

CONT. 71-73

HWY. 401

BET. HWY. 27

AND DIXON ROAD

30M11-167

MATERIALS & TESTING OFFICE  
CENTRAL REGION

30M11-167
GEOCRES No.

SOILS DESIGN REPORT

W.P. 132-70-01, Highway 401

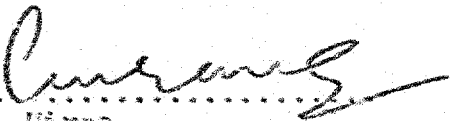
Noise Barriers on South Side of Highway  
401 Between Highway 27 and Dixon Road

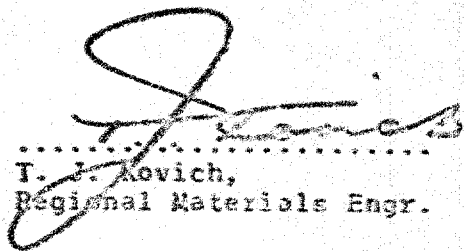
Toronto District  
CONT 71-73.

Soils Profile: None

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# SOILS DESIGN REPORT

Highway 401

W.P. 132-70-01

1.1 Miles

Noise Barriers on South Side of Highway 401

Between Highway 27 and Dixon Road

Proposed: Grading, Drainage and Structures

## 1. INTRODUCTION

Preliminary studies of noise pollution in residential areas adjacent to major highways in Ontario have been undertaken by the Functional Planning Office and the Research Branch. Various remedial measures for the attenuation of highway traffic noise levels to tolerable limits (70 dBA or less) have been considered. Amongst these, the most promising appears to be the installation of a sound barrier (noise barrier) between the source and the recipient. In order to test the efficacy, economics, design and construction features of noise barriers, a trial area for the installation of various types of barriers has now been selected. This area is located south of Highway 401, within the Department's right-of-way, and is bounded on the east by Dixon Road and on the west by Mimico Creek.

This project is programmed for the current year (1971) and includes the work involved in the grading, drainage and erection of the various types of noise barriers.

## 2. DESIGN CRITERIA

The design criteria for this project were issued in December, 1970 following the submission of a Program Justification Report dated November 4, 1970.

The requirements of a noise barrier are that the barrier be sound opaque and not liable to vibrate. These requirements are considered to be satisfied by a free-standing earth berm, or by a concrete wall designed to the minimum thickness permissible within the constraints of economy, construction and structural requirements. The barrier types which are to be constructed in this project are classified broadly into three categories:

- A. Earth Berm
- B. Earth Berm Surmounted by a Wall
- C. Wall

The different types of barriers are to be provided as available property permits, in the order of preference A, B, C.

The barriers are intended to provide an estimated noise attenuation such that the adjacent residential properties receive peak noise levels of no greater than 70 dBA. However, due to practical limitations, it is estimated that approximately ten of the homes on Clarion Road will receive peak noise levels in excess of 70 dBA.

### 3. PHYSIOGRAPHY AND SITE CONDITIONS

The project is situated in the South Slope physiographic region. The landforms of this region consist of ground moraines exhibiting irregular knolls and hollows. The glacial tills of the ground moraine are believed to date back to the Wisconsin glaciation of this area.

The site conditions within the project area have been modified in recent years as a result of grading and drainage works associated with several Highway 401 widening and related contracts. From about station 138+00 of the proposed noise barrier traverse line easterly to the east limits of this project, Highway 401 was widened under Contract 66-296. This contract also included the relocation of Martingrove Road and the reconstruction of the Dixon Road, Martingrove and Highway 401 Interchange Complex. A major portion of the proposed barrier centreline is aligned over sewer runs and ramp fills which were constructed under this contract.

The widening of Highway 401 was continued westerly under Contract 69-05. Most of the original topsoil within the right-of-way was stripped and later replaced with a nominal three-inch thickness of topsoil. The new ditches and back slopes were sodded and staked.

At the present time, grading within the project area for the Mimico Creek relocation (Contract 70-129) has been almost completed. It is believed that no boulders were encountered

during these grading operations. However, a boulder (erratic) is presently located on the top of the cut back slope in the vicinity of station 107+00. This boulder is about four feet in size. No reasonable explanation is available for its presence in this area. It would appear that such boulders in the area would be the exception rather than the rule.

#### 4. SOILS INVESTIGATION

Following the decision to install the noise barriers, a soils investigation was carried out by this Office in February, 1971. A trailer-mounted Pennadrill auger machine pulled by a Bombardier was used for this work. The bore holes were augered to depths of five to 20 feet at spacings varying between 150 and 400 feet along and adjacent to the centreline of the proposed noise barriers.

