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W.P. No. 10-67

CONT. No.

W. O. No. 71-11048

STR. SITE No. 29-158

HWY. No. 17N

LOCATION HALEY STN WESTERLY

17 MILES TOWARDS PEMBROKE

No of PAGES - ~

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FORM SB-OS-35A

MINISTRY
OF
TRANSPORTATION AND COMMUNICATIONS
ONTARIO

FILE No. W.P. 10-67 ~~1-67-03~~

REMARKS ~~SITE PHOTOS~~

DATE

Ontario
Department of Transportation and Communications
MEMORANDUM

31F-31

TO: Mr. T. C. Kingsland,(2)
Regional Bridge Planning Engineer,
Eastern Region,
Kingston, Ontario.

FROM: Foundations Office,
Design Services Branch,
Central Bldg., Downsview.

ATTENTION:

DATE: September 28, 1971.

OUR FILE REF.

IN REPLY TO OCT 4 1971

SUBJECT:

352300
5061500
31F10W
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PRELIMINARY
FOUNDATION INVESTIGATION REPORT FOR
Structures & Related Creek Crossings
of Highway 17N, Haley Station
Westerly 17 Mi. Towards Pembroke
Twp's of Ross & Westmeath, Co. of
Renfrew, District 9 (Ottawa)
W.O. 71-11048 -- W.P. 10-67

Attached, we are forwarding to you our Preliminary Foundation Investigation Report pertaining to the above sites. Presented in this report are the results of the investigation, together with our general comments pertaining to the stability of the approaches and recommendations regarding structure foundations at various crossings.

We believe that the information contained therein, will prove adequate for your immediate use. Should you require further data, or clarification of the report, please do not hesitate to contact this Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER.

AGS/ao
Attach.
cc: Messrs. B. R. Davis
D. W. Farren
S. J. Markiewicz
A. Rutka
J. E. Callaghan
I. C. Campbell
E. R. Saint
J. Percy (2)
G. A. Wrong
B. J. Giroux
B. A. Singh

Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT
For
Structures & Related Creek Crossings of
Highway 17N, Haley Station
Westerly 17 Mi. Towards Pembroke
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Renfrew, District 9 (Ottawa)
W.O. 71-11048 -- W.P. 10-67

1. INTRODUCTION:

The Foundation Section was requested to carry out a preliminary foundation investigation at the possible structures and related creek crossings to be situated within the aforementioned 17 mile stretch of Hwy. 17N. The purpose of the investigation is to provide information pertaining to foundation design to aid in the planning studies for Hwy. #17N in this area.

The request for this foundation investigation was contained in a memo from Mr. T. C. Kingsland, Regional Bridge Planning Engineer, Eastern Region, dated May 31, 1971. An investigation was subsequently carried out by this Section to determine the subsoil, bedrock and groundwater conditions across this area.

This report presents all the factual information obtained from this investigation. Included are recommendations pertaining to foundation design at the various possible crossings, as well as the stability and settlement considerations associated with fills and cuts.

2. DESCRIPTION OF THE AREA AND GEOLOGY:

The area under investigation extends from Haley Station westerly to a point about 9 miles south-east of Pembroke, a distance of approximately 17 miles. The major portion of this area lies immediately north of Muskrat Lake and Muskrat River. The whole area lies about thirty miles to the south-east of Algonquin Provincial Park and is located within the Townships of Westmeath and Ross in the County of Renfrew.

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2. DESCRIPTION OF THE AREA AND GEOLOGY: (cont'd)

The area is generally hilly in relief, with moderate to steep slopes. The ground surface ranges from elevation 435 on the floor of the natural valleys to elevation 535 on the crests of the higher plateaus.

It is primarily an agricultural area with approximately 20 to 30 per cent involved in production of field crops; such as wheat, oats, and barley. The remainder of the area is in the natural woodland state, with the presence of small bogs and beaver dammed gullies.

The proposed highway and alternate route lie entirely on a feature known physiographically as the Muskrat Lake Ridges. These ridges are formed of the protruding crests of fault blocks, with two such ridges dominating the area. One lies along the north-east side of Muskrat Lake, presenting a steep scarp towards the south-west, and sloping gently to the north-east under a cover of sand. The other ridge, similar in nature, borders Olmsted Lake.

The major sand deposits seem to lie in the area around Olmsted Lake with the deposits being greater than 125 feet thick. Relatively shallow granular deposits (ranging from 3 to 30 feet in thickness) are also present at the north-west extremity of Muskrat Lake.

Northerly of the deep sand deposits, at Olmsted Lake, the overburden, however, consists generally of a glacial till, with an average thickness of fifteen (15) feet; the till lies directly on bedrock.

The bedrock of the fault blocks consists mainly of a reddish-grey gneiss and granite of the Precambrian Period.

The surface drainage is controlled mainly by the bedrock geology, the prominent influence being the fault line at the base of the Muskrat Ridges. Along this fault runs a pre-glacial river valley, which presently is occupied in sections by the Muskrat River, Muskrat Lake, and Olmsted Lake, and several smaller lakes between Muskrat Lake and Olmsted Lake.

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2. DESCRIPTION OF THE AREA AND GEOLOGY: (cont'd) ...

The surface water drains mainly into this system to be led northward into the Ottawa River. Both permanent and intermittent streams are present and occupy small gullies and notches in the ridges. On the north-east slopes, some very small streams lead north-easterly to the Ottawa River.

3. FIELD AND LABORATORY WORK:

A total of thirteen boreholes were put down by means of conventional diamond drill rigs adapted for soil sampling purposes. In addition, two hand dug holes were performed in an area inaccessible to drilling equipment.

Samples of the overburden were obtained, at specified intervals, in a 2-inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. Where cohesive deposits were encountered, the split-spoon sampling was supplemented by taking 2-inch I.D. Shelby tubes, which were pushed manually into the soil. In addition, field vane tests were carried out, where possible, to determine the undrained shear strength of the clay strata. Bedrock was proven in 10 of the borings by obtaining either AXT or BX size rock core samples.

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes. An artesian water pressure head was encountered in the borehole put down at Site No. 10; the open hole was sealed at the source of the artesian water flow following completion of the boring operations.

The soil, bedrock and groundwater conditions encountered at the boring locations are presented on the Record of Borelog sheets, appended to this report. The location and elevation of the various boreholes were provided by personnel from the Eastern Region Engineering Surveys Section. The elevations in this report are referenced to a Geodetic datum. Boring locations and elevations are shown on Drawing No. W.O. 71-11048A.

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3. FIELD AND LABORATORY WORK: (cont'd) ...

An estimated stratigraphical profile, along the proposed alignment, is also plotted on the drawing.

All the samples were subjected to a careful visual examination in the field, and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following engineering properties of the overburden:

Bulk Density
Natural Moisture Content
Atterberg Limits
Grain-Size Distribution
Undrained Shear Strength
Consolidation Characteristics

The results of this testing are plotted on the Record of Borelog sheets and summarized on Figures No. 1 to 4, inclusive, all contained in Appendix 1 of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

Three main soil types were observed. They are in character: interglacial granular deposits, clay and glacial till.

Granular deposits, ranging from 23 feet to greater than 125 feet in thickness are present in an area running north-westerly from Haley Station to the north-west side of Olmsted Lake. Shallow deposits also exist on the north-west point of Muskrat Lake near the vicinity of Hwy. 17; in this area the granular material ranges from 1 to 30 feet in thickness.

An isolated, 39 foot thick, silty clay deposit was encountered along Cedar Haven Road, at a point about one mile north of Muskrat Lake.

Glacial till deposits overlay bedrock in that portion of the area south of Cedar Haven Park Road.

The overburden deposits are underlain by metamorphic bedrock of Precambrian Age.

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4. SUBSOIL AND BEDROCK CONDITIONS:

4.2) Surficial Deposits:

4.2.1) Fill:

A number of holes were put down in the vicinity of existing roadways. At one of these borings, Borehole No. 2, a fill material approximately 2 feet thick was encountered. The fill consisted of a reddish-brown sand with a trace of gravel. A standard penetration test carried out within the fill, gave an 'N' value of 13 blows/ft. This value indicates the fill to have been subjected to a moderate degree of compaction.

4.2.2) Peat:

A 6 foot thick surficial deposit of soft to firm black peat was encountered at Sites No. 7 and 8. This material is fibrous in nature.

4.3) Granular Deposits:

4.3.1) Silty Sand to Sandy Silt (Upper Deposit):

A granular deposit, composed of brown silty sand to sandy silt, was encountered in two general areas, one area running westerly of Olmsted Lake from Haley Station to Airport Road, and the other area running northerly from the north extremity of Muskrat Lake.

The southern deposit ranges in thickness between 23 and 85 feet, at Sites No. 1 and 3, respectively. A two foot layer of firm to very stiff clayey silt is present within these deposits. Further, at Site No. 2, boulders up to 8 inches in size were encountered below elevation 479.

The northern deposit, found at Sites No. 9 to 13, inclusive, ranges in thickness from 2 to 30 feet.

Grain-size distribution testing, carried out for samples of this deposit are plotted on Figure No. 1.

Standard penetration testing was carried out within this deposit; the results of which are shown on the Record of Borelog sheets. This testing gave 'N' values which range from 4 to 65 blows/ft. Based on these results, it is estimated that the relative density of this granular material varies from loose to very dense, being generally in the compact range.

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4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd) ...

4.3) Granular Deposits: (cont'd) ...

4.3.2) Gravelly Sand to Sand (Lower Deposit):

A granular deposit of gravelly sand to sand, brown to grey in colour, was encountered below the upper granular deposit at Sites No. 3 and 10. At Site No. 8 this deposit was found sandwiched between the peat and the silty clay stratum. At this location it was 5 feet thick and contained boulders up to 10" in size.

Penetration resistance testing carried out within this material, gave 'N' values ranging from 16 to 96 blows/ft. These results indicate a relative density varying from compact to very dense, being generally in the dense range.

