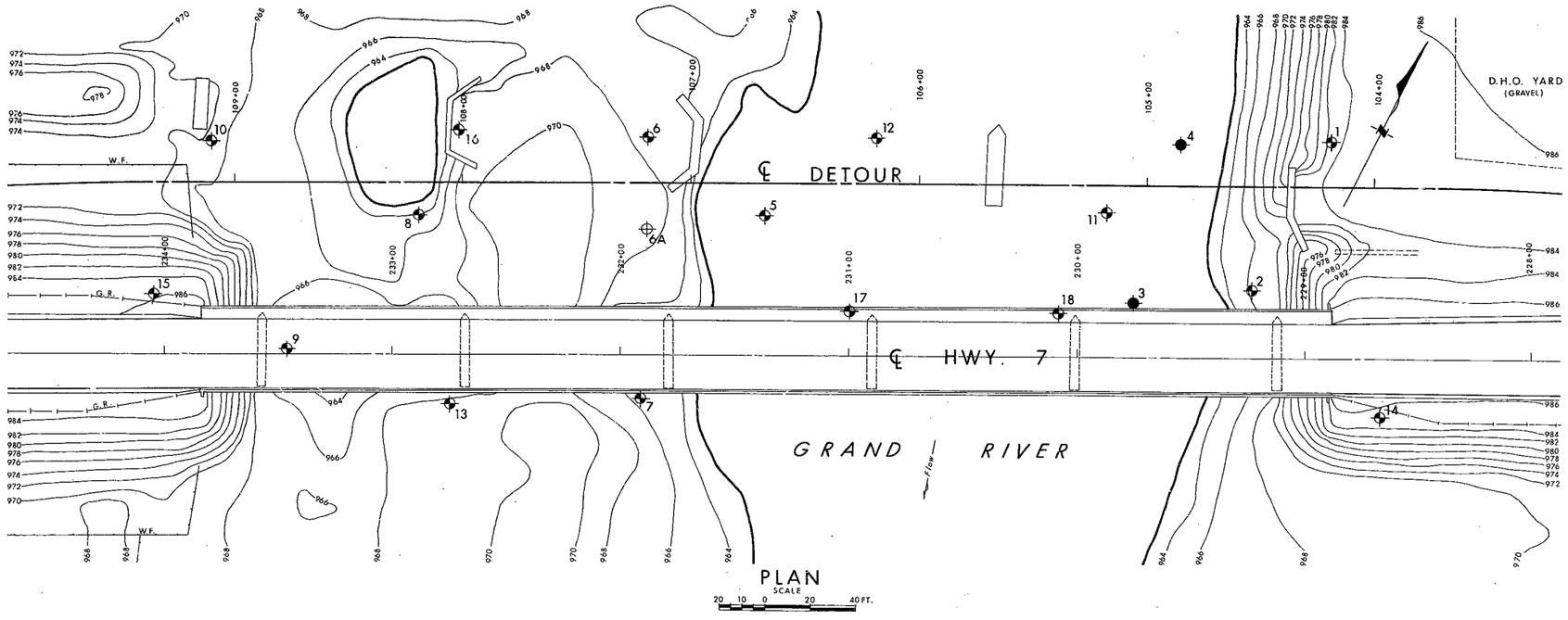
CONT. 72-13

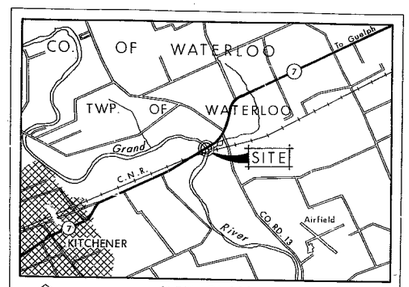
HWY. 7 +

GRAND RIVER

40P8-59

REDUCE THIS DIMENSION TO 22"