Standard Penetration Resistance tests were carried out in a number of bore holes, at selected depths, by driving a standard, two-inch O.D. split-spoon sampler with a 140-pound hammer falling freely through a distance of 30 inches. The number of blows of the hammer required to cause a 12-inch penetration of the sampler into the ground was recorded as the 'N' value of the soil at the depth of sampling.

The samples and auger cuttings were identified in the field as to texture and moisture. Representative samples were

later examined in the laboratory for verification of field identification, and laboratory tests carried out to determine the moisture contents, Atterberg limits and grain size distributions. The laboratory test results are summarized on the Figures 1 and 2 in Appendix I. Bore hole logs are contained in Appendix II.

## 5. SOIL CONDITIONS

From the west limits to about station 134+00, the project area is covered by a superficial thickness of topsoil (zero to four inches) which is followed by two to four feet of a brown, cohesive soil having a texture ranging from loam to silty loam. Between station 134+00 and Martingrove Road, the bore holes encountered backfill material in the vicinity of the existing sewers. This material is a loam to clay-loam with topsoil mixed in, in various proportions. At station 149+10 (O/S 2' Rt. of Traverse Line) a boulder approximately three feet in size was encountered below eight inches of topsoil. With this one exception, the backfill material is relatively stone free. 'N' values in the loam to silty loam and the backfill material ranged between 11 and 25 blows per foot, indicating that the soil is generally of stiff consistency.

Between Martingrove Road and Dixon Road the proposed alignment is underlain by up to 11 feet of earth fill having a loamy texture. In some locations, layers of sandy and granular-



type soils were also encountered in this fill material. The 'N' values in the fill ranged between six and 19 blows per foot. The lower 'N' values were obtained in the more moist to wet zones within the fill stratum.

Underlying the loam stratum in the western portion of the project area and the backfill and fill material in the eastern portion is a deposit of glacial till which has a texture ranging from silty clay-loam to clay-loam. In the Unified Soil Classification System this till may be described as a clayey silt to silt with some sand and traces of gravel (CL - ML). The gravel sizes range generally between one-half and two inches. Occasionally, the augers encountered pockets of gravel in some of the bore holes; however, there was no difficulty in penetrating to the desired depth through these gravel pockets with the five-inch diameter augers.

Split-spoon samples obtained from the glacial till stratum indicate that the upper seven to 12 feet of the deposit is desiccated and fissured. In isolated locations, the till contains layers of stiff to hard clay having a maximum thickness of two feet. More frequently, however, the till contains thin seams of silt and fine sand which are water bearing below a depth of about ten feet.

The results of laboratory tests on representative samples of the glacial till, together with the 'N' values obtained in the field are summarized on the following page.

<u>Glacial Till</u>	<u>Range</u>	<u>Average</u>
Moisture Content - %	9.6 - 14.4	11.3
Liquid Limit - %	18 - 30	24
Plastic Limit - %	15 - 18	16
Plasticity Index - %	3 - 12	8
<u>Grain Size Distribution -</u> <u>(Unified Soil Classification)</u>		
Gravel - %	2 - 5	-
Sand - %	22 - 30	-
Silt - %	48 - 57	-
Clay - %	16 - 21	-
<u>Standard Penetration Resistance -</u>		
'N' Values - blows/ft.	20 - 125	-

The Atterberg limits and grain size distributions are shown on Figures 1 and 2, respectively, in Appendix I.

Water level measurements, which were carried out in the open bore holes, indicate that the groundwater is at a depth of 10 to 14 feet below the existing ground level. In the spring and early summer, however, the groundwater level may be expected to be somewhat higher.

## 6. DESIGN FEATURES

The selection of the various types of noise barriers for this project has been dictated, within the constraints of

economy, partially by the availability of space within the existing right-of-way and partially by the experimental nature of the installation. The barrier types which have been selected and their approximate locations are given below:

<u>Station to Station</u>	<u>Type of Noise Barrier</u>
100+00 - 113+00	6" precast concrete wall, height 10' above right-of-way ground line
112+50 - 120+00	earth berm, height 10', crest width 5', 2:1 - 3:1 side slopes
123+50 - 127+00	6" precast concrete wall, height 7' above right-of-way ground line
127+00 - 135+00	4" porex wall, height 7' above right-of-way ground line
135+00 - 141+70	2" or 4" porex wall, 3' high on earth berm, total height 7' above Highway 401 pavement
141+70 - 146+50	2" or 4" porex wall, 4' high on earth berm, total height 7' - 8' above Highway 401 pavement
146+50 - 151+45	4" porex wall, 7' high on earth berm, total height 7' ± above Highway 401 pavement
151+45 - 153+60	Martingrove Road - no barrier
153+60 - 158+00	earth berm, height 7' above Ramp W-NS
157+20 - 164+10	4" porex wall, 8' high on earth berm, total height 8' above Ramp W-NS

