

MEMORANDUM

TO: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: August 19, 1969

OUR FILE REF.

IN REPLY TO

AUG 25 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed Structure at the Crossing
of the South Nation River and
Hwy. #43 (Rev'n. Line 'L')
Chesterville Village, Winchester Twp.
District No. 9 (Ottawa)
W.J. 69-F-51 -- W.P. 148-66-01

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 do not hesitate to contact our Office.

AGS/MdEF
Attach.

A. G. Sternmac
A. G. Sternmac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
S. J. Markiewicz
C. R. Robertson
T. C. Kingsland
J. E. Gruspier
R. A. Singh

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed Structure at the Crossing
of the South Nation River and
Hwy. #43 (Rev'n. Line 'L')
Chesterville Village, Winchester Twp.
District No. 9 (Ottawa)
W.J. 69-F-51 -- W.P. 148-66-01

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation at the proposed bridge crossing of the South Nation River and Hwy. #43 (Rev'n. Line 'L'), in the Township of Winchester, County of Dundas. The request was contained in a memo from the Kingston Bridge Location Section (Mr. T. C. Kingsland, Regional Bridge Location Engineer), dated June 11, 1969. An investigation was subsequently carried out by this Section to determine the subsoil and groundwater conditions at this site.

This report contains the results of the investigation, together with the recommendations pertaining to the foundations of the proposed structure, as well as the stability and settlement of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is situated in the southern part of the Village of Chesterville, at a point on the South Nation River approximately 1/2 mile upstream from the small dam, which is located in close proximity to Hwy. #43B. At this crossing the South Nation River is about 200 feet wide from crest to crest, and 15 feet deep. At the time of the investigation the river level was at elevation 220 - i.e., the water was approximately 6 feet deep. The natural slope of the river banks is somewhere between 2-1/2:1 and 3:1.

The surrounding terrain is flat to gently undulating in relief; at the present time, it is being utilized for farming purposes. A line of mature trees, however, is located along the north bank of the river.

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

Physiographically, the site is situated in the "Winchester Clay Plains" region. In general, the predominant stratum in this area is composed of a sensitive marine clay deposited, in the geologic past, by the Champlain Sea. The clay, which is encountered at a relatively shallow depth below ground surface, varies anywhere from 10 to 40 feet in thickness. It, in turn, is underlain by competent glacial till deposits.

It should be noted that the area is one of great geologic complexity and the aforementioned pattern is periodically interrupted. For instance, at some locations the till protrudes very close to ground surface; such areas are often characterized by low-lying drumlinized ridges.

The overburden deposits are underlain by limestone bedrock of the Trenton and Black River formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Eight sampled boreholes, 4 of which were accompanied by a dynamic cone penetration test, were put down during the course of the recent field investigation. The borings were advanced by means of conventional diamond drill rigs adapted for soil sampling purposes. One of the drill rigs was mounted on a drum raft in order to put down the two borings located in the South Nation River.

Samples of the overburden were obtained, at specified intervals, 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. Bedrock was proved in four of the borings by obtaining either AXT or BXT size rock core samples.

The groundwater level conditions across the site were determined by installing sealed piezometers in four of the boreholes.

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

This information was supplemented by recording the water level in the open holes during the course of the investigation.

The locations and elevations of all the borings were surveyed in the field by personnel from the Kingston Regional Engineering Survey Section. They are shown on Drawing No. 69-F-51A, together with the estimated stratigraphical profile across the site. All elevations were referenced to a geodetic datum.

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this inspection, laboratory tests were performed on selected samples to determine the engineering properties of the various soil types, namely:

Natural Moisture Contents
Grain-Size Distributions
Atterberg Limits

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on the figures, all of which are contained in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The predominant overburden stratum across the site is a very stiff to hard or compact to very dense glacial till composed of a heterogeneous mixture of clay, silt, sand and gravel. The thickness of this deposit varies from 14 to 20 feet. This till sheet, in turn, is underlain by a lower, very dense glacial till sheet composed of boulders in a clayey silt, sand and gravel matrix. The thickness of this lower till varies from 5 to 36 feet.

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

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

Beneath the river bed the glacial till sheets are overlain by up to 5 feet of compact sand with gravel, while some distance back of the river banks, it is overlain by as much as 7 feet of stiff to very stiff clayey silt. The overburden deposits are underlain by limestone bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borehole sheets. The stratigraphical profile, shown on Drawing 68-F-51A, is inferred from this boring data.

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

4.2) Surficial Deposits:

Along the river banks the terrain is surficially covered with a mantle of clayey silt to silt topsoil approximately 2 feet thick.

The river bed is covered by a 4 to 5 feet thick deposit of compact sand with some gravel.

4.3) Clayey Silt:

A deposit of stiff to very stiff ('N' values between 13 and 29 blows/ft.) clayey silt with a trace of sand is encountered beneath the surficial mantle, along the approaches to the banks of the South Nation River. The thickness of this deposit varies from 4.5 to 7 feet. A typical grain-size distribution curve, obtained on a sample of this cohesive subsoil, is plotted on Figure #1 in the Appendix of this report.

Two Atterberg limit tests were carried out on representative samples of the clayey silt; the results of this testing, which are given on the Borelog sheets, are summarized on the Plasticity Chart, Figure #4. The results indicate that the subsoil is inorganic and

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

4.3) Clayey Silt: (cont'd.) ...

of low plasticity; the corresponding liquidity indices were found to be 0.5 and 0.85.

At B.H. #1 the clayey silt is underlain by a compact to dense ('N' values 22 and 41 blows/ft.) silty sand with a trace of clay. At this boring location the thickness of the granular soil is 12 feet. Occasional shale fragments up to 1/8" in size are located throughout this zone. A grain-size distribution curve obtained on a sample from this deposit, is plotted on Figure #2.

4.4) Glacial Till:

The clayey silt (silty sand at B.H. #1), encountered along the approaches, and the surficial deposits in the immediate vicinity of the South Nation River, are underlain by glacial till sheets. The upper sheet ranges from 14 to 20 feet in thickness. This portion is basically composed of a heterogeneous mixture of clayey silt, sand and gravel, with the matrix being cohesive in nature. There are, however, localized areas where the deposit is granular in nature, consisting of a mixture of silt, sand and gravel.

The borings put down, in the immediate vicinity of the river banks (B.H.'s #2, 3, 6 and 7), penetrated a 'reworked zone' located within this upper till sheet. The surface of this zone was encountered between elevations 216 and 218; its thickness was proven to be of the order of 3 to 4 feet.

Grain-size distribution curves, obtained on samples of the glacial till using 2" O.D. sampling equipment, are plotted in envelope form on Figure #3.

Atterberg limit tests, carried out on the more cohesive portions of the glacial till, are summarized on the Plasticity Chart shown on Figure #4. The results of this testing indicate

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

4.4) Glacial Till: (cont'd.) ...

that the liquid and plastic limits range from 13 to 19 and 10 to 14, respectively - i.e., the cohesive portion is basically inorganic and of low plasticity, the corresponding moisture content being consistently less than the plastic limit, with the exception of in the 'reworked zone', where it is often greater than the liquid limit.

The standard penetration tests, carried out within the deposit, are plotted on the Record of Borelog sheets. This testing gave 'N' values which range from 15 to 123 blows/ft., being typically greater than 30 blows/ft. In the 'reworked zone' the 'N' values vary between 6 and 12 blows/ft. Based on these values, it is estimated that the consistency of the cohesive portions of the deposit ranges from stiff to hard. The granular zones have a relative density in the compact to very dense range. Further, it is inferred that the 'reworked zone' has a stiff consistency.

The upper till sheet is underlain by a lower sheet which is primarily composed of boulders (up to 18 inches in size); the boulders are occasionally bound by clayey silt, sand and gravel. The thickness of this sheet varies from 5 feet at B.H. #4 to 36 feet at B.H. #7. This deposit is in a very dense state as evidenced by the necessity of employing diamond drilling techniques to advance the borings through this zone.

4.5) Limestone Bedrock:

Bedrock was proven in boreholes #2, 4, 6 and 7, by obtaining from 3 to 12 feet of either BXT or AXT size rock core samples. Over the majority of the site the bedrock surface was encountered between elevations 190 and 195. At B.H. #7, however, the surface was found to be at about elevation 170. This would indicate that the bedrock dips steeply to the north, beyond the north bank of the river.

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

4.5) Limestone Bedrock: (cont'd.) ...

The bedrock is composed of a grey limestone with minor interbedded shale zones. In general, bedrock is sound throughout; however, some signs of fracturing and jointing were observed in the upper 4 to 5 feet at the majority of the boring locations.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out during the period of the investigation in: i) sealed piezometers installed in some of the boreholes, and ii) the open holes at the remaining boring locations. The observations are recorded on the borelog sheets and summarized on Drawing No. 69-F-51A. The results of the measurements indicate that the piezometric groundwater level, within the overburden deposits, ranges between elevations 221 and 223 - i.e., some 4 to 10 feet below ground surface. These elevations correspond closely with the river elevation of 219.5, recorded during the period of the investigation.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

The proposed structure will carry Hwy. #43 over the South Nation River, at a point where the river is located within the southern limits of the Village of Chesterville. The present proposals call for a 32-foot wide, 5-span structure - (68'-68'-68'-68'-68'). In the vicinity of the structure, Hwy. #43 has a profile grade between elevations 239 and 240.5. The associated approach fills will have a maximum height of the order of 11 feet above the existing ground surface.

The predominant stratum across the site is a glacial till deposit, the upper 14 to 20 feet of which is composed of a stiff to hard or compact to very dense, heterogeneous mixture of clay, silt, sand and gravel. Below this depth the glacial till is primarily formed of boulders up to 18 inches in size. Along the

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

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

the approaches to the river, the glacial till is overlain by between 4.5 and 7 feet of stiff to very stiff clayey silt. Further, the river bed is covered by up to 5 feet of compact sand and gravel.

6.2) Structure Foundations:

6.2.1) General:

The predominant stratum across the site, as far as foundation considerations are concerned, is the glacial till stratum. This deposit is basically competent, and thus consideration can be given to founding the structure elements on spread footings. At the abutment and end pier locations, however, a 'reworked zone' was encountered at elevations between 216 and 218 (refer to Sub-section 4.4)). This zone must not be overstressed by the footing loads. This being the case, this zone is a controlling factor in determining the allowable bearing values for spread footing design. If spread footing design is impractical or uneconomical, the elements could be supported on end-bearing piles. These factors will be discussed in the sub-sections to follow.