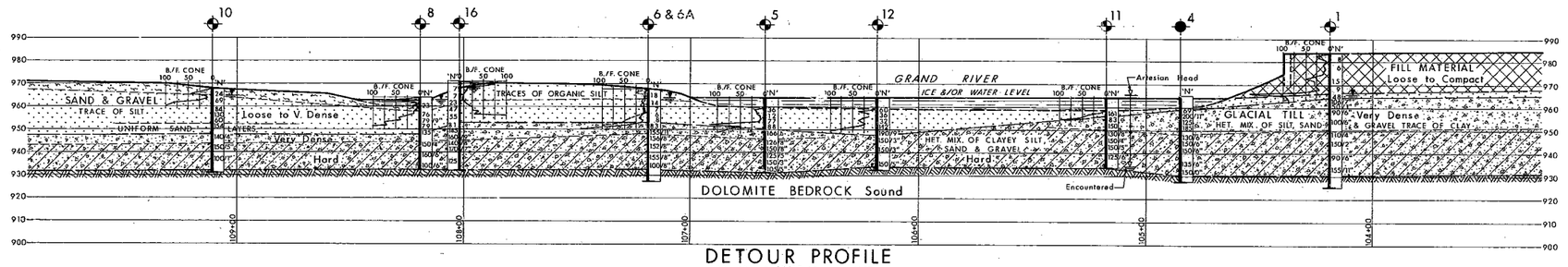


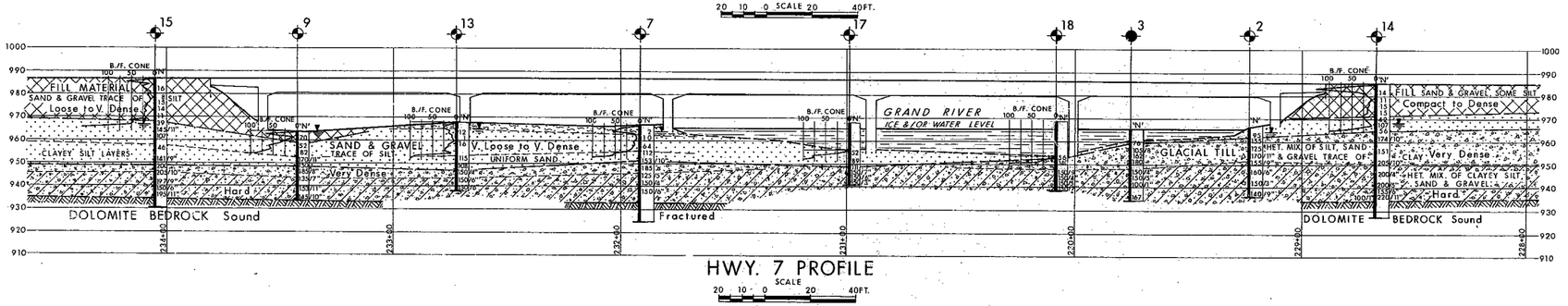


LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation Feb., March & April 1971

NO.	ELEVATION	STATION	OFFSET	
1	984.5	104+19	20' RT.-D	D-DETOUR 7-HWY. 7
2	967.0	229+23	30' RT.-7	
3	965.4	229+75	24' RT.-7	
4	965.4	104+85	18' RT.-D	
5	963.9	106+68	14' LT.-D	
6	968.0	107+19	20' RT.-D	
6A	968.5	107+19	20' LT.-D	
7	967.0	231+91	19' LT-7	
8	964.0	108+19	14' LT-D	
9	964.3	233+46	2' RT.-7	
10	969.0	109+10	18' RT.-D	
11	964.0	105+18	12' LT.-D	
12	964.0	106+19	20' RT.-D	
13	968.0	232+74	21' LT.-7	
14	986.3	228+67	25' LT.-7	
15	986.6	234+05	26' RT.-7	
16	971.0	108+02	23' RT.-D	
17	968.0	230+99	19' RT.-7	
18	969.0	230+08	19' RT.-7	





REF. NO. E-4811-1

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

GEOCRES NO. 40P8-59

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

GRAND RIVER

HIGHWAY NO. 7 & DETOUR DIST. NO. 3
CO. WATERLOO
TWP. WATERLOO LOT 123 & 114 CON. U.B.G.T.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D W.H.	CHECKED	W.P. NO. 194-63	M. & T. DRAWING NO.
DRAWN	CHECKED	JOB NO. 71-11013	71-11013A
DATE April 27, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

40P8-59
GEOCRES No.

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,
Bridge Planning Engr.

Date: April 14, 1971

Our File Ref.