The precast concrete and porex wall sections are to be provided in predetermined panel lengths. Each wall panel is to be supported between the flanges of either steel or concrete, wide flanged I-beams which will extend vertically above the ground line to the required free height of each wall panel. The lower six to 12 inches of each panel will be buried in the

original ground or earth berm in order to prevent the transmission of sound below the wall.

A proper alignment and spacing of the supporting vertical beams (H-type piles) is one of the prerequisites of the design in order to ensure that the prefabricated wall panels can be inserted between the flanges (tolerance  $\frac{1}{2}$ "  $\pm$ ). For this reason, it is not proposed to drive the H-type piles. Instead, it is proposed to auger holes of the required diameters and to the necessary depths in order to construct concrete caisson types of cylindrical footings at each support location. The supporting H-type piles could then either be embedded within these cylindrical footings or they could be supported as columns by connecting them structurally to the tops of the caissons.

The cylindrical footings are to be designed to support the dead loading from the wall as well as any lateral loading imposed by wind forces. The magnitudes of tolerable differential settlements or heaving of the wall structure and the allowable distortions perpendicular to the length of the wall are not known.

## 7. BORROW MATERIAL

The fill material required to construct the earth berms will have to be obtained from sources located outside the project area. It is understood that no surplus material will

be available from any of the Highway 401 and Highway 27 contracts currently underway in the vicinity of this project.

## 8. RECOMMENDATIONS

### 8.1 Structure Foundations - General

This Office arranged a meeting on March 2, 1971 between the Consultant (McCormick, Rankin & Associates Limited) and the Foundation Section (Mr. M. Devata, Supervising Foundation Engineer) to discuss the existing soil conditions and the design aspects of the proposed structure foundations. The recommendations made by the Foundation Section at this meeting are included herein.

#### 8.1.1 Soil Design Parameters

The following soil parameters may be used in earth pressure computations:

<u>Soil Type</u>	<u>Undrained Shear Strength C<sub>u</sub> - PSF</u>	<u>Angle of Shearing Resistance φ - Degrees</u>	<u>Wet Unit Weight γ - PCF</u>
Loam - Silty Loam	1,000	0	120
Glacial Till	2,500 or	30	135
Existing Fill Material	750	0	115
Earth Borrow, Compacted			
Cohesive	1,000	0	125
Non-cohesive	0	25	120

The computations for earth pressures in the glacial till deposit should be carried out using either the  $C_u$  or the  $\phi$  value shown. The design should be based on whichever parameter yields the most critical condition.

For design purposes, the passive resistance developed by the footings should be ignored to the depths below the grade line as follows:

Station 100+00 to Station 113+00	- 2'
Station 119+50 to Station 132+00	- 2'
Station 132+00 to Station 135+00	- 4'
Compacted Earth Fill Sections	- 2'

#### 8.1.2 Allowable Loads

- (a) footings located within glacial till.....2.5 T.S.F.
- (b) footings located within compacted earth fill:
  - (i) footing base located at least  
1' above original ground.....1.0 T.S.F.
  - (ii) footing base located less than  
1' above original ground.....0.75 T.S.F.

The allowable loads given above are for the end bearing capacity of the footings. The adhesion between the cylindrical footings and the soil may be taken to be equal to the undrained shear strength values listed in Section 8.1.1, for purposes of computing frictional resistances.

All footings should be provided with a minimum of 3' of earth cover for frost protection purposes.

### 8.1.3 Settlements

The settlement of footings located within the glacial till deposit will be negligible. Footings located within the compacted earth berm at similar founding levels may be expected to undergo similar settlements. However, where the earth berm will be situated over existing sewer backfill, the settlement of the footings at these locations may be differential with respect to other footings, and therefore, some tolerance should be provided to accommodate such differential movements.

### 8.1.4 Dewatering

Due to the cohesive nature of the soil along the proposed noise barrier alignment, no major dewatering problems are anticipated. Depending on the seasonal variation of the ground water table, the groundwater level may be located above the base of the footing excavation. Any seepage into such excavations can be handled by pumping. In order to prevent the softening of the subsoil at the base of the footing excavation, due to seepage or surface runoff, it is recommended that the footings be poured immediately following the completion of the excavation. If the footing excavations are allowed to remain open, care should be taken to ensure that all free water and any softened soil at the base and/or sides of the excavation is removed prior to concreting operations.