6.2.2) Pier Foundations:

The two centre piers will be placed within the confines of the South Nation River, while the two end piers will be located on the river banks. The recommendations pertaining to each will be discussed separately.

1) Centre Piers (Refer to B.H.'s #4 and 5)

The glacial till, underlying the river bed deposits, is competent. Therefore, these piers can be founded on spread footings located within this deposit, at or below elevation 209. For footings founded at this elevation, an allowable bearing value of up to 5.0 t.s.f. can be used in design.

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

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

6.2.2) Pier Foundations: (cont'd.) ...

1) Centre Piers (Refer to B.H.'s #4 and 5) (cont'd.) ...

The most practical means of carrying out the excavations at the centre pier locations will be in the dry. It will be necessary, therefore, to employ a dewatering scheme to control the river water. As discussed previously, the glacial till contains numerous granular zones. Because of this, the excavations will be susceptible to a boiling condition due to the unbalanced hydrostatic water pressure head. If closed interlocking steel sheeting is used in a dewatering scheme, this should be driven to a minimum depth below footing level equal to the unbalanced head existing above this level. This will involve driving the sheeting to about elevation 198.

Once the excavations reach footing level, it is recommended that the foundation subsoil be protected. This could be accomplished by pouring a lean concrete pad or, alternatively, placing a working mat composed of properly compacted granular material. The footings should be protected against any possible river scour action.

Settlement of the foundation subsoil will take place due to the applied footing loading. For the size of the footing contemplated (approximately 6 to 8 feet in width), imposing the above loading, it is estimated that the settlement will be negligible. The majority of this settlement will be due to recompression of the highly preconsolidated glacial till; it should, therefore, be realized during or immediately following the construction period.

ii) End Piers (Refer to B.H.'s #3 and 6)

Two alternate schemes can be considered for the proposed end pier footings.

The piers can be founded on spread footings located within the glacial till and/or the upper stiff clayey silt deposit. The

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

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

6.2.2) Pier Foundations: (cont'd.)

ii) End Piers (Refer to B.H.'s #3 and 6) (cont'd.) ...

footings should be founded at as high an elevation as possible within the competent deposits; this footing elevation should, however, provide 5 feet of earth cover, to the underside of the footings, for frost protection purposes. Taking the aforementioned into consideration, the footings could be founded at or below the following elevations:

North Pier	--	Elev. 222
South Pier	--	Elev. 226

The safe bearing pressure for design should be limited to 2.5 t.s.f. in order to ensure that the 'reworked zone', encountered between elevation 216 to 218, is not overstressed.

To reach foundation level, the pier excavations will extend some 4 to 6 feet below ground surface. These excavations will be carried out above the groundwater level recorded during the period of the investigation. Based on this, no major dewatering problems are anticipated. Any minor seepage into the excavations could be handled by pumping from sumps or other suitable means. The adjacent natural slopes should not be trimmed steeper than the existing conditions.

Settlement of the subsoil will take place, due to recompression of the cohesive glacial till, induced by the applied footing loads. For reasons discussed previously, this settlement should be negligible.

As an alternative, the end piers can be supported on end-bearing piles driven to an approximate tip elevation of 198 to 204; these piles would extend into the lower bouldery glacial till

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

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

6.2.2) Pier Foundations: (cont'd.) ...

ii) End Piers (Refer to B.H.'s #3 and 6) (cont'd.) ...

sheet. Allowable loads will depend on the pile section chosen (e.g., 12 BP 74 steel H-piles may be designed for 90 tons/pile).

6.2.3) Abutment Foundations (Refer to B.H.'s #2 and 7)

The proposed abutments may be constructed within the approach fills; two alternative methods are given for the foundation support of the abutments:

i) The abutments may be supported on spread footings perched within the approach fills. The material, below the tops of the footings, should consist of well compacted G.B.C. Class 'A' material, and should extend to a horizontal distance of at least 10 feet from the footing edges in the plane of the footing tops. This portion of the fill should be constructed with side slopes no steeper than 2:1. The remainder of the fill should be completed to about profile grade for a distance of about 50 feet behind the abutments before re-excavating for the abutment footings. An allowable bearing value of 2.0 t.s.f. may be used in footing design.

ii) The abutments for the structure may be supported on end-bearing piles driven to practical refusal at an approximate elevation of 205; again the piles would extend into the lower bouldery glacial till sheet. The pile capacities will be similar to those discussed in Sub-section 6.2.2) ii).

No bouldery or rock fill should be used in areas in which piles are to be driven.

6.2.4) Differential Settlement Between Structure Elements:

If the entire structure is supported on spread footings, some differential settlements can be anticipated. This would be

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

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

6.2.4) Differential Settlement Between Structure Elements:
(cont'd.) ...

a maximum between the 'perched' abutment footings and the end pier footings. The magnitude of the differential settlements, between these elements would be between 1/2 to 1 inch. The differential settlement between the end and centre piers will be negligible.

6.3) Approach Embankments:

The approach fills will be of the order of 11 feet in height. No stability problems are anticipated for embankments of this height, if constructed of properly compacted fill with standard 2:1 slopes.

Recompression settlements will be induced in the underlying stiff clayey silt deposit and extensive glacial till stratum. For the magnitude of loading being applied, this settlement will be of a minor amount and will not create any major maintenance problems.

7. MISCELLANEOUS:

The field work, performed during the period of July 3 to 15, 1969, was supervised by Mr. K. Kwan, Project Foundation Engineer.

The preparation of this report was undertaken by Mr. B. T. Darch, Senior Foundation Engineer.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed this report.

Equipment used was owned and operated by F. E. Johnston Drilling Co. Ltd.

August 1969.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 8 $\frac{1}{2}$ + 55 @ Prop. Line 'L'

W.P. 148-66-02 BORING DATE July 10, 11, 1969

DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing

ORIGINATED BY KK

COMPILED BY KK

CHECKED BY *AK*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLING NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT	SHEAR STRENGTH PSF 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 Y P.C.F.	REMARKS
231.6	Ground Level									
229.6	Sandy silt, tr. of gravel (topsoil)	1	SS	11	230					
2.0	Clayey silt, trace of sand (desiccated) (mottled grey & brown)	2	SS	13						
223.6	stiff	3	SS	13						
8.0	Silty sand, trace of clay (occ. shale fragments up to 1/8" in size throughout)	4	SS	22	220					
	Grey	5	SS	41						
211.6	Compact to dense									
20.0	Het. mix. of clay, silt, sand & gravel (Glacial Till)	6	SS	33	210					
204.6	Hard or Dense to very dense	7	SS	51						
27.0	End of Borehole				200					

0 7 68 25

0 84 (16)

29 50 (21)

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 85 + 35 o/s 16' Lt. (Prop. Line 'L')

W.P. 148-66-02 BORING DATE July 10, 11, 14, 1969

DATUM Geodetic BOREHOLE TYPE Washboring - NX, BX Casing - BXT Rock Core

ORIGINATED BY KK

COMPILED BY KK

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH PSF ○ UNCONFINED - FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — % *p *w *L	WATER CONTENT % 10 20 30	BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT						
227.0	Ground Level										
225.0	Clayey silt, trace of sand (Topsoil)		1	SS	8						
2.0	Het. mix. of clay, silt, sand & gravel (Glacial Till)		2	SS	22	220		○		40.4%	▼ 221.
	Reworked Zone (Stiff) (Grey)		3	SS	24			—		○	18 35 34 13
	Very stiff or compact		4	SS	6			○ —			33 32 26 9
209.0			5	SS	20						
18.0	Boulders (up to 18" in size)		6	SS	-	210		○ —			
			7	BXT	39%						
			8	BXT	75%						
			9	BXT	33%	200					Piez. Tip el. 200.
194.0			10	BXT	56%						
33.0	Limestone Bedrock with shale interbeds (fractures)		11	BXT	85%						WL in piez.
191.2											July 15/69
35.8	End of Borehole					190					

Piez. Tip
el. 200.WL in piez.
July 15/69

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ———— w _L	PLASTIC LIMIT ———— w _P	WATER CONTENT ———— w	BULK DENSITY Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	SHEAR STRENGTH PSF	* * ————— *	WATER CONTENT %		
226.5	Ground Level											
223.5	Sandy silt, trace of gravel (topsoil)		1	SS	3							
3.0	Het. mix. of clay, silt, sand & gravel		2	SS	19	220						
	(Glacial Till)		3	SS	29							
	Reworked Zone		4	SS	7							
	Stiff		5	SS	17	210						
	(fragments of shale below elev. 212)		6	SS	16							
	Grey		7	SS	79/9"							
205.7	Very stiff to Hard or Compact to very dense											
20.8	End of Borehole											
201.6												
24.9	End of Cone Test					200						

▼ 222.5

Piez. tip
el. 206.5

WL in piez.
July 15/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 87 + 39 @ Prop. Line 'L'
 W.P. 148-66-02 BORING DATE July 9, 10, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX, BX Casing - BXT Rock Core

ORIGINATED BY KK
 COMPILED BY KK
 CHECKED BY *KK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		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		SHEAR STRENGTH P.S.F.		WATER CONTENT % 10 20 30				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
219.5	River Level												GR. SA. SI. CL.
	Water												
213.5	River Bed												
6.0	Sand, some gravel												
209.5	River bed deposit												
209.5	Grey Compact					210							
10.0	Het. mix. of clay, silt, sand & gravel		1	SS	46								
	(Glacial Till)		2	SS	54								
	(fragments of shale up to 1/2" in size throughout)					200							31 27 30 12
195.5	Grey Hard. or V. Dense		3	SS	64								
24.0	Boulders		4	BXT	13%								
191.5	(up to 8" in size)												
28.0	End of Borehole					190							

