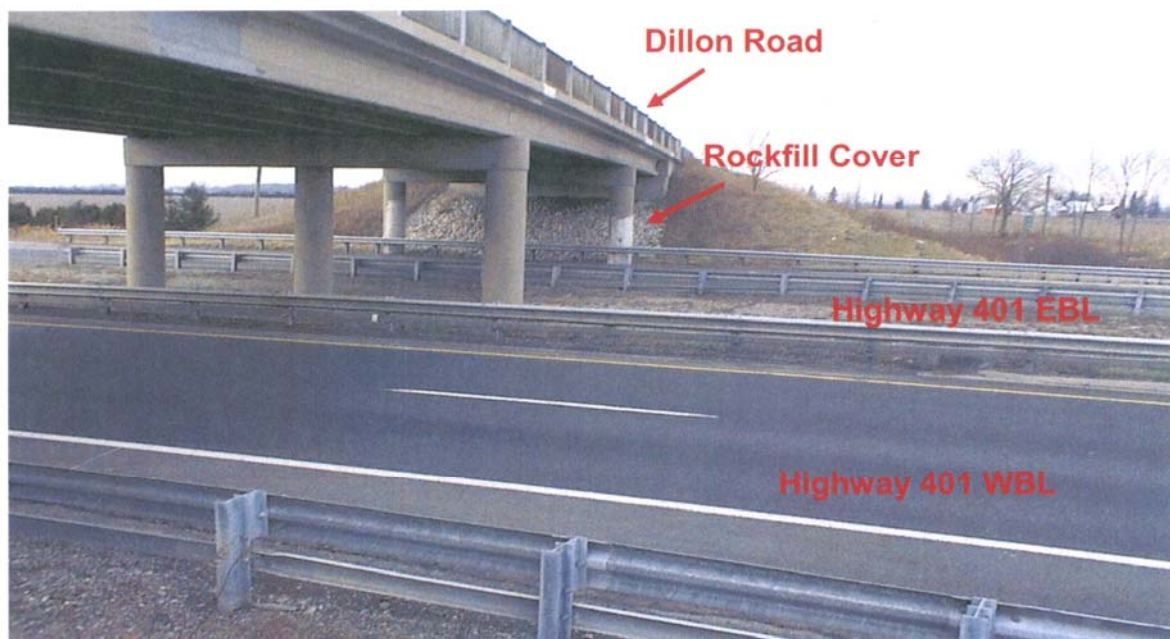


**PHOTOGRAPH 2-16:** Government Drain No. 2 Bridges. Looking southerly under EBL bridge from northwest corner of west abutment. Note sedimentation at base of west abutment, wide channel south of bridge, clayey silt type soil at base of slope of drain channel. (June 28, 2006)





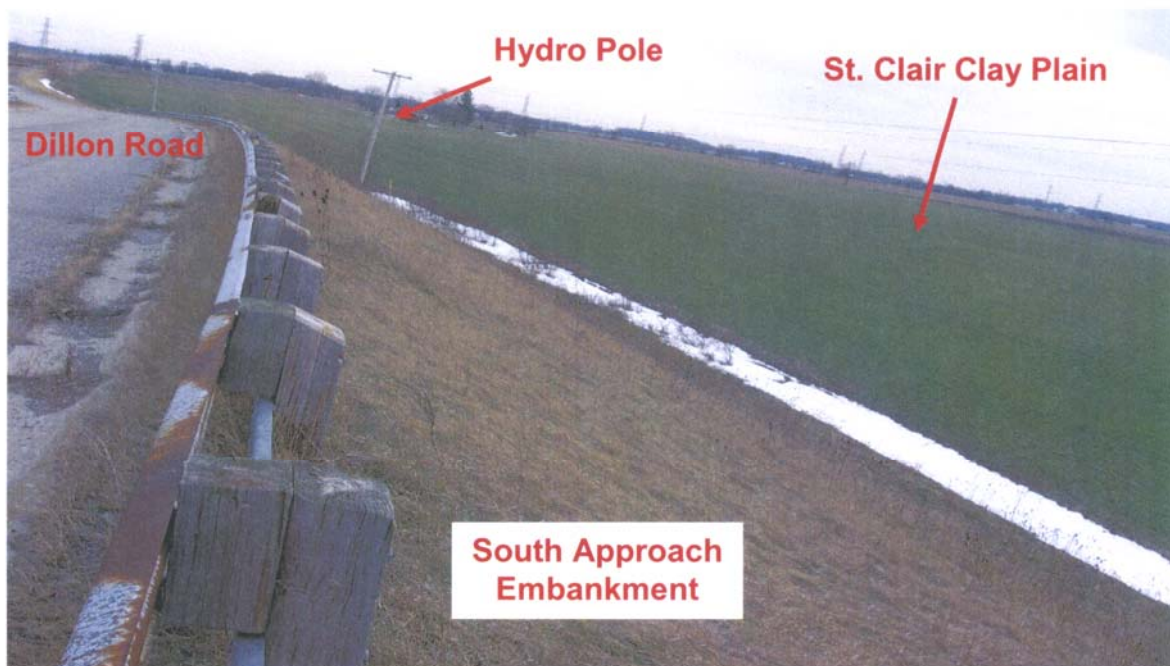
**PHOTOGRAPH 2-17:** Dillon Road Underpass. Looking north from southeast end of south approach embankment to Dillon Road Underpass structure. Note Government Drain No. 3 bridges about 40 m to the east of the structure, flat terrain in background and curved south approach embankment built-up to structure. (January 27, 2006)



**PHOTOGRAPH 2-18:** Dillon Road Underpass. Looking north along east side of Dillon Road Underpass structure from south shoulder of Highway 401. Note flat terrain in the background of photograph. Rockfill cover on foreslope of north abutment (similar condition on foreslope of south abutment). (January 27, 2006)

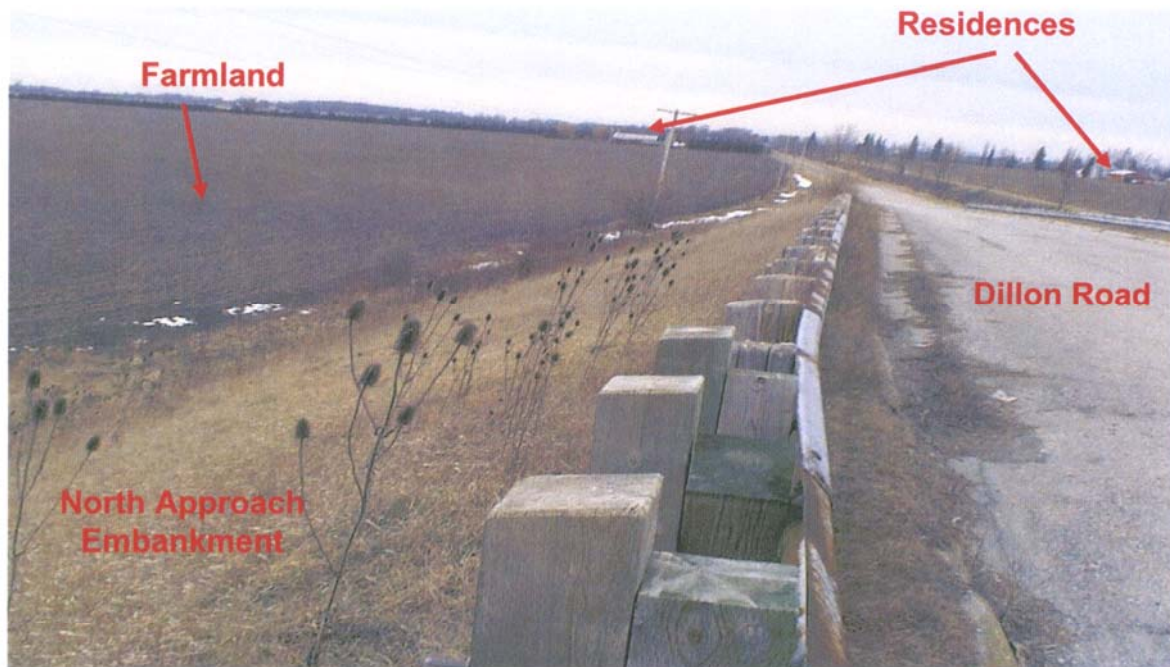


**PHOTOGRAPH 2-19:** Dillon Road Underpass. Looking west from south approach embankment. Note typically flat terrain of the St. Clair Clay Plain, farmland use and wet roadside ditch. (January 27, 2006)

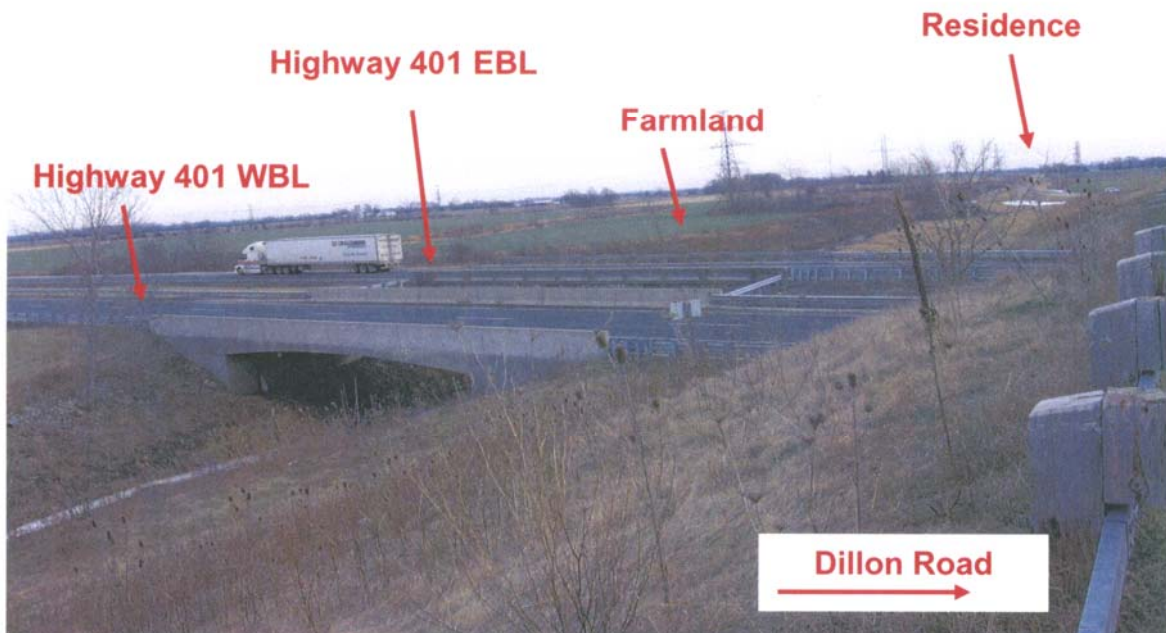


**PHOTOGRAPH 2-20:** Dillon Road Underpass. Looking southwesterly from top of south approach embankment. Note flat terrain, curved south approach embankment, good condition of west side slope and line of hydro poles at toe of slope. (January 27, 2006)





**PHOTOGRAPH 2-21:** Dillon Road Underpass. Looking northwest from top of north approach embankment. Note curving north approach embankment, farmland and residences in background of photograph. (January 27, 2006)

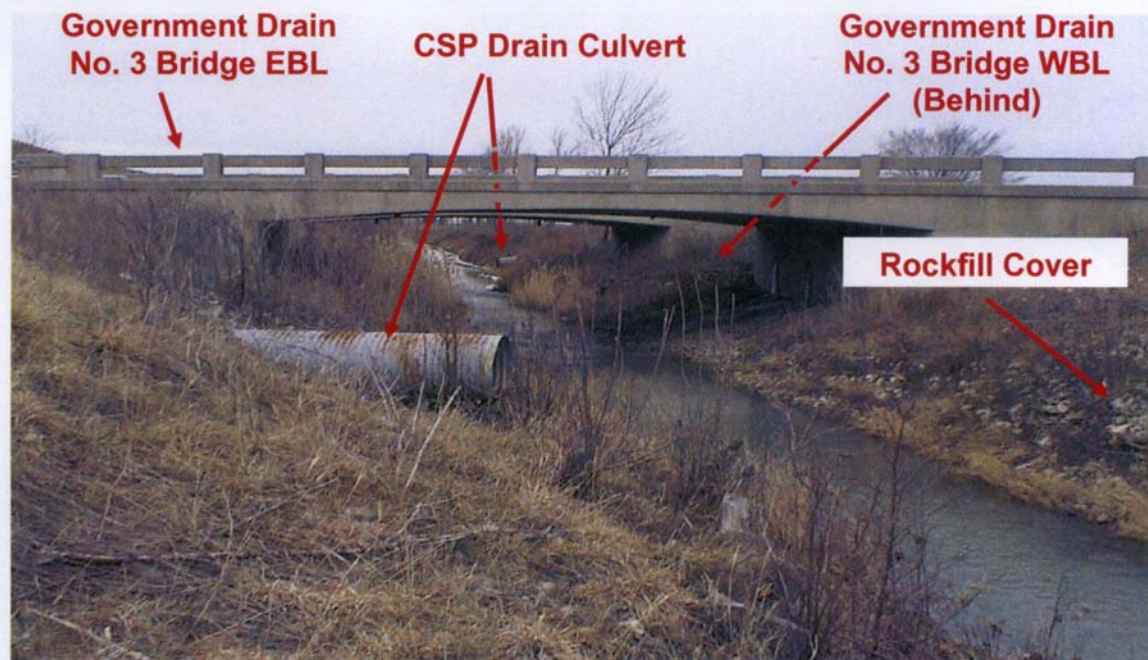


**PHOTOGRAPH 2-22:** Dillon Road Underpass. Looking southeasterly from east side of north approach embankment. View of Government Drain No. 3 Bridges EB and WB 40 m to the east, flat terrain with residence and farming land use in background. (January 27, 2006)





**PHOTOGRAPH 2-23:** Government Drain No. 3 Bridges. Looking east from deck of Dillon Road Underpass structure at Government Drain No. 3 Bridges EBL and WBL and Highway 401. Note flat terrain (St. Clair Clay Plain) and grassed centre median. (January 27, 2006)

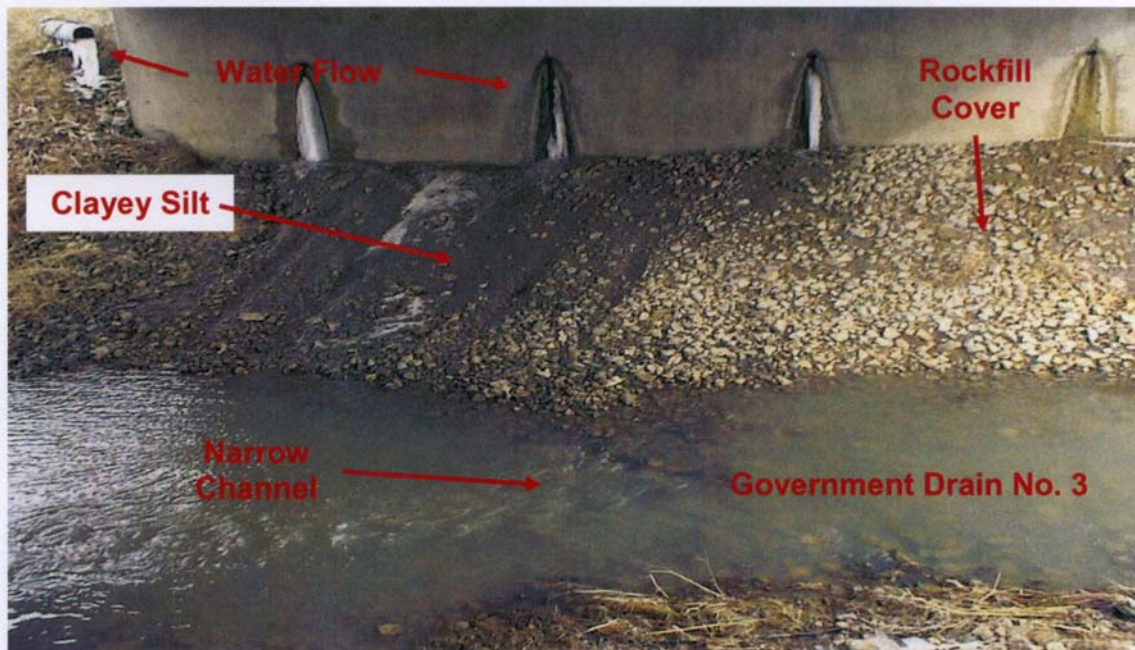


**PHOTOGRAPH 2-24:** Government Drain No. 3 Bridges. Looking north along Government Drain No. 3. View of Bridges for EBL of Highway 401 with WBL Bridge behind. Note grassed over side slopes of channel. Rockfill cover on east slope and CSP culvert. (January 27, 2006)





**PHOTOGRAPH 2-25:** Government Drain No. 3 Bridges. Looking northeasterly at east sideslope of Government Drain No. 3. Note rockfill cover south of east abutment of bridge for Highway 401 EBL. (January 27, 2006)



**PHOTOGRAPH 2-26:** Government Drain No. 3 Bridge EBL. Looking east at east slope of channel under bridge for EBL of Highway 401. Note local erosion of clayey silt soil under rockfill cover. Note groundwater flow through weep holes and drain pipe on upper left corner of photograph. (January 27, 2006)





**PHOTOGRAPH 2-27:** Raleigh Plains Drain Bridges. Looking north at Raleigh Plains Drain Bridge EBL with Bridge WBL behind. Photograph taken from south service road. Note grassed side slopes of drainage channel, CSP culvert with one-way valve covers, rockfill over east bank. (January 27, 2006)



**PHOTOGRAPH 2-28:** Raleigh Plains Drain Bridge EBL. Looking easterly at east bank of Raleigh Plains Drain south of Bridge for Highway 401 EBL. Note clayey silt subgrade with rockfill cover, water flow through weeping holes on east abutment. (January 27, 2006)



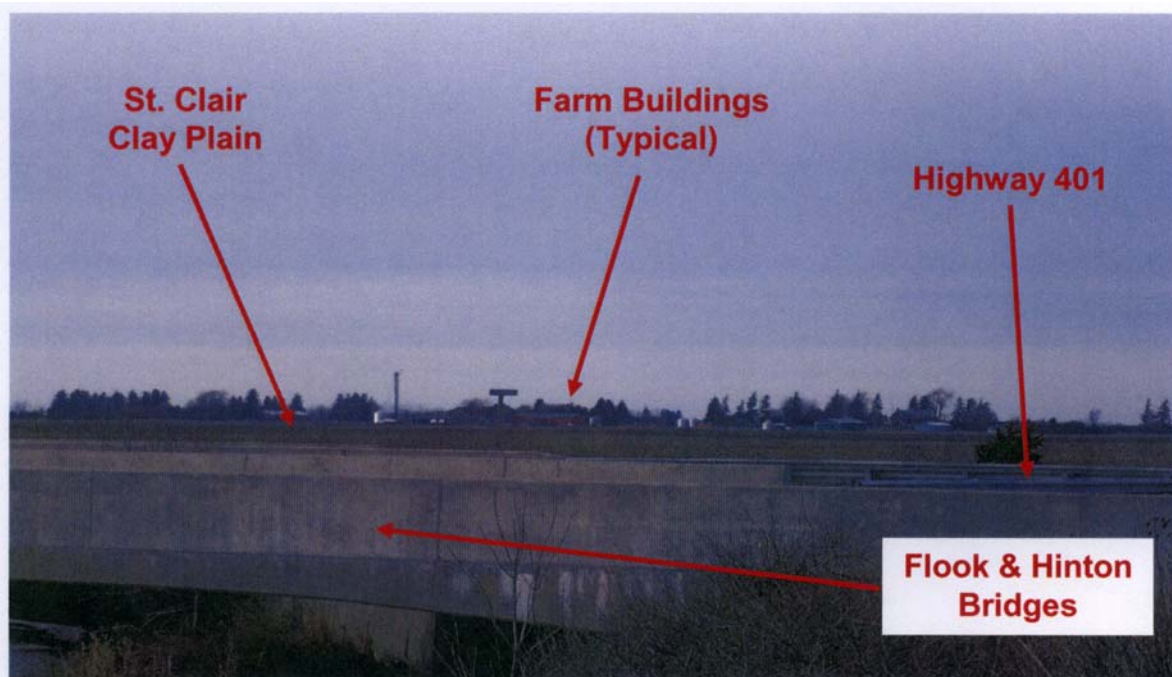


**PHOTOGRAPH 2-29:** Raleigh Plains Drain Bridges. Looking north easterly at Raleigh Plains Drain Bridges EBL and WBL (under white truck). Note erosion scars under each bridge accentuated by dark colour. Refer to following photograph for close-up. (January 27, 2006)

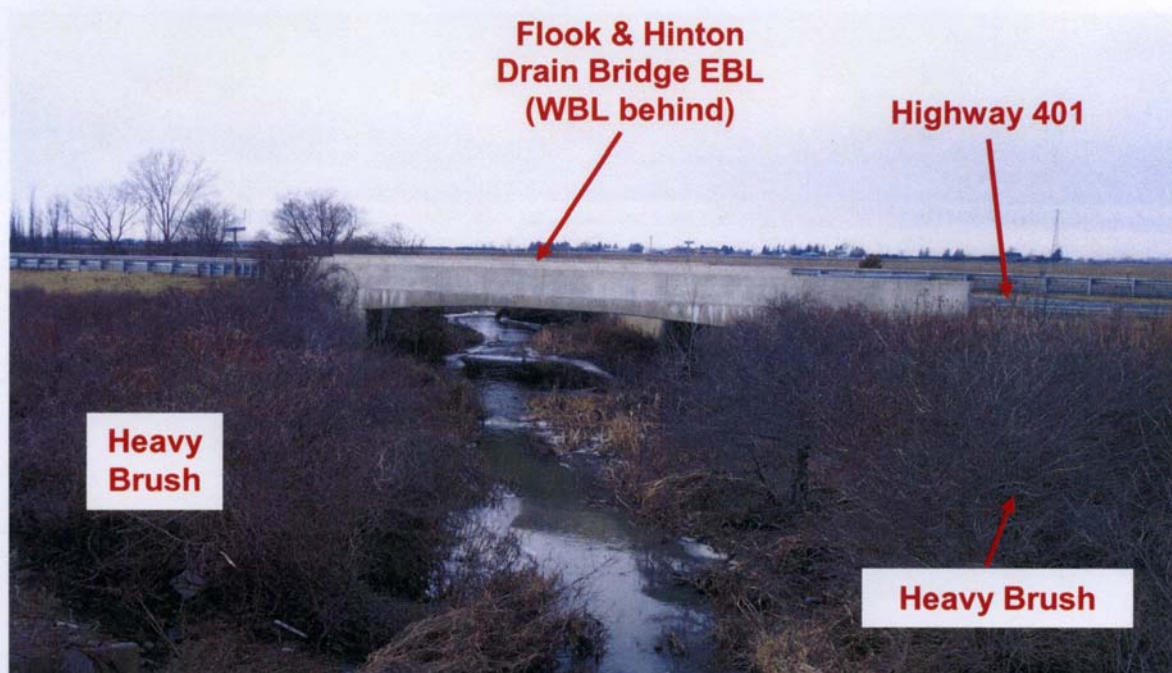


**PHOTOGRAPH 2-30:** Raleigh Plains Drain Bridges. Close-up of typical erosion scar under Raleigh Plains Drain Bridge EBL. Note clayey silt type subsoil. (January 27, 2006)





**PHOTOGRAPH 2-31:** Flook & Hinton Drain Bridges. Looking north across top of Flook & Hinton Drain Bridges EBL and WBL. Note the typically flat terrain of the St. Clair Clay Plain in the background and farm building. (January 27, 2006)

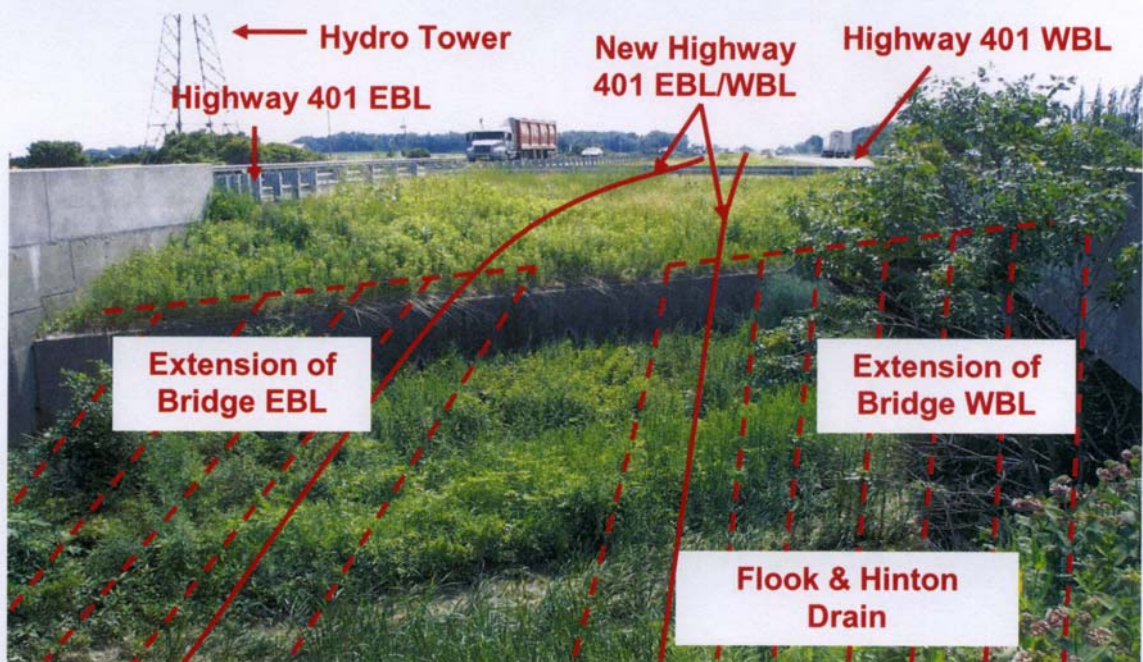


**PHOTOGRAPH 2-32:** Flook & Hinton Drain Bridges. Looking north through Flook and Hinton Drain bridges. (Photograph taken from south service road.) Note heavy brush south of bridges and meandering channel under bridges. (January 27, 2006)



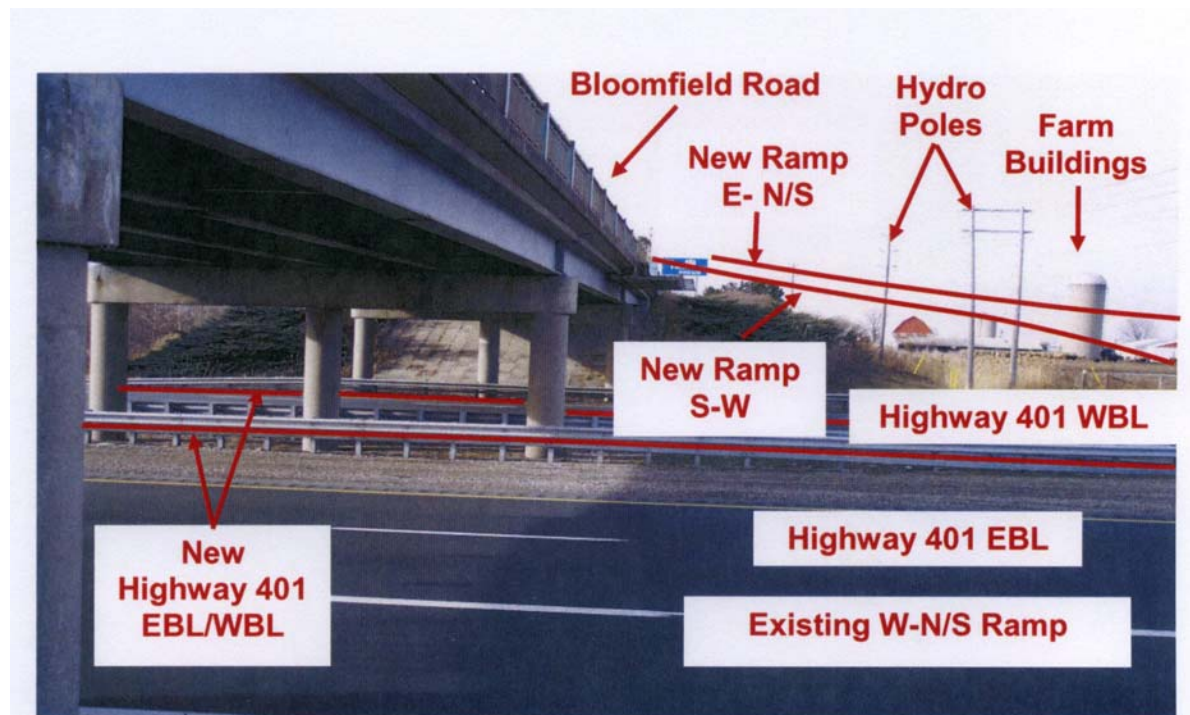


**PHOTOGRAPH 2-33:** Flook & Hinton Drain Bridges. Looking north at Flook & Hinton Drain Bridges EBL and WBL. (WBL Bridge located behind EBL Bridge). Note possible soil sloughing or sedimentation and narrowing of drainage channel under bridges. (January 27, 2006)



**PHOTOGRAPH 2-34:** Flook & Hinton Drain Bridges. Looking westerly from east side of median of Highway 401. Note well vegetated median, Hydro Tower south of Highway 401 and excess vegetation in drain channel indication local sedimentation. Preferred Option: Future extension of the bridges and Highway 401 EBL and WBL in the median are depicted. (June 28, 2006)



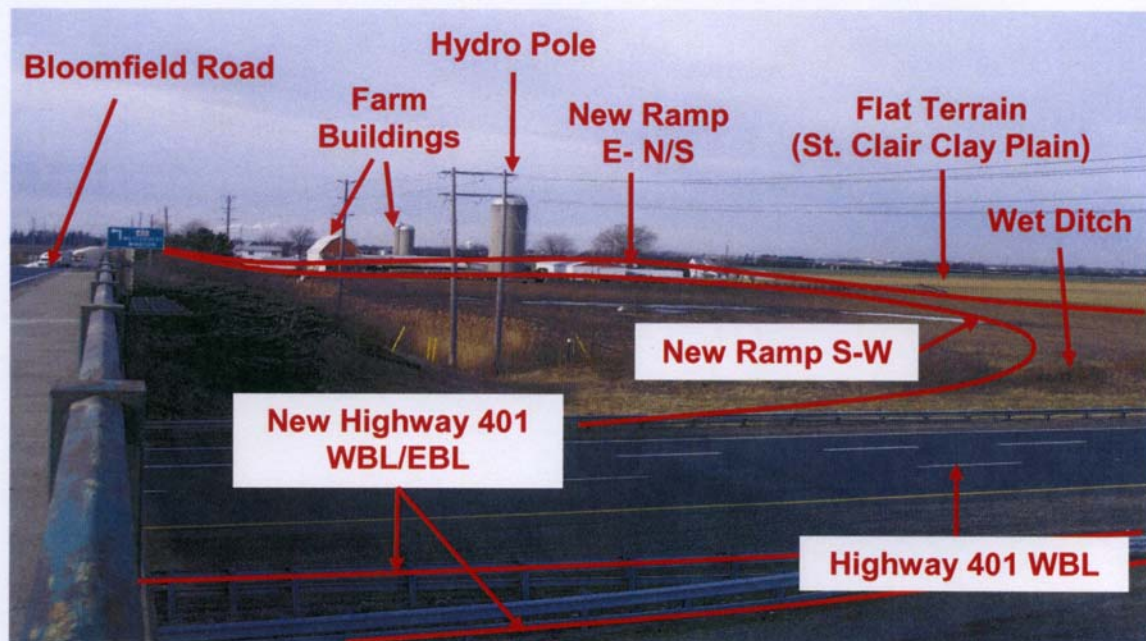


**PHOTOGRAPH 2-35:** Bloomfield Road Interchange. Looking north along east side of Bloomfield Road underpass structure. Note farm buildings in background of photograph, hydro pole line. Preferred Option: Future Highway 401 EBL and WBL, E-N/S and S-W ramps are shown. (January 27, 2006)

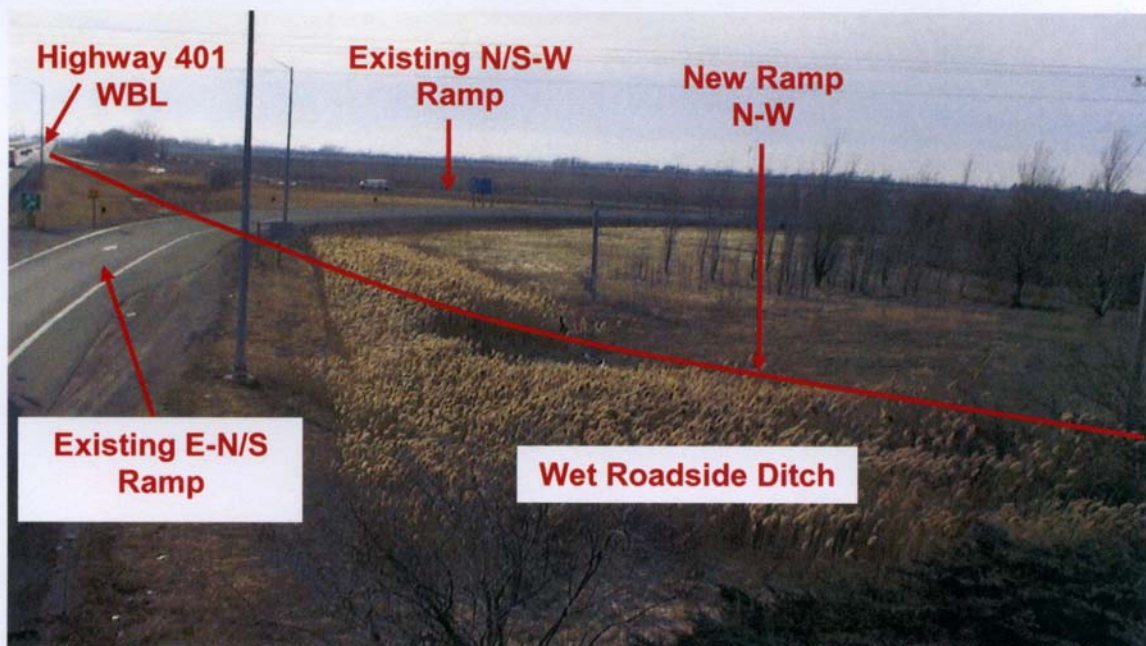


**PHOTOGRAPH 2-36:** Bloomfield Road Interchange. Close-up of local condition of concrete revetment of fore slope of south approach embankment. (January 27, 2006)



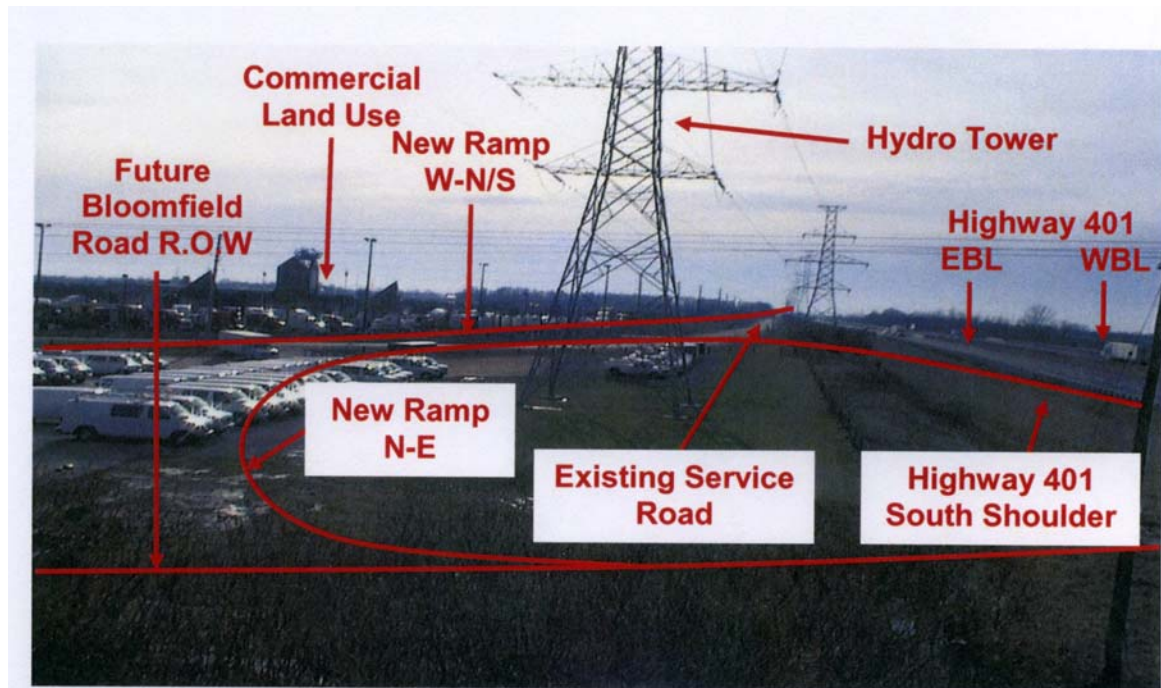


**PHOTOGRAPH 2-37:** Bloomfield Road Interchange. Looking northeasterly from southeast corner of underpass structure. Note flat terrain of the St. Clair Clay Plain. Wet ditches in middle of photograph, farm building and hydro pole line. Preferred Option: Future Highway 401 EBL and WBL, E-N/S and S-W ramps are depicted. (January 27, 2006)



**PHOTOGRAPH 2-38:** Bloomfield Road Interchange. Looking northwesterly from west side of north approach embankment. Note E-N/S and N/S-W ramps constructed on shallow embankments, wet roadside ditch near toe of slope of north approach embankment. Preferred Option: Future N-W ramp is illustrated. (January 27, 2006)



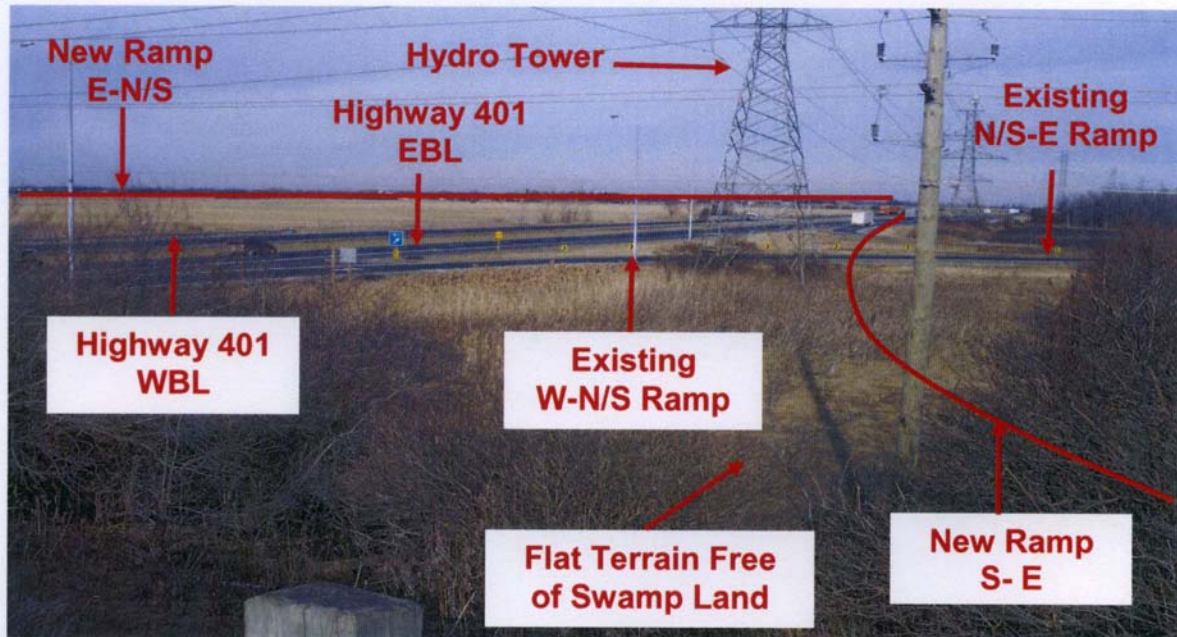


**PHOTOGRAPH 2-39:** Bloomfield Road Interchange. Looking west from south approach embankment. Note typical flat terrain, hydro towers near Highway 401 south shoulder and commercial land use. Preferred Option: Future Bloomfield Road R.O.W, W-N/S and N-E ramps are depicted. (January 27, 2006)

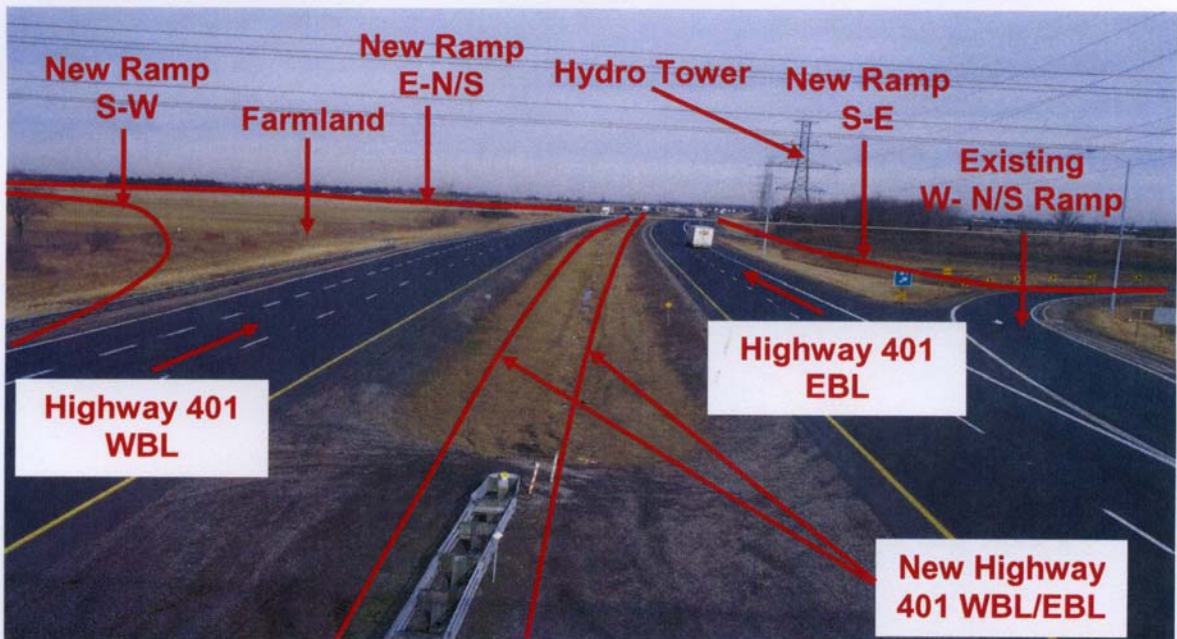


**PHOTOGRAPH 2-40:** Bloomfield Road Interchange. Looking south westerly from top of south approach embankment. Note well vegetated embankment slope and commercial land use near toe of slope. Preferred Option: Future Bloomfield Road R.O.W, W-N/S and N-E ramps are depicted. (January 27, 2006)



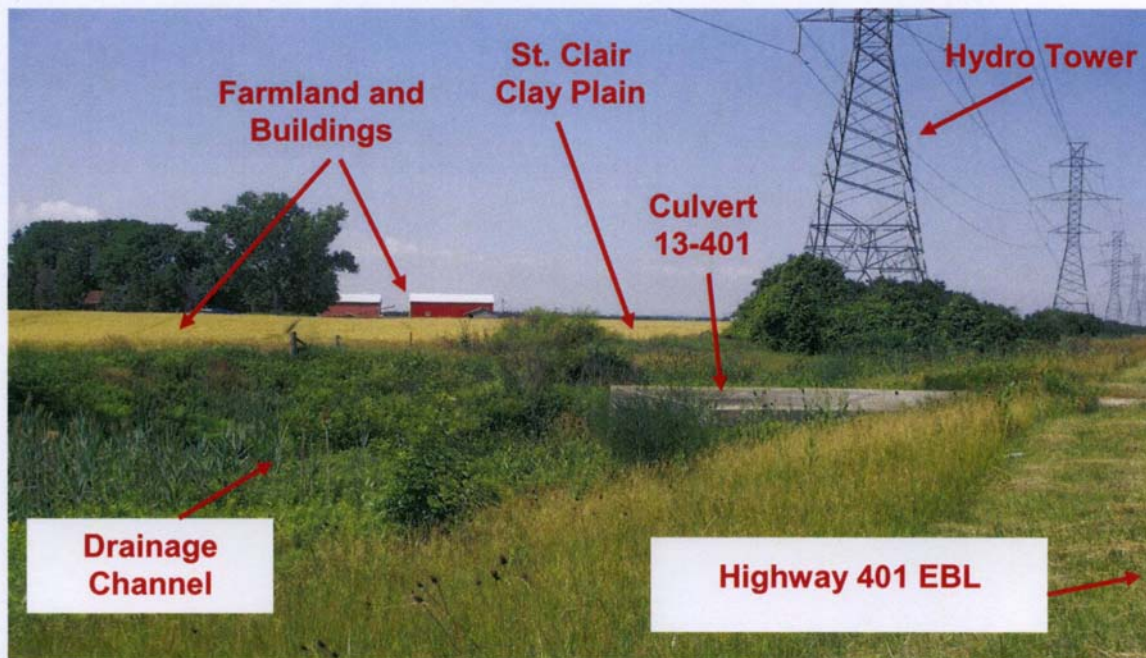


**PHOTOGRAPH 2-41:** Bloomfield Road Interchange. Looking east from middle of south approach embankment. Note flat terrain, swamp free land, W-N/S Ramp and N/S-E Ramp built on low embankments and Hydro tower line. Preferred Option: Future E-N/S and S-E ramps are depicted. (January 27, 2006)



**PHOTOGRAPH 2-42:** Bloomfield Road Interchange. Looking east from underpass structure. Note flat terrain Hydro tower near Highway 401 south shoulder, grassed roadside ditches and median and farm land beyond right-of-way. Preferred Option: Future Highway 401 EBL and WBL, S-E and S-W ramps are depicted (January 27, 2006)



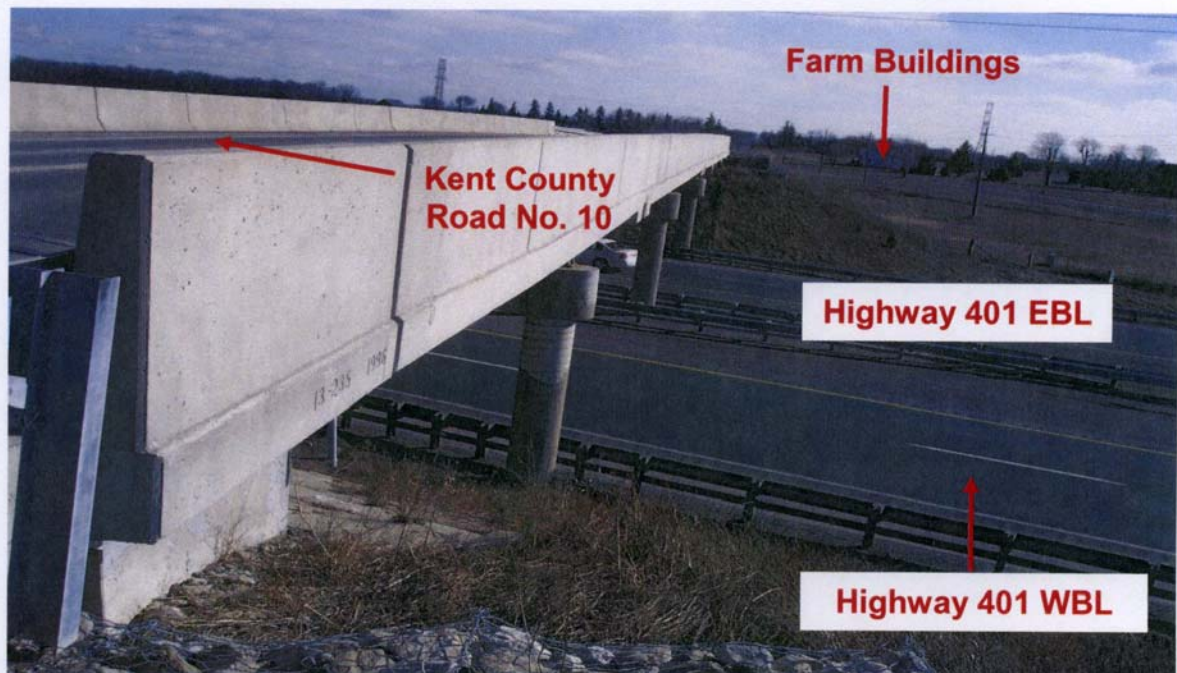


**PHOTOGRAPH 2-43:** Culvert Site 13-401. Looking southwesterly from south shoulder of Highway 401 EBL. Note flat terrain of the St. Clair Clay Plain, line of Hydro Towers south of Highway 401, well vegetated drainage channel south of culvert. (June 28, 2006)

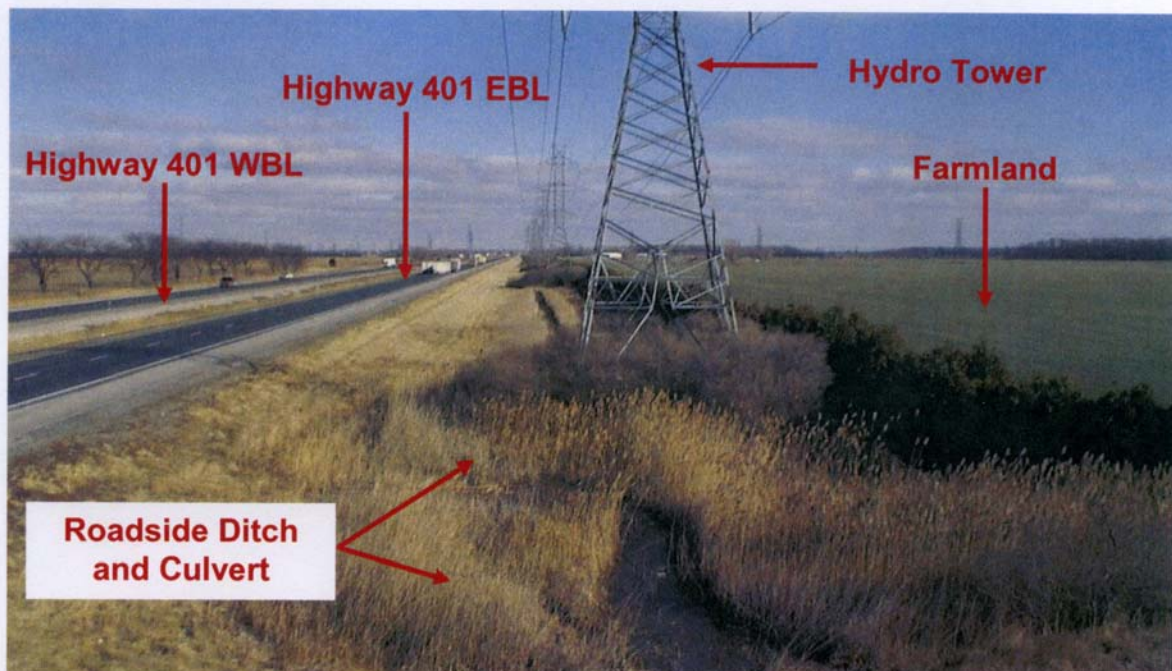


**PHOTOGRAPH 2-44:** Culvert Site 13-401. Looking easterly from west bank of drainage channel at north end of culvert. Close-up view of sloughing of soil at end of culvert. Note suspended silt in water indicating erosion. (June 28, 2006)





**PHOTOGRAPH 2-45:** Kent County Road No. 10 Underpass. Looking south along west side of Underpass structure. Note typical flat terrain farmland use and swamp - free landscape. (January 26, 2006)

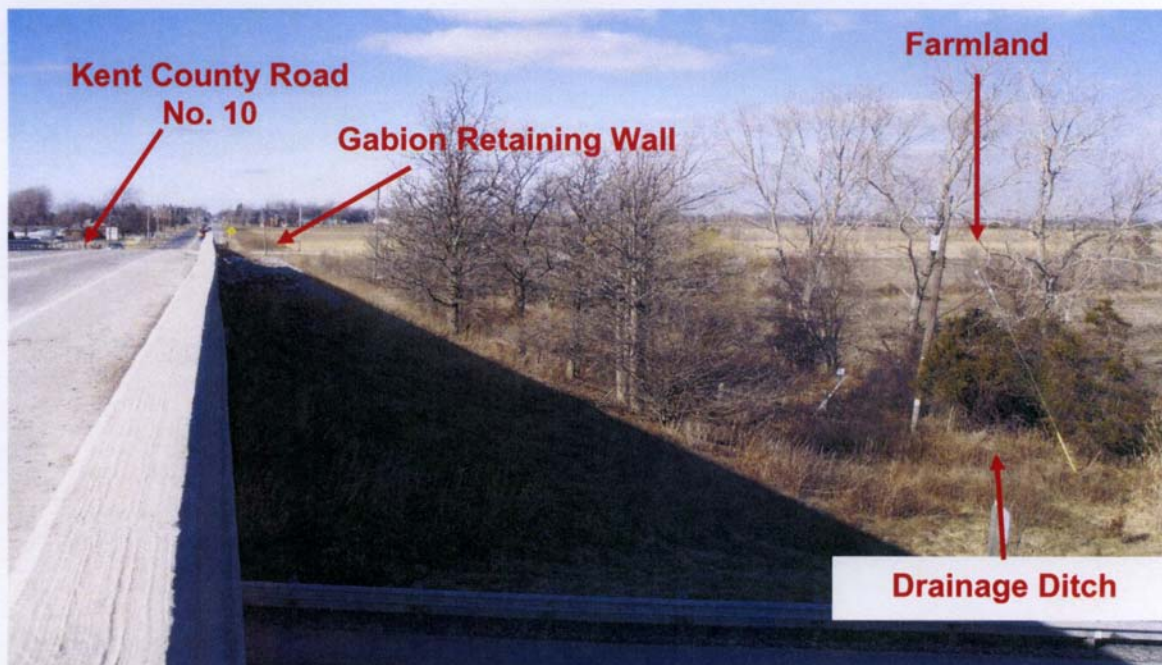


**PHOTOGRAPH 2-46:** Kent County Road No. 10 Underpass. Looking east from middle of south approach embankment. Note wet roadside ditch and culvert on foreground, flat terrain and farmland in background of photograph. (January 26, 2006)





**PHOTOGRAPH 2-47:** Kent County Road No. 10 Underpass. Looking north from middle of south approach embankment. Note flat terrain, built-up south approach embankment in good condition, gabion basket retaining wall at structure and farming land use.