### 8.2 Earth Embankment

The earth berms should be constructed as specified in

Form 200, Section 214, of the Department's Specifications. Topsoil stripping will not be necessary for the free-standing earth berm sections. The earth embankment in the vicinity of Ramp W-NS should be constructed by "keying-in" as per Standard DD-414.

### 8.3 Drainage

Drainage behind the noise barrier (towards the existing private properties) may be effected by open ditches if the space between the barrier and the existing right-of-way permits and provided a sufficient gradient exists along the length of the noise barrier. Where open ditches would be impractical, a system of subdrains utilizing perforated pipe and granular backfill should be provided. If the length of such a subdrain system becomes excessive, some means for outlet should be provided below the noise barrier to the north side.

The crest of the earth berm sections should be crowned to facilitate drainage away from the barrier.

### 8.4 "Burial" Treatment for Wall Sections

As discussed in Section 6, the lower 6" to 12" of the wall sections are to be buried to prevent transmission of sound. This operation will presumably be carried out by trenching. In order to minimize differential frost heaving between the two ends of any one wall panel, the trench backfill should be a cohesive soil which should be thoroughly compacted to prevent the infiltration of water into the trenched section. The



subgrade conditions within the distance of one panel length are expected to be fairly uniform so that no special subgrade treatment is considered necessary in this respect. However, it would be desirable to compact the base of the trench prior to the installation of the wall panels. Any trimming and leveling required in the base of the trench should be carried out using native material.

#### 8.5 Transition - Earth Berm to Wall

In order to minimize differential frost heaving, it would be desirable to separate the wall panels in the vicinity of the toe of the earth fill by providing a supporting pile at this location.

#### 8.6 Boulder Treatment

The investigation indicates that boulders are not present in the original subsoil within the project area. However, the glacial history of this area does not preclude the existence of boulders altogether. For this reason, it is suggested that should a boulder be encountered during augering for the footings, the removal of the boulder be carried out at a price to be negotiated at the time of removal.

Should the subexcavation required for removal of a boulder be so great as to preclude backfilling with mass concrete, the backfilling should be carried out with well-compacted granular material to within 2' of the grade line. Native material may be used to complete the backfilling above the granular fill surface.