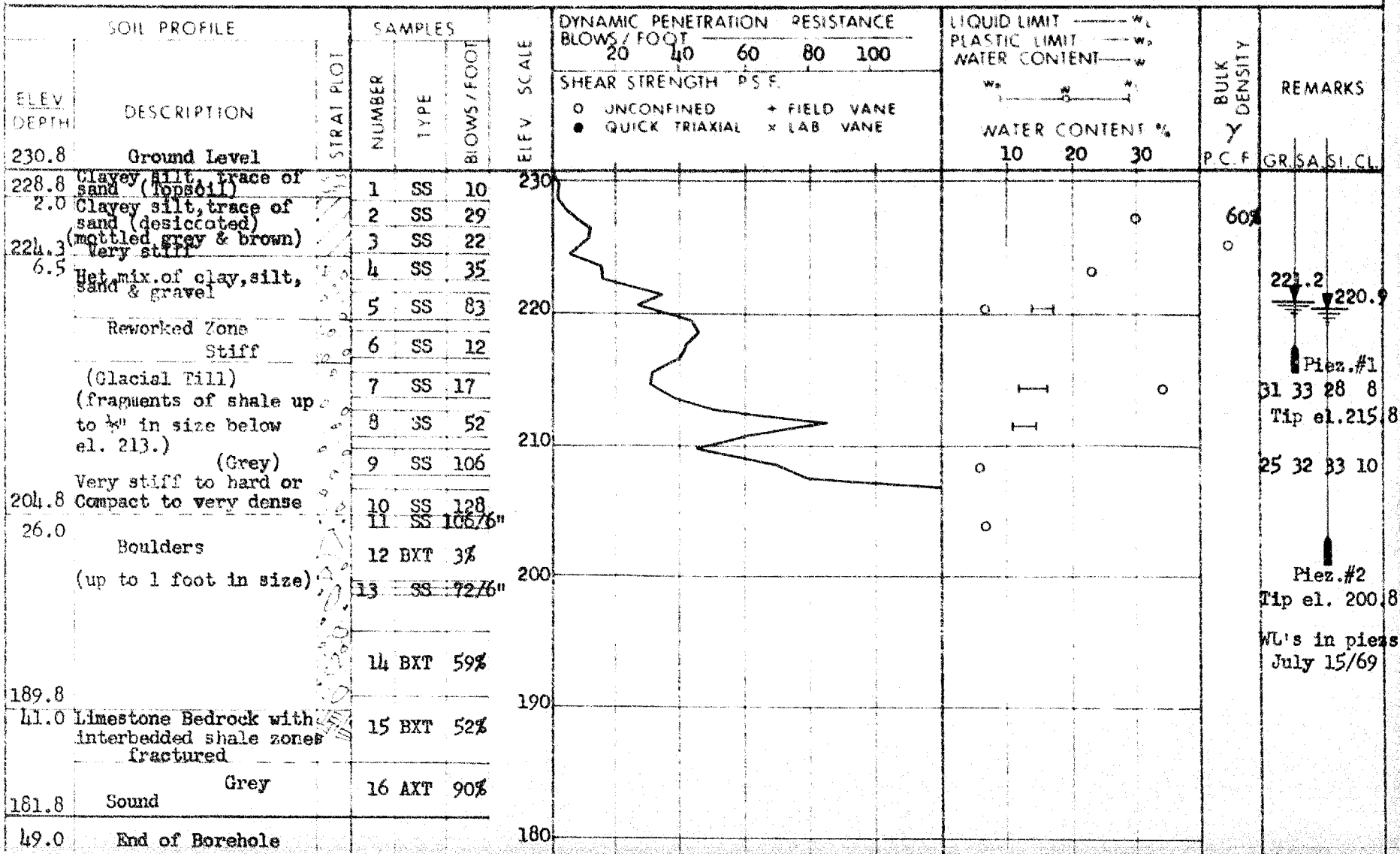
31 27 30 12

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 88 + 07 @ Prop. Line 'L' ORIGINATED BY KK
W.P. 148-66-02 BORING DATE July 3, 4, 5, 7, 8, 1969 COMPILED BY KK
DATUM Geodetic BOREHOLE TYPE Washboring - NX, BX Casing - BXT, AXT Rock Core CHECKED BY *AK*



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 88 + 75 o/s 16' Rt. Line 'L' ORIGINATED BY KK
 W.P. 148-66-02 BORING DATE July 7, 8, 9, 1969 COMPILED BY KK
 DATUM Geodetic BOREHOLE TYPE Washboring-NX,BXCasing - BXT Rock Core CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT					SHEAR STRENGTH P.S.F.				WATER CONTENT % 10 20 30	
							20	40	60	80	100	UNCONFINED + FIELD VANE QUICK TRIAXIAL x LAB. VANE					
231.6	Ground Level																
229.6	Clayey silt, trace of gravel (topsoil)		1	SS	11	230									44%		
2.0	Clayey silt, trace of sand (desiccated)		2	SS	15												
224.6	Mottled grey & brown silt		3	SS	34												
7.0	Het. mix. of clay, silt, sand & gravel (Glacial Till)		4	SS	26	220									67.4%		
	Reworked Zone		5	SS	16												
	Stiff (fragments of shale throughout)		6	SS	7												
	Stiff to hard or Compact to very dense		7	SS	37	210											
206.1			8	SS	13												
25.5			9	SS	76												
	Boulders (up to 1 foot in size)		10	BXT	22%	200											
			11	BXT	20%												
			12	BXT	27%	190											
			13	BXT	-	180											
			14	SS	75/6"												
169.6			15	BXT	1%	170											
62.0	Fractured Limestone Bedrock with shale bands up to 18" in thickness. (Grey)		16	SS	60/3"												
160.6			17	BXT	100%												
			18	BXT	88%												
71.0	End of Borehole		19	BXT	100%	160											

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-51 LOCATION Sta. 89 + 55 @ Prop. Line 'L'

W.P. 148-66-02 BORING DATE July 11, 1969

DATUM Geodetic BOREHOLE TYPE Washboring - NX, BX Casing

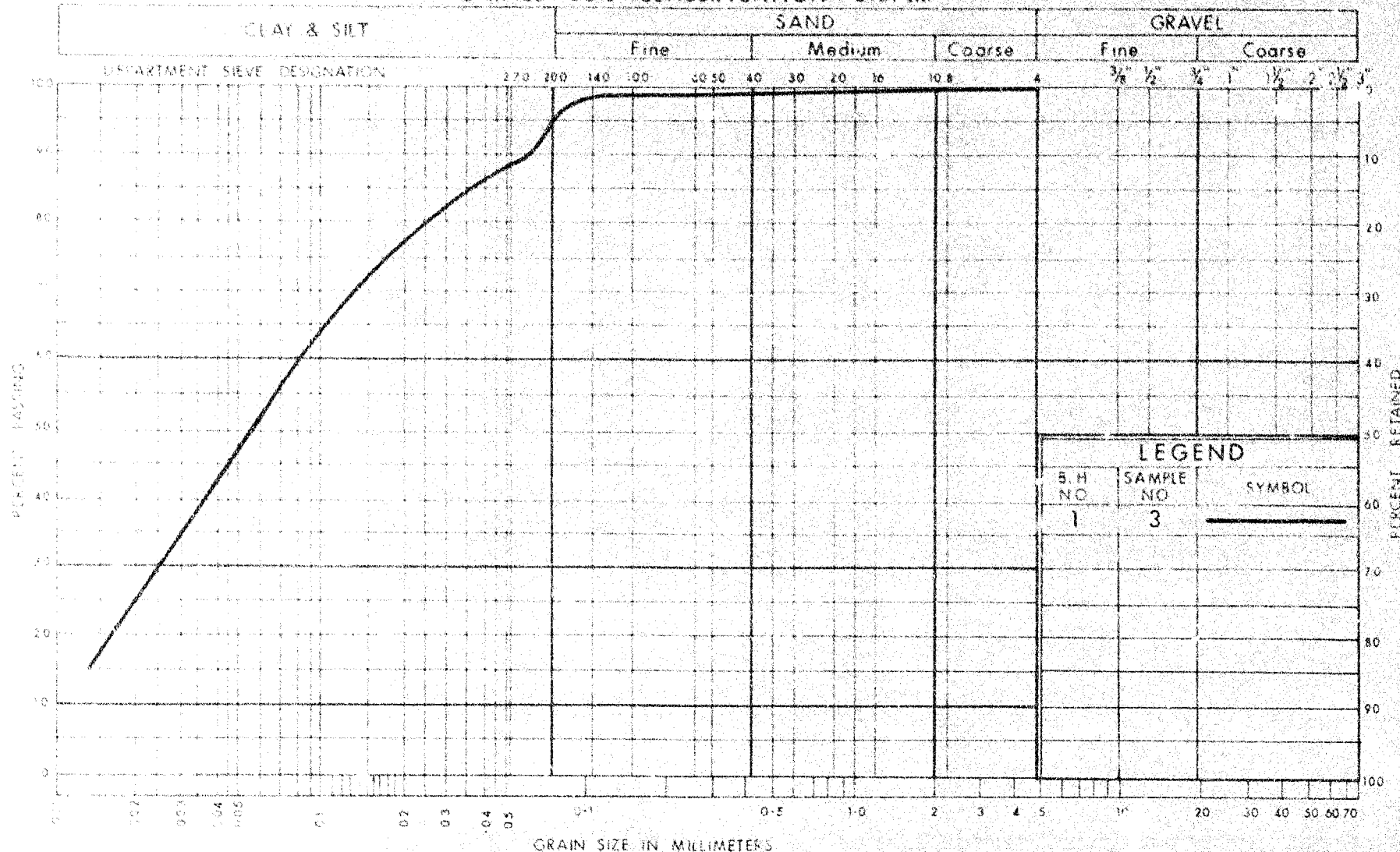
ORIGINATED BY KK

COMPILED BY KK

CHECKED BY *AK*

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _P WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE		BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE			
230.4	Ground Level										
228.4	Clayey silt, trace of sand (topsoil)				230						
228.0	Clayey silt, trace of sand (desiccated) (mottled gray & brown)		1	SS		13					
221.4	stiff										▼ 223.
221.0	Met. mix. of clay, silt, sand & gravel (Glacial Till) (occ. fragments of shale below el. 205.)		2	SS	220	48			○		
	Very stiff to hard or		3	SS		15			○ —→		40 29 22 9
	Compact to dense		4	SS	210	18					
206.4			5	SS		16			○ —→		26 32 31 11
24.0	End of Borehole				200						WL in open hole July 11/69