**PHOTOGRAPH 2-48:** Kent County Road No.10 Underpass. Looking northeasterly from top of Underpass structure. Note tree growth along drainage ditch, farmland in background. Gabion basket retaining wall atop north approach embankment.



## **APPENDIX B**

### Previous Soil Data and Records of Boreholes

- (1) Foundation Investigation Report for WP 89-67-00 (Government Drain No. 1 Bridge at Highway 2, North of Highway 401)
- (2) Contract Drawings for WP 69-59 (Merlin Road Underpass)
- (3) Foundation Investigation Report for WP 10-59 and 69-59 (Government Drain No. 1 and Merlin Road Underpass)
- (4) Contract Drawing for WP 81-59 (Drake Road Underpass)
- (5) Foundation Investigation Report for WP 81-59 (Drake Road Underpass)
- (6) Additional Borings for WP 81-59 (Revised Drake Road Underpass)
- (7) Contract Drawings for WP 11-59 (Government Drain No. 2 Bridges)
- (8) Foundation Investigation Report for WP 11-59 (Government Drain No. 2 Bridges)
- (9) Contract Drawings for WP 299-60 (Dillon Road Underpass)
- (10) Foundation Investigation Report for WP 12-59 (Government Drain No. 3 Bridges and Dillon Road Underpass)
- (11) Contract Drawings for WP 12-59 (Government Drain No. 3 Bridges)
- (12) Contract Drawings for WP 13-59 (Raleigh Plains Drain Bridges)
- (13) Foundation Investigation Report for WP 13-59 (Raleigh Plains Drain Bridges)
- (14) Contract Drawings for WP 14-59 (Flook & Hinton Drain Bridges)
- (15) Foundation Investigation Report for WP 14-59 (Flook & Hinton Drain Bridges)
- (16) Contract Drawings for WP 297-59 (Bloomfield Road Interchange Underpass)
- (17) Foundation Investigation Report for WP 297-59 (Bloomfield Road Underpass)
- (18) Contract Drawings for WP 56-59 (Kent County Road No. 10 Underpass)
- (19) Foundation Investigation Report for WP 56-59 (Kent County Road No. 10 Underpass)
- (20) Contract Drawings for WP 51-77-01 (General data only)
- (21) Contract Drawing for WP 600-93-01 and 600-93-00 (General data only)





- (1) Foundation Investigation Report for Government Drain No. 1 Bridge at Highway 2, North of Highway 401, WP 89-67-00, dated December 1974, Geocres No. 40J8-36.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

W.P. 89-67-00 LOCATION Sta. 0 + 16 o/s 38' Lt. ORIGINATED BY PJS  
 DIST. 1 HWY. 2 BORING DATE December 11, 1974 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
585.6	Ground Level															GR. SA. SI. CL.
0.0	Clayey silt to silty clay, some sand, trace of gravel.		1	SS	9	580										2 20 49 29
			2	SS	13											
			3	SS	37											
			4	SS	29	570										
	Stiff to Hard		5	SS	16											
			6	SS	20	560										0 32 35 33
			7	SS	19	550										
			8	SS	28	540										
						530										
			9	SS	22	520										0 19 56 25
510.6						510										
75.0	Fine Sand Some Silt Compact		10	SS	20	500										0 85 (15)
502.6	Clayey silt with sand.															
83.0	Hard															
493.1	Probable Bedrock															
92.5	End of Borehole					490										

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO-

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

W.P. 89-67-00 LOCATION Sta. 0 + 16 o/s 44' Rt. ORIGINATED BY PJS  
DIST. 1 HWY. 2 BORING DATE December 13, 1974 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
585.3	Ground Level															
0.0	Clayey silt to silty clay, some sand.		1	SS	20	580									0 5 46 49	
			2	SS	14											
			3	SS	17											
	Stiff to Very Stiff		4	SS	23											
			5	TW	PH	570									130 0 20 50 30	
			6	SS	21											
			7	TW	PH										133 0 20 48 32	
			8	SS	22	560										
553.8			9	SS	20										0 20 50 30	
31.5	End of Borehole					550										
	Note: Water Level not established.															

OFFICE REPORT ON SOIL EXPLORATION



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

W.P. 89-67-00 LOCATION Sta. 1 + 03. o/s 23' Lt. ORIGINATED BY PJS  
 DIST. 1 HWY. 2 BORING DATE December 13, 1974 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WP	WL	W		
585.2	Ground Level															
0.0	Clayey silt to silty clay, some sand.		1	SS	14	580										
			2	SS	11											
			3	SS	25											
	Stiff to Hard		4	TW	PH											
			5	SS	24	570										
			6	SS	24											
			7	SS	25	560										
553.7			8	SS	41											
31.5	End of Borehole					550										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

W.P. 89-67-00 LOCATION Sta. 1 + 03 o/s 23' Rt. ORIGINATED BY EJS  
 DIST. 1 HWY. 2 BORING DATE December 16, 1974 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
585.3	Ground Level															
0.0	Clayey silt to silty clay, some sand.		1	SS	19	580									132	0 18 48 34
			2	SS	11											
			3	TW	PH											
			4	SS	44											
			5	SS	21	570										
			6	SS	23											
			7	TW	PH										131	0 21 47 32
	Stiff to Hard		8	SS	15	560										
			9	SS	16											
			10	SS	15	550										
			11	SS	21	540										
			12	SS	19	530										
510.3						520										
75.0	Fine Sand					510										
502.3	Compact					500										
83.0	Clayey Silt with sand.															
	Hard		13	SS	70	490										
493.0																
92.3	Limestone Bedrock															
488.8	Shale Layers															
96.5	End of Borehole															
	Note: Water Level not established.															

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

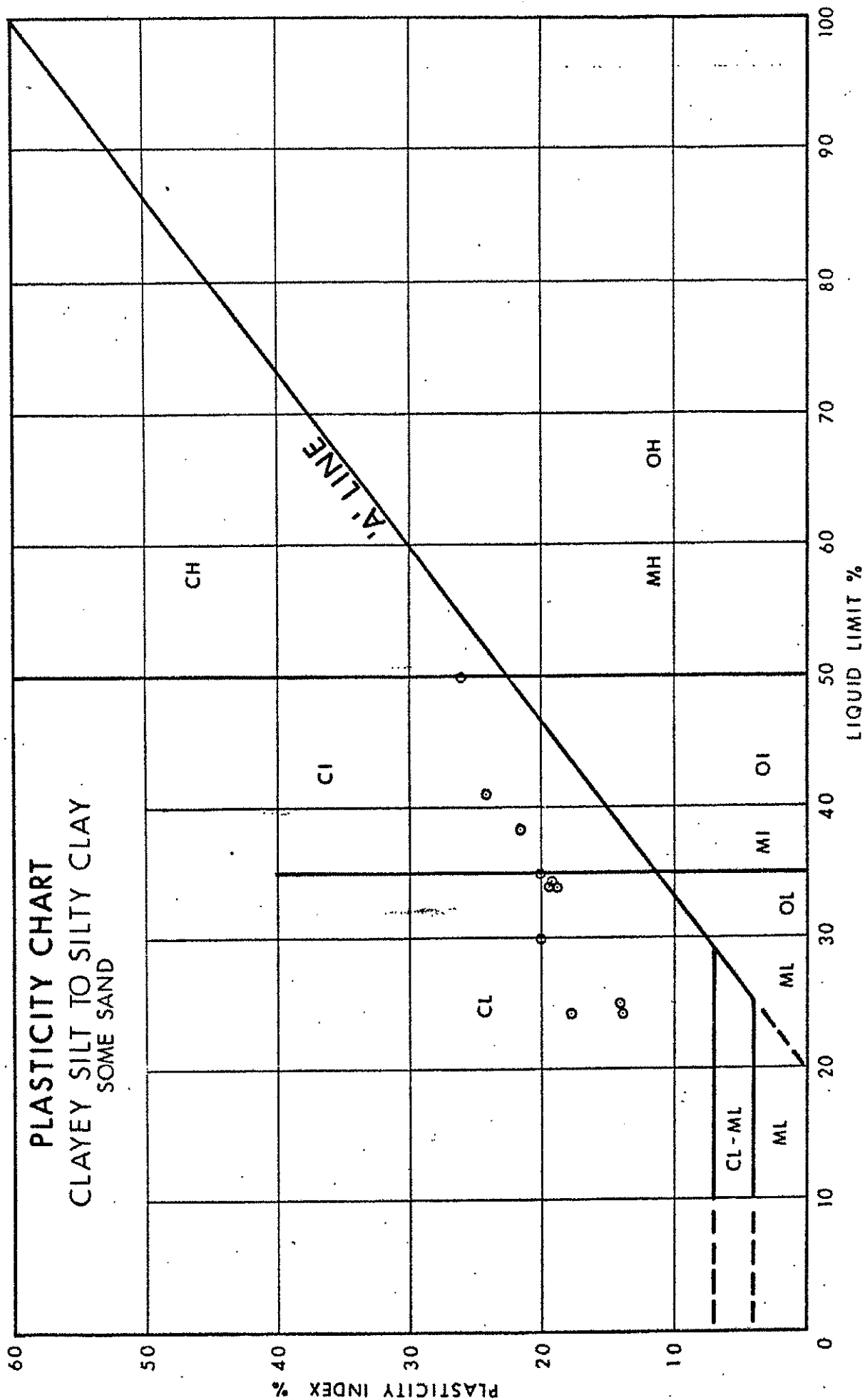


FIG. 1.



# GRAIN SIZE DISTRIBUTION

## UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	
					$\frac{3}{16}$ " $\frac{1}{2}$ " $\frac{3}{4}$ " 1" $1\frac{1}{2}$ " 2" $2\frac{1}{2}$ " 3"		

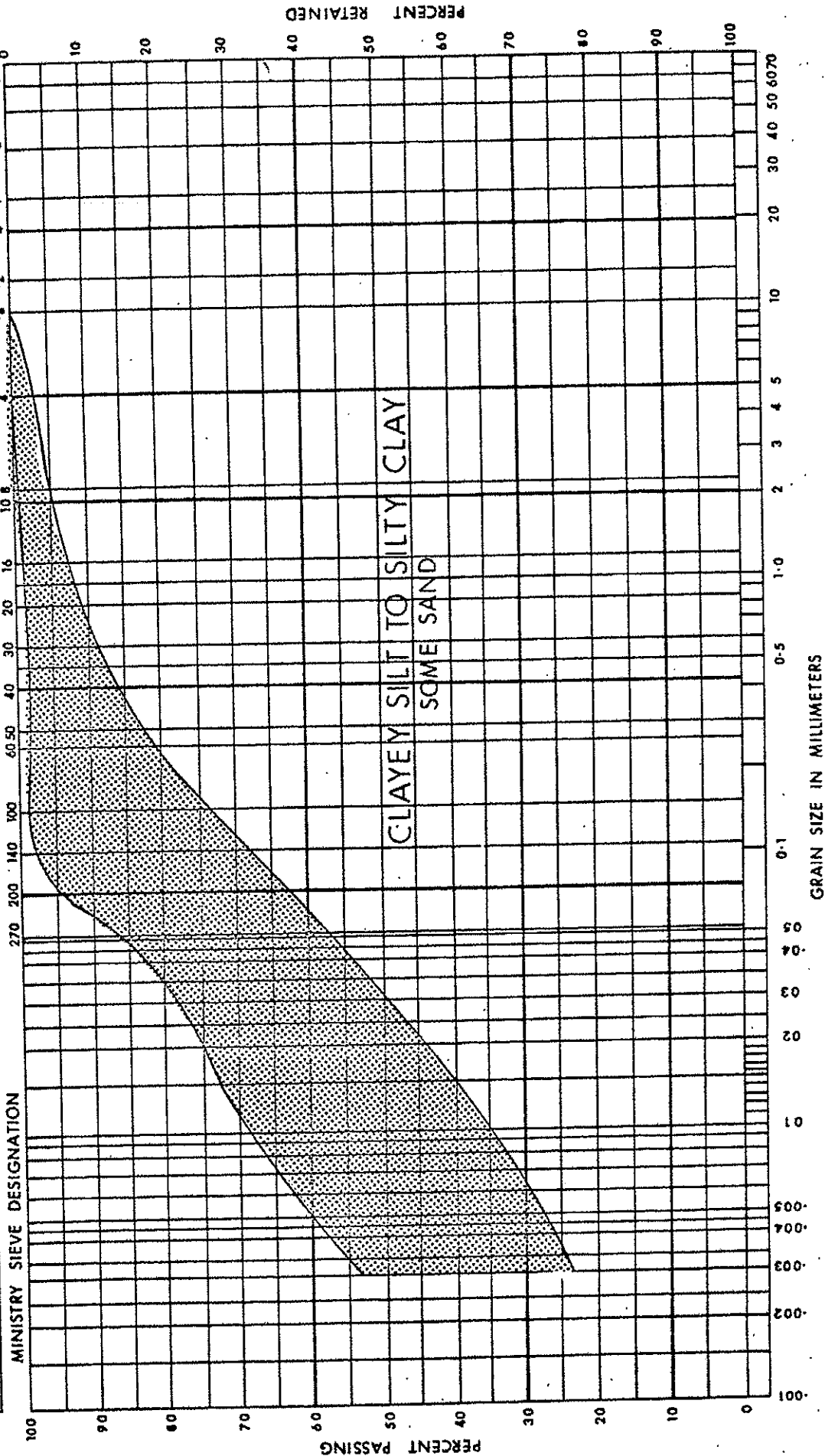
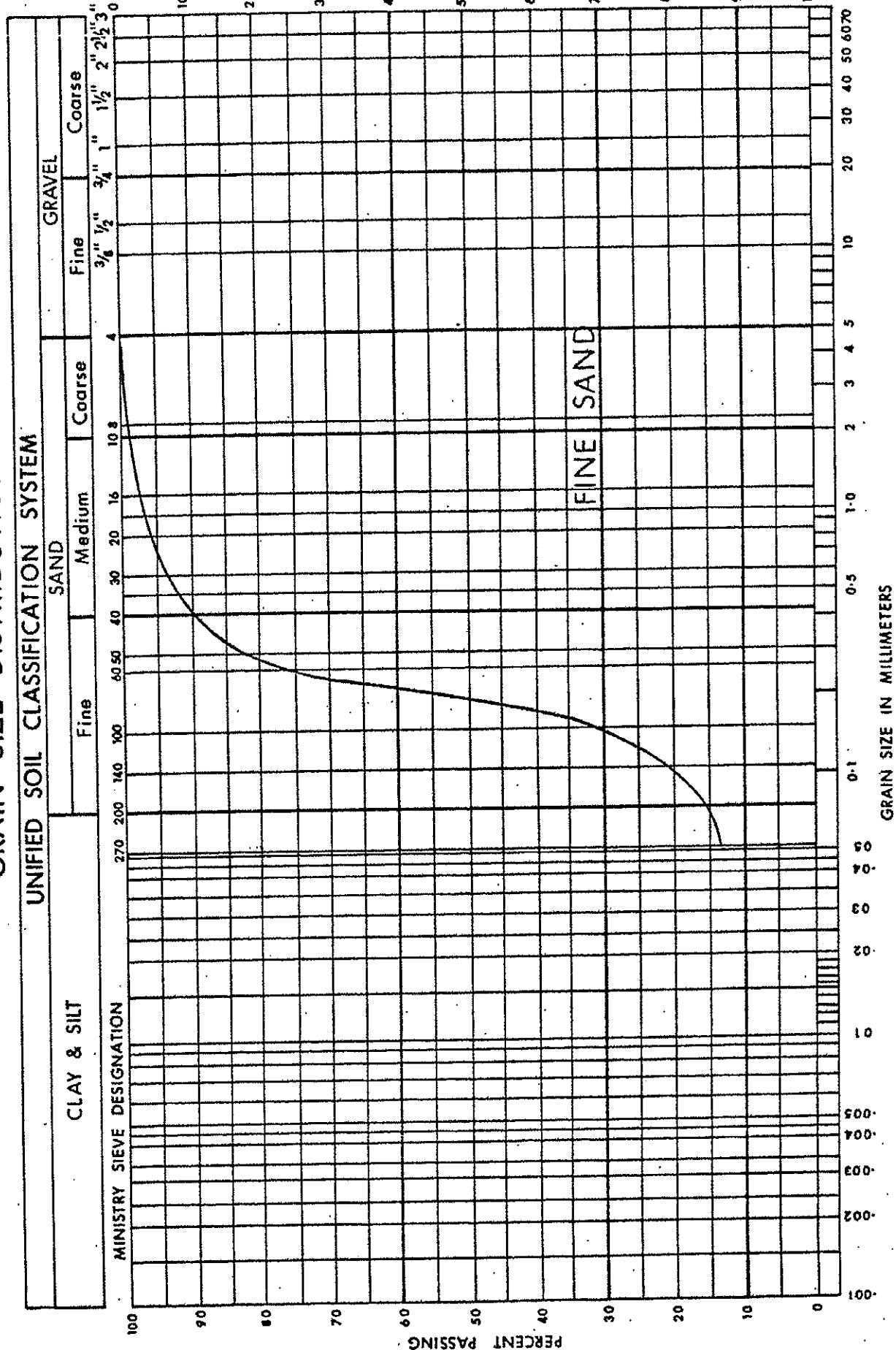
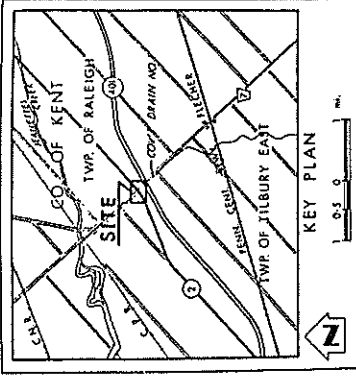


FIG. 2

# UNIFIED SOIL CLASSIFICATION SYSTEM



W. P. 89-67-00



LEGEND		
	Bore Hole	
	Dynamic Cone Penetration Resistance Test	
	Water Level	
	Bore Hole & Case Test	
Notes: Levels established at time of field investigation 11 Dec 1974. No Water Levels established. S.T. No. 2 & 4.		
NO.	ELEVATION	STATION
1	585.6	0+16
2	585.3	0+16
3	585.2	1+03
4	585.3	1+03

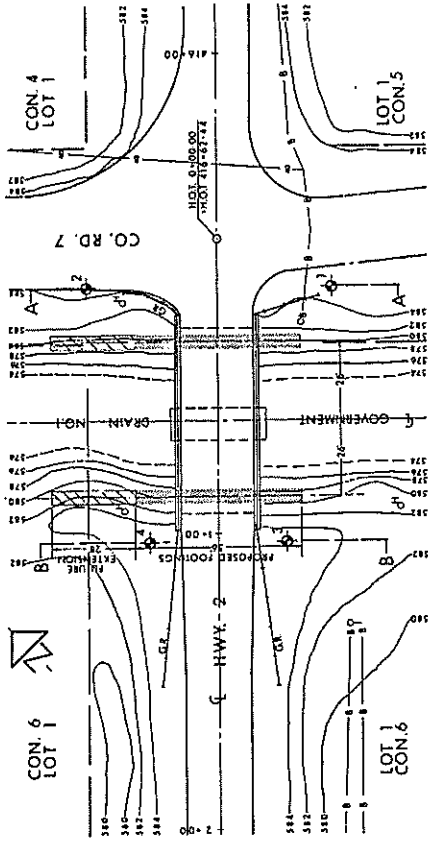
NOTE: FOR CONTRACT DOCUMENTS  
The complete foundation investigation report for this structure may be examined at the Structural Engineering Office, Department of Transportation and Communications, and at the CHAIRMAN'S OFFICE.

—NOTE—  
The boundaries between the bore holes have been established only at the Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

SECTION	DATE	BY	CHKD	APP'D
1	24 DEC 1974	S.T. NO. 2		

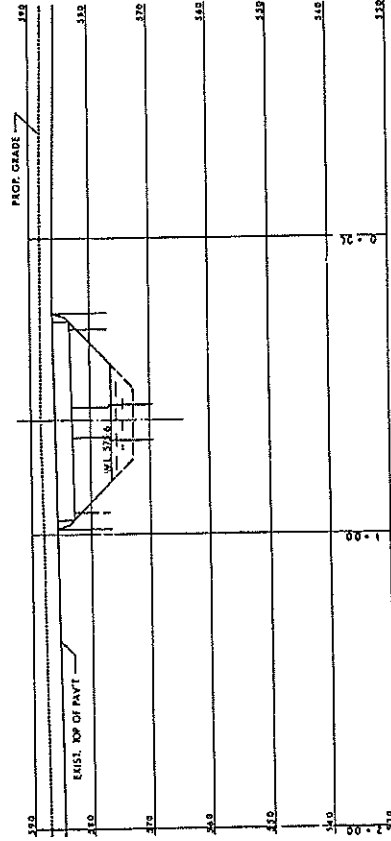
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
FISCAL SERVICES BRANCH—GENERAL ENGINEERING SECTION

PROPOSED CROSSING  
AT  
GOVERNMENT DRAIN NO. 1  
HIGHWAY NO. 2  
CD KENT TWP. TILBURY EAST LOT 1 CON. 6  
BORE HOLE LOCATIONS & SOIL STRATA  
LUMP P.S. CHECKED TWP. NO. 87-87-00 STATION 20  
BRAND G.L. CHECKED DATE 24 DEC 1974 S.T. NO. 2  
896700-A  
APPROVED DATE 24 DEC 1974 S.T. NO. 2



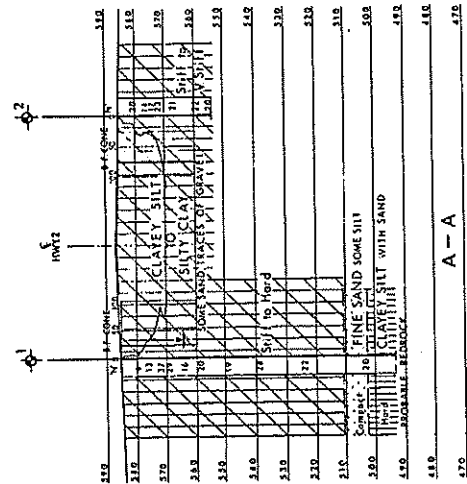
PLAN

SCALE 0 10 20 FT

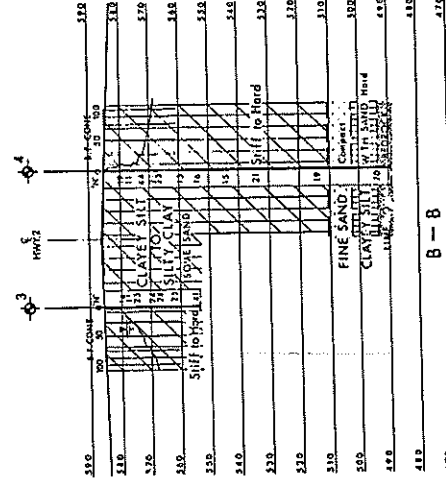


PROFILE

SCALE 0 10 20 FT  
VEL 10 20 30 40



A - A



B - B

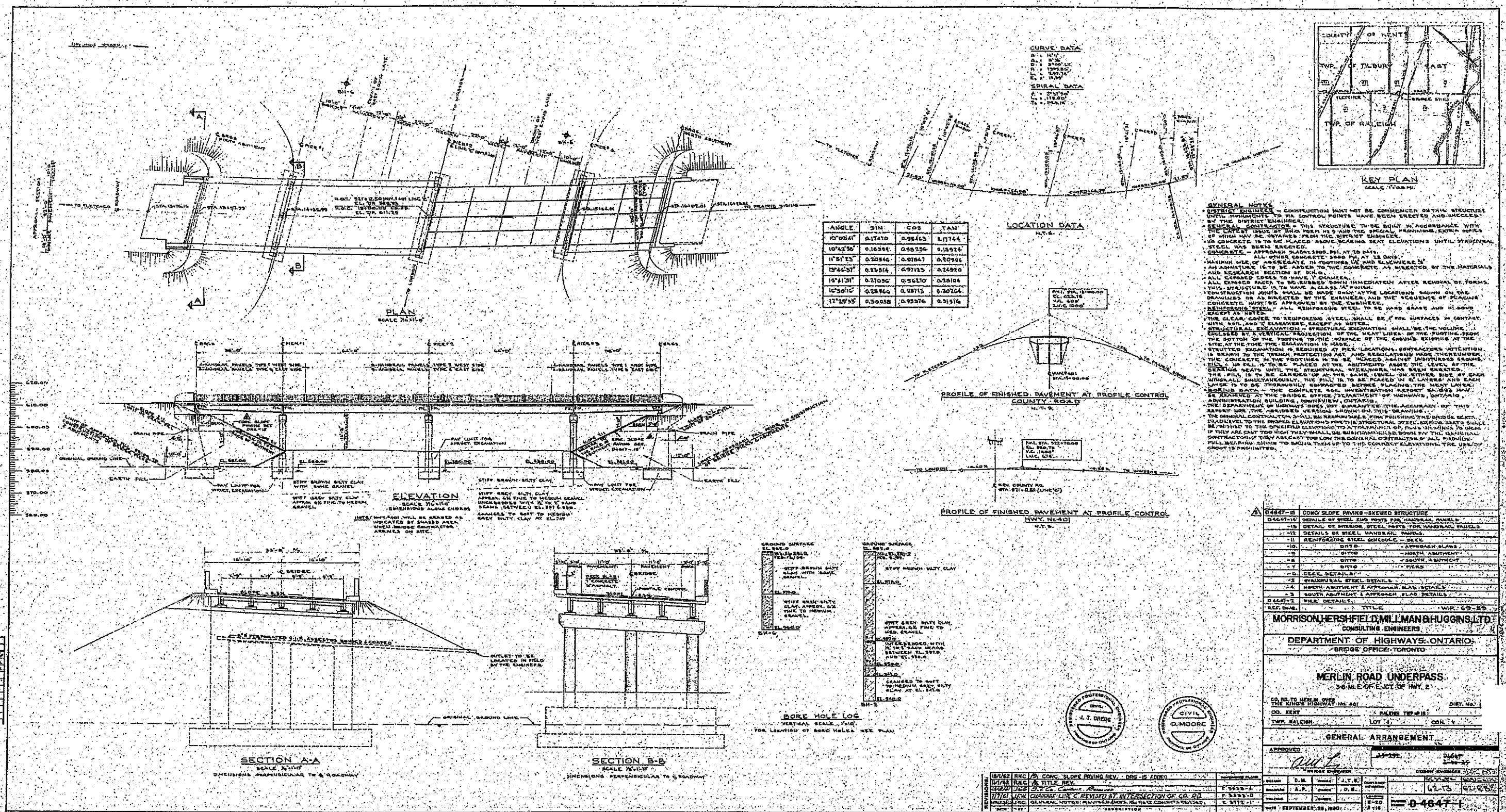
SECTIONS

SCALE 0 10 20 FT





- (2) Contract Drawings for Merlin Road Underpass at Highway 401 prepared by Morrison, Hershfield, Millman & Huggins Ltd. WP 69-59, dated September 28, 1960.





- (3) Foundation Investigation Report for Highway 401, Line 'C; and Drainage Canal (Government Drain No. 1) and Realigned County Road (Merlin Road Underpass) prepared May 1959, WP 10-59 and 69-59, Geocres No. 40J8-7.

**DEPARTMENT OF HIGHWAYS - ONTARIO**  
**MATERIALS AND RESEARCH SECTION**

W.P. 10-59. BORE HOLE NO. 1.  
 JOB F-59-13 STATION 522+18 (50' Lt.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Feb. 12/59. CHECKED BY A.L.

2" DIA SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 2" SHELBY  
 CASING

**LEGEND**

BSS 1/2 UNCONFINED COMPRESSION  
 BTW VANE TEST (C) AND SENSITIVE  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				CONSISTENCY		
				2000	4000	6000	8000	MOIST. CONTENT - DRY WT.		
	Ground Level.	521.4		50	100	150	200	10	20	30
	Stiff brown silty clay.	W.L. 521.4								
	Stiff grey silty clay - Approx. 6% fine to med. gravel.	520.4	10							
	Interbedded with 2" to 4" sand seams.	516.0	30							
	End of Borehole.		40							



MATERIALS AND RESEARCH SECTION

BORE HOLE NO. 4.

STATION 523+34 (50' Lt.)

COMPILED BY B.K.

- CHECKED BY           A.L.          

2" SHELBY TUBE ..

2" SPLIT TUBE  
3" DIA. CONE

2" DIA CONE  
2" SHELBY

**CASING** -

## LEGEND

■ TW VANE TEST (C) AND SENSITIVE  
NATURAL MOISTURE AND

NATURAL MOISTURE AND LIQUIDITY INDEX

LIQUID LIMIT \_\_\_\_\_

PLASTIC LIMIT \_\_\_\_\_

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				CONSISTENCY
				2000	4000	6000	8000	
	Ground Level.	584.4		50	100	150	200	MOIST. CONTENT - % DRY WT. 10 20 30
1/2 Frost	Stiff brown silty clay.	583.2						
	W.L.	577.4						
	Stiff grey silty clay - Approx. 6% fine to medium gravel interbedded with 1/2" sand seams between Elev. 563' and 559.		10					
	Changed to soft to medium grey silty clay at Elev. 551.0'		20					
			30					
			40					
	End of Borehole.	551.4						

**DEPARTMENT OF HIGHWAYS - ONTARIO**  
**MATERIALS AND RESEARCH SECTION**

W.P. 10-59

BORE HOLE NO. 5.

JOB F-59-13

STATION 521/70 (50' Rt.)

DATUM Geodetic

COMPILED BY B.K.

BORING DATE Feb. 9/59. CHECKED BY A.L.

**LEGEND**

2" DIA SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA CONE  
 2" SHELBY  
 CASING

BSS 1/2 UNCONFINED COMPRESSION  
 BTW VANE TEST (C) AND SENSITIVE  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				CONSISTENCY		
				2000	4000	6000	8000	MOIST. CONTENT - % DRY WT		
	Ground Level	557.0		50	100	150	200	10	20	30
	Stiff brown silty clay.	557.0								
	Stiff grey silty clay - Approx. 6% fine to med. gravel interbedded with 1/2" to 2" sand seams between Elev. 557' and 550'.	557.0	10							
	Changed to soft to medium grey silty clay at Elev. 547'.		20							
			30							
			40							
	End of Borehole.	540.0								

**MATERIALS AND RESEARCH SECTION**

W.P. 10-59

BORE HOLE NO. 6.

JOB F-59-13.

STATION 521/70 (50' Lt.)

DATUM ... Geodetic

COMPILED BY B.K.

BORING DATE Feb. 12/59 CHECKED BY

CHECKED BY A.L.

2" DIA. SPLIT TUBE

2" SHELBY TUBE

2" SPLIT TUBE

2<sup>o</sup> DIA CONE  
2<sup>o</sup> DIA CONE

2' SHEL  
CASING

## LEGEND

ESS  
BTH

1/2 UNCONFINED COMPRESSION  
VANE TEST (C) AND SENSITIVITY  
NATURAL MOISTURE AND  
LIQUIDITY INDEX \_\_\_\_\_  
LIQUID LIMIT \_\_\_\_\_  
PLASTIC LIMIT \_\_\_\_\_

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				2000	4000	6000	8000
	Ground Level	582.0		50	100	150	200
	W.L.	571.0					
	Stiff brown silty clay with some gravel.		10				
		570.0					
	Stiff grey silty clay - Approx. 6% fine to medium gravel.		20				
		560.0					
	End of Borehole.		30				
			40				

[illegible]

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 59

W.P. 10

SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET. RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH psi.	UNIT WEIGHT p.c.f.	REMARKS
T1	7'-9'	Stiff brown silty clay.	-	21.1	-	-	2310	123.0	Approximately medium gravel
T2	10'-12'	Stiff grey silty clay.	-	16.8	-	-	5240	127.0	
T3	15'-17'	" " " "	-	16.6	-	-	3980	132.0	
T4	20'-22'	" " " "	-	17.7	-	-	3180	129.0	
S5	27'-28'6"	Stiff grey silty clay interbedded with 2" to 4" sand seams.	48	13.6	-	-	-	-	
S6	29'-30'6"		35	14.0	-	-	-	-	
T1	5'-7'	Stiff brown silty clay.	-	25.6	-	-	4100	117.0	Approximately medium gravel
T2	10'-12'	Stiff grey silty clay.	37	16.7	17.7	32.0	6780	130.0	
T3	15'-17'	" " " "	20	17.8	-	-	3510	128.0	
T4	20'-22'	" " " "	-	18.3	16.1	27.2	-	127.0	
T5	25'-27'	Stiff grey silty clay interbedded with 2" sand seams at 26'.	35	16.0	-	-	-	130.0	Approximately medium gravel
T1	3'-5'	Stiff brown silty clay.	-	19.5	-	-	1526	120.7	
T2	6'-8'	Stiff grey silty clay.	56	17.2	17.7	30.5	6300	135.0	
T3	10'-12'	" " " "	31	15.8	-	-	3800	132.6	
T4	15'-17'	" " " "	-	16.0	16.1	26.8	3120	133.3	
T5	20'-22'	Stiff grey silty clay interbedded with 1/2" sand seams	23 for 6"	16.4	-	-	3320	130.8	
S6	22'-23'6"	between 21'6" and 25'6".	29	18.4	15.1	26.8	-	142.2	

cont'd.

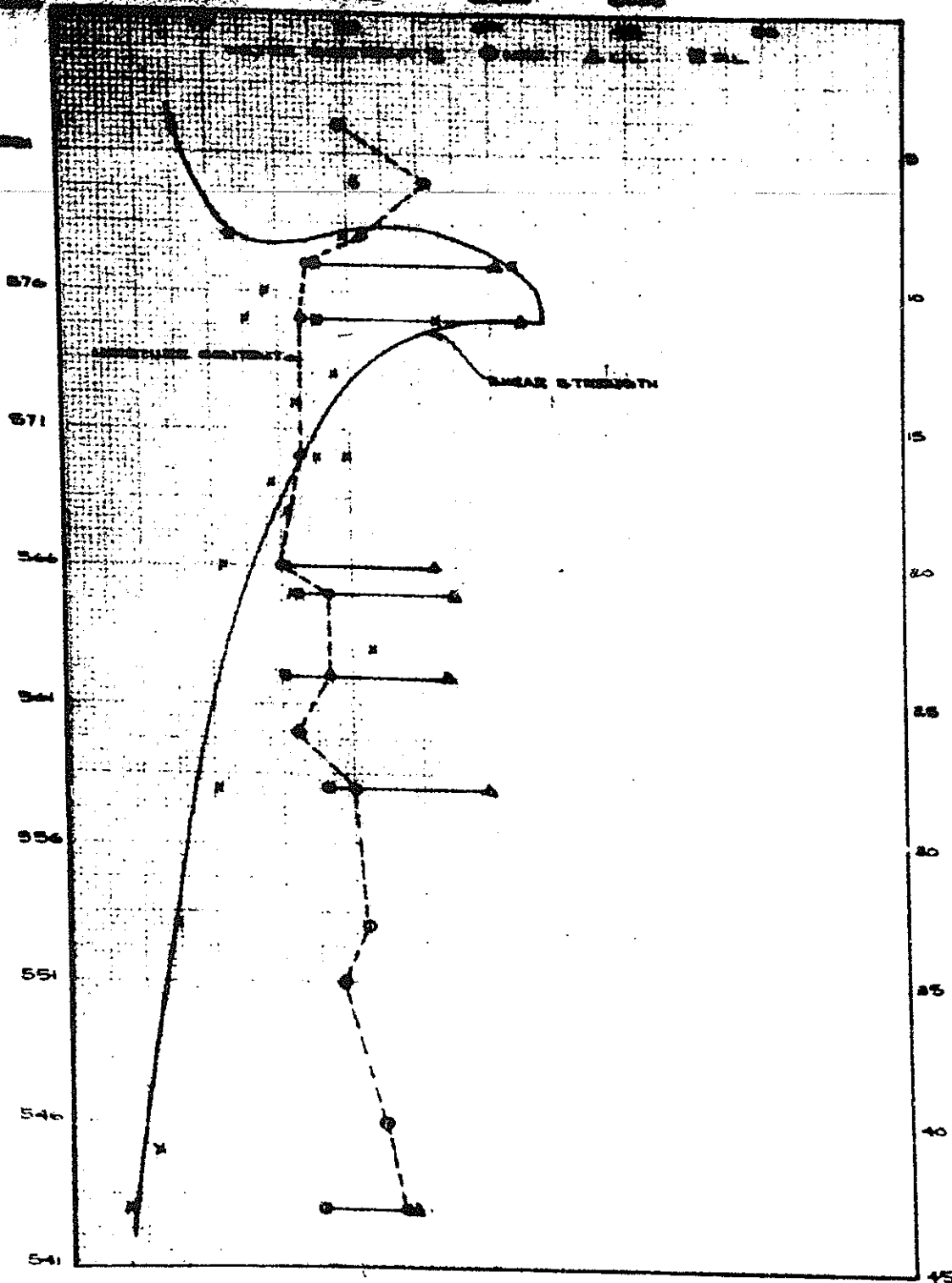


## SUMMARY OF FIELD &amp; LABORATORY TESTS

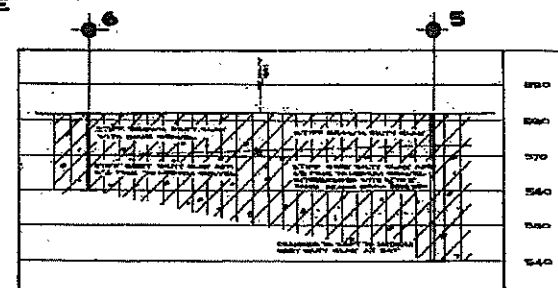
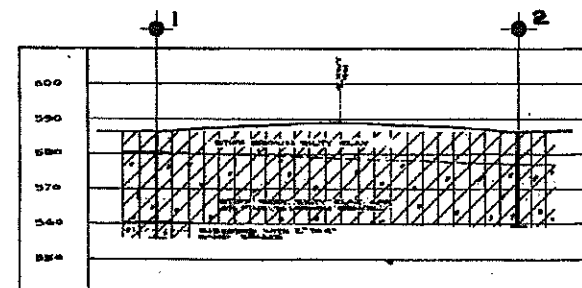
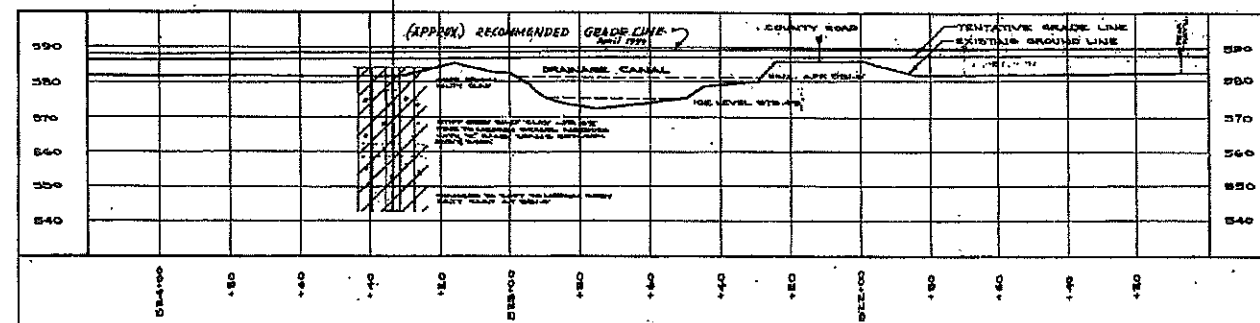
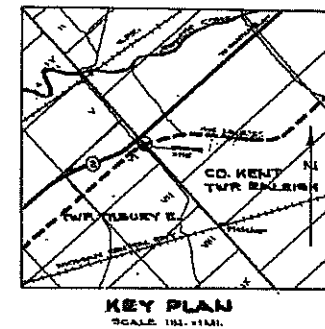
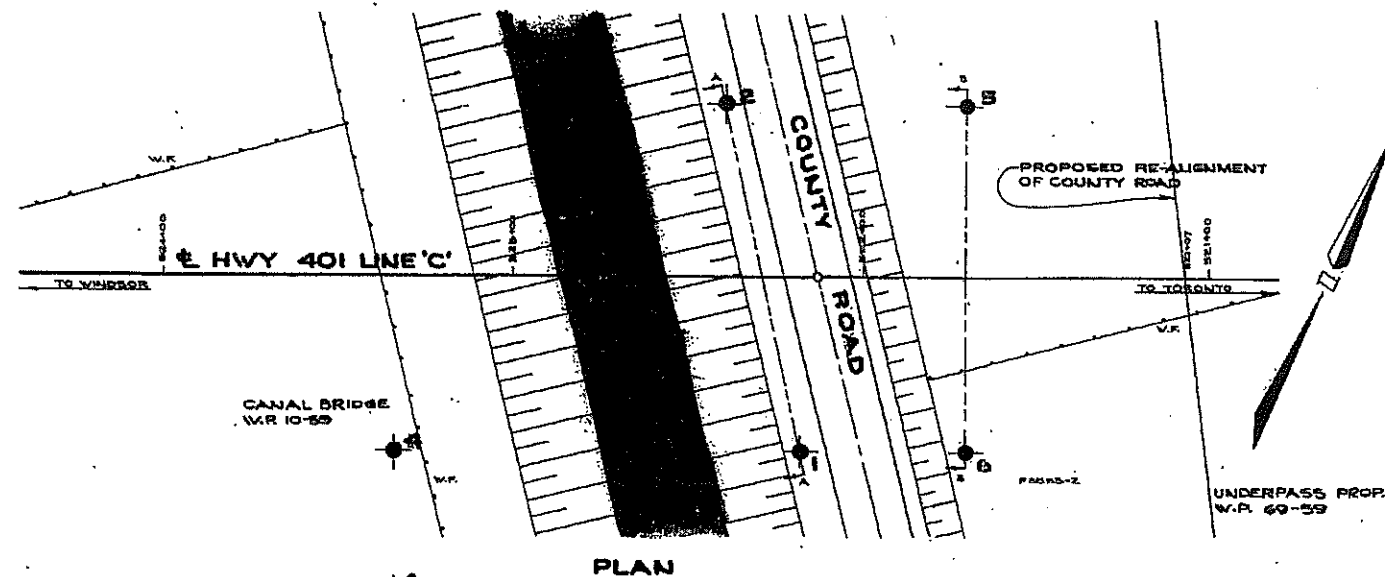
JOB 59-1  
W.P. 10-5

SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH PSI	UNIT WEIGHT P.C.F.	REMARKS
27	25'-27'	Stiff grey silty clay.	-	19.9	18.1	29.6	2074	128.0	
28	30'-32'	Medium stiff grey silty clay.	-	20.9	-	-	1448	126.5	
29	40'-42'	Soft to medium grey silty clay.	-	23.8	17.5	24.0	767	128.0	
31	5'-7'	Stiff brown silty clay.	-	12.5	-	-	2820	126.0	Approximately medium gravel
32	12'-14'	Stiff grey silty clay.	23	16.8	-	-	2880	132.0	
33	15'-17'	" " " "	-	15.8	15.8	25.8	7000	133.0	
34	20'-22'	" " " "	-	17.4	-	-	-	132.0	
35	25'-27'	Stiff grey silty clay inter- )	-	15.8	-	-	-	-	
36	30'-31'6"	bedded with 1/2" to 2" sand )	17	19.4	-	-	-	131.6	
		seams between 25'-0" to 32'-0"							
37	35'-36'6"	Medium stiff grey silty clay.	20	22.2	-	-	-	-	
38	40'-42'	Soft to med. grey silty clay.	-	21.4	-	-	1250	122.2	
39	3'-5'	Stiff brown silty clay.	-	18.8	-	-	3950	128.0	Approximately medium gravel
40	6'-8'	" " " "	-	19.4	-	-	2540	127.4	
41	9'-11'	" " " "	45	21.2	-	-	3240	124.5	
42	15'-17'	Stiff grey silty clay.	-	18.1	-	-	2150	128.2	
43	20'-22'	" " " "	-	17.2	15.0	27.6	-	132.0	
		T1 - denotes thin walled Shelby sample. S1 - denotes split spoon sample.							
		Consolidation Characteristics:-							
		Depth: 0'-35' - Coefficient of volume compressibility .....							0.007 sq. f
		Coefficient of consolidation .....							0.14 sq. f
		Depth: 35' and below - Compression Index .....							0.18
		Coefficient of consolidation .....							0.0875 sq. f
		Preconsolidation pressure .....							Submerged u x depth (no c

ELEVATION IN FEET



DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT



LEGEND

SOIL HOLE

PENETRATION HOLE

SOIL & PENETRATION HOLE

HOLE NO.	ELEVATION	STATION	DISTANCE FROM E
1	586.4'	5+21.8	50' E
2	586.4'	5+21.8	50' E
4	586.4'	5+21.8	50' E
5	586.4'	5+21.8	50' E
6	586.4'	5+21.8	50' E

NOTE -

THE BOUNDARY BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT SOIL HOLE LOCATIONS. BETWEEN SOIL HOLE THE BOUNDARIES ARE DERIVED FROM INTERPOLATION. CHECKED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH SECTION

COUNTY ROAD & CANAL

PROPOSED CROSSING

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 DISTRICT COUNTY JORDAN

TOWNSHIP TILBURY & EGREMONT LOT 1 & 2 C.O. 30 & 31

LOCATION AND ELEVATION OF HOLES

DATE MAY 17/59 APPROVED BY [Signature] DESIGNED BY [Signature]

SCALE 1" = 20'

F58-153

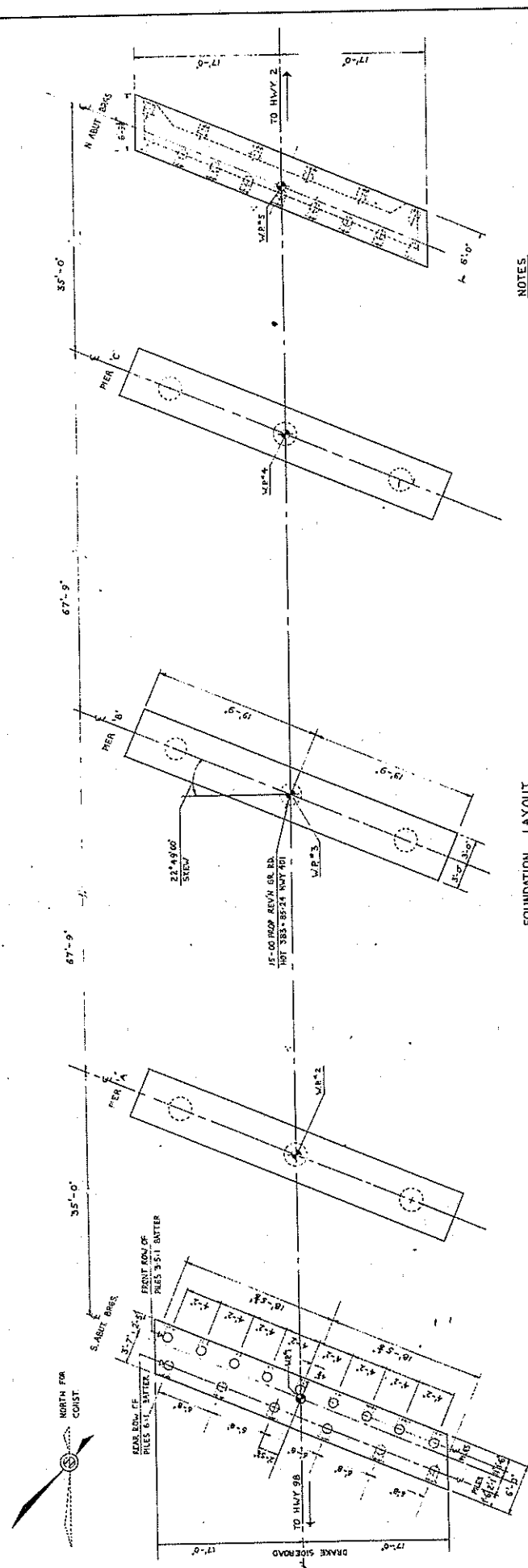
4038-7

ROAD No.