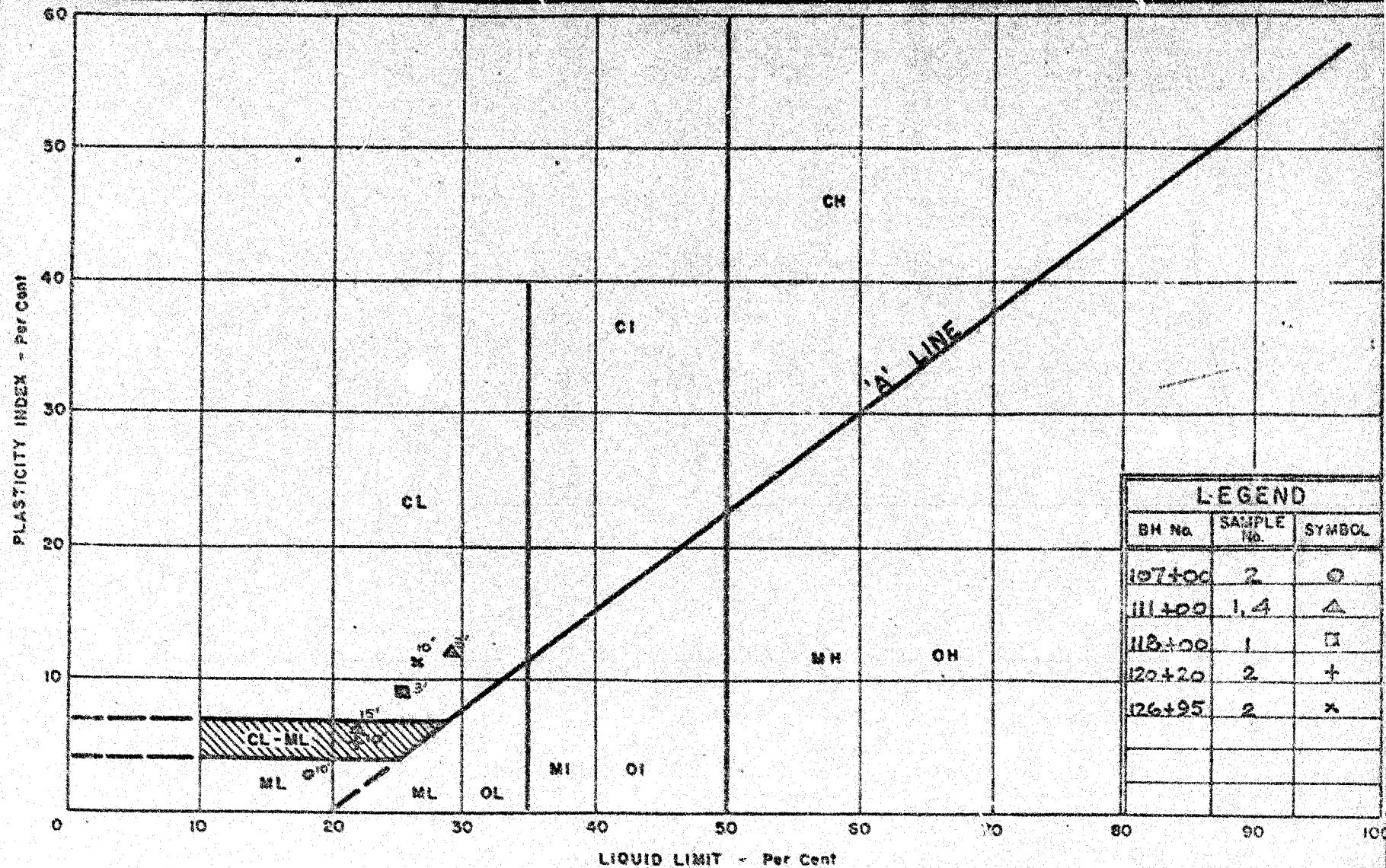
8.7 Topsoil

The topsoil required for the earth berms will have to be imported. If sod is used on the earth berms, a minimum of 2" of topsoil should be provided.

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APPENDIX I

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DEPARTMENT OF HIGHWAYS  
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DIVISION

