

## MEMORANDUM

(31G-61)

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: May 21, 1970

OUR FILE REF.

IN REPLY TO

JUN 1 1970

SUBJECT:

## FOUNDATION INVESTIGATION REPORT

For

Proposed Structures at the Crossing  
Of the Scotch River (East Branch)  
And Proposed Hwy. #417  
(Eastbound and Westbound lanes)  
Kenyon Township -- Glengarry County  
District No. 9 (Ottawa)  
W.J. 70-11028 -- W.P. 36-66-09

31G-61  
GEOCRE No.

Attached, we are forwarding to you our detailed foundation investigation report on the subsoll 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/WdeF  
Attach.

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

*A. G. Stermac*  
A. G. Stermac  
PRINCIPAL FOUNDATION ENGINEER

Foundations Files ✓  
Gen. Files

70-F-28

MEMORANDUM

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

From: Bridge Section,  
Kingston, Ontario.

ATTENTION:

Date: March 31, 1970.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 36-66-09, Site 31-289,  
Scotch River (East Branch),  
(2.3 Mi. South of Ste. Isidore de Prescott),  
Highway 417, District 9 - Ottawa

We are sending you herewith two prints of Bridge Site Plan E-4691-1 on which we have marked the proposed location of the above 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 June 10, 1970.

T. C. Kingsland  
Regional Bridge Planning Engineer

TCK/hl

Encls.

c.c. (with encl.)

Bridge Office Files Section (Mr. S. McCombie)

c.c. Mr. R. Forrest

70-F-28

36-66-09/15

204/WBL.  
Hwy. 417 & Scotch River E.Pr.

31C-61

W.O.

W.P.

LOCATION

GEOCRES NO.

● DATA ON FILE IN SOIL MECHANICS SECTION

REFER TO: Contract 71-47

REMARKS

GEOCRES

INDEXING CARD FOR REPORTS NOT MICROFILMED

GI-20 AUG. 74

SUPERIMPOSED DOCUMENT MAY  
APPEAR AS MULTI-FEED ON FILM

FIELD RECONNAISSANCE REPORT  
REQUIRED BY FOUNDATION SECTION  
FOR

East Branch

FF-69  
SEPT. 1968

W.P. NO. 36-66-09 HIGHWAY NO. 417 DISTRICT 9 SITE PLAN NO. E-4691-1 PROFILE NO. ?  
RIVER CROSSING ☒ GRADE SEPERATION ☐ R.R. X ☐ OTHER (SPECIFY) \_\_\_\_\_  
ALTERNATE SCHEME (IF ANY) \_\_\_\_\_

EXISTING SITE CONDITIONS

DESCRIPTION:

TOPOGRAPHY: HILLY ☐ ROLLING ☐ VALLEY ☐ GULLIED ☒ at site FLAT ☒  
VEGETATION: TREES ☒ BRUSH ☐ GRASS ☐ SWAMP ☐ FARM CROPS ☒ CLEARED ☐  
SNOW COVER: 0"-6" ☐ 6"-12" ☐ >12" ☒  
ROCK OUTCROP (SPECIFY LOCATIONS) None visible

UNDERGROUND UTILITIES:

UTILITY COMPANY

TELEPHONE NO. FOR DEFINITE LOCATION

1 None

2

3

4

5

EXISTING STRUCTURE(S): N/A

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 Contact Property Section, Eastern Region

2

3

4

WHO WILL OBTAIN NECESSARY PERMISSION? Property Section, Eastern Region

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

WILL CLEARING BE NECESSARY TO ENTER SITE AREA? YES ☒ NO ☐

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 Approx. 4 FT

CURRENT: SWIFT ☐ MODERATE ☒ SLOW ☐

DRILLING OPERATIONS

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

ADDITIONAL INVESTIGATION REQUIRED FOR THE FOLLOWING PURPOSES:

ALTERNATE SCHEME: YES ☐ NO ☐ IF YES, SPECIFY \_\_\_\_\_

HYDROLOGIC REASONS: YES ☐ NO ☐ IF YES, SPECIFY (SCOUR, ETC.) \_\_\_\_\_

REMARKS

NEAREST AVAILABLE ACCOMODATION: Hotel Moderne, Ste. Isidore de Prescott

OTHER COMMENTS:

DATE March 31, 1970

REGIONAL BRIDGE LOCATION ENGINEER  
Planning

*[Signature]*

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Structures at the Crossing  
Of the Scotch River (East Branch)  
And Proposed Hwy. #417  
(Eastbound and Westbound Lanes)  
Kenyon Township -- Glengarry County  
District No. 9 (Ottawa)  
W.J. 70-11028    --    W.P. 35-66-09

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation at the above mentioned river crossings of proposed Hwy. #417. The request was contained in a memo from the Eastern Region Bridge Section (Mr. T. C. Kingsland, Regional Bridge Planning Engineer), dated March 31, 1970. An investigation was subsequently carried out by this Section to determine the subsoil, bedrock and groundwater conditions at this site.

This report contains the factual results obtained from this investigation, together with 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 located immediately east of Glengarry County Rd. #20, approximately 2.3 miles south of the Village of St. Isidore de Prescott.

In the vicinity of the crossing, the Scotch River - (East Branch) is approximately 50 feet wide and 4 feet deep (the water level elevation, under normal conditions, is about 212). The slopes of the banks of the river vary considerably, but they are generally quite gentle, the slope being about 3:1. At the time of the investigation, the river had topped its channel thus flooding a portion of the site, particularly along the west bank; the elevation of the water at this time was about 214. This flooding was due to spring break-up.

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

The surrounding terrain, which is lightly cultivated, is flat to gently undulating in relief. There is light bush on either side of the river.

Physiographically, the site is situated in the "Winchester Clay Plains" region. The area is characterized by a predominant stratum of sensitive marine (beds) clay deposited by the Champlain Sea. The clay is encountered very close to the surface (sometimes within 3 feet); it is up to 15 feet in thickness. The cohesive stratum is underlain by a competent glacial till deposit which, in turn, is underlain by limestone bedrock of the Trenton and Black River Groups, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Seventeen sampled borcholes, three of which were accompanied by a dynamic cone penetration test, were put down during the course of the field investigation. In addition, one other dynamic cone penetration test was performed. The borings were advanced by means of conventional diamond drill rigs adapted for soil sampling purposes. The drill rigs were mounted on drum rafts when necessary, in order to put down the borings located in the river and the adjacent flooded area.

Samples of the upper desiccated portion of the cohesive stratum and the lower glacial till deposit, were obtained in a 2" O.D. split-spoon sampler, which was hammered into the ground in accordance with the specification for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Samples of the lower portion of the clay were obtained in 2" I.D. Shelby tubes, which were manually pushed into the material. In situ vane tests were carried out within this zone to determine the undrained shear strength of the subsoil. Bedrock was proven in 9 of the borings by obtaining AXF size rock core samples.

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

The groundwater level conditions across the site were determined by recording the water levels in the open holes during the course of the investigation. The artesian conditions, encountered in B.H.'s #1 and #6, were completely sealed, at their source, during the period of the drilling operations.

The locations and elevations of all the borings were surveyed in the field by personnel from the Kingston Regional Engineering Surveys Section. They are shown on Drawing No. W.J. 70-110264, together with the estimated stratigraphical profiles along the centre-line of the East- and Westbound lanes. 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. In addition, 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

Undrained Shear Strength Testing

Consolidation Testing

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on Figures No. 2 to 6, inclusive, all of which are contained in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant overburden stratum across the site is composed of a soft to firm clay to silty clay. The thickness of this deposit varies from 5 to 15 feet. The clay is underlain by



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

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

a compact (or firm) to very dense (or hard) glacial till which ranges from 5 to 15 feet in thickness. The glacial till is, in turn, underlain by limestone bedrock.

Within the confines of the river channel, a surficial layer of organic silt was encountered.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borehole sheet. The stratigraphical profiles, shown on Drawing No. W.J. 70-11028A are inferred from this boring data.

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

4.2) Organic Material:

Beneath the river and at some areas close to the shore, there exists a deposit of soft organic silt, which is up to 4 feet in depth. The organic content, as determined by laboratory analyses, ranges between 1.2% and 4.6% (by weight).

4.3) Clay to Silty Clay (Sensitive):

Directly beneath the surficial topsoil cover or the organic silt deposit is the predominant stratum across the site, which is composed of a grey clay to silty clay. The clay is a sensitive, marine deposit, known locally as "Leda Clay". In general, the overall thickness of the stratum varies from 5 to 15 feet. North of Stations 183+00 to 183+50 (W.B.L.) the lower glacial deposits were found to protrude to within a few feet of ground surface. Here the thickness of the clay ranges between 1 and 3 feet (refer to Section A-A on Drawing W.J. 70-11028A). With the exception of the area directly beneath the river, the upper 3 - 8 feet of this cohesive stratum has been desiccated, forming a crust. Throughout the stratum, there are numerous organic mottles, as well as random pockets of sand (less than 1/2"). Grain-size distribution curves for samples of the cohesive subsoil are shown on Figure #3, located in the Appendix of this report.

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

4.3) Clay to Silty Clay (Sensitive): (cont'd.) ...

The engineering properties of the stratum, as determined by field and laboratory testing, are summarized on Figure #2. A brief resumé, presented in tabular form, follows:

<u>Identity Tests</u>		<u>Range</u>	<u>(Average)</u>
Bulk Density	( $\gamma$ )	94 - 107	(98)
Liquid Limit	( $W_L$ )	42 - 86	(59)
Plastic Limit	( $W_p$ )	17 - 35	(26)
Natural Moisture Content (%)	( $W$ )	21 - 83	(68)
Liquidity Index	( $I_L$ )	0.8 - 1.7	(1.3)
<u>Consolidation Characteristics</u>			
Initial Void Ratio ( $e_o$ )		1.85 and 1.96	) Two Tests
Compression Index ( $C_o$ )		1.03 and 1.11	
Degree of Preconsolidation (t.s.f.) ( $P_c - P'_o$ )		0.75 and 0.90	
<u>Undrained Shear Strength (<math>C_u</math>)</u>			
(p.s.f.)			
1)	Field Tests	350 - 1600	
2)	Lab. Tests	300 - 1100	

Note:- The above properties are only for that part of the cohesive stratum which was not subjected to desiccation.

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

4.3) Clay to Silty Clay (Sensitive): (cont'd.) ...

The Atterberg limit tests are also plotted on the Plasticity Chart, Figure #4. These results indicate that the material is essentially inorganic with a plasticity that varies from intermediate to high; however, the majority of tests indicate a high plasticity. The natural water content consistently exceeds the liquid limit; this is indicative of a sensitive material.

The consistency of the upper desiccated zone varies from firm to very stiff, while that of the lower zone varies from firm to soft.

The consolidation characteristics of the stratum were determined by carrying out two laboratory tests, the results of which are shown as Void Ratio vs. Pressure plots on Figure #5. The results of these tests indicate that the clay stratum is preconsolidated by about 1500 to 1800 p.s.f. in excess of existing overburden pressure. In the upper desiccated zone, the degree of preconsolidation would be considerably higher than this range. The relatively high values for the initial void ratio ( $e_0$ ) and the compression index ( $C_c$ ) compare favourably with those of other cohesive deposits in this area, and are further indication of the sensitive nature of the stratum.

4.4) Heterogeneous Mixture of Clay, Silt, Sand and Gravel - (Glacial Till):

The cohesive stratum is underlain by a deposit of glacial till which is heterogeneous in composition. The thickness of this deposit varies from 5 to 15 feet. The upper 2 to 5 feet of the glacial till is in a "reworked" condition - i.e., it was once exposed to the atmosphere and weathered by the elements.

The major portion of the glacial till is granular in nature - i.e., composed of silt, sand, gravel with a trace of clay.

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

4.4) Heterogeneous Mixture of Clay, Silt, Sand and Gravel -  
(Glacial Till): (cont'd.) ...

There are, however, zones throughout which are cohesive; the matrix in these areas is composed of clayey silt binding sand and gravel. A predominant feature of this till is the relatively large percentage of gravel and coarse-grained material that it contains. Grain-size distribution curves for samples of the deposit, obtained with 2" O.D. sampling equipment, are plotted on Figure #6.

The Standard Penetration Tests, carried out within the glacial till deposit are plotted on the Record of Borelog sheets, as well as on Figure #2. This testing gave 'N' values which range from 23 blows/ft. to 60 blows/6 inches. In the upper "reworked" zone, the 'N' values range from 10 to 18 blows/ft. Based on these values, the relative density of the granular zones is dense to very dense, while the consistency of the cohesive zones is very stiff to hard. In the "reworked" zone, the relative density and consistency are compact and stiff, respectively.

4.5) Limestone Bedrock:

The glacial till is directly underlain by bedrock which was proven in eight boreholes, by obtaining from 5 to 11 feet of AXT size rock core samples. Over the site the bedrock surface was found to vary between elevations 189 and 195.

The bedrock is composed of sound limestone with small shaly carbonate interbeds up to 1 inch in thickness.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out, during the period of the investigation, in most of the open boreholes. At the time of the investigation, spring flooding had caused a 2-foot rise in river water level (to elev. 214). On account of this flooding, several boreholes were under up to 2 feet of water. The groundwater level in the remaining boreholes was at a depth of

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

less than 3 feet below the existing ground surface. This depth corresponds to elevations between 212 and 216.

An artesian condition was encountered at boreholes #1 and #6, both located on the west bank of the river. Both of these holes were under 1 to 2 feet of water at the time of the investigation. The artesian groundwater condition was encountered once the borings penetrated through the cohesive stratum into the underlying glacial till and upper portion of the bedrock - i.e., at elevations 196 (borehole #1) and 189 (borehole #6). Once this zone was tapped, the groundwater rose instantaneously in the casing; the artesian head stabilized itself between elevations 215 and 216. These elevations correspond to a head of water about 2 to 5 feet above the existing ground level. The zone in which the artesian groundwater condition was encountered is quite pervious in nature and is overlain by the relatively impervious clay stratum. It is inferred, therefore, that this zone is acting as a confined aquifer. The aquifer is probably being charged with groundwater from the surrounding terrain which is at a higher elevation. The artesian condition exists only within the valley of the Scotch River.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct twin single-span structures at the proposed crossings of the East- and Westbound lanes of Hwy. #417 and the realigned East Branch of the Scotch River, in the Township of Kenyon, County of Glengarry. The structures, which will be 42 feet in width, will be approximately 120 feet apart.

