

MEMORANDUM

30M13-1

To: Mr. E. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: November 30, 1970

OUR FILE REF.

IN REPLY TO

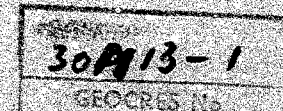
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SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed Extension to the Overpass
Structure at the Crossing of Hwy. #400
And Township Road (Site #37-59)
Township of King -- County of York
District No. 6 (Toronto)
W.O. 70-11038 -- W.P. 105-70-10

CONT 71-016



Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/MieF
Attach.

cc: Messrs. B. R. Davis
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PRINCIPAL FOUNDATION ENGINEER

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed Extension to the Overpass
Structure at the Crossing of Hwy. #400
And Township Road (Site #37-59)
Township of King -- County of York
District No. 6 (Toronto)
W.O. 70-11088 -- W.P. 105-70-10

1. INTRODUCTION:

Major reconstruction is proposed for Hwy. #400 from the northern limits of Metropolitan Toronto northerly to the outskirts of the City of Barrie. This will involve the extensions of existing structures at various locations. In conjunction with this project, the Foundation Section was requested, in a memo from Mr. G. C. E. Burkhardt, Regional Bridge Planning Engineer, Central Region, dated October 6, 1970, to carry out a subsurface investigation at the crossing of Hwy. #400 and King Twp. Road. An investigation was subsequently carried out by this Section to determine the subsoil and groundwater conditions at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations for the widening of the existing overpass structure, as well as stability and settlement considerations of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is situated at the crossing of Hwy. #400 and a King Township Road; this is located in Concession V, between Lots 15 and 16. Hwy. #400 has two lanes in both the Northbound and Southbound direction. There is an existing structure at this crossing; the pertinent details will be discussed in Section 6.

The area, which is cultivated and being used for farming purposes is gently undulating in relief between about elevations 1076 and 1080.

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

Physiographically the site is situated in the region known as "Oak Ridges". The Oak Ridges region is basically covered by an interlobate moraine of Wisconsinan glacial age. In this localized area it appears to have a kame topography - i.e., it is hilly with a knob-and-basin relief. The hills are primarily composed of irregularly mixed sandy or gravelly materials. In some areas, however, extensive thicknesses of boulder clay protrude above the outwash. The overburden deposits are underlain by shale bedrock of the Meaford-Dundas formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Two sampled boreholes, each accompanied by a dynamic cone penetration test, were put down at this site. The borings were advanced by means of a conventional diamond drill adapted for soil sampling purposes.

Samples of the subsoil were recovered at required depths in a 2" O.D. split-spoon sampler which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests.

The locations and elevations of all the borings were surveyed in the field by personnel from the Foundation Section; they are shown on Drawing 70-11038A, together with an estimated stratigraphical section across the site. All elevations in the report are referenced to a geodetic datum.

All samples were visually examined and identified in the field and later in the laboratory. Following this, laboratory tests were carried out on selected representative samples to determine the following physical properties:

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

Atterberg Limits
Natural Moisture Contents
Bulk Densities
Grain-Size Distributions

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on Figures #1 to 5, located in the Appendix of the report.

4. SUBSOIL CONDITIONS:

4.1) General:

The predominant stratum across the site is composed of a stiff to hard clayey silt with occasional seams of silty sand, extending at least 40 ft. below the natural ground surface. The clayey silt deposit is overlain by a 4-ft. surficial layer of sand at certain locations of the site.

The boundaries of the various deposits are shown on the accompanying borelog sheets. The stratigraphical profile plotted on Dwg. #70-11088A, is inferred from this boring data.

From ground surface downwards, the various soil types encountered are as follows:

4.2) Sand - some Silt and Gravel:

A four-ft. thick granular layer of sand, some silt and gravel was encountered at the southwest side of the underpass at B.H. #1. Based on the Standard Penetration Test, 'N' values of 27 blows/ft., it is estimated that the relative density of this granular layer is compact. One grain-size distribution curve for a sample obtained from this granular layer is shown on Fig. #1 in the Appendix of this report.

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

4.3) Clayey Silt:

Underlying the surficial cover of sand, where it exists, and immediately below the natural ground surface elsewhere, is the predominant stratum of clayey silt across the site. Occasional seams of silty sand up to 2 inches thick are observed throughout the deposit. The clayey silt deposit was not fully penetrated at any of the boring locations; it is, however, proven to extend for a depth of 40 ft. at B.H. #1.