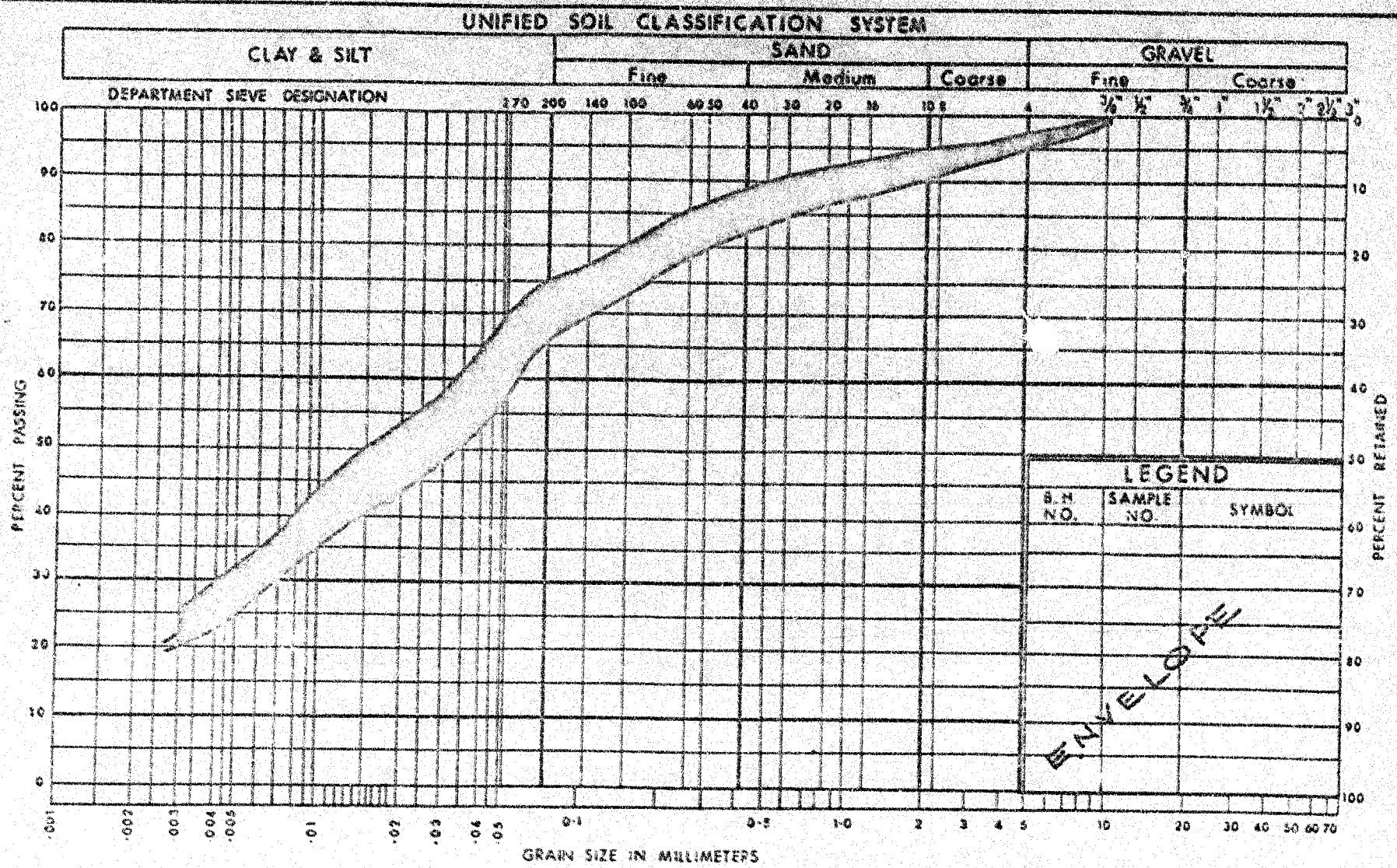
FIG. 1

# PLASTICITY CHART GLACIAL TILL

WP No. 132-70-01

JOB No. HWY 401

NOISE BARRIERS



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

**FIG. 2 GRAIN SIZE DISTRIBUTION**  
**GLACIAL TILL**

W.P. No. 132-70-01  
JOB No. HWY 401  
NOISE BARRIERS

APPENDIX II

# LOG OF BORE HOLES

W.P.132-70-01

## Station 101+00, O/S 20' ± Lt. T.L. (Traverse Line)

(Done in 1966 by Dominion Soil for Foundation Section under  
W.J. 66-F-112 - Contract 69-05 - Related to Existing Ground Level)

0 - 15' lo. till, hard, damp - moist  
15' - 18' sa. lo. (75% sa., 25% si.)  
18' - 30' lo. till, hard, damp - moist

## Station 103+30, O/S 1' Lt. T.L.

(no tops.)  
0 - 3½' br. lo. (with wood frag.), moist  
3½' - 7' br. lo. - si. cl. lo. (½" max. stone), damp, desiccated  
7' - 17' gry. br. lo. - si. cl. lo. till, hard, damp, fissured  
17' - 19' gry. si. cl. lo. till, hard, damp  
water at 14½'

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
4½' - 6'	5-6-9	15
9½' - 11'	18-25-33	58
14½' - 16'	25-100	125

## Station 107+00, O/S 3' Rt. T.L.

0 - 4" dk. br. lo. tops.  
4" - 4' br. lo. - si. lo.  
4' - 12½' gry. br. si. lo. - si. cl. lo. till, hard, damp, fissured  
12½' - 16' gry. si. lo. - si. cl. lo. till (max. ¾" stone), hard,  
damp, fissured

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
4½' - 6'	13-18-26	44
9½' - 11'	23-37-64	101
14½' - 16'	26-56-59	115

## Station 111+00, O/S 3' Rt. T.L.

0 - 12" dk. br. lo. tops.  
12" - 4' br. si. cl. lo. (max. ½" stone), moist, stiff  
4' - 14½' br. - gry. br. si. cl. lo. - si. lo. till (1" max.),  
hard, damp  
14½' - 20' gry. lo. - si. lo. till, hard, damp - moist (silt seams  
from 16' ±, water bearing)  
water @ 15' ±



Depth	Blows/6"	'N'
4 $\frac{1}{2}$ ' - 6'	14-17-30	47
9 $\frac{1}{2}$ ' - 10 $\frac{1}{2}$ '	20-100	120
14 $\frac{1}{2}$ ' - 16'	12-18-32	50

Station 114+00, O/S 40' Lt. T.L.

0	- 6"	dk. br. lo. tops.
6"	- 4 $\frac{1}{2}$ '	br. lo. - si. cl. lo., damp - moist ( $\frac{1}{2}$ " max.)

Station 118+00, O/S 20' Lt. T.L.

		(no tops.)
0	- 2 $\frac{1}{2}$ '	br. si. cl. lo., damp
2 $\frac{1}{2}$ '	- 4 $\frac{1}{2}$ '	br. si. lo. - si. cl. lo., moist - wet (gritty)

Station 120+20, O/S 45' Rt. T.L.