- (4) Contract Drawing for Drake Road Underpass at Highway 401, WP 81-59, dated November 1967.





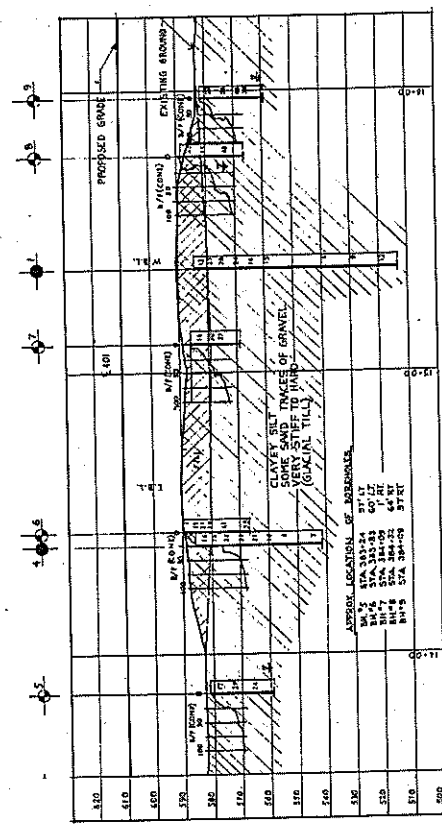
FOUNDATION LAYOUT  
SCALE: 1" = 1'-0"

- NOTES
- DIMENSIONS AND PILE LAYOUT SHOWN FOR BOTH ABUTMENTS.
  - ABUTMENT PILE SPACING TO BE MEASURED AT UNDERPIER OF FOOTING.
  - ABUTMENT PILES ARE TO BE DRIVEN IN ACCORDANCE WITH STD. CODE OF PRACTICE BUT NOT TO EXCEED 50% OF DESIGN LOAD PER PILE.
  - TIE PILES TO BE FILLED WITH 3,000 PSI CONCRETE AFTER INSTALLATION AND INSPECTION.
  - DIMENSIONS FOR ALL PIER FOOTINGS ARE SHOWN.

LOCATION	NO.	LENGTH	TYPE
ABUT	12	24'-0"	12" Ø x 30" WALL THICKNESS
PIER	15	24'-0"	STEEL TUBE PILES

- NOTES
- THE BOUNDARIES BETWEEN SOIL STRATA ARE ESTABLISHED ONLY AT BORE HOLE LOCATIONS.
  - BETWEEN BORE HOLES THE BOUNDARIES ARE INTERPOLATED.
  - THE BORE HOLES MAY BE SUBJECT TO CONSIDERABLE ERROR.

THE COMPLETE SOIL INVESTIGATION REPORT IS AVAILABLE FROM THE CHATWAM DISTRICT OFFICE, AND AT THE CHATWAM DISTRICT OFFICE.



PROFILE  
SCALE: 1" = 20'-0"

DEPARTMENT OF HIGHWAYS, ONTARIO  
DESIGNED BY

DRAKE SIDE ROAD UNDERPASS

5.4 MI. E. OF EAST 1ST AVE. 2. INTERCHANGE 2. BRIDGE HIGHWAY NO. 401 (H.C. 2000) EST. NO. 1  
CO. 1001 RAILROAD TIE RAILROAD TIE NO. 12  
IMP. RAILROAD 101 7 1001 6

FOUNDATION LAYOUT 1 BORE HOLES

APPROVED	DATE	BY	NO.
1001	10-26-2	1001	1001
1001	10-26-2	1001	1001
1001	10-26-2	1001	1001

1001-262-25

• ADAPTED FROM D-4129 JUNE 1947



- (5) Foundation Investigation Report for Proposed Crossing of Highway 401 and Drake Road, File No. 67-F-202 prepared by Dominion Soil Investigation Limited dated June 5, 1967, WP 81-59, Geocres No. 40J8-31.

# LOG OF BOREHOLE...5.....

Our Reference No. 7-5-14  
 YOUR REF. No. W.P. 81-59  
 CLIENT: D.H.O.  
 PROJECT: PROP. CROSSING HWY. No. 401 - DRAKE SD. RD.  
 LOCATION: STA. 383+24 97' LT.  
 DATUM: ELEVATION: GEODETIC

Enclosure No. 1

## DRILLING DATA

Method: AUGERING  
 Diameter: 4.5"  
 Date: 24 MAY/67

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %			REMARKS						
ELEVATION Feet	DEPTH Feet	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	IN Blows / Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL		LIQUID LIMIT					
								UNDRAINED SHEAR STRENGTH 1000 lbs/sq. ft.					COMPRESSION TEST								
								+ FIELD VANE TEST													
								2	3	4	5		W <sub>p</sub>	W	W <sub>L</sub>						
582.0	0	GROUND SURFACE																			
		4" TOPSOIL																			
580	2	v. stiff hard			1	SS	17														
		brown grey			2	TW	PH														
575	7				3	SS	29														
		CLAYEY SILT			4	TW	PH														
570	12	with some Sand and embedded Gravel																			
		(glacial till)			5	SS	24														
565	17																				
					6	TW	PH														
560	22	END OF BOREHOLE																			

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: D.G.H. CHECKED:

## LOG OF BOREHOLE...6.....

YOUR REF. No. W.P. 81 - 59

PROJECT: PROP. CROSSING HWY. No. 401 - DRAKE SD. RD.

LOCATION: STA. 383 + 83 60' LT.

DATUM: ELEVATION: -GEODETIC

### Method: AUGERING

**Method:** AUGERING

Diameter: 4.5"

Date: 24 MAY/67

Enclosure №...2

[illegible]

VERTICAL SCALE: 1 inch = 5 feet

**DOMINION SOIL INVESTIGATION LIMITED**

MADE: DCH. CHECKED:



# LOG OF BOREHOLE .....7.....

Enclosure No. 3

Our Reference No. 75-14  
 YOUR REF. No. W.P. 81-59  
 CLIENT: D.H.O.  
 PROJECT: PROP. CROSSING HWY. No 401 - DRAKE SD. RD.  
 LOCATION: STA. 384 + 09 1<sup>st</sup> RT  
 DATUM: ELEVATION: GEODETIC

## DRILLING DATA

Method: AUGERING  
 Diameter: 4.5"  
 Date: 24 MAY/67

SUBSURFACE PROFILE			SAMPLES		PENETRATION RESISTANCE					WATER CONTENT %			REMARKS			
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N Blows / Foot	Blows / Foot						PLASTIC LIMIT W <sub>p</sub>	NATURAL W	LIQUID LIMIT W <sub>L</sub>
								20	40	60	80	100				
586.6	0	GROUND SURFACE														
		3" TOPSOIL														
585.5	1.1	CLAYEY SILT brown-grey mottled FILL			1	SS	16									
		v. stiff			2	TW	PH									
580.0	6.6	Hard CLAYEY SILT with some Sand and embeded Gravel brown grey (glacial fill)			3	SS	30									
					4	TW	PH									
					5	SS	37									
575.0	11.6				6	TW	PH									
570.0	16.6															
569.0	17.6	END OF BOREHOLE														

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: DGH CHECKED:

# LOG OF BOREHOLE 8

Enclosure No. 4

Our Reference No. 7-5-14

YOUR REF. No. W.P. 81-59

CLIENT: D.H.O.

PROJECT: PROP. CROSSING HWY. No. 401 - DRAKE SD. RD.

LOCATION: STA. 384 + 32 64' RT.

DATUM ELEVATION: GEODETIC

## DRILLING DATA

Method: AUGERING

Diameter: 4.5"

Date: 24 MAY/67

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %			REMARKS						
ELEVATION Feet	DEPTH Feet	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	IN Blows / Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL		LIQUID LIMIT					
								UNDRAINED SHEAR STRENGTH 1000 lbs./sq. ft.													
								+ FIELD VANE TEST					COMPRESSION TEST					W <sub>p</sub> W W <sub>L</sub>			
								2	3	4	5										
GROUND SURFACE																					
589.9	0	24" SAND & GRAVEL																			
		CLAYEY SILT FILL			1	SS	23														
585	5			2	TW	PH															
		v. stiff - multicoloured																			
581.5	8.0			3	SS	15															
580	10	v. stiff hard			4	TW	PH														
	12.0																				
575	15	brown grey  CLAYEY SILT with some Sand and embedded Gravel (glacial fill)			5	SS	48														
570	20				6	TW	PH														
567.4	22.5	END OF BOREHOLE																			
565	25																				

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: D.G.H. CHECKED:

# LOG OF BOREHOLE ....9.....

Enclosure No. 5

Our Reference No. 7-5-14

YOUR REF. No. WP. 81 - 59

CLIENT: D.H.O.

PROJECT: PROP. CROSSING HWY. N. 401 - DRAKE SD. RD.

LOCATION: STA. 384 + 09 97' RT.

DATUM: ELEVATION: GEODETTIC

## DRILLING DATA

Method: AUGERING

Diameter: 4-5"

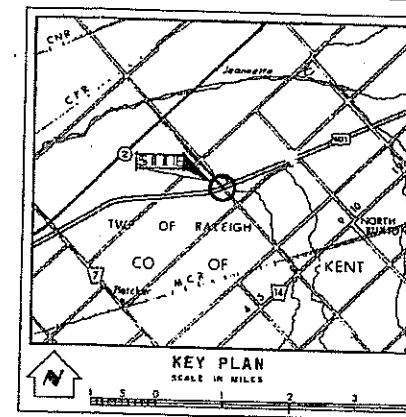
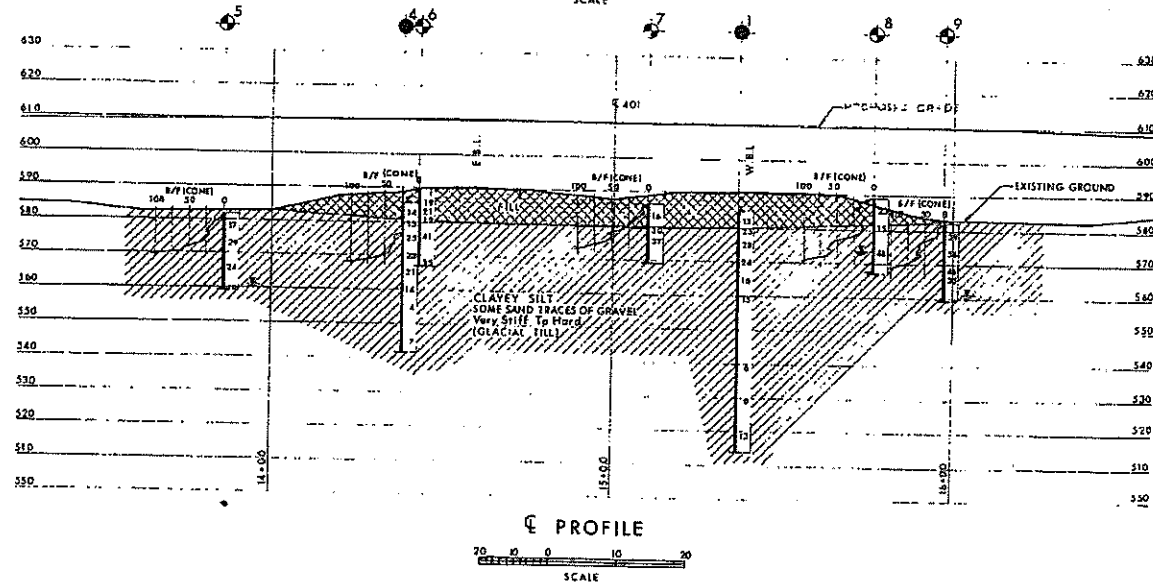
Date: 23 MAY/67





SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					Blows / Foot			WATER CONTENT %			REMARKS			
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	IN Blows / Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL	LIQUID LIMIT						
								UNDRAINED SHEAR STRENGTH 1000					156 / sq. ft.						W <sub>p</sub>	W	W <sub>L</sub>
								+ FIELD VANE TEST					COMPRESSION TEST								
								2	3	4	5										
582.1	0	GROUND SURFACE																			
		3" TOPSOIL																			
580	2	v. stiff hard  brown grey  																			

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: DGH - CHECKED:



LEGEND				
	Bore Hole			
	Cone Penetration Hole			
	Bore & Cone Penetration Hole			
	Water Levels established at time of field investigation.			
NOTE	MAY 1967			
	BORE HOLES BY DOWNHOLE SOES TO 100			
	NO 1 TO 4 DONE IN JAN 1967			
	NO 5 TO 9 DONE IN MAY 1967			
	NO 2 & 3 NOT USED FOR THIS DOW			
NO.	ELEVATION	STATION	OFFSET	
3	583.0	383+24	82'11"	
6	589.4	383+02	90'11"	
7	586.6	384+09	1'82"	
8	589.9	714+32	84'82"	
9	582.1	384+09	97'21"	

- NOTE -

NOTE  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

DRAKE SIDE ROAD

KING'S HIGHWAY NO. 401 DIST. NO. 1  
CO. KENT  
TWP. RALEIGH LOT 7 CON. 6

BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT M.D.	CHECKED	W.P. NO	81-59	W ET, DRAWING NO
DRAWN R.S.	CHECKED	JOB NO	67-F-51	67-F-51A
DATE	18 JUNE 67	SITE NO		UNIDGT DRAWING NO
APPROVED	<i>[Signature]</i>	COPY NO		

REF ID: A6002-1





- (6) Additional Borings for Revised Drake Road Underpass, W.J. No. 67-F-51,  
WP 81-59, dated June 20, 1967, Geocres No. 40J8-30.

**CHECKED BY**

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT				
582.0	GROUND LEVEL								
0.0	Clayey silt with some sand and traces of gravel		1	SS	17	580			
			2	TW	PH				132
			3	SS	29				
			4	TW	PH	570			134
			5	SS	24				
			6	TW	PH	560			132
22.5	End of Borehole								

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 67-F-51

LOCATION Prop. Crossing Hwy. 401-Drake Rd., Sta. 383+83; 60' Lt.

W.P. 81-59

BORING DATE May 24, 1967

ORIGINATED BY Dom. Soil

DATUM Geodetic

BOREHOLE TYPE Augering

COMPILED BY

CHECKED BY ML

ELEV. DEPTH	SOIL PROFILE	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT WP WL	BULK DENSITY P.C.F.	REMARKS
		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane o Unconfined			
589.4	GROUND ELEVATION				20 40 60 80 100				
0.0	18" Sand & Gravel	1	SS						
	Multicolored clayey silt with some org. matter. (fill). V. Stiff	2	SS						
581.4		3	SS						
8.0	Clayey Silt with some sand & traces of gravel, occ. silt pockets or seams. (Glacial till)	4	TW	580				130	
		5	SS						
		6	TW					133	
566.9		7	SS	570					
22.5	End of Borehole								

May 25/67  
Hole dry.

DEPARTMENT OF HIGHWAYS - ONTARIO

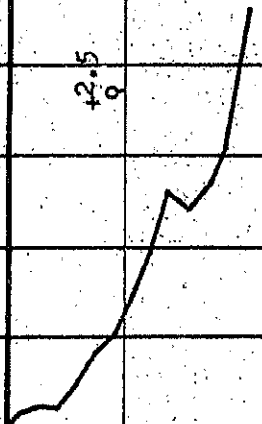
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 67-E-51 LOCATION Prop Crossing Hwy 401-Drake Rd. ORIGINATED BY Don. Soil  
 W.P. 81-59 BORING DATE May 24, 1967 COMPILED BY \_\_\_\_\_  
 DATUM Geodetic BOREHOLE TYPE Augering CHECKED BY AL

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLG	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100		
586.6	GROUND LEVEL													
0.0	3" Topsoil		1	SS	16									
	Brown-Grey mottled Clayey Silt (Fill)		2	TW	PH									
	V. Stiff		3	SS	30									
579.6			4	TW	PH									
7.0	Clayey silt with some sand & traces of gravel. (Glacial Till)		5	SS	37									
569.1	Hard		6	TW	PH									
17.5	End of Borehole													





DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 67-F-51 LOCATION Prop. Crossing Hwy. 401-Drake St. Rd. ORIGINATED BY Dom. Seil  
 W.P. 81-59 BORING DATE May 23, 1967 COMPILED BY \_\_\_\_\_  
 DATUM Geodetic BOREHOLE TYPE Augering CHECKED BY SK

ELEV. DEPTH	SOIL PROFILE	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane o Unconfined	WATER CONTENT %	PLASTIC LIMIT		
582.1	GROUND LEVEL				20 40 60 80 100		20 40 60			
0.0	3" Topsoil	1	SS 29	580						
	Clayey silt with some sand & traces of gravel. (Glacial Till)	2	TW PH							
		3	SS 56							
		4	TW PH	570						
		5	SS 46							
		6	SS 35							
559.6		7	TW PH	560						
22.5	End of Borehole									

131  
561.0  
May 25/67

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-E-51

W.P. 81-59

DATUM Geodetic

# RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

LOCATION Prop. Crossing Hwy. 401-Drake St. Rd.

ORIGINATED BY Dom. Soil

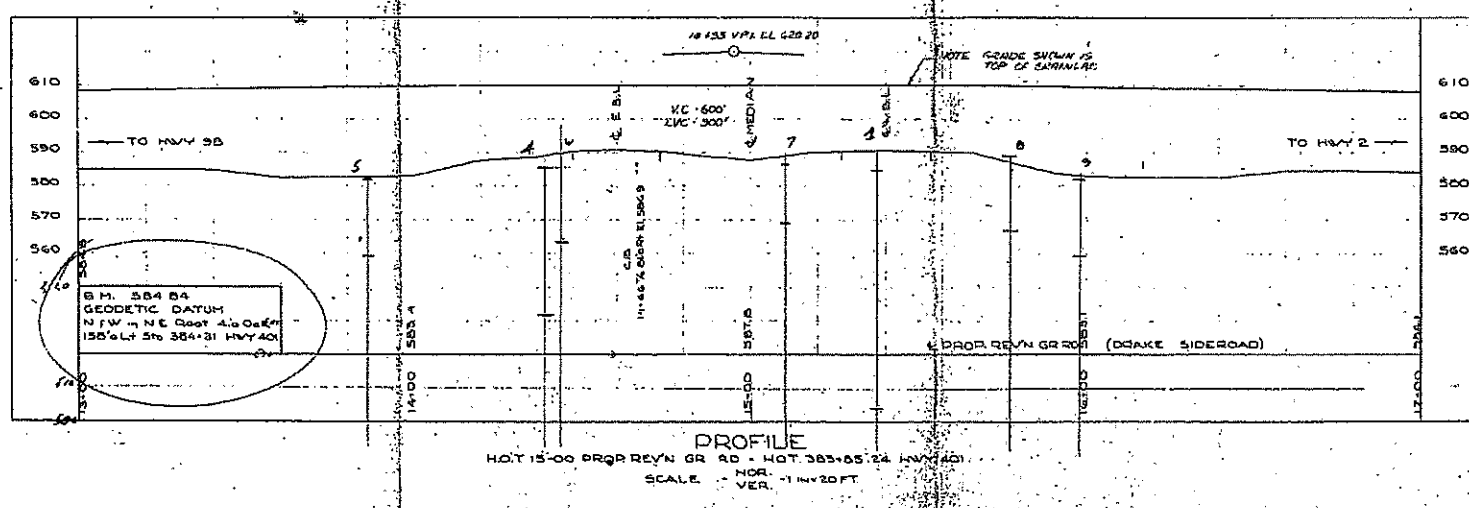
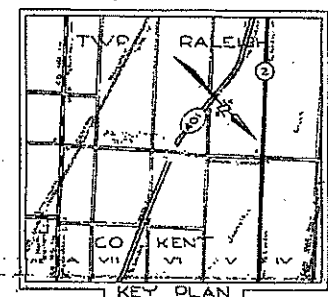
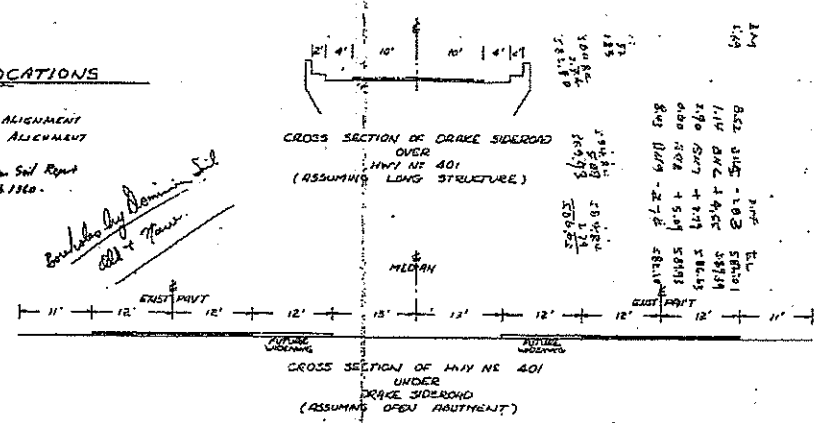
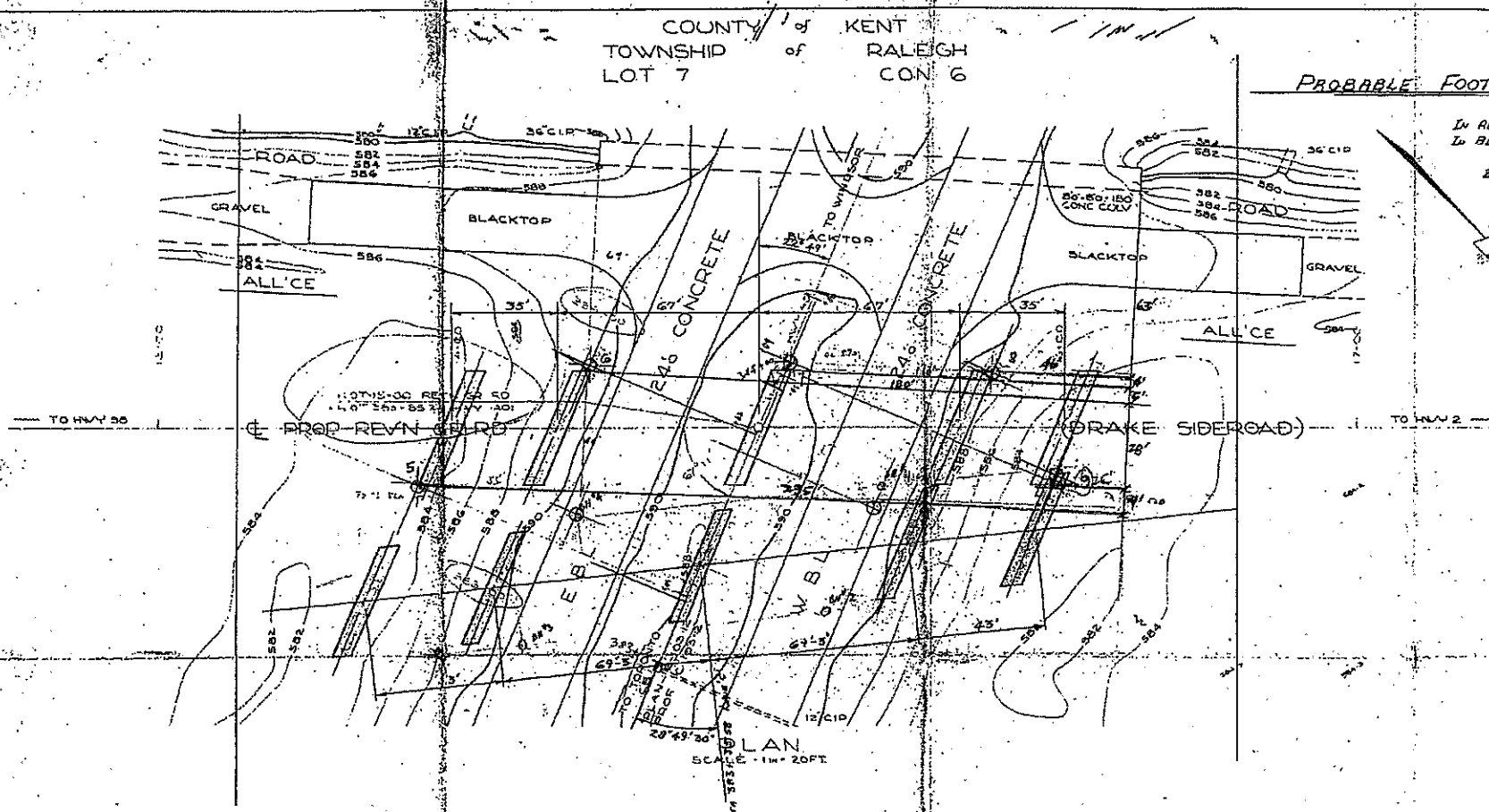
BORING DATE May 23, 1967

COMPILED BY

BOREHOLE TYPE Augering

CHECKED BY

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT PLASTIC LIMIT WATER CONTENT	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
582.1	GROUND LEVEL							
0.0	3" Topsoil	1	SS	29				
	Clayey silt with some sand & traces of gravel. (Glacial Till)	2	TW	PH				
		3	SS	56				
		4	TW	PH				
		5	SS	46				
		6	SS	35				
		7	TW	PH				
559.6							131	V 561.0 May 25/67
22.5	End of Borehole							



SEE B-PLAN B-103-12  
C-PROFILE C-103-12  
67-F-51  
W.P. 81-59

DATE	REVISIONS & ADDITIONS	BY	CHKD
Jan 27	Grade 2-2nd Section Added	E.S.	R.S.
DATE DUE JUN 17/61			

DEPARTMENT OF HIGHWAYS ONTARIO  
DESIGN BRANCH  
ENGINEERING SURVEYS DIVISION

BRIDGE SITE

PROPOSED CROSSING  
AT  
PROP REV'N GR RD (DRAKE SIDEROAD)  
AND  
KING'S HIGHWAY 401

LOT 7 CON 6  
TOWNSHIP OF RALEIGH - COUNTY OF KENT

SCALE AS SHOWN	DISTRICT NO 1 CHATHAM	REGION SOUTH WESTERN
W.D. 2582-46-87	DATE FEB 1961	SITE NO.
SURVEY BY Chief of Party R. AGNEW Supervisor G. BAUN	DRAWN BY Draftsman J. LAMOTHE Supervisor J. CAMILLERI	PLAN NO E-4800-1
CHECKED BY Draftsman K. SMART Supervisor J. CAMILLERI		



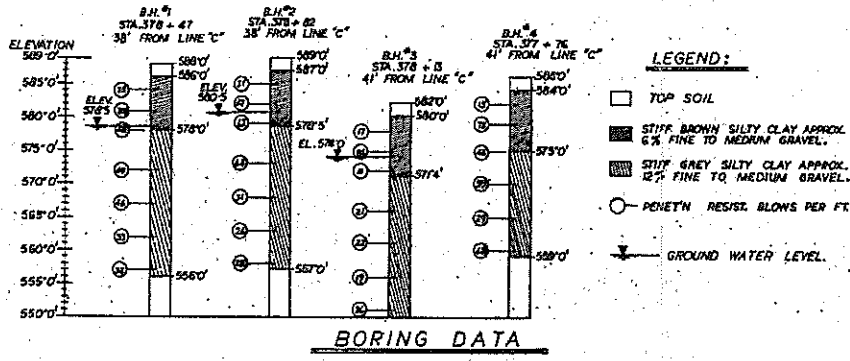
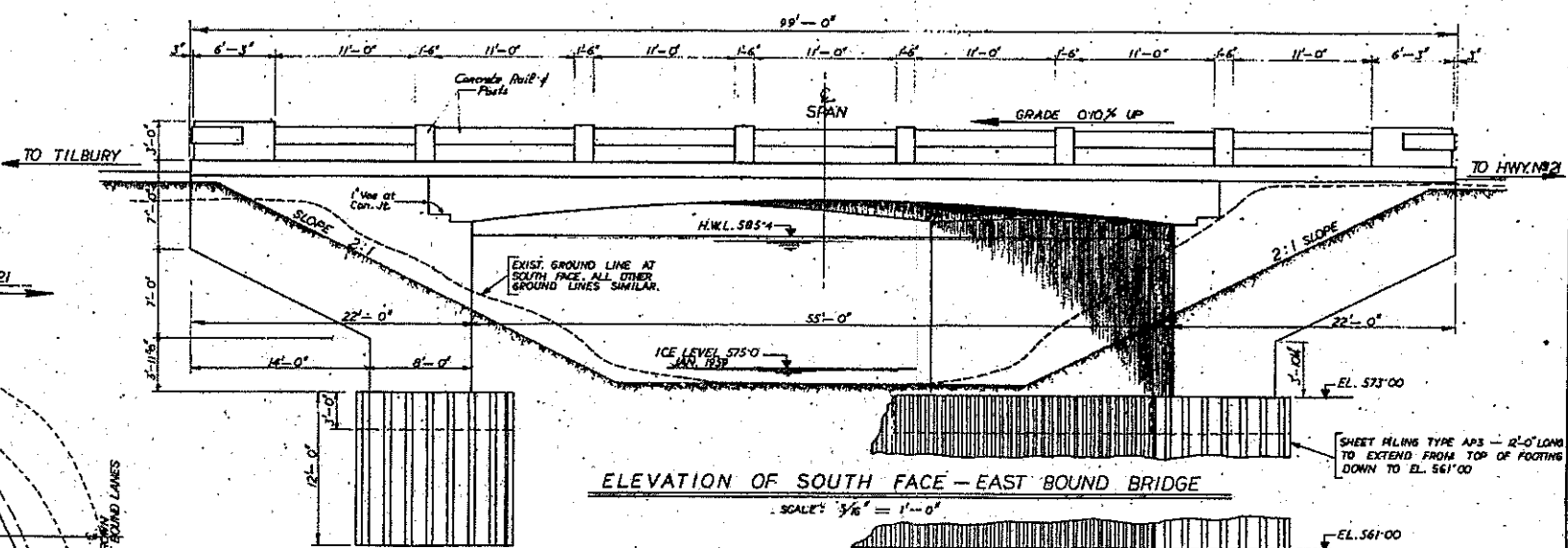
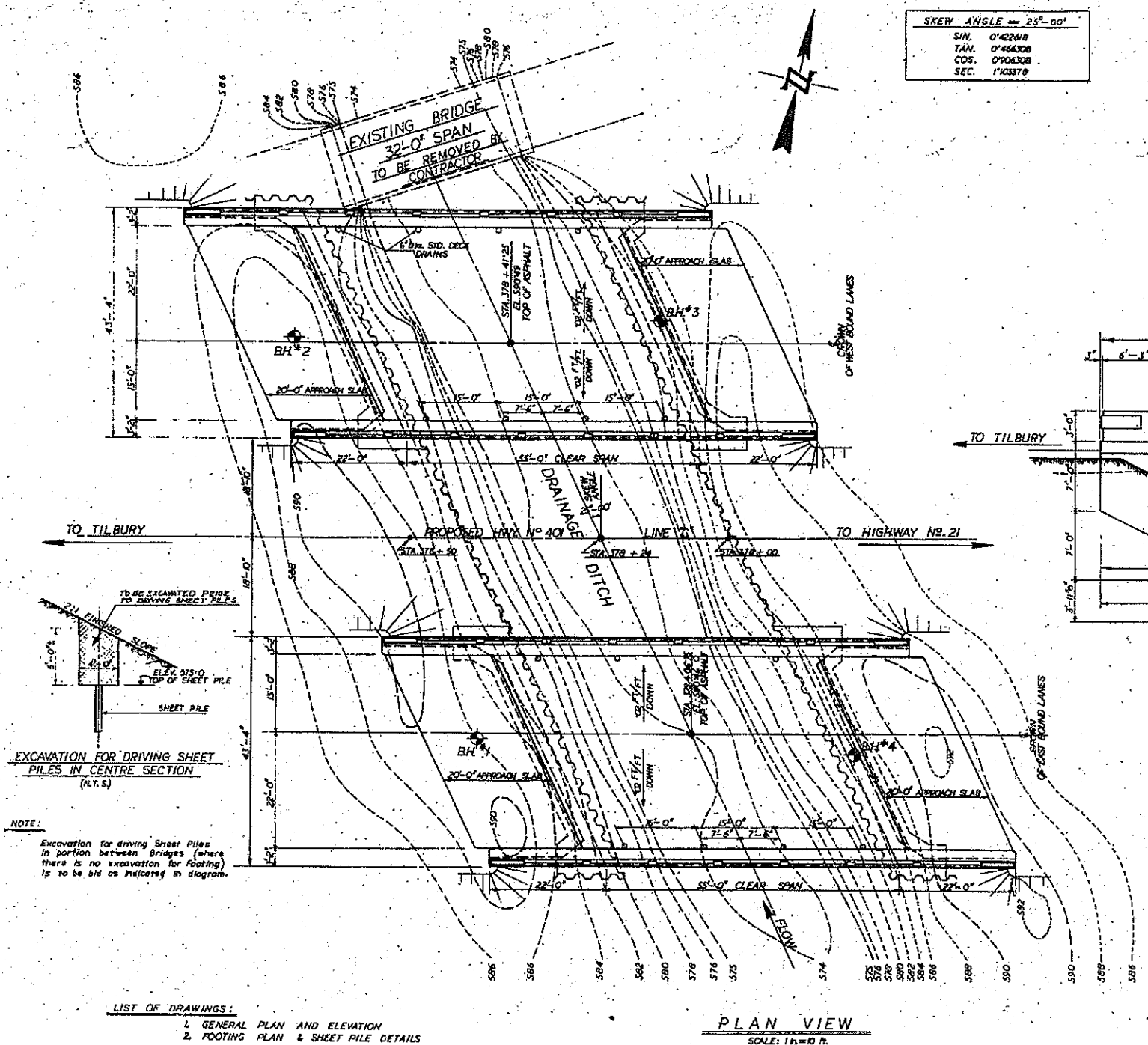
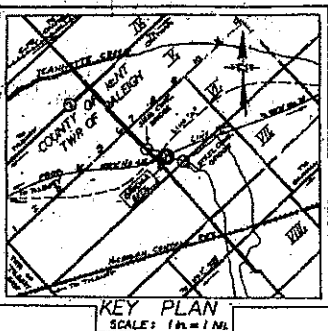
- (7) Contract Drawings for Raleigh Township Bridge No. 12 (Government Drain No. 2 Bridges), WP 11-59 dated September 1959.



SKEW ANGLE = 25°-00'  
 SIN. 0°42'48"  
 TAN. 0°46'30"  
 COS. 0°46'30"  
 SEC. 1°43'37"

**NOTES:**

**NOTE TO DISTRICT ENGINEER:** Concrete work on this structure must not be commenced until monuments to fix control points have been erected and checked by the District Engineer.  
**NOTE TO CONTRACTOR:** Structure to be built in accordance with form No. 9 and the Special Provisions, extra copies of which may be obtained from the Dist. Eng. All Construction Details must be approved by the Bridge Engineer.  
**CONCRETE MIX:** Minimum Strength @ 28 days for Footings - 2500 psi, all other structure - 3000 psi. An approved admixture supplied by the Department will be added to all concrete as specified by the Engineer. Maximum size of aggregate: Footings 1 1/2", Structure 1", unless otherwise specified.  
**BORING DATA:** The complete soil investigation report BA-294 may be examined at the Bridge Office, 150 Davenport Road, Toronto. The Department does not guarantee the accuracy of this report or the abridged version shown on these plans.  
**CONSTRUCTION NOTES:** 1) All exposed edges to be given 1" chamfer.  
 2) Do not remove falsework until wingwalls are poured and have attained 28 days strength.  
 3) Contractor to cut off Deck Drains 3" below bottom of Deck concrete.  
**REINFORCING STEEL:** (Minimum cover): 3" to surfaces in contact with earth & water, 2" elsewhere. Deck and guardrail as shown.



WP 11-59  
 DEPARTMENT OF HIGHWAYS, ONTARIO  
 BRIDGE OFFICE - TORONTO  
**RALEIGH TWP. BRIDGE**  
 NO. 12  
 THE KING'S HIGHWAY NO. 401  
 DIST. NO. 1  
 DO. KENT  
 TWP. RALEIGH  
 LOT 7  
 CON. VI.  
**GENERAL PLAN AND ELEVATION**  
 APPROVED: *[Signature]*  
 DATE: SEPTEMBER 1959  
 SCALE: 1" = 10'

- LIST OF DRAWINGS:**
1. GENERAL PLAN AND ELEVATION
  2. FOOTING PLAN & SHEET PILE DETAILS
  3. DETAILS OF FRAME & WING-WALLS
  4. APPROACH SLAB
  5. REINFORCING STEEL SCHEDULE

**PLAN VIEW**  
SCALE: 1" = 10' R.

**BORING DATA**

NO.	DATE	BY	CHKD.
1			
2			
3			
4			
5			

**NOTE:**  
 Excavation for driving Sheet Piles in portion between Bridges (where there is no excavation for footing) is to be bid as indicated in diagram.



- (8) Foundation Investigation Report for Highway 401, Line 'C' and Drainage Ditch Crossing Lot 7, Concession 6 (Government Drain No. 2 Bridges), WP 11-59, dated May 8, 1959, Geocres No. 40J8-4.

# SUMMARY OF FIELD & LABORATORY

WELL NO.	TRAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET. RESIST. (BLDG. TEST)	MOIST. CONT. (%)	LIQ. LIMIT (%)	PL. LIMIT (%)	UNSAT. WGT. (pcf)	WATER WGT. (pcf)	REMARKS
1	T1	3'-5'	stiff brown silty clay.	25	26.5	34.4	68.5	2200	118.0	Appro medium
"	T2	6'-8'	" " "	35	17.1	19.1	31.6	5570	127.3	
"	T3	9'-11'	" " "	48	16.6	17.7	32.0	6150	135.2	
"	T4	15'-17'	stiff grey silty clay.	49	21.2	15.0	27.4	2125	129.3	Appro medium
"	T5	20'-22'	" " "	46	21.5	15.7	26.8	2220	134.0	
"	T6	25'-27'	" " "	33	21.6	14.3	25.8	1670	124.5	
"	T7	30'-32'	" " "	33	19.4	16.5	27.2	2490	134.0	
2	T1	3'-5'	stiff brown silty clay.	31	18.7	-	-	4920	131.2	Appro medium
"	T2	6'-8'	" " "	47	15.5	18.7	33.6	8580	132.7	
"	T3	9'-11'	" " "	62	14.8	16.8	29.1	6870	134.0	
"	T4	15'-17'	stiff grey silty clay.	64	17.2	16.2	28.9	2800	135.0	Appro medium
"	T5	20'-22'	" " "	31	17.2	-	-	-	132.2	
"	T6	25'-27'	" " "	26	18.1	15.9	26.0	1800	131.8	
"	T7	30'-32'	" " "	28	18.2	-	-	2420	134.1	
3	T1	3'-5'	stiff brown silty clay.	17	25.7	24.7	48.5	1440	122.0	Appro medium
"	T2	6'-8'	" " "	50	16.8	-	-	7220	135.6	
"	T3	9'-11'	" " "	8	16.7	15.3	29.2	3270	137.0	
"	T4	15'-17'	stiff grey silty clay.	21	17.9	16.3	26.8	1070	132.2	Appro medium
"	T5	20'-22'	" " "	22	20.2	-	-	40	131.0	
"	T6	25'-27'	" " "	10	18.5	15.5	23.1	1015	124.4	
"	T7	30'-32'	" " "	25	17.1	-	-	-	131.8	

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT





# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

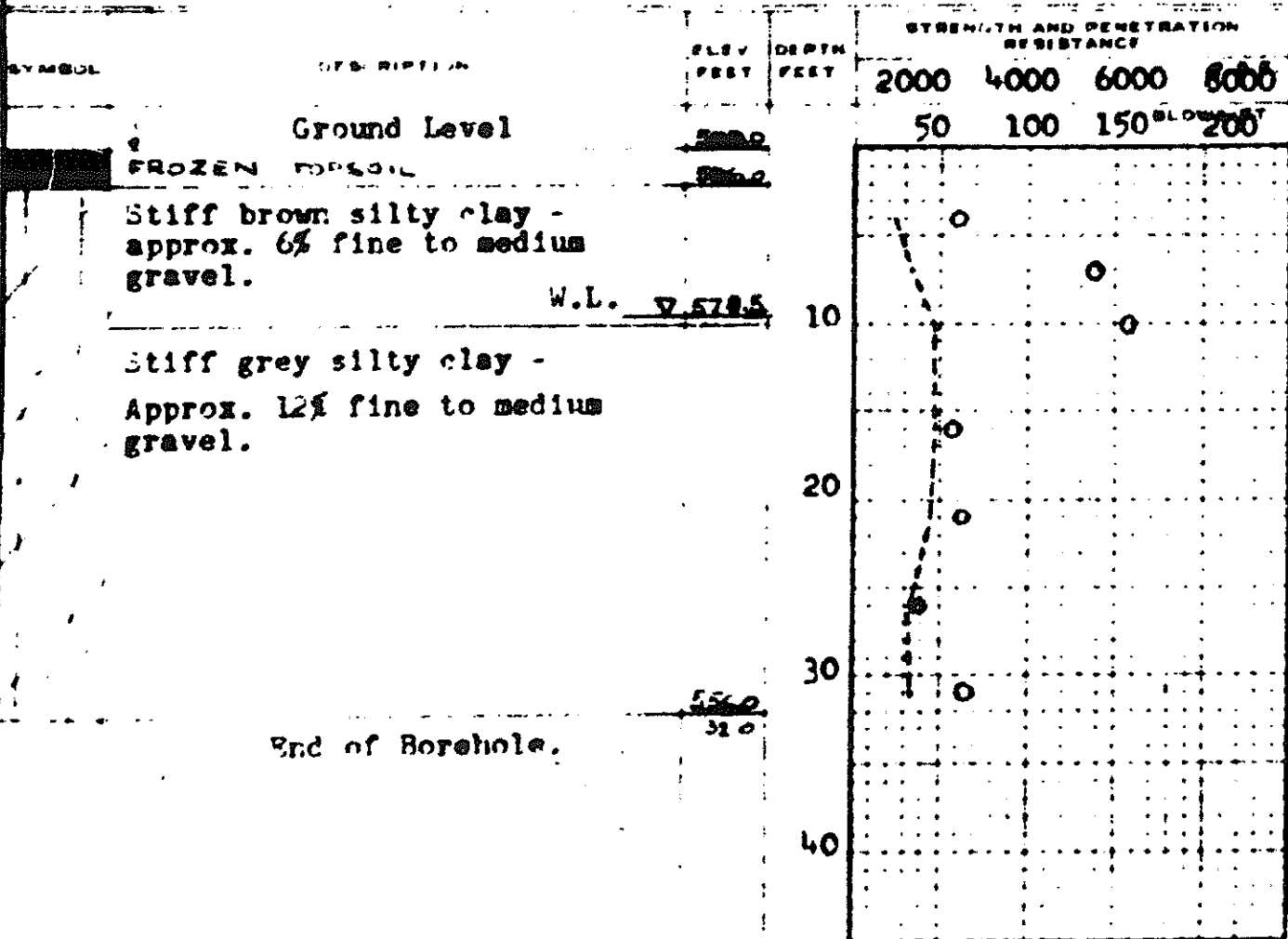
W.P. 11-59 BORE HOLE NO. 1  
 JOB F-59-6 STATION 378+47 (38' Lt.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Jan. 28/59 CHECKED BY A.L.