In reply to MAY 12 1971

Subject:

FOUNDATION INVESTIGATION REPORT
For
New Structure and Related Detour
Crossing at Hwy. #7 and Grand River
0.3 Mi. West of the Village of Breslau
Twp. of Waterloo -- Co. of Waterloo
District No. 3 (Stratford)
W.O. 71-11013 -- W.P. 194-63-00
Cont 72-013 etc 33-100

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.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeP
Attach.
cc: Messrs. B. R. Davis
F. G. Allen
D. W. Farren
W. Zonnenberg
H. C. Dernier
A. P. Watt (2)
J. Roy
B. J. Giroux
B. A. Singh
Foundations Files
Gen. Files

Prof. P. F. Karrow,
University of Waterloo

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
New Structure and Related Detour
Crossing at Hwy. #7 and Grand River
0.3 Mi.West of the Village of Breslau
Twp. of Waterloo -- Co. of Waterloo
District No. 3 (Stratford)
W.O. 71-11013 -- W.P. 194-63-00

1. INTRODUCTION:

Major reconstruction is proposed at the crossing of Hwy. #7 and the Grand River, at a point about 0.3 miles west of the Village of Breslau. This will involve the replacement of the deck of the existing structure, which is in a state of poor repair, or alternatively, the construction of a new structure. If the former procedure is adopted, a temporary detour structure will have to be constructed in order to accommodate the vehicular traffic along Hwy. #7. In the latter case, the existing structure could remain in use while the new structure is being constructed. The Foundation Section was requested to carry out a detailed subsurface investigation for each possible scheme. The request was contained in a memo from Mr. A. P. Watt, Regional Bridge Planning Engineer, Southwestern Region, dated February 10, 1971.

An investigation was carried out by this Section in order to determine the subsoil, bedrock and groundwater conditions in the area under consideration. This report contains all the factual data obtained from this investigation, together with our recommendations pertaining to the design of the foundations for the various schemes.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located at the crossing of Hwy. #7 and Grand River, specifically about 0.3 miles west of the Village of Breslau in the Township of Waterloo. The west bank slopes

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

gently towards the river; along this bank the ground surface varies from about elevation 963 to 970. From the river's edge, on the east bank, the terrain increases in elevation in a northeasterly direction. The crest of this bank, which has an overall slope of about 2:1, is at about elevation 986 - i.e., it is about 23 feet above the river water level. This is virgin land which is covered with grass and light brush.

The south-flowing Grand River meanders across the terrain in this area. The river channel, during periods of normal flow, varies from 150 to 200 feet in width in the vicinity of the site. During the early stages of the field investigation (March, 1971), the water level was at about elevation 964; at this time the depth of water ranged from 5 to 8 feet. During early April, however, the water level rose to as high as elevation 969. It is inferred that this level corresponds to the high water condition during peak spring run-off. At this time the relatively flat, low-lying west bank of the river was flooded, increasing the overall width of the river to something of the order of 450 feet.

There is an existing structure at the crossing of Hwy. #7 and the Grand River. In addition, a structure carries the C.N.R. over the river; this structure is located about 500 to 600 feet south of the Hwy. #7 crossing. The specific details of these two structures will be presented in Section #6 of this report.

The site is situated in the physiographic region known as the 'Waterloo Hills'. In the vicinity of the site the terrain is covered by kame moraines with outwash sands occupying the intervening hollows. The glacial deposits are generally of the order of 25 to 30 feet thick. The upper part of the Grand River, which encompasses this site, flows in a spillway which was previously formed on the till plain. The 'spillway' deposits

..... 3

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

are generally composed of sand and gravel, the thickness of which generally varies from 2 to 10 feet. The overburden is underlain by dolomite bedrock of the Salina formation, Silurian Period.

3. FIELD AND LABORATORY INVESTIGATION:

Eighteen sampled boreholes, 15 of which were accompanied by a dynamic cone penetration test, as well as one additional cone test, were put down during the course of the field study. The borings were advanced by means of a conventional diamond drill rig adapted for soil sampling purposes. During the course of the investigation, the drill rig was mounted on a drum raft in order to advance those borings (No. 11 and 12) put down through the river bed.

Samples of the fill and parent overburden were obtained in a 2" O.D. split-spoon sampler, which was hammered into the subsoil in accordance with the specifications for the Standard Penetration Test. The dynamic cone penetration tests were advanced using the same method. Bedrock was proven in eight of the borings by obtaining up to 8 feet of AXT size rock core samples.

The groundwater level conditions across the site were determined, during the course of the investigation, by recording the water levels in the open boreholes.

The testing techniques used, the subsoil and bedrock sequence encountered at the individual boring locations, are shown on the Record of Borelog sheets appended to this report.

The locations and elevations of all the boreholes, together with two estimated stratigraphical profiles across the site, are shown on Drawing No. W.O. 71-11013A. The surveying was carried out by personnel from the Stratford District Surveys Section. All elevations were referenced to a Geodetic datum.