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

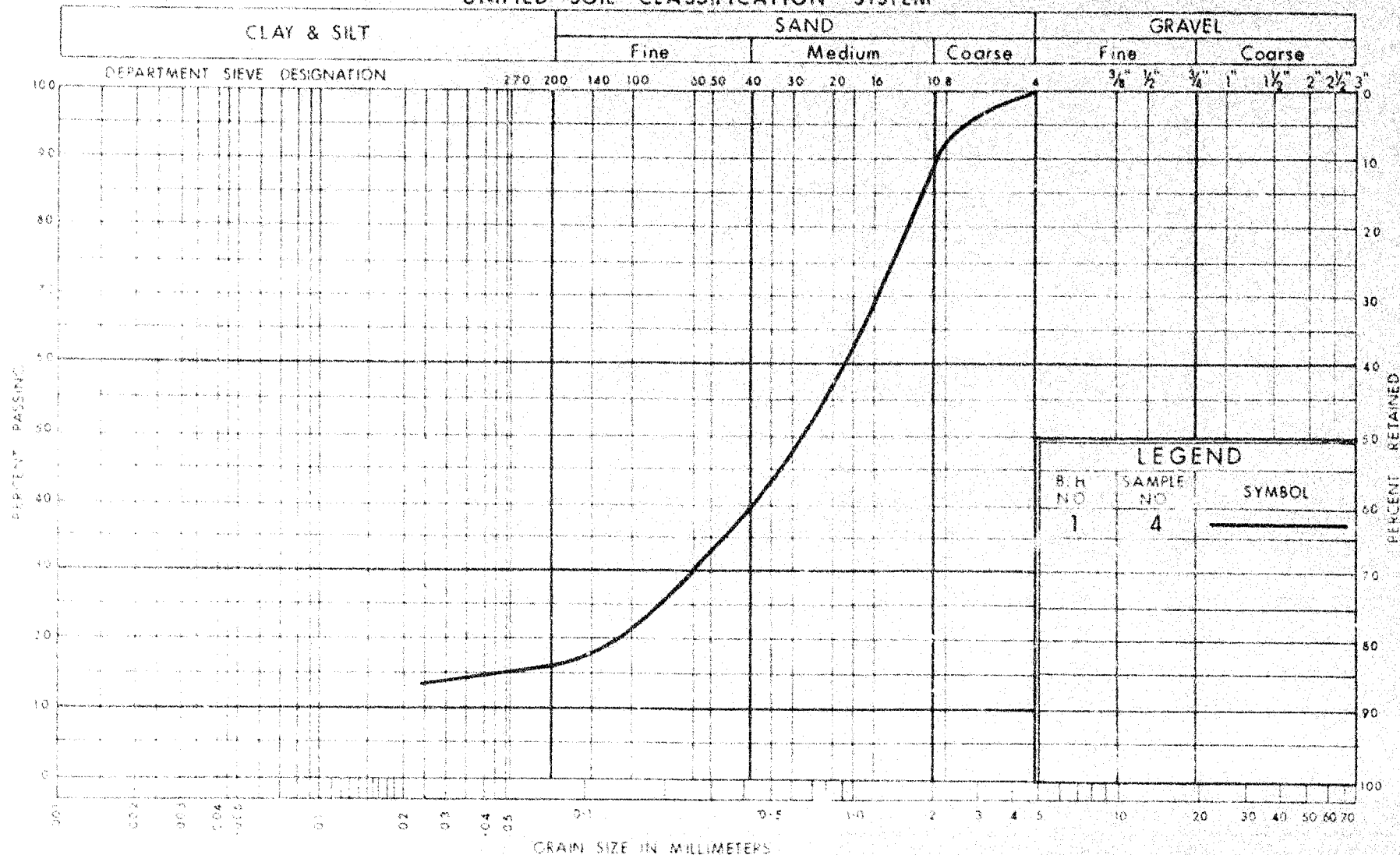
GRAIN SIZE DISTRIBUTION
CLAYEY SILT
TRACE OF SAND

W.P. No 148-66-02

JOB No 69-F-51

FIG. NO. 1

UNIFIED SOIL CLASSIFICATION SYSTEM

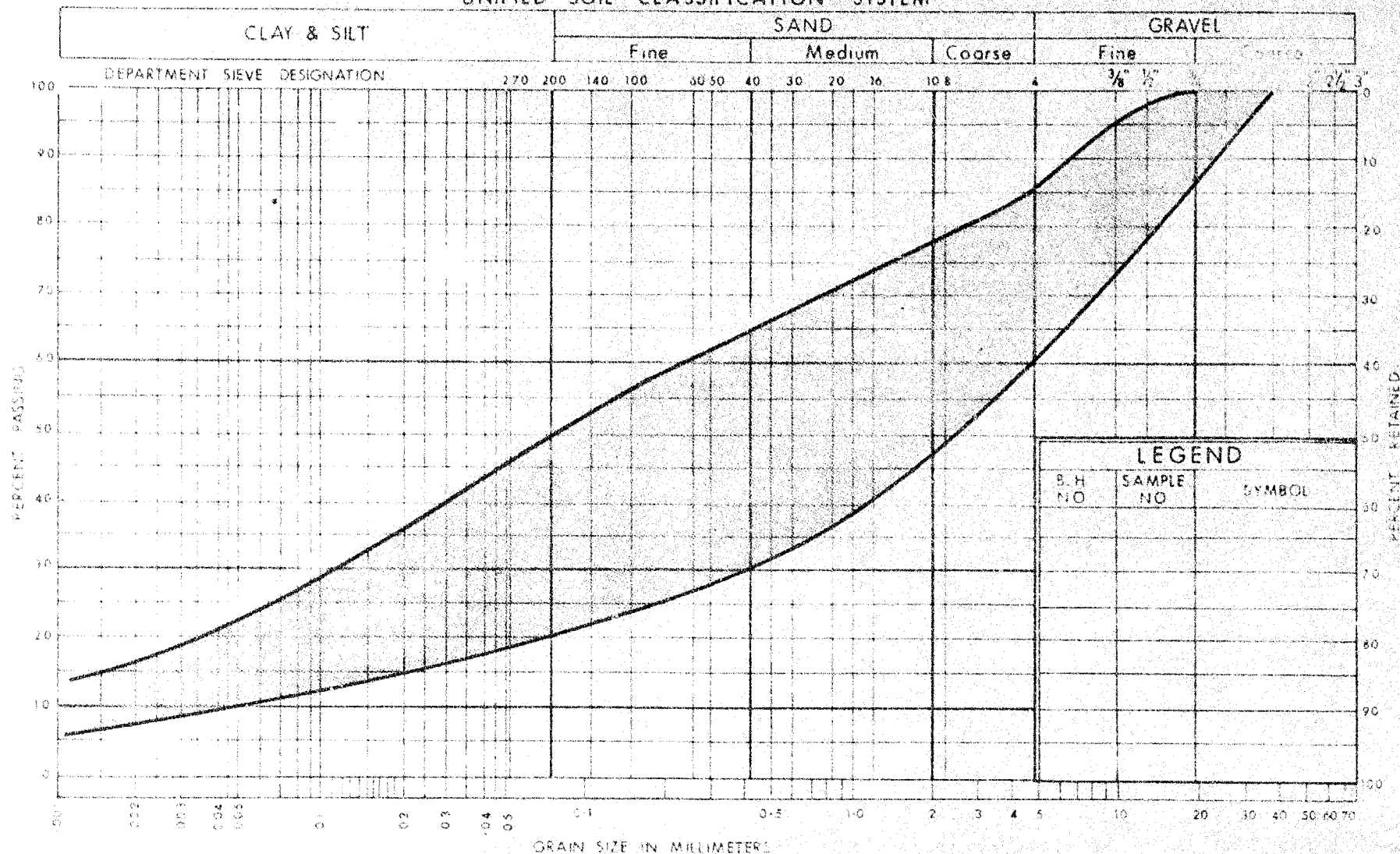


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SILTY SAND
TRACE OF CLAY

W.P. No. 148-66-02
JOB No. 69-F-51
FIG. NO. 2

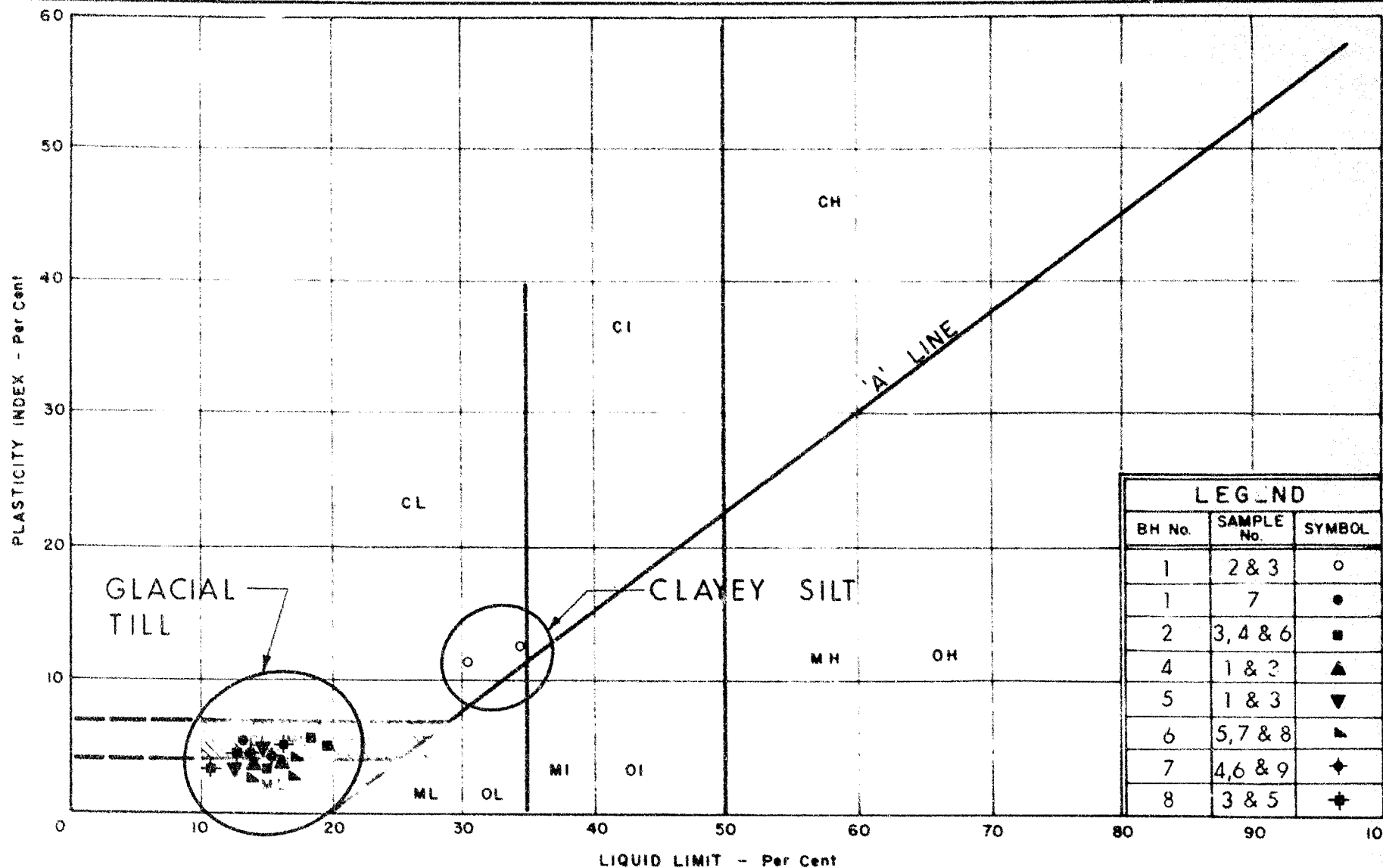
UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HETROGENEOUS MIXTURE OF CLAY, SILT, SAND & GRAVEL