4.4) Silty Clay to Clay:

At one location only, namely Site #8, a stratum of firm to very stiff clay to silty clay was encountered immediately beneath a surficial cover of peat and granular material. The stratum is 39 feet thick. Occasional sand seams, up to 1/2 inch thick, are found throughout this deposit.

Two Atterberg limit tests were carried out on samples of the cohesive soil, the results are plotted on the Borelog sheets as well as on the Plasticity Chart, Figure #2. This testing indicates that the cohesive stratum is inorganic and has a plasticity which ranges from intermediate to high.

Grain-size distribution testing was carried out on samples obtained from the two distinct zones within the till, using 2-inch O.D. split-spoon sampling equipment. The gradational variations between the two are shown on Figure No. 4.

The compressibility characteristics of the soil was determined by carrying out two laboratory oedometer tests on a representative sample. The tests are summarized as e vs. log P curves on Figure #3. Based on these results it is estimated that the deposit is preconsolidated by about 2,500 p.s.f. in excess of the existing overburden pressure, in the upper portion, increasing with depth to as much as 5,000 p.s.f.

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4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd) ...

4.5) Glacial Till:

In the area running southerly from Cedar Haven Park Road, the granular and cohesive deposits, discussed previously, are generally underlain by a glacial till. This pattern is interrupted east of the Village of Cobden, where the till protrudes to within a few feet of existing ground surface (refer to Sites No. 4, 5 and 6). The overall thickness of this deposit ranges from 9 to 15 feet. The upper 3 to 7 feet of the glacial till is cohesive in nature; i.e., it is composed of a clayey silt binding sand and gravel. This is underlain by a granular till consisting of a heterogeneous mixture of silt, sand, and gravel. Numerous boulders are present in the lower granular glacial till; the boulders are up to 14 inches in size.

Standard penetration testing was carried out within the deposit. This testing gave 'N' values which varied as follows:

Upper Cohesive Zone - 19 - 97 blows/ft.
Lower Granular Zone - 16 blows/ft. - 70 blows/3 inches

Based on this testing, it is estimated that the consistency of the cohesive zone within the till ranges from very stiff to hard, while the relative density of the granular zone varies from compact to very dense.

4.6) Bedrock:

Bedrock was proven at 10 of the boring locations by obtaining between 4.5 and 18.0 feet of either AXT or BX size rock core samples. The surface of the bedrock is very irregular in this area, varying from elevation 402.5 at Site No. 10 to 507 at Site No. 4. The variability of the bedrock topography is most likely due to faulting within the area as evidenced by the major fault scarps discussed in Section No. 2.

The bedrock is of Precambrian origin, typical of the Canadian Shield, and consists mainly of gneisses, that have been metamorphosed by intrusions of granite, mica, quartz and hornblende, with occasional interbeds of either pegmatitic granite or schist. The rock is grey in colour and generally is fractured in the upper 2 to 3 feet.

4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd) ...

4.6) Bedrock: (cont'd) ...

Site No. 6 showed the only difference in bedrock, here the bedrock was composed of a grey sandstone to shaly dolomite.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the course of the investigation, by recording the water level in the open boreholes. The observations are recorded on the borelog sheets and are summarized on Drawing No. W.O. 71-11048A.

The groundwater levels, as obtained by these observations, vary from a few inches below surface (Site 8) to below 80 feet (Site 2), the general depth being within 5 to 10 feet below ground surface.

An artesian water pressure head was encountered in the upper zone of the bedrock at Site #10, the head of which rose to elevation 458.5, which corresponds to a height approximately 2.5 feet above the surrounding ground surface. An aquifer condition probably exists in the upper part of the bedrock; this zone is being charged by groundwater from the surrounding terrain which is at a higher elevation.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

A new alignment, for Hwy. #17 North, has been proposed running westerly from Haley Station to about 9 miles south of Pembroke; a total length of about 17 miles. The purpose of this report is to provide preliminary information relating to the foundation aspects associated with this particular area.

The proposed highway will eventually incorporate two lanes in either direction, which will be separated by a wide median. It is understood that initially two lanes are to be constructed with an additional two lanes to be constructed in the future.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

6.1) General: (cont'd) ...

The subsoil, bedrock, and groundwater conditions, encountered in the area under investigation, have been discussed previously in this report under Sections No. 4 and 5. An inferred stratigraphical profile, along the proposed alignment, is shown on Drawing No. 71-11048A.

Two possible alignments for Hwy. #17N, designated 'North' and 'South' alignments, have been investigated. Structures will be required at various roadway and creek crossings along either alignment. These crossings are shown in plan on Drawing No. W.O. 71-11048A.

Preliminary (assumed) design data, recommendations pertaining to foundation design of the various structures, as well as the stability and settlement considerations for the approach fills, will be presented in tabular form in the following Subsections:

Subsection 6.2) 'North' Alignment

Subsection 6.3) 'South' Alignment

6.2) Hwy. #17N Crossings - 'North' Alignment:

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FOUNDATION RECOMMENDATIONS - SITE #1

HWY. #17N CROSSING OF CREEK

Predominant Overburden Strata Approx. Thickness (ft.)	EMBANKMENT		Remarks
	Approx. Height of Fill Proposed (2:1 Slopes)	Stability and Settlement	
Silty Sand to Sandy Silt (Loose to Dense) (23') Glacial Till - i) Cohesive (Hard) (20') ii) Granular (Very Dense) (21.5') (Boulders up to 14" in size throughout) Underlain by Granitic Gneiss Bedrock.	8' to 10'	1) No stability problems anticipated for fills with 2:1 slopes. 2) Probable elastic settlement. 1" (max.)	C.S.P. culvert could be placed beneath the fill in order to allow the creek to flow through this area.

FOUNDATION RECOMMENDATIONS - SITE #2

Underpass Structure - Hwy. #17N & Pinewood Park Rd.

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Approaches Fill Heights- 21' to 25'	
534.6	Fill (sand) - Compact (2') Sand to Silty Sand -Compact to very dense. (77'+) (Boulders up to 8" in size below elevation 482)	Pier(s): Spread footings founded at or below elevation 530 within the granular deposit Allowable bearing pressure up to 2.5 t.s.f. Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well-compacted granular material, using an allowable bearing value of 2.0 t.s.f. Alternatively, friction piles extending a minimum of 40' into the parent subsoil. eg. #14 timber piles could be designed using an allowable load of 25 tons/pile. Note: Differential settlements between the abutments and adjacent piers will not exceed ½"	Stability: Fills up to 25' (with 2:1 slopes) will be stable. Probable Elastic Settlement: 25' Fill (2:1 slopes) 1" (Max.)	

FOUNDATION RECOMMENDATIONS - SITE #3

UNDERPASS STRUCTURE - HWY. #17N and Airport Road

Approx. Existing Ground level	Predominant Overburden Strata Approx. Thickness (ft.)	RECOMMENDATIONS		Remarks
		Structure	Approaches Heights - 20 to 22'	
518±	Silty Sand to Sand. Loose to Very Dense. (85') Gravelly Sand. Dense to Very Dense. (39'+)	Piers and Abutments: Supported on friction type piles located in the upper granular deposit. eg. #14 timber piles extending 45' into the natural subsoil could be designed using an allowable load of about 20 tons/pile. Note: Differential settlements between the pile supported piers and abutments should not exceed 1".	Stability: Fills up to 22' (with 2:1 slopes) will be stable. Probable Elastic Settlement: Fills up to 20' (Max.) (2:1 slopes) 1" (Max.)	-----

FOUNDATION RECOMMENDATIONS - SITE # 4

Underpass Structure - Hwy. #17N and Roadway

Approx. Exist. Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Heights - 20' to 25'	
520±	Glacial Till i) Cohesive (Very stiff) (6.5') ii) Granular (Dense to very dense) (6.5') Underlain by granitic gneiss bedrock.	Pier(s): Spread footings founded at or below elev. 515 within the glacial till. Allowable bearing pressure up to 3.5 t.s.f. Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f. Alternatively, end-bearing piles driven to bedrock. Estimated pile tip elev. 507 - designed for the max. capacity for the pile section chosen. Note: Differential settlement between the abutments & adjacent piers will be negligible.	Stability : 25' high approaches (with 2:1 slopes) will be stable. Probable Elastic Settlement: Negligible.	Pier footing excavations will extend below the groundwater level recorded during the period of the investigation. A dewatering scheme will be required.

FOUNDATION RECOMMENDATIONS - SITE #6

Underpass Structure - Hwy. #17N and Roadway

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		
		Structure	Approaches Heights - 20' to 25'	
497	Glacial Till i) Cohesive (Very stiff to hard) (8') ii) Granular (Very dense) (7.5') Underlain by sandstone dolomite bedrock.	<u>Pier(s)</u>: Spread footings founded at or below elev. 491 within the glacial till. Allowable bearing pressure up to 4.5 t.s.f. <u>Abutments</u>: 'Perched on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f. Alternatively, end-bearing piles driven into the Glacial till stratum. Estimated pile tip elev. 485 - designed for the max. capacity for the pile section chosen.	<u>Stability</u>: 25' high approaches (with 2:1 slopes) will be stable. <u>Probable Elastic Settlement</u>: Negligible	------

FOUNDATION RECOMMENDATIONS - SITE #8

Hwy. 17N Cedar Haven Park Road

Underpass Structure

Approx. Existing Ground Level	Predominant Overburden Strata, Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Height of Fill 22'	
435±	Peat (Fibrous) (Soft) (6') Silty Sand and Gravel (Compact to Dense) (4.5') Silty Clay to Clay (Firm to Very Stiff) (36.5') Glacial Till - Compact (5') Underlain by gneiss bedrock	Piers and Abutments: Supported on end-bearing piles driven to bedrock. Estimated tip elevation 380. Designed for the max. capacity of the pile section chosen at the pier locations.	Stability: Fills up to 22' (with 2:1 slopes) will be stable, provided all organic material sub-excavated to its full depth. Probable Consolidation Settlement: 22' Fill (with 2:1 slopes) 3" to 4" in 2 to 3 years. 6" to 8" in 8 to 10 years.	Consideration should be given to constructing the approach fills prior to construction of the structure foundations, in order to: Minimize post-construction settlement.