..... 4

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

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

Natural Moisture Content
Grain-size Distribution
Atterberg Limits

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on Figures #1 to 4 inclusive, all of which are contained in the Appendix of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is composed of a competent glacial till, which varies from 14 to 34 feet in thickness. The glacial till is overlain by a surficial spillway deposit composed of loose to very dense sand and gravel. The thickness of the spillway deposit ranges from 1 to 21 feet; it is most extensive on the west bank of the Grand River. The overburden sequence is underlain by sandy dolomite bedrock.

Up to 18 feet of fill has been placed along the approaches to the existing structure. The fill is primarily composed of a silty sand and gravel.

The stratigraphical sequence encountered in the borings is plotted on the Record of Borelog sheets. Two stratigraphical sections have been inferred from this data; these are plotted on Drawing No. W.O. 71-11013A. The subsoil and bedrock, encountered from ground surface downward, is presented in the sub-sections to follow.

..... 5

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

4.2) Fill:

Up to 18 feet of fill was encountered at those borings put down along the approaches to the existing structure. The fill was primarily composed of a silty sand to sand and gravel; at B.H. #9, however, the fill material is a clayey silt with some sand and gravel. Occasional seams of organic silt, up to 1/4 inch thick, are present throughout the fill. Grain-size distribution curves, for samples obtained from the fill, are plotted on Figure #1 in the Appendix to this report.

Standard penetration testing was carried out within the fill material; the values obtained are plotted on the Record of Borelog sheets. The results gave 'N' values which range from 6 to 15 blows/ft. Based on this testing, it is estimated that the fill has been subjected to a moderate degree of compaction.

4.3) Spillway Deposit - Silty Sand and Gravel:

The surficial deposit across the site is composed of a sand and gravel with a trace to some silt. The thickness of this deposit ranges from 1 to 21 feet; it is most extensive on the west bank of the river, tapering off in an easterly direction. Traces of organic silt were often encountered in the upper 4 to 5 feet of the deposit; further, the lower 3 to 4 feet is periodically composed of a uniform sand. In addition, occasional sandy silt seams, up to 4 inches in thickness, are present throughout as well as random clayey silt layers up to 3 feet thick. Grain-size distribution curves, for samples obtained from the granular spillway deposit are plotted on Figure #2.

Standard penetration testing was carried out within the granular deposit, the 'N' values obtained generally range between 23 blows/ft. and 150 blows for 4 inches. Based on these results, it is estimated that the relative density of the sand and gravel varies from compact to very dense. An exception to

..... 6

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

4.3) Spillway Deposit - Silty Sand and Gravel: (cont'd.) ...

this pattern occurs along the west bank, in the immediate vicinity of the river (refer to B.H.'s #6, 7 and 13), here the 'N' values in the upper portion of the deposit range from 1 to 18 blows/ft., indicating a relative density which varies from very loose to compact. The topography in this area would seem to indicate that this was once part of the old river channel. If this is the case, it could be inferred that the lower relative densities would be indicative of 'reworking' of the material by the scour action of the river.

4.4) Glacial Till:

The granular spillway deposit is underlain by the predominant stratum across the site which is composed of a glacial till. The thickness of the till sheet varies from 14 to 34 feet, being most extensive in those areas where the surficial deposits are thinnest - i.e., on the east bank of the river. The upper 3 to 14.5 feet of the stratum is reddish-brown in colour, below this zone the till is grey; the transition between the zones is clearly indicated on the borelog sheets. The upper reddish-brown zone is basically granular, being composed of silt, sand and gravel with a trace of clay. The lower portion, however, is primarily cohesive in nature - i.e., it has a matrix of clayey silt binding sand and gravel. Boulders were encountered in the lower portion of the stratum (generally below elevation 943) at B.H.'s #10, 11, 12 and 15. These boulders ranged from 4 to 16 inches in size.

Atterberg limit tests were performed on samples of the glacial till; the results are plotted on the borelog sheets as well as on the Plasticity Chart, Figure #4. The testing is summarized in the following table:

..... 7

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

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

	* Upper Zone (Reddish-Brown)	Lower Zone (Grey)
Liquid Limit (W_L) (%)	13 - 17	16.5 - 23.5
Plastic Limit (W_P) (%)	11 - 13	11.5 - 14.5
Natural Moisture Content (W) (%)	7 - 9.5	8.5 - 16.5

* Testing carried out wherever possible.

Based on these results, it is estimated that the upper, reddish-brown zone is basically non-plastic - i.e., granular type of material. The testing carried out in the lower grey zone, however, would indicate that in this area the till is composed of an inorganic soil of low plasticity.

Standard penetration testing carried out within this stratum gave 'N' values which were consistently greater than 100 blows/ft.; these values are summarized on the borelog sheets. Based on this testing, it is estimated that the relative density of the upper granular portion of the glacial till is very dense. The lower cohesive zone would have a hard consistency.