W.P. No. 148-66-02
JOB No. 69-F-51
FIG NO. 3



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

W.P. No. 148-66-02

JOB No. 69-F-51

FIG. NO. 4

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, 6. 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 :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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

Q _u	UNCONFINED COMPRESSION	L V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

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
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
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
$\bar{\sigma}$	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 (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

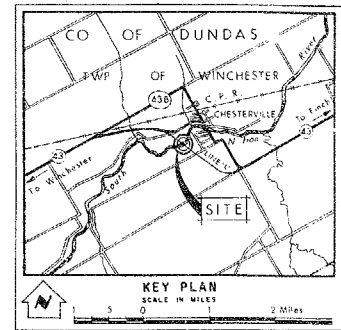
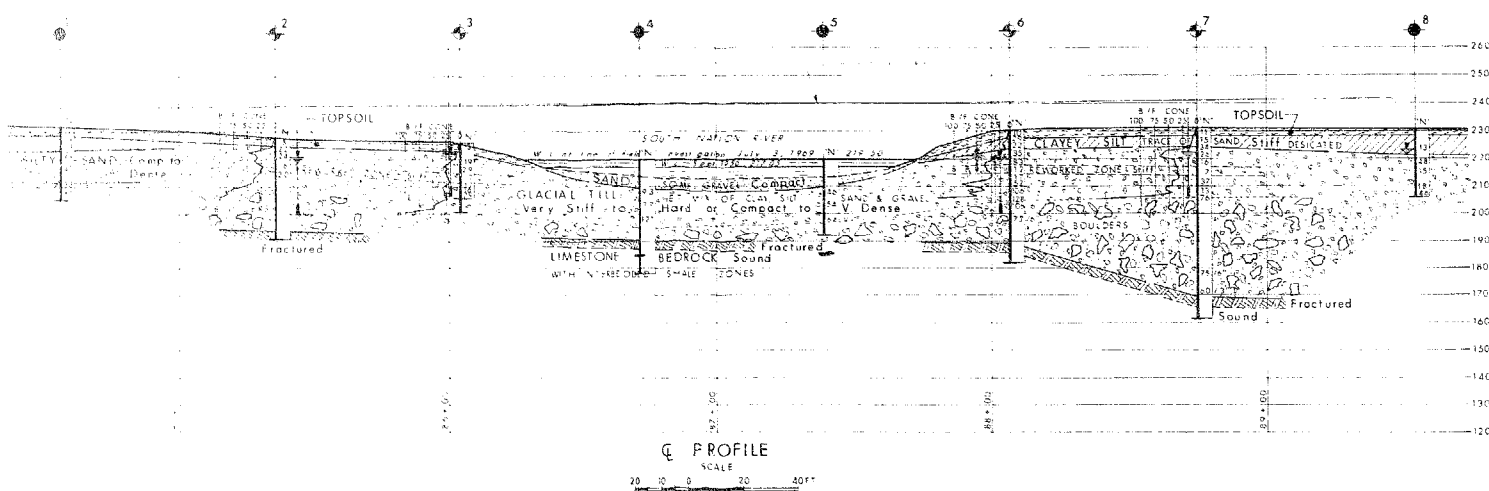
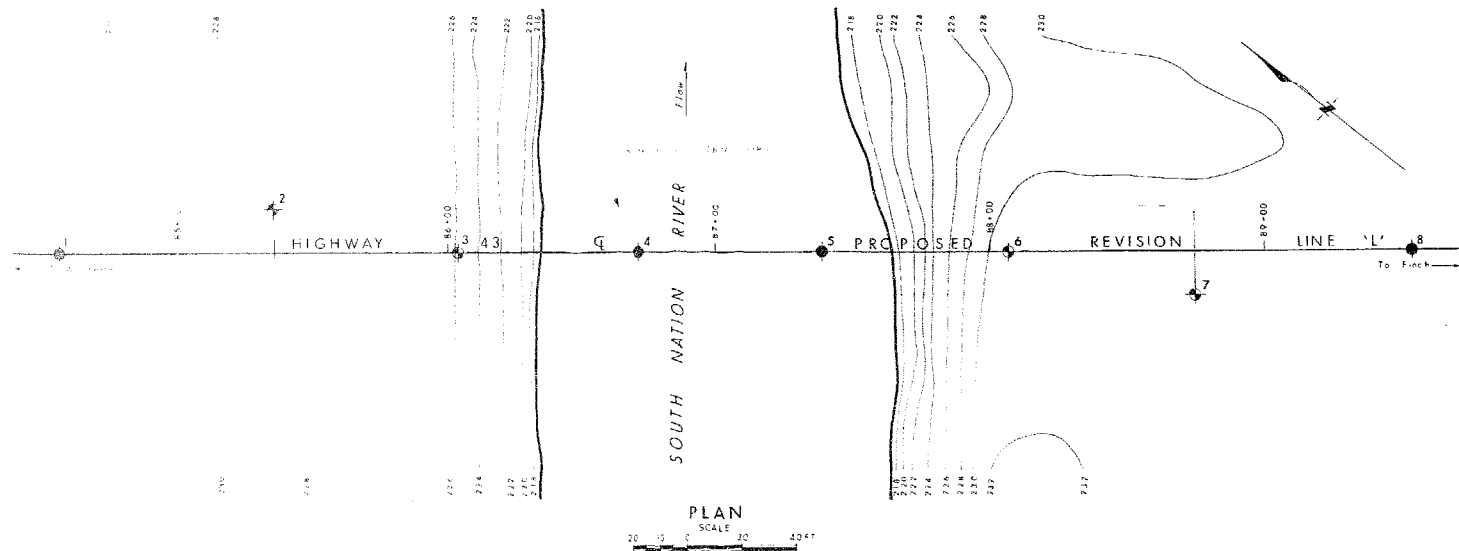
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, July 15, 1969		
	Piezometer		
NO.	ELEVATION	STATION	OFFSET
1	231.0	84+55	0
2	227.0	85+35	10' LT
3	226.5	86+03	0
4	219.5	86+71	0
5	219.5	87+34	0
6	230.8	88+07	0
7	231.0	88+75	10' RT
8	230.4	89+55	0

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.

REGIONS	DATE	BY	REVISION

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

SOUTH NATION RIVER
(CHESTERTONVILLE)

KING'S HIGHWAY NO. 43 REV'N LINE 'L' DIST. NO. 9
CO. DUNDAS
TWP. WINCHESTER LOT 17 CON. II

BORE HOLE LOCATIONS & SOIL STRATA

SUBNO. 110 CHECKED	WP NO. 148 - 60 - 02	W.P.T. DRAWING NO.
DRAWN C.P. CHECKED	JOB NO. 60 - 6 - 51	69-F-51A
DATE AUG. 20, 1969	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.	

Department of Highways Ontario

Copy for the information of

Mr. M. Devata

Mr. J.E. Callaghan,

District Engineer,

Ottawa, Ontario

Bridge Office,

Downsview

Mr. L.M. Peverett,
Construction Engineer

December 16, 1970

South Nation River Bridge - Chesterville Diversion
W.P. 148-66-02, Site No. 31-279
Highway 43, District #9 - Ottawa

Further to your teletype of December 11, 1970, we have again looked into the use of caissons for pier foundations. During the preliminary design of this bridge, three different schemes for pier foundations were considered.

The first scheme consisted of spread footings. In order to satisfy the future channelization and scour requirements, the footings were founded at El. 293.00, i.e. about 15 ft. below normal water level. This scheme required extensive sheet piling and unwatering and was discarded on the basis of its high cost.

The second scheme consisted of steel H-piles driven inside 24"Ø tube piles, with a concrete pier cap as in Contract 67-43, Jewellville Bridge. With the future channelization and scour down to El. 203, it was imperative to drive the steel H-piles to El. 193.00 or below in order to provide the necessary fixity at the bottom of the piles. Due to the presence of boulders below El. 196.00, it was felt that it may be impossible to drive these piles to this elevation, and consequently structural stability could not be ensured. This scheme was then abandoned.

The third scheme consisted of the 48"Ø caissons socketed 2 ft. into bedrock and filled with tremie concrete. Due to the presence of boulders above the bedrock we were also concerned that the installation of the caissons may be difficult. This was discussed with the Foundation Office, who felt that the caissons could be installed, and this was subsequently confirmed by two contractors specializing in foundations. Copies of the letters from these contractors are attached for your information.

We have again reviewed this with the Foundation Office, who feel that a competent contractor using proper equipment should be able to install these caissons without undue problems.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. M. Devata

K. Bassi

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: March 9, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: South Nation River Bridge
W.P. 148-66-02, Site 31-279
Highway 43, District No. 9

69-F-51

Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.



C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

March 11, 1970

No comments

NOTE ^(estimated) The pile lengths at the
abutment locations are
reasonable.

ii) the Piers - founded on
4' dia. caissons - approx. 35' in
length - i.e. extend 2' to 3' into
sound bedrock - through the fractured
zone

BTD



See
148-66-02
March 12/70



69-F-51

Lundy
als1575 STEELES AVE. EAST
WILLOWDALE, ONTARIO
TELEPHONE: - 223 7581
223 856

November 19, 1969.

Department of Highways,
Materials and Testing Division,
Keele St. - Hwy 401,
Downsview, Ontario.

Attention: Mr. A. Stermac, P. Eng.