0	- 1"	dk. br. tops.
1"	- 4'	br. si. cl. lo. till ( $\frac{1}{2}$ " max.), damp
4'	- 11'	gry. br. lo. till ( $\frac{1}{2}$ " max.), hard, damp - moist, fissured
11'	- 19'	gry. si. lo. - si. cl. lo. till, hard, moist, fissured

Depth	Blows/6"	'N'
4 $\frac{1}{2}$ ' - 6'	21-32-31	63
9 $\frac{1}{2}$ ' - 11'	20-33-39	72
14 $\frac{1}{2}$ ' - 16'	15-17-24	41

Station 122+65, O/S 16' Rt. T.L.

0	- 4"	dk. br. lo. tops.
4"	- 4 $\frac{1}{2}$ '	br. lo., moist (gritty)
4 $\frac{1}{2}$ '	- 12'	gry. br. si. lo. - si. cl. lo. till, hard, fissured, damp
12'	- 16'	gry. si. cl. lo. till, hard, damp - moist, fissured

Depth	Blows/6"	'N'
4 $\frac{1}{2}$ ' - 6'	15-19-25	44
9 $\frac{1}{2}$ ' - 11'	16-23-35	58
14 $\frac{1}{2}$ ' - 16'	17-27-45	72

Station 126+95, O/S 18' Lt. T.L.

0	- 2"	dk. br. tops.
2"	- 18"	br. lo. + wood frag. mix., fill
18"	- 5 $\frac{1}{2}$ '	br. si. cl. lo. till, moist



5½' - 8' gry. si. lo. till, damp - moist, v. stiff - hard  
 8' - 10½' gry. lt. cl., moist, v. stiff  
 10½' - 11' + gry. si. lo. till, moist, hard  
 water @ 10' ±

Station 131+25, O/S 8' Lt. T.L.

0 - 2" tops. (sod - fresh)  
 2" - 12" dk. br. lo., hard, damp  
 12" - 4½' br. sa. lo., moist  
 4½' - 11' br. - gry. br. lo. - si. cl. lo. till, hard, damp  
 (gry. @ 8')

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
9½' - 11'	8-11-24	35

Station 134+00, O/S 5' Lt. T.L.

0 - 12" dk. br. lo. tops  
 12" - 4' br. lo. + tops. mix, moist - wet  
 4' - 11' br. - gry. br. si. lo. - lo. till, hard  
 ) - fill

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
4½' - 6'	8-14-22	36
9½' - 11'	23-34-39	73

Station 136+50, O/S 12' Lt. T.L.

0 - 8" br. si. lo., damp  
 8" - 2' blk. cl. lo. tops.  
 2' - 4½' br. lo. - cl. lo. (sm. grav.), moist  
 4½' - 5½' br. lo. + tops. mix, moist - wet  
 5½' - 11' br. - gry. br. lo. till, fissured, hard, moist  
 water @ 10'

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
4½' - 6'	2-3-8	11
9½' - 11'	17-34-46	80

Station 139+00, O/S 17' Lt. T.L.

0 - 12" br. si. lo. tops. (wood pieces), damp  
 12" - 2½' br. si. lo. (gritty), damp (cobbles @ 2½')  
 2½' - 3½' blk. lo. tops., moist  
 3½' - 6' br. lo. till, moist, fissured

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
4½' - 6'	3-6-14	20

Station 141+50, O/S 10' Lt. T.L.

0 - 6"	dk. br. sa. lo. tops.
6" - 12"	br. si. lo., damp
12" - 24"	br. v.f. sa. - si. (sm. grav.)
24" - 4½'	br. - dk. br. lo. - si. cl. lo. + tops. mix., moist
4½' - 11'	gry. br. si. cl. lo. till, fissured (v. thin si. & sa. seams), moist

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
2' - 3½'	4-7-10	17
4½' - 6'	7-10-13	23
9½' - 11'	15-26-45	71

Station 143+00, O/S 6' Lt. T.L.

0 - 8"	dk. br. si. lo. tops.
8" - 2'	br. si. lo., stony
2' - 6'	br. si. lo. - lo. till, damp - moist (tops. @ 4½' - 6')

<u>Depth</u>	<u>Blows/6"</u>	<u>'N'</u>
2' - 3½'	8-12-12	24
4½' - 6'	4-7-10	17

Station 144+50, O/S 16' Lt. T.L.

	(no tops.)
0 - 2'	br. sa. si. lo., stony, damp
2' - 5'	dk. br. lo., moist

Station 146+00, O/S 5' Rt. T.L.

0 - 12"	dk. br. cl. lo. tops., sat.
12" - 3'	br. si. lo., stony, damp, fairly soft
3' - 5'	dk. br. lo. + tops. mix., firm
5' - 9'	br. si. lo. - lo., damp - moist
9' - 14'	br. si. lo. till, moist, stiff - hard

Station 146+50, T.L.