2" DIA SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA CONE  
 2" SHELBY  
 CASING

## LEGEND

1/2 UNC  
 VANE  
 NATUR.

LIQUID  
 PLASTI



# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 11-59.

BORE HOLE NO. 2

JOB F-50-6

STATION 378+82 (38' Rt.)

DATUM Geodetic

COMPILED BY R.K.

BORING DATE Feb. 3/59. CHECKED BY A.L.

2" DIA SPLIT TUBE

2" SHELBY TUBE

2" SPLIT TUBE

2" DIA CONE

2" SHELBY

CASING

## LEGEND

1/2 UNCL

VANE T

NATURA

LIQUID

PLASTIC

SYMBOL

EX. RPT. IN

ELEV  
FEETDEPTH  
FEETSTRENGTH AND PENETRATION  
RESISTANCE

2000 4000 6000 8000

50 100 150 200

MOIST

10

Ground Level.

589.0

FED. EN. TOP SOIL

587.0

Stiff brown silty clay -  
Approx. 6% fine to medium  
gravel.

W.L. 584.5

578.5

Stiff grey silty clay -  
Approx. 12% fine to medium  
gravel.

10

20

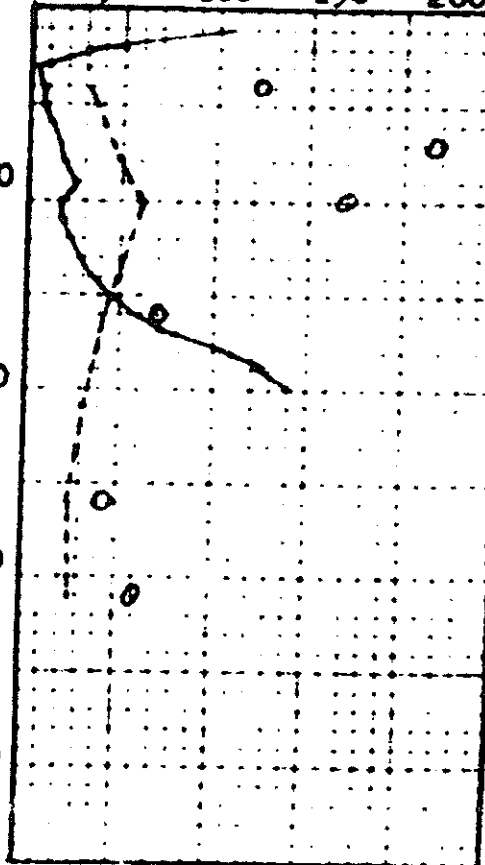
30

40

End of Borehole.

557.0

52.0



# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

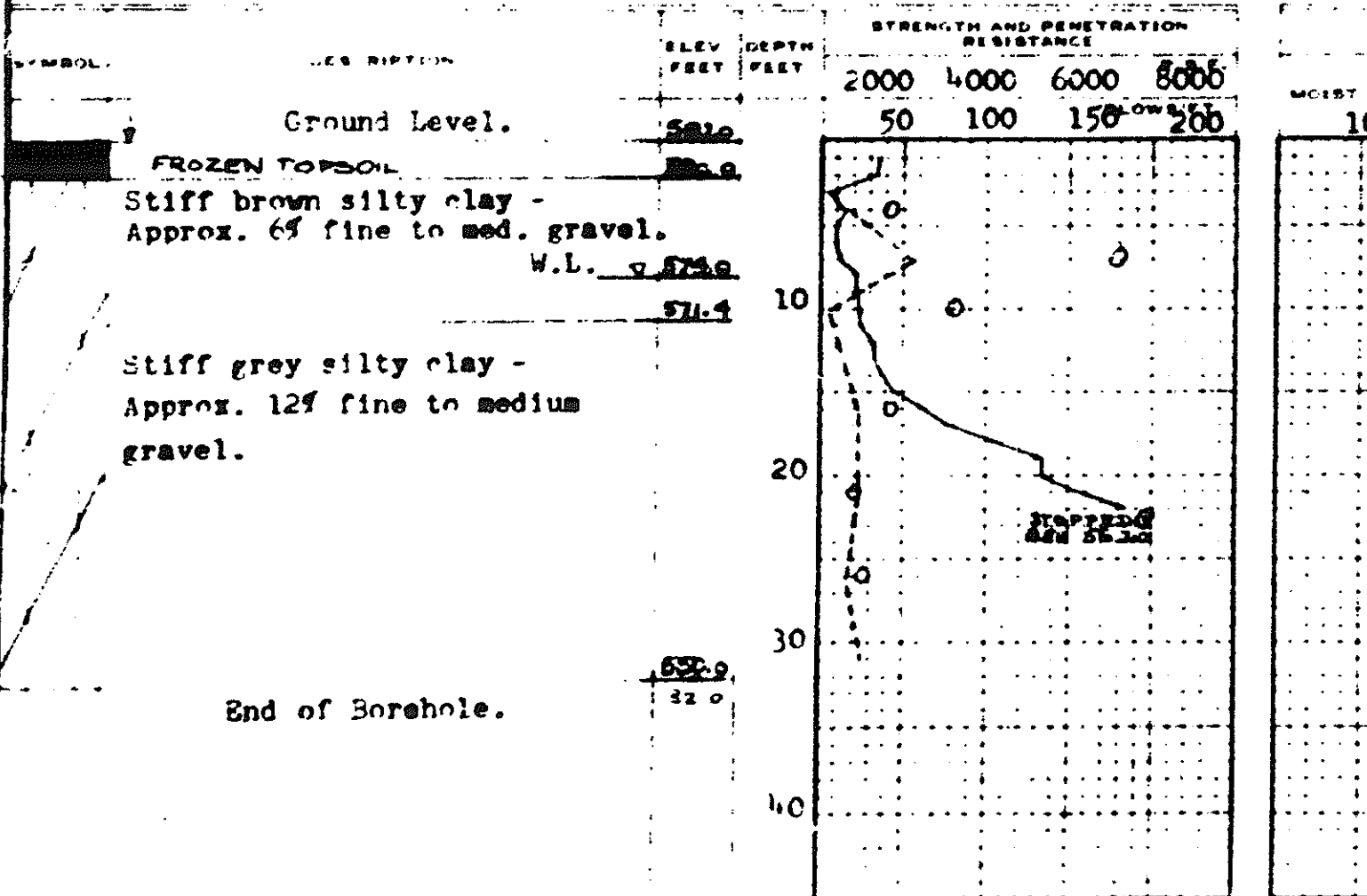
W.P. 11-59 BORE HOLE NO. 3.  
 JOB F-59-6. STATION 378+13 (41' Rt.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Feb. 4/59. CHECKED BY A.L.

2" DIA SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA CONE  
 2" SHELBY  
 CASING

## LEGEND

1/2 UNC  
 VANE  
 NATURAL

LIQUID  
 PLASTICITY



# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 11-59 BORE HOLE NO. 4  
JOB P-59-6 STATION 377+76 (41' Lt.)  
DATUM Geodetic COMPILED BY B.K.  
BORING DATE Feb. 5/59. CHECKED BY A.L.

2" DIA SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA CONE  
2" SHELBY  
CASING

## LEGEND

2" DIA SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA CONE  
2" SHELBY  
CASING

SYMBOL

DESCRIPTION

ELEV. FEET DEPTH FEET

STRENGTH AND PENETRATION RESISTANCE

2000 4000 6000 8000  
50 100 150 200

MOIST

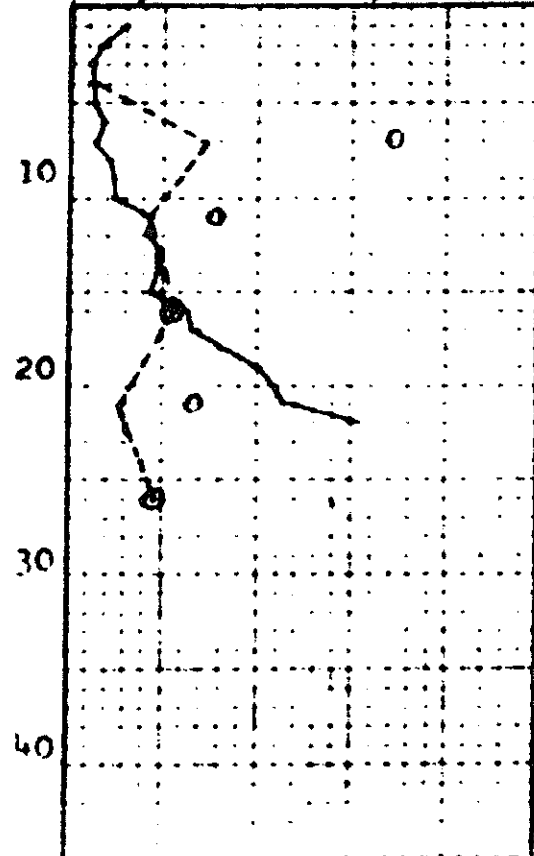
Ground Level

FROZEN TOPSOIL

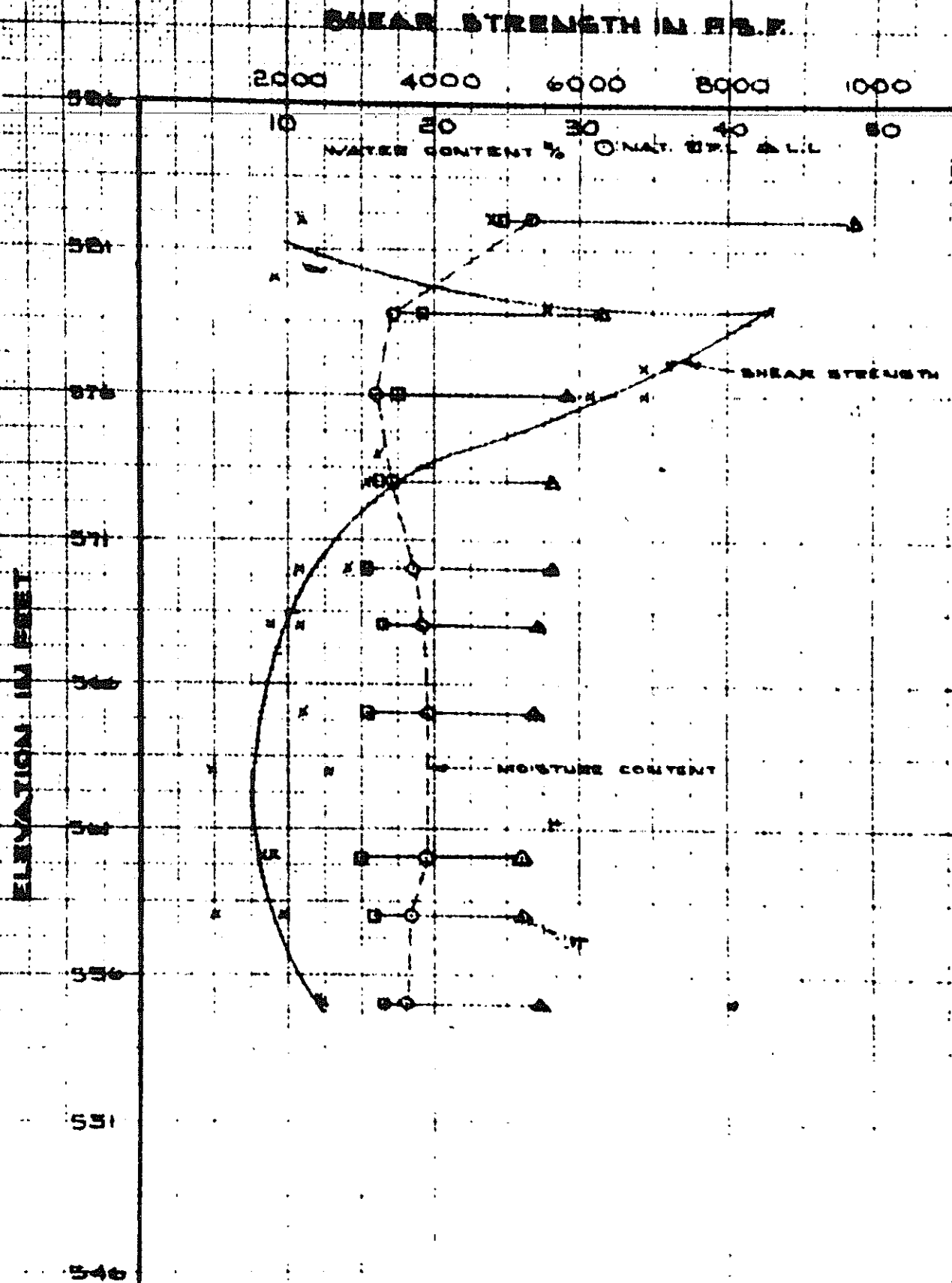
Stiff brown silty clay -  
Approx. 6% fine to med. gravel.

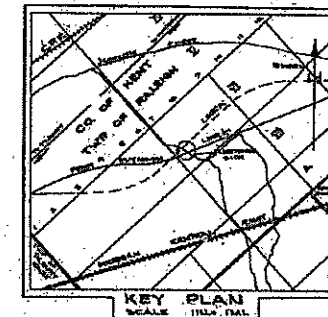
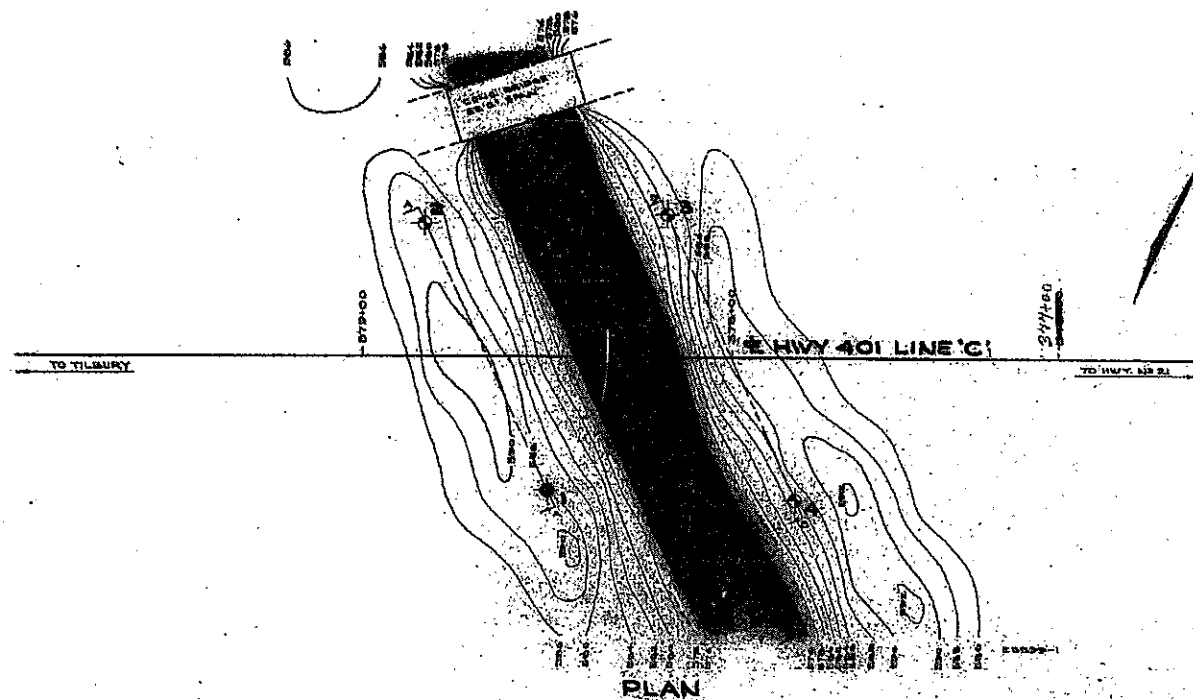
Stiff grey silty clay -  
Approx. 12% fine to medium  
gravel.

End of Borehole.



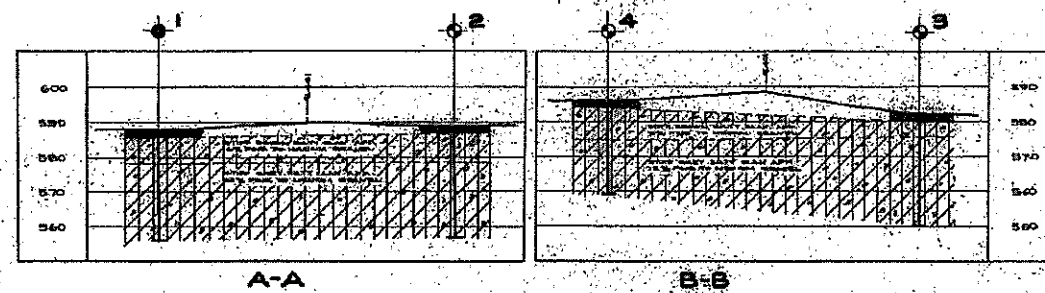
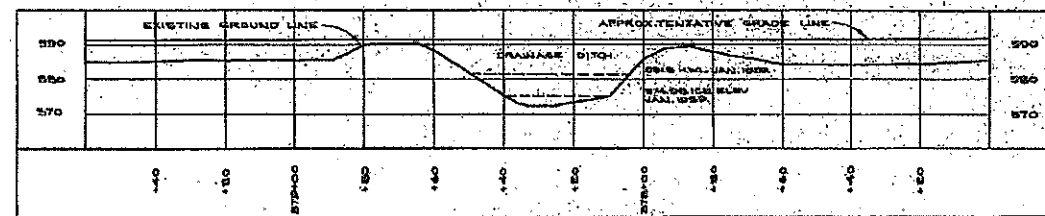






LEGEND			
BORER HOLE			
PENETRATING HOLE			
BORER PENETRATING HOLE			
HOLE NO.	ELEVATION	STATION	ENTRANCE PROPOSED
1	580.0'	STB-471	580.0'
2	580.0'	STB-472	580.0'
3	580.0'	STB-473	580.0'
4	580.0'	STB-474	580.0'

NOTE -  
THE BOUNDARIES BETWEEN BORER STATIONS HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM OBSERVATION. BOUNDARIES MAY BE SUBJECT TO CONSIDERABLE VARIATION.



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**DRAINAGE DITCH  
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLES

PROJECT NO. \_\_\_\_\_ DISTRICT \_\_\_\_\_ COUNTY \_\_\_\_\_

DESIGNED BY \_\_\_\_\_ CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

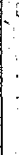
SCALE 1" = 10'

FILE NO. **F52-6A**

4078-4  
DRAINAGE DITCH



- (9) Contract Drawings for Dillon Road Underpass at Highway 401, WP 299-60, dated January 1967.







- (10) Foundation Investigation Report for Highway 401, Line 'C' and Jeannette Creek and Gravel Road Proposed Crossing (Government Drain No. 3 Bridges and Dillon Road Underpass), Lots 12 and 13, Concession 7; Township of Raleigh, WP 12-59, W.J.F-59-61, dated July 1959, Geocres No. 40J8-11.

## SUMMARY OF FIELD & LABORATORY TESTS

80F T-59-61

W.P. 12-59

[illegible]

TABLE NO. 1. (CONT'D)

F-59-61

JOB

W.P. 12-59

SUMMARY OF FIELD & LABORATORY TESTS

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETR. RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH psi	UNIT WEIGHT pcf	REMARKS
5	T1	5'-7'	Stiff brown silty clay.	14	-	-	-	-	-	
	T2	10'-12'	Stiff grey silty clay with approximately 6% fine to medium gravel.	10	18.9	-	-	-	130.1	
	Vane	13'	" " " "	-	-	-	-	800	-	Sens. 1.4
	S3	15'-16.5'	" " " "	15	-	-	-	-	-	
	T4	20'-22.0'	" " " "	16	18.0	16.7	26.5	1960	130.8	
	Vane	23.5'	" " " "	-	-	-	-	1600	-	Sens. 1.8
	S5	25'-26.5'	" " " "	16	-	-	-	-	-	
	T6	30'-32'	" " " "	15	18.6	17.3	25.8	987	128.4	
	T7	50'-52'	" " " "	25	19.8	16.3	24.4	1150	125.3	
6	S1	5'-6.5'	Stiff brown silty clay	7	-	-	-	-	-	
	S2	10'-11.5'	Stiff grey silty clay with approximately 6% fine to medium gravel.	13	-	-	-	-	-	
	S3	15'-16.5'	" " " "	19	-	-	-	-	-	
	T4	20'-22'	" " " "	17	18.8	-	-	1270	130.8	
	T5	30'-32'	" " " "	16	-	-	-	-	-	
	T6	35'-37'	" " " "	16	18.6	17.2	26.8	1184	130.2	
	T7	45'-47'	" " " "	21	-	-	-	-	-	Cont'd. 3/...

JOB F-59-61  
W.P. 12-59

# SUMMARY OF FIELD & LABORATORY TESTS

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH P.S.I.	UNIT WEIGHT P.C.F.	REMARKS
6	T8	50'-52'	Stiff grey silty clay with approximately 6% fine to medium gravel.	38	16.6	16.7	24.1	2700	131.1	
			S. Denotes Split Spoon Sample							
			T. " Thin Walled Shelby Tube							

## OFFICE REPORT ON SOIL EXPLORATION

## DEPARTMENT OF HIGHWAYS - ONTARIO

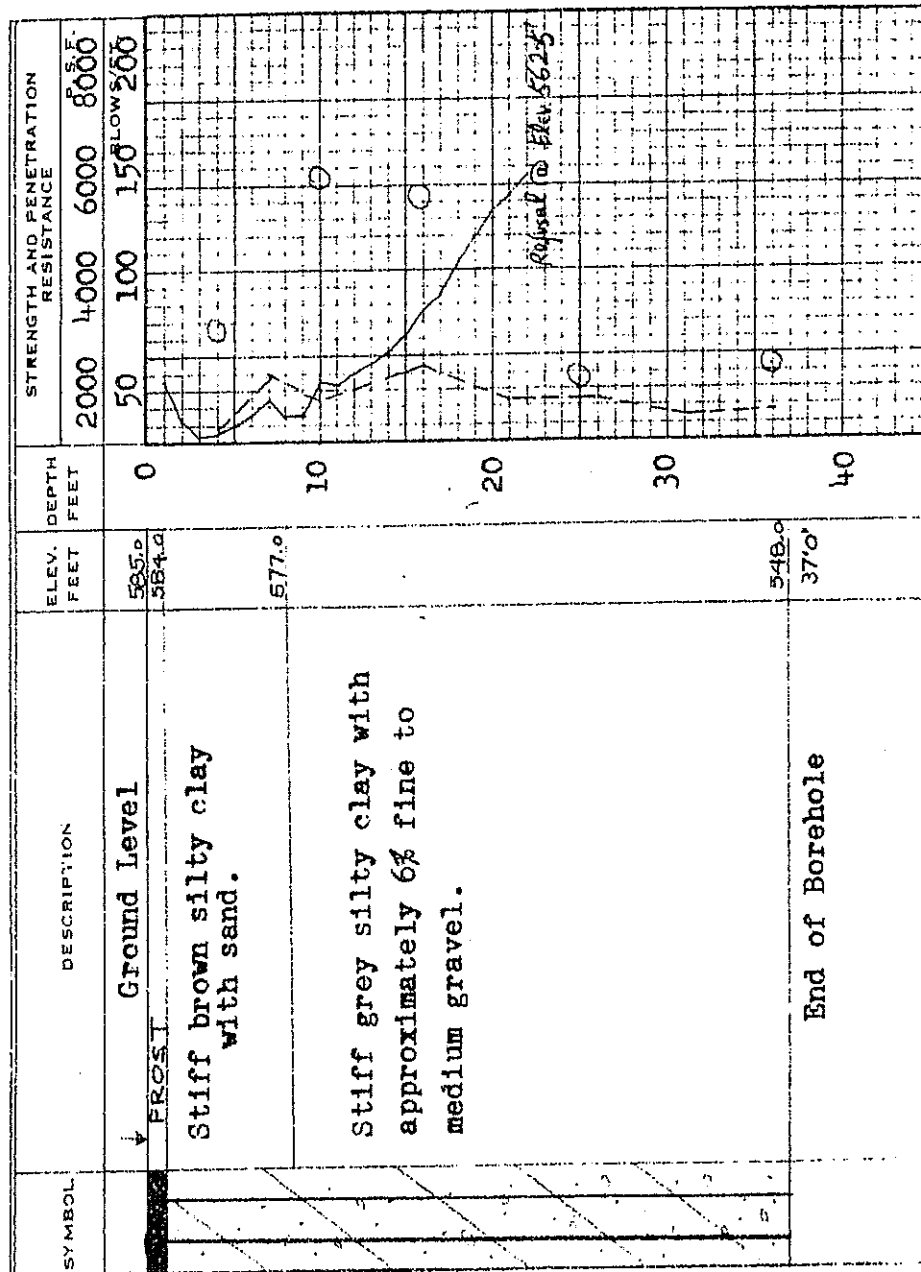
## MATERIALS AND RESEARCH SECTION

W.P. 12-59 BORE HOLE NO. 1  
 JOB F-59-61 STATION 256+08 (37° Rt.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Feb. 14/59 CHECKED BY A.L.

## LEGEND

SS 1 UNCONFINED COMPRESSION (Qu) --- O  
 TW VA. TEST (C) AND SENSITIVITY (S) --- +  
 LIQUIDITY INDEX --- LI  
 LIQUID LIMIT --- X  
 PLASTIC LIMIT ---

2" DIA. SPLIT TUBE ---  
 2" SHELBY TUBE ---  
 2" SPLIT TUBE ---  
 2" DIA. CONE ---  
 2" SHELBY ---  
 CASING --- X



Borehole No. 1.

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30		
	TW 1	126.0
	TW 2	127.2
	TW 3	128.8
	TW 4	133.0
	TW 5	129.0
	TW 6	131.8
	TW 7	120.3
	TW 8	130.2



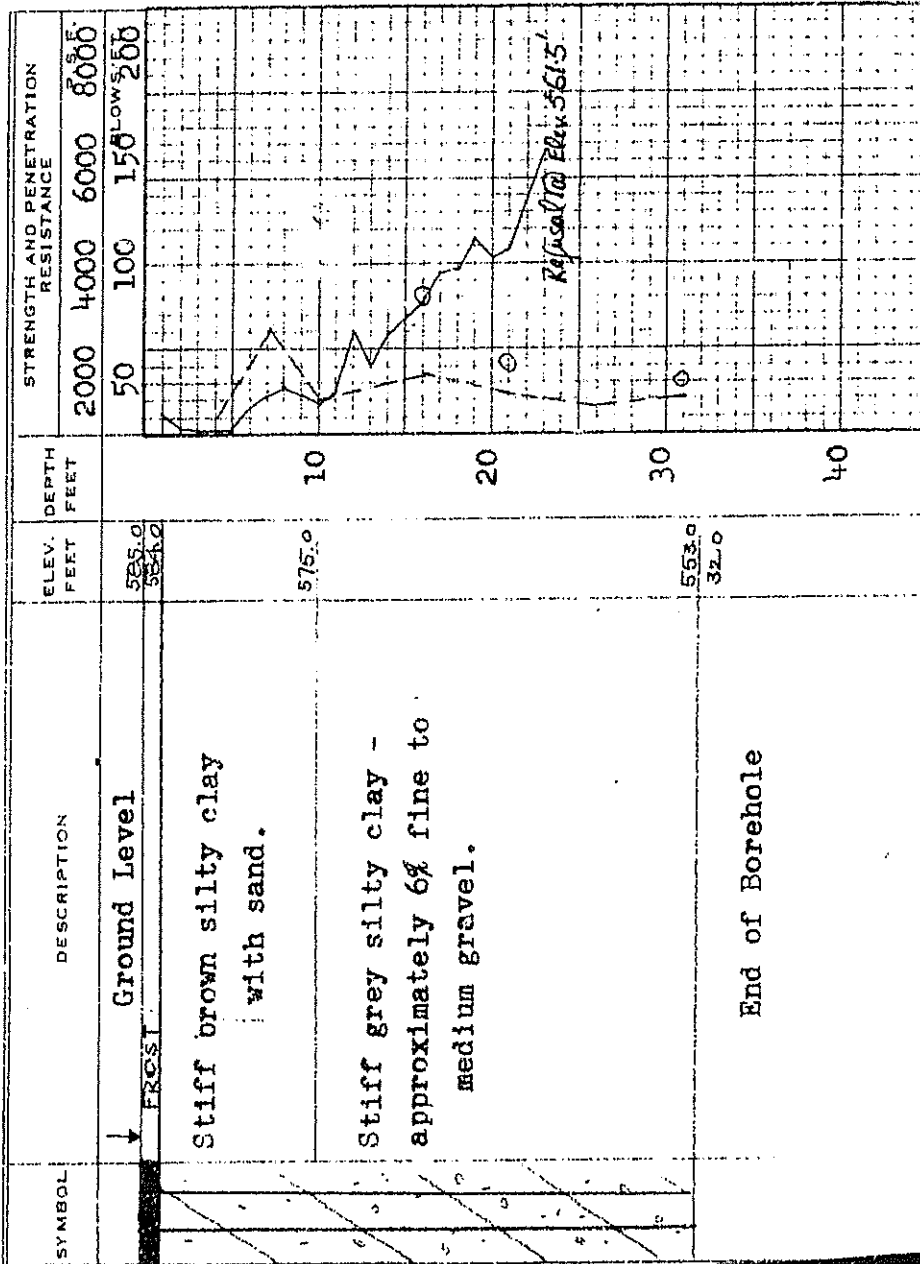
## OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59 BORE HOLE NO. 2  
 JOB F-59-61 STATION 255+82 (37'lt.)  
 DATUM Geodetic COMPILED BY D.K.  
 BORING DATE Feb. 14/59 CHECKED BY A.L.

## LEGEND

2" DIA. SPLIT TUBE ---  $\sigma_{ss}$  1/2 UNCONFINED COMPRESSION ( $Q_u$ ) ---  $\sigma$   
 2" SHELBY TUBE ---  $\sigma_{TW}$  VANE TEST (C) AND SENSITIVITY (S) ---  $+s$   
 2" SPLIT TUBE ---  $\sigma$  NATURAL MOISTURE AND LIQUIDITY INDEX ---  $X$   
 2" DIA. CONE ---  $\sigma$  LIQUID LIMIT ---  $\sigma$   
 2" SHELBY ---  $\sigma$  PLASTIC LIMIT ---  $\sigma$   
 CASING ---  $\sigma$



Borehole No. 2

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST CONTENT - % DRY WT		
10 20 30		
	TW 1	126.0
	TW 2	129.4
	TW 3	122.8
	TW 4	136.0
	TW 5	132.0
	TW 6	127.8
	TW 7	128.0

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

LEGEND

SS	1/2 UNCONFINED COMPRESSION (Qu)	0
TW	VANE TEST (C) AND SENSITIVITY (S)	+5
	NATURAL MOISTURE AND	LI
	LIQUIDITY INDEX	X
	LIQUID LIMIT	0
	PLASTIC LIMIT	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				P.S.F.
				2000	4000	6000	8000	
	↓ Ground Level	587.6		50	100	150	200	
	Stiff brown silty clay with sand. W.L. $\nabla$ 582.6							
		578.0	10					
	Stiff grey silty clay - approx. 6% fine to medium gravel interbedded with 1" sand seams between Elev. 582 & 580.		20					
			30					
			40					
	End of Borehole	545.6						

CONSISTENCY		MOIST. CONTENT - % DRY WT.		SAMPLE UNIT WT. F.C.F.	NATURAL
10	20	30			
				TW 1	124.0
				TW 2	118.0
				TW 3	129.0
				TW 4	132.0
				TW 5	128.0
				TW 6	129.9
				TW 7	-Lost

## OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59

BORE HOLE NO. 14

JOB F-59-61

STATIC. 256+57 (37'lt.)

DATUM Geodetic

COMPILED BY B.K.

BORING DATE Feb. 13/59

CHECKED BY A.L.

## LEGEND

SS 1/2 UNCONFINED COMPRESSION (Qu) --- O  
TW VANE TEST (C) AND SENSITIVITY (S) --- +s  
NATURAL MOISTURE AND LIQUIDITY INDEX --- LI  
LIQUID LIMIT --- X  
PLASTIC LIMIT --- I

2" DIA. SPLIT TUBE ---  
2" SHELBY TUP. ---  
2" SPL. ---  
2" DIA. CONE ---  
2" SHELBY ---  
CASING --- X

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE
	Ground Level	587.6		2000 4000 6000 8000 50 100 150 200
	Stiff brown silty clay with sand.	583.6	10	
	Stiff grey silty clay - approximately 6% fine to med. gravel interbedded with 1" sand seams between Elevations 582 & 580.	577.0	20	
	End of Borehole	561.0 27.0	30 40	

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30		
	TW 1	118.0
	TW 2	123.4
	TW 3	137.5
	TW 4	131.5
	TW 5	127.5

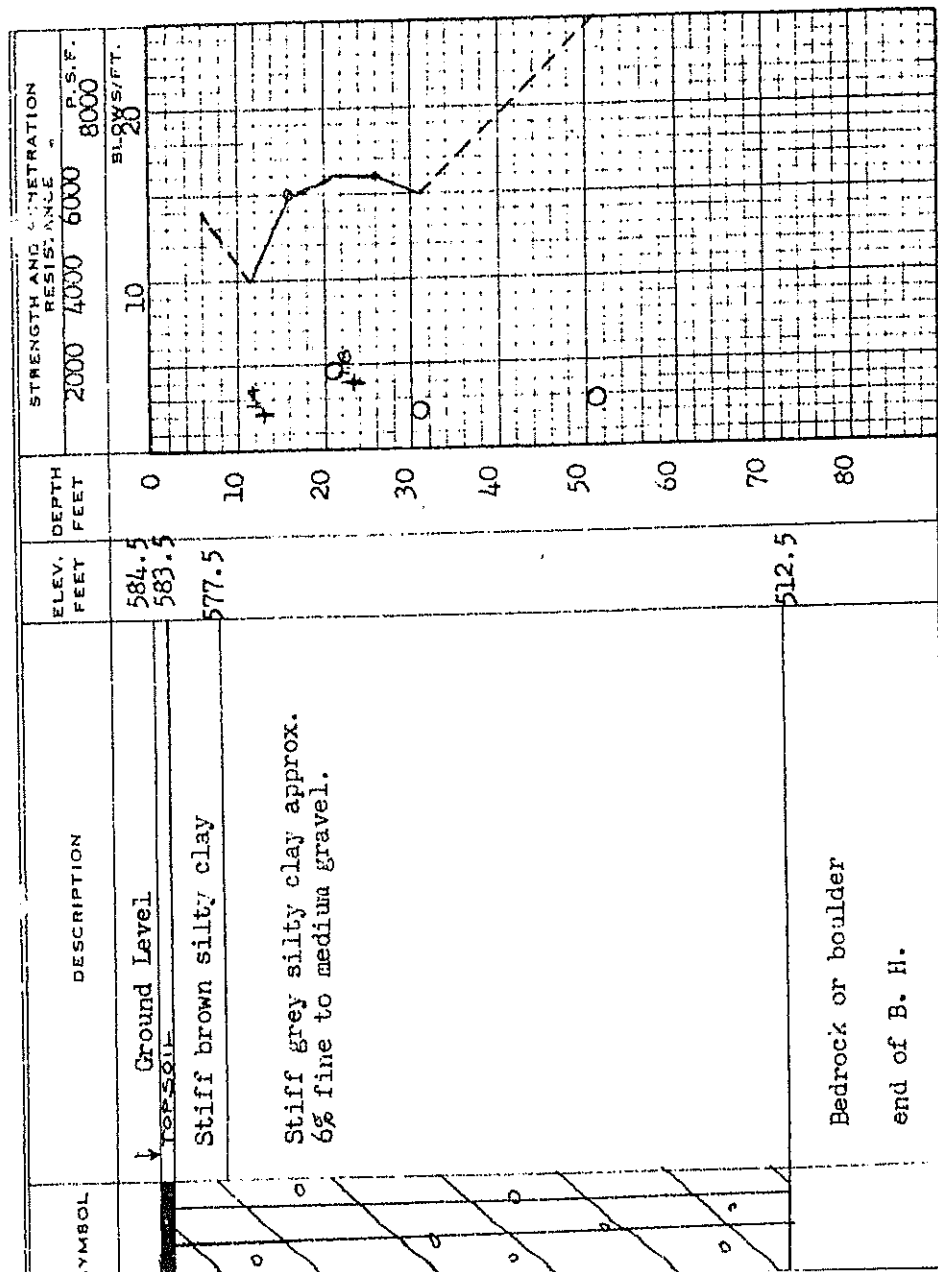
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

N.P. 12-52 BORE HOLE NO. 5  
 JOB P-59-61 STATION 254 ± 84 (45' RT.)  
 DATUM Elev. 584.5' COMPILED BY B. H.  
 BORING DATE June 15/59 CHECKED BY A. L.

## LEGEND

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 2" SHELBY  
 CASING

1/2 UNCONFINED COMPRESSION ( $Q_u$ )  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT



Borehole No. 5

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30	T1	-
	T2	130.1
	S3	-
	T4	130.8
	S5	-
	T6	128.4
	T7	125.3

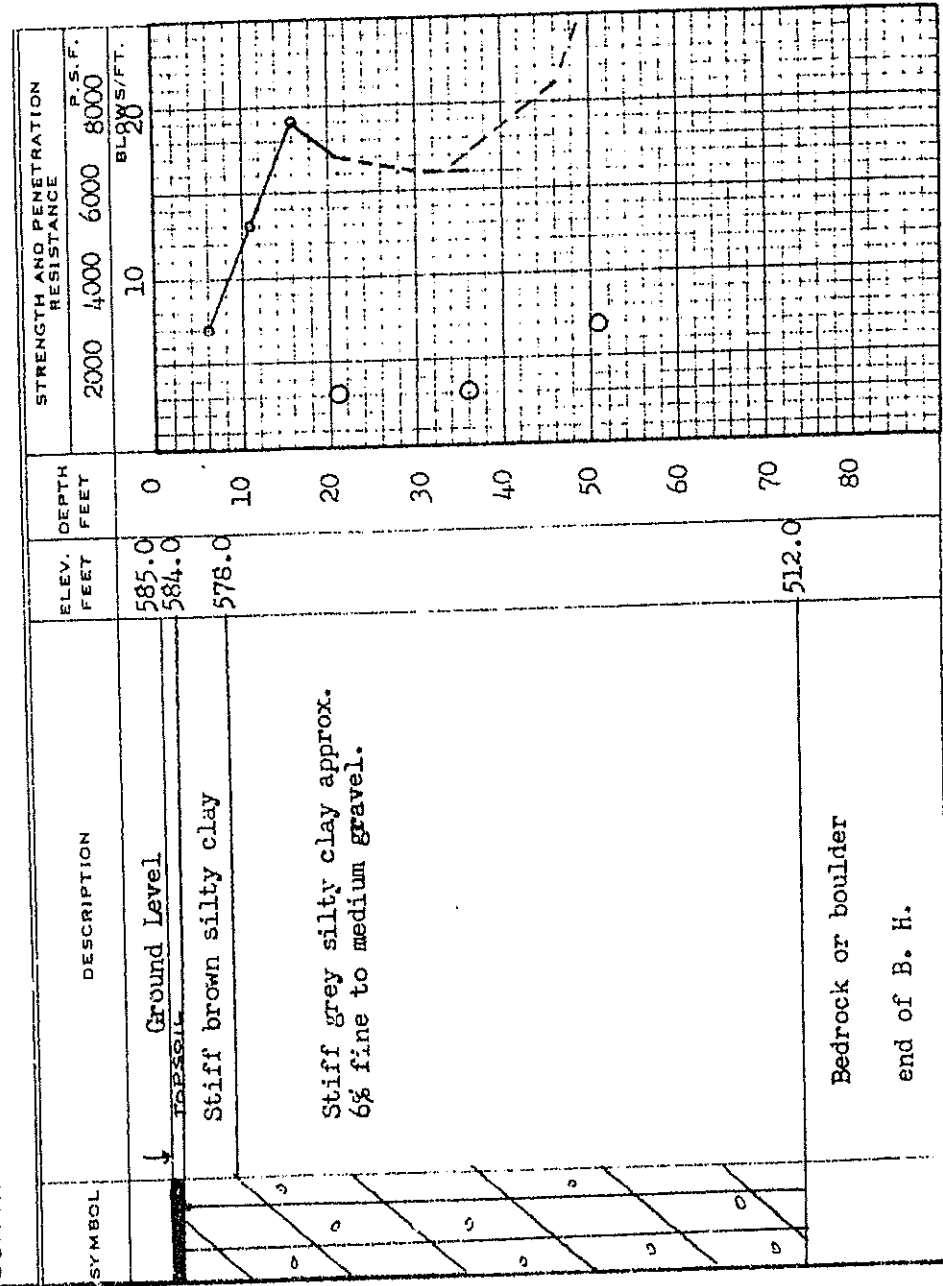
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59 BORE HOLE NO. 6  
JOB E-59-61 STATION 255 + 26 (45' LT)  
DATUM Elev. 584.5' COMPILED BY B. K.  
BORING DATE June 16/59 CHECKED BY A. L.

LEGEND

2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
2" SHELBY  
CASING

1/2 UNCONFINED COMPRESSION (Qu)  
VANE TEST (C) AND SENSITIVITY (S)  
NATURAL MOISTURE AND LIQUIDITY INDEX  
LIQUID LIMIT  
PLASTIC LIMIT



Borehole No. 6

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30	S1	-
	S2	-
	S3	-
	T4	130.8
	T5	-
	T6	130.2
	T7	-
	T8	131.1



W. P. 12-59

JOB F-59-61

# SHEAR STRENGTH IN P. S. F.

1000 2000 3000 4000 5000 6000

ELEVATION IN FEET

585  
575  
565  
555  
545  
535  
525  
515

DEPTH IN FEET

10  
20  
30  
40  
50  
60  
70

⊙ B.V. NOS 1 & 2  
⊙ B.V. NOS 5 & 6  
+ B.V. NOS 3, 4 & 9  
+ B.V. NOS 7 & 8

WATER CONTENT % X NAT. -> ATTERBERG LIMITS

GRAPH FOR FOUNDATION REPORTS.

FILE NO. I - (cont'd.)

JOB F 59-61  
W.P. 12-59

# SUMMARY OF FIELD & LABORATORY TESTS

HOLE NO.	SAMP NO	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
7	T 1	5'-6.5'	Stiff brown silty clay.	P	25.4	22.0	28.2	2030	121.4	Approx. 6% fine to medium gravel.
	T 2	10'-11.5'	Stiff grey silty clay.	P	30.0	20.7	38.0	-	108.2	
	T 3	15'-16.5'	"	P	19.0	18.3	30.0	2060	130.5	
	T 4	20'-21.5'	"	P	19.0	16.5	27.0	1430	130.4	
	T 5	25'-26.5'	"	P	19.0	17.4	27.9	1210	131.5	
	T 6	30'-31.5'	"	P	18.4	17.1	21.3	1395	132.0	
	T 7	36'-37.5'	"	P	18.7	17.6	27.0	2060	130.8	
	T 8	45'-46.5'	"	P	21.4	17.2	26.2	-	126.7	
	T 9	55'-56.5'	"	P	18.9	15.3	23.5	1410	130.0	
8	T 1	5'-6.5'	Stiff brown silty clay.	11	28.8	-	-	6300	127.0	Approx. 6% fine to medium gravel.
	T 2	10'-11.5'	Stiff grey silty clay.	P	17.6	-	-	1700	136.4	
	T 3	15'-16.5'	"	P	19.8	-	-	1205	132.1	
	T 4	20'-21.5'	"	P	20.1	-	-	1128	131.6	
	T 5	25'-26.5'	"	P	19.3	-	-	1410	130.8	
	T 6	30'-31.5'	"	P	19.4	-	-	1280	129.9	
	T 7	35'-36.5'	"	P - 6" for 46" for 12"	18.0	-	-	1655	133.0	
	T 8	40'-41.5'	"	P	18.5	-	-	1832	129.9	
	T 9	45'-46.5'	"	P	18.5	-	-	1832	129.9	
9	T 1	5'-6.5'	Stiff brown silty clay.	P	25.6	-	-	1740	122.2	Sens: 1.0 cont'd. ....
	T 2	10'-11.5'	Stiff grey silty clay.	P	27.3	-	-	1685	122.0	
	T 3	15'-16.5'	Med. grey silty clay.	P	29.2	-	-	940	119.2	
	Vane	18'	"	-	-	-	-	960	-	

TABLE NO. 1 - (cont'd.) ...

JOB F 59-61  
W.P. 12-59.

SUMMARY OF FIELD & LABORATORY TESTS

HOLE NO	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETR. RESIST. BLOWS/FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH psi	UNIT WEIGHT pcf	REMARKS
9	T 4	23'-24.5'	Med. grey silty clay.	P	19.5	17.2	24.6	1055	131.0	
	Vane	26'	" " "	-	-	-	-	960	-	Sens: 1.0
	T 5	30'-31.5'	Med. to stiff grey silty clay.	P	19.7	-	-	1355	130.9	
	T 6	35'-36.5'	" " "	P	19.7	16.5	26.5	1150	129.0	
	T 7	45'-46.5'	Stiff grey silty clay.	P	18.6	15.9	25.2	1780	131.8	
			T Denotes thin-walled Shelby Tube							

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59 BORE HOLE NO. 7  
J08 F 59-61 STATION 257+84 (58' Rt.)  
DATUM Elev. 586' COMPILED BY B.K.  
BORING DATE July 22/59 CHECKED BY A.L.

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) --- O  
VANE TEST (C) AND SENSITIVITY (S) --- +  
NATURAL MOISTURE AND LIQUIDITY INDEX --- LI  
LIQUID LIMIT --- X  
PLASTIC LIMIT --- P

2" DIA. SPLIT TUBE --- S  
2" SHELBY TUBE --- T  
2" SPLIT TUBE --- O  
2" DIA. CONE --- C  
2" SHELBY CASING --- X

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
				500 1000 1500 2000 B.S.F.	MOIST. CONTENT - % DRY WT. 10 20 30		
	↓ Ground Level	586.0	0			T1	121.4
	Stiff brown silty clay.	579.0	10			T2	108.2
			20			T3	130.5
			30			T4	130.4
			40			T5	131.5
			50			T6	132.0
			60			T7	130.8
			70			T8	126.7
			80			T9	130.0
	Probably bedrock. End of hole.	508.0					

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59  
BORE/HOLE NO. 8.  
J08 F 59-61 STATION 257+62 (58' Lt.)  
DATUM Elev. 586' COMPILED BY B.K.  
BORING DATE July 23/59 CHECKED BY A.L.

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O  
VANE TEST (C) AND SENSITIVITY (S) +s  
NATURAL MOISTURE AND LIQUIDITY INDEX LI  
LIQUID LIMIT X  
PLASTIC LIMIT ---

2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
2" SHELBY  
CASING

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				500	1000	1500	2000	2500
↓	Ground level	586.0	0					
	Topsoil							
	Stiff brown silty clay.	577.0	10					
	Stiff grey silty clay.		20					
			30					
			40					
		545.0	50					
			60					
			70					
			80					
	End of Borehole.							

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30	T 1	127.0
	T 2	136.4
	T 3	132.1
	T 4	131.6
	T 5	130.8
	T 6	129.9
	T 7	133.0
	T 8	129.9



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 12-59 BORE HOLE NO. 9  
JOB F 52-61 STATION 256+70 (Q)  
DATUM Elev. 587' COMPILED BY B.K.  
BORING DATE July 23/59 CHECKED BY A.L.