4.5) Dolomite Bedrock:

Grey dolomite bedrock was encountered below the glacial till. The bedrock was proven at 8 of the boring locations by obtaining up to 8 feet of AXT size rock core samples. The surface of the bedrock varies between elevations 930.5 and 933.5, which corresponds to depths of between 25.5 and 36 feet below the original ground surface.

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

4.5) Dolomite Bedrock:

The bedrock was generally found to be in a sound condition as evidenced by the high percentage of rock recovery. At a few isolated boring locations, however, specifically B.H.'s #1 and 7, the upper 4 to 5 feet is in a fractured condition.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out, during the period of the investigation, by recording the water levels in the open holes. The observations are recorded on the borelog sheets and summarized on Drawing No. W.O. 71-11013A. The results of the measurements indicate that the piezometric groundwater level, within the overburden, generally varies between elevations 964 and 968.5, which corresponds to depths of 1.5 to 4 feet below the original ground surface in the area. The river water level, at the time of the investigation, varied from elevation 964 (normal flow conditions) to 969 (spring run-off).

At B.H. #11, put down through the river bottom, an artesian water pressure was encountered. The artesian pressure occurred once the casing was advanced into a bouldery zone located near the base of the glacial till stratum (at about elevation 935). Once this zone was penetrated the water rose instantaneously in the casing eventually stabilizing itself at about elevation 966, which is about 2 feet above the river level. This lower, bouldery zone is more pervious than the overlying basically cohesive part of the glacial till. It is inferred that this zone is acting as a confined aquifer which is being charged with groundwater from the higher surrounding terrain. Artesian conditions were not encountered anywhere else during the drilling programme. It is believed, however, that such conditions may exist at other isolated locations where a similar stratigraphical sequence exists, particularly within the low-lying river channel.

6. EXISTING STRUCTURES:

The existing highway structure crossing the Grand River is a seven-span, 493.5 feet long, 38 feet wide concrete beam bridge, the structural details of which are shown on Drawings No. 553-2, 3 and 4, dat· January, 1931. The drawings indicate that the piers and abutments are supported on timber piles. Because of the competent dense nature of the glacial till, it is believed that these piles must have met practical refusal after penetrating a shallow depth into this stratum. The super-structure is in a poor state of repair - for instance, the concrete is spalling off at an alarming rate. Because of this, major renovation of the existing structure is required; alternatively, a new structure is to be constructed at this crossing.

The profile grade of Hwy. #7, in the vicinity of the structure, is at about elevation 986. The heights of the existing approach embankments are of the order of 16 to 18 feet above existing ground surface. The slopes of the approaches, in the transverse directions, vary between 2:1 and 2-1/2:1; in the longitudinal directions, however, the slopes are 1-1/2:1. The approach fills are performing satisfactorily.

A C.N.R. structure crosses the Grand River at a point south of the Hwy, #7 structure. The structure details of this bridge are not known.

It is understood that the subsoil surrounding the upstream end of those piers located within the Grand River channel have been scoured to some degree by the river. The scour has been particularly severe at the location of the C.N.R. structure.

..... 10

7. DISCUSSION AND RECOMMENDATIONS:

The existing structure at the crossing of Hwy. #7 and the Grand River is in poor condition and as a result of this, reconstruction of a new deck for the existing structure, or entirely new structure north of the present crossing, is proposed. These two schemes are as follows:

i) The first scheme is to replace the deck on the existing structure and to lengthen it by constructing new abutments. A temporary detour structure will be required in this case; this detour is to be located approximately 40 feet north of the existing structure.

ii) The second scheme is to construct a new structure north of the existing one; the present structure could then serve as a detour during the construction period.

The predominant stratum across the site is composed of a 14 to 34 feet thick competent glacial till. The glacial till is overlain by a granular spillway deposit, which is primarily composed of compact to very dense sand and gravel; the thickness of the spillway deposit ranges from 1 to 21 feet being most extensive on the west bank of the Grand River. The overburden is underlain by dolomite bedrock.

The recommendations pertaining to structure foundations, as well as the stability and settlement of the associated approaches, for each of the possible schemes, will be discussed separately in the following sub-sections.

..... 11

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure:

7.1.1) General:

The reconstructed seven-span structure will be 528.5 feet long (an increase of 35 feet); the 38 feet width will not be changed - i.e., it will accommodate 2 lanes of traffic. The profile grade of the highway will remain at about elevation 986; the existing 16 to foot high approach fills will be maintained.