0 - 4½'	cl. lo., moist - wet, + tops. mix.	} - sewer backfill
4½' - 6'	gry. br. lo. (stones 1" max.), damp, hard	
6' - 14½'	br. - gry. si. cl. lo. - cl. lo. till, fill + tops. mix., moist	

Depth	Blows/6"	'N'
4 1/2' - 6'	7-10-15	25
9 1/2' - 11'	5- 5- 6	11

Station 149+05, O/S 2' Rt. T.L.

0 - 12"	dk. br. si. cl. lo. tops., sat., soft
12" - 4'	dk. br. - gry. si. cl. lo. till fill, moist - wet
4' - 4 1/2'	dk. br. sa. cl. lo. tops., wet (grav. @ 2' - 2 1/2')
4 1/2' - 7 1/2'	dk. br. sa. cl. lo. + tops. mix (cobbles @ 6' + >')
7 1/2' +	br. si. lo. till, moist, hard

Station 149+10, O/S 2' Rt. T.L.

0 - 8"	dk. br. cl. lo. tops., sat.
8" +	bldr. (est. size 3'±)

Station 151+00, O/S 30' Lt. T.L. (@ Toe of 401 S. Slope)

0 - 8"	dk. br. sa. - cl. lo. tops.
8" - 7'	br. - dk. br. si. cl. lo. fill + tops. mix., moist
7' - 16'	gry. br. si. lo. till, hard, fissured (with si. sa. - v.f. sa. seams), damp water @ 14'

Depth	Blows/6"	'N'
4 1/2' - 6'	5- 7-12	19
9 1/2' - 11'	17-23-34	57
14 1/2' - 16'	24 42	68 110

Station 154+25, O/S 25' Lt. T.L.

0 - 3"	br. tops.
3" - 3'	qty. sa. (Gran. 'C'), moist
3' - 3' 9"	dk. br. sa. lo. tops.
3' 9" - 5'	br. si. cl. lo., moist (sm. stones)

Station 156+00, O/S 18' Lt. T.L.

0 - 3"	br. tops.
3" - 2 1/2'	br. sa. lo. & f. grav., damp - moist
2 1/2' - 4 1/2'	br. cl. lo. - lt. cl. till, moist - wet
4 1/2' - 6'	sa. cl. lo. (grav. + asph. & tops. mix @ 5 1/2')
6' - 11'	dk. br. si. cl. lo. fill, wet, hard @ 10 1/2'

- fill

Depth	Blows/6"	'N'
4½' - 6'	12-8-8	16
9½' - 11'	6-7-11	18

Station 157+80, O/S 5' Lt. T.L.

0	- 2"	tops.	
2"	- 2'	qty. sa. & grav.	
2'	- 6'	br. sa. cl. lo. + blk. tops. mix., moist - wet	) - fill
6'	- 9½'	br. cl. lo. - sa. cl. lo., f. grav., wet, <u>soft</u>	
9½'	- 10' 3"	lt. br. cr. rock screen., <u>sat.</u>	
10' 3"	- 11'	br. sa. lo. + tops. mix., moist - hard water @ 10' (in screenings layer)	

Depth	Blows/6"	'N'
4½' - 6'	4-3-3	6
9½' - 11'	13-14-20	34

Station 158+10, O/S 50' Rt. T.L.

0	- 3"	tops.	
3"	- 2½'	br. qty. sa. (Gran. 'C')	) - fill
2½'	- 3½'	sa. cl. lo. + tops. mix., moist	
3½'	- 5'	br. lt. cl., stiff, moist	

Station 161+42, O/S 7' Lt. T.L.

0	- 6"	dk. br. sa. cl. lo. tops.	
6"	- 12"	dk. br. sa. cl. lo.	
12"	- 30"	br. sa. (clean), moist	
30"	- 4'	gry. qty. sa., moist	
4'	- 4½'	dk. br. si. lo. tops.	
4½'	- 7'	gry. br. si. cl. lo. f. grav., v. stiff, moist	
7'	- 11'	br. si. lo. till, hard, fissured, damp	

Depth	Blows/6"	'N'
4½' - 6'	4-7-9	16
9½' - 11'	24-42-80	122

Station 163+50, O/S 35' Lt. T.L.

0	- 4"	dk. br. tops.	
4"	- 20"	br. sa. si. lo., damp	
20"	- 4'	si. lo. (with si. & v.f. sa. seams)	
4'	- 10'	br. si. lo. till (with cl. lo. layers), fissured, hard, damp - moist	