The physical properties of the stratum, as determined by field and laboratory testing, are as follows:

		<u>Range</u>
Natural Moisture Content	(W%)	13 - 22
Liquid Limit	(W _L %)	18 - 28
Plastic Limit	(W _p %)	12 - 17

The Atterberg limit test results, given in the table, are also summarized on the Plasticity Chart, Figure #1. The testing indicates that the cohesive stratum is inorganic with a low plasticity. The natural moisture content varies randomly throughout the deposit from a few percent below the plastic limit to values between the liquid and plastic limits.

Standard Penetration Resistance testing was carried out within this stratum; the results are plotted on the Borelog sheets. This testing gave 'N' values which varied generally from 14 to 136 blows/10", being typically greater than 25 blows/ft. In B.H. #1 in the upper portion, a low 'N' value of 7 blows/ft. was obtained. Based on these results, it is estimated that the consistency of the cohesive deposit varies from stiff to hard.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out in the open boreholes during the period of investigation. These observations are recorded on the Borelog sheets as well

5. GROUNDWATER CONDITIONS: (cont'd.) ...

as on Drawing 70-11088A. These observations indicate that the groundwater level varies from elevation 1076 to 1078, which correspond to depths ranging from 1 to 5 ft. below natural ground surface.

6. EXISTING STRUCTURE:

The existing structure is a single-span, 37 feet long, 88 feet wide, rigid frame concrete bridge. The closed-type abutments are founded on spread footings which are approximately 12 feet wide; the bases of the footings are located at about elevation 1074 - i.e., some 4 to 5 feet below the original ground surface. In addition, 28-foot long walls extend behind the abutments at either end; these walls are supported on spread footings.

The profile grade of Hwy. #400, in the vicinity of the structure, varies from elevation 1100 to 1102. At this grade the heights of the existing approach embankments are of the order of 21 feet.

Both the structures and the approach fills are performing satisfactorily without any visible signs of distress.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to widen the existing single-span overpass structure at the crossing of Hwy. #400 and King Twp. Rd. The widening will be about 25 ft. on either side of Hwy. #400 to accommodate future traffic lanes. The existing alignments and profile grades of Hwy. #400, as well as King Twp. Rd. will be maintained without any changes. The maximum height of the widened portion of the approach fills will be in the order of 22 ft. above the natural ground surface.

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

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

The subsoil at the site consists of an extensive deposit of stiff to hard clayey silt with occasional thin seams of silty sand. The clay silt stratum is covered with a thin layer of compact sand at certain locations.

7.2) Structure Foundations:

The proposed widening of the abutments can be founded on spread footings, located within the upper portion of the clayey silt stratum. The new footings should be located at or below elev. 1074, in order to provide a minimum 4-ft. frost cover from the base of the footing. Spread footings, meeting the aforementioned requirements, can be designed using an allowable safe bearing pressure of up to 3.0 t.s.f.

The footings for the extensions will be located below the groundwater level. Since the subsoil at the footing formation level is a cohesive deposit, no major dewatering problems are anticipated during construction. Any ground seepage or surface run-off into the excavations could be handled using standard techniques, such as pumping from sumps, etc. In order to prevent softening of the foundation subsoil due to surface run-off, or groundwater seepage, it is recommended that a lean concrete base slab or granular pad be placed immediately after the completion of the footing excavations.

If the structure is designed as a rigid frame, then a coefficient of earth pressure at rest (K_0) of 0.5 should be assumed for the granular fill material behind the wall, when designing the abutments. However, if some movement of the top of the wall is permitted, then a coefficient of active earth pressure (K_a) of 0.33 can be used.

Settlement of the foundation subsoil will take place due to the induced footing pressure. For footings, inducing the aforementioned bearing pressure, the settlement will not exceed

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

7.2) Structure Foundations: (cont'd.) ...

one inch. Therefore, it is recommended that a construction joint be provided between the existing and the widened portion of the abutment in order to accommodate any possible differential settlements.

7.3) Approach Embankments:

No stability problems are anticipated for the proposed widening of the approach embankments with standard 2:1 slopes. It is estimated that the differential settlements between the existing and new fill sections, could be of the order of 1-1/2 to 2 inches. It is anticipated that the majority of the settlements will take place during or immediately after the construction of the additional fill sections.

In order to have a smooth transition from the existing fill to the new fill section, it is recommended that all topsoil from the existing fill section, prior to placing the future fill and also the widened portion of the fill, be 'keyed' into the existing approaches as per current D.H.O. methods.

8. MISCELLANEOUS:

The field work, carried out during the period October 16, 1970, was supervised by Mr. V. Korlu, Project Foundation Engineer, who also prepared this report.

Equipment used was owned and operated by Master Soil Investigations, Ltd.