FOUNDATION RECOMMENDATIONS - SITE #10

Hwy. #17N — Crossing of Creek

Predominant Overburden Strata Approx. Thickness (ft.)	Embankment		Remarks
	Approx. Height of Fill Proposed (2:1 Slopes)	Stability and Settlement	
Peat - Soft (0.5') Silty Sand to sand with gravel. Loose to very dense (53') Underlain by mica hornblend gneiss bedrock.	14' to 16'	Stability: No stability problems anticipated for fills with 2:1 slopes. Probable Elastic Settlement: 1 to 2" (max.)	C.S.P. Culvert could be placed beneath the fill in order to allow the creek to flow through this area. Note: All soft organic material must be removed from within the plan limits of the culvert and approach fills. The sub-excavation so formed should be backfilled with non-cohesive material.

FOUNDATION RECOMMENDATIONS - SITE #12

Underpass Structure - Hwy. #17N and Roadway

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Heights - 20' to 25'	
481±	Sandy topsoil (2.5 ft.) Underlain by mica hornblend gneiss bedrock.	Pier(s): Spread footings founded on or within sound bedrock (at or below elev. 475) Allowable bearing pressure up to 20 t.s.f. Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f.	Stability: 25' high approaches (with 2:1 slopes) will be stable. Probable Settlement: Negligible.	--------

FOUNDATION RECOMMENDATIONS - SITE #13

Underpass Structures - Hwy. 17N and Existing Hwy. 17

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches	
472±	Sand (trace of gravel) Compact. (4') Underlain by mica quartz gneiss bedrock.	Pier(s): Spread footings founded on fractured bedrock (elev. 468.5) or within sound bedrock. Allowable bearing values 10.0 and 20.0 t.s.f. respectively Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f. Note: Differential settlement between the spread footing supported abutments and adjacent piers will not exceed 1/2".	Stability: 25' high approaches (with 2:1 slopes) will be stable. Probable Elastic Settlement: Negligible.	-------

6.3) Hwy. #17N Crossings

'South' Alignment'

Site No.	Crossing	Type		Page No.
1	Common to 'North' Alignment		Refer to	10
2			" "	11
3			" "	12
4			" "	13
5	Roadway	Underpass Structure		20
7	Cedar Haven Park Rd.	Underpass Structure		21
9	Creek	Culvert, Fill		22
11	Roadway	Underpass Structure		23
13	Common to 'North' Alignment		Refer to	18

FOUNDATION RECOMMENDATIONS - SITE #5

Hwy. 17N and Roadway

Underpass Structure

Approx. Existing Ground Level	Predominant Overburden Strata Approximate Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Heights - 20' to 25'	
486±	Glacial Till i) Cohesive (hard) (3.5') ii) Granular (very dense) (4.5) Underlain by granitic gneiss bedrock.	Pier(s): Spread footings founded at or below elev. 482 within the glacial till. Allowable bearing pressure up to 5.0 t.s.f. Alternatively, footing to rest on bedrock with allowable pressure up to 20.0 t.s.f. Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well compacted material, using an allowable bearing value of 2.0 t.s.f. Alternatively, end-bearing piles driven to bedrock. Estimated tip elevation 477 - designed for the max. capacity for the pile section chosen.	Stability: 25' high approaches (with 2:1 slopes) will be stable. Probable Elastic Settlement: Negligible.	------

FOUNDATION RECOMMENDATIONS - SITE #7

Hwy. 17N and Cedar Haven Park Road

Underpass Structure

Approx. Existing Ground Level	Predominant Overburden Strata Approximate Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Heights - 20' to 25'	
451±	Peat (soft to firm) (6') Glacial Till i) Cohesive (very stiff to hard) (5') ii) Granular (compact) (10') Underlain by mica and horn-blend gneiss bedrock.	Piers: Spread footings founded at or below elev. 442, within the glacial till. Allowable bearing pressure to 2.5 t.s.f. Alternatively, end-bearing piles may be driven to bedrock. Abutments: End-bearing piles driven to bedrock. Estimated tip elevation 430. Designed for the maximum capacity for the pile section chosen. Note: Differential settlements between the abutments and piers on spread footings will not exceed 1".	Stability: 25' high approaches (with 2:1 slopes will be stable. Probable Elastic Settlement: Negligible.	All organic material within location of structures and approach fills must be removed. Approx. depth of excavation - 6 feet. The sub- excavation so formed should be back-filled with non-cohesive material. Excavation for footings and removal of organic material will extend below water level. A de-watering scheme will be required.

FOUNDATION RECOMMENDATIONS - SITE #9

Hwy. 17N

Crossing of Creek

Predominant Overburden Strata Approx. Thickness (ft.)	Embankment		Remarks
	Approx. Height of Fill Proposed (2:1 Slopes)	Stability and Settlement	
Sand to silty sand (Compact) (4') Silty Sand (below 4')	15' to 20'	Stability: No stability problems anticipated for fills with 2:1 slopes. Probable Elastic Settlement: Negligible.	C.S.P. culvert could be placed beneath the fill in order to allow the creek to flow through this area.

FOUNDATION RECOMMENDATIONS - SITE #11

Hwy. 17N and Roadway

Underpass Structure

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches Heights - 20' to 25'	
498±	Sandy topsoil (2.5) Underlain by mica quartz shist bedrock.	Pier(s): Spread footings founded on or within sound bedrock (at elev. 495). Allowable bearing pressure up to 20 t.s.f. Abutments: 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f.	Stability: 25' high approaches (with 2:1 slopes) will be stable. Probable Settlement: Negligible.	-------

6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

Based on our soil information obtained and recommendations pertaining to the structures required at each site, it appears that no major difficulties will be encountered and that either route would be acceptable, from a foundation point of view.

It should be stressed that the recommendations, given in this report, are of a preliminary nature. A complete foundation investigation will be required at all the sites, once the alignment for this portion of Hwy. #17N has been selected and the design details become available for the various sites.

7. MISCELLANEOUS:

The field work, performed during the period of May 27 to June 11, 1971 was supervised by Mr. A.E. Dyer, Student Technician (Field).

The drilling equipment was owned and operated by F.E. Johnston Drilling Company Ltd., Ottawa.

This report was written by Mr. A.E. Dyer and reviewed by Mr. M. Devata, Supervising Foundation Engineer.

September, 1971

APPENDIX I

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 1

FOUNDATION SECTION

JOB 71-11048 LOCATION ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 8 & 9, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Core CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
505.4	Ground level.					
0.0	Sandy topsoil.		1	SS	7	
1.0	Silty sand to sandy silt (Brown to grey)		2	SS	16	500
			3	SS	7	
	Clayey silt, some sand. Firm		4	TW	PM	
	Loose to compact.		5	SS	5	
	Silty sand with some gravel. Grey. Compact to dense.		6	SS	14	490
482.4			7	SS	39	
23.0	Clayey silt with sand and gravel. (Glacial Till) Grey. Hard.		8	SS	78	480
			9	SS	97	
			10	SS	74	470
			11	SS	64	
	Heterogeneous mixture of silt, sand and gravel, trace of clay. (Glacial Till) (Boulders throughout- up to 14" in size) Very dense.		12	SS	40/1"	460
			13	SS	70/3"	450
			14	SS	115/10"	
441.1			15			440
64.3	Granitic gneiss bedrock. Grey.		16	BX RC	50% Rec.	
436.1	Sound.					
69.3	End of borehole.					430

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P — w — w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

0 42 (58)
▼ 499.0
W.L. in open B.H.
9 76 (15)
June 9/71

6 44 44 6

20
15 ✛ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 2

FOUNDATION SECTION

JOB 71-11048 LOCATION Hwy. 17N & Pinewood Park Rd. ORIGINATED BY A.E.D.

W.P. 10-67 BORING DATE May 27, 28, 29 & 31, 1971 COMPILED BY H.R.

DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
534.6	Ground level.					
0.0 532.6	Sand (Fill) Compact.		1	SS	13	
2.0	Sand, trace of silt to silty sand. Occasional seams of clayey silt up to ¼" thick. Brown. Compact to dense.		2	SS	23	530
			3	SS	18	
			4	SS	26	
			5	SS	22	
			6	SS	25	520
			7	SS	26	
			8	SS	14	
			9	SS	30	510
			10	SS	35	
			11	SS	56	500
			12	SS	42	
			13	SS	31	490
			14	SS	42	
	Silty sand. (Random boulders throughout - up to 8" in size) Grey. Compact to very dense		15	BX RC	10% Rec	480
			16	SS	55	
			17	SS	45	470
			18	SS	26	
455.7			19	BX RC	20% Rec.	460
78.9	End of borehole.					450

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
w_p w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

0 92 (8)

B.H. dry during 6 7¼ (20) drilling operations May & June, 1971

0 72 (28)

2 84 (14)

8 52 (40)

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 4

FOUNDATION SECTION

JOB 71-11048 LOCATION ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE May 31, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
519.9 / 0.0	Ground level. Clayey topsoil.		1	SS	4	
1.0	Clayey silt with sand and gravel. Glacial Till. Very stiff.		2	SS	19	
	Het. mix. of silt, sand & gravel. Glacial Till. Brown. Dense to very dense.		3	SS	31	
507.1			4	SS	74	510
			5	SS	60/4"	
12.8	Fractured		6	BX RC	83% Rec.	
	Granitic gneiss bedrock. Grey to pink. Sound.		7	RC BX	92% Rec.	500
			8	BX RC	100% Rec.	
			9	AXT RC	96% Rec.	
489.1			10	AXT RC	96% Rec.	490
30.8	End of borehole.					480

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

▼517.4
2 32 51 15
W.H.in
47 42 (11)
open B.H.
June 4/71

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 5

FOUNDATION SECTION

JOB 71-11048 LOCATION Hwy. 17N ORIGINATED BY A.E.D.