Two schemes are being considered, namely:

i) spill-through type, where the abutments are 'perched' within the approach fills. Alternatively,

ii) closed-type of abutments, in which case the approach fills would be retained by the abutment walls in the longitudinal direction.

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

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

The finalized span length will be dependent on the scheme adopted.

The profile grade of the E.B. and W.B. lanes of Hwy. #417, in the vicinity of the crossings, will be between elevations 227 and 228. Further, it is understood that the invert of the realigned channel will be at about elevation 208. The associated approach fills will, therefore, have a maximum height of the order of 14 feet above existing ground surface in the transverse direction. In the forward or longitudinal direction, however, the crest of the fills will be approximately 19 feet above the invert of the channel.

The predominant stratum across the site is composed of a soft to firm compressible clay, which generally varies from 5 to 15 feet in thickness. The cohesive stratum is underlain by a relatively thin competent glacial till deposit, which, in turn, is followed by limestone bedrock, the surface of which was encountered between elevations 191 and 198. Within the confines of the existing river valley, a surficial deposit of organic silt is present (up to 4 feet in thickness).

The presence of the soft, compressible cohesive stratum, at a shallow depth below ground surface, is the governing factor from a foundation point of view, since it will be necessary to ensure that it is not overstressed by either the embankment or structure foundation surcharge loadings.

The two alternate schemes are discussed separately in Sub-sections 6.2) and 6.3) to follow. A comparison of the merits of the schemes will be given in Section #7.

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

6.2) Spill-through Type of Abutments:

6.2.1) Stability of Approach Fill Sections -

It is recommended that the surficial organic silt deposit be completely subexcavated from within the plan limits of the proposed embankments, prior to the placement of any fill. The excavation so formed should be backfilled with suitable granular material extending to the prevailing groundwater level. Any other acceptable earth material may be used above this level.

The critical condition for stability of an embankment on normally or slightly overconsolidated cohesive subsoils, as is the case at this site, generally occurs during or immediately after construction. This being the case, a total stress analysis ( $\phi = 0$ ) provides a suitable means of assessing the stability of the embankment sections. In this method of analysis, stability is governed by the applied loads and by the stress-strain and undrained shear strength characteristics of the foundation and embankment soils.

Analyses have been carried out, therefore, in terms of total stresses, both manually and by the use of the electronic computer, to determine the stability of the approaches. The geometric sections at the approaches, and the soil properties for the fill and natural subsoil, assumed for computational purposes, are presented on Figure #1, in Appendix I of this report. The results of the analyses, presented on the aforementioned figure, are summarized in the following paragraphs.

- 1) Forward or Longitudinal Direction (19 feet from crest of embankment to invert of channel) -

All the approaches, with the exception of the west approach to the R.E.L. structure, will be inherently stable ( $F.S. \geq 1.3$ ) in the forward direction, provided -

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

6.2) Soil-through Type of Abutments: (cont'd.) ...

6.2.1) Stability of Approach Fill Sections - (cont'd.) ...

(a) the forward slope of the embankments are no steeper than 2:1; and

(b) the toe of the fills are located a minimum of 10 feet from the river channel.

This investigation has indicated that the cohesive stratum, in the vicinity of the west approach to the E.B.L. structure, is slightly softer than elsewhere (minimum undrained shear strength of the order of 400 p.s.f.). In order to ensure the overall stability of this approach in the longitudinal direction, it is recommended that a 10-foot wide berm be constructed at about elevation 215 (refer to section on Figure #1).

ii) Transverse Direction (Max. Height of Fill 14 feet) -

The computations carried out indicate that, embankments 14 feet in height with standard 2:1 side slopes, will be stable in this direction.

The approach fills should be protected against the scour action of the river; rip-rapping to a point above the design high water level would be suitable for this purpose.

6.2.2) Settlement Considerations:

The underlying compressible clay stratum will undergo settlements due to consolidation, over a period of time, under the weight of the approach embankments. Settlement computations were, therefore, carried out, the results of which are summarized on Figure #1.



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

6.2) Spill-through Type of Abutments: (cont'd.) ...

6.2.2) Settlement Considerations: (cont'd.) ...

Based on the computations, it is estimated that the maximum consolidation settlement could be of the order of 5 inches. The total amount of this predicted settlement should take place within a period of 18 to 24 months. About 50% should, however, occur within 4 to 6 months.

Since the predicted settlements will occur relatively quickly, it would be advantageous to place the fills prior to construction of the structure, in order to minimize post-construction maintenance. If scheduling permits, a period of at least 6 months should be provided for this purpose. In any event, final paving should be delayed as long as possible.

6.2.3) Abutment Foundations:

The abutments, which will be perched within the approach fills, can be supported on end-bearing piles driven to bedrock. The pile tip elevations would range from 190 (West abutment - E.B.L. structure) to 195 (West abutment - W.B.L. structure). The allowable pile load would be dependent on the section chosen - for example, 12 BP 74 steel H-piles may be designed for 95 tons/pile.

No boulder or rock fill should be placed in that portion of the fill through which piles are to be driven.

6.3) Closed-Type of Abutments:

As mentioned previously, the invert of the realigned channel will be at about elevation 203. In order to provide a minimum of 5 feet of earth cover for frost protection purposes, it would be necessary to found the abutment walls at or below elevation 203. In most instances the abutment walls founded at the aforementioned elevation, would be underlain by compressible clay.

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

6.3) Closed-Type of Abutments: (cont'd.) ...

Prior to placing fill in the vicinity of the existing river valley the organic silt should be sub-excavated and backfilled as discussed in Sub-section 6.2.1).

To ensure stability in the longitudinal direction, it will be necessary to locate the foundations of the closed-end abutments within the lower competent portion of the glacial till (refer to the summary of stability analyses presented on Figure #1).

Since a) the surficial elevation, and b) the extent of the upper 'reworked' zone of the glacial till is often variable, it may be advantageous to step some of the footings. This is particularly true in the vicinity of the west approach to the W.B.L. structure (refer to Section A-A, Drawing No. 70-11028A); here the abutment footing may step up from elevation 198 at the south end to 201 at the north end. Elsewhere, it is estimated that the abutments should be founded at the following elevations:

<u>Structure</u>	<u>Abutment Location</u>	<u>Estimated Footing Elev.</u>
W.B.L.	East	200
E.B.L.	West	194
E.B.L.	East	195

If founded at these elevations, the abutments can be supported on spread footings, using an allowable bearing pressure of 3.0 t.s.f. in design.

Settlement of the foundation subsoil, due to the induced footing pressure, will be elastic in nature and negligible in magnitude.

The excavations for the spread footings will extend between 14 and 20 feet below the river water level. A boiling condition may, therefore, develop, within the glacial till deposit, at the base of the excavation, due to the unbalanced hydrostatic

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

6.3) Closed-Type of Abutments: (cont'd.) ...

water pressure head existing. This being the case, a dewatering scheme will be required.

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.

It is recommended that a value of 0.6 be used for the coefficient of friction in the computations to determine the sliding resistance between the base of the footing and the underlying basically granular glacial till.

The cohesive subsoil, beneath the approach fills, will be subjected to consolidation settlement, due to the imposed surcharge loading. The magnitude and time-rate of the settlement will be similar to that discussed in Sub-section 6.2.2).

7. CONCLUSIONS:

If the closed-type abutment scheme is adopted, it will be necessary, as discussed in Sub-section 6.3), to carry the abutments down into the glacial till deposit which underlies the soft compressible cohesive stratum. The excavations for the abutment footings will have to extend between 14 feet (W.B.L. structure) and 20 feet (E.B.L. structure) below the river water level. A major dewatering scheme would, therefore, be required.

7. CONCLUSIONS: (cont'd.) ...

Based on these factors, it is concluded that this scheme would not likely be economically feasible.

It is inferred, therefore, that a spill-through scheme would be the most practical from a foundation point of view. This alternative was discussed in detail in Sub-section 6.2).

In order to ensure the stability of the approach embankments, in the longitudinal direction, the overall span lengths will have to be as follows:

W.B.L. Structure - 114 feet	} Assuming realigned river channel is approx. 36 feet wide.
E.B.L. Structure - 124 feet	

Either a single-span, or alternatively, a three-span structure incorporating two piers, could be employed at the respective crossings. In the latter case the piers can be supported on end-bearing piles driven to bedrock, as discussed in Sub-section 6.2.3).

8. MISCELLANEOUS:

The field work, performed during the period of April 9 and May 1, 1970, was carried out under the immediate supervision of Mr. H. Stankaitis, Technician. The equipment was owned and operated by the F. E. Johnston Drilling Co. Ltd., Ottawa.

This report was written by Mr. F. A. Patterson, Student Technician (Field) and Mr. B. T. Darch, Senior Foundation Engineer. This project was carried out under the general supervision of Mr. E. Devata, Supervising Foundation Engineer, who reviewed this report.

May, 1970.

APPENDIX I

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DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11028 LOCATION Hwy.417 Sta. 183 + 33 o/s 23' Lt. WBL ORIGINATED BY VK  
W.P. 36-66-07 BORING DATE April 15, 1970 COMPILED BY VK  
DATUM Geodetic BOREHOLE TYPE Washboring-NX,BX Casing-AXT Rock Core CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		$w_p$ — $w$ — $w_L$ WATER CONTENT % 20 40 60				
214.0	Water Level												
211.5	Water Ground Level												
209.0	Organic silt with some clay. Soft		1	SS	10	210							0 16 32 52
208.0	Clay. Sensitive. Soft		2	SS	10								Org. 1.2%
3.5	Reworked Zone		3	SS	18								
	Compact		4	SS	12	200							
195.5	Het. mix. of silt, sand & gravel, trace of clay (Glacial Till) Dense		5	SS	37								36 43 20 1
16.0	Shaley limestone bed-rock. Shaley interbeds up to 1" in size. Sound		6	AXT	100%								$\gamma$ 196.5
190.4													Artesian condition encountered
21.1	End of Borehole					190							

FOUNDATION SECTION

JOB	70-11028	LOCATION	Hwy. 417 Sta. 183 + 50 o/s 19' Rt. WBL	ORIGINATED BY	VK
W.P.	36-66-77	BORING DATE	April 15, 1970	COMPILED BY	VK
DATUM	Geodetic	BOREHOLE TYPE	Washboring-NX, BX Casing; AXT Rock Core	CHECKED BY	

[illegible]





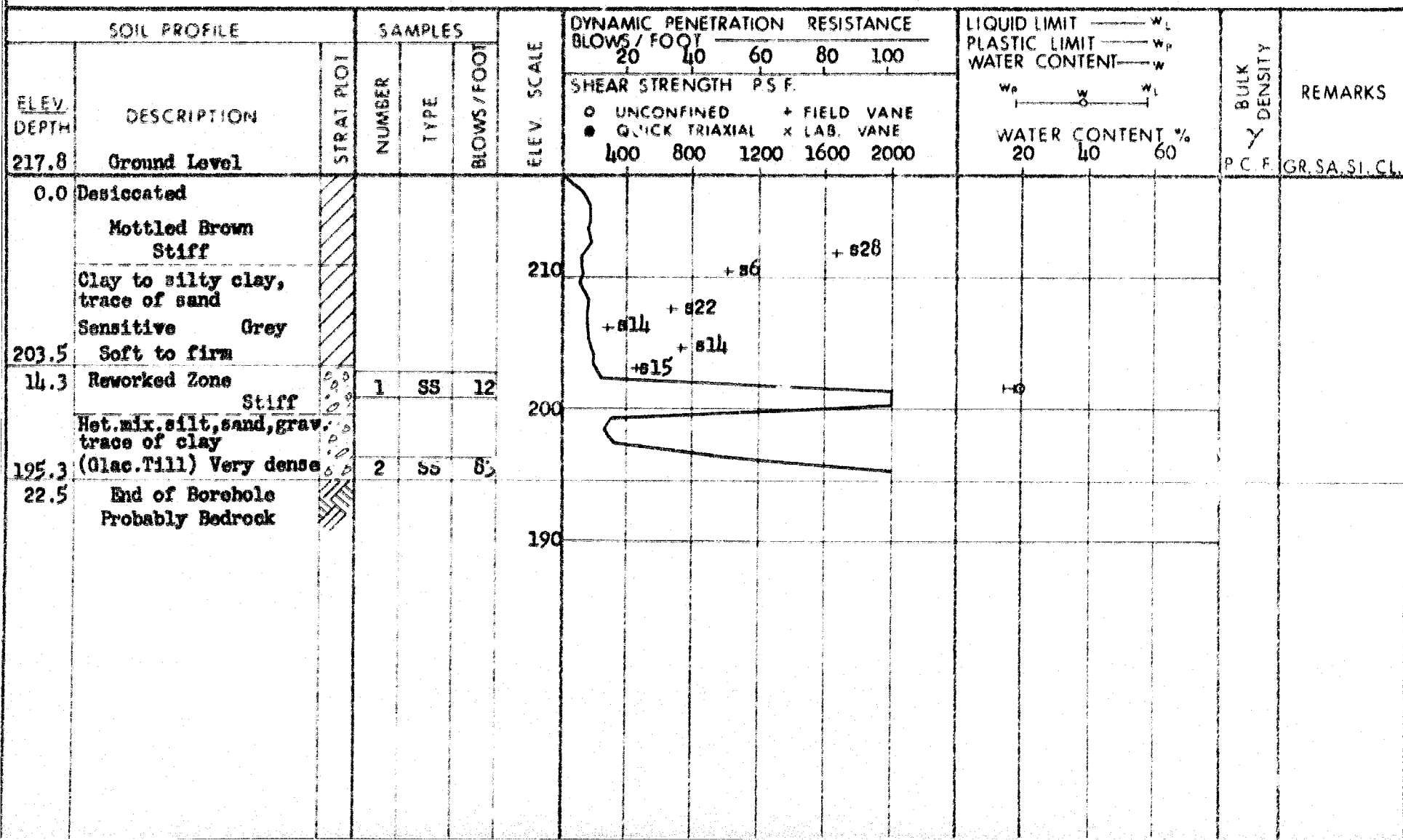
[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 4A