Re: Caissons - South Nation River - Proposed Bridge -

Dear Sir:

We have reviewed the bore hole information provided on your drawing 69-F-51 A and drawing D-6727-P. We feel that a caisson foundation could be installed by using a chopping bit and crane to advance a heavy wall casing into the limestone bedrock. The casing would be sealed into the rock however we feel it would not be possible to seal off all the water thus making it necessary to tremie the concrete. It would also be necessary to leave the heavy wall casing in place.

Our budget estimate to install 4 caissons 48 inch diameter would be \$27,000.00.

This estimate includes:

1. Supply and installing a 48 inch diameter steel liner approximate wall thickness to be 5/8 inches. The liner would be founded at approximately elevation 188 and the cutoff elevation at approximately 222.
2. We would fabricate reinforcing steel cages and place them in the caissons.
3. We would supply and place concrete into the caisson from elevation 188 to approximately elevation 232.
4. We would supply and place sonotube above the caisson cut-off to elevation 232.

The following items to be by others:

1. Layout elevations and all field engineering.
2. Supply of reinforcing steel.
3. Provide a working surface off which our equipment can work.

cont.

SPECIALISTS IN ALL TYPES OF SHORING, CAISSONS, UNDERPINNING, ETC.

We appreciate this opportunity to provide this budget and look forward to bidding on this project when it goes out for tender.

Yours truly,

Anchor Shoring Limited.



G. R. Demetrick, P. Eng.

per:

GRD/js

WESTERN CAISSONS LTD.

FOUNDATION SPECIALISTS

WESTERN CAISSONS (1969) LTD.
46 Creditstone Road
Maple, Ontario
Phone 889-7383

November 26, 1969

Ontario Department of Highways
Materials and Testing Office,
Room 107, Lab Building,
Highway 401 and Keele Street,
Downsview, Ontario.

Attention: Mr. M. DeVata, Supervising Engineer.

Dear Sir:

Re: Preliminary Estimate,
Proposed South Nation River Bridge,
Chesterville Diversion.

We have reviewed the Foundation Site Investigation Report as per your drawing Number 69-F-57A, dated October 1, 1969, and your drawing Number D-6727-B, dated October, 1969, showing the plan and profile of the proposed bridge.

You had requested that we consider using 48" diameter caissons, and if such is the case, then we would recommend these caissons be taken down onto the fractured shale bedrock, as the bearing capacity requirement would be in the order of 16 tons per square foot. This is based on the understanding that each pier would be designed for a total load of 400 tons, and there would be two 48" diameter caissons under each pier. Our estimate for the construction of a total of four caissons with the cut-off elevation at grade would be approximately \$15,000.00. This is based on the understanding that access would be provided for our equipment onto each and every caisson location, and the above estimate is based on supply and placing concrete, as well as a nominal amount of reinforcing steel. It may be required

.....con't

Ontario Department of Highways

to tremie the concrete if it is not possible to effect a seal on the fractured bedrock. Should it be required to penetrate the bedrock, we would estimate the cost of this would be in the neighbourhood of \$60.00 per lineal foot including concrete and a nominal amount of reinforcing steel.

We trust this information is of value to you, and should you desire to discuss this further, please feel free to contact us.

Yours very truly,

WESTERN CAISSONS (1969) LIMITED



P. Kozicki, P. Eng.

PK/jm

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Laboratory Building,
Downsview, Ontario.

From: Bridge Section,
Kingston, Ontario.

DATE: June 11, 1969.

ATTENTION:

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 148-66-02, Site 31-279,
South Nation River Bridge
(Chesterville Diversion)
Hwy. 43 (Rev.), District 9

69-F-51

We are sending to you herewith two prints of Bridge Site Plan E-4674-1 on which we have marked the proposed location of the subject structure. Also enclosed are two copies of your Field Reconnaissance Report.

We would be pleased if you will make arrangements for the necessary foundation investigation and to have your report, the scheduled date for which is July 9, 1969.

CHANGE : AUG. 20, 1969 (RICK FOREST)

JUN. 13, 1969.

T. C. Kingsland

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl
Encls.
c.c. (With encl.)
Bridge Office Files Section

FIELD RECONNAISSANCE REPORT
REQUIRED BY FOUNDATION SECTION
FOR

FF-69
SEPT. 1968

Plan No. B-212-6

W.P. NO. 148-66-02 HIGHWAY NO. 43 DISTRICT 9 SITE PLAN NO. E-4674-1 PROFILE NO. C-212-12
RIVER CROSSING ☒ GRADE SEPERATION ☐ R.R.X. ☐ OTHER (SPECIFY) _____
ALTERNATE SCHEME (IF ANY) _____

EXISTING SITE CONDITIONS

DESCRIPTION:

TOPOGRAPHY: HILLY ☐ ROLLING ☐ VALLEY ☐ GULLIED ☐ FLAT ☒
VEGETATION: TREES ☒ BRUSH ☐ GRASS ☐ SWAMP ☐ FARM CROPS ☒ CLEARED ☒
~~SNOW COVER~~ ☐ ~~3"-6"-12"~~ ☐ ~~4"-12"~~ ☐ ~~12"~~ ☐
ROCK OUTCROP (SPECIFY LOCATIONS) None

UNDERGROUND UTILITIES: UTILITY COMPANY TELEPHONE NO. FOR DEFINITE LOCATION

- 1 None
- 2 _____
- 3 _____
- 4 _____
- 5 _____

EXISTING STRUCTURE(S): None

FOUNDATIONS: SPREAD FOUNDATIONS ☐ SIZE _____ ELEVATION(S) _____
PILES ☐ TYPE _____ LENGTH(S) _____
DESIGN LOAD _____ T.S.F. _____ TONS / PILE _____
CONDITION OF STRUCTURE _____

APPROACHES: CUT ☐ FILL ☐ SIDE SLOPES _____
BERMS YES ☐ NO ☐

OTHER OBSERVATIONS (USE BACK OF SHEET TO DESCRIBE ANY FAILURES IN AREA, PAST PERFORMANCE OF EXISTING APPROACHES & STRUCTURE, ETC.)

ACCESSIBILITY

IS STRUCTURE LOCATED ON D.H.O. RIGHT OF WAY? YES ☒ NO ☐ IF NO,
HAS PERMISSION BEEN OBTAINED TO ENTER PROPERTY? YES ☐ NO ☐ IF NO,
PROPERTY OWNER(S):

NAME ADDRESS TELEPHONE NO.

- 1 _____
- 2 _____
- 3 _____
- 4 _____

WHO WILL OBTAIN NECESSARY PERMISSION? _____

HAS SITE BEEN SURVEYED & STAKED? YES ☒ NO ☐ IF YES, DATE OF MOST RECENT SURVEY June 1969

WILL CLEARING BE NECESSARY TO ENTER SITE AREA? YES ☐ NO ☒ If entrance is made from south side of river.

IS SITE ACCESSIBLE TO WHEELED VEHICLES? YES ☒ NO ☐

IF RIVER CROSSING:

WILL A RAFT BE NECESSARY? YES ☒ NO ☐ IF YES, GIVE MAX. DEPTH OF WATER 3 to 4 FT.
CURRENT: SWIFT ☐ MODERATE ☐ SLOW ☒ on June 11/69

DRILLING OPERATIONS

NEAREST SOURCE OF WATER (GIVE HAULING DISTANCE, IF KNOWN) _____ at site

ADDITIONAL INVESTIGATION REQUIRED FOR THE FOLLOWING PURPOSES:

ALTERNATE SCHEM: YES ☐ NO ☐ IF YES, SPECIFY _____

HYDROLOGIC REASONS: YES ☐ NO ☒ IF YES, SPECIFY (SCOUR, ETC.) _____

REMARKS

NEAREST AVAILABLE ACCOMODATION: Dockstader Bros. Motel, Winchester - Phone: 774-2600

OTHER COMMENTS: None (Make reservations several days in advance)

DATE June 11, 1969

REGIONAL BRIDGE LOCATION ENGINEER H. Kingsland

ABUTMENT FOUNDATIONS

1. Spread Footing Design.

a) Bearing Capacity. (Granular Theory)

$N_{ave} = \underline{20 \text{ blows/ft. (uncorrected)}}$

$$\phi = 35^\circ$$

$$N_y = 40$$

$$q_o = \frac{\gamma b}{2} N_y + C N_c + \cancel{q' N_q}$$

$$q_{allow} = \frac{125 \times 8}{2} \times 40 = \frac{1}{3} \times \frac{20,000}{2000} \text{ p.s.f.}$$

$$\underline{q_{allow} \approx 3 \text{ t.s.f.}}$$

b) Settlement Criteria

Assume ①. $q_{allow} = 2.0 \text{ t.s.f.}$

$$\Delta_{allow} \approx 1"$$

In Design $\Delta_{allow} \approx \underline{0.75"} \quad \text{---}$

$$q_{CB}' = m' \times \left[\frac{q_{allow}}{\Delta_{allow}} \right]^2$$

$$\frac{125 \times 8}{2} \times 40 = \frac{32}{8} \approx 4 = m'$$

$$m' = 0.45$$

$$m' = 0.45 \times 4 = 1.8$$

$$\alpha_o = \frac{\ln f t^2}{\text{ton}} = 0.18.$$

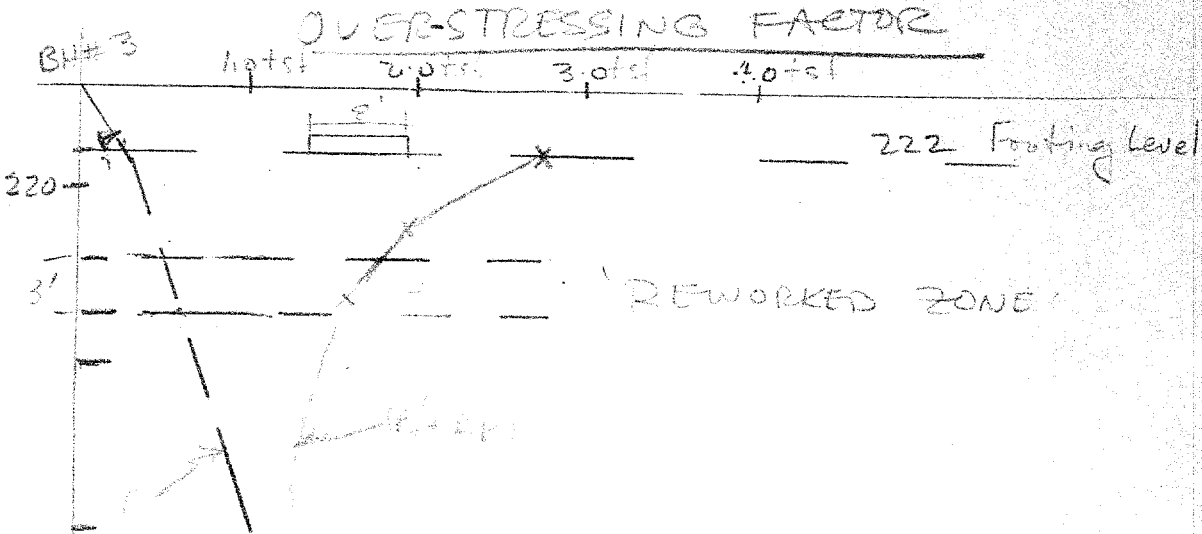
$$0.75" = 0.18 \times 1.8 [4] \text{ } \approx \text{allow.}$$