W.P. 10-67 BORING DATE June 2, 1971 COMPILED BY H.R.

DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
485.6	Ground level.					
0.0	Clayey silt(topsoil)		1	SS	6	
1.0	Clayey silt with sand & gra.(Glacial Till) Hard.		2	SS	46	
	Het. mix. of si.sand, gra.(Glacial Till) Boulders in size at elev.Hol. V. dense.		3	RC	30%	480
477.1			4	SS	56	
8.5	Pegmatic granite bedrock. Pink Sound		5	BX RC	100% Rec.	
			6	BX RC	100% Rec.	470
465.7	Granitic gneiss, grey, Sound.		7	BX RC	100% Rec.	
19.9	End of borehole.					460

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

▽ 484.8
W.L. in
8 62 (30)

open B.H.
June 4, 197

Pier
Spread footings
481 — 50 t.s.f
alternatively to bedrock 20.0 t.s.f

Abutments
i) Perched in approaches
spread footings 2.0 t.s.f
ii) End-bearing piles to bedrock

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No.6

FOUNDATION SECTION

JOB 71-11048 LOCATION 17N ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 2, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
496.6	Ground level.					
0.0	Clayey topsoil		1	SS	8	
1.0	Clayey silt with sand and gravel. Glacial Till. Very stiff to hard.		2	TW	PM	
			3	SS	22	
			4	SS	45	490
	Het. mix. of silt, sand & gravel (Glacial Till) Boulders up to 8" in size throughout).		5	BX-RC	50%	
			6	BX-RC	42%	
			7	SS	79/9"	
481.3	Very dense.		8	SS	50/4"	
15.3	Sandstone to shaly dolomite bedrock. Grey.		9	BX	100%	480
				RC	Rec	
			10	BX	100%	
471.4	Sound.			RC	Rec.	
25.2	End of borehole.					470

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

▼ 495.1
7 36 43 14
W.L. in open B.H. June 2,1971
31 63 (6)

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No.7

FOUNDATION SECTION

JOB 71-11048 LOCATION 17N & Cedar Haven Park Road (Alt.) ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 2, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Coring CHECKED BY D.M.

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
450.6	Ground level.					450
0.0	Peat. Black.		1	SS	14	
444.6	Soft to firm.		2	SS	5	
			3	SS	13	
6.0	Clayey silt with some sand & gra. (Glacial Till) V. stiff to hard		4	TW	PH	
			5	SS	33	440
	Het. mix. of silt, sand & gravel. (Glacial Till) Grey		6	SS	17	
			7	SS	16	
430.2	Compact.					430
20.4	Fractured		8	BX RC	60% Rec.	
			9A	BX-RC	92%	
	Mica and hornblend gneiss Bedrock. (Pegmatic granite interbeds)		9B	BX RC	93% Rec.	420
			10	BX RC	96% Rec.	
413.3	(Grey) Sound.					
37.3	End of borehole.					410

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS
GR. SA. SI. CL.

448.0 W.L. in open B.H. June 4/71

23 64 (13)

3.0 tsf.

2 - 2½

Piers
Spread footings in glacial till (elev. 442) 3.0 tsf.
alternate end-bearing to bedrock.
Abutments
End-bearing piles to bedrock

Differential Settlement
Piers on S.F. ∑ 1" max.)
Abutments on Piles

20
15 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.1 SITE No.8 FOUNDATION SECTION

JOB 71-11048 LOCATION 17N & Cedar Haven Park Road (South Side) ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 3 & 4, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
435.6	Ground level.					
0.0 / 429.6	Peat (Fibrous) (Black) Soft		1	SS	1	
			2	TW	PM	
			3	SS	75/6"	430
6.0 / 424.6	Silty sand & gravel (Boulders up to 10" in size) Brown. V. Dense		3A	BX-RC	75%	
			3B	BX-RC	50%	
11.0	Silty clay to clay Sensitive. Occasional seams of sand up to ½" thick throughout. Grey. Firm to very stiff.		4	SS	1	
			5	TW	PM	420
			6	TW	PM	
			7	TW	PM	410
			8	TW	PM	
			9	TW	PM	400
			10	TW	PM	
			11	TW	PM	390
385.6						
50.0 / 380.4	Het. mix. of silt, sand & gravel. (Glacial Till) Compact.		12	SS	6	
55.2	Fractured		13	BX RC	75% Rec.	380
	Mica hornblend gneiss Bedrock		14	BX RC	100% Rec.	
368.8	Grey. Sound.		15	BX RC	80% Rec.	370
66.8	End of borehole.					360

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

+10 +8 +12 +14 +16 ×●5 +17 +12 +26 +6 +36 +7 ×6 +11 +7 ++2700 +5 +5.5

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_p
WATER CONTENT — w
w_p w w_L
WATER CONTENT %
20 40 60

W_p/94 W_L/97 W/236

BULK DENSITY γ P.C.F.

115 118.5

REMARKS

435.3
W.L. in open B.H. June 4/71

GR. SA. SI. CL.

20
1/2 ⊕ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

$P_c \approx 4 \times C_u$ 36' 72 2' 1 A 9 = 22×140 + 30×6

a = 44'
b = 18'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.2 SITE No.8 FOUNDATION SECTION

JOB 71-11048 LOCATION 17N & Cedar Haven Park Road (North Side) ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 8, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
435.6	Ground level.					
	Peat (Fibrous) Black. Soft.		1&2	TW	PM	
429.6			3	TW	PM	430
6.0	Silty sand & gravel. Brown.					
425.1	Compact to dense.		4	SS	2	
10.5	Silty clay to clay.		5	TW	PM	
	Sensitive.					420
	Occasional seams of sand up to ½" thick throughout.					
	Grey.					410
	Firm to very stiff.					
						400
388.5						390
47.1	End of borehole.					380

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

+3.5
+13
9
+12
+10
+10
+15
+24
+8
+11
+9
+15
+16.5
+5.5
+5
+7

e_o = 1.93
P_c = 1.9

LIQUID LIMIT w_L
PLASTIC LIMIT w_p
WATER CONTENT w
WATER CONTENT %
20 40 60

W_p	W_L	W
65 / 77	76 / 89	182

BULK DENSITY γ P.C.F.: org. cont. 17%

REMARKS: ▼ 434.6 W.L. in open B.H. June 9/71

3400

20
15 ⊹ 5 % STRAIN AT FAILURE
10

3.6

(890 + / 720)

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.1 SITE No.9 FOUNDATION SECTION

JOB 71-11048 LOCATION Hwy. 17N & Creek ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 10, 1971 COMPILED BY A.E.D.
DATUM Geodetic BOREHOLE TYPE Hand Dug CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
435±	Ground level.									
0.0	Sandy topsoil.		1	C.S.	---			○		
2.0	End of hole. Bedrock.					430				Hole dry June 10/71

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2 SITE No.9 FOUNDATION SECTION

JOB 71-11048 LOCATION ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 10, 1971 COMPILED BY A.E.D.
DATUM Geodetic BOREHOLE TYPE Hand Dug CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE
443+	Ground level.					
9.8	Sandy topsoil.					
439.0	Sand to silty sand. Compact.					440
437.5						
5.5	End of hole.					
	Clayey silt with some sand and gravel. (Glacial Till) Grey. Hard.					430

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
O UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_p
WATER CONTENT w
w_p — w — w_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL.

Hole dry, June 10/71

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD–MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 10

FOUNDATION SECTION

JOB 71-11048 LOCATION 17N & Creek ORIGINATED BY A.E.D.

W.P. 10-67 BORING DATE June 10 & 11, 1971 COMPILED BY H.R.

DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Rock Coring CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
456.0	Ground level.					
0.0	Peat Soft		1	SS	9	
0.5	Silty sand to sand, some silt. Brown. Loose to very dense.		2	SS	23	450
			3	SS	16	
			4	SS	13	
			5	SS	13	
			6	SS	15	440
			7	SS	5	
			8	SS	64	430
427.0						
29.0	Silty sand with gravel to sand with		9	SS	16	
	Silty clay. Firm. gravel. Brown to grey. Compact to very dense.		10	SS	4	420
			11	SS	53	
			12	SS	31	410
402.5			13	SS	46	
53.5	Mica hornblend gneiss Bedrock. Interbedded with orthoclase gneiss. Grey. Sound.		14	BX RC	74% Rec.	400
392.7			15	BX RC	70% Rec.	
63.3	End of borehole.					390

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

w_P w w_L

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

Artesian Head ▽ EL. 458.5 BR.SA.SI.CL.

▽ 456 W.L. in open B.H.

○ 50 (50) June 11/71

5 53 34 8

▽ Artesian water encountered El. 402.5

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No.11

FOUNDATION SECTION

JOB 71-11048 LOCATION 17N ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 4, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing, BX Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	REMARKS
497.5	Ground level.						
0.0 / 495.0	Sandy topsoil.		1	SS	29		
2.5	Mica quartz schist. Bedrock. Grey. Sound		2	BX-RC	92%		B.H. dry, June 4/71
			3	BX RC	90% Rec.	490	
			4	BX-RC	100%		
482.0			5	AXT RC	100% Rec.		
15.5	End of Borehole.					480	

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

GR.SA.SI.CL.

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MTC - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No.12

FOUNDATION SECTION

JOB 71-11048 LOCATION 17N ORIGINATED BY A.E.D.

W.P. 10-67 BORING DATE June 7, 1971 COMPILED BY H.R.