FOUNDATION SECTION

JOB 70-11028 LOCATION Hwy. 17 Sta. 184 + 20 o/s 19' Rt. & WBL ORIGINATED BY VK  
 W.P. 36-66-07 BORING DATE May 1, 1970 COMPILED BY VK  
 DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone Test CHECKED BY VK





CHECKED BY

FOUNDATION SECTION

[illegible]

## FOUNDATION SECTION

CHECKED BY \_\_\_\_\_

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 70-11028

LOCATION Hwy. 417 Sta. 185 +43 o/s 23' Rt. of EBL

ORIGINATED BY VK

W.P. 36-66-07

BORING DATE April 16, 1970

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Washboring-NX, BX Casing; AXT Rock Core

CHECKED BY *AK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					$w_p$ — $w$ — $w_L$				
213.2	Water Level						400	800	1200	1600	2000	20	40	60		
210.2	Water River Bottom					210										
0.0	Organic silt, tr. of clay grey, brown, soft to firm		1	SS	PM											
206.2			2	SS	6											
4.0	Clay		3	SS	PM											
	Sensitive Grey		4	SS	3											
	Soft to firm		5	TW	PM	200										
195.2			6	TW	PM											
15.0	Glacial Till. Compact		7	SS	22											
192.7																
17.5	Shaley limestone Bed-rock. Calcareous shaley interbeds to 1". Sound		8	AXT	100%	190										
187.7																
22.5	End of Borehole															
						180										

0 43 39 18  
Org. 4.6%

0 95

FOUNDATION SECTION

JOB	70-11028	LOCATION	Hwy. 417 & Sta. 185 + 60 o/s 19' Lt. 2 (EBL)	ORIGINATED BY	VK
W.P.	36-66-07	BORING DATE	April 15, 1970	COMPILED BY	VK
DATUM	Geodetic	BOREHOLE TYPE	Washboring, NX, BX Casing; AXT Rock Core	CHECKED BY	

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ——— W <sub>L</sub>	PLASTIC LIMIT ——— W <sub>P</sub>	WATER CONTENT ——— W	BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH PSF	W <sub>p</sub> A      W <sub>L</sub>			Y	
							○ UNCONFINED + FIELD VANE ■ QUICK TRIAXIAL x LAB VANE	WATER CONTENT %				
							400 800 1200 1600 2000	20 40 60				
213.7	Water Level											
208.4	Water River Bottom					210						
0.0	Clay		1	SS	2							
	Sensitive		2	SS	2							
	Grey		3	SS	PM							
			4	SS	PM	200						
	Soft		5	SS	PM							
195.4			6	SS	PM							
13.0	Het. mix. clay, silt, sand		7	SS	2C							
193.2	grav. (Giac. Till) v. stiff											
15.2	Shaley limestone bedrock		8	AXT	100%	190						
	Calcareous shaley interbeds up to 1"		9	AXT	100%							
183.2												
25.2	End of Borehole					180						





DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 70-11028

LOCATION Hwy. 417 Sta. 183 + 51 @ EBL

ORIGINATED BY VK

W.P. 36-66-07


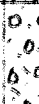


BORING DATE April 20, 1970

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Washboring NX, BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — $w_L$			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT — $w_p$	WATER CONTENT — $w$			
							SHEAR STRENGTH P.S.F.			WATER CONTENT %		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE			$w_p$ — $w$ — $w_L$		
							400 800 1200 1600 2000			20 40 60		
217.7	Ground Level											
0.0	Desiccated											
	Very stiff		1	SS	22							
	Clay		2	TW	PM	210						
	trace of organic inclusions		3	TW	PM							
	Sensitive		4	TW	PM							
	Grey		5	TW	PM							
199.0	Soft to firm				200							
18.7	Het. mix. clay, silt, sand & gravel (Glacial Till)		6	SS	49							
191.6	Hard or very dense		7	SS	82							
26.1	End of Borehole Probably Bedrock					190						
						180						

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY VK

CHECKED BY *[Signature]*

[illegible]



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 70-11028

LOCATION Hwy. 417 Sta. 185 + 41 @ WBL

ORIGINATED BY VK

W.P. 36-66-07

BORING DATE April 20, 1970

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Washboring-NX, BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$			BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					PLASTIC LIMIT ——— $w_p$				
							SHEAR STRENGTH P.S.F.					WATER CONTENT ——— $w$				
							400	800	1200	1600	2000		$w_p$ ——— $w$ ——— $w_L$			
													WATER CONTENT %			
													20 40 60			
219.5	Ground Level														P.C.F. CR SA SI CL	
0.0	Desiccated - organic inclusions. Stiff		1	SS	10											
			2	SS	23											
	Clay - Sensitive		3	SS	14											
	Soft to firm		4	TW	FM											
			5	TW	FM											
208.5	Grey-brown					210										
207.3	Glacial Till. Very dense															
12.2	End of Borehole															
	Probably Bedrock					200										

216.4  
WL in open  
BH Apr. 20/70

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 70-11028

LOCATION Hwy. 17 Sta. 183 + 00 WBL

ORIGINATED BY VK

W.P. 36-66-09

BORING DATE Apr 11 20, 1970

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Washboring, NX, BX Casing; Cone Test

CHECKED BY

[illegible]

FOUNDATION SECTION

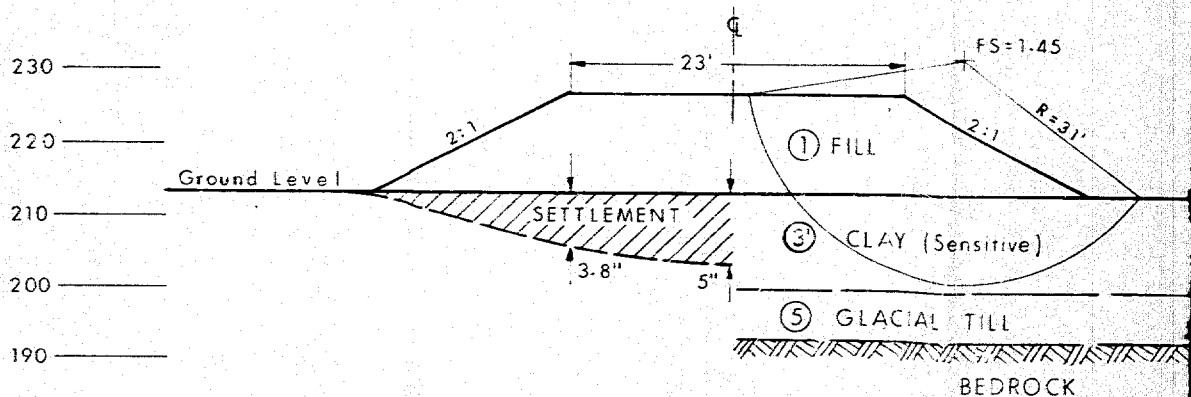
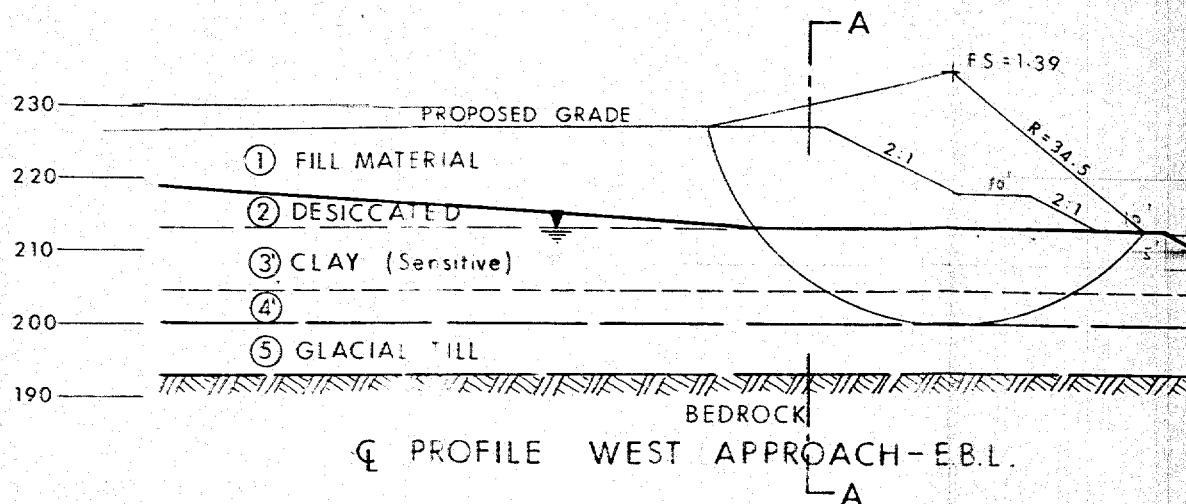
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SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	WATER CONTENT %			
212.0	Water Level										
210.0	Water River Bottom					210					
0.0	Probably clay sensitive										
205.5											
4.5	Probably Glacial Till					200					
196.5											
13.5	End of Cone Test Probably Bedrock					190					

FOUNDATION SECTION

CHECKED BY *[Signature]*

[illegible]



### SECTION A-A

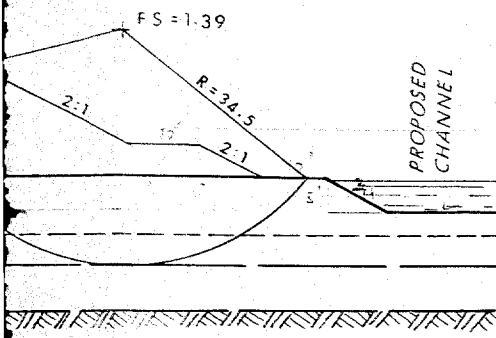
#### ESTIMATED TIME RATE OF CONSOLIDATION SETTLEMENT

50% 4 - 6 Months  
100% 12 - 18 Months



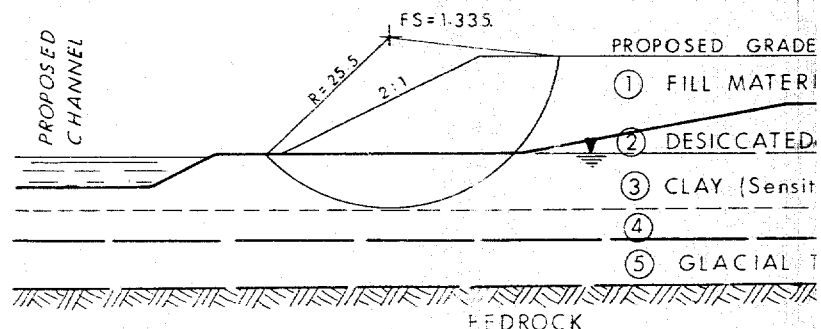
# PROPOSED SPILL THROUGH APPROACHES

A

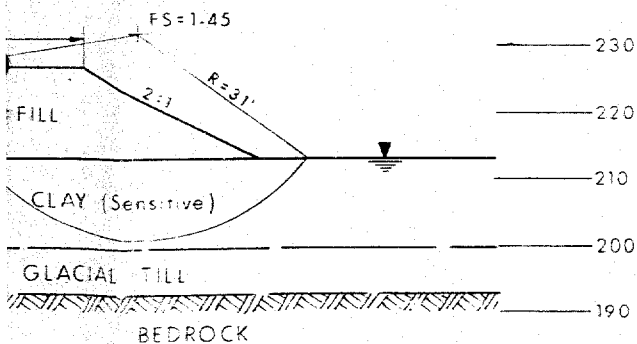


ACH-E.B.L.

A



Q PROFILE EAST APPROACH-E.B.L.  
ALSO EAST & WEST APPROACHES-W.E.



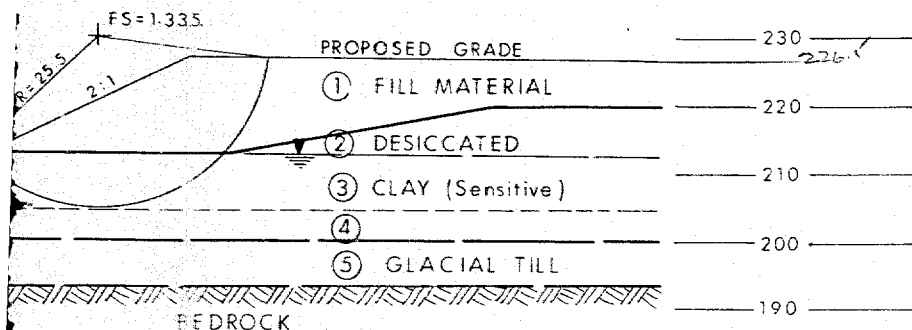
LIDATION SETTLEMENT

15  
hs

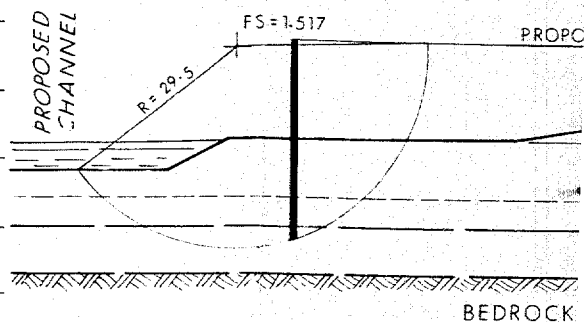
## SOIL PROPERTIES

SOIL	NO.	Undrained Shear Strength $C_u$ (psf)	Angle of Friction $\phi$	Total Unit Weight $\gamma$ (pcf)
FILL	1	0	30°	125
Desiccated Zone	2	900	0	110
CLAY (Sensitive)	3	450	0	40
	4	500	0	40
	3'	400	0	40
	4'	450	0	40
GLACIAL TILL	5	0	40°	65

# PROPOSED CLOSED-



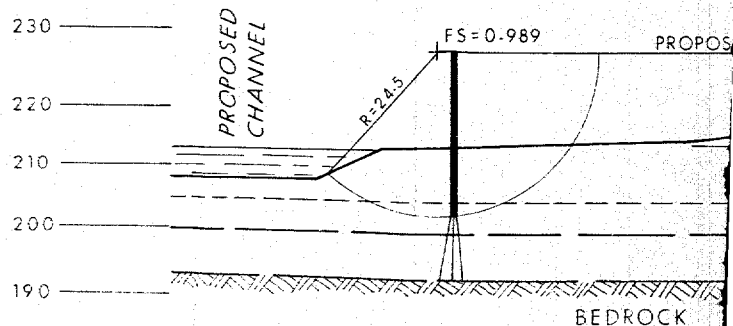
FILE EAST APPROACH - E.B.L.  
EAST & WEST APPROACHES - W.B.L.