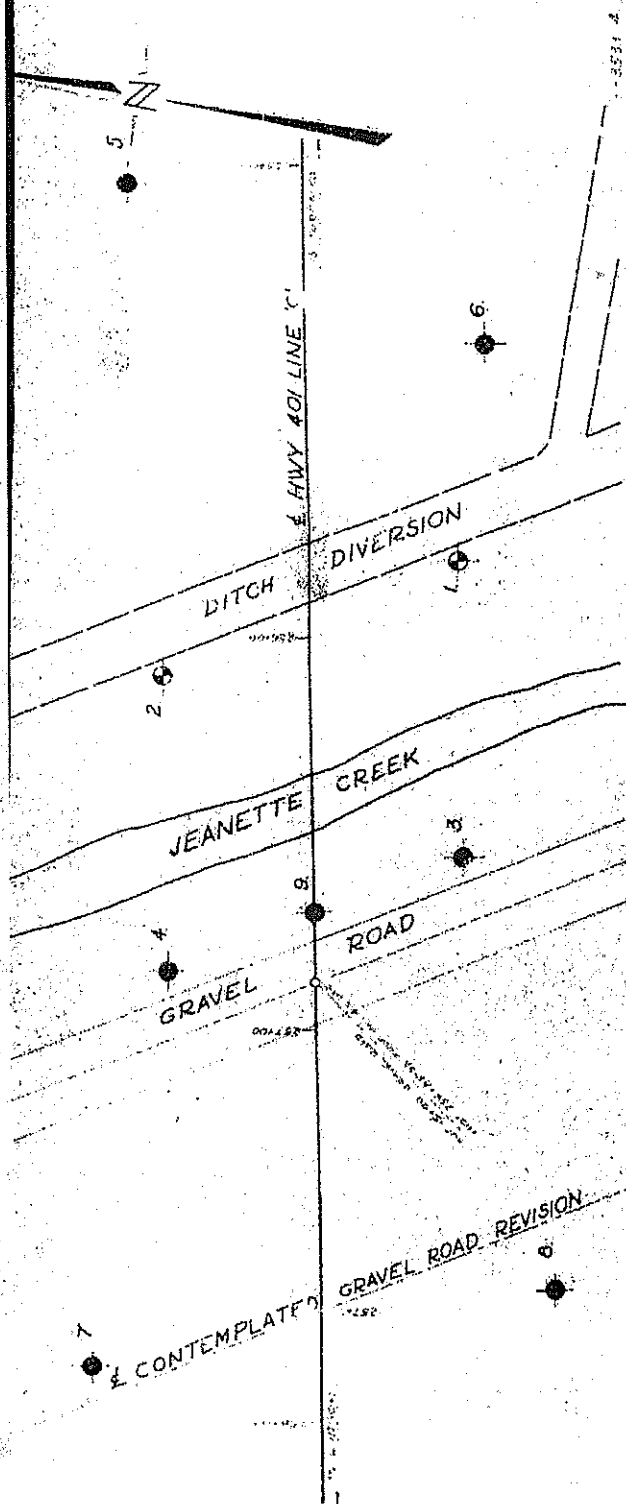
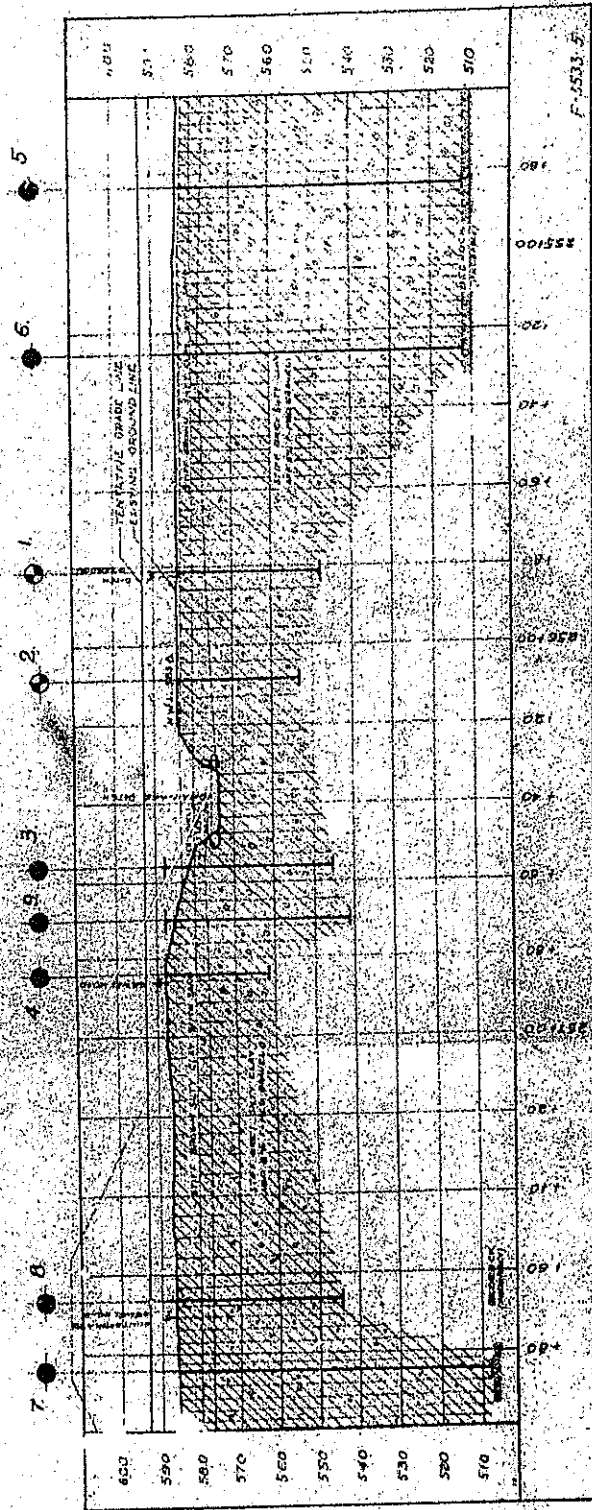
2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
2" SHELBY  
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) --- O  
VANE TEST (C) AND SENSITIVITY (S) --- +  
NATURAL MOISTURE AND LIQUIDITY INDEX --- X  
LIQUID LIMIT --- O  
PLASTIC LIMIT --- O

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	BLOWS/FT.
↓	Ground Level	587.0	0	500 1000 1500 2000	
	Stiff brown silty clay.	576.0	10		
	Stiff grey silty clay.		20		
			30		
			40		
			50		
	End of Borehole.	540.0	60		
			70		
			80		

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P. C. F.
MOIST. CONTENT - % DRY WT.		
10 20 30	T 1	
	T 2	
	T 3	
	T 4	
	T 5	
	T 6	
	T 7	

[illegible][illegible]



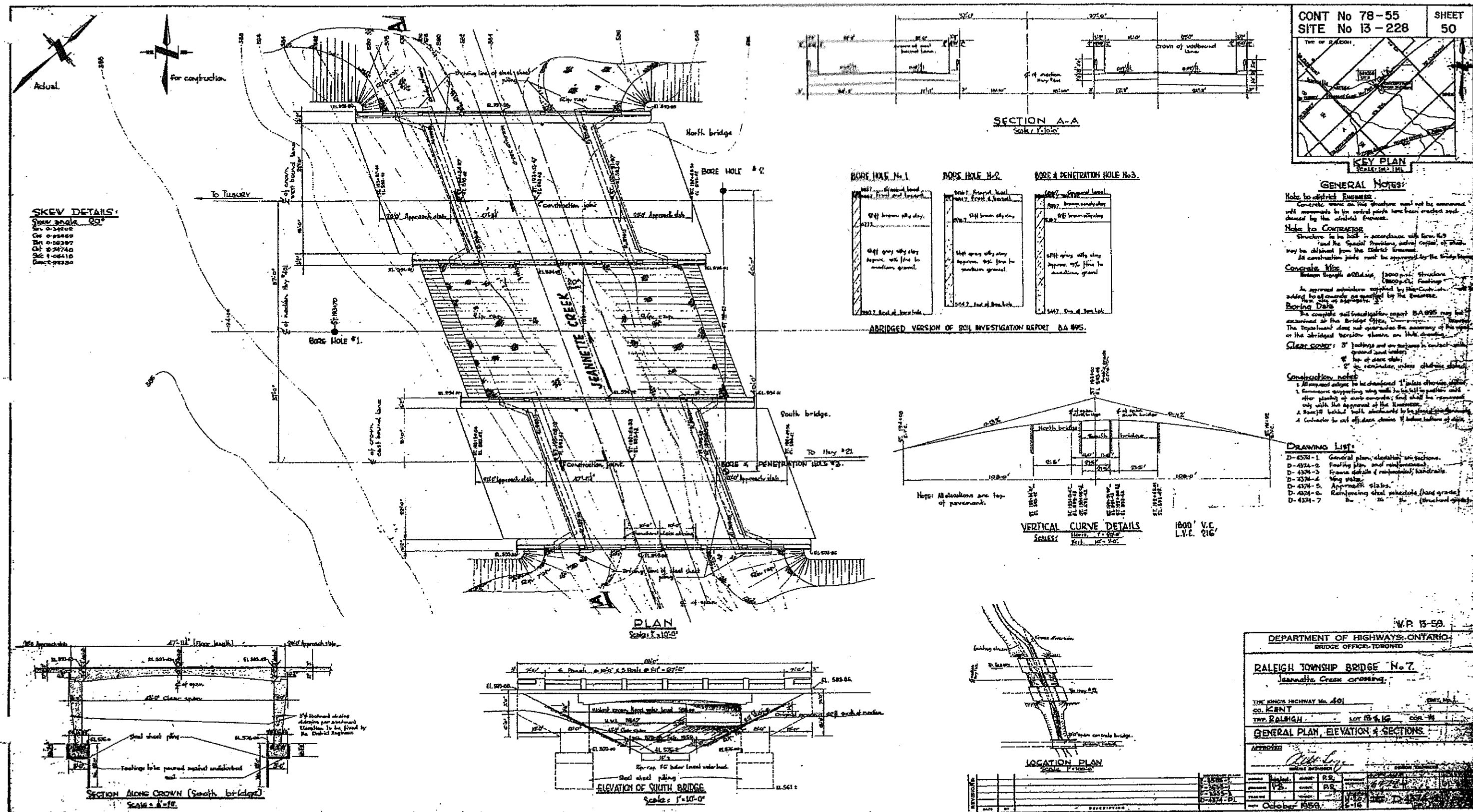
- (11) Contract Drawings for Raleigh Township Bridge No. 9 (Government Drain No. 3 Bridges), WP 12-59, dated October 1959.





- (12) Contract Drawings for Raleigh Township Bridge No. 7 (Raleigh Plains Drain Bridges), WP 13-59, dated November 6, 1959.







- (13) Foundation Investigation Report for Highway 401, Line 'A' and Jeannette Creek Crossing Lots 15 and 16, Concession VII (Raleigh Plains Drain Bridges), WP 13-59, W.J.F-59-14, dated May 6, 1959, Geocres No. 40J8-8.

TABLE NO. I.

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB F 59-14.

W.P. 13-59.

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	T1	5'-7'	Stiff brown silty clay with some sand.	-	31.6	-	-	-	-	Approximately 9% fine to medium gravel throughout.
	T2	10'-12'	Stiff grey silty clay.	-	20.7	18.3	31.0	3720	130.0	
	T3	15'-17'	" " "	-	18.5	-	-	2002	133.0	
	T4	20'-22'	" " "	-	18.8	16.8	26.1	-	130.2	
	T5	25'-27'	" " "	-	17.6	-	-	1928	131.0	
	T6	33'-35'	" " "	-	17.2	15.2	28.0	-	129.4	
2	T1	5'-7'	Med. Stiff brown silty clay.	-	22.0	-	-	1385	121.0	Approximately 9% fine to medium gravel throughout.
	T2	10'-12'	Stiff grey silty clay.	-	19.5	-	-	3320	133.8	
	T3	15'-17'	" " "	-	17.9	-	-	2430	132.6	
	T4	20'-22'	" " "	-	18.9	-	-	1820	132.2	
	T5	25'-27'	" " "	-	18.0	15.7	26.2	-	132.0	
	T6	30'-32'	" " "	-	17.2	17.5	28.4	3100	128.7	
3	T1	3'-5'	Stiff brown sandy clay.	-	16.8	-	-	7490	129.0	Approximately 9% fine to medium gravel throughout.
	T2	6'-8'	Stiff brown silty clay.	-	15.6	-	-	7920	133.0	
	T3	10'-12'	Stiff grey silty clay.	-	15.6	16.1	24.0	-	136.8	
	T4	15'-17'	" " "	-	17.8	16.1	27.8	2140	133.3	
	T5	20'-22'	" " "	-	19.2	-	-	1640	124.0	
	T6	25'-27'	" " "	-	19.0	16.7	27.1	1930	131.2	
	T7	30'-6"-32'	" " "	-	19.0	-	-	2560	132.0	
	T8	40'-42'	" " "	-	20.0	16.0	25.5	1530	129.0	

T1 - denotes thin walled Shelby sample.

W.P. 13-59 BORE HOLE NO. 1  
JOB F 59-14 STATION 193+70  $\epsilon$   
DATUM Geodetic COMPILED BY B.K.  
CORRECTING DATE Feb. 16/59 CHECKED BY A.L.

3808 HOLLAND NO 1

STATION 193+70 £

COMPILED BY B.K.

BORING DATE Feb. 16/59

CHECKED BY A.L.

**ONEGENT**

	0	5	10	15	20
UNCONFINED COMPRESSION (QU)					
SWELLING TEST(S) AND SENSITIVITY(S)					
NATURAL MOISTURE AND LIQUIDITY INDEX					
LIQUID LIMIT					
PLASTIC LIMIT					

2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA CONE  
2" SHELBY  
CASINGS

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				2000	4000	6000	8000	P.S.P.
	Ground Level.	587.7		50	100	150	200	BLOWS/FT.
	Frost and Topsoil.	585.7						
	Stiff brown silty clay.							
		577.7	10					
	Stiff grey silty clay - approximately 9% fine to medium gravel.		20					
			30					
	End of Borehole.	552.7	40					

CONSISTENCY	MOIST. CONTENT- % DRY WT.	SAMPLE UNIT WT.	NATURAL
10 20 30			
		STW 1	
		STW 2 130.0	
		STW 3 133.0	
		STW 4 130.2	
		STW 5 131.0	
		STW 6 129.4	

Borehole No. 1

## MATERIALS AND RESEARCH SECTION

BORING DATE Feb. 16/59. CHECKED BY A.L.

	0	+	-
1/2 UNCONFINED COMPRESSION (Qu)			
VANE TEST (C) AND SENSITIVITY (S)			
NATURAL MOISTURE AND			
LIQUIDITY INDEX			
LIQUID LIMIT			
PLASTIC LIMIT			

CONSISTENCY	MOIST. CONTENT - % DRY WT.	SAMPLE UNIT WT. P.C.F.	NATURAL UNIT WT.
	10 20 30		
	X	TW 1	121.0
	X	TW 2	133.8
	X	TW 3	132.6
	X	TW 4	132.2
	1-X-O	TW 5	132.0
	X	TW 6	128.7

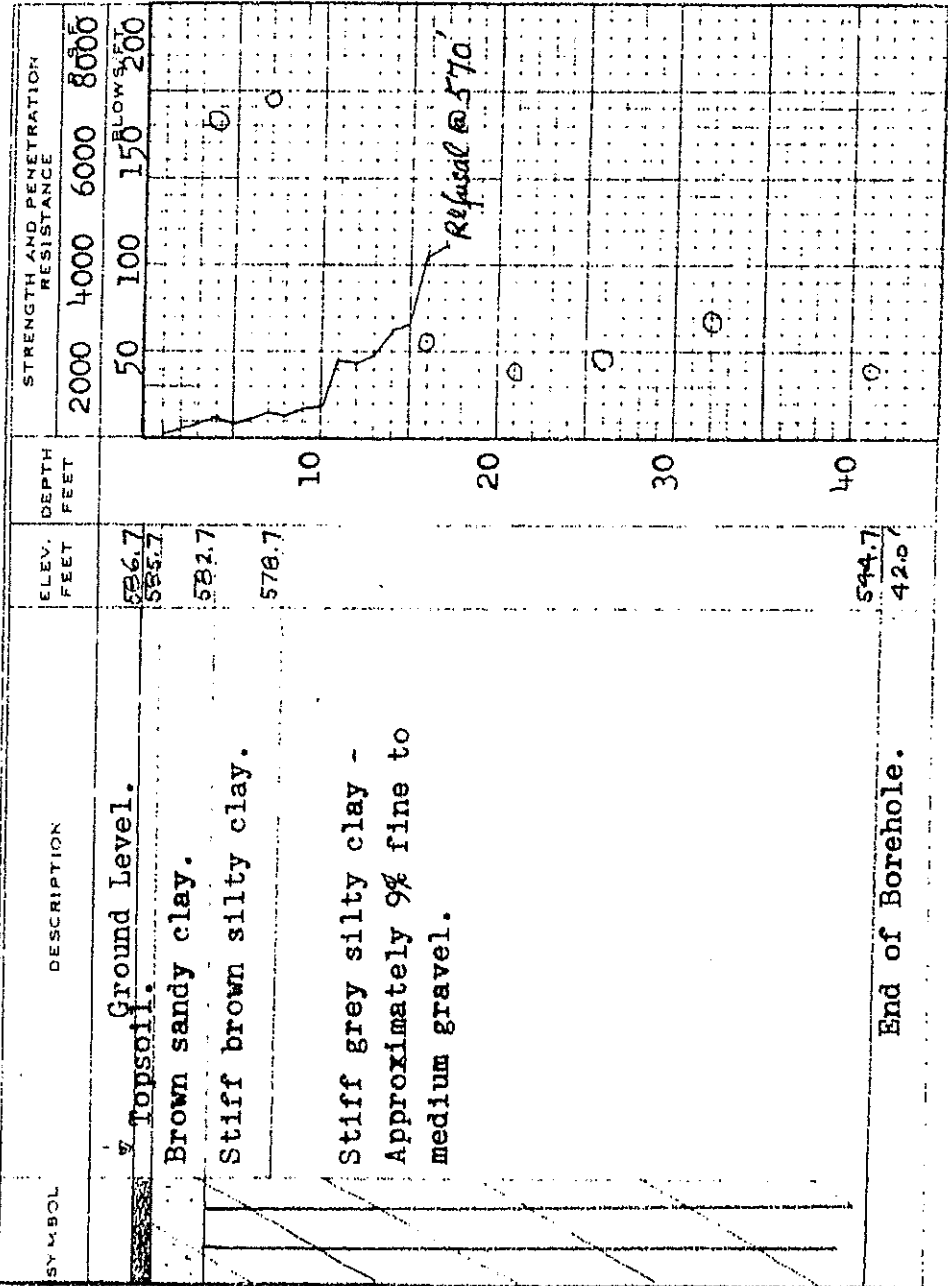


# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 13-59. BORE HOLE NO. 3.  
JOB F 59-14. STATION 192+60 (40' Lt.)  
DATUM Geodetic. COMPILED BY B.K.  
BORING DATE Feb, 14/59. CHECKED BY A.L.

## LEGEND

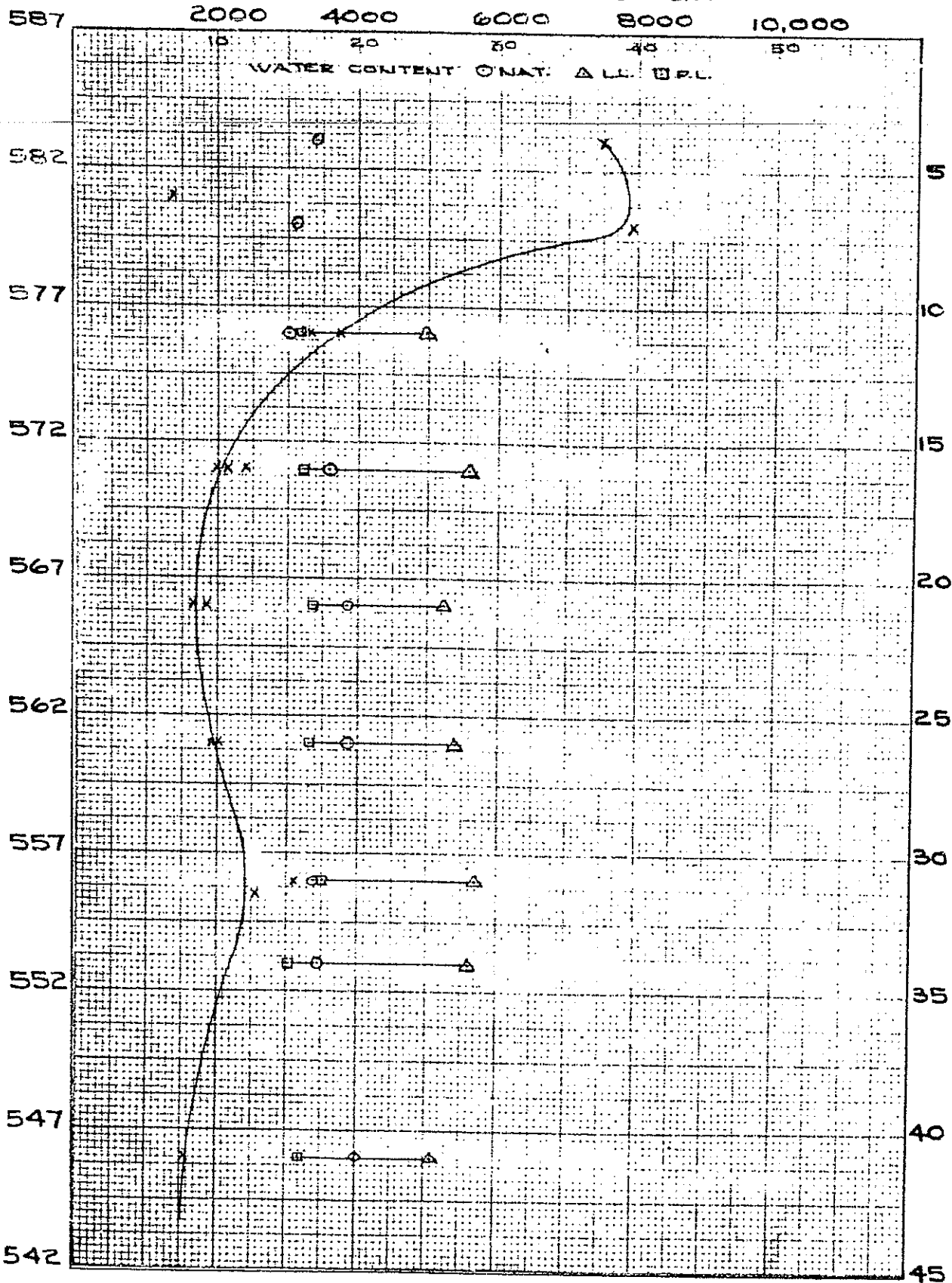
1/2 UNCONFINED COMPRESSION (Qu) --- O  
VANE TEST (C) AND SENSITIVITY (S) --- +  
NATURAL MOISTURE AND LIQUIDITY INDEX --- X  
LIQUID LIMIT --- O  
PLASTIC LIMIT --- O

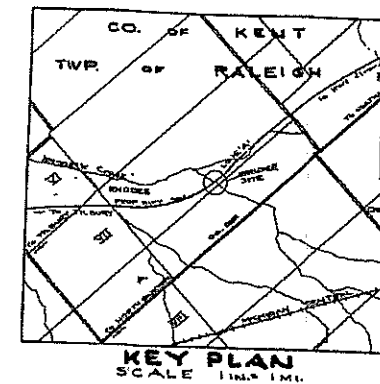
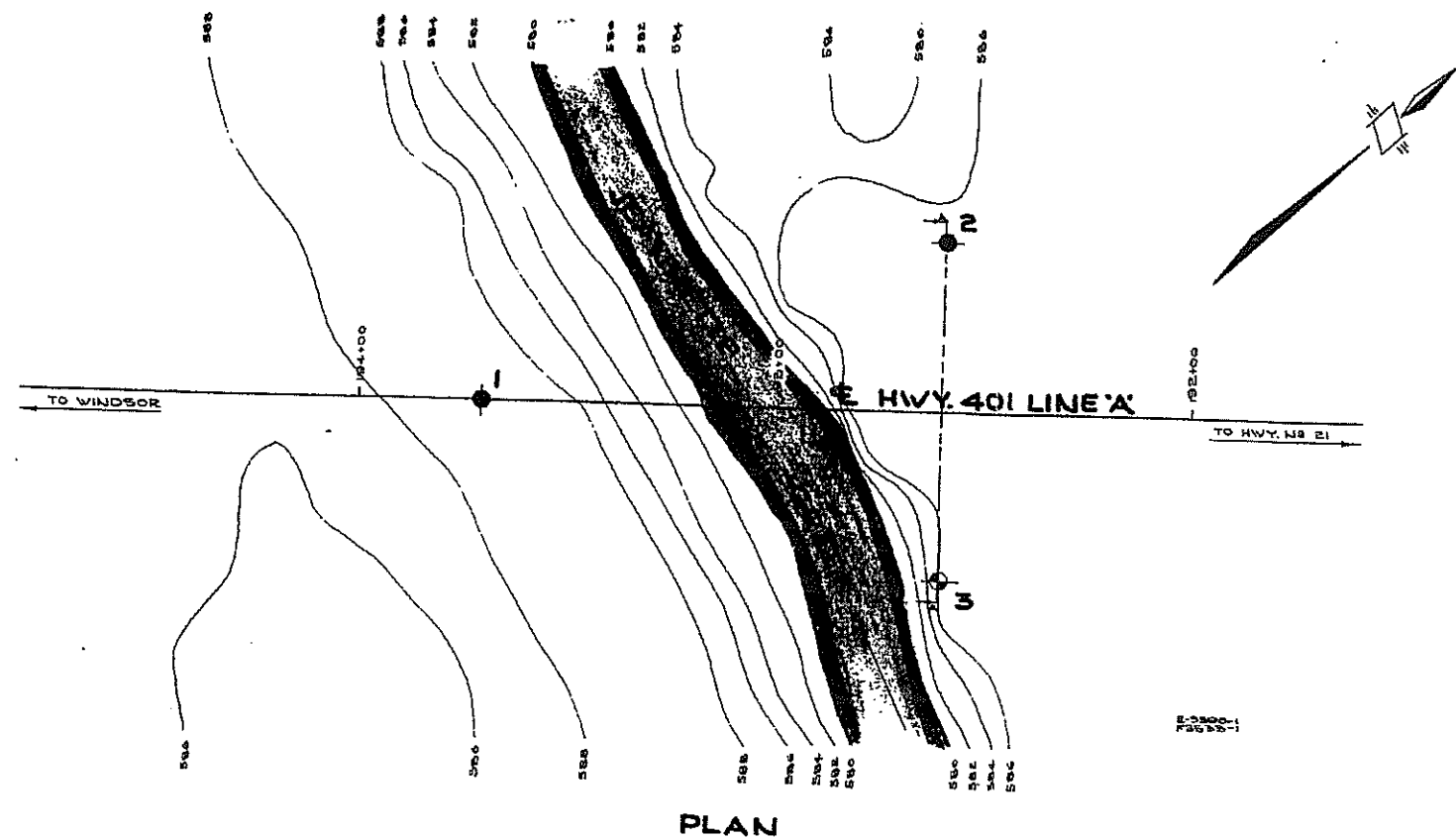


Borehole No. 3

CONSISTENCY	SAMPLE UNIT WT. P.C.F.	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
10 20 30		
X	TW 1	129.0
X	TW 2	133.0
X	TW 3	136.8
X	TW 4	133.3
X	TW 5	124.0
X	TW 6	131.2
X	TW 7	132.0
X	TW 8	129.0

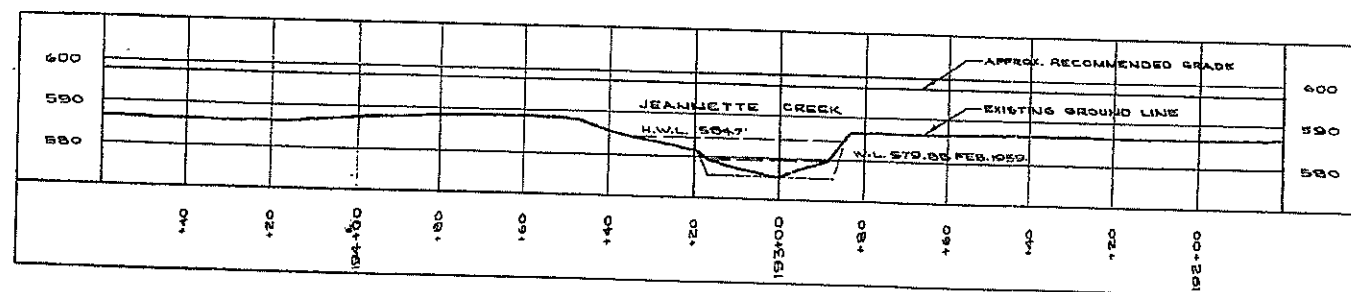
# SHEAR STRENGTH IN P.S.F.



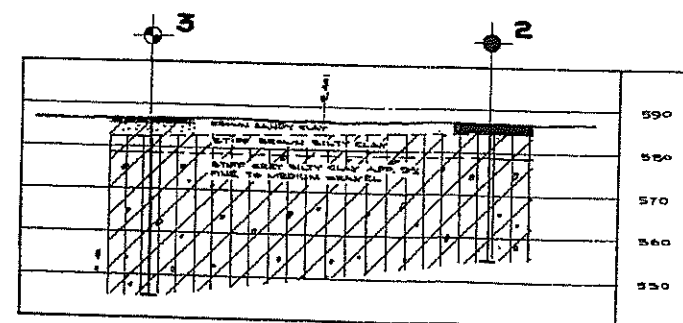
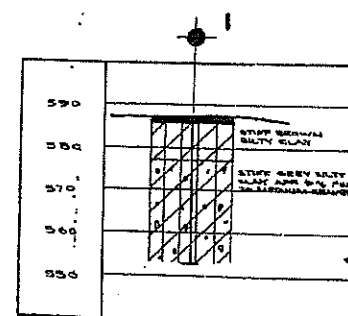


LEGEND			
BORE HOLE			
PENETRATION HOLE			
BORE & PENETRATION HOLE			
HOLE NO.	ELEVATION	STATION	DISTANCE
1	587.70	193+70	42
2	586.70	192+60	40' RT.
3	586.70	192+60	40' LT.

- NOTE -  
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.



PROFILE

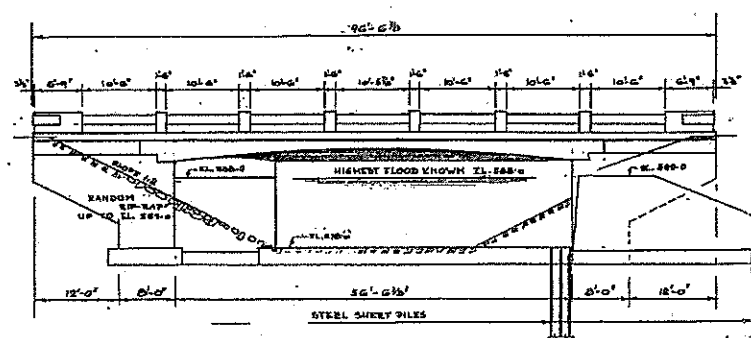
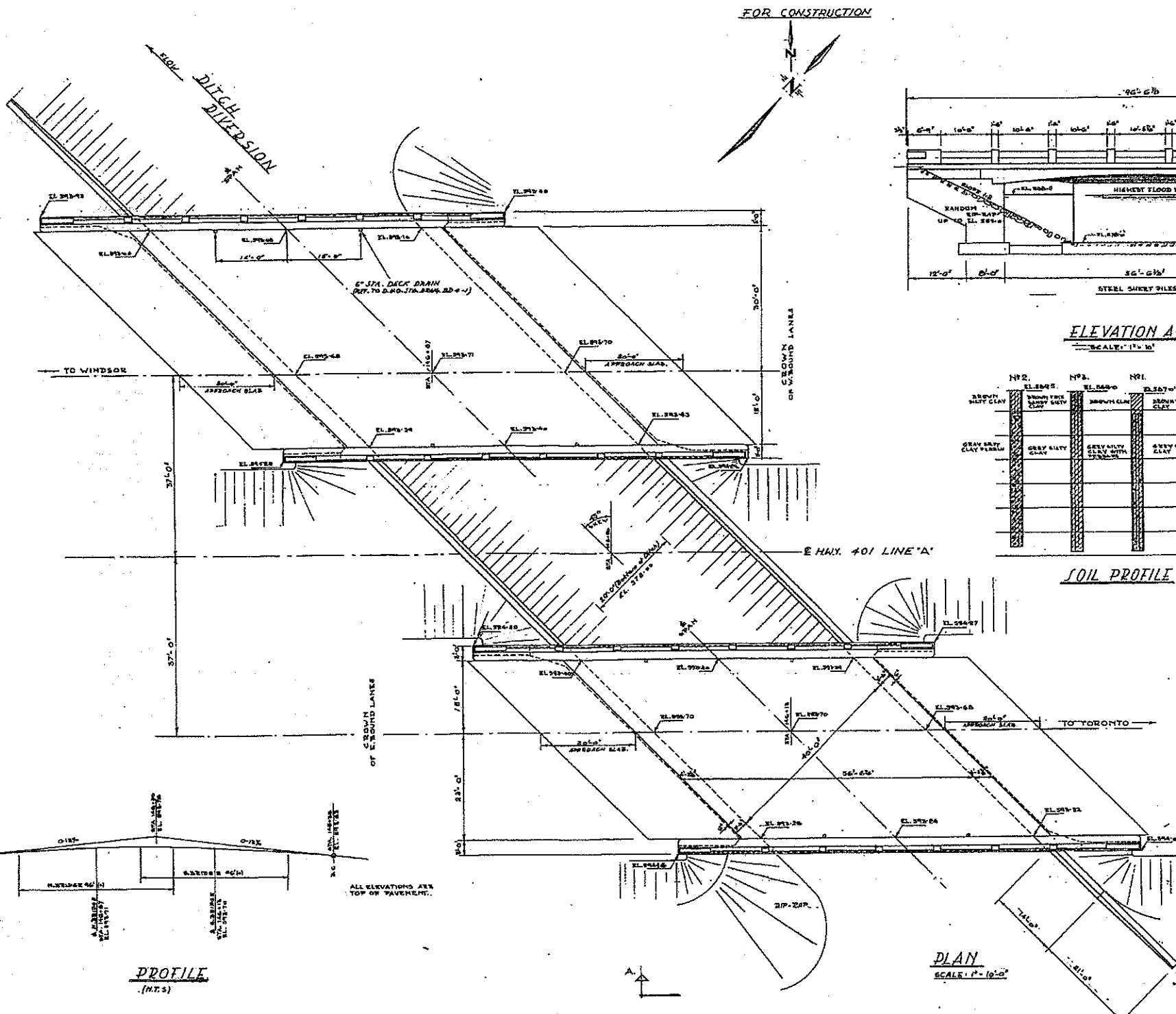


A-A

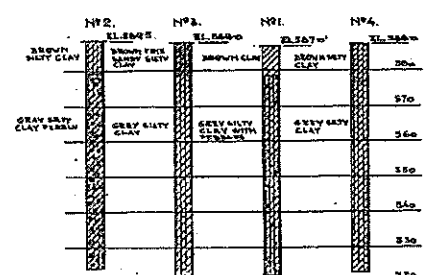
DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS IN RESEARCH SECTION			
DITCH (JEANNETTE CREEK) PROPOSED CROSSING			
SHOWING POSITIONS & ELEVATIONS OF HOLES			
HWY. 401	DISTRICT 1	COUNTY KENT	
TOWNSHIP RALEIGH	LOT 15 & 16	CON. VII	
LOCATION APP. 3/4 MI. S. OF CHATHAM			
DRAWN BY: T. MELLORE	CHECKED BY: [Signature]	W.P. 13-59	
DATE: 6 MAY 1959	APPROVED BY: [Signature]	DRAWING NO.	
SCALE: 1" = 20'		F59-14A	



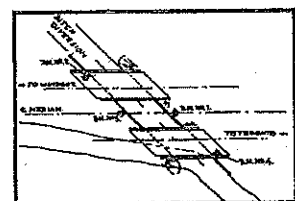
- (14) Contract Drawings for Raleigh Township Bridge No. 6 (Flook & Hinton Drain Bridges), WP 14-59, dated January 8, 1960.



ELEVATION A-A  
SCALE: 1" = 10'



SOIL PROFILE



SITE PLAN

SKEW 45°	
SIN. 45°	0.7071
COS. 45°	0.7071
TAN. 45°	1.0000
SEC. 45°	1.4142

NO.	DATE	REVISION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

PROFILE  
(N.T.S.)

PLAN  
SCALE: 1" = 10'-0"

NOTE TO DISTRICT ENGINEERS.  
CONCRETE WORK ON THIS STRUCTURE MUST NOT BE COMMENCED UNTIL MONUMENTS TO FIX CONTROL POINTS HAVE BEEN ERECTED AND CHECKED BY THE DISTRICT ENGINEER.

NOTE TO CONTRACTOR.  
STRUCTURE TO BE BUILT IN ACCORDANCE WITH FORM NO. 9 AND THE SPECIAL PROVISIONS, EXTRA COPIES OF WHICH MAY BE OBTAINED FROM THE DISTRICT ENGINEER. ALL CONSTRUCTION JOINTS MUST BE APPROVED BY THE DISTRICT ENGINEER.

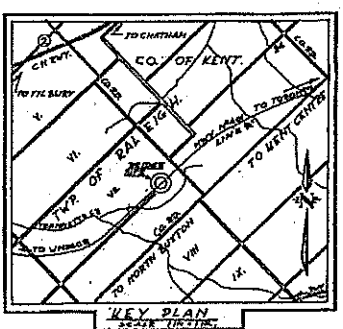
CONCRETE MIX.  
FOOTINGS, 2500 P.S.I. ALL OTHER CONCRETE 3000 P.S.I. AN APPROVED ADMIXTURE SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER. MAXIMUM SIZE AGGREGATE IS 1" IN FOOTING; 3/4" IN STRUCTURE.

BOILING DATA.  
THE COMPLETE SOIL INVESTIGATION REPORT NO. 101 MAY BE EXAMINED AT THE DISTRICT OFFICE, DOWNSVIEW. THE DEPARTMENT DOES NOT GUARANTEE THE ACCURACY OF THIS REPORT OR THE ADDED VERSION SHOWN ON THESE PLANS.

REINFORCING STEEL.  
CLEAR COVER IN FOOTINGS & ABUTMENTS 3"; CURBS 1 1/2"; DECK 2".

CONSTRUCTION NOTES.  
1) ALL EXPOSED EDGES TO BE CHAMFERED 2" UNLESS OTHERWISE NOTED.  
2) BACKFILL BEHIND ABUTMENTS TO BE CARRIED OUT SIMULTANEOUSLY AT BOTH ABUTMENTS OF BRIDGE.  
3) FALSEWORK UNDER WING WALLS NOT TO BE REMOVED UNTIL CURB CONCRETE ATTAINED 0-08K.

LIST OF DRAWING:  
D4376-1 GENERAL PLAN  
D4376-2 FOOTING PLAN & APPROACH SLAB  
D4376-3 FOOTING, RETAIN. WALLS, END POSTS, INTER. POSTS & HANDRAILS REINFORCEMENT.  
D4376-4 RIGID FRAME & WING WALLS.  
D4376-5 STEEL TABLE.  
D4376-6 STEEL TABLE.



KEY PLAN  
SCALE: 1" = 1 MILE

WP: 14-59

DEPARTMENT OF HIGHWAYS-ONTARIO  
BRIDGE OFFICE-TORONTO

RALEIGH TOWNSHIP BRIDGE NO. 6

THE KING'S HIGHWAY No. 401 DIST. No. 1

CO. KENT

TWP. RALEIGH LOT. 16 CON. 14

GENERAL PLAN

APPROVED: *Am. L.*

DESIGNED BY: *Am. L.*

DATE: NOVEMBER, 1919

NO. 103-229-1-A





- (15) Foundation Investigation Report for Jeannette Creek & Highway 401, Line 'A'  
Crossing Raleigh Township Lot 18, Concession 7 (Flook & Hinton Drain Bridges),  
WP 14-59, W.J.F-59-34, Geocres No. 40J8-9.

## SUMMARY OF FIELD & LABORATORY TESTS

108  
F-59-34

W.P. 14-59.

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETN RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	T1	5'-7'	Brown silty clay.	13	27.2	17.5	46.5	835	122.8	
	T2	9'-11'	Grey silty cl. with some sand & pebbles.	15	18.2	16.5	27.6	-	-	
	T3	14'-16'	" " " "	26	20.0	19.4	29.9	1770	131.2	
	T4	19'-21'	" " " "	62	17.5	16.1	24.9	2130	133.8	
	T5	24'-26'	" " " "	44	17.7	-	-	2090	132.4	
	T6	34'-36'	" " " "	58	18.0	15.9	27.5	2180	133.6	
	S7	39'-41'	" " " "	40	16.3	-	-	-	-	Lost.
	T8	44'-46'	" " " "	32	-	-	-	-	-	"
	S9	54'-56'	" " " "	22	-	-	-	-	-	
	Vane	57.5'	" " " "	-	-	-	-	-	-	57.5' Vane (1600 Sens. -
	S10	64'-65.5'	" " " "	-	-	-	-	-	-	" ( 900 1.54
2	T1	4'-6'	Brown silty clay.	6	26.7	17.5	42.7	763	117.8	
	T2	9'-11'	Grey & brown silty clay.	9	27.2	16.7	30.8	974	124.8	
	T3	14'-16'	Grey silty clay with sand & pebbles.	17	22.9	16.2	28.1	735	121.6	
	T4	19'-21'	" " " "	43	18.8	13.1	26.1	1610	132.7	
	T5	29'-31'	" " " "	58	17.9	16.0	27.4	1885	126.3	
	T6	39'-41'	" " " "	26	19.8	15.8	26.2	1065	129.3	
	S7	49'-50.5'	" " " "	13	20.2	-	-	-	-	
	S8	59'-60.5'	" " " "	22	-	-	-	-	-	
	Vane	7.5'	" " " "	-	-	-	-	1840	-	Sens: 3.84
		12.5'	" " " "	-	-	-	-	1920	-	2.67

cont'd. /2 ...

cont'd. 12

TABLE NO. I.

Page - 2 -

 JOB F-59-34  
 W.P. 14-59.

## SUMMARY OF FIELD &amp; LABORATORY TESTS

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
3	T1	4'-6'	Brown, sandy, clayey silt.	18	12.2	17.5	34.0	-	133.7	
	T2	9'-11'	Brown & grey silty clay with sand & pebbles.	50	17.0	-	-	5960	130.8	
	T3	14'-16'	Grey silty clay with sand & pebbles.	33	16.5	15.3	26.8	4770	131.3	
	T4	19'-21'	" " " "	33	16.3	15.6	25.5	3110	128.4	
	T5	29'-31'	" " " "	38	17.2	14.7	26.1	1820	132.5	
	T6	39'-41'	" " " "	41	19.2	15.9	25.5	1040	131.5	
4	T1	4'-6'	Brown, sandy, silty clay.	12	20.3	15.5	35.8	1800	124.5	
	T2	9'-11'	" " " "	13	29.9	21.5	56.1	645	121.2	
	T3	14'-16'	Grey silty clay with sand & pebbles.	33	10.8 17.5	15.4	25.8	1815	131.2	Clay sand Clay
	T4	19'-21'	" " " "	38	17.0	15.5	27.2	2460	134.0	
	T5	29'-31'	" " " "	54	15.8	15.5	26.0	2650	133.7	
	T6	39'-41'	" " " "	57	17.8	15.8	25.0	2930	133.4	

T1 Denotes Shelby Tube Sample.

S1 Denotes Split Spoon Sample.

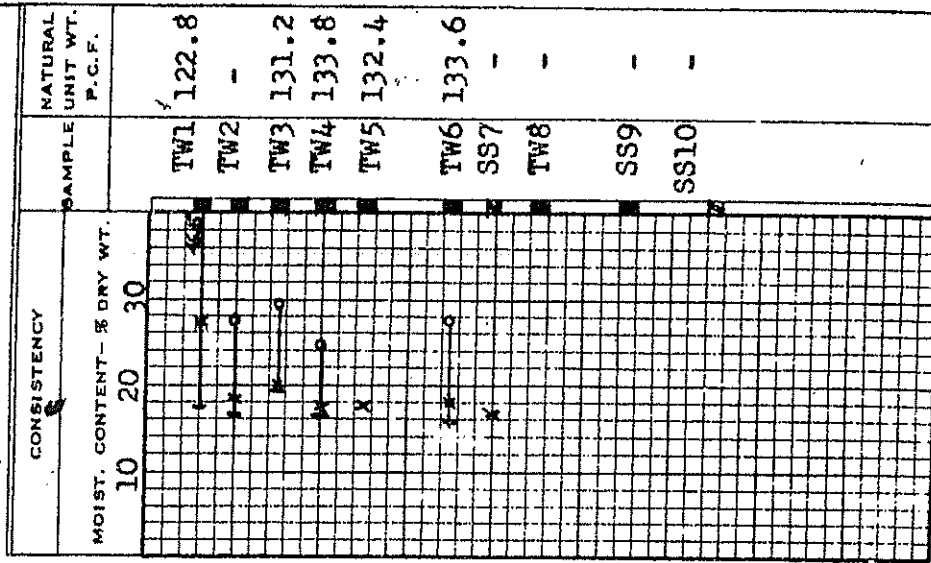
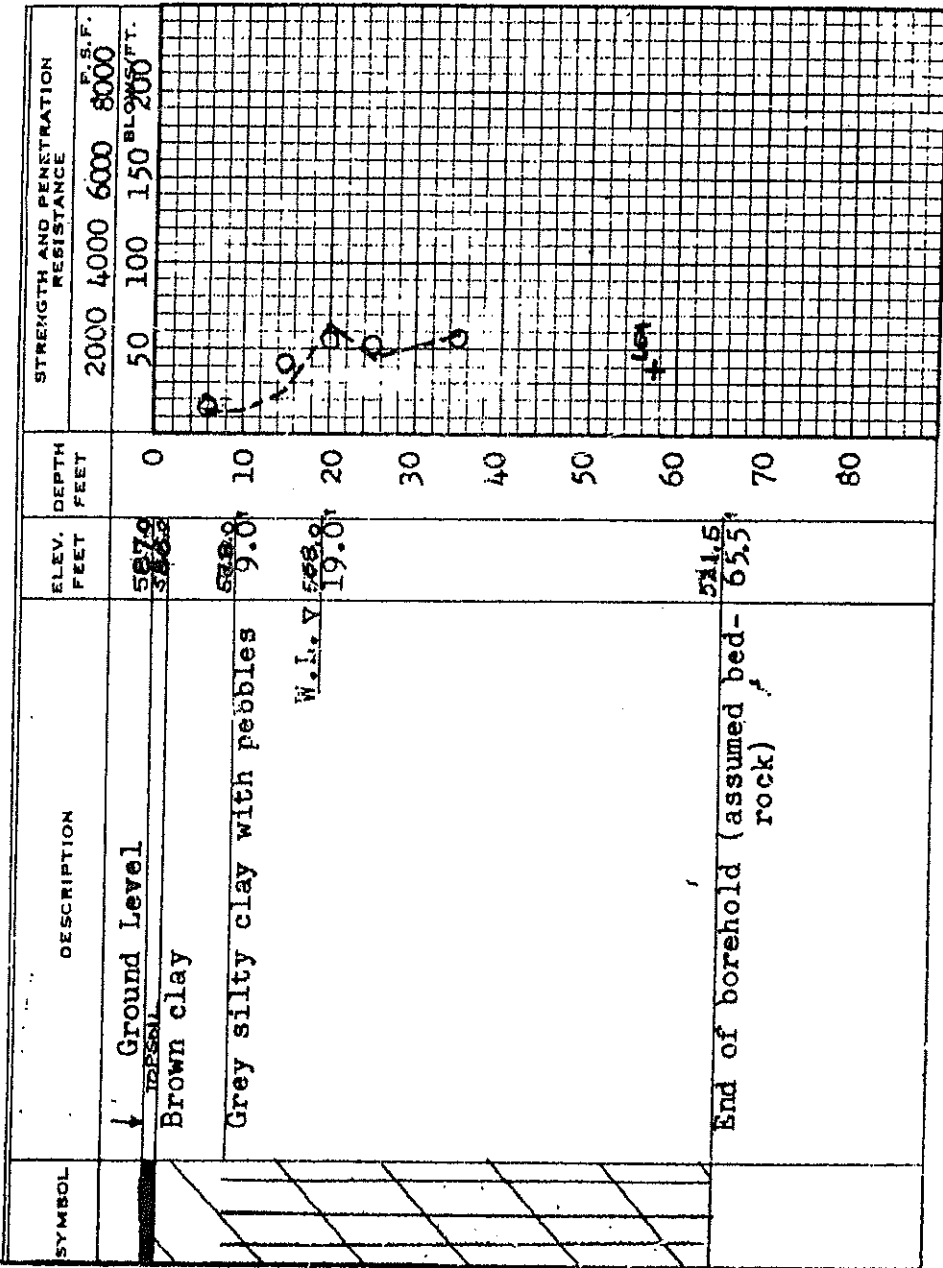
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 14-59 BORE HOLE NO. 1  
JOB F 59-34 STATION 146+10 C.L.  
DATUM Geodetic COMPILED BY B.K.  
BORING DATE Apr. 27/59 CHECKED BY V.K.