DATUM Geodetic BOREHOLE TYPE NX Casing, BX & AXT Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
480.8	Ground level.					480
0.0 / 478.3	Sandy topsoil.		1	SS	6	
2.5	Sandstone bedrock, White, Fractured		2	BX RC	No Rec.	
			3	BX-RC	100%	
	Mica hornblend gneiss bedrock.		4	AXT RC	85% Rec.	470
	Grey. Sound.		5	AXT RC	100% Rec.	
462.0	Pegmatite Sound.		6	AXT RC	90% Rec.	
18.8	End of borehole.					460

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR.SA.SI.CL.

B.H. dry, June 7/71

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No.13

FOUNDATION SECTION

JOB 71-11048 LOCATION Hwy. 17N ORIGINATED BY A.E.D.

W.P. 10-67 BORING DATE June 3, 1971 COMPILED BY H.R.

DATUM Geodetic BOREHOLE TYPE NX Casing & BX Rock Coring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE
472.2	Ground level.					
0.0	Sandy topsoil.		1	SS	16	470
1.0 / 468.5	Sand, trace of gravel & silt. Compact.		2	SS	30/2"	
3.7	Fractured		3	BX-RC	75%	
			4	BX-RC	100%	
	Mica quartz gneiss bedrock, interbeds of schist. Grey to pink. Sound.		5	BX RC	100%	460
455.2			6	BX RC	100%	
17.0	End of borehole.					450

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
WATER CONTENT % 10 20 30

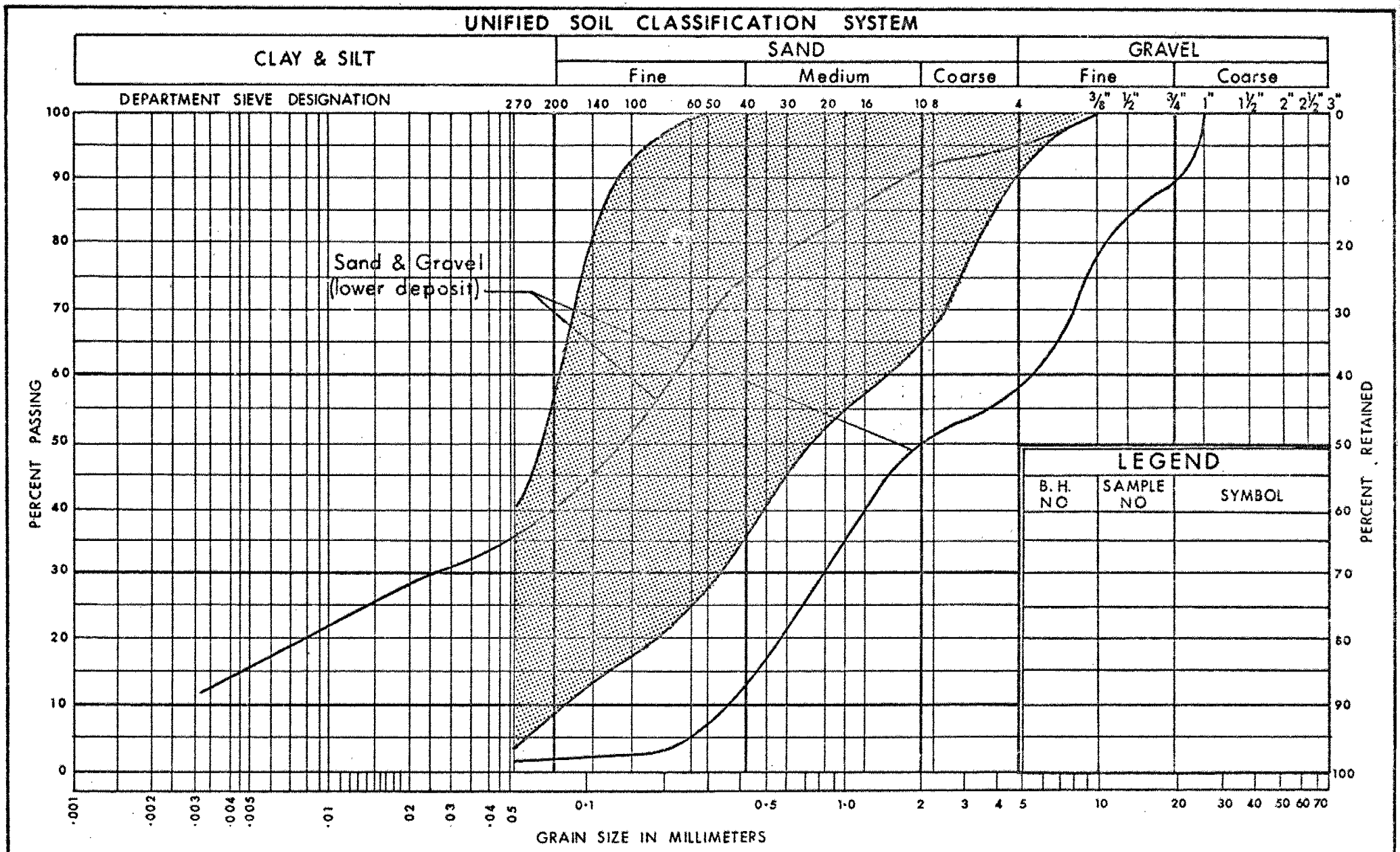
BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.

9 81 (10)
B.H. dry, June 3/71

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB MT-17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SILTY SAND TO SANDY SILT