SPREAD FOOTINGS PL

## SOIL PROPERTIES

Undrained Shear Strength Cu (psf)	Angle of Friction $\phi$	Total Unit Weight $\gamma$ (pcf)	Submerged Unit Weight $\gamma$ Sub (pcf)
0	30°	125	65
900	0	110	50
450	0	40	40
500	0	40	40
400	0	40	40
450	0	40	40
0	40°	65	65



ABUTMENT IN CLAY SUPPORT

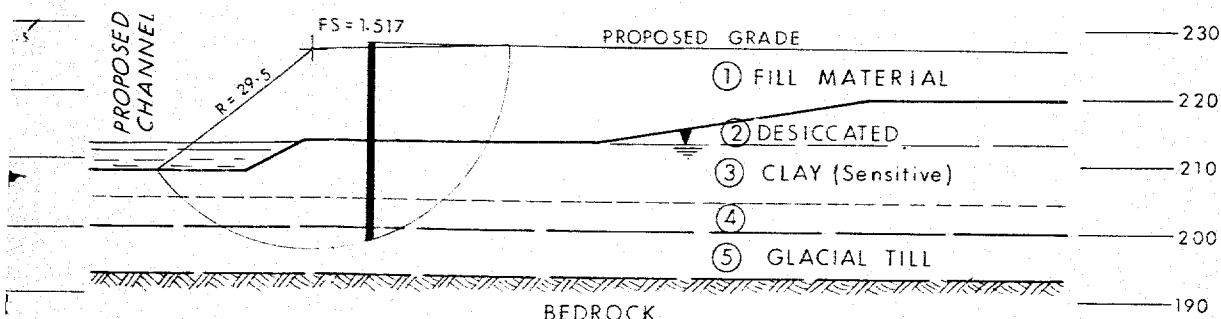


DEPARTMENT OF HIGHWAYS  
**MATERIALS and  
TESTING  
DIVISION**

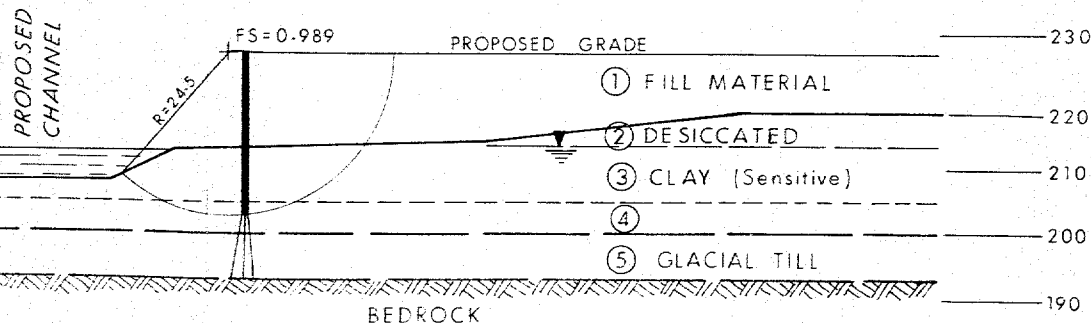
ONTARIO

DATE May 26, 1970

# PROPOSED CLOSED-TYPE ABUTMENTS



SPREAD FOOTINGS PLACED IN GLACIAL TILL



ABUTMENT IN CLAY SUPPORTED ON PILES TO BEDROCK



ONTARIO

DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