General supervision of the project was undertaken by Mr. M. Devata, Supervising Foundation Engineer, who also reviewed the report.

December, 1970.

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11088 LOCATION Sta. 302 + 27 60' Lt.
 W.P. 105-60-10 BORING DATE Oct. 16, 1970
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger

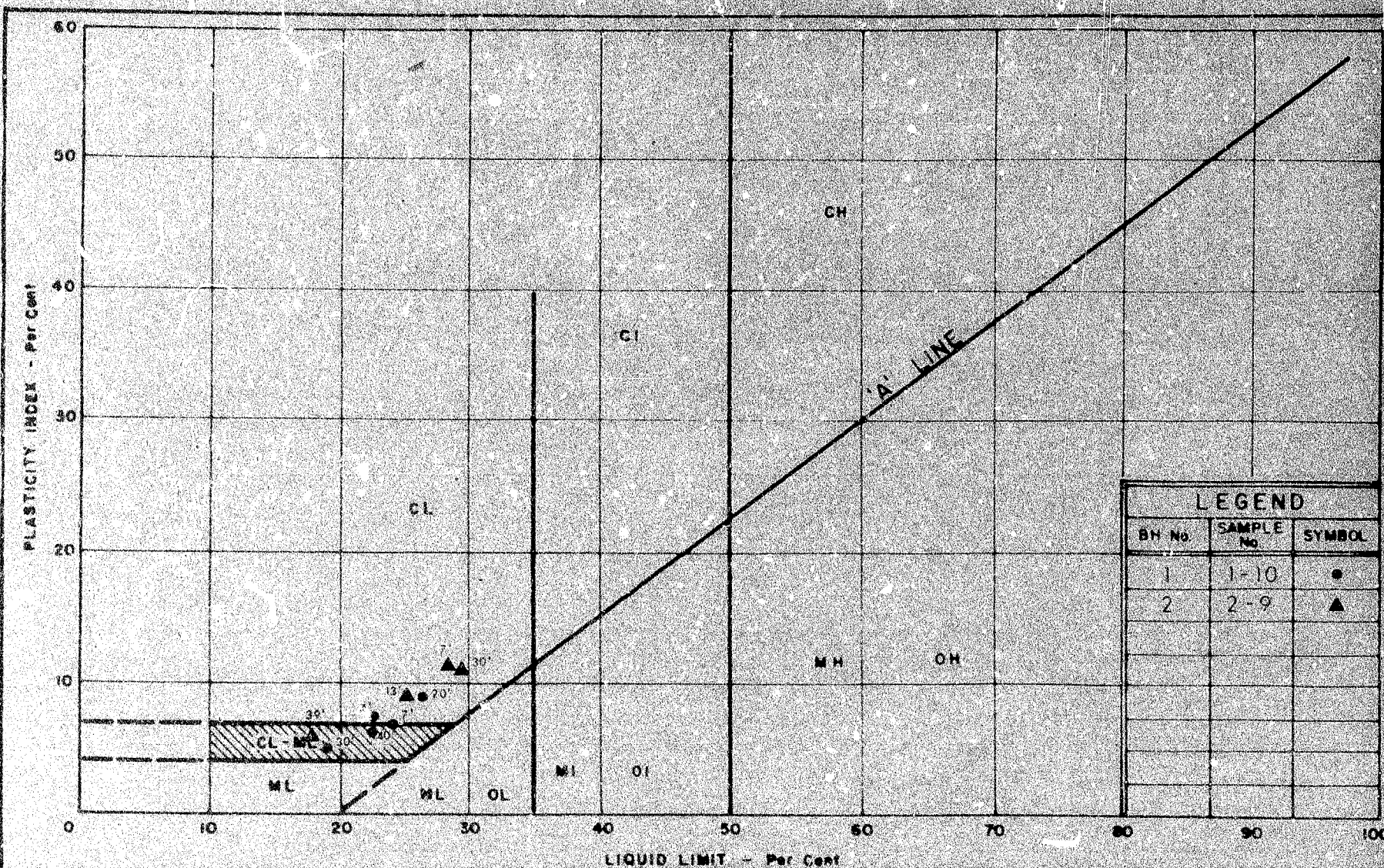
ORIGINATED BY VK
 COMPILED BY WH
 CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W _L	W _P	W		
1081.3	Ground Level															GR, SA, SI, CL
0.0						1080										
	Clayey silt, trace of sand and gravel		1	SS	18											
			2	SS	7											
	occ. silty sand seams up to 2" thick throughout.		3	SS	30	1070										
			4	SS	27											
			5	SS	41											
			6	SS	30	1060										
1057.3	Sand Seam		7	SS	14											
24.0																
25.0	Stiff to Hard		8	SS	25	1050										
			9	SS	29											
	Brown to Grey															
1040.8			10	SS	100 1/2"											
40.5	End of Borehole					1040										