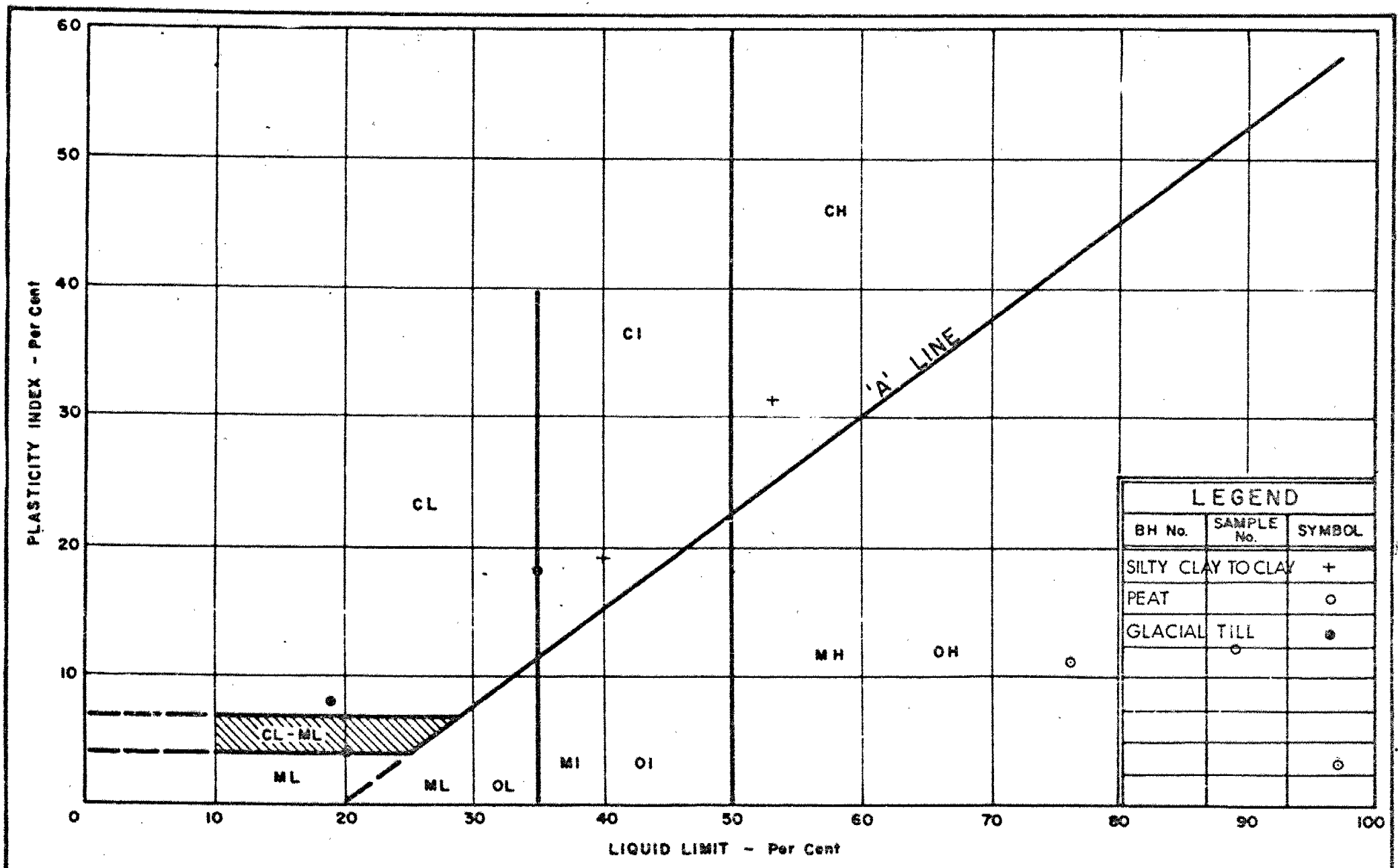
W.P. No. 10 - 67

JOB No. 71-11048

FIG. No 1

FORM OB-MT-252

REVISED JUL[illegible]966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

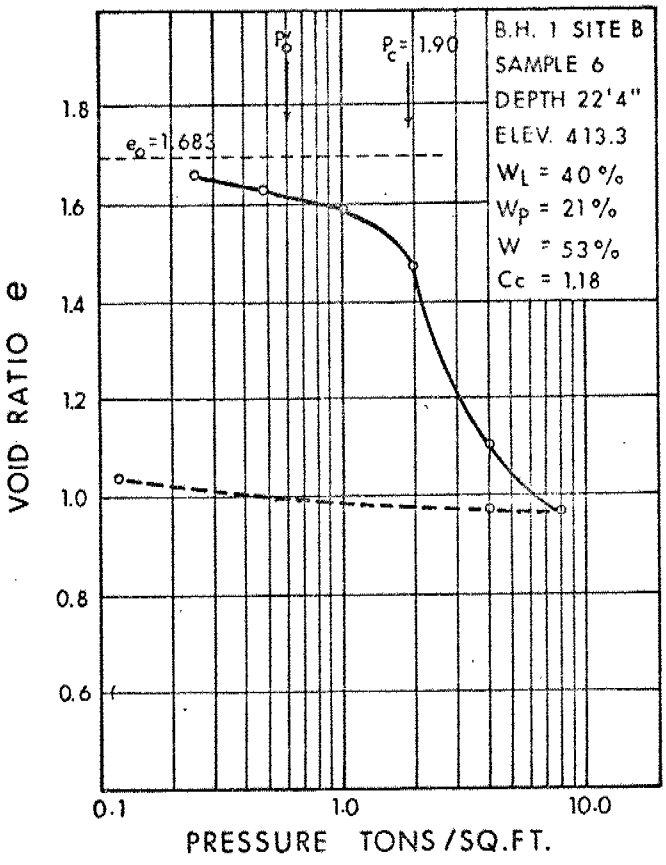
W.P. No. 10 - 67

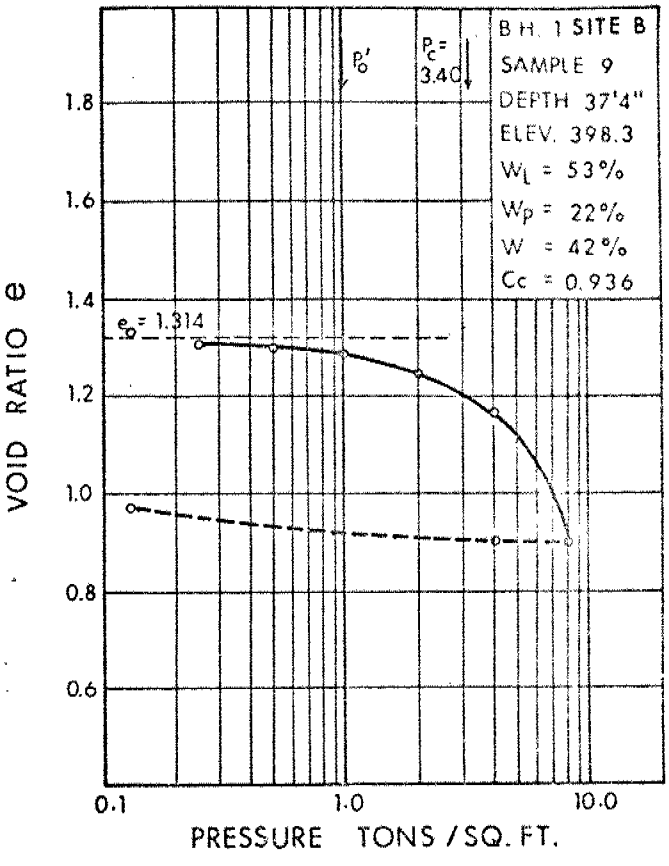
JOB No. 71 - 11048

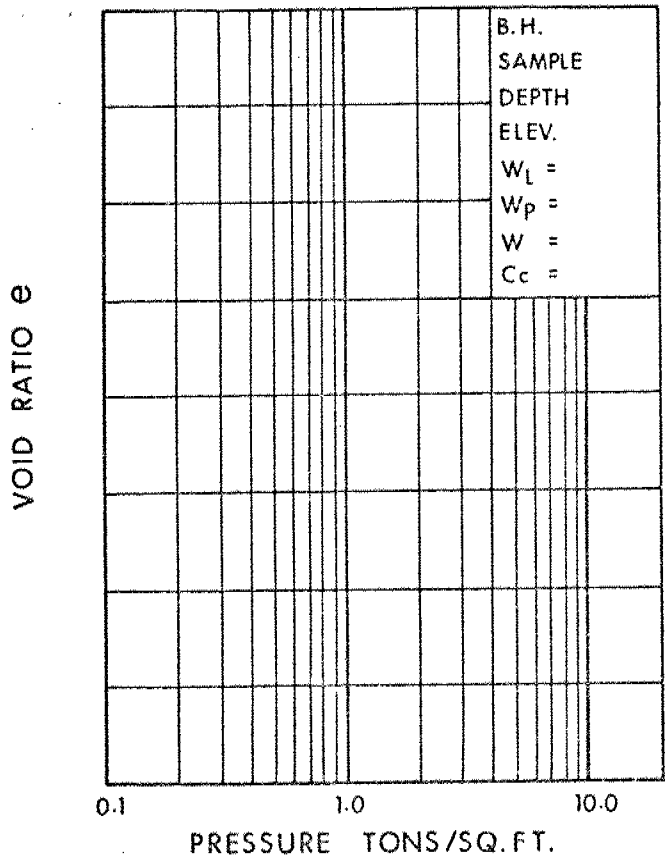
FIG. No. 2

VOID RATIO – PRESSURE CURVES

JOB NO. 71-11048







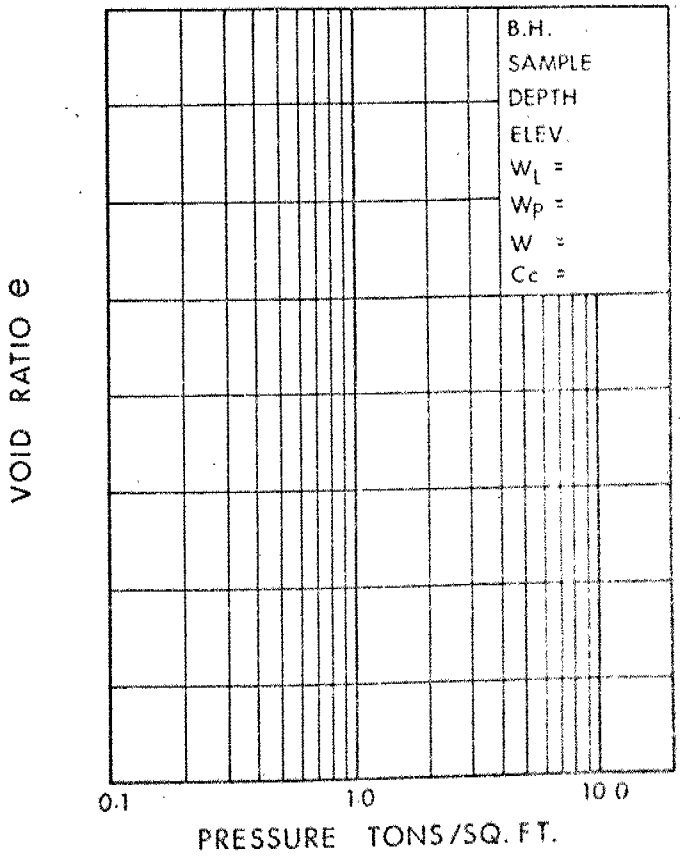
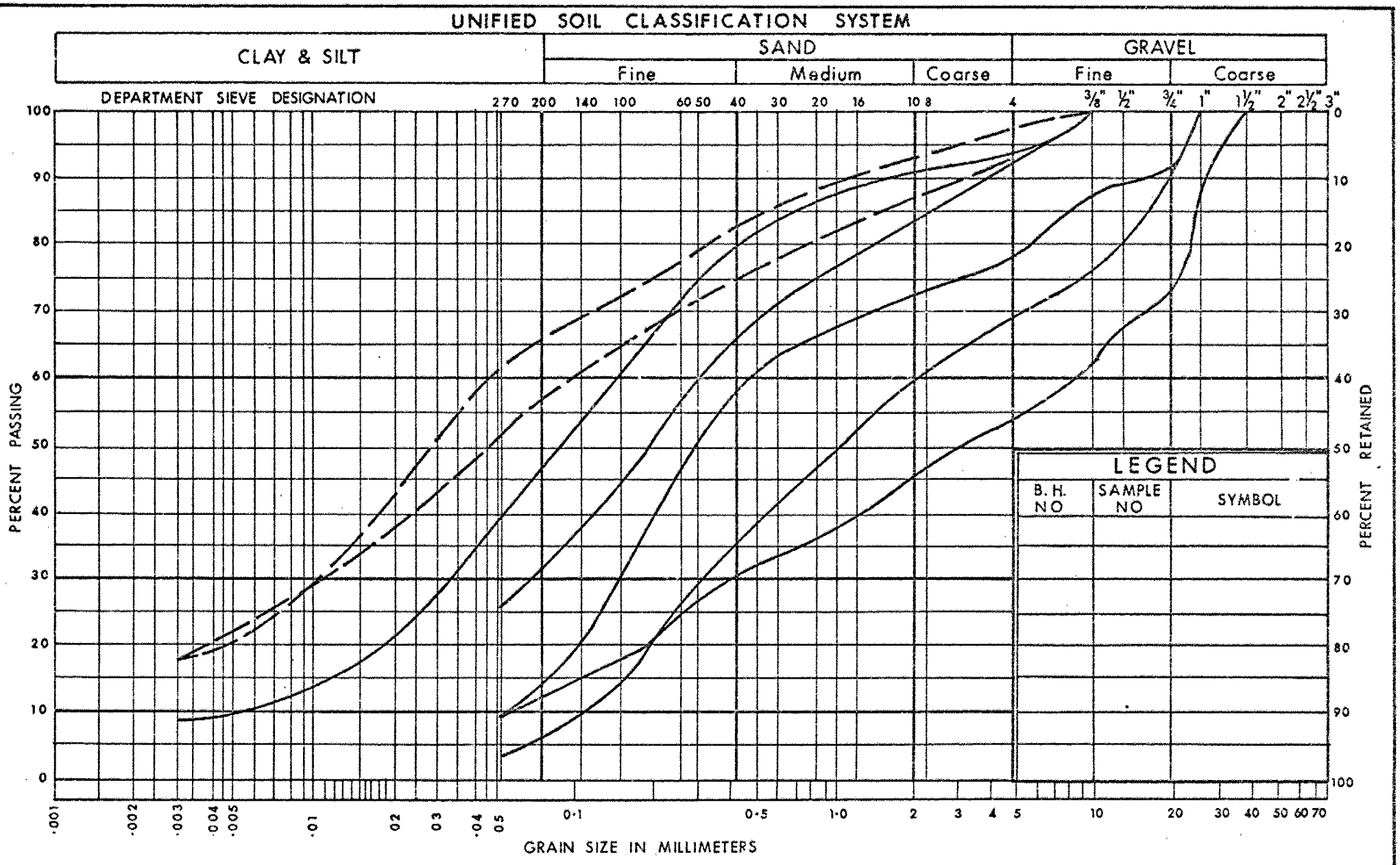