SUMMARIZED RESULTS. STABILITY  
AND SETTLEMENT ANALYSES

DATE May 26, 1970

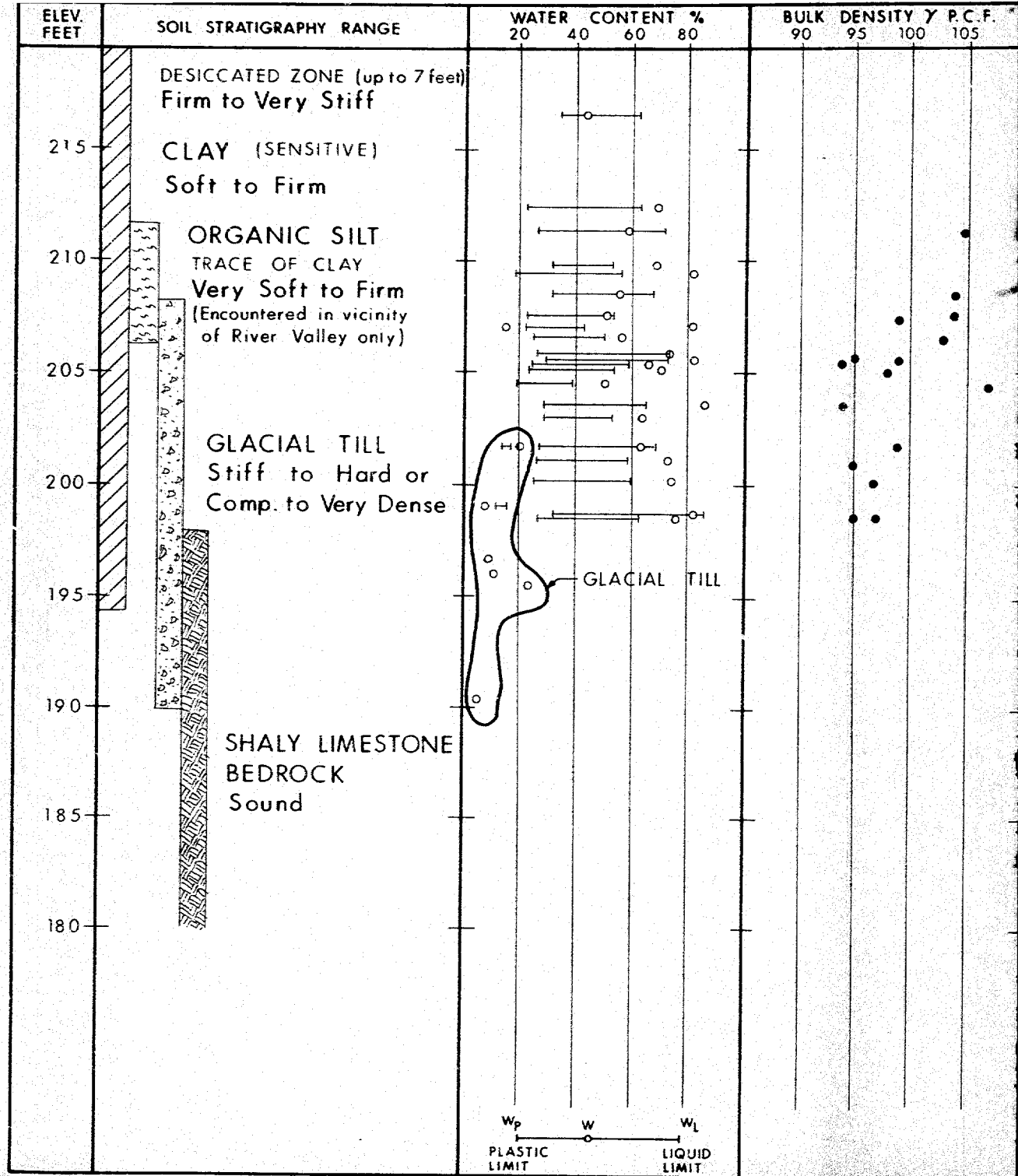
APPROVED

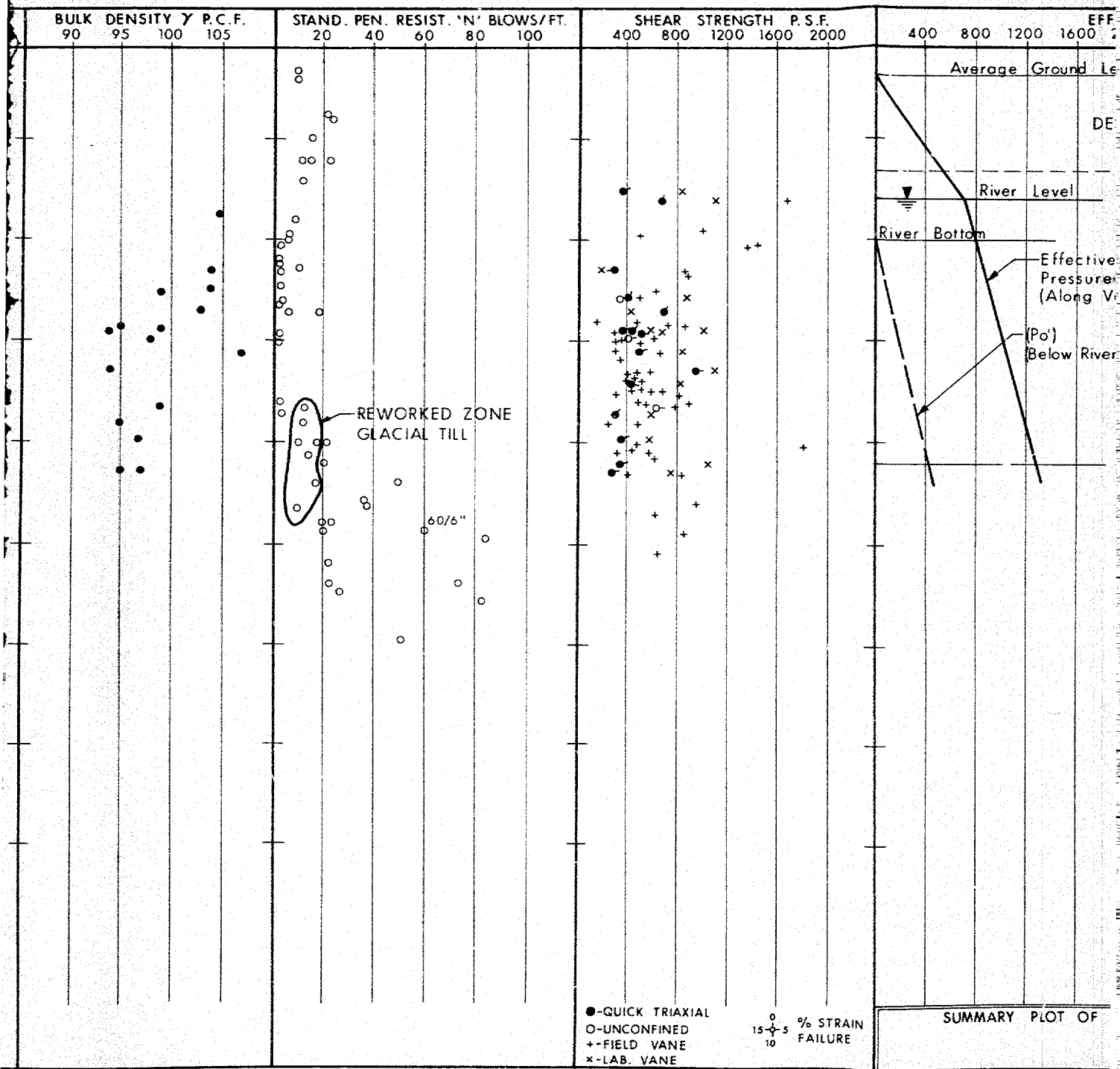
W.P. 36-66-09

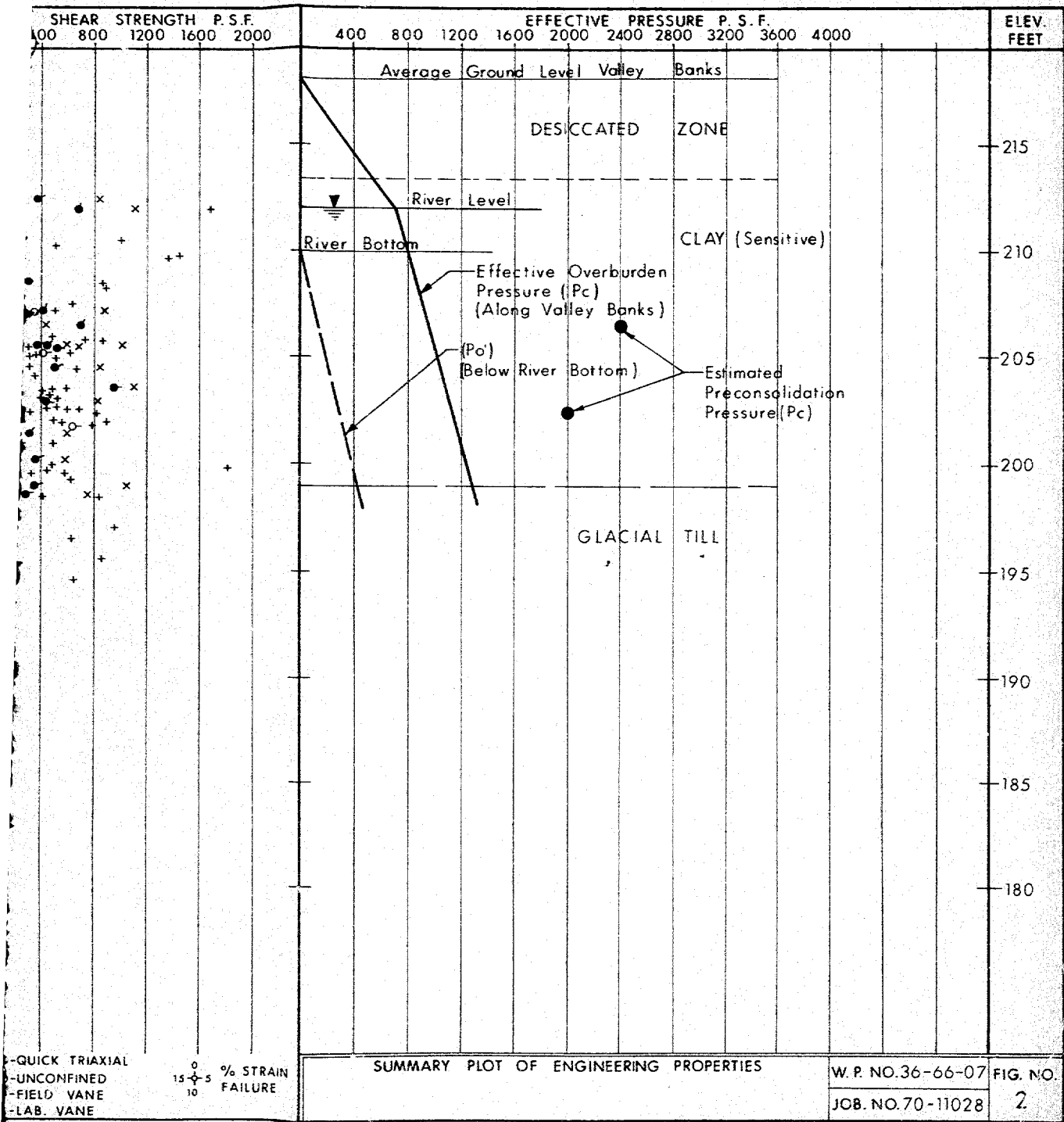
JOB 70-11028

HWY. 417

FIG. NO. 1







SUMMARY PLOT OF ENGINEERING PROPERTIES

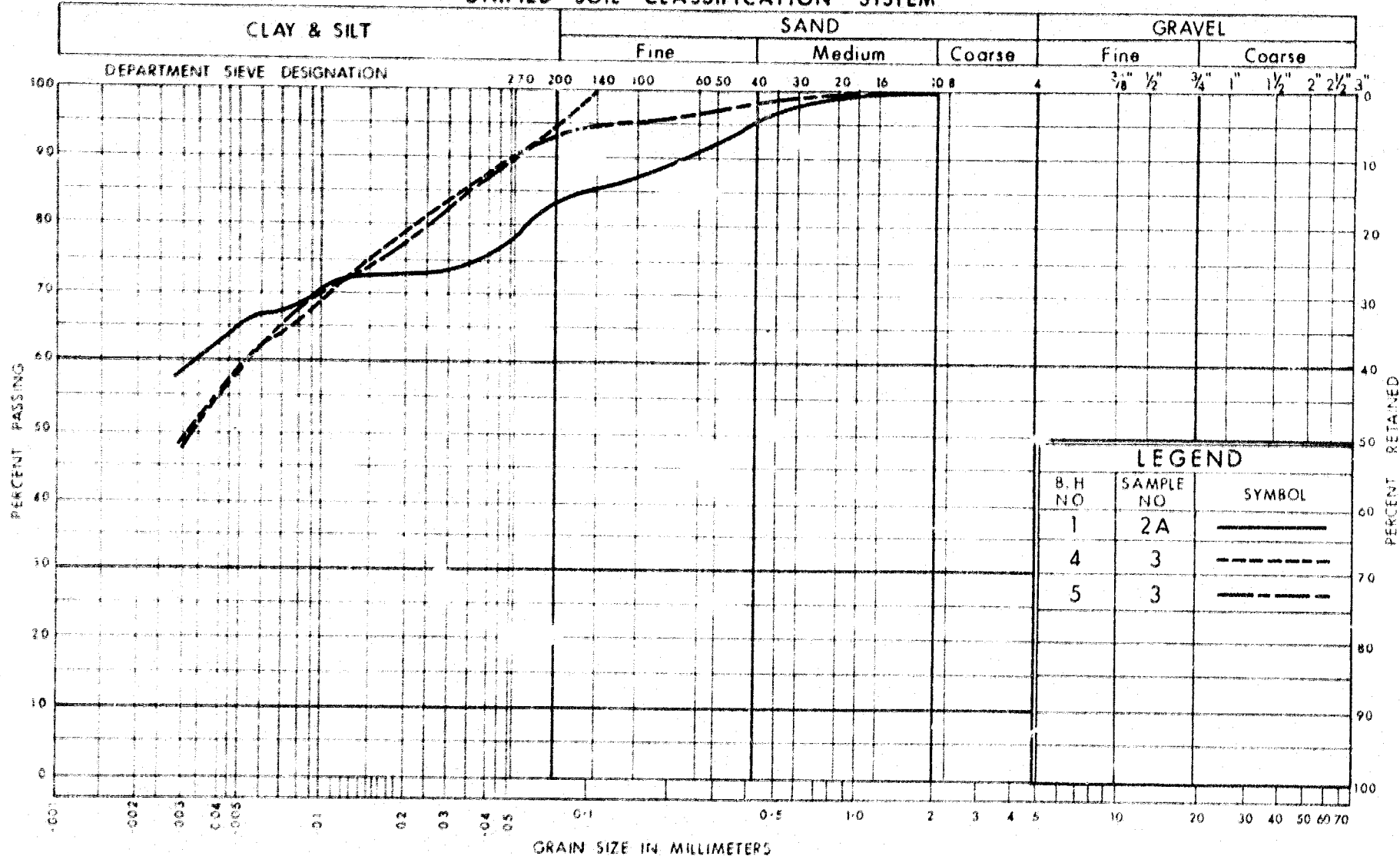
W. P. NO. 36-66-07

FIG. NO.

JOB. NO. 70-11028

2

# UNIFIED SOIL CLASSIFICATION SYSTEM



## LEGEND

B. H. NO.	SAMPLE NO.	SYMBOL
1	2A	—————
4	3	- - - - -
5	3	- . - . -



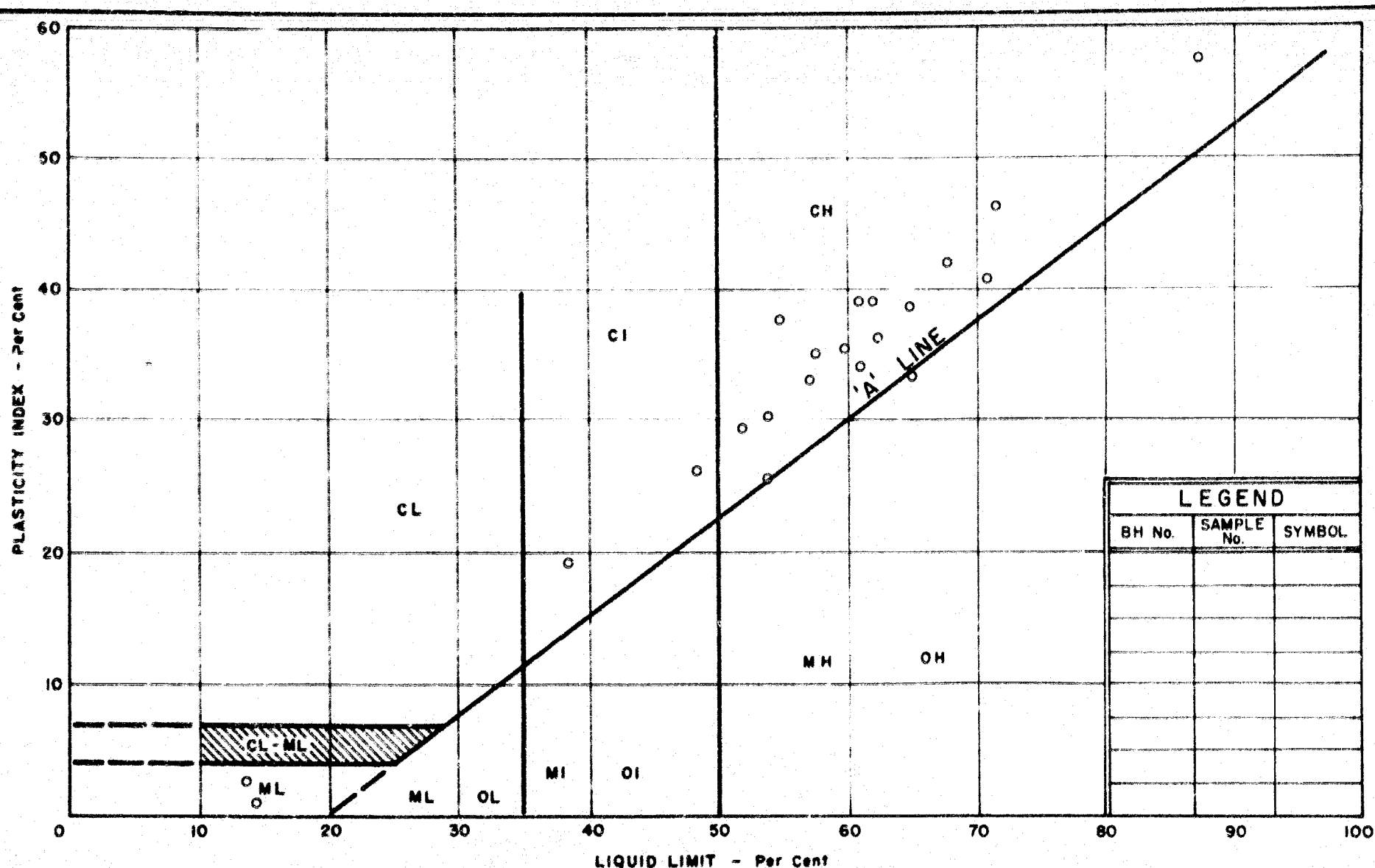
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
CLAY TO SILTY CLAY (SENSITIVE)