LEGEND

2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
2" SHELBY  
CASING

1/2 UNCONFINED COMPRESSION (Qu)  
VANE TEST (C) AND SENSITIVITY (S)  
NATURAL MOISTURE AND LIQUIDITY INDEX  
LIQUID LIMIT  
PLASTIC LIMIT



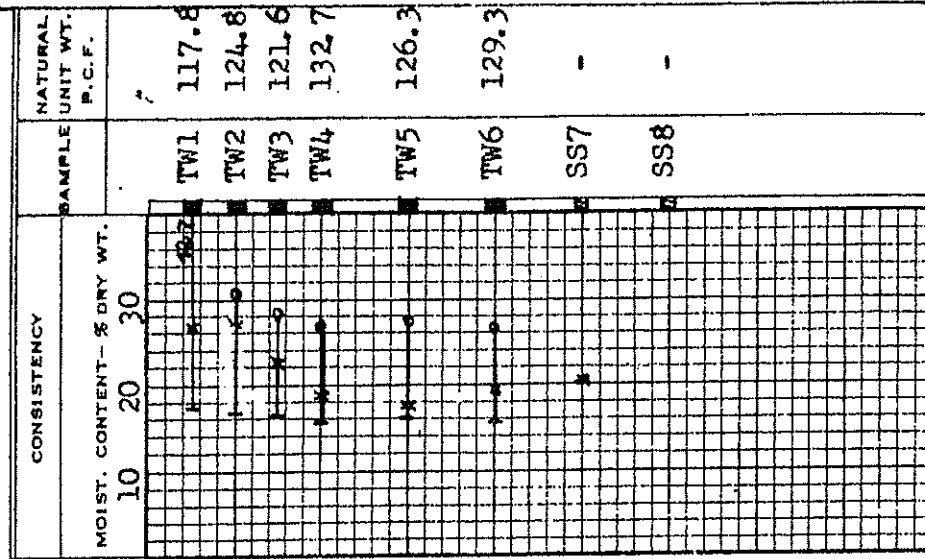
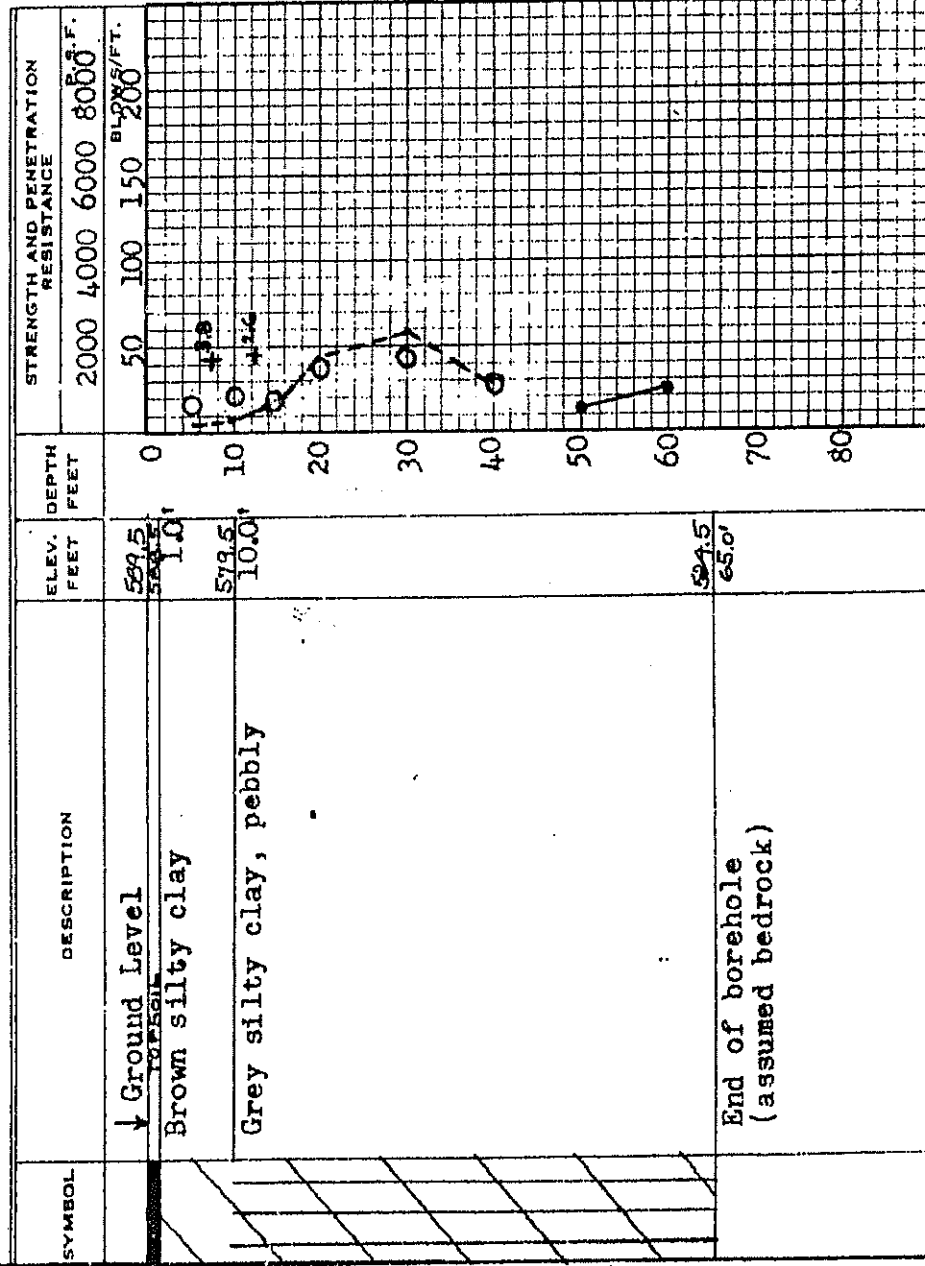
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 14-59 BORE HOLE NO. 2  
 JOB F 59-34 STATION 147+40 (70ft. R.L.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Apr. 22/59 CHECKED BY V.K.

## LEGEND

1/2 UNCONFINED COMPRESSION (Qu) — O  
 VANE TEST (C) AND SENSITIVITY (S) — +  
 NATURAL MOISTURE AND LIQUIDITY INDEX — LI  
 LIQUID LIMIT — X  
 PLASTIC LIMIT — X

2" DIA. SPLIT TUBE —  
 2" SHELBY TUBE —  
 2" SPLIT TUBE —  
 2" DIA. CONE —  
 2" SHELBY —  
 CASING — X





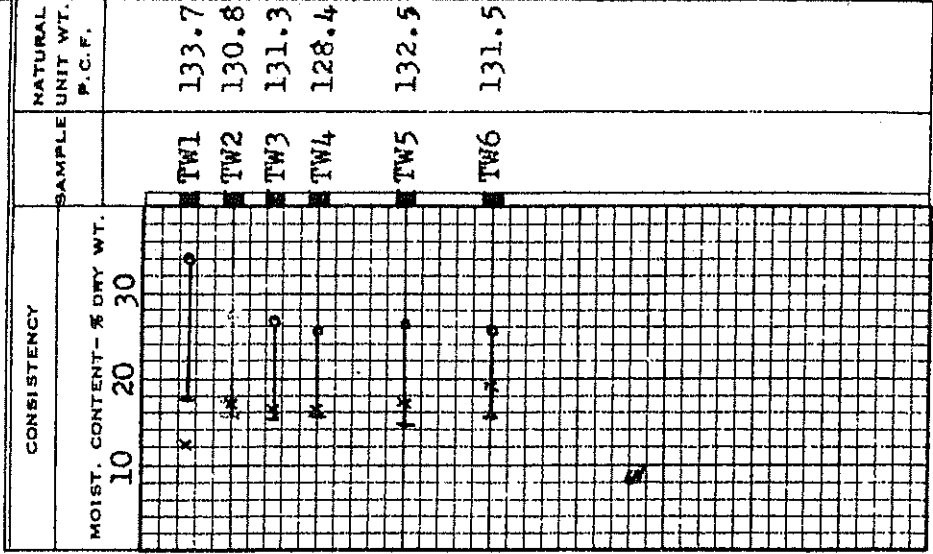
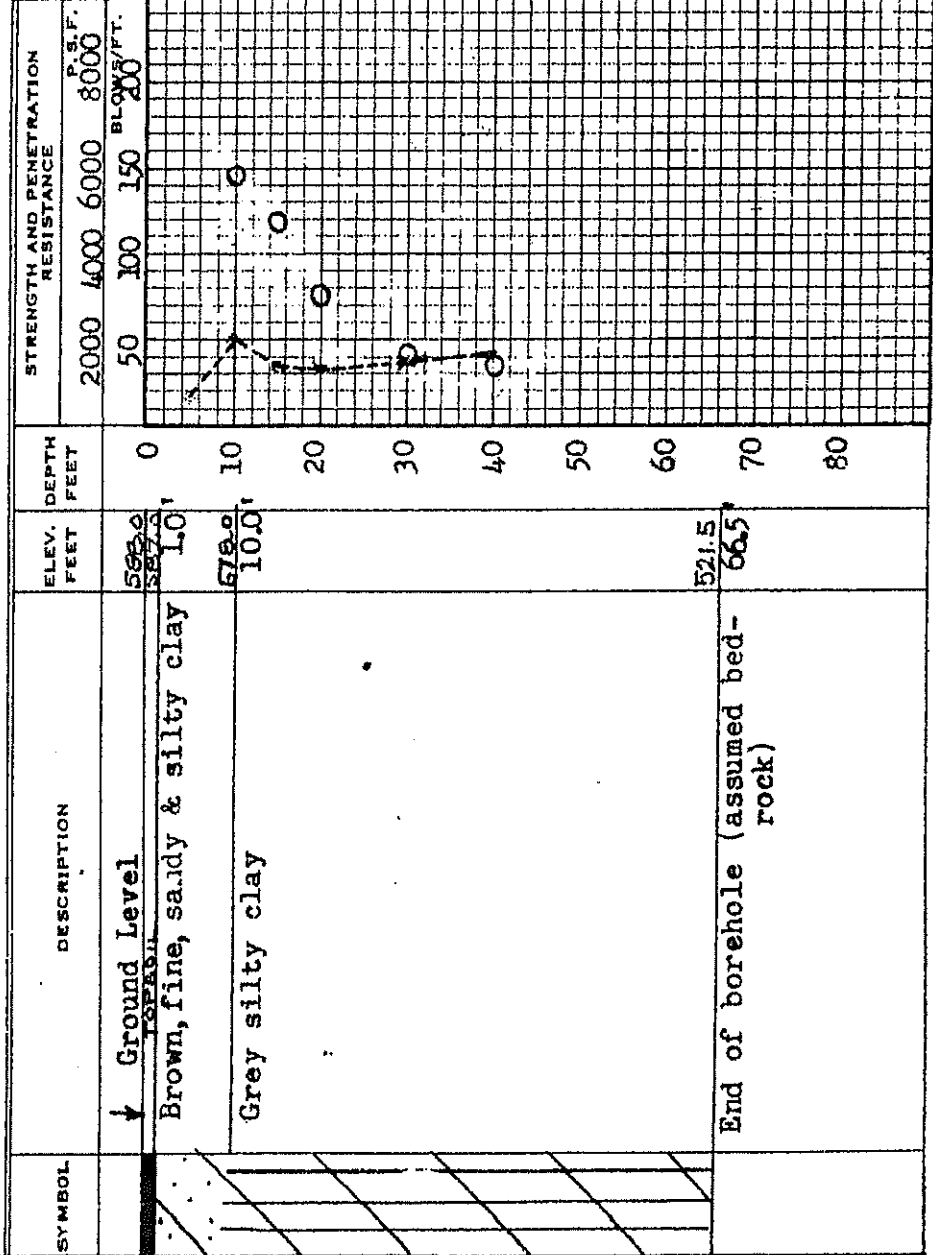
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 14-59 BORE HOLE NO. 3  
 JOB F-59-34 STATION 146+85 C.  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Apr. 29/59. CHECKED BY V.K.

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 2" SHELBY  
 CASING

## LEGEND

1/2 UNCONFINED COMPRESSION (Qu) O  
 VANE TEST(C) AND SENSITIVITY(S) +  
 NATURAL MOISTURE AND LIQUIDITY INDEX LI  
 LIQUID LIMIT X  
 PLASTIC LIMIT



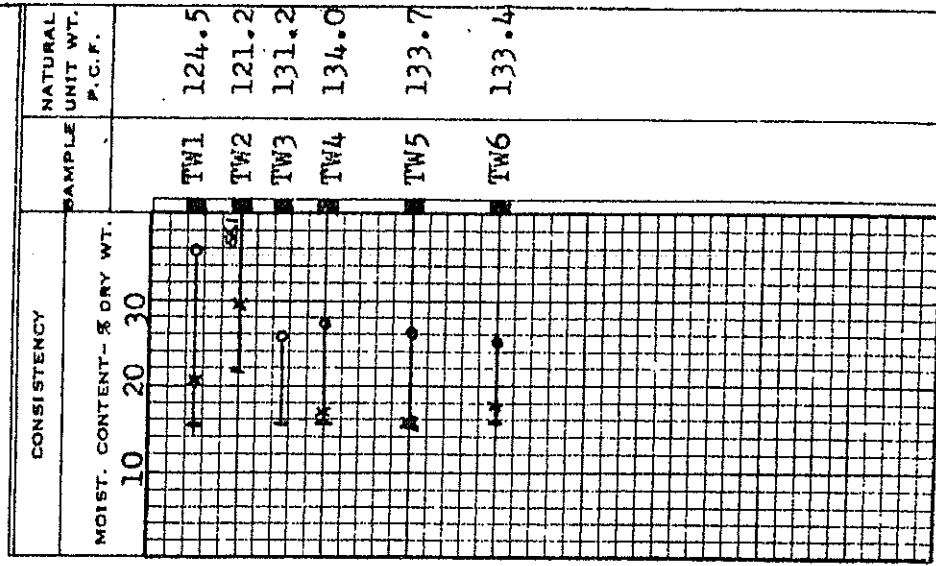
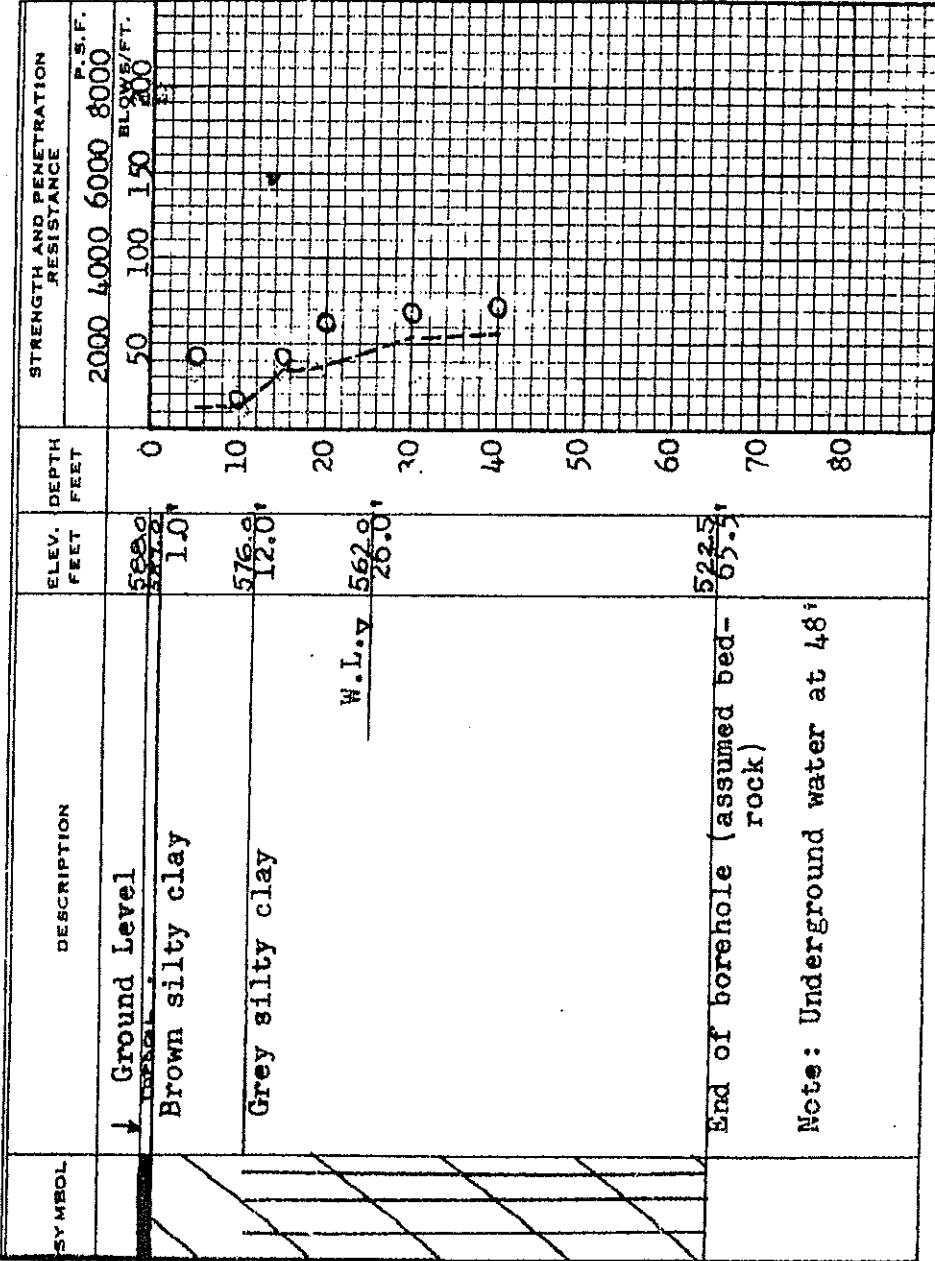
# DEPARTMENT OF HIGHWAYS - ONTARIO

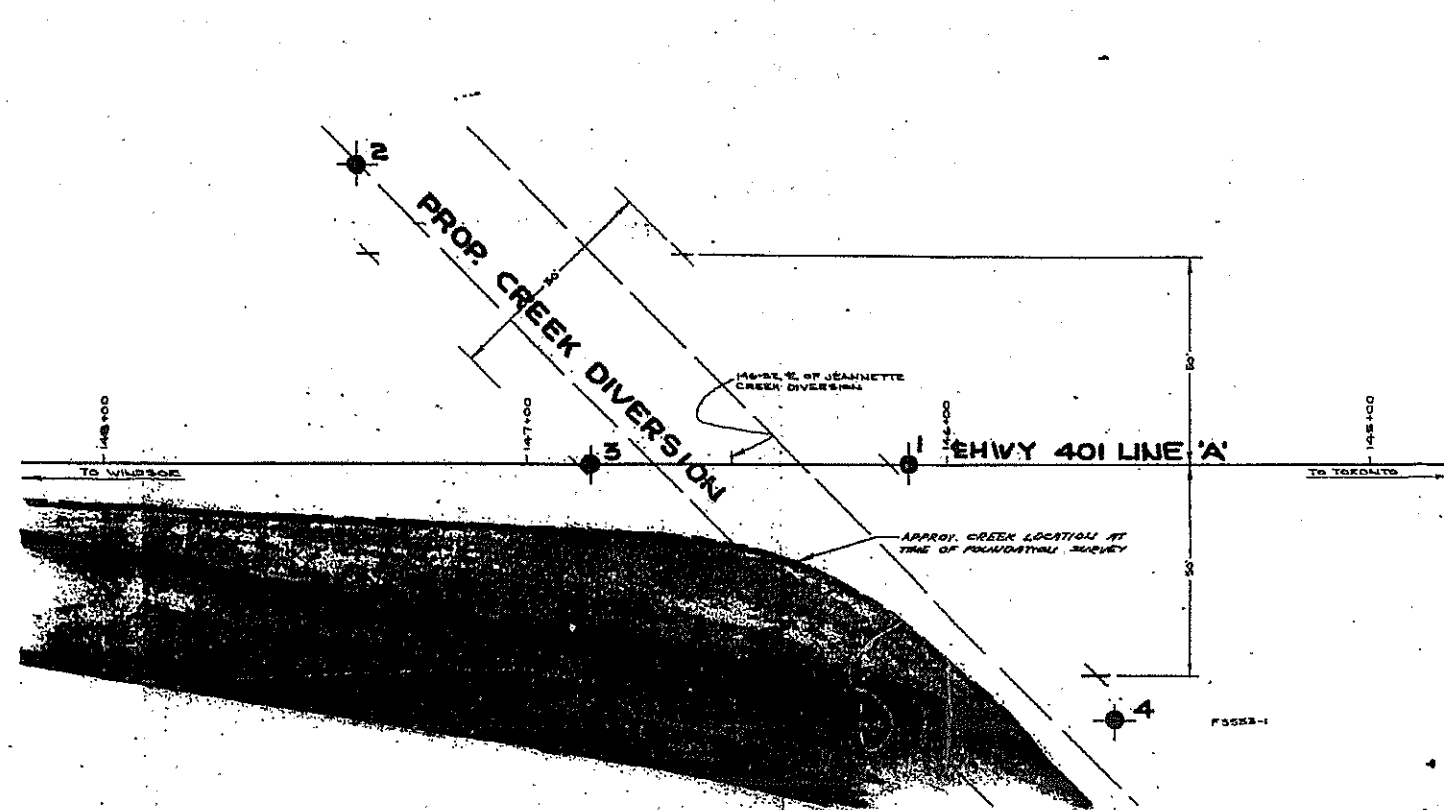
## MATERIALS AND RESEARCH SECTION

W.P. 14-59 BORE HOLE NO. 4  
 JOB F-59-24 STATION 145+60 (60ft. L.)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Apr. 30/59. CHECKED BY V.K.

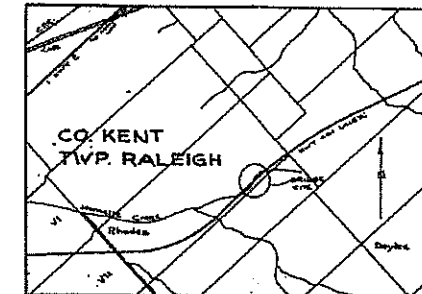
### LEGEND

1/2 UNCONFINED COMPRESSION ( $Q_u$ ) — ○  
 VANE TEST (C) AND SENSITIVITY (S) — +  
 NATURAL MOISTURE AND LIQUIDITY INDEX — LI  
 LIQUID LIMIT — X  
 PLASTIC LIMIT — —





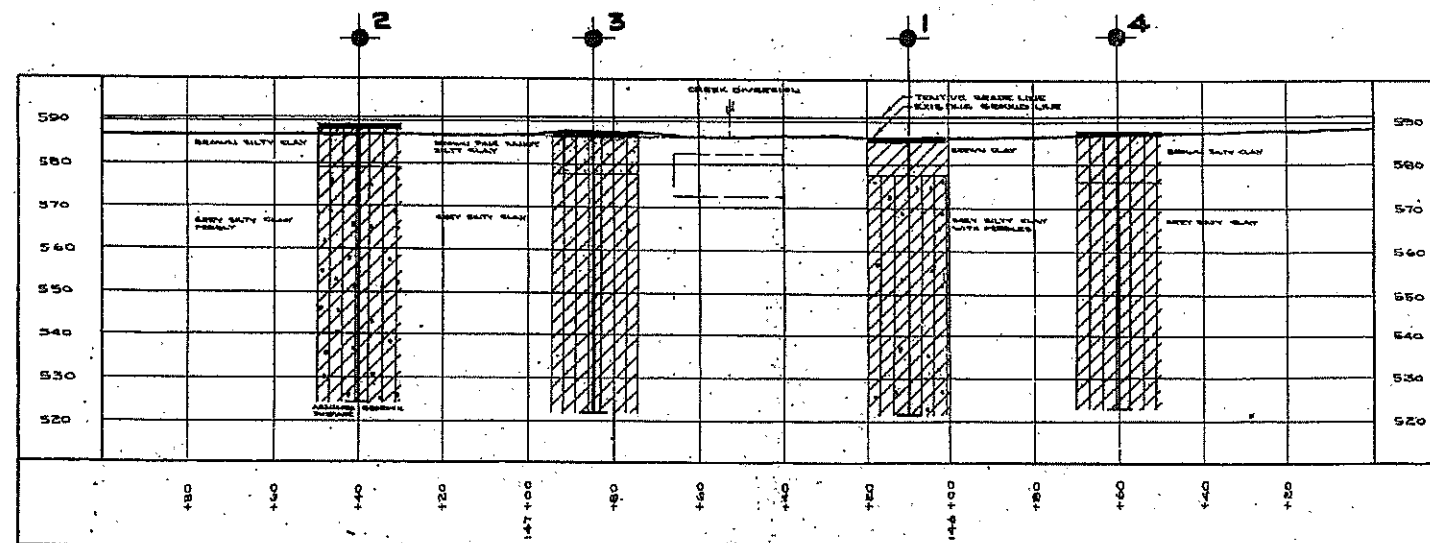
PLAN



KEY PLAN  
SCALE 1/4" = 1 MI.

LEGEND			
BORE HOLE			
PENETRATION HOLE			
BORE & PENETRATION HOLE			
HOLE NO.	ELEVATION	STATION	DISTANCE FROM E.
1	557.0'	146+10	7'
2	559.5'	147+40	70' RT.
3	558.0'	146+55	7'
4	558.0'	145+40	60' LT.

**- NOTE -**  
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.



PROFILE

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**JEANNETTE CREEK DIVERSION  
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 DISTRICT 1 COUNTY KENT  
TOWNSHIP, RALEIGH LOT 15 CON. VII  
LOCATION 1/2 MI. S. OF CHATWAIN

DRAWN BY: T. MELLOREY CHECKED BY: W.P. H-59  
DATE: 23 MAY 58 APPROVED BY: DRAWING NO.  
SCALE: 1/4" = 1 MI. F-59-34A



- (16) Contract Drawings for Bloomfield Road Interchange Underpass, WP 297-59, dated October/November 1960.







- (17) Foundation Investigation Report for proposed underpass structure of Highway 401 at County Road 27 (Bloomfield Road Underpass), Project No. J419 prepared by William A. Trow & Associates Ltd., WP 297-59, dated October 2, 1959, Geocres No. 40J8-19.

Table 1

SUMMARY OF LABORATORY AND FIELD TEST RESULTS

Hole No.	Sample Depth Ft.	Description	Field Vane psf	Shear Strength Undrained Triaxial psf*	Natural Moisture % dry wt.	Atterberg Limits PL LL	Natural Unit Weight pcf
1	7	Beyond vane capacity.	2100+				
2	6-8	Grey silty clay with 5" med. sand seam noted from 6'11". Many 1/8" fine sand seams irregularly spaced.		1320 unconfined	24.6	17.2 33.4	120
	10		882				
3	10-12	Grey silty clay with silt pockets and occasional gravel sizes.		370 unconfined	29.0	17.1 34.2	122
4	13		588				
	13-14½	Grey silty clay, much fine to coarse gravel from 13½ ft.		1080	28.7	18.1 38.3	134
	16½		1050				
5	17-18½	Grey silty clay with some fine to med. gravel sizes, little fine sand.		900	21.6		131
	19½		1008				
6	20-21½	Grey silty clay, sandy with sand and gravel sizes.		1650	18.0	18.6 31.0	131
	22	Beyond vane capacity.	2100+				
7	24-25½	Grey clayey silt with some sand and fine subangular gravel.		1670	17.9		131
8	28-29½	Grey silty clay with many fine to coarse gravel pieces.		2500	17.5	16.3 30.8	134

Table 1

SUMMARY OF LABORATORY AND FIELD TEST RESULTS cont'd.

Hole No.	Sample No.	Depth Ft.	Description	Field Vane psf	Shear Strength Undrained Triaxial psf*	Natural Moisture % dry wt.	Atterberg Limits PL LL	Natural Unit Weight pcf
2	9	1/3	Could not insert vane.	2100+				
		10 1/2		1090				
	13	1/3		847				
4	13-14 1/2		Grey silty clay, alternating layers of silt and clay approx. 1/32 to 1/16 inch thick.		750	32.5		118
	15 1/2			673				
	16			630				
5	18-19 1/2		Grey silty clay containing many fine to med. gravel sizes, some silt and fine sand.		too gravelly for test	17.8		
	19 1/2			1092				
	20 1/2			1010				
6	22-23 1/2		Grey silty clay, some sand and fine to med. gravel, clay seams noted from 22 1/2 to 23 ft., hair-line sand seam at 23 1/2 ft.		2025	16.0		133
	25		Beyond vane capacity.	2100+				
3	9		Beyond vane capacity.	2100+				
	10 1/2			1010				
	12			756				
4	13-14 1/2		Grey silty clay with occasional sand partings and lenses.		435	49.5	21.4 51.9	110
	15			462				
	15 1/2			630				
	18		Beyond vane capacity.	2100+				

SUMMARY OF LABORATORY AND FIELD TEST RESULTS cont'd.

Hole No.	Sample No.	Depth Ft.	Description	Shear Strength		Natural Moisture % dry Wt.	Atterberg Limits		Natural Unit Weight pcf
				Field Vane psf	Undrained Triaxial psf*		PL	LL	
3	5	18-19½	Grey silty clay containing sand and gravel sizes, middle 6" of sample grey clay.		1530	18.6			130
		20½	Beyond vane capacity.	2100+					
		21	Beyond Vane capacity.	2100+					
6		22-23½	Grey clayey silt with some sand and fine gravel.		1630	17.7			134
		25	Beyond vane capacity.	2100+					
7		28-29½	Grey silty clay containing many fine to coarse gravel sizes and little fine sand.		2200	18.0			132
4			Could not insert vane.	2100+					
		7½		882					
		8		840					
3		8-9½	Grey clayey silt and clay. Clay is in layers inclined at irregular intervals, slightly lensed with fine sand.		580	36.6			119
		10½		462					
		11		504					
4		13-14½	Grey slightly sandy silty clay containing occasional coarse sand sizes particularly below 14 feet.		550	26.6			123
		14		966					
		15½	Beyond vane capacity.	2100+					

Table 1

## SUMMARY OF LABORATORY AND FIELD TEST RESULTS cont'd.

Hole No.	Sample No.	Depth Ft.	Description	Field Vane psf	Shear Strength Undrained Triaxial psf*	Natural Moisture % dry wt.	Atterberg Limits PL IL	Natural Unit Weight pcf
4		17		1764				
		20	Beyond vane capacity.	2100+				
6		22-23½	Grey clayey silt with sand and fine to med. gravel.		2240	17.9		133
		25	Beyond vane capacity.	2100+				
7		55-56½	55-55.2' Hard grey clayey silt with small sand pockets, some fine gravel. -55.7' Dense grey fine sand. -56.0' Very stiff grey clayey silt with some sand and fine to medium gravel.		no test	15.9		136
9		15½		1428				
		19		2100				
		24½	Beyond vane capacity.	2100+				
4		22-23½	Grey silty clay with gravel sizes. Occasional sand pockets.		1430	18.8		132
		25	Beyond vane capacity.	2100+				
10		3½	Could not insert vane.					
		7	Beyond vane capacity.	2100+				
		10		861				
		13		1008				
		16½		924				
		19½		672				



Table 1

SUMMARY OF LABORATORY AND FIELD TEST RESULTS cont'd.

Hole No.	Sample No.	Depth Ft.	Description	Shear Strength Field Vane psf	Undrained Triaxial psf*	Natural Moisture % dry wt.	Atterberg Limits PL LL	Natural Unit Weight pcf
10		22½		1057				
		25	Beyond vane capacity.	2100+				
11		3½	Could not insert vane.					
		6	Could not insert vane.					
		9½	Could not insert vane.					
		13	Beyond vane capacity.	2100+				
		16		1344				
		19 1/3	Beyond vane capacity.	2100+				

Legend

\* Tested at overburden pressure.

PL = Plastic Limit.

LL = Liquid Limit.

PROJECT NO. J419

DRAWING NO. 4

## WILLIAM A. TROW &amp; ASSOCIATES LTD.

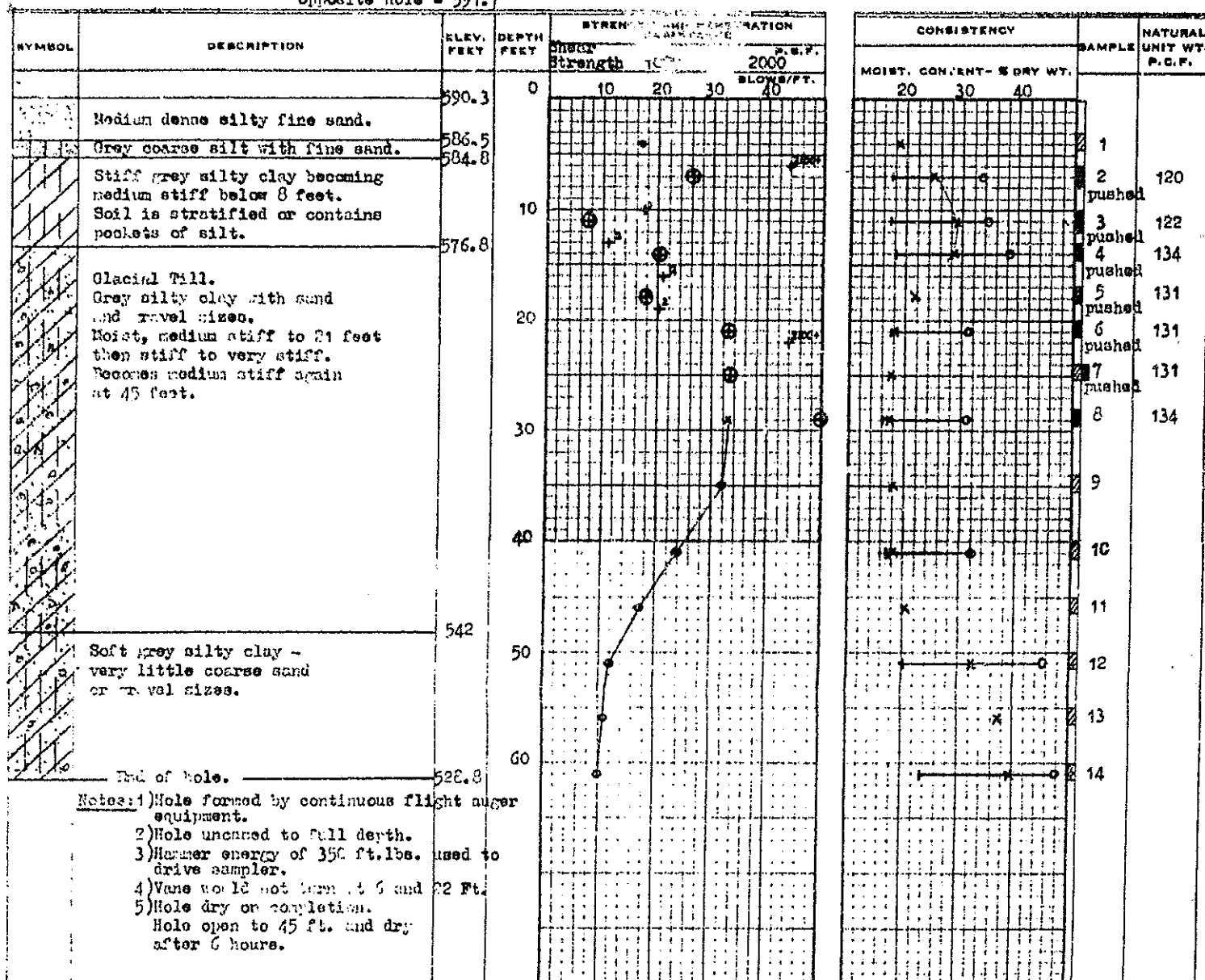
SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Highway 401 Underpass W.P. 297-59  
 LOCATION Blenheim Road SW of Chatham  
 HOLE LOCATION See dwg. No. 1  
 HOLE ELEVATION AND DATUM 590.3 C.L. of Road  
 opposite hole = 591.7

BORERHOLE NO. 1  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

## LEGEND

1" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 CASING  
 2" SHELBY  
 1/2 UNCONFINED COMPRESSION (Qu)  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT



PROJECT NO. 3419

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTING

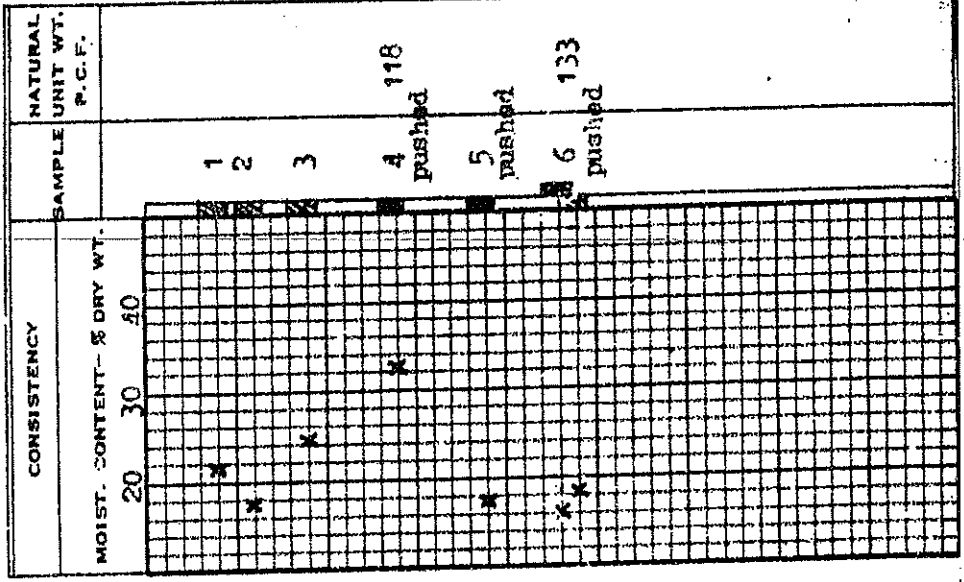
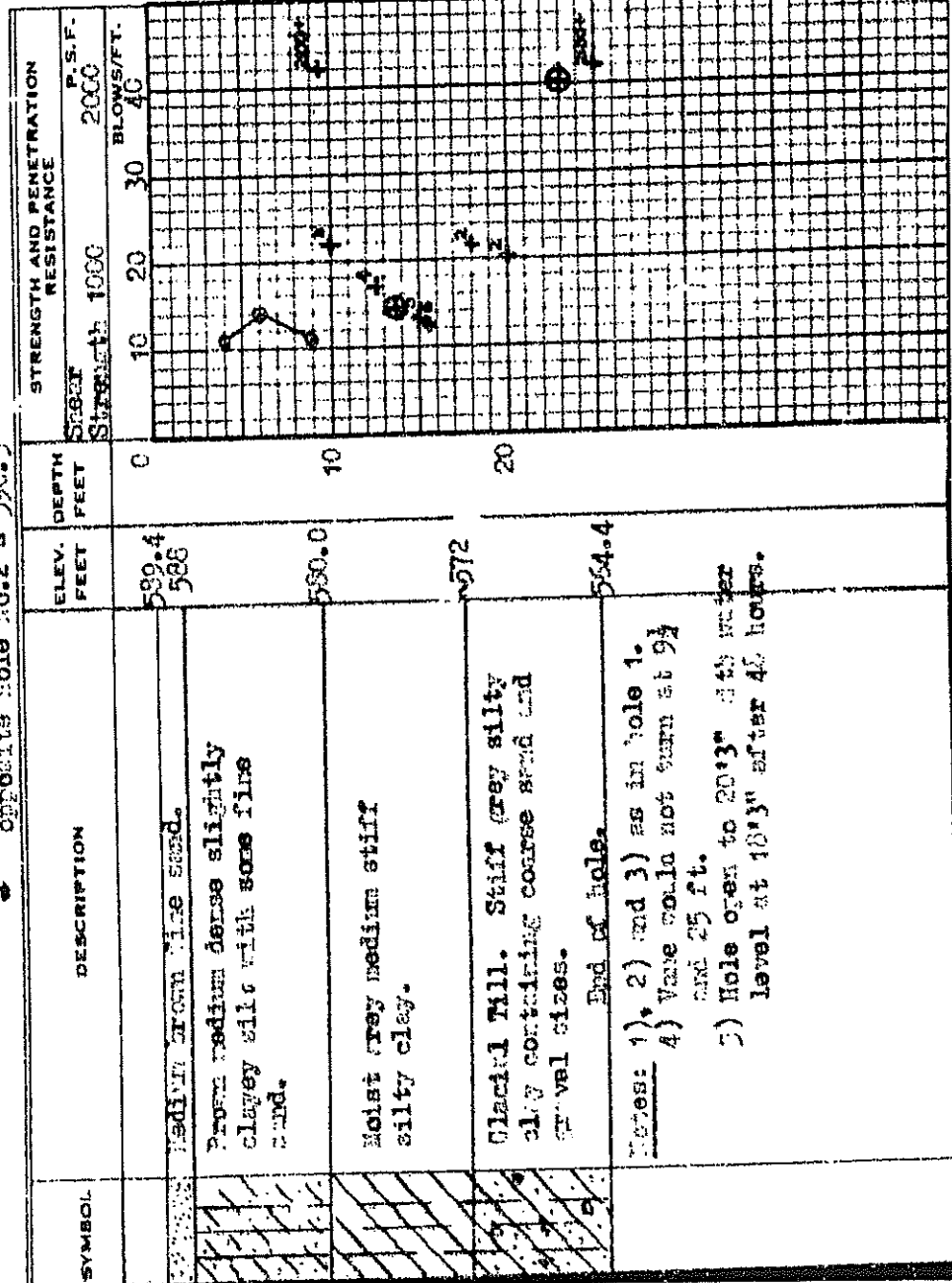
PROJECT Highway 401 Underpass W.P. 297-55  
 LOCATION Bloemfontein Road SW of Orlam  
 HOLE LOCATION See dwg. No. 1  
 HOLE ELEVATION AND DATUM 589.4 C.L. of Road  
 opposite hole No. 2 = 590.5

BOREHOLE NO. 2  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

DRAWING NO. 2

LEGEND

- 2" DIA. SPLIT TUBE
- 2" S. SPLY TUBE
- 2" SPLY TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT



PROJECT NO. J419

## WILLIAM A. TROW &amp; ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Highway 401 Underpass W.P. 297-59  
 LOCATION Bloomfield Rd. & SW of Chatham  
 HOLE LOCATION See drg. No. 1  
 HOLE ELEVATION AND DATUM 588.9 C.I. of Road  
 opposite hole = 590.5

BORERHOLE NO. 3  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

DRAWING NO.

## LEGEND

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 CASING  
 2" SHELBY  
 1/2 UNCONFINED COMPRESSION (QU)  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				SEGT Strength	1000	2000	P.S.F. BLOWS/FT.
		588.9	0		10	20	30
	Medium brown silty sand.	585.9					
	Very dry dense brown silt containing pockets of fine sand. 6" seam of clay noted at 8 ft.	580	10				
	Medium stiff grey silty clay - few thin sand lenses noted.	571	20				
	Glacial Till. Stiff to very stiff grey silt-clay containing sand to coarse gravel sizes. Medium stiff some noted at 40 ft. Thin sand partings noted from 40 to 45 ft. Material is medium stiff below 55 feet.		30				
			40				
			50				
			60				
	End of hole.	527.4					
Notes: 1), 2) & 3) as in hole 1.							
4) Vane would not turn at 10, 20 and 25 feet.							
5) Hole open to 59 1/2 ft. and dry after 48 hours.							