The proposed 5-span (100'-90'-100'-100'-100') temporary detour structure will be located approximately 40 feet north of the existing structure. The detour is to accommodate two lanes of traffic. It is understood that the profile grade across the detour will be about the same as that for the existing structure. This being the case, up to 16 feet of fill will have to be placed along the western approach to the detour.

7.1.2) Foundations - Reconstruction of the Existing Structure:

i) Piers -

Consideration is being given to utilizing the existing timber pile-supported pier foundations. The design drawings of the existing structure indicate that the base of those pier pile caps, located outside of the river channel, are at about elevation 958, whereas those pier pile caps located within the river channel are at approximate elev. 954.

It is our opinion that the existing foundations will not be adequate structurally, to support the additional load imposed by the renovated structure. In view of this, the foundations will have to be reinforced. This could be accomplished by increasing the loaded area - i.e., the size of the foundations.

..... 12

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.2) Foundations - Reconstruction of the Existing Structure: (cont'd.) ...

i) Piers - (cont'd.) ...

One possibility is to found the necessary foundation extensions on spread footings located either in the glacial till (eastern section) or lower, competent portion of the surficial granular spillway deposit (western section). A minimum of 4 feet of earth cover should be provided to the underside of the footings for frost protection purposes. Further, it will be necessary to found those footings, located within or immediately adjacent to the river channel, well below the active scour zone. The subsoil, particularly the upper granular deposits, will be susceptible to scour. It is understood that the Hydrology Section will be submitting, during the final design stage, their recommendations pertaining to scour protection requirements at the individual pier locations.

Taking the aforementioned into consideration, it is recommended that the spread footing-supported extensions could be founded as follows:

Pier No.	Location	Refer to B.H.	Recommended Base of Footing	Footing Located in
1	Sta. 229+10.5	2	Elev. 955	Glacial Till
2	Sta. 230+00	18	Elev. 950	Glacial Till
3	Sta. 230+89.5	17	Elev. 950	Glacial Till
4	Sta. 231+79	7	Elev. 955	Sand and Gravel
5	Sta. 232+68.5	13	Elev. 955	Sand and Gravel
6	Sta. 233+58	9	Elev. 955	Sand and Gravel

Footings founded at these elevations could be designed using an allowable bearing value of up to 5.0 t.s.f.

..... 13

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.2) Foundations - Reconstruction of the Existing Structure: (cont'd.) ...

i) Piers - (cont'd.) ...

The pier footing excavations will extend through basically granular deposits; further, the bases will be located between 9 and 14 feet below the normal river water level. The base of the excavations may boil due to the unbalanced hydrostatic water pressure head; in addition, groundwater seepage can be expected to occur. A positive dewatering scheme will, therefore, be required. One possible scheme would be to carry the excavations out from within a cofferdam composed of interlocking steel sheet piling. If this is adopted, it will be necessary to drive the sheeting to a depth below the excavation bottom equal to the unbalanced hydrostatic water head existing above this level. Because of the dense nature of the overburden deposits, this may prove to be exceedingly difficult.

Settlement of the granular foundation subsoil will take place due to the imposed footing pressure. This settlement will be elastic in nature and negligible in magnitude, provided the subsoil is not loosened by seepage, surface run-off, or construction traffic. In this regard, it is recommended that the base of the footing excavations be covered with a pad of lean concrete, as soon as this level is reached.

According to available information, as an alternative scheme, new piers may be constructed at the location of the existing structure. In such a case, new piers could be supported on caissons founded directly on the surface of the bedrock, or within the glacial till stratum, in order to eliminate the dewatering complications associated with the spread footing scheme. For estimating purposes, it can be assumed that 24 and 30-inch diameter caissons could be designed for allowable loads

..... 14

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.2) Foundations - Reconstruction of the Existing Structure: (cont'd.) ...

i) Piers - (cont'd.) ...

of approximately 150 and 200 tons/caisson, respectively. This Section has been in contact with a number of caisson contractors with regard to the installation of caissons on this site. Detailed recommendations, including allowable loads and tip elevations, are forthcoming.

ii) Abutments -

The abutments, which will be perched in the existing approach fills, can be founded on end-bearing piles driven into the glacial till stratum. For estimating purposes, it can be assumed that the pile tips for the abutments will be as follows:

			Refer to
East Abutment	--	Elev. 955 to 960	B.H. #14
West Abutment	--	Elev. 948 to 950	B.H. #15

Piles founded at these elevations could be designed using the maximum capacity for the particular pile section chosen. For example, 12 BP 74 steel H-piles may be designed for 95 tons/pile. In any case, pile driving during construction, should be controlled by the use of the Hiley Formula as per current D.H.O. Standards.