FIG. 3

FORM CB MT-17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL

——— GRANULAR — · — · — COHESIVE

W.P. No. 10-67

JOB No. 71-11048

FIG. No4

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

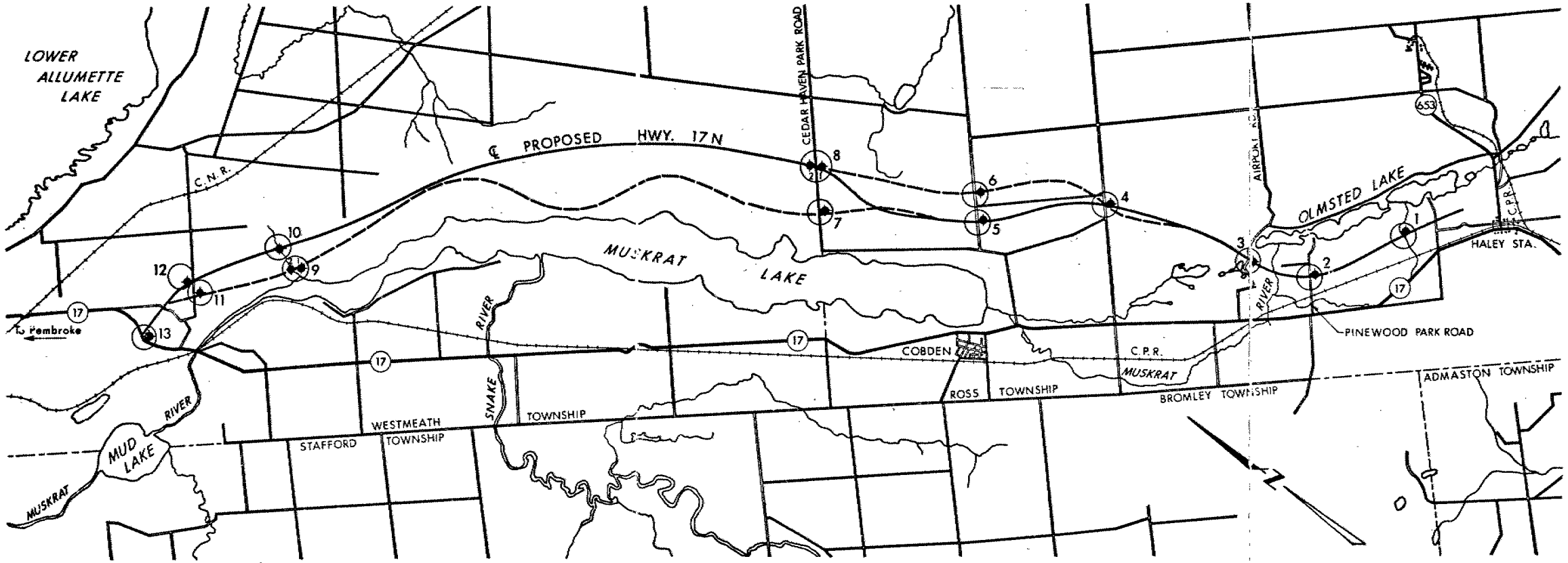
CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

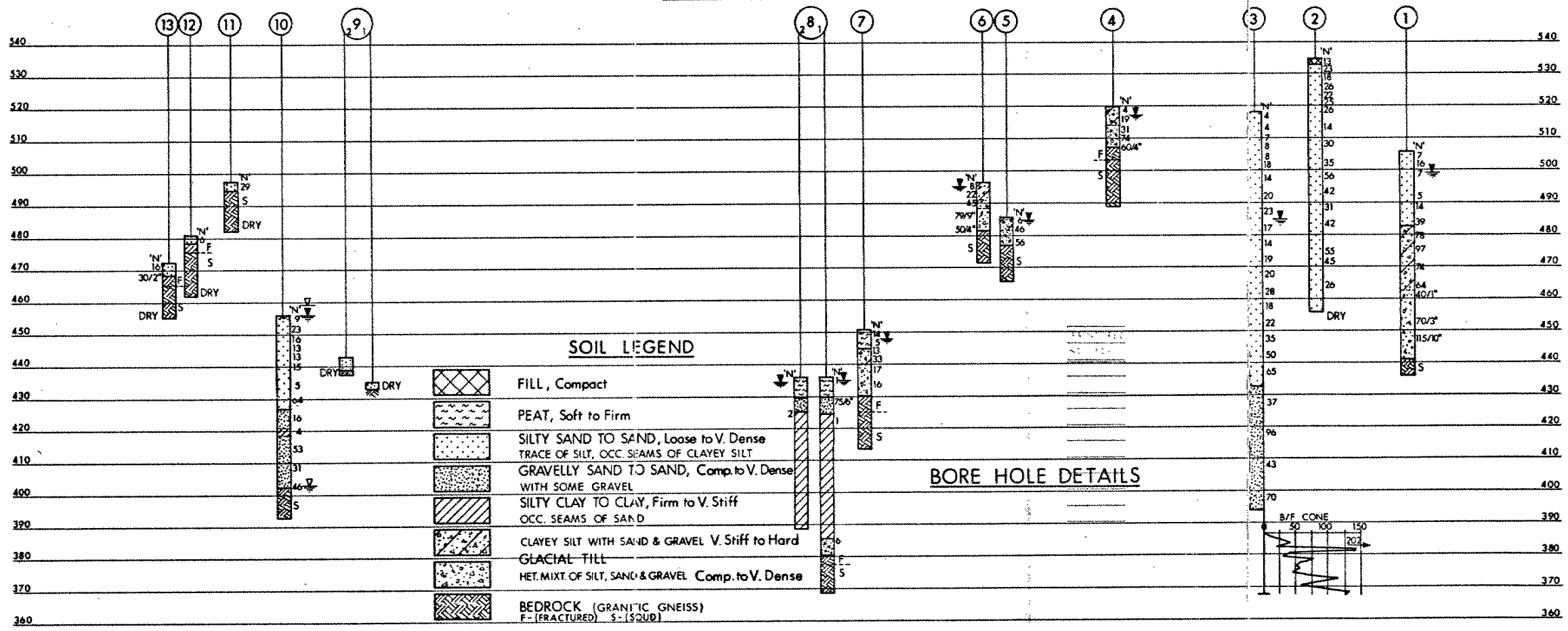
TYPE OF SAMPLE

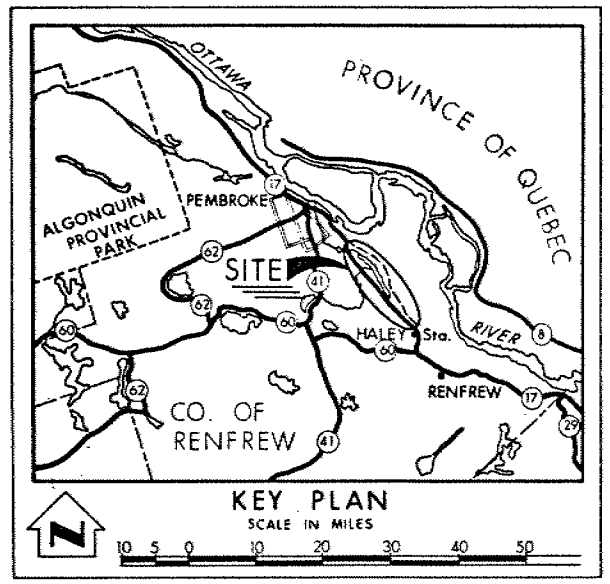
S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY







LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. May & June 1971.
- Site Locations
- Artesian Water Level (Head / Encountered)

NO.	ELEVATION	STATION	OFFSET
1	505.4		
2	534.6		
3	517.9		
4	519.9		
5	485.6		
6	496.6		
7	450.6		
8(1)	435.6		
8(2)	435.6		
9(1)	435.0		
9(2)	443.0		
10	456.0		
11	497.5		
12	480.8		
13	472.2		

— 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.

REVISIONS

DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION SECTION

PRELIMINARY INVESTIGATION

HALEY STA. WESTERLY 17-5 MILES

HIGHWAY NO. PROP. 17N DIST. NO. 9
CO. RENFREW
TWP. WESTMEATH & ROSS LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. B.T.D.	CHECKED	W.P NO. 10 - 67	DRAWING NO. 71 - 11048 A
DRAWN S.R.	CHECKED	JOB NO 71 - 11048	
DATE JULY 26, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

Copies made for: (TCK: 16/6/75)
C. S. Gre[redacted]tt. K. Bassi
M. Devata
Indian River Bridge File

Mr. F. D. Billings,
Regional Director,
Kingston, Ontario.

Engineering Plans Office,
Kingston, Ontario.

11 June 75.

PEMBROKE BYPASS
W.P. 1-67-01 and W.P. 10-67-01

At the schedule meeting held on 4 June 75, some discussion took place regarding the above projects relative to survey activity, and in particular the "final alignment" aspect.

For the record, it should be noted that at no time since a survey request was issued for these projects (22 April 75), has any semblance of finality been apparent. The following chronological sequence of events may serve to illustrate this.