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
20	30	40		
			1	
*			2	
*			3	
	*			
		*		
			4	110
			pushed	
	*		5	130
			pushed	
*			6	134
			pushed	
*			7	132
			pushed	
*			8	
*			9	
*			10	
*			11	
*			12	
		*	13	

PROJECT NO. J419

## WILLIAM A. TROW &amp; ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

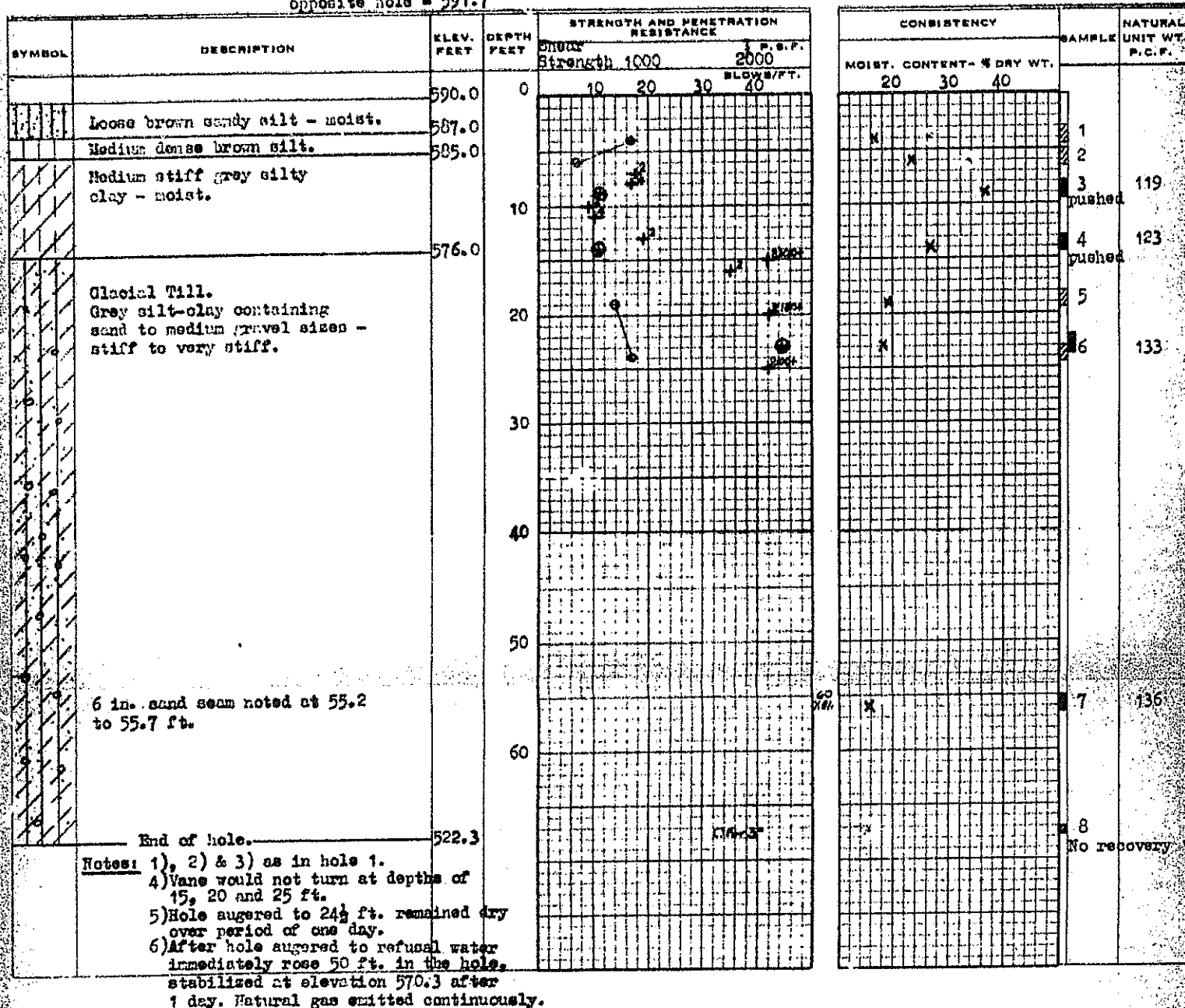
PROJECT Highway 401 Underpass W.P. 297-59  
 LOCATION Bloomsfield Road SW of Chatham  
 HOLE LOCATION See Aug. No. 1  
 HOLE ELEVATION AND DATUM 590.0 C.L. of Road  
 opposite hole = 591.7

BOREHOLE NO. 4  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

DRAWING NO. 7

## LEGEND

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 CARING  
 2" SHELBY  
 1/2 UNCONFINED COMPRESSION (Qu)  
 VANE TEST (C) AND SENSITIVITY (Si)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT





PROJECT NO. J419

## WILLIAM A. TROW &amp; ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

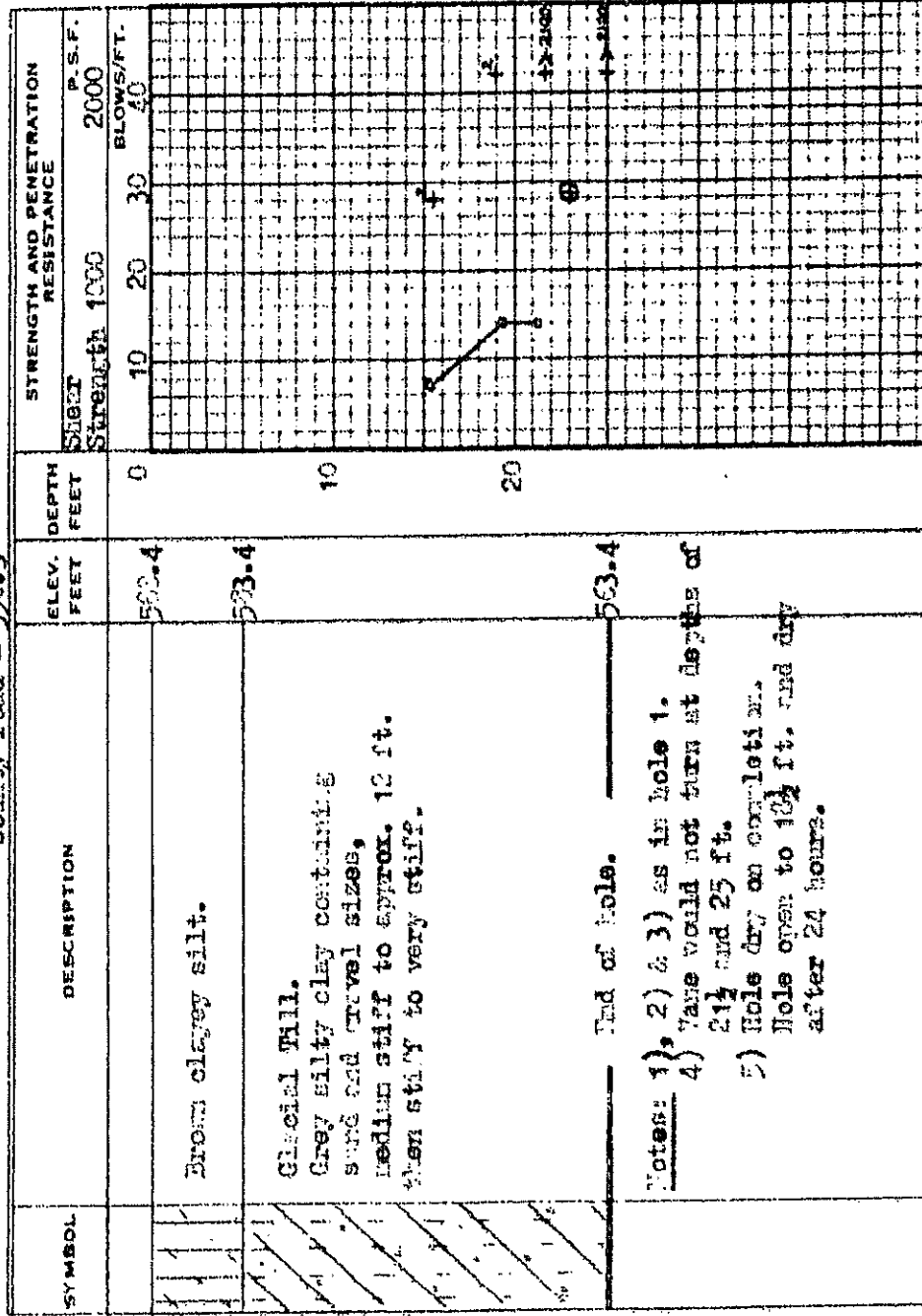
DRAWING NO. 2

## LEGEND

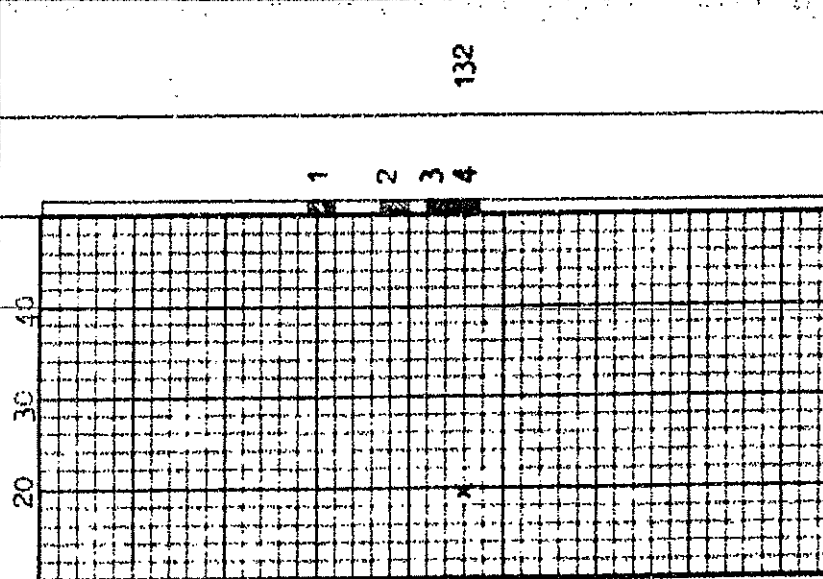
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2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
CASING  
2" SHELBY  
1/2 UNCONFINED COMPRESSION (QU)  
VANE TEST (C) AND SENSITIVITY (S)  
NATURAL MOISTURE AND  
LIQUIDITY INDEX  
LIQUID LIMIT  
PLASTIC LIMIT

PROJECT Highway 401 Underpass W.P. 297-59  
LOCATION Bloombfield Road SW of Chatham  
HOLE LOCATION See map. No. 1  
HOLE ELEVATION AND DATUM 593.4 C.L. of adjacent  
country road = 590.3

BOREHOLE NO. 3  
FIELD SUPERVISOR  
DRILLER  
PREP.



CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		



PROJECT NO. J419

# WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

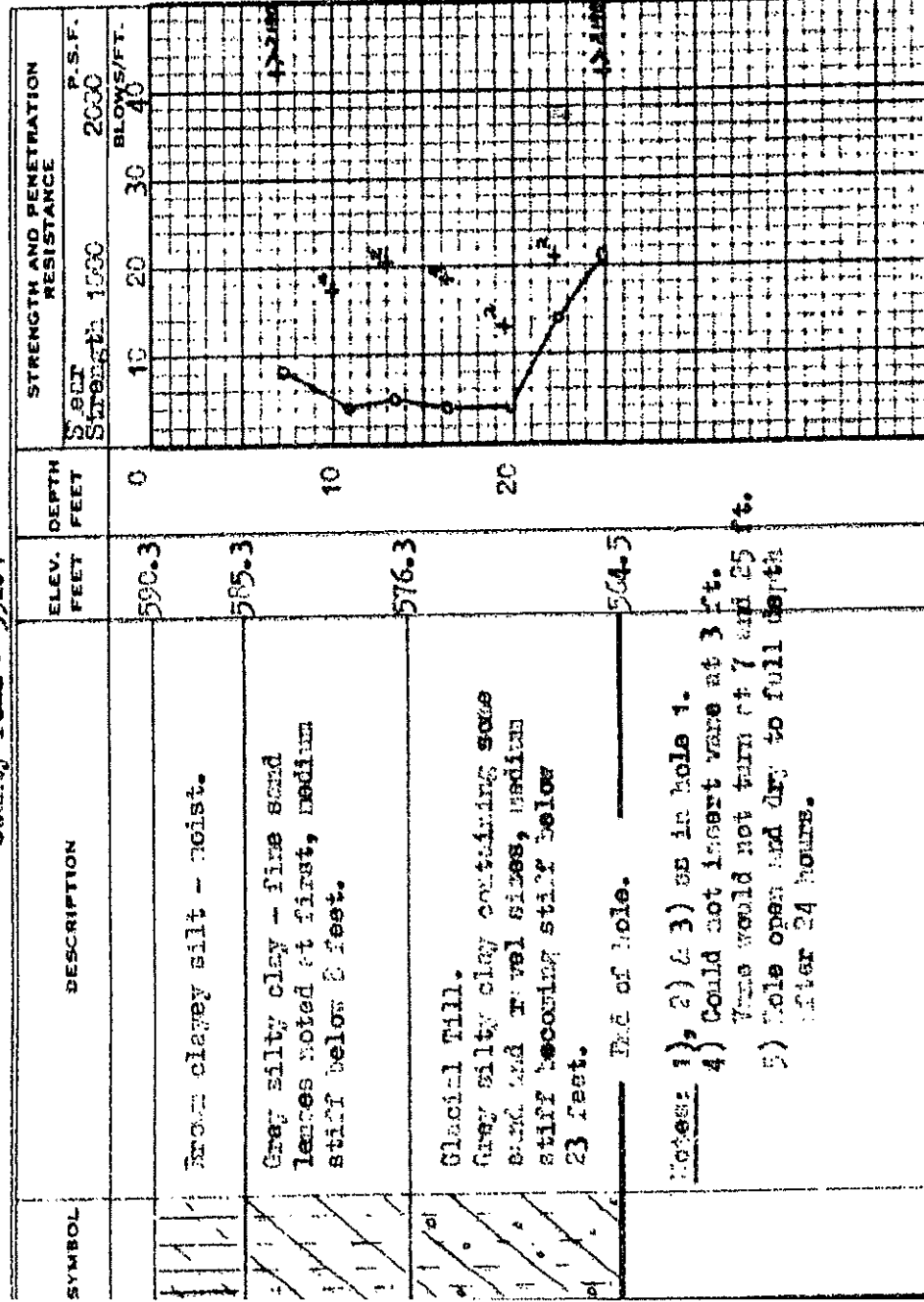
DRAWING NO. 9

## LEGEND

- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (QU)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

BOREHOLE NO. 10  
FIELD SUPERVISOR  
DRILLER  
PREP.

PROJECT Highway 401 Underpass W.P. 297-59  
LOCATION Bloomfield Road SW of Carleton  
HOLE LOCATION See map. No. 2  
HOLE ELEVATION AND DATUM 590.3 C.L. of adjacent county road = 592.1



CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.	1 2 3 4 5 6 7	

3419

**WILLIAM A. TROW & ASSOCIATES LTD.**

# SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Highway 401 Underpass W.P. 297-59  
LOCATION Bloedel Rd SW of Chatham  
HOLE LOCATION See dwg. No. 2  
HOLE ELEVATION AND DATUM 589.7 C.L. of adjacent  
country road = 598.3  
SOREHOLE NO. 11  
FIELD SUPERVISOR  
DRILLER  
PREP.

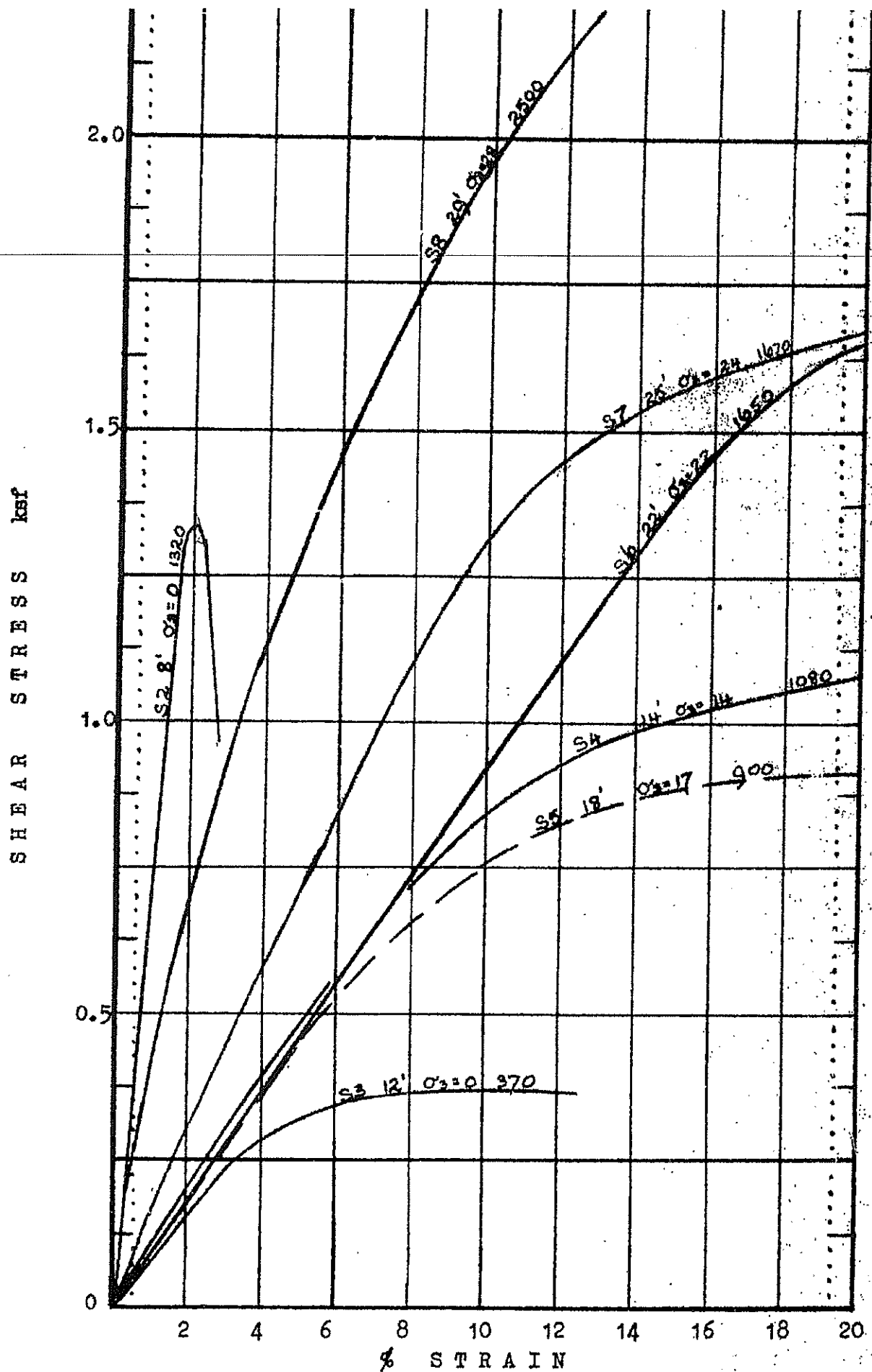
DRAWING NO. 10

**LEGEN D**

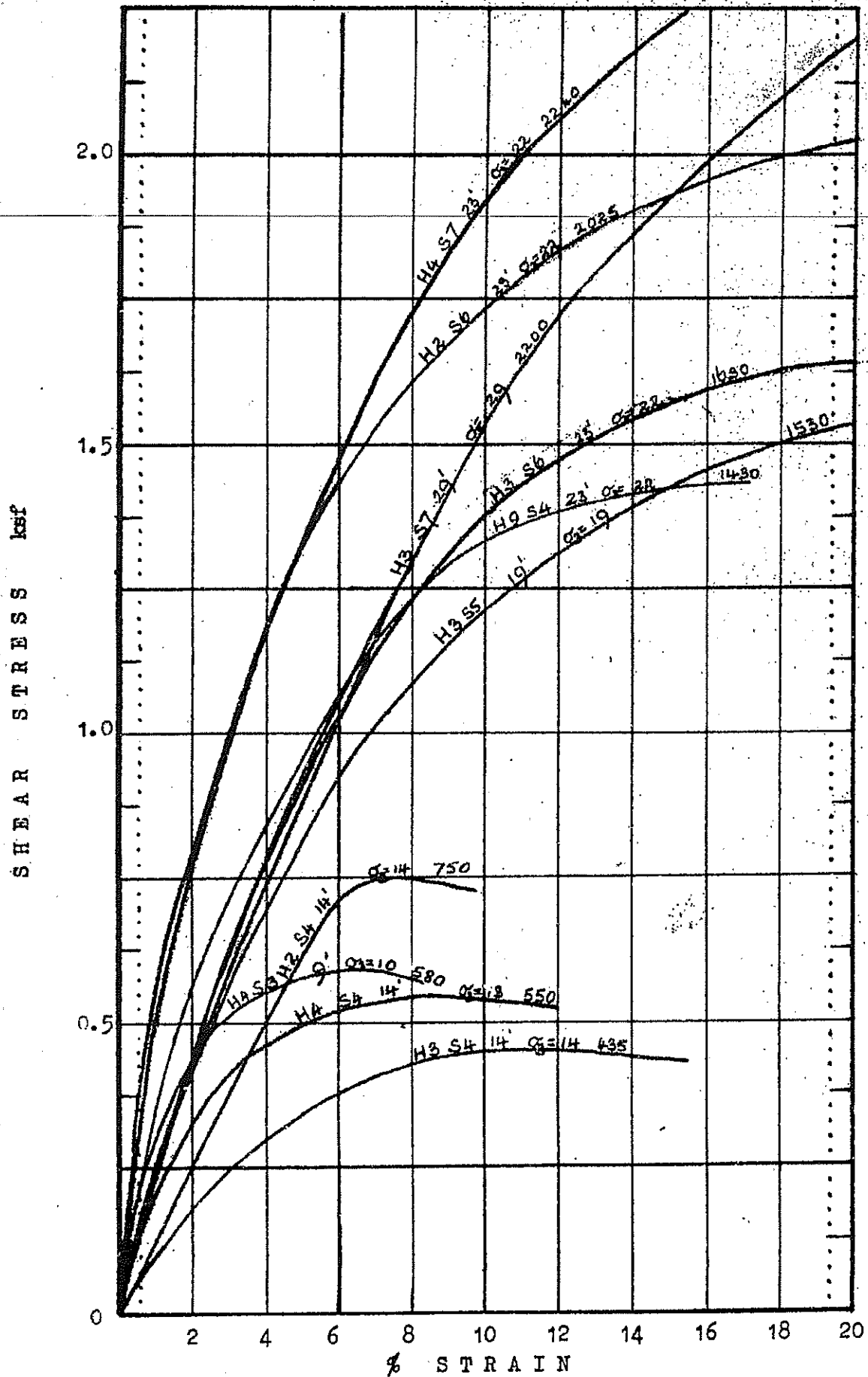
- |                                      |   |
|--------------------------------------|---|
| 2" DIA. SPLIT TUBE                   | 2 |
| 2" SHELBY TUBE                       | 2 |
| 2" SPLIT TUBE                        | 2 |
| 2" DIA. CORE                         | 2 |
| CASING                               | 2 |
| 2" SHELBY                            | 2 |
| 1/2 UNCONFINED COMPRESSION (QU)      | 2 |
| VANE TEST (C) AND SENSITIVITY (S)    | 2 |
| NATURAL MOISTURE AND LIQUIDITY INDEX | 2 |
| LIQUID LIMIT                         | 2 |
| PLASTIC LIMIT                        | 2 |

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				Strength	1000	2000	P.S.F.
		579.7	0	10	20	30	40
	Clayey silt - brown dry.						
	Silty clay - grey, contains sand and gravel sizes.	579.7	10				
	End of hole.	579.4	20				

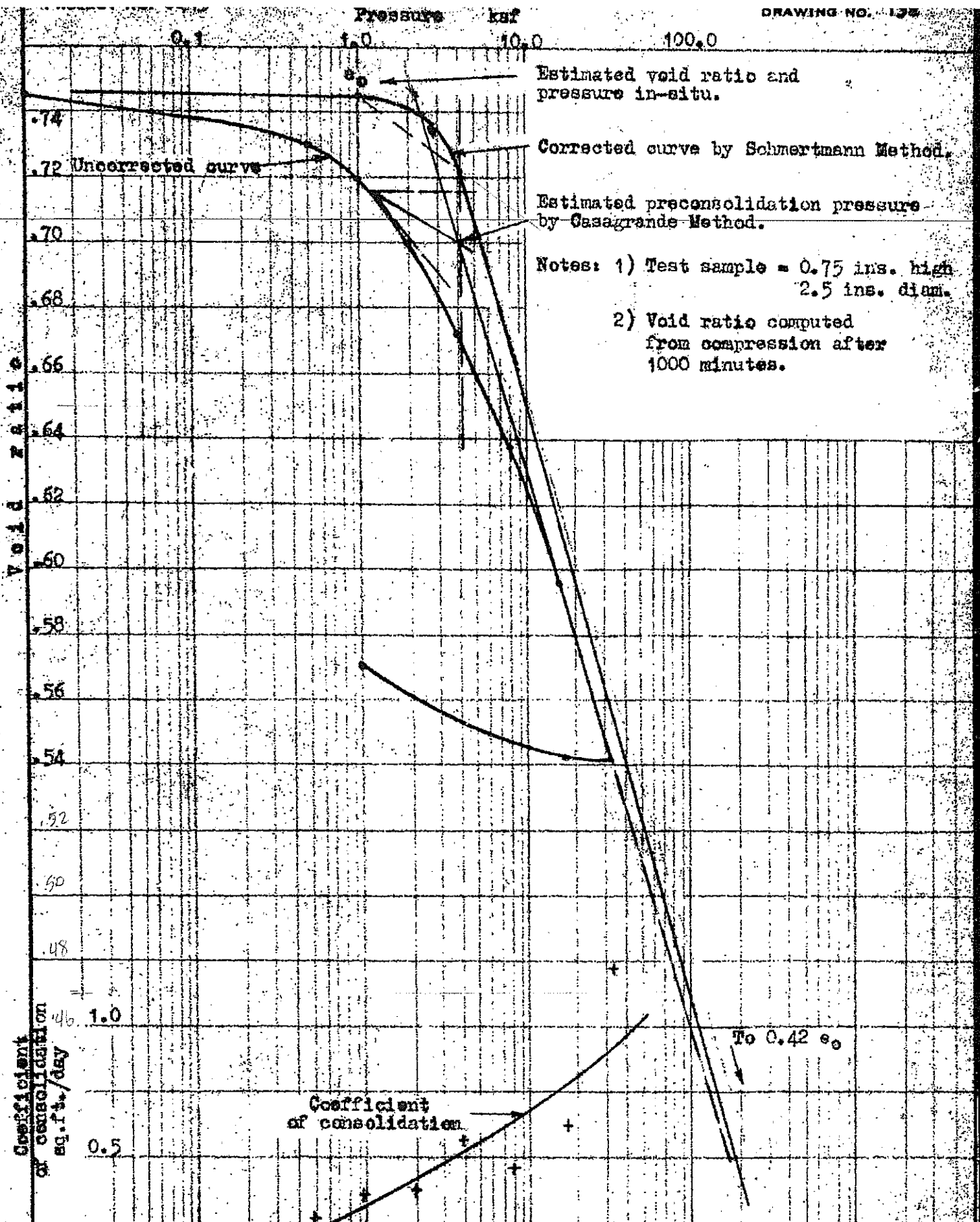
Notes: 1), 2) & 3) as in hole 1.  
 4) Could not insert vane at 3, 6 and 9 ft.  
 Vane would not turn at 13 and 19 ft.  
 5) Hole open to 17 1/2 and dry after 4 hours.



Stress-Strain Curves - Shear Tests on Samples from Hole 1



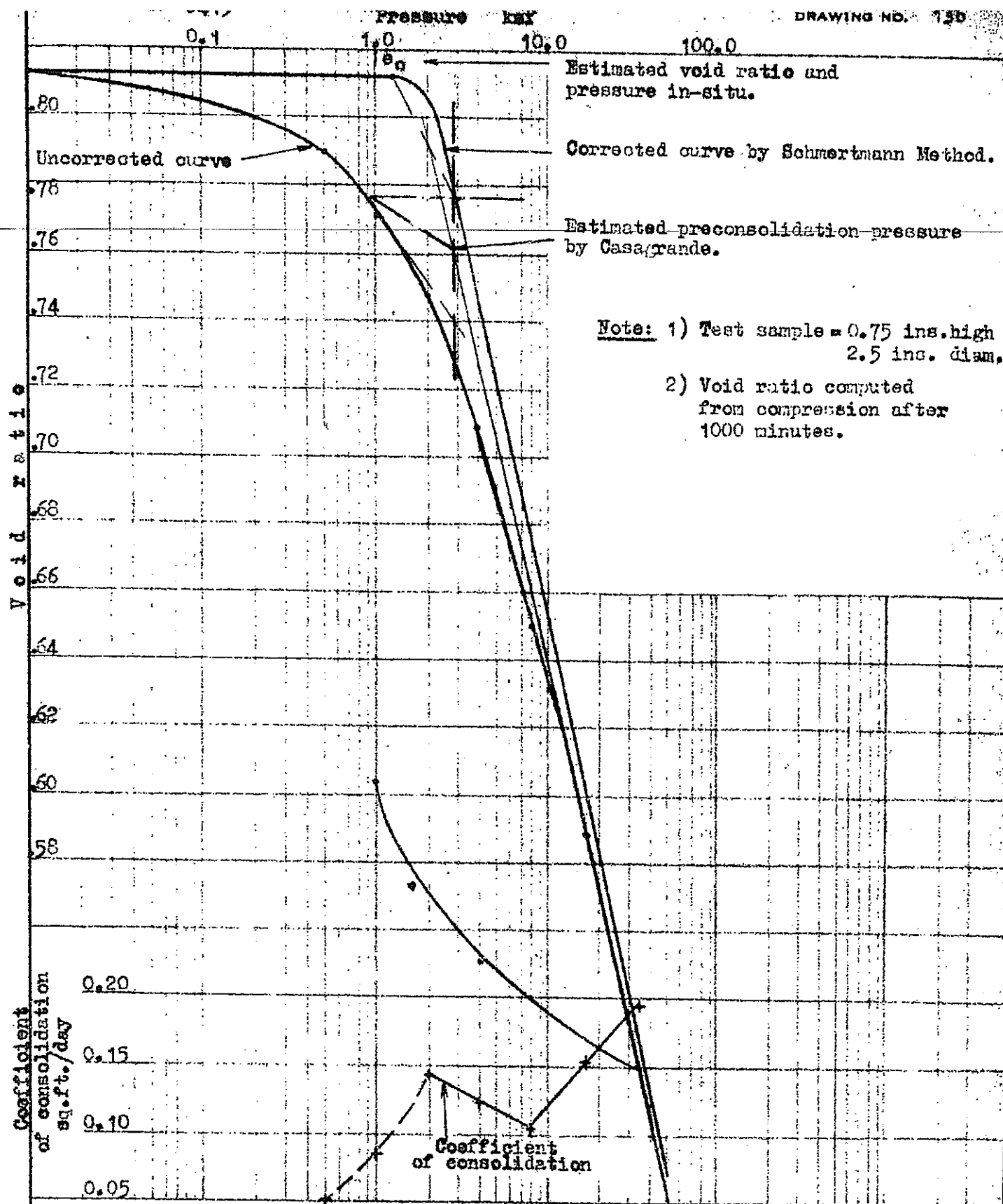
Stress-Strain Curves - Shear Tests on Samples from Holes 2 - 9



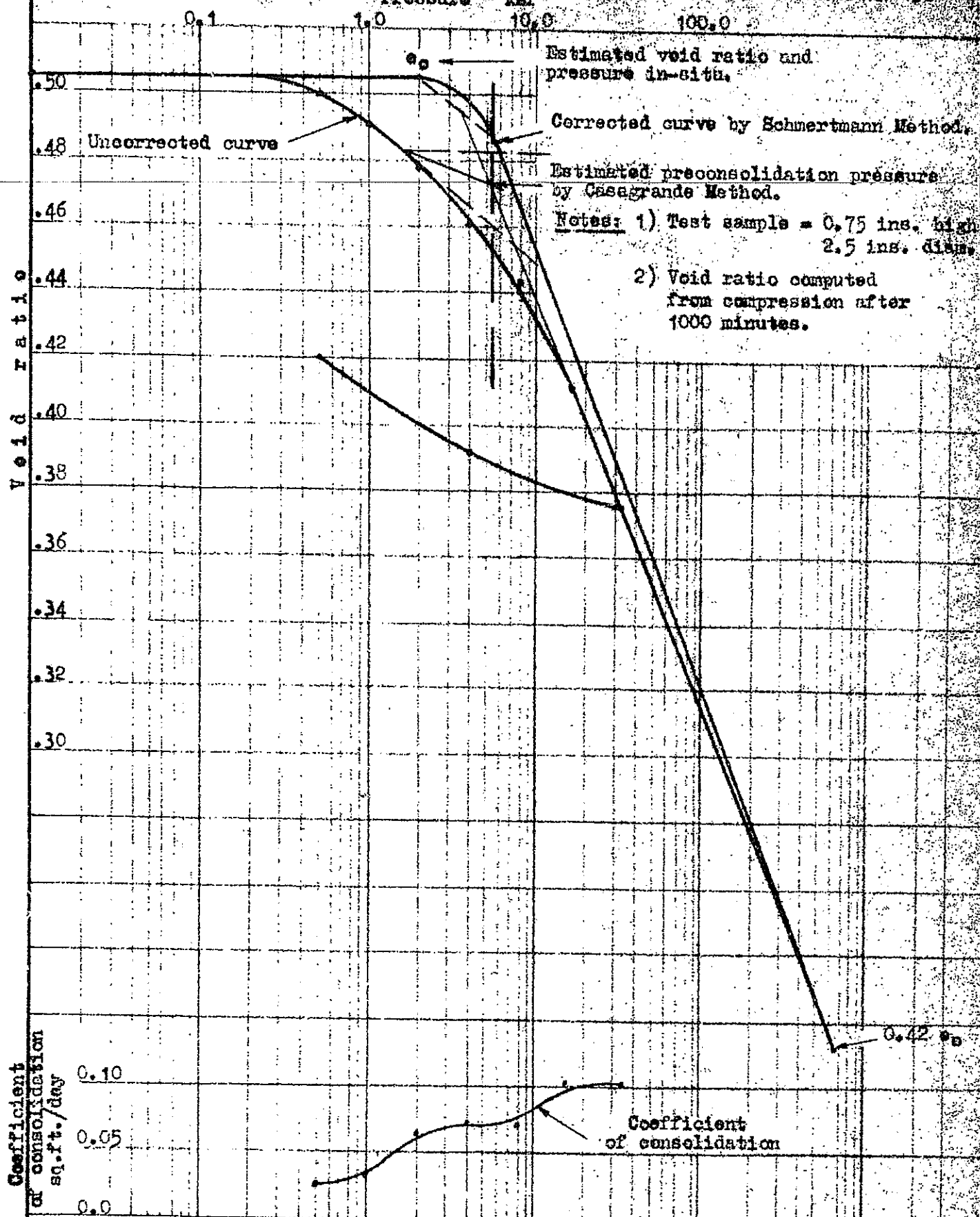
CONSOLIDATION TEST RESULT HOLE 1 - 7½ Ft. HIGHWAY 401 UNDERPASS  
W.P. 297-59 CHATHAM, ONTARIO.

WILLIAM A. TROW AND ASSOCIATES

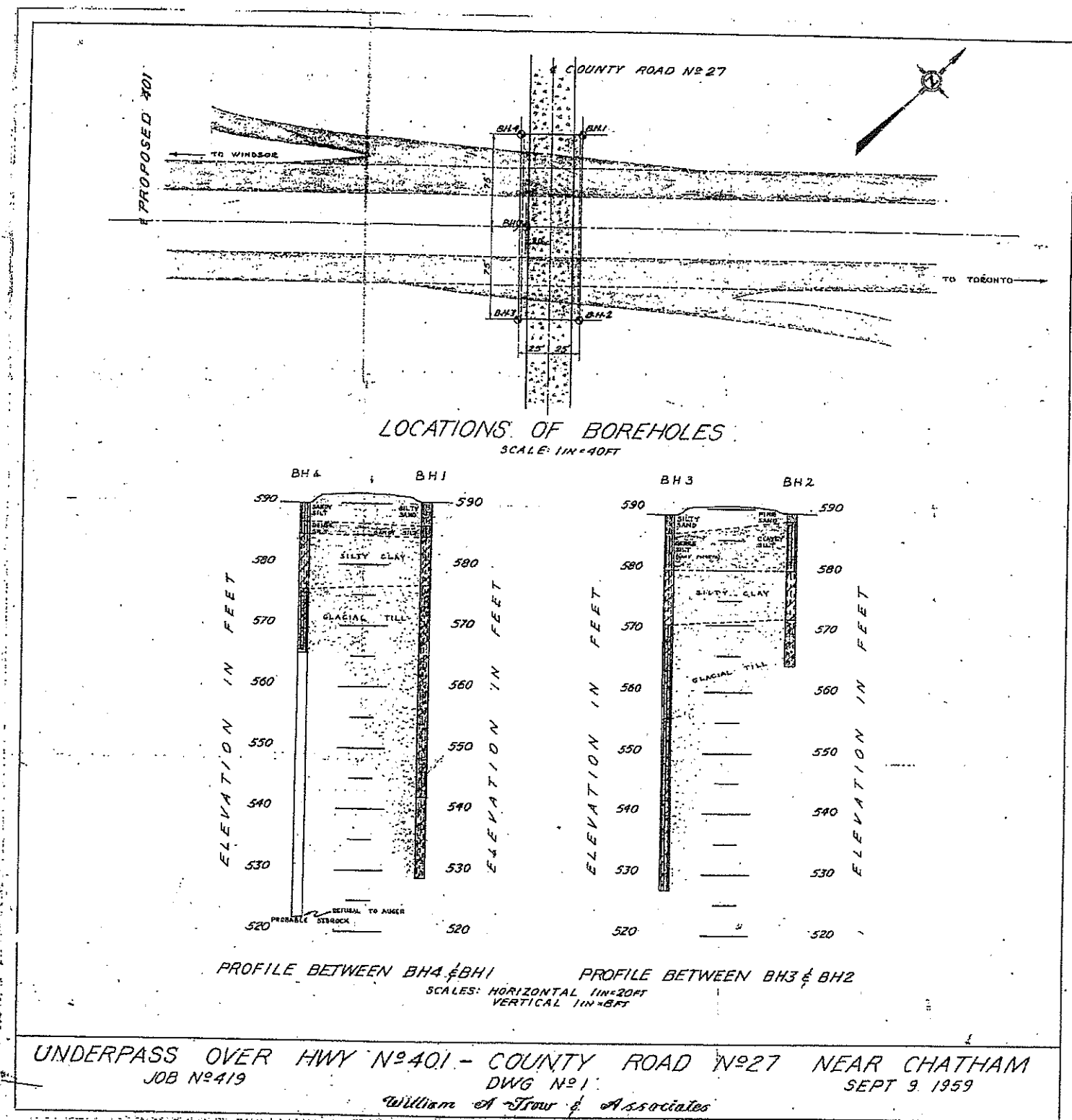




CONSOLIDATION TEST RESULT HOLE 1 - 11½ Ft. HIGHWAY 401 UNDERPASS  
W.P. 297-59. CHATHAM, ONTARIO.



CONSOLIDATION TEST RESULT HOLE 1 - 21 Ft. HIGHWAY 401 UNDERPASS  
W.P. 297-59 CHATHAM, ONTARIO.







- (18) Contract Drawings for Kent County Road No. 10 Underpass at Highway 401,  
WP 56-59, dated June 1961.







- (19) Foundation Investigation Report for Highway 401 underpass at Kent County Road No. 10 Underpass, WP 56-59 prepared by E.M. Peto Associates Ltd. dated December 17, 1959, Geocres No. 40J8-16.

# DYNAMIC CONE PENETRATION TEST

## Test Hole #1

<u>Depth</u>		<u>No. of</u>
<u>From</u>	<u>To</u>	
		<u>Driving Blows</u>
0	1	4
1	2	3
2	3	3
3	4	5
4	5	11
5	6	18
6	7	40
7	8	50
8	9	58
9	10	40
10	11	45
11	12	58
12	13	68
13	14	78
14	15	109
15	16	136
16	17	144
17	18	167
18	19	245
19	20	280
20	21	Further cone penetration test.
21	22	Abandoned
22	23	

# e. m. peto associates ltd. SOIL TESTING LABORATORY

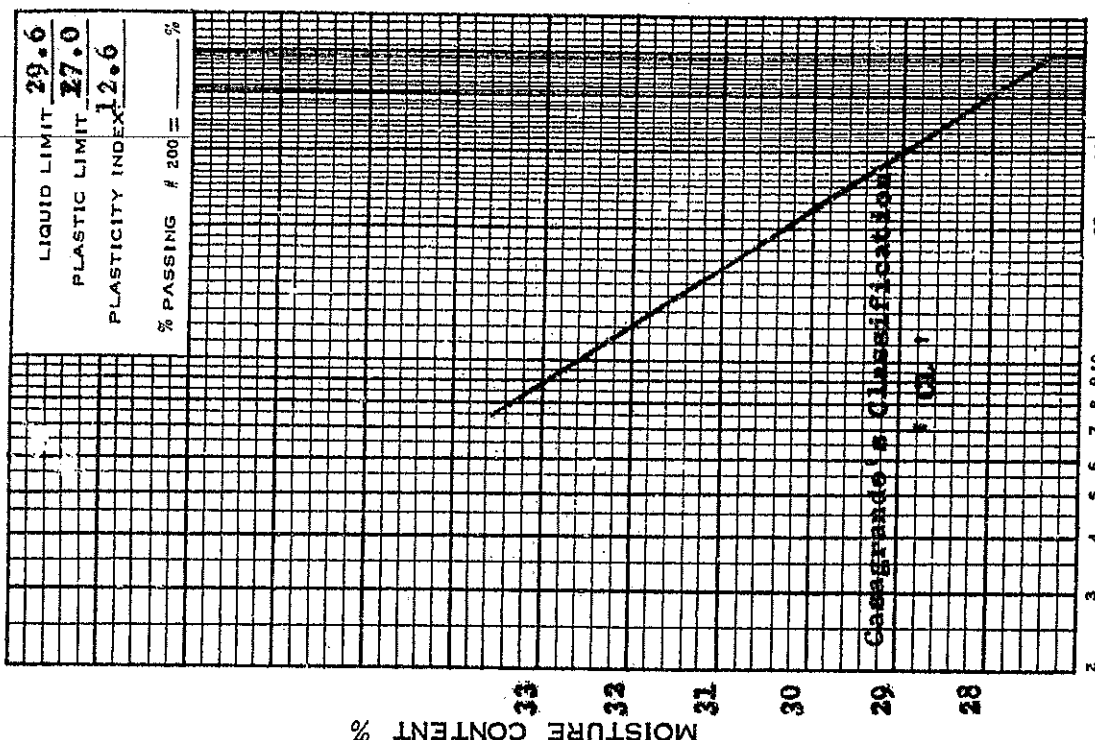
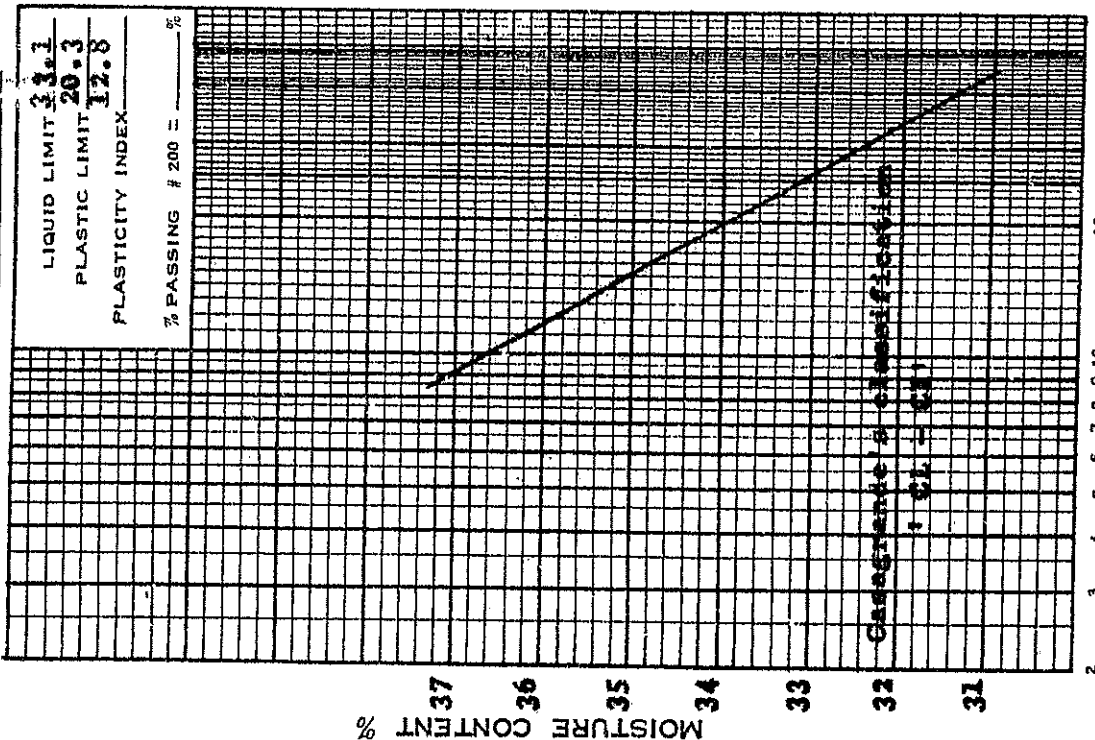
## LIQUID LIMIT TEST

## FLOW LINE CHARTS

JOB No. 59252 PROJECT HWY. 401 Underpass, Twp. Harwich.  
 SAMPLE FROM B.H. # 1. Sample # 3. B.H. # 1. Sample # 7.

DEPTH 5' - 6'

DEPTH 25' - 26'



NO. OF BLOWS (LOG SCALE)

e. m. pelo associates ltd.

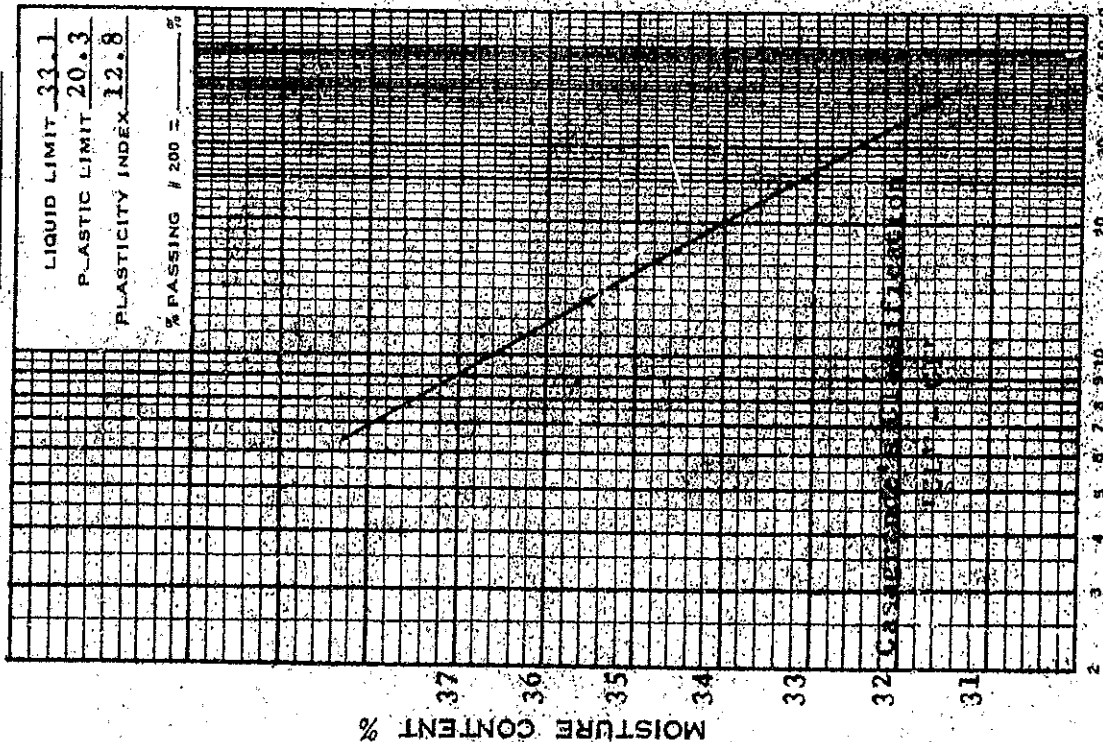
Toronto 18, Ontario

### LIQUID LIMIT TEST

Job No. 59252 PROJECT Hwy. 401 Underpass, Twp. Harwich.

SAMPLE FROM B.H. #1 Sample #3

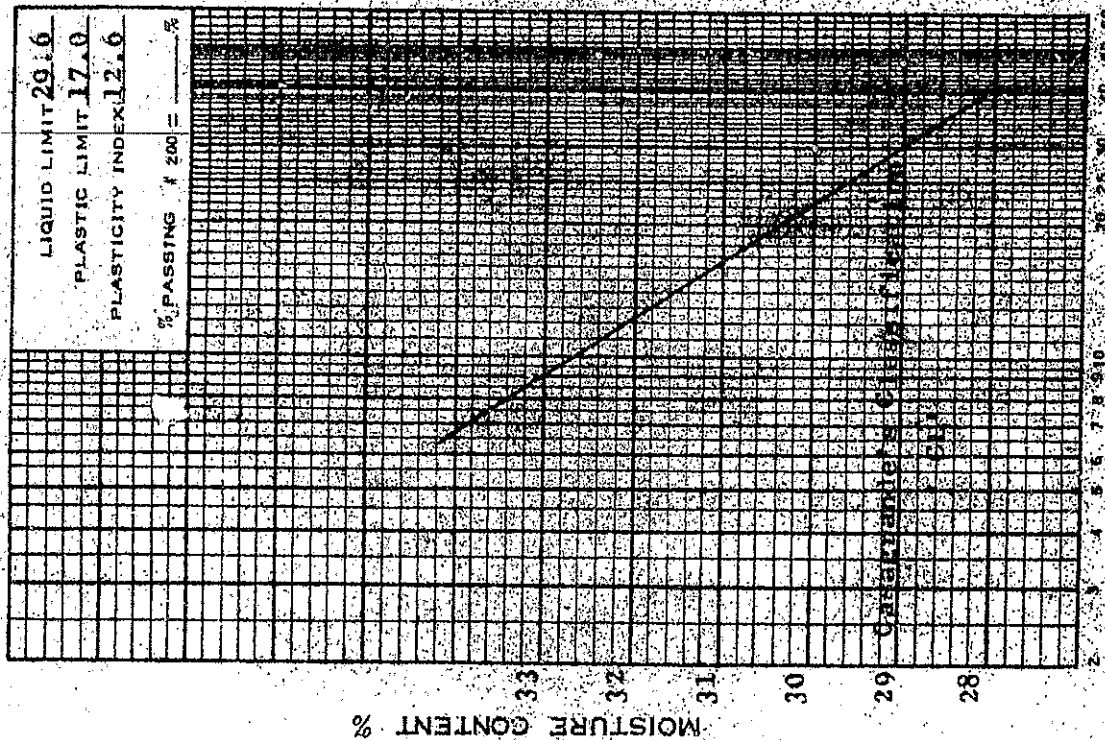
DEPTH 5' - 6'



### FLOW LINE CHARTS

SAMPLE FROM B.H. #1. Sample #7.