W.P. No. 36 - 66 - 09

JOB No. 70 - 11028

FIG. No. 3



DEPARTMENT OF HIGHWAYS  
 MATERIALS and  
 TESTING  
 DIVISION

# PLASTICITY CHART CLAY TO SILTY CLAY (SENSITIVE)

WP No. 33 - 66 - 09

JOB No. 70 - 11028

FIG.No. 4



# VOID RATIO - PRESSURE CURVES

JOB NO. 70 - 11028

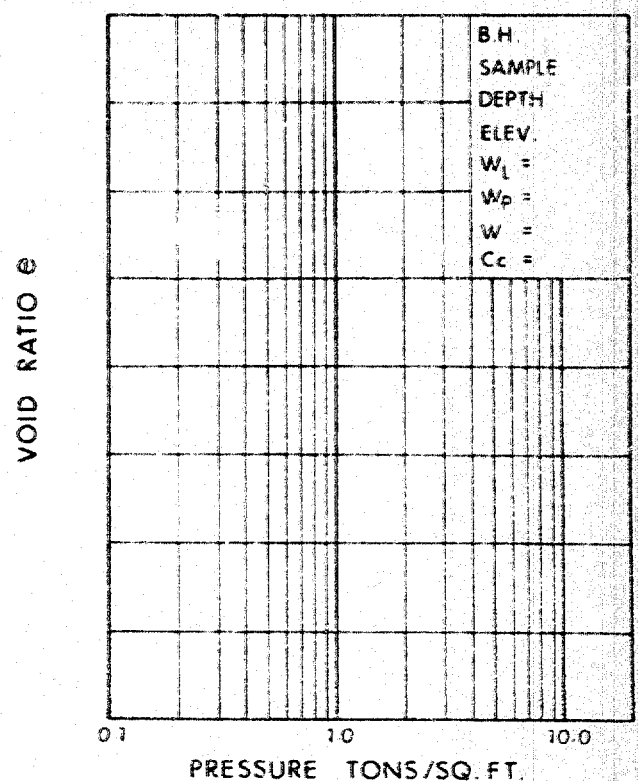
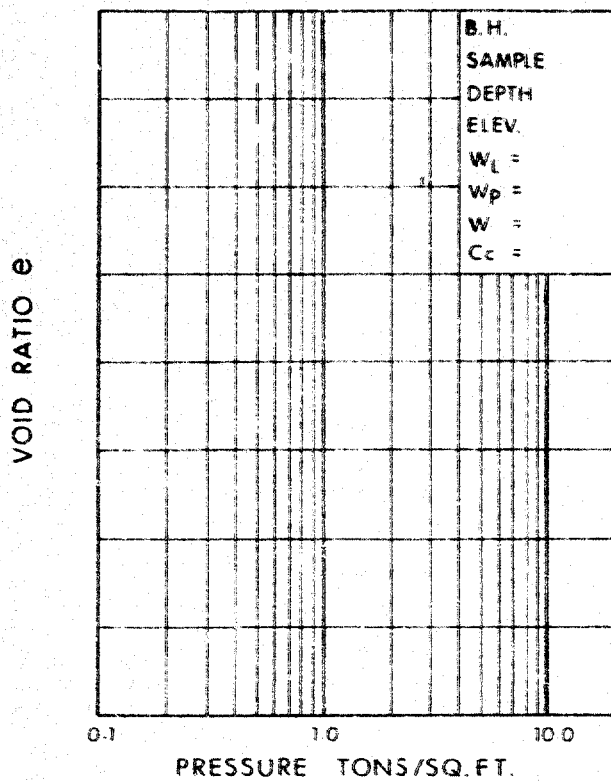
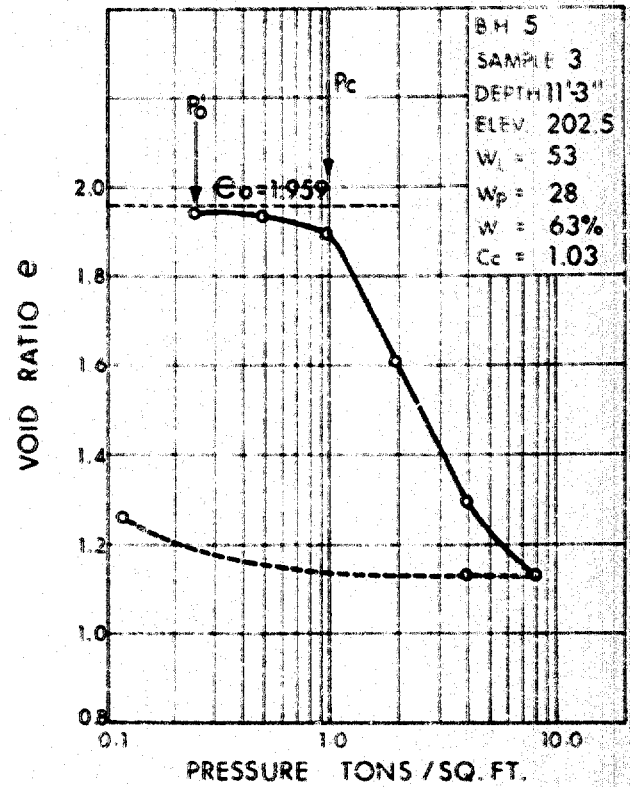
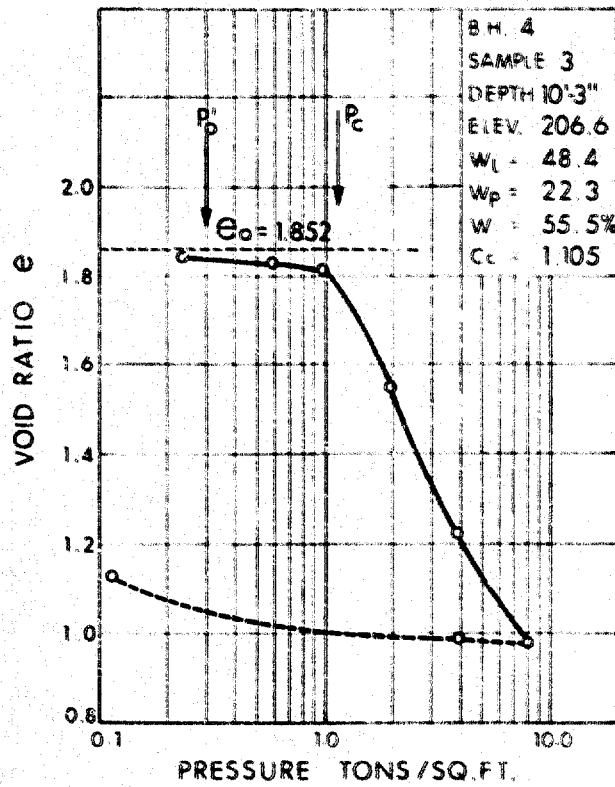
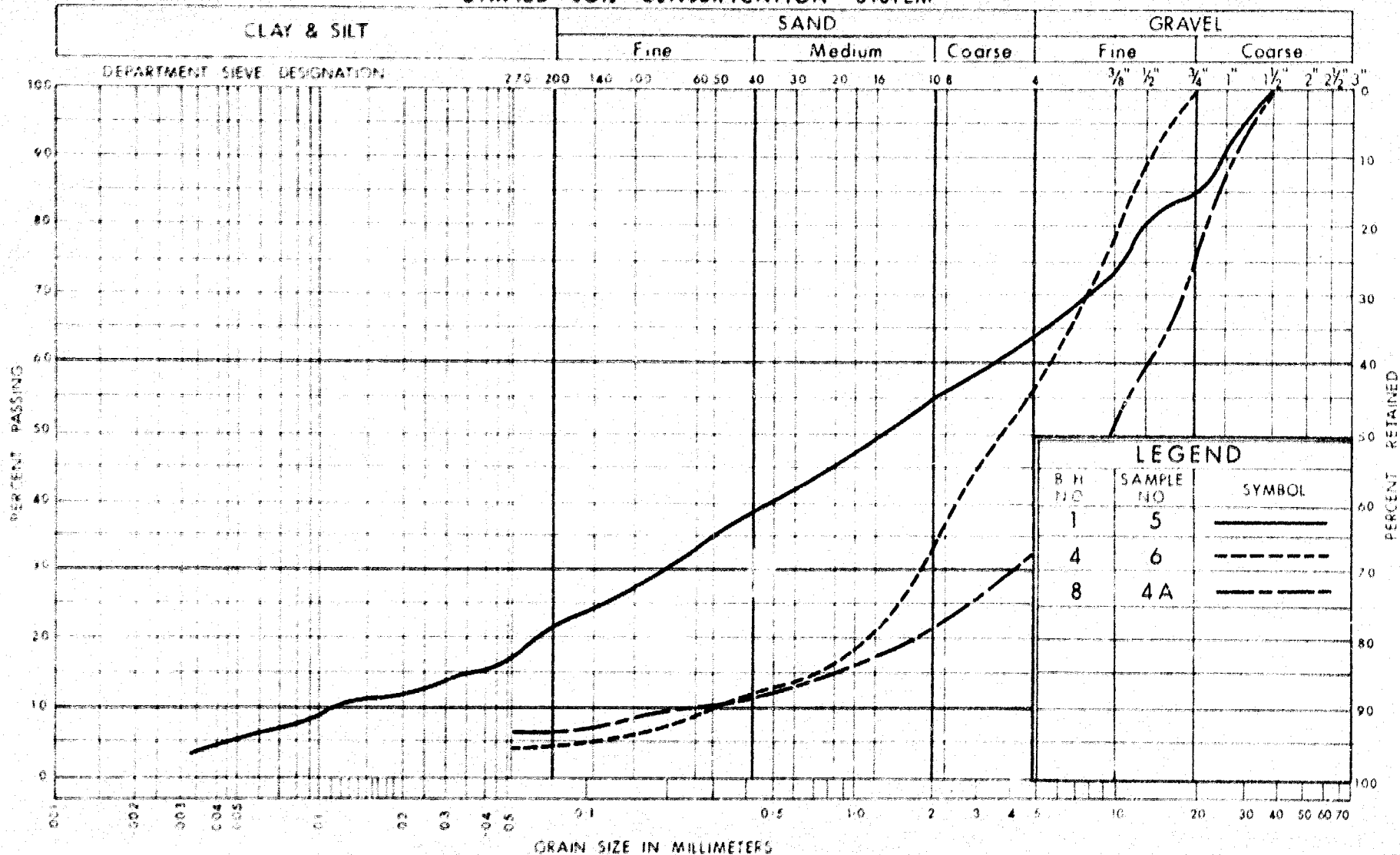


FIG. 5

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION GLACIAL TILL

WP No. 36 - 66 - 09

JOB No. 70 - 11028

FIG. No. 6

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

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

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

### DESCRIPTION OF SOIL

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

<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.	ROD CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

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

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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 $= \frac{w_L - w_p}{I_p}$
$e_{max}$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	$= 3.1416$
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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

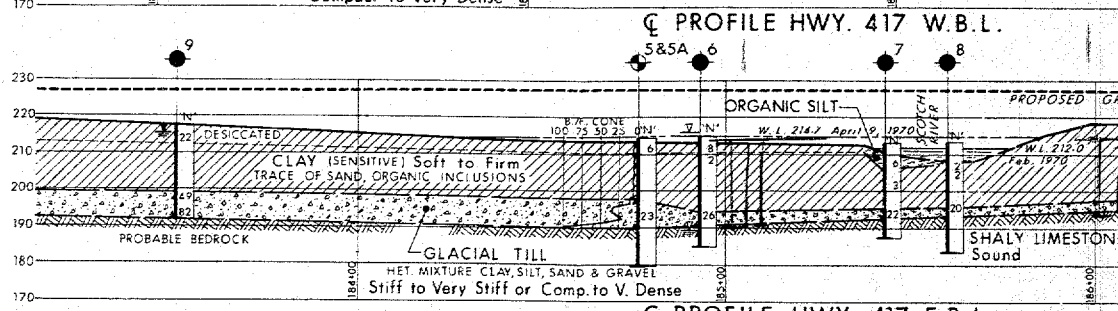
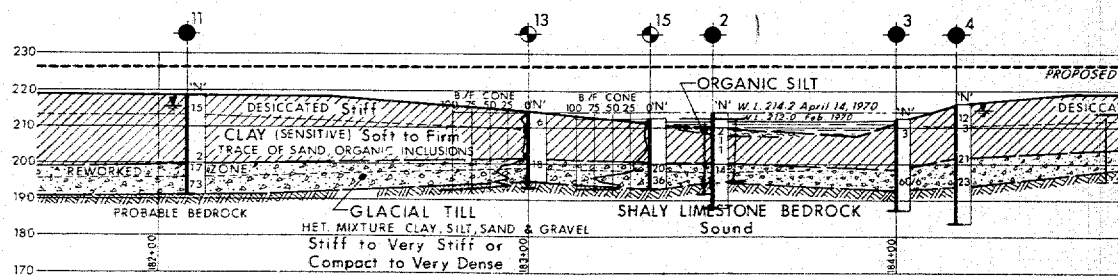
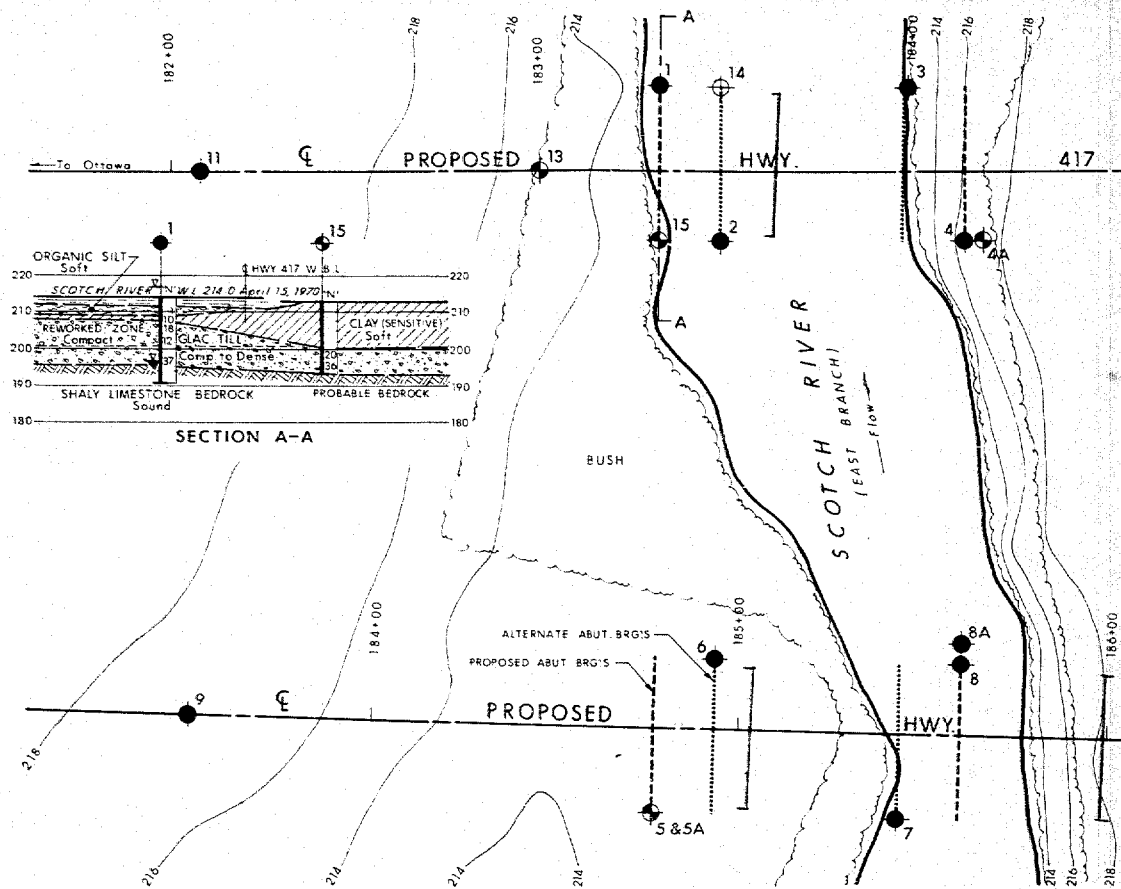
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

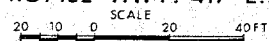
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