$$I_{\text{allow}} = \frac{0.75 \text{ in}}{0.18 \frac{\text{in. ft.}^2}{\text{ton}} \times 1.8 \times 4} \approx 1 \text{ ton/sq ft.}$$

b) Cohesive Theory

$$C_{u \text{ min}} = 2500 \text{ p.s.f.}$$

$$I_{\text{allow}} = \frac{1}{3} \times \frac{6 \times 2500}{2000} \approx \underline{\underline{2.5 \text{ t.s.f. net}}}$$



$$A_g = \frac{8 \times 32}{12 \times 6} \times 2.5 \text{ at } 4' = 1.47 \text{ t.s.f.}$$

$$= \frac{8 \times 32}{16 \times 40} \times 2.5 \text{ at } 5' = 1.00 \text{ t.s.f.}$$

Induced excess pressure in 'reworked zone'
 $\approx 1 \text{ t.s.f.}$

Cement in this zone = 800 p.s.f.

$$\text{Gallon} = \frac{6 \times 800}{3 \times 2000} = \frac{1600}{2000} \approx 0.8 \text{ t.s.f.}$$

\therefore should be OK.

Settlement Considerations

Elastic Settlement at Pier locations.

$$B = 8' \quad D = 4' \quad H = 10'$$

Assume $E_{\text{composite}} = 350 \text{ t.s.f.}$

$$H/B = 10/8 = 1.25 \quad \frac{B}{\beta} = \frac{32}{8} = 4$$

$$M_1 = 0.7 \quad M_0 = 0.9$$

$$\delta_1'' = \frac{0.7 \times 0.9 \times 2.5 \times 8 \times 12}{300} \approx 0.5''$$

MEMORANDUM

72-96

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Downsview, Ontario.

From: Bridge Section,
Kingston, Ontario.

Attention: Mr. M. Devata

Date: October 3, 1969.

Our File Ref.

In Reply To

Subject: W.P. 148-66-02, Site 31-279,
South Nation River Bridge (Chesterville Diversion),
Highway 43, District 9

We would be pleased if you would send an extra copy of your Foundation Report BA-3075 for the subject project.

As mentioned earlier, we now require 2 copies of your Foundation Report for our bridge projects as we have been asked to include one with the Bridge Planning Report for the designer's use.

T.C. Kingsland

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/h1

c.c. Bridge Office Files Section

69-F-51

CONT 72-96

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY*43-CHESTERVILLE BOREHOLE No. 1 GROUND ELEVATION 231.6'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	0'-2'			Tr	15	85		DULL	MED	LOW	ORGAN	BROWN	NONE		SILT, SOME SAND, TRACE of ORGANICS & GRAY (TOP SOIL)	
2	3'-5'			—	Tr	100		"	SLOW	MED	EARTHY	MOTT. BROWN	STRONG		CLAYEY SILT, TRACE of SAND (COHESIVE)	
3	6'-8'			Tr	Tr	100		"	"	LOW	NONE	"	"		CLAYEY SILT, TRACE of SAND (COHESIVE)	
4	10'-12'			Tr	100	Tr	LOW	"	QUICK	"	"	BROWN GREY	"		SILTY SAND, TRACE of CLAY	
5	15'-17'			Tr	100	Tr	"	"	"	"	"	"	"		SAME AS ABOVE.	
6	20'-22'	1 1/2"	ANG	10	90	Tr	"	"	"	"	"	GREY	"		SAME AS, ABOVE.	
7	25'-27'	1/2"	SUB ROUND	10	50	40		"	SLOW	MED	"	"	"		CLAYEY SILT AND SAND. SOME GRAVEL (COHESIVE)	

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

WITH 20%
SAND 10-15
CLAY

PROJECT 69-F-51 SITE HWY*43-CHESTERVILLE BOREHOLE No. '2' GROUND ELEVATION 227.0'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	0'-2'			-	Tr	100	HIGH	DULL	SLOW	LOW	ORGANIC	MOTT. BROWN	WEAK	FIRM	(TOP SOIL) CLAYEY SILT, TRACE of SAND & ORGANICS	OL
2	3'-5'	1/2"	SUB ANG	35	15	50	"	SHINE	SLOW	MED	EARTHY	"	STRONG	VERY STIFF	CLAYEY SILT WITH SAND & GRAVEL	ML
3	6'-8'	3/4"	SUB ANG	30	15	55	"	DULL	SLOW	"	NONE	"	STRONG	"	CLAYEY SILT WITH GRAVEL & SAND.	"
4	9'-11'	1 1/4"	"	40	20	40	"	"	SLOW	LOW	"	BROWN GREY	STRONG	FIRM	CLAYEY SILT AND GRAVEL, WITH SAND.	"
5	12'-14'													VERY STIFF	SAMPLE LOST.	
6	15'-17'	"	"	30	20	50	"	"	"	MED	"	DARK GREY	"	HARD	CLAYEY SILT WITH GRAVEL & SAND, COHESIVE.	"

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY#43-CHESTERVILLE BOREHOLE No. '3' GROUND ELEVATION 226.5'

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION			DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE										
		GRAVEL	SAND	SILT & CLAY										
1	0'-2'													
2	5'-7'													
3	8'-10'													
4	11'-13'												SAMPLE LOST	
5	14'-16'													
6	17'-19'													
7	20'-26'9"													

NOTES:— VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:—

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY #43-CHESTERVILLE BOREHOLE No. 4 GROUND ELEVATION 213.7

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	0'-5'	1/8"	SUB 3	10	90	75	NONE	DULL	NONE	NONE	NONE	BLACK	STRONG		CHIPS of SHALE & FRAGMENTS of SHALE (RIVERBED) NON-COHESIVE	SW
1	5'-7'	1"	SUB. ROUND.	25	25	50	HIGH	"	"	LOW	"	DARK GREY	"	HARD	CLAYEY SILT WITH SAND & GRAVEL, FRAGMENTS of SHALE. COHESIVE.	ML
2	10'-12'	1"	SUB ANG.	20	30	50	"	"	SLOW	HIGH	"	"	"	"	SAME AS ABOVE	"
3	15'-16'	1"	ANG	15	30	55	"	"	"	"	"	DARK GREY	"	"	CLAYEY SILT WITH SAND, SOME GRAVEL COHESIVE.	"

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY*43-CHESTERVILLE BOREHOLE No. '5' GROUND ELEVATION 214.0'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	5'-7'	1"	ANG	10	30	60	HIGH	DULL	SLOW	LOW	NONE	DARK GREY	STRONG	HARD	CLAYEY SILT WITH SAND, SOME GRAVEL. COHESIVE.	ML
2	10'-12'	1 3/4"	"	10	30	60	"	"	"	MED	"	"	"	"	SAME AS ABOVE CLAYEY GRAVEL	GC
3	15'-17'	1"	"	10	30	60	"	"	"	"	"	"	"	"	SAME AS ABOVE	"

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY #43 - CHESTERVILLE BOREHOLE No. 6 GROUND ELEVATION 230.8'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	0'-2'			-	10	90		DULL	SLOW	MED	ORGAN.	MOTT BROWN	NONE		CLAYEY SILT, TRACE of SAND + ORGANIC (TOP SOIL)	
2	2'-4'			-	75	100		"	"	"	EARTHY	"	"		CLAYEY SILT, TRACE of SAND (VERY COHESIVE)	
3	4'-6'	1/4"	SUB ROUND	5	15	80		"	"	"	NONE	"	STRONG		CLAYEY SILT, SOME SAND, TRACE of GRAVEL. (COHESIVE)	
4	6'-8'	1"	ANG	10	15	75		"	"	"	"	"	"		SAME AS ABOVE	
5	9'-11'	1 1/2"	ANG	20	25	55		"	"	"	"	"	"		CLAYEY SILT, WITH SAND + GRAVEL (COHESIVE)	
6	12'-14'														SAMPLE LOST	
7	15'-17'	1 1/4"	ANG	25	25	50		"	MED	LOW	"	GREY	"		CLAYEY SILT, WITH SAND + GRAVEL (COHESIVE)	
8	18'-20'	1"	ANG	25	30	45		"	"	MED	"	"	"		CLAYEY SILT AND SAND WITH GRAVEL (COHESIVE)	
9	21'-23'	1 1/2"	"	15	30	55		"	SLOW	"	"	DARK GREY	"		CLAYEY SILT, WITH SAND. SOME GRAVEL (COHESIVE)	

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY#43-CHESTERVILLE BOREHOLE No. 6' (CONTD.) GROUND ELEVATION 230.8'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
10	24'-26'	1"	ANG	10	25	65		DULL	SLOW	MED	NONE	DARK GREY	STRONG		CLAYEY SILT, SOME SAND, TRACE of GRAVEL (COHESIVE)	
11	26' 3" 26' 9"		SUB ANG.	5	20	75		"	"	"	"	"	"		CAME AS ABOVE.	
12	31' 6" 32'														SAMPLE LOST	