On 28 Feb. 75, a request was acted upon to survey compass lines in the area of the CPR crossing on W.P. 10-67-01. As of this writing, no decision has been passed to us concerning final alignment. One is expected in two or three weeks.

A Survey Request covering both projects was issued on 22 Apr. 75. Work commenced at County Road 17 on W.P. 1-67-01 on 28 Apr. 75. A start at the westend is imperative due to survey methods requiring surveys to commence at township lines and to run west to east, or south to north. Two survey parties were involved.

...../2

On 28 Apr. 75, a request was issued for investigative work in the form of detail and other topographical ties to the Indian River, just east of Hwy. #41 in the Township of Stafford. This put a halt on all survey activity on W.P. 1-67-01 east of Hwy. #62, because the P.I. of the tangent crossing the Indian River and the tangent crossing Hwy. #62, would be altered if there were any change in the Indian River crossing.

Further, no survey activity could be commenced on W.P. 10-67-01, because this same doubtful Indian River crossing controlled the location of the first tangent in the Township of Stafford. The indecision regarding the CPR crossing prevented any survey work in the Township of Westmeath, since that site is located at the beginning of the Township, preventing application of survey methods.

Consequently, at the middle of May/75, there was only one area where survey activity could be carried out on a continuous basis, that being the 2 miles± from County Road 17 to Hwy. #62, the very west end of W.P. 1-67-01. Ironically, it is on this portion that an Indian burial ground is alledgedly located, presumably on the proposed R.O.W.

With these developments, it became obvious that we no longer had a firm line anywhere, and it was necessary to reduce the number of parties from two to one to eliminate over-staffing of the only area available to work in.

...../3

The Indian River crossing was resolved and passed to us 26 May 75. However, we pointed out to Planning and Design that a further small shift would allow complete avoidance of an owner they wished to leave alone. This was considered and on 2 June 75 a firmed up line was passed to the field for processing. This permitted work to get underway through to the Muskrat River (W.P. 10-67-01) at which point a further problem had developed.

An investigation precedure, field-wise and mathematically, was carried out to ascertain a change in degree of curvature, east of the Muskrat River crossing, to effect a shift away from the north bank of the river. This has just now been accomplished, and this portion of the line is now firmed up (11 June 75). Surveying may now proceed into Pembroke Township, coming to a halt west of the CPR crossing until that site is located and finalized.

The second survey party was returned to the job on 9 June 75. It has been scheduled for a third to move in on 23 June 75 and a fourth on 30 June 75, barring any disaster of the aforementioned variety.

On 10 June 75, Planning and Design advised that a change in curvature would be necessary at the east end of W.P. 10-67-01, where it connects to Hwy. #17 at Meath Hill. This is now being processed mathematically and should not cause any delay.

...../4

Prior to any project survey work, considerable framework survey was necessary to traverse and tie to the 2nd order control, in order to compute, analyse and store the control network, thereby facilitating computation and co-ordination of the final alignment. This pre-project work assisted immeasurably in the determination of final alignments in the contentious areas. This work was commenced in early March and carried out as and when other work on the job permitted. Some of it still remains to be done.

Permision to enter and survey was obtained by the Property Section prior to any entry of private property. Some embarassment was experienced when agents were confronted by owners asking why they were securing permission to enter when people had been in and out of their property already. This was in an area east of the Muskrat River and west of the CPR crossing, in Pembroke and Stafford Townships.

Our survey staff had in fact been in and finished in that area prior to the agent's canvass, however, they were acting on permission to enter obtained a year previously related to foundation investigations, and in every case the owner was approached verbally by our Party Chief and was granted permission. I want to make this quite clear - our policy, as required by the Ministry, is at all times to verbally approach each resident owner and advise of our intentions, and if necessary, secure verbal permission to enter prior to the written document. This is standard practice.

...../5

We could have advised the agents of our activities, however this particular permission to enter had been secured a year earlier, and was a matter of file record. We did not assume it would be overlooked by others.

All this has led to scheduled date adjustments on W.P. 1-67-01, the project that possibly will be processed last anyway. Dates for W.P. 10-67-01 were initially set later than W.P. 1-67-01 because of its many doubtful line locations and the necessity to commence work at the west end for survey purposes. The changes are as follows.

W.P. 1-67-01

Cross-sections issued - was 13 Aug. 75 - to 17 Sept. 75

"E" and "G" issued - was 23 July 75 - to 20 Aug. 75

Plan Profile issued - was 1 Oct. 75 - to 5 Nov. 75

ETR issued - was 29 Oct. 75 - to 7 Jan. 76

Due to the delicate balance of present scheduling, staffing arrangements and vacation schedules any further line revisions or adjustments will automatically require date assessment and possible change on one or both projects. I have already advised R. Forrest of above changes.

A. G. Boucher.

AGB.sgb

c.c. A. J. Percy,
R. J. Forrest,
A. E. Lodge,
T. C. Fitzgaland,
E. R. Saint.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

AE8

W.O. 71-11048 BD

TO: Mr. M. R. Ernesaks,
Reg. Functional Planning Engineer,
Kingston, Ontario.

FROM: Bridge Section,
Kingston, Ontario.

ATTENTION: Mr. C. E. Pritchard

DATE: June 28, 1971.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 10-67-00, Highway 17N,
Haley Station to Pembroke,
District 9 - Ottawa

With reference to your memorandum dated May 20, 1971, I attach herewith a list of preliminary bore hole results obtained on the alternative alignments for the above project shown on the 1" = 1000' photo mosaic enclosed with your memo. The bore hole numbers refer to the sites as numbered on the mosaic.

You will see from the results that the only site where possible structural problems might arise is Site #8 where clay was encountered having a minimum shear strength of 700 lb. per sq. ft. At all other sites competent material was found. These results are preliminary only, having been abstracted from notes in the field. A report from Foundation Section will follow shortly.

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl
Encl.
c.c.-
P. D. Billings
B. R. Davis
E. R. Saint
L. G. Timson
S. McCombie
A. G. Stermac - Att. M. Devata

W.P. 10-67-00, Highway 17N
Haley Station to Pembroke
District 9 - Ottawa

Bore Hole Number		Foundation Soils	
1	OK	0 - 1'	Top Soil
		1' - 12'	Loose compact sand
		12' - 31'	Compact to very dense glacial till
		31' - 64'-3"	Bouldery zone in till
		64'-3" -	Granite bedrock
2	OK.	0 - 60'	Competent sand
		60' - 79'	Glacial till
3	OK	0 - 70'	~~(Loose to Dense)~~ Silty sand & gravel
		70' - 124'	~~Dense to Very~~ dense sand
4	OK	0 - 1'	Top Soil
		1' - 5'	Sand (Loose to Compact)
		5' - 13'	Glacial till (Dense to Very Dense)
		13' - 30'	Bedrock (GRANITE)
5	OK.	0 - 8'5'	Glacial till (Dense to Very Dense)
		8'5' - 19'-11"	Granite bedrock
6	OK.	0 - 1'	~~Loose sand~~ TOPSOIL
		~~1'-6" - 3'~~	~~Silty clay~~ (COMPACT TO VERY DENSE)
		1'3" - 15'4"	Dense sand & boulders
		15'4" - 25'-2"	Bedrock (GRANITE)
7	Minor Change.	0 - 3'	~~Peat~~ Sand Fill (Compact)
		3' - 8'	Peat
		8' - 20'-5"	Silty sand & gravel (GLACIAL TILL) (COMPACT TO DENSE)
		20'-5" -	Bedrock
8 (a)	OK.	0 - 5'	Soft peat
		5' - 11'	Very dense sand & gravel
		11' - 49'-4"	Firm to very stiff clay
		49'-4" - 55'-3"	Glacial till (Compact)
		55'-3" -	Bedrock (Granite)

Note: Lowest shear strength in upper strata of clay 700 lb./sq. ft. Will probably support normal height fills with no problems.

.....2

Bore Hole Number	Foundation Soils	
8 (b) OK	0 - ~~8~~'	Soft peat
	~~8~~' - 12'	Sand & gravel
	12' - 46'	Firm to very stiff clay
	46' -	Refusal
9 OK	Bedrock visible at creek bottom	
10 OK.	0 - 53'-5"	Loose to very dense silty sand
	53'-5" -	Bedrock (Granite)
11 OK	Bedrock at 3' below ground level	
12 OK	Bedrock 2'-6" - 3' below ground level	
13 OK.	Bedrock 4' below ground level	

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl
June 28, 1971

FORM OD-M 3 - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE No. 3

FOUNDATION SECTION

JOB 71-11048 LOCATION Hwy. 11N & Airport Road ORIGINATED BY A.E.D.
W.P. 10-67 BORING DATE June 1, 2, 4, 5 and 7, 1971 COMPILED BY H.R.
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Cone Penetration CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w / WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
517.9	Ground level.									
0.0	Sandy topsoil.		1	SS	4					
2.0	Silty sand to sand, some silt. Brown. Loose to compact.		2	SS	4					
			3	SS	7	510		o		0 49 (51)
			4	SS	8					
			5	SS	8					
			6	SS	18	500				
			7	SS	14			o		0 90 (10)
			8	SS	20	490				
			9	SS	23					
	Silty sand. Grey		10	SS	17					▼ 485.0 W.L. in open B.H. June 7/71
			11	SS	14	480				
			12	SS	19					
	Clayey silty sand. Very stiff.		13	SS	20	470				
			14	SS	28			o		0 67 (33)
	Compact to very dense.		15	SS	18	460				
			16	SS	22					
			17	SS	35	450				
			18	SS	50					
			19	SS	65	440				
432.9										
85.0	Gravelly sand to sand, with some gravel. Grey.		20	SS	37	430		o		41 58 (1)
			21	SS	96	420				

	Dense to very dense.	22	SS	43	410	
					400	
		23	SS	70		
393.9						
124.0	End of borehole.				390	
					380	202
368.1					370	132 126.9
149.8	End of cone test.					
					360