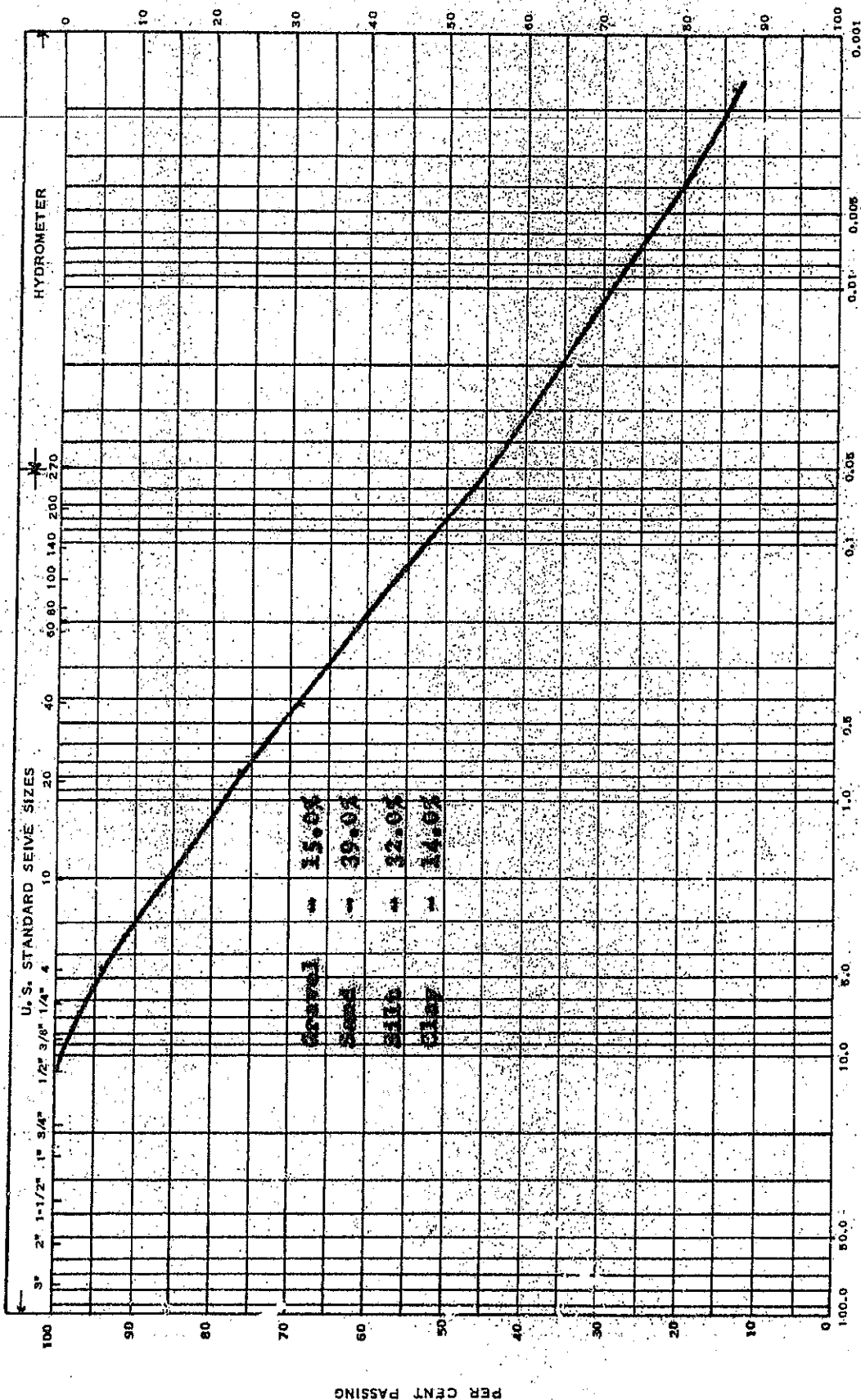
DEPTH 35' - 26'



NO. OF BLOWS (Log Scale)

e. m. pelo associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

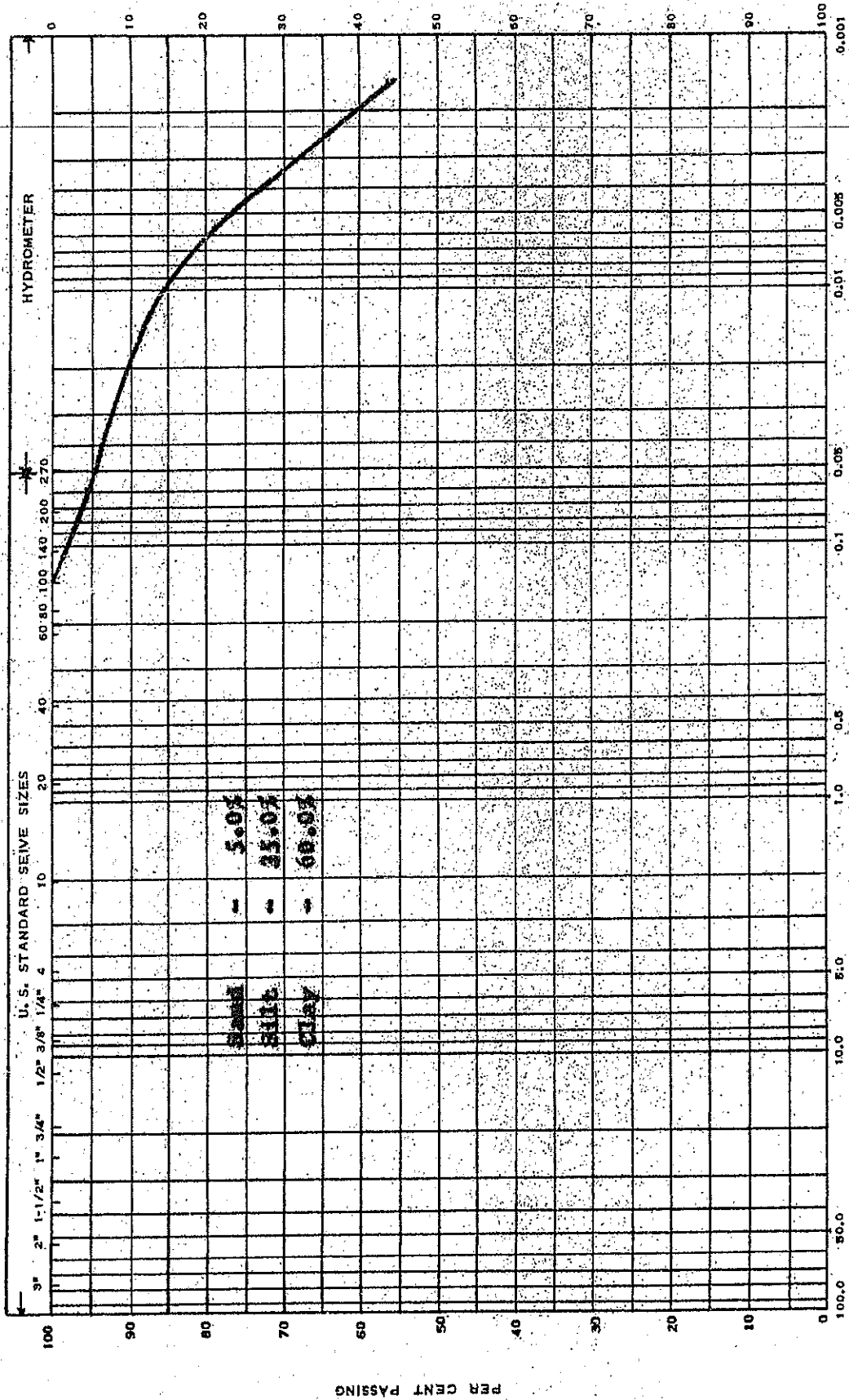
MASS. INST. OF TECH. CLASSIFICATION

JOB NAME 401 Underpass JOB NO. 59352 HOLE NO. 1 SAMPLE NO. 10  
 DEPTH 3.5m ELEVATION 33.4 REMARKS Textural classification: Silty Sand (MID)

GRAIN SIZE DISTRIBUTION

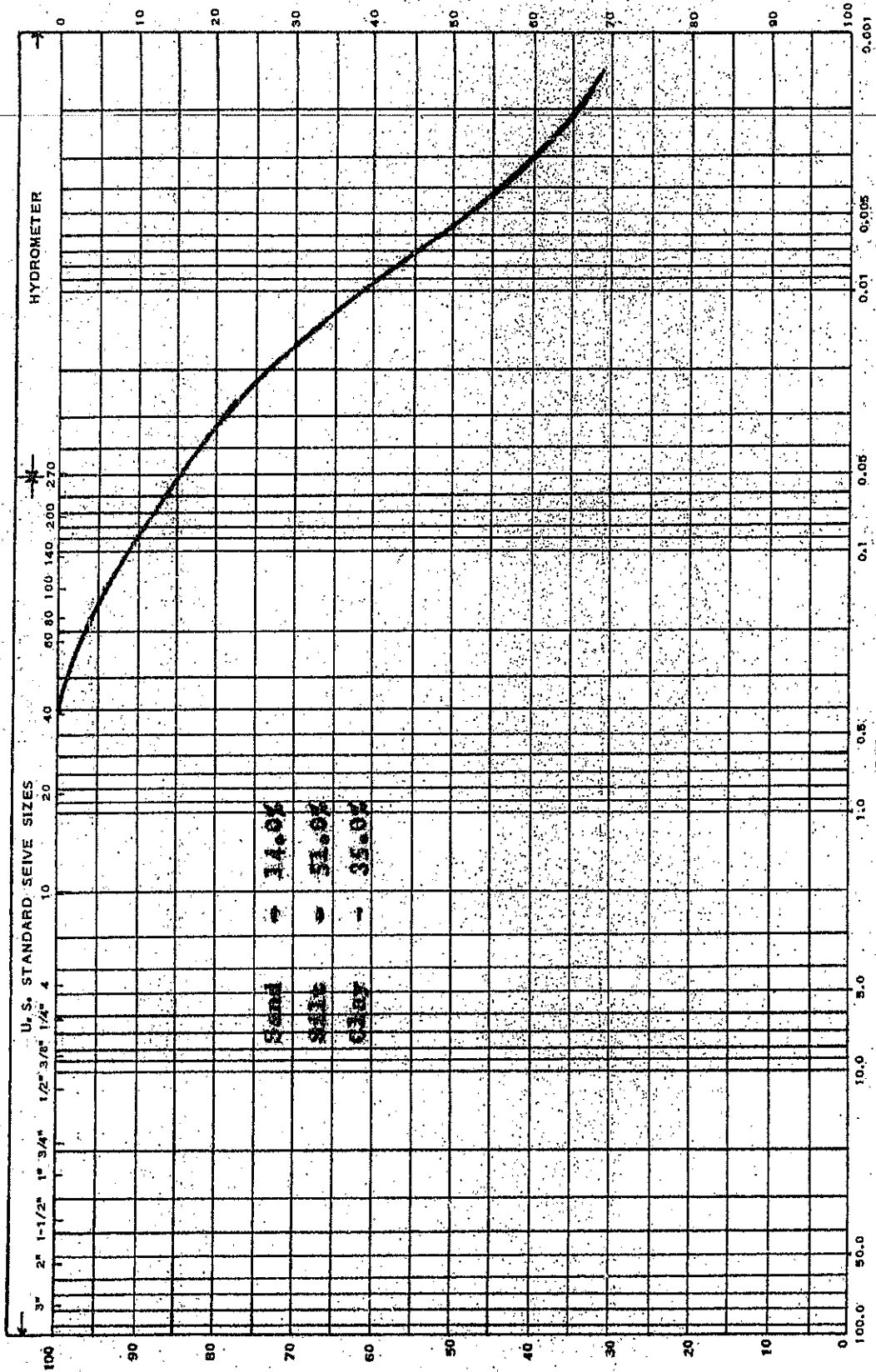
e. m. peto associates ltd.

Toronto 19, Ontario





e. m. pelo associates ltd.  
Toronto 19, Ontario

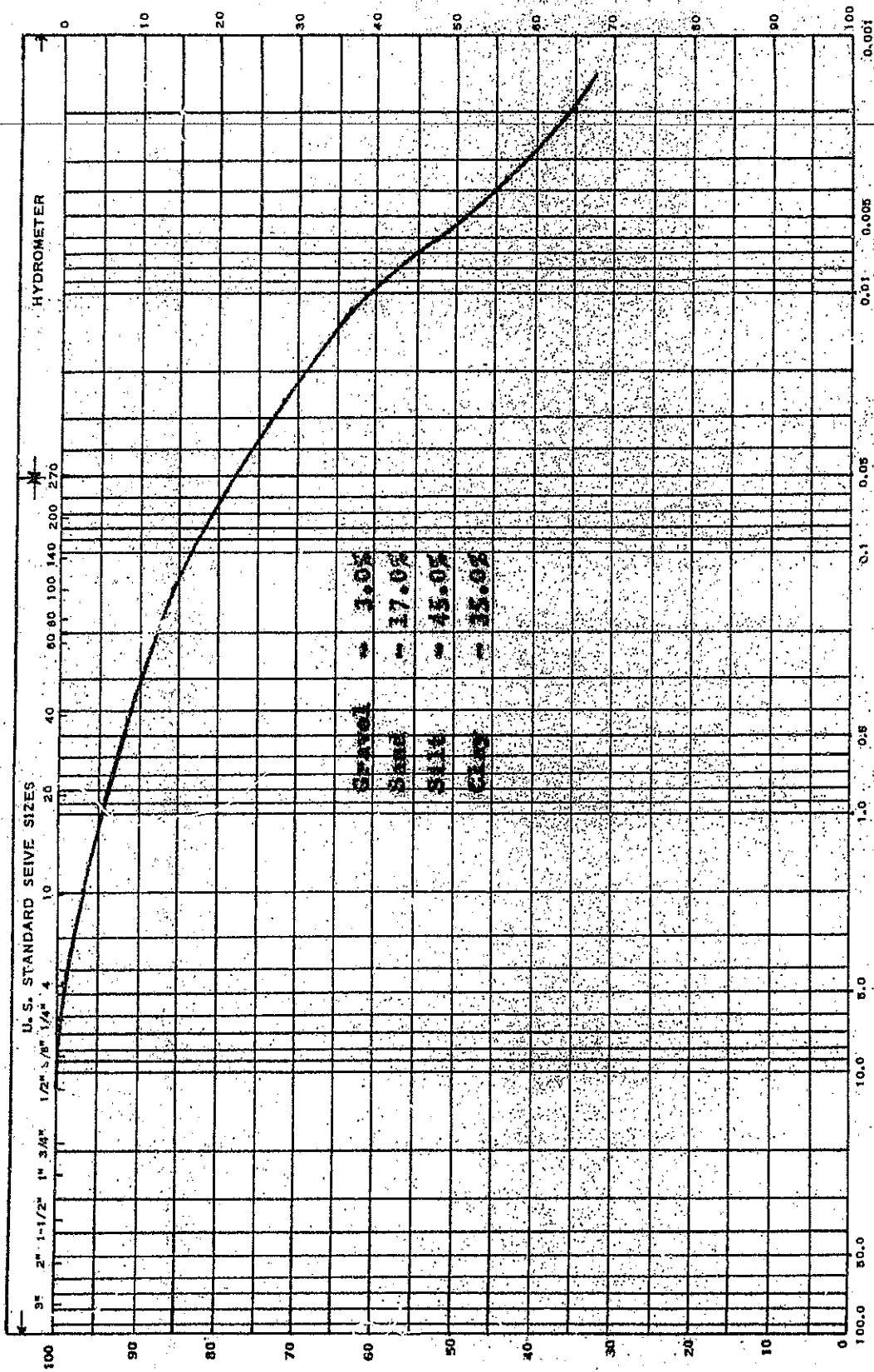


STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

JOB NAME Box 401 Underpass. JOB NO. 59252 HOLE NO. 3 SAMPLE NO. 2  
 DEPTH 5'-6" ELEVATION 598.9 REMARKS Textural Classification - 1 Silty clay  
 GRAIN SIZE DISTRIBUTION

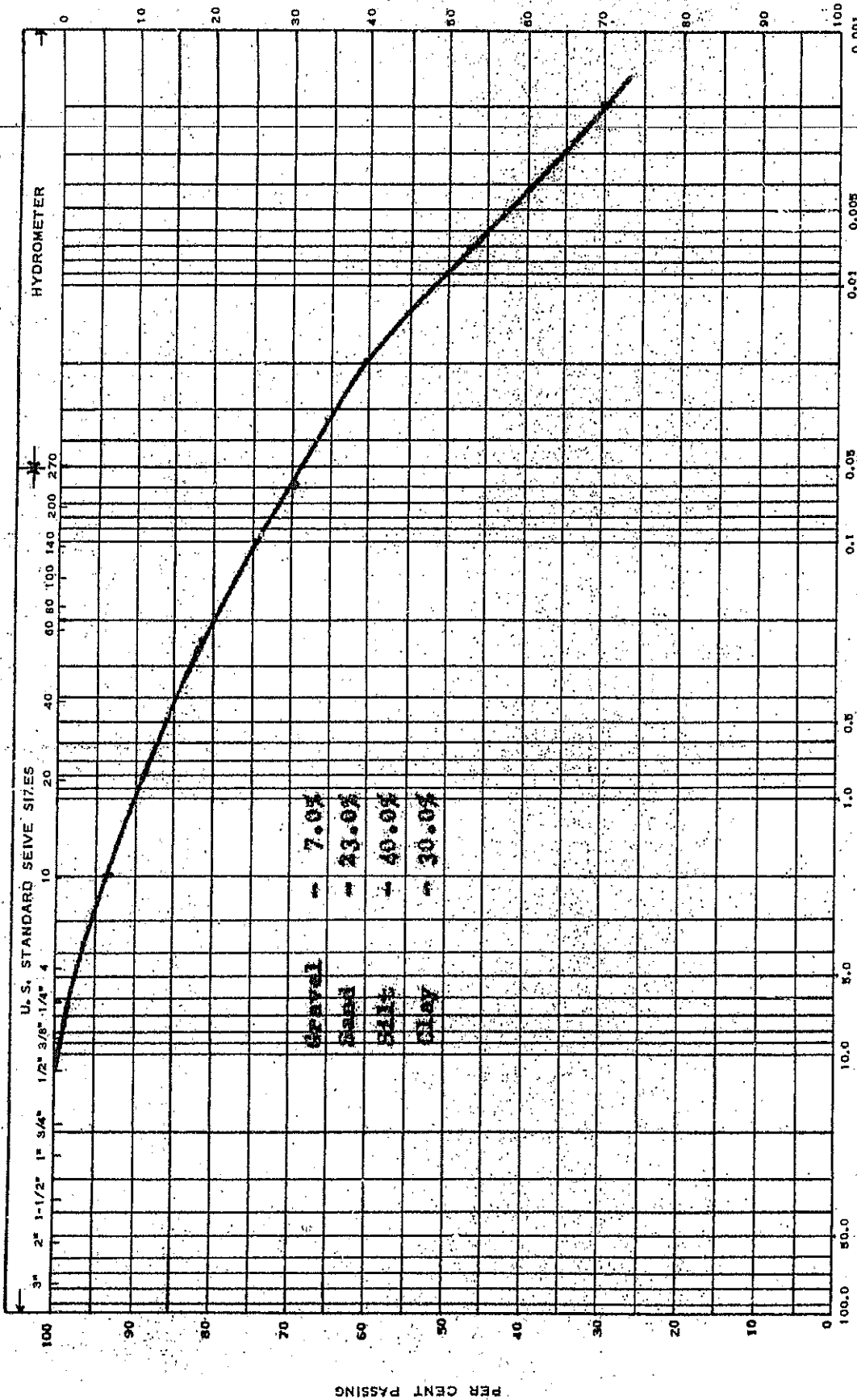
e. m. pelo associates ltd.

Toronto 19, Ontario



e. m. pelo associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Key. 401 Underpass JOB NO. 59252 HOLE NO. 3 SAMPLE NO. 8

DEPTH 30'-31' ELEVATION 161.9 REMARKS Textural Classification = 1 Sandy clay

GRAIN SIZE DISTRIBUTION

# e. m. peto associates ltd. SOIL TESTING LABORATORY

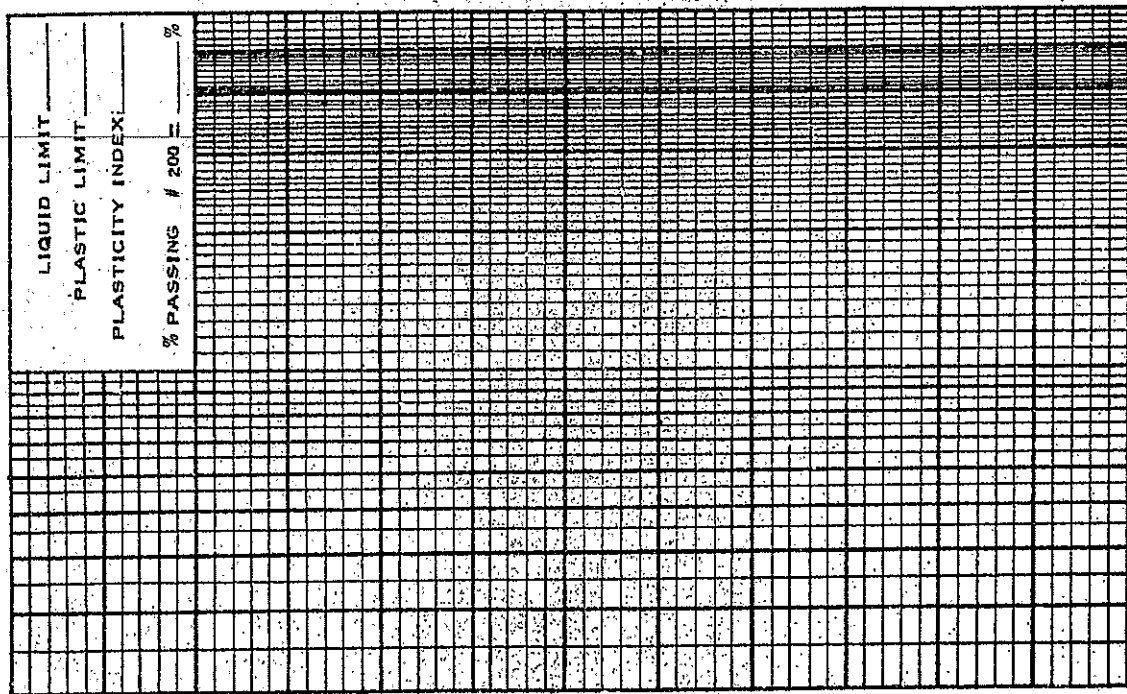
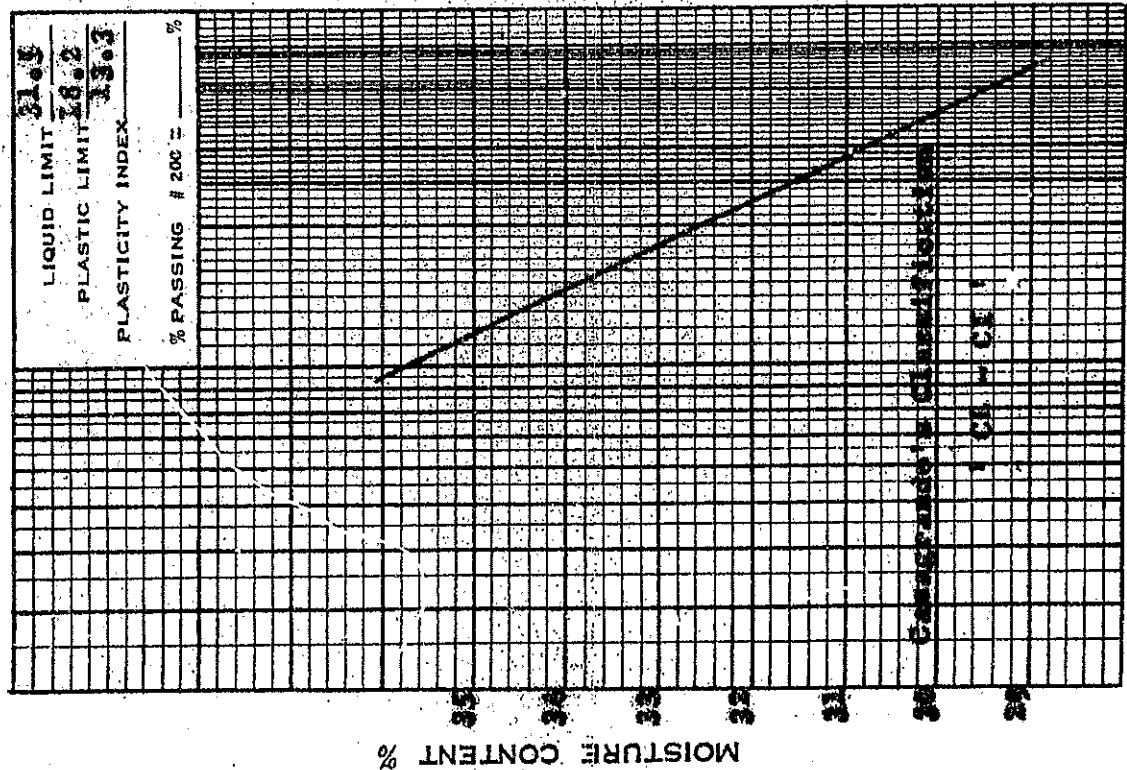
## LIQUID LIMIT TEST

## FLOW LINE CHARTS

Job No. 59232 PROJECT Rwy. 401 Underpass  
 SAMPLE FROM Box # 8. Sample # 5.  
 DEPTH 15' - 16'

SAMPLE FROM

DEPTH

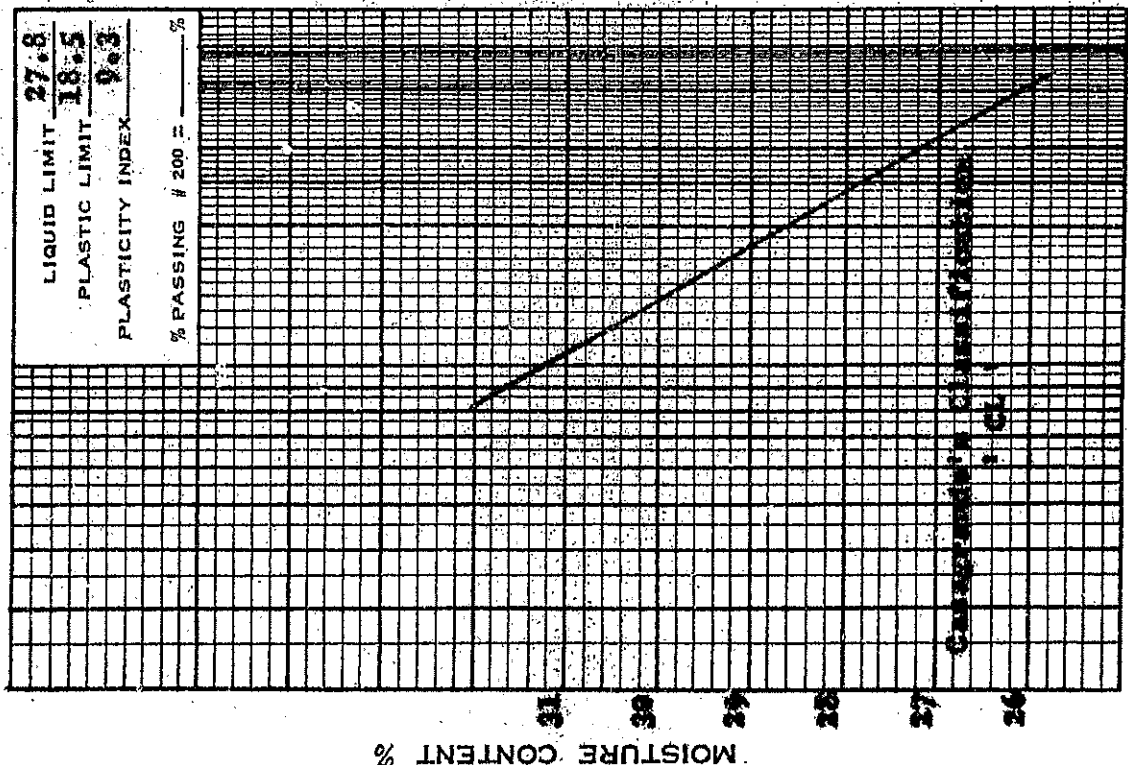


NO. OF BLOWS (LOG SCALE)

# e. m. peto associates ltd. SOIL TESTING LABORATORY

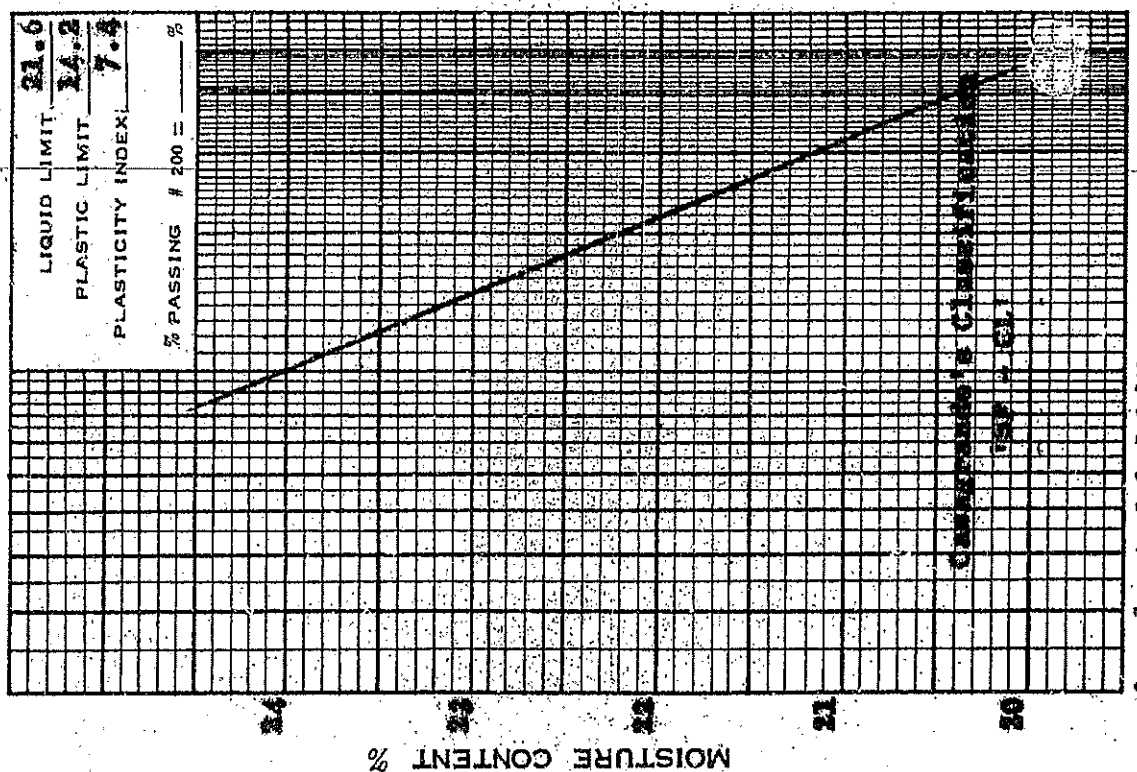
## LIQUID LIMIT TEST

Job No. 59252 PROJECT Way. 401 Underpass  
SAMPLE FROM B.H. # 5. Sample # 9.  
DEPTH 35' - 36'



## FLOW LINE CHARTS

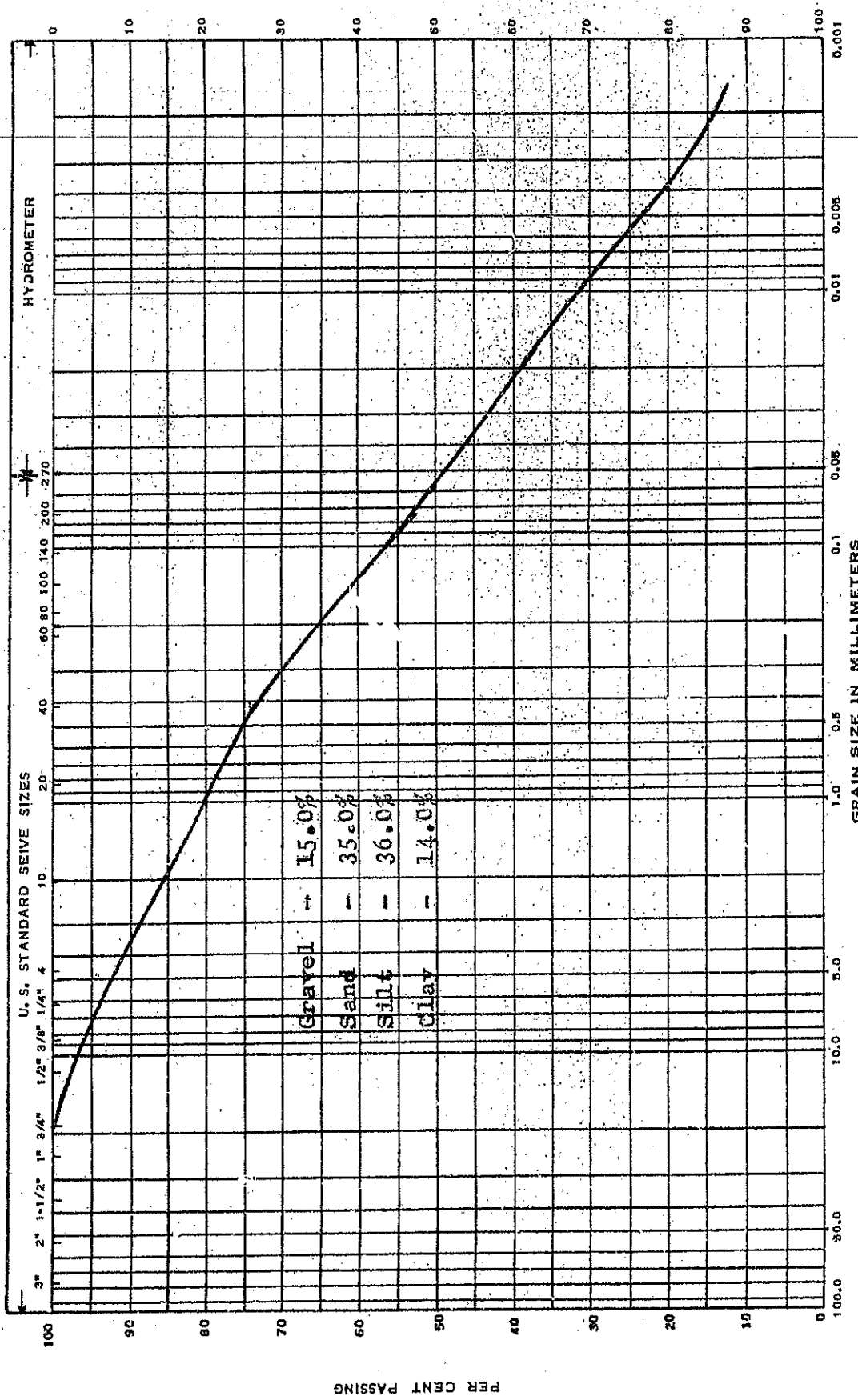
SAMPLE FROM B.H. # 5. Sample # 10.  
DEPTH 40' - 41'



NO. OF BLOWS (LOG SCALE)

e. m. pelo associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

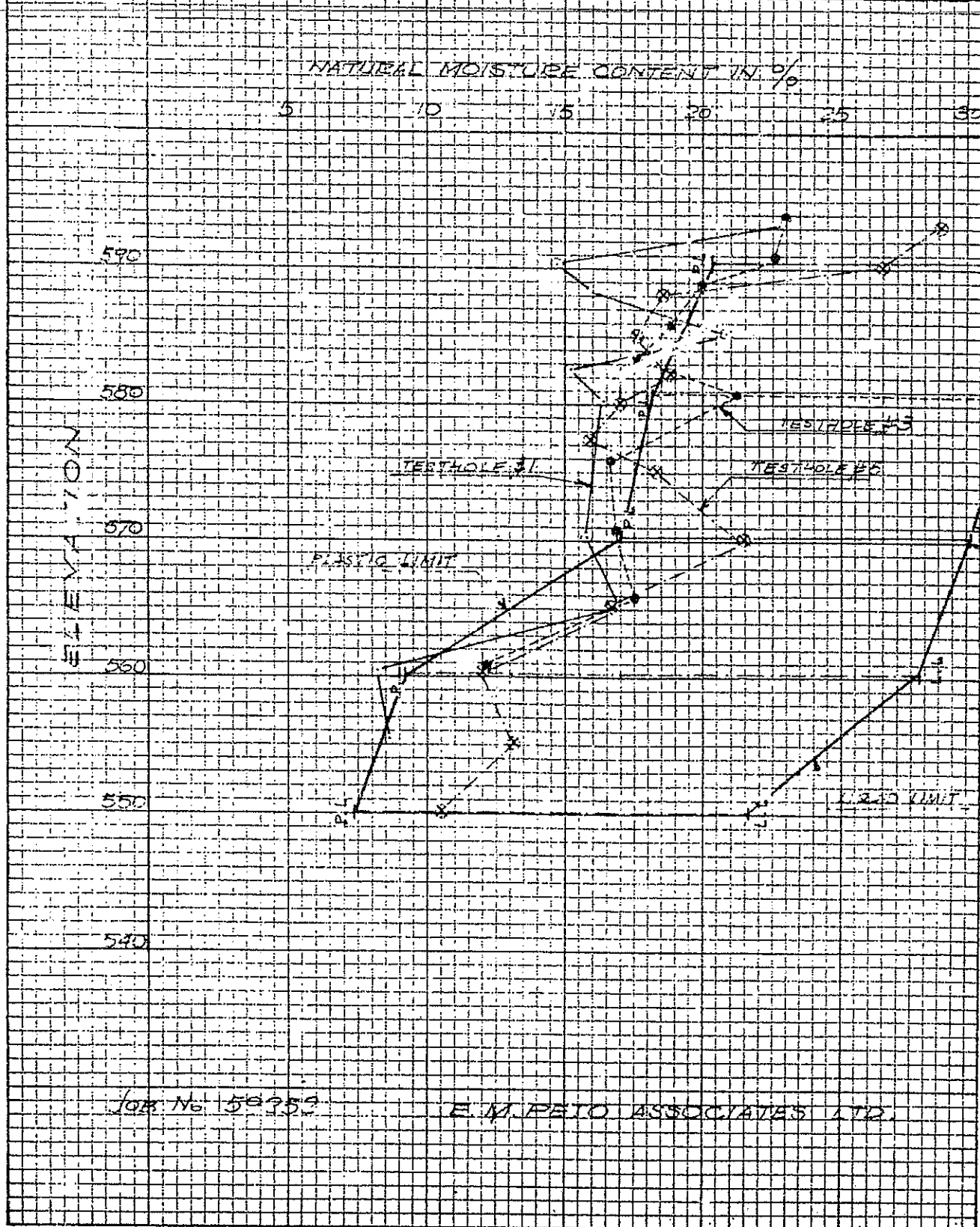
JOB NAME Hwy. 401 Underpass JOB NO. 59252 HOLE NO. 5 SAMPLE NO. 11

DEPTH 461 ELEVATION 50.4 REMARKS Textural classification, Silty sand (mill)

GRAIN SIZE DISTRIBUTION



# Natural Moisture Content & Atterberg Limits versus Elevation



SOIL ENGINEERING SERVICE - TORONTO, ONT.

# BOREHOLE LOG

Job Name Two, Harwich & Raleigh B. Job No. 59252








Borehole No. 1

Client Dept. of Always, Ont. Casing JK

Boring Date. Dec. 10 - 11/59

Datum: Dendetic ..... Compiled By: B.J. ....

Checked By ..... E.M.P.

		FEDERAL TEST SPECIFICATIONS	
	UNDISTURBED	A.S. AUGER SAMPLE	Y.T. IN SITU VANE SHEAR TEST
	FAIR	C.S. CASING SAMPLE	C. SOIL SHEAR STRENGTH LBS./SQ.FT.
		S.S. 2" STANDARD SPLIT TUBE SAMPLE	W.L. WATER LEVEL IN CASING
	DISTURBED	S.L. SPLIT BARREL WITH LINERS	W.T. GROUND WATER TABLE IN SOIL
		S.T. THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L. WETTER THAN PLASTIC LIMIT
	LOST	W.S. WASH SAMPLE	D.T.P.L. DRIER THAN PLASTIC LIMIT
		R.C. ROCK CORE	





[illegible]



**e. m. peto associates ltd.**  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
BOREHOLE LOG

Job Name Hwy. # 401 Underpass Job No. 59252 Borehole No. # 3.  
Client Twp. Harwich & Raleigh East Casing BX ( 2.1/2" Dia.) Boring Date Dec. 12th. 1959.  
Datum Geodetic Compiled By B.L. Checked By F.H.

**SAMPLE CONDITION**

-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

**SAMPLE TYPE**

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBESAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

**ABBREVIATIONS**

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Moisture Content	WATER LEVELS & REMARKS
Ground surface			0' 0"						
Asphalt surface & concrete base, organic topsoil.	DK Brown to black	596.4	0' 10"		1	C.S.			Moist.
Stratified silty clay, traces layers of organic matter.	of grey & brown	Firm	5' 0"		2	S.S.	6	23.0%	W.T.P.L.
As above	Layers of grey & brown	Stiff to very stiff	7' 1"		3	S.S.	17	22.6%	W.T.P.L.
Clayey till	Brownish-grey	Very stiff	7' 1"		4	S.S.	25	20.0%	D.T.P.L.
Clayey till	Grey	Very stiff	10' 3"		5	S.S.	19	18.8%	W.T.P.L.
(Silty clay, some sand content, grits & pebbles)					6	2" S.	Tapped	17.6%	
As above	Grey		15' 0"						
As above	Grey	Very stiff			7	S.S.	27	21.3%	W.T.P.L.
									Washwater used after 16' 0" depth.
As above.	Grey	Hard	20' 0"		8	S.S.	39	16.7%	W.T.P.L.
As above	Grey	Hard	25' 0"		9	S.S.	35	16.8%	W.T.P.L.
As above	Grey	Very stiff	30' 0"		10	S.S.	21	17.5%	W.T.P.L.
									Stiffens at 32' 6"
Sandy till	Dark grey	Very dense	35' 0"		11	S.S.	70	12.2%	3" thick layer of mixed grey fine sand at 35' 0" to 35' 6"
									Hole terminated at 36' 0"

**e. m. peto associates ltd.**  
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO  
BOREHOLE LOG

Job Name Hwy. # 401 Underpass  
Client Twp. Harwich & Raleigh East.  
Dep't. of Highways of Ontario  
Datum Geodetic

Job No. 59252  
Casing BX ( 2.1/2" Dia.)  
Compiled By F.H.

Borehole No. # 5  
Boring Date Dec. 13th. 1959.  
Checked By B.L.

**SAMPLE CONDITION**

☒ UNDISTURBED  
☒ FAIR  
☒ DISTURBED  
☒ LOST

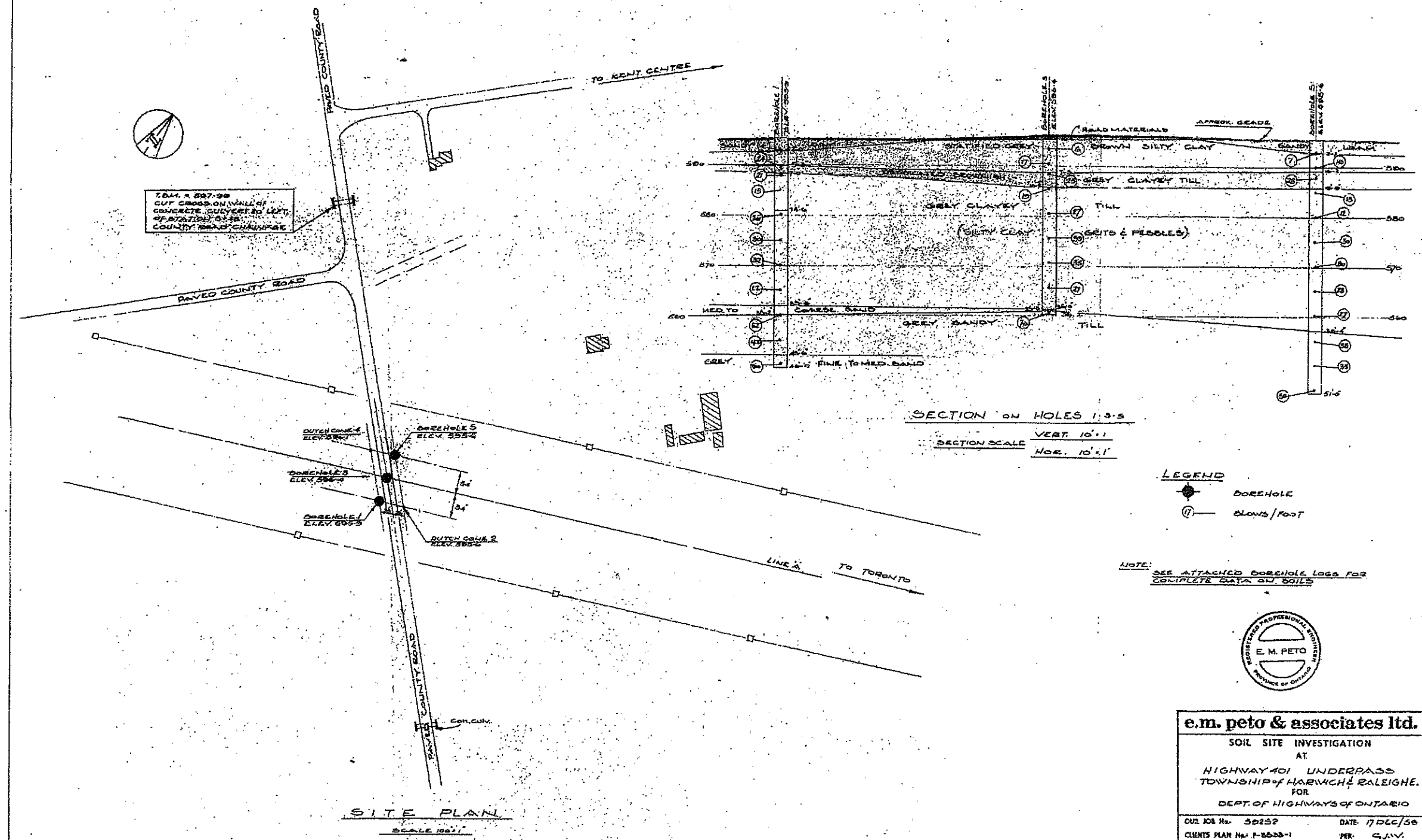
**SAMPLE TYPE**

A.S. AUGER SAMPLE  
C.S. CASING SAMPLE  
S.S. 2" STANDARD SPLIT TUBE SAMPLE  
S.L. SPLIT BARREL WITH LINERS  
S.T. THIN-WALLED SHELBY TUBE SAMPLE  
W.S. WASH SAMPLE  
R.C. ROCK CORE

**ABBREVIATIONS**

V.T. IN SITU VANE SHEAR TEST  
C. SOIL SHEAR STRENGTH LBS/SQ. FT.  
W.L. WATER LEVEL IN CASING  
W.T. GROUND WATER TABLE IN SOIL  
W.T.P.L. WETTER THAN PLASTIC LIMIT  
D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Logged	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0' 0"						
Topsoil	Dark brown to black	595.0	0' 8"		1	C.S.			Moist.
Sandy loam	Brown		2' 7"		2	S.S.	7	28.6%	Moist.
Silty clay some organic matter, pockets of wet sandy gravel.	Layers of grey Firm & brown		5' 0"						W.T.P.L.
As above	Layers of grey stiff to very stiff & brown		6' 12"		3	S.S.	16	26.5%	W.T.P.L.
Clayey till	Brownish-grey to hard				4	S.S.	28	18.6%	D.T.P.L.
			9' 9"						
Clayey till, some stones	Grey	Very stiff			5	S.S.	18	17.6%	W.T.P.L.
As above	Grey				6	2"S.L. Tapped	18.8%		At 13' 6" seam of grey silty fine sand
			15' 0"						
As above	Grey	Stiff			7	S.S.	12	17.0%	W.T.H.L.
As above	Grey				8	2"S.L. Tapped	15.3%		
			20' 0"						
As above, pebbles.	Grey	Very stiff to hard			9	S.S.	30	18.3%	D.T.P.L.
									Washwater used after 21' 0" depth.
			25' 0"						
As above	Grey	Very stiff to hard			10	S.S.	30	21.5%	D.T.P.L.
			30' 0"						
As above	Grey	Very stiff			11	S.S.	23	16.7%	W.T.P.L.
			35' 0"						
As above	Grey	Very stiff			12	S.S.	27	12.1%	Seam of sandy silt.
			38' 4"						
			40' 0"						
Sandy silt	Grey	Dense			13	S.S.	35	13.1%	Just moist.
			45' 0"						
Sandy till (Sandy silt some clay content)	Grey	Dense			14	S.S.	35	10.5%	layers of grey fine sand.
			50' 0"						Stiffened at 50' 9"
As above	Grey	Dense to very dense	51' 0"		15	S.S.	50		
									Hole terminated at 51' 0"







- (20) Contract Drawings for Hot Mix Paving, Contract No. 78-55 from east of interchange No. 8 Tilbury North (Essex County Road 42) easterly to west of Bloomfield Road, WP 51-77-01, dated February 9, 1978 (General data only - no additional soil data).



- (21) Contract Drawing for Hot Mix Paving, Contract No. 97-43, from 0.7 km east of Highway 2 easterly to 0.8 km west of County Road 27 (Bloomfield Road), WP 600-93-01 and 600-93-00, dated April 18, 1997 (General data only - no additional soil data).