7.1.3) Foundations - Temporary Detour Structure:

i) Abutments -

The abutments for the detour structure can be supported on timber cribs. The crib for the East abutment will be perched within the existing granular fill, while the West abutment can be

..... 15

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.3) Foundations - Temporary Detour Structure: (cont'd.)

i) Abutments - (cont'd.) ...

located within well compacted new fill. It is recommended that the latter crib be founded directly on an 18-inch thick pad of select granular material. This pad should extend a minimum of 3 feet outside the plan limits of the crib. Cribs founded as described could be designed using an allowable bearing value of 1,000 p.s.f.

The underlying fill and parent subsoil will settle due to the imposed loading. Taking into consideration the magnitude of the loading involved, it is estimated that this settlement will be of the order of 1 inch. This settlement will be elastic in nature - i.e., take place during or immediately following the construction period.

As an alternative, the abutments could be supported on timber piles driven at least 10 feet into the natural subsoil (corresponding to a tip elevation at or below 955). The capacity of the piles would depend on the pile section chosen; a No. 14 timber pile, for instance, could be designed for 25 tons. The underlying soil will settle due to the load transferred by the piles. Because of the dense nature of the subsoil, this settlement will be negligible.

No rock or bouldery fill should be placed in areas where piles are to be driven.

..... 16

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.3) Foundations - Temporary Detour Structure: (cont'd.)

ii) Piers -

Consideration has been given to supporting the piers on timber cribs. This was found to be impractical because of the excessive height that would be required to reach the deck elevation.

The piers should, therefore, be supported on end-bearing piles driven into the competent glacial till stratum. For estimating purposes, the following pile tips can be assumed to attain a safe load of 50 tons for a 12 BP 53 steel H-pile:

*Pier No.	Refer to B.H.	Tip Elevation
A	11	937 to 940
B	12	940 to 945
C	6	942 to 947
D	8	940 to 945

- *Refer to Drawing No. W.O. 71-11013A

The piles should penetrate a minimum of 10 feet into the natural subsoil. Because of the dense nature of the glacial till at Piers A and D, this may be difficult to realize at these locations. If this proves to be the case, then a pre-augering technique could be employed at these locations. The augering should extend at least 8 feet into the natural subsoil, prior to pile driving. Following the pile driving operation, the annular space between the soil and pile section should be filled with a lean concrete or other suitable material.

..... 17

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

7.1) Scheme No. 1 - Renovation of the Existing Structure and Construction of a Temporary Detour Structure: (cont'd.)

7.1.3) Foundations - Temporary Detour Structure: (cont'd.)

ii) Piers - (cont'd.) ...

The base of the pile caps should be founded at an elevation which is compatible with the scour protection requirements at the respective locations.

A temporary dewatering scheme will be required to prevent water from the river flowing into pile cap excavations located within, or in close proximity to the Grand River channel. A relatively impervious dyke, located between the excavation and the river, would be a suitable solution. This dyke could be composed of locally available cohesive soil. Any minor seepage or surface run-off into the excavations could be pumped from sumps.

7.1.4) Approach Fills:

Up to 18 feet of fill will be placed along the west approach to the detour structure. Fills of this height will be inherently stable with respect to a deep-seated foundation failure, provided the temporary slopes are no steeper than 1-1/2:1. The fill will induce settlement in the underlying foundation subsoil. This settlement, which will take place during or immediately following placement, should not exceed 1 inch.

The forward slopes of the fills, in the vicinity of the river channel, should be protected against the scour action of the river.

..... 18

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

7.2) Scheme No. 2 - Construction of New Structure:

7.2.1) General:

The new structure would be located about 40 feet north of the existing one. It will be approximately 40 feet wide and have seven spans (528.5 feet in length). The profile grade of the highway will be at about elevation 986. At this grade between 16 and 18 feet of fill will be required along the west approach, while only a negligible amount will be needed along the east approach.

If this scheme is adopted, the existing structure will be utilized as the detour.

7.2.2) Foundations - New Structure:

i) Piers -

The piers could be founded on spread footings, the most easterly piers would be founded in the glacial till, while the westerly ones would be located in the surficial granular spillway deposit. As discussed in detail in Sub-section 7.1.2), the piers would have to be protected against frost action, and more importantly, the scour action of the Grand River.