▼ 1076.5
 Nov. 18/70

0 Bl (16)

[illegible]



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	1-10	●
2	2-9	▲



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

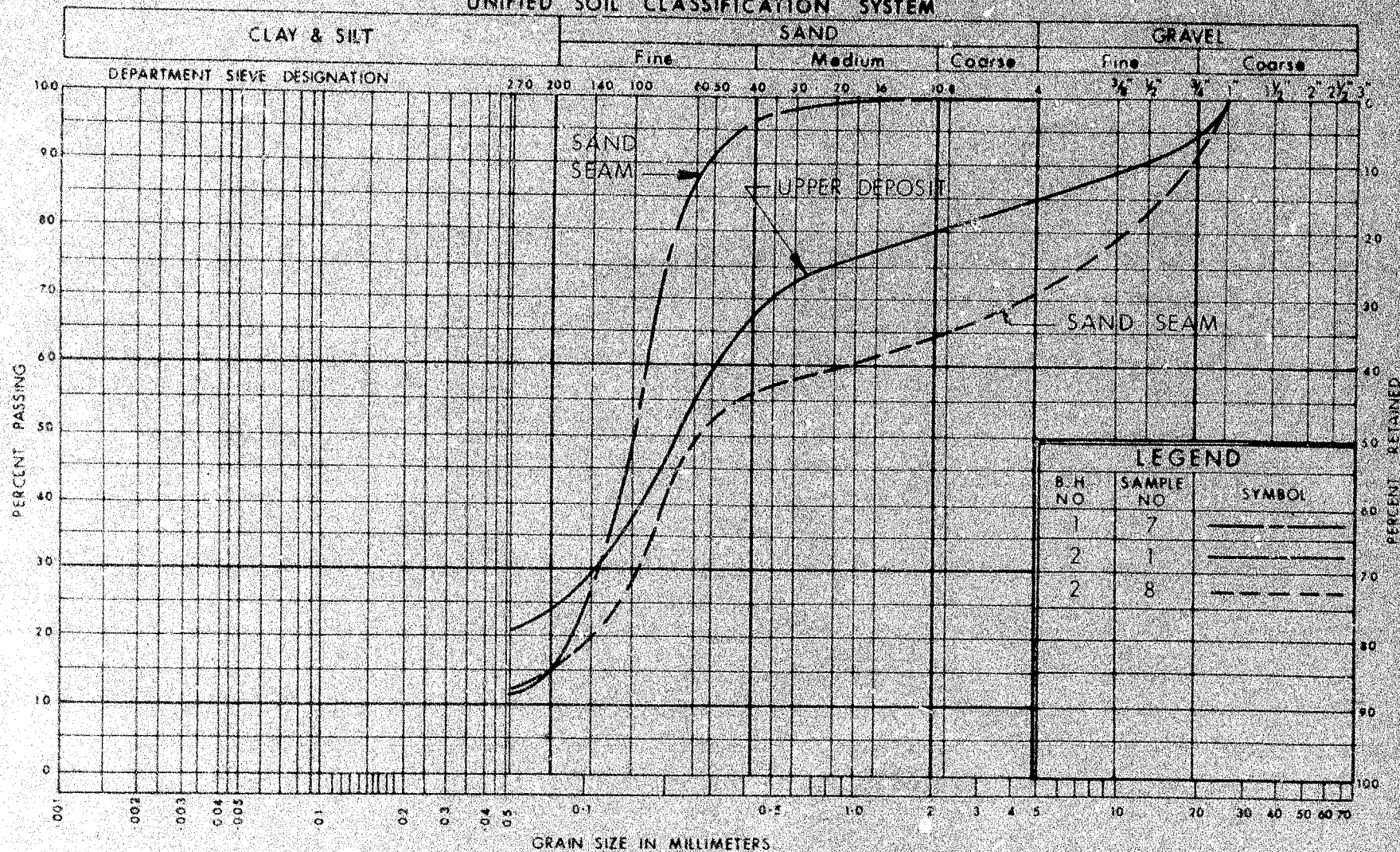
PLASTICITY CHART CLAYEY SILT

WP No. 105-70-10

JOB No. 70-11088

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SAND
SOME SILT & GRAVEL

W.P. No. 105-70-10
JOB No. 70-11088
FIG 2

CONT. 71-16

HWY. 400 +

TOWNSHIP RD.

COUNTY OF YORK

30M13-1