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY #43 - CHESTERVILLE BOREHOLE No. 7 GROUND ELEVATION 231.6'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION			DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE										
				GRAVEL SAND SILT & CLAY										
1	0'-2'			TR. 15 25		DULL	SLOW	LOW	ORGAN	MOTT BROWN	NONE		CLAYEY SILT, SOME SAND, TRACE OF GRAVEL & ORGANICS (TOP SOIL)	
2	3'-5'			— TO 100		SHINE	"	MED	EARTHY	"	"		CLAYEY SILT, TRACE OF SAND. (VERY COHESIVE)	
3	6'-8'	1 1/2"	ANG.	15 15 70		DULL	"	"	"	"	STRONG		CLAYEY SILT, SOME SAND & GRAVEL. (COHESIVE)	
4	9'-11'	3/4"	ANG.	15 20 65		"	"	LOW	NONE	BROWN GREY	"		CLAYEY SILT, SOME SAND & GRAVEL. (COHESIVE)	
5	12'-14'	1"	ANG.	20 20 60		"	MED	"	"	DARK GREY	"		CLAYEY SILT, WITH SAND, SOME GRAVEL. (COHESIVE)	
6	15'-17'	1 1/2"	ANG.	15 20 65		"	"	"	"	"	"		SAME AS ABOVE	
7	18'-20'	1"	ANG.	20 20 60		"	"	"	"	"	"		SAME AS ABOVE	
8	21'-23'	1"	"	20 25 55		"	"	MED	"	"	"		SAME AS ABOVE	
9	24'-25'6"	1 1/2"	"	15 25 60		"	"	"	"	"	"		SAME AS ABOVE	

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

PROJECT 69-F-51 SITE HWY#43-CHESTERVILLE BOREHOLE No. '7' (CONTD.) GROUND ELEVATION 231.6'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
10	53'-53'6"														SAMPLE LOST.	
11	60'-60'3" 1"		ANG.	20	30	50		DULL	SLOW	LOW	NONE	DARK GREY	STRONG		CLAYEY SILT, WITH SAND & GRAVEL (COHESIVE)	
												</				

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

VISUAL CLASSIFICATION SHEET

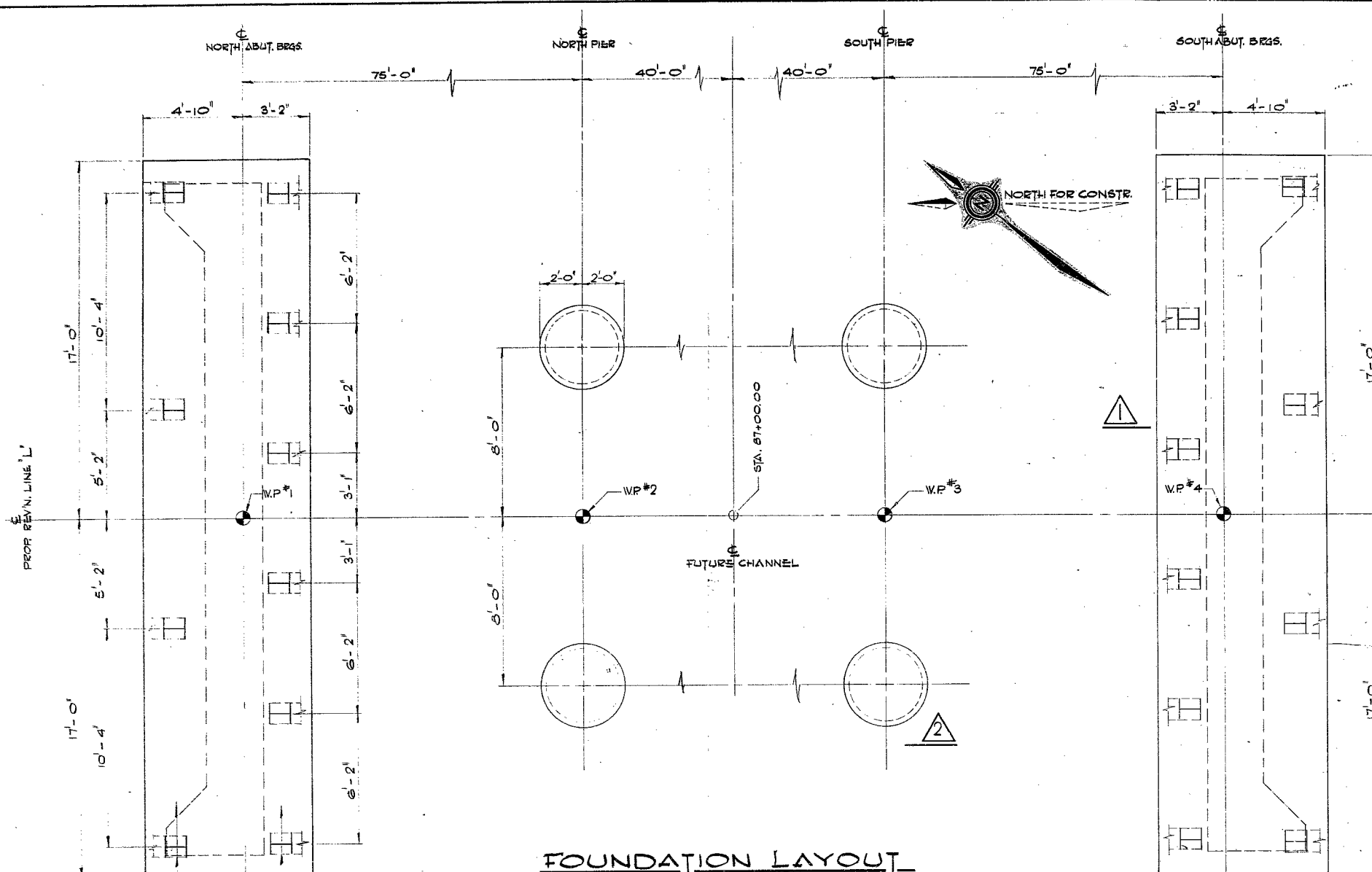
PROJECT 69-F-51 SITE HWY#43-CHESTERVILLE BOREHOLE No. '8' GROUND ELEVATION 230.4'

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	5'-7'			-	75	100		DULL	SLOW	LOW	EARTHY	MOTT. BROWN	STRONG		CLAYEY SILT, TRACE of SAND. (VERY COHESIVE)	
2	10'-12'	3/8"	ANG SUB-ROUND	20	20	60		"	MED	"	NONE	"	"		CLAYEY SILT, WITH SAND & GRAVEL (COHESIVE)	
3	15'-17'	1 1/8"	ANG	25	25	50		"	"	"	"	BROWN GREY	"		SAME AS ABOVE	
4	20'-22'														SAMPLE LOST	
5	23'-24'	1"	ANG	25	25	50		"	"	MED	NONE	DARK GREY	"		CLAYEY SILT WITH SAND & GRAVEL (COHESIVE)	

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

69-F-51
W.P. 148-66-02
H.W.Y. #43
(REV'N. LINE 'L')
SOUTH NATION RIVER
BRIDGE



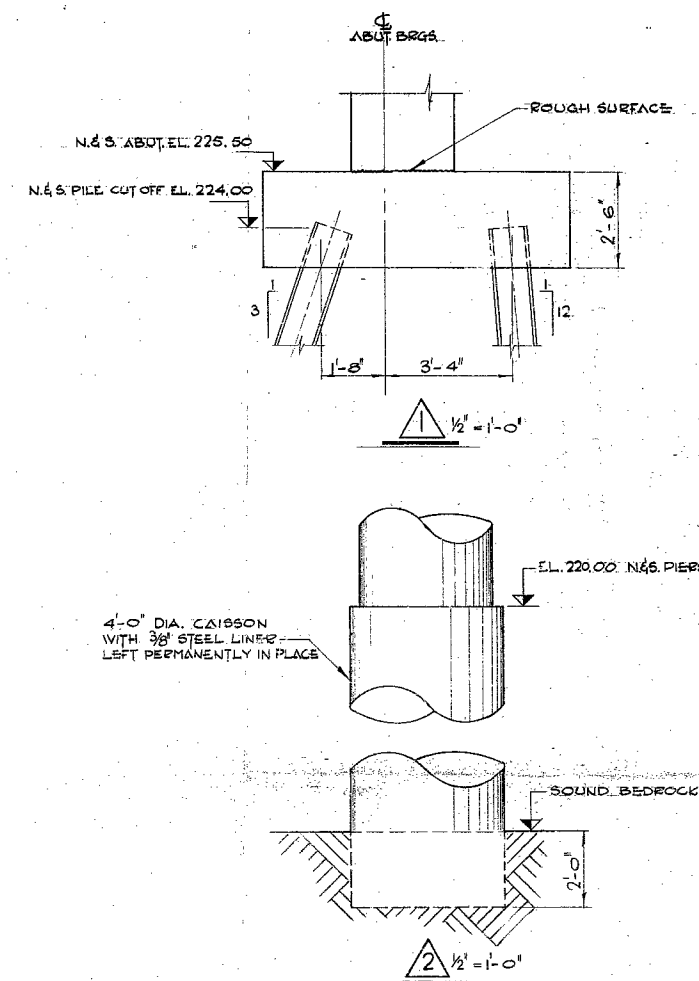
FOUNDATION LAYOUT
(FOOTINGS & PILE LAYOUT SIMILAR FOR BOTH ABUTMENTS.)
SCALE: 3/8" = 1'-0"

PILES

LOCATION	QUANTITY	LENGTH	TYPE	DESIGN LOAD
NORTH ABUTMENT	10	26'-0" <i>OK</i>	10 BP 42	55 TONS/PILE
SOUTH ABUTMENT	10	22'-0" <i>OK</i>	H PILES	

CAISSONS

LOCATION	DIA.	QUANTITY	STEEL LINER THICKNESS	DESIGN LOAD
NORTH PIER	4'-0"	2	3/8"	250 TONS/CAISSON
SOUTH PIER	4'-0"	2	3/8"	250 TONS/CAISSON



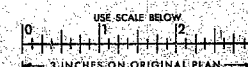
NOTES

- PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING
- PILES TO BE DRIVEN TO REFUSAL IN ACCORDANCE WITH STD. DD-1219 (SEE DVG. D-6727-12)

REVISIONS	DATE	BY	DESCRIPTION



FOR REDUCED PLAN



DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-F-51

SOUTH NATION RIVER BRIDGE
CHESTERTON DIVERSION

KING'S HIGHWAY No. 43 DIST. No. 9

CO. DUNDAS

TWP. WINCHESTER LOT 17 CON. IV

FOUNDATION LAYOUT

APPROVED: [Signature] SITE No. 51-279 W.P. No. 148-00-02

DESIGN: G.N.B.D. CHECK: A.S.A. CONTRACT No. [Blank]

DRAWING: T.B.L. CHECK: G.M.B. DRAWING No. D-6727-3

DATE: JAN 1970