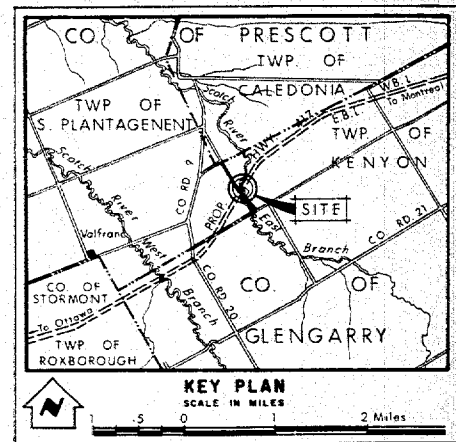
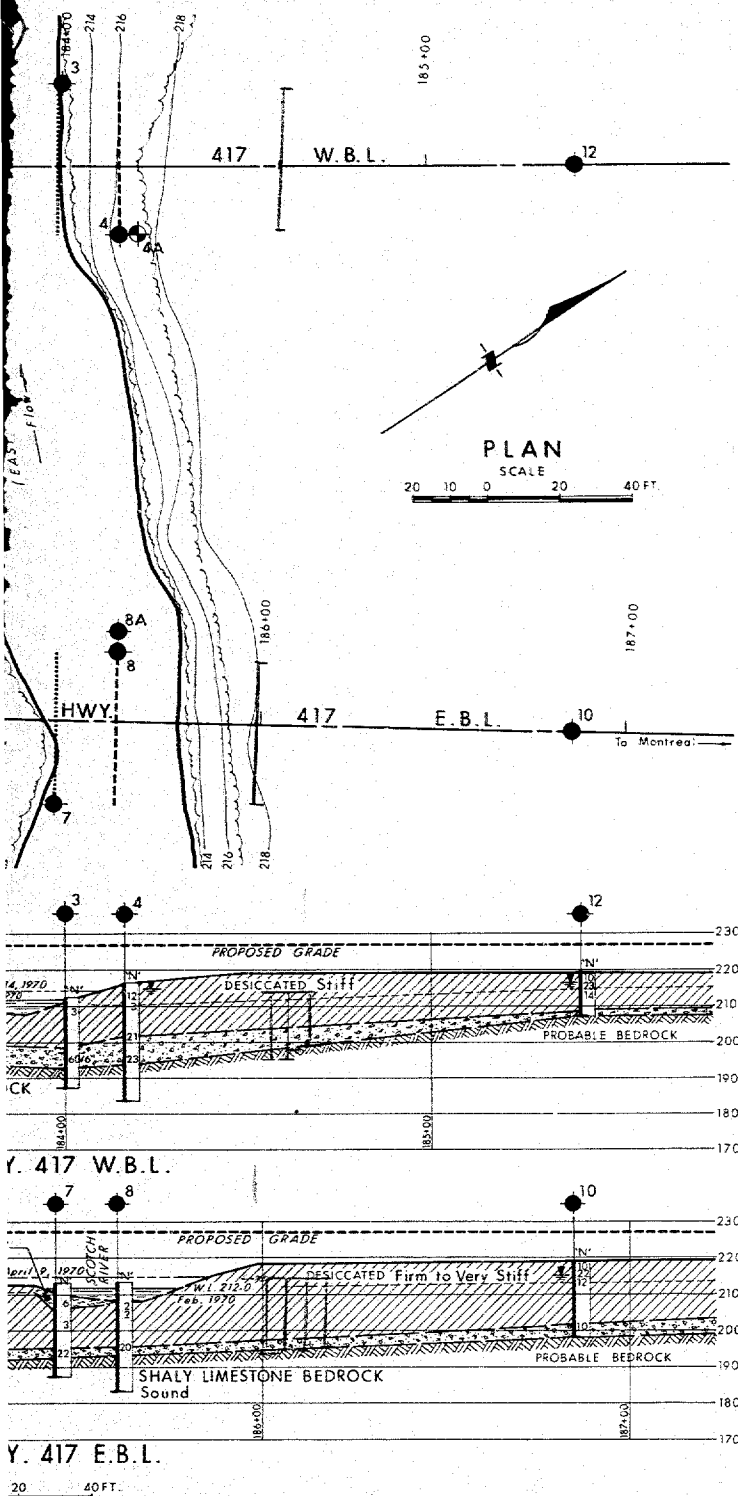
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



Q PROFILE HWY. 417 E.B.L.



PRINT RECORD  
NO. FOR DATE



### LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore & Cone Penetration Hole
- ⊕ Water Levels established at time of field investigation. April & May 1970
- ⊕ Head Arterial Conditions Encountered

NO.	ELEVATION	STATION	OFFSET
1	214.0	183+33	23' LT. W.B.L.
2	214.2	183+50	19' RT. W.B.L.
3	212.5	184+00	23' LT. W.B.L.
4	216.8	184+16	19' RT. W.B.L.
4A	217.8	184+20	19' RT. W.B.L.
5	214.5	184+76	23' RT. E.B.L.
5A	214.0	184+76	25' RT. E.B.L.
6	214.7	184+93	19' LT. E.B.L.
7	213.2	185+43	23' RT. E.B.L.
8	213.7	185+60	19' LT. E.B.L.
8A	213.7	185+60	24' LT. E.B.L.
9	217.7	183+51	Q E.B.L.
10	218.9	186+85	Q E.B.L.
11	219.0	182+08	Q W.B.L.
12	219.5	185+41	Q W.B.L.
13	214.5	183+00	Q W.B.L.
14	212.0	183+50	23' LT. W.B.L.
15	212.5	183+33	19' RT. W.B.L.

### 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.

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & TESTING OFFICE - FOUNDATION SECTION			
<b>SCOTCH RIVER</b> (EAST BRANCH)			
KING'S HIGHWAY NO. Prop. 417 W.B.L. & E.B.L. DIST. NO. 9			
CO. GLENGARRY			
TWP. KENYON		LOT 37	CON. IX
<b>BORE HOLE LOCATIONS &amp; SOIL STRATA</b>			
SUBM'D E.T.D. CHECKED	W.P. NO. 36-66-09	M.B.T. DRAWING NO.	
DRAWN G.P. CHECKED	JOB NO. 70-11028	<b>70-11028A</b>	
DATE May 14, 1970	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>		CONT. NO.	

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac, Principal Foundation Engineer,  
Room 107, Lab. Bldg.

Mr. T.C. Kingsland,  
Reg. Bridge Planning Engineer,  
Kingston Regional Office,  
Kingston, Ontario

Bridge Office,  
Downsview

September 2, 1970

Scotch River (East Branch) Bridge (E.B.L.)  
2.3 Mi. South of St. Isidore De Prescott  
W.P. 36-66-09, Site 31-289  
Highway 417, District 9

70-710-28

Attached herewith are prints of the Preliminary Bridge Plan  
Drawing D-6864-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$94,000. This  
cost includes tender, materials, engineering and sundry construction.

Any comments or revisions you may have should be submitted  
within three weeks.

CSG:rd

C.S. Grebski,  
Bridge Design Engineer

Attach.

C.C. S. McCombie  
A. Stermac (2)  
J. Anderson

1) <sup>Comments to</sup> I have reviewed the stability of the  
sections shown for the E.B.L. and W.B.L. structure. They  
are satisfactory.

2) note on Drawing with regard to piling should  
be changed to read.

12 BP 74 steel H-piles driven to bedrock  
(instead of refusal) Design load 95 T. per pile  
(instead of 90 T. per pile)

*PD Lupton*  
Sept 21/70

BTD Sept 21/70



Department of Highways Ontario  
Copy for the information of

Mr. A. Stermac

Mr. T.C. Kingsland,  
Reg. Bridge Planning Engineer,  
Kingston Regional Office,  
Kingston, Ontario

Bridge Office  
Downsview

September 2, 1970

Scotch River (East Branch) Bridge (W.B.L.)  
2.3 Mi. South of St. Isidore De Prescott  
W.P. 36-66-15, Site 31-289  
Highway 417, District No. 9

70-110-28

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6865-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$94,000. This cost includes tender, materials, engineering and sundry construction.

Any comments or revisions you may have should be submitted within three weeks.

CSG:rd

C.S. Grabski,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac (2)  
J. Anderson

200 comments

M. L. L. L.

Sept 21/70



## MEMORANDUM

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

FROM: C.S. Grebski,  
Bridge Office

ATTENTION:

DATE: October 28, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Scotch River (East Branch) Bridge (E.B.L.)  
W.P. 36-66-09, Site No. 31-289  
Highway 417, District No. 9

73-110-28

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

*Refer to comment on  
(W.B.L.) drawings.*

*BTD*

*no comment*

*On Landa*

*6th Nov/70*



## MEMORANDUM

TO: Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Bldg.

FROM: C.S. Grebski,  
Bridge Office

ATTENTION:

DATE: October 28, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Scotch River (East Branch) Bridge (W.B.L.)  
W.P. 36-66-15, Site No. 31-289  
Highway 417, District No. 9

70-11028

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

*Piles should be driven to ~~refined~~  
~~to~~ bedrock. Design load 70T  
per pile (D. 6865-1)*

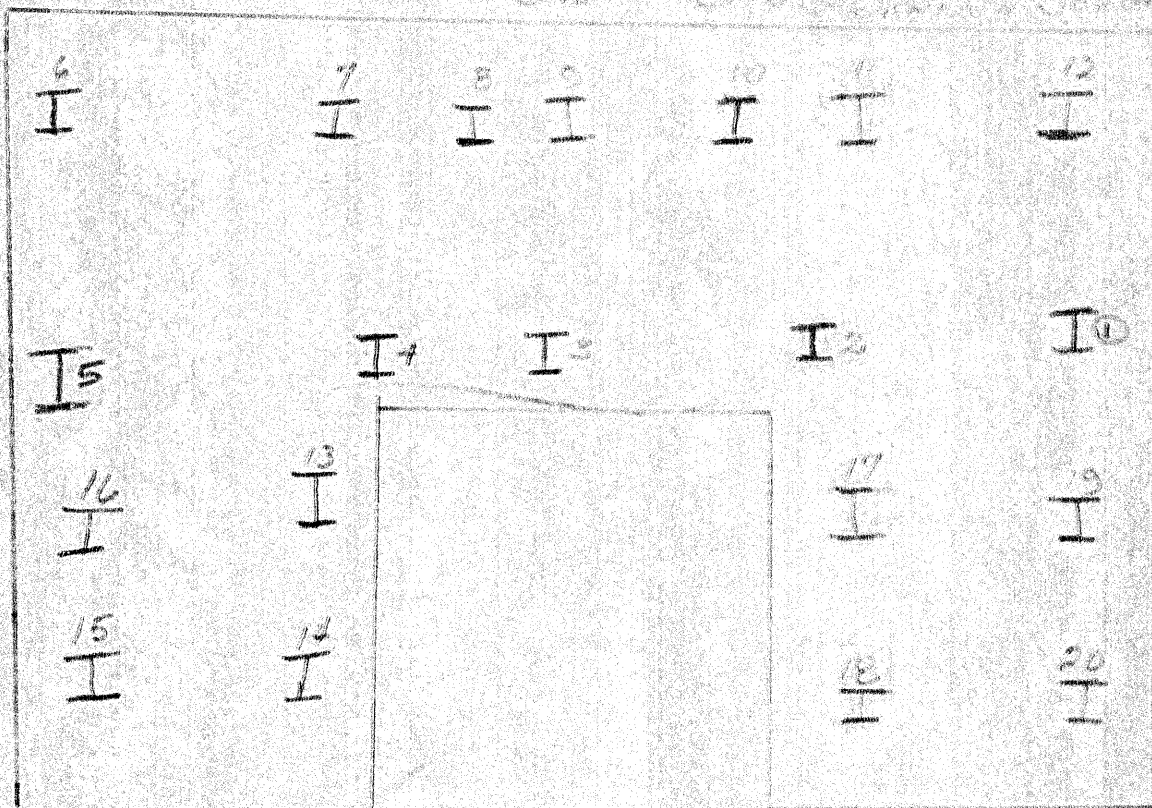
*note: "to bedrock" should be added.*

*BTD.   
otherwise no comments.*

*Advised Mr R. Basse on Phone.*

*M. Levata 6th Nov/70*

ENST ABUT ENCL ENST ENCL ENCL ENCL ENCL



1945 Jan 26 in period with 1945

I I I



EAST BRANCH Scotch River  
WEST ABUT. FTG - W.B.L.

20 JUL 55 22 AUG 55 - 12 P.M. 55  
- 10:00 AM 55

1.3 FRONT FACE BRIDGE

15 JUL 55

*Handwritten title or header text, possibly "The ... of ..."*

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
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15

SITE: COTCH RIVER (EAST BRANCH) # Hwy 417

HAMMER TYPE DROP Hammer WEIGHT 4000 lb ENERGY

PLEASE DRAWN TO BEDROCK



# SUMMARY OF PILE DRIVING RECORDS

W.O. 70-11028 W.P. 36-66-09 CONT. 71-47 DIST. 9

SITE SCOTCH RIVER (EAST BRANCH) # 417

DATE DRIVEN Aug 11 - Oct. 30/72 WEIGHT OF ANVIL 800 lb

HAMMER TYPE DROP HAMMER WEIGHT 4000 LB ENERGY

[illegible]



OVERSIZED DRAWINGS

General Layout  
Foundation " < Reinforcement

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 316-61

DIST. 9 REGION EASTERN

W.P. No. 36-66-09/15

CONT. No. 71-47

W.O. No. 70-F-28

STR. SITE No. 31-289

HWY. No. 417

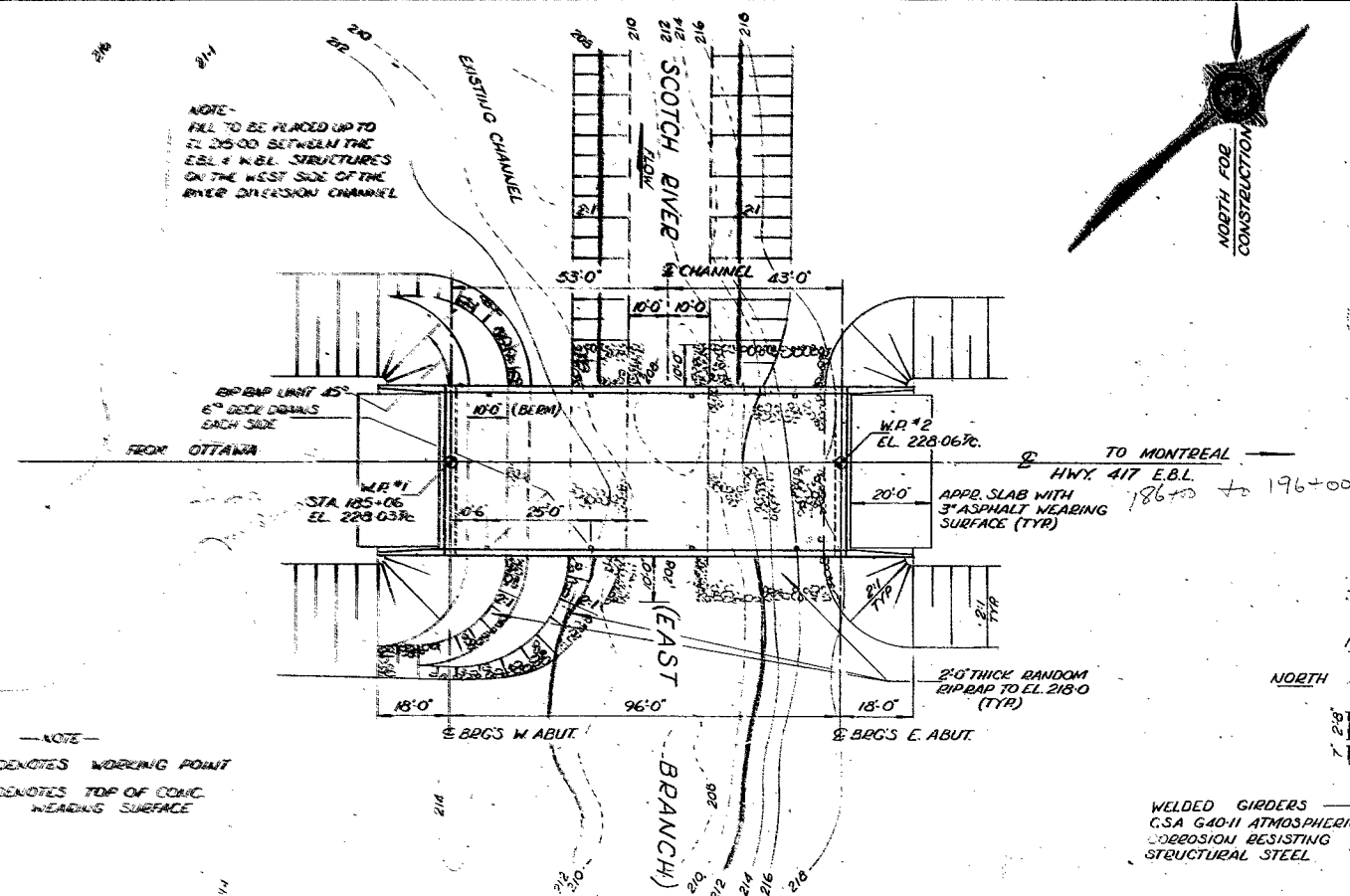
LOCATION HWY. 417 & SCOTCH

RIVER E. BR.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 2

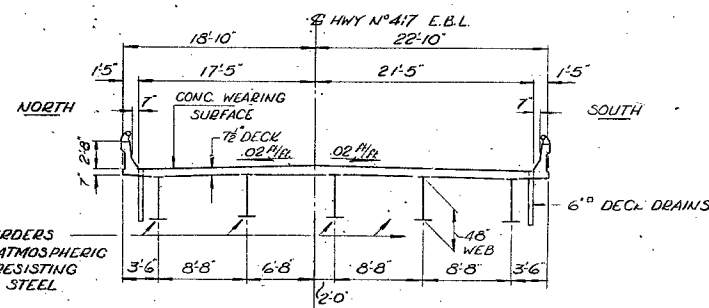
REMARKS: DOCUMENTS TO BE UNFOLDED  
BEFORE MICROFILMED

G.I.-30 SEPT. 1976



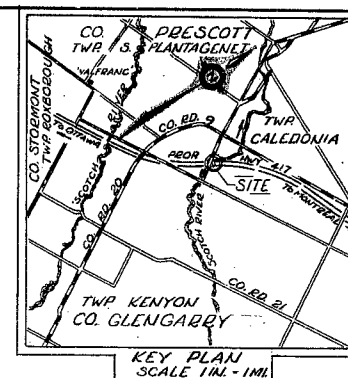
PLAN  
SCALE 1/4" = 20 FT.

WELDED GIRDERS  
G.S.A. 640-11 ATMOSPHERIC  
CORROSION RESISTING  
STRUCTURAL STEEL



TYP DECK SECTION  
SCALE 1/8" = 1 FT.

- LIST OF DRAWINGS
- D6864 -1 GENERAL LAYOUT  
-2 BORE HOLE LOCATION & SOIL STRATA  
-3 FOUNDATION LAYOUT & REINFORCING  
-4 ABUTMENTS  
-5 STRUCTURAL STEEL & BEARING DETAILS  
-6 DECK  
-7 CONCRETE BARRIER WALL (2'-8" HIGH)  
-8 APPROACH SLABS  
-9 DETAILS OF 9" HIGH STEEL PARAPET RAILING  
D6864-10 STANDARD DETAILS



NOTES

CLASS OF CONCRETE  
DECK & BARRIER WALLS 4000 P.S.I.  
REMAINDER 3000 P.S.I.

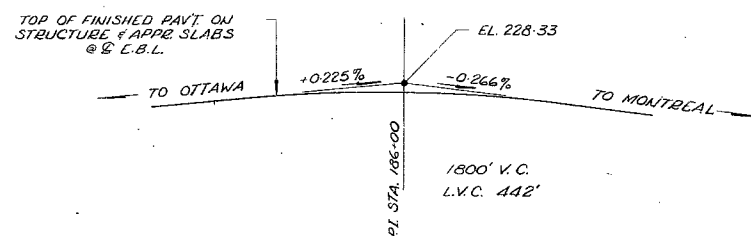
CLEAR COVER ON REINFORCING STEEL  
FOOTINGS & ABUTMENTS -3"  
TOP OF DECK -1 1/2" BOT. OF DECK -1"  
BARRIER WALLS -1 1/2"

CONSTRUCTION NOTES

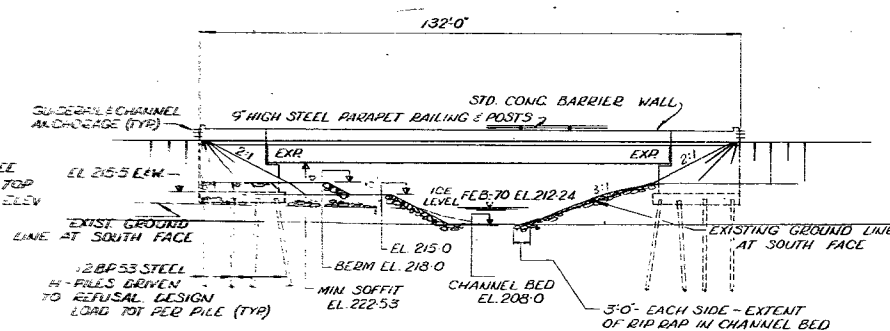
- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm 1/8$  IN.
- NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED

G.B.M. 626-S ELEV. 240-187  
BOULDER (12' x 8' x 4' FEET HIGH) ON SOUTHWEST SIDE OF ROAD RUNNING SOUTHEAST TO DUNVEGAN, 1000 FEET SOUTHEAST OF ROAD ALONG PRESCOTT- GLENGARRY COUNTY LINE, 1.3 MILES NORTHWEST OF DUNVEGAN CORNER, 75 FEET SOUTHWEST OF CENTRE LINE OF ROAD, TABLET IN TOP OF HIGHEST POINT. QUAD N°45074 S.W. LINE 256 DUNVEGAN

319-61  
GEOCES No.



PROFILE OF HWY 417 E.B.L.  
N.T.S.



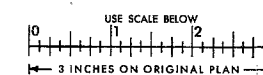
SOUTH ELEVATION  
SCALE 1/4" = 20 FT.

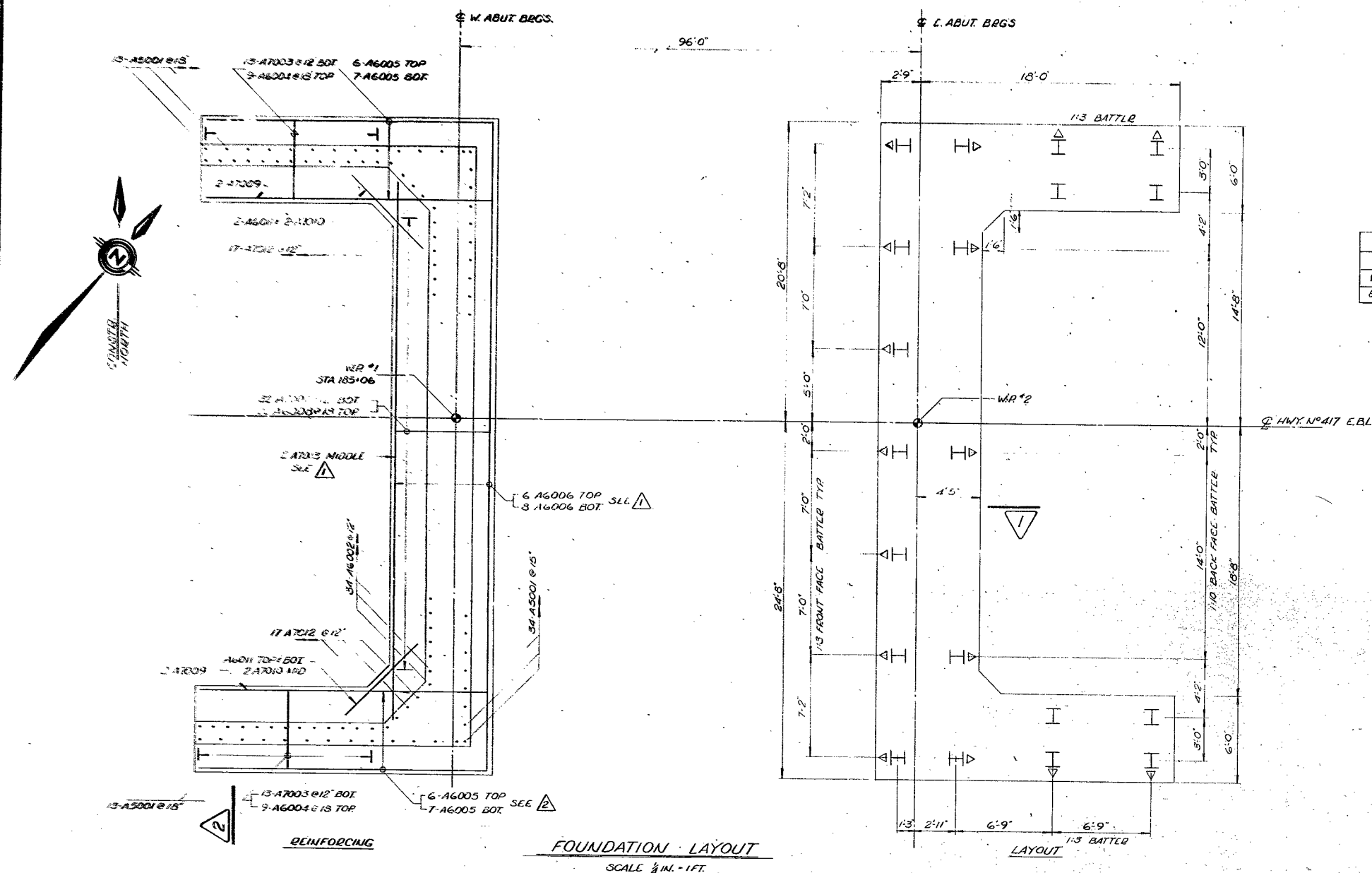
REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION	
70-11028	
SCOTCH RIVER (EAST BRANCH) BRIDGE (E.B.L.) 2.3 MILES SOUTH OF ST. ISIDORE DE PRESCOTT KING'S HIGHWAY No. 417 E.B.L. DIST. No. 9 CO. GLENGARRY TWP. KENYON LOT 37 CON. 1X	
GENERAL LAYOUT	
APPROVED	SITE No. 31289 W.P. No. 36-66-09
DESIGN A.I.O. CHECK H.S.M.	CONTRACT Nos.
DRAWING A.I.O. CHECK H.S.M.	DRAWING No. D6864-1
DATE OCT. 70	LOADING 11520-44



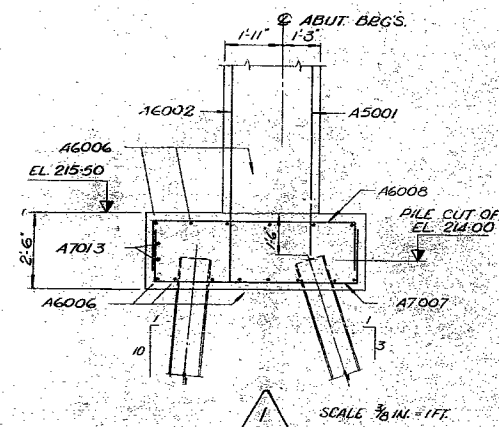
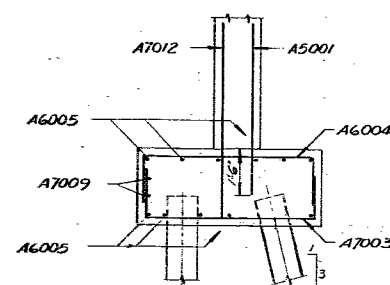
FOR REDUCED PLAN





PILE DATA			
LOCATION	N <sup>o</sup>	LENGTH	TYPE
WEST ABUT.	20	26' 5" <i>ML</i>	12 BP 53
EAST ABUT.	20	22' 0" <i>ML</i>	12 BP 53

- NOTES:
- DIMENSIONS, WEIGHT & PILE LAYOUT SIMILAR FOR EAST & WEST ABUT. FOOTINGS.
  - PILES TO BE DRIVEN TO REFUSAL IN ACCORDANCE WITH STD. SD-827 DWG. D6864-10
  - SPACING OF PILES TO BE MEASURED AT UNDERSIDE OF FOOTINGS
  - PILE DESIGN LOAD TO T PER PILE



REVISIONS					
	DATE	BY	DESCRIPTION		
<p align="center"><b>DEPARTMENT OF HIGHWAYS ONTARIO</b>  <b>BRIDGE DIVISION</b></p>					
<p align="right">90-11228</p> <p><u>SCOTCH RIVER (EAST BRANCH) BRIDGE</u></p>					
<p align="center">(E.B.L.)</p> <p>2.3 MILE'S SOUTH OF ST. SIDORE DE PRESCOTT</p>					
KING'S HIGHWAY No. <u>417 E.B.L.</u>				DIST. No. <u>9</u>	
CO. <u>GLENGARRY</u>					
TWP. <u>KENYON</u>				LOT <u>37</u>	CON. <u>1K</u>
<p align="center"><b>FOUNDATION LAYOUT AND REINFORCEMENT</b></p>					
APPROVED			SHEET No. <u>31289</u>	W.P. No. <u>3666-0</u>	
BRIDGE ENGINEER			CONTRACT Nos.		
DESIGN	<u>M. J. O.</u>	CHECK <u>[Signature]</u>			
DRAWING	<u>M. J. O.</u>	CHECK <u>[Signature]</u>	DRAWING No.		
DATE	<u>OCT 20</u>	LOADING <u>42320</u>			
			<u>D6864-3</u>		