The exact location of the piers was not known at the time this report was prepared. Preliminary pier footing elevations are given below for the most likely locations:

Likely Pier Locations	Recommended Base of Footing	Footing Located in
Vicinity B.H. # 2	Elev. 955	Glacial Till
" B.H. #11	Elev. 947	Glacial Till
" B.H. #12	Elev. 950	Sand and Gravel
" B.H. # 6	Elev. 950	Glacial Till
" B.H. #16	Elev. 955	Sand and Gravel
" B.H. # 8	Elev. 955	Sand and Gravel

..... 19

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

7.2) Scheme No. 2 - Construction of New Structure: (cont'd.) ...

7.2.2) Foundations - New Structure: (cont'd.) ...

i) Piers - (cont'd.) ...

Footings founded at these elevations could be designed using an allowable bearing value of up to 5.0 t.s.f.

The footing excavations will extend below the river water level. Major dewatering complications are expected because of: a) the granular nature, and b) the extremely dense composition of the major portion of the subsoil. These aspects were discussed in detail in Sub-section 7.1.2).

As an alternative to spread footing support, the piers could be founded on caissons founded directly on bedrock, or within the glacial till stratum, as discussed in Sub-section 7.1.2).

ii) Abutments -

The abutments, which will be perched in the approach fills, can be founded on end-bearing piles driven into the glacial till, or spillway deposit. For estimating purposes, it can be assumed that the pile tips for the abutments will be as follows:

			Refer to
East Abutment	--	Elev. 955 to 957	B.H. # 1
West Abutment	--	Elev. 948 to 950	B.H. #10

Piles founded at these elevations could be designed using the maximum capacity of the pile section chosen. For example, 12 BP 74 steel H-piles may be designed for 95 tons/pile.

..... 20

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

7.2) Scheme No. 2 - Construction of New Structure: (cont'd.) ...

7.2.3) Approach Fills:

Up to 18 feet of fill will be required along the east approach to the structure. Stability and settlement considerations, pertaining to fills of this order of magnitude placed on the soil types encountered at this site, were discussed in detail in Sub-section 7.1.4).

8. MISCELLANEOUS:

The field work, performed during the period of March 1 to April 14, 1971, was carried out under the immediate supervision of Messrs. W. Hutton, Project Foundation Engineer and J. Weibe, Student Technician (Field).

The equipment was owned and operated by Dominion Soil Investigation Ltd., Toronto.

This report was written by Mr. B. T. Darch, Senior Foundation Engineer. The entire project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

April, 1971

APPENDIX I

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 104 + 19 Ø Detour 20' Rt. ORIGINATED BY WH
W.P. 194-63 BORING DATE Feb. 24, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE Washboring, NX & BX Casing, Bi Cone Bit, AXT Core CHECKED BY

Cone Test

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
984.5	Ground Level					
0.0	Fill Material					
	Sandy silt to silty sand, trace of gravel & clay, occasional organic inclusiona (¼" thick)		1	SS	8	980
			2	SS	6	
			3	TW	PM	
			4	SS	15	
	Loose to Compact Brown		5	SS	9	970
966.5						
18.0	Sand & Gravel. Dense		6	SS	48	
20.0	Glacial Till Het. mixture of silt, sand & gravel, trace of clay.		7	SS	100/7"	
			8	SS	50/3"	
			9	SS	90/6"	960
	Very Dense		10	SS	100/6"	
950.5	Reddish Brown					
34.0			11	SS	110/4"	950
	Het. mixture of clayey silt, sand & gravel		12	SS	150/2"	
	Hard		13	SS	90/6"	940
	Grey		14	SS	155/11"	
930.5						
54.0	Dolomite Bedrock (Fractured)		15	AXT	7%	930
925.5						
59.0	End of Borehole					
						920

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE
400 800 1200 1600 2000
+s7
100/5"

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

BULK DENSITY γ P.C.F.

REMARKS — GR. SA. SI. CL.

Hole caved at el 976.5 Mar. 9/71
8 31 58 3
Feb. 26/71 ▼ 966.0
45 34 18 3
38 38 19 5
39 29 28 4
4 35 45 16

20
15 ⊹ 5 % STRAIN AT FAILURE
10

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB	71-F-1013	LOCATION Sta. 229 + 23 ℄ Hwy. 7 o/s 30' Rt.	ORIGINATED BY WH
W.P.	194-63	BORING DATE March 1, 1971	COMPILED BY HR
DATUM Geodetic		BOREHOLE TYPE NX, BX Casing, Bicone Bit	CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
967.0	Ground Level					
0.0	Sand & gravel, layers of sandy silt (6" thick).					
962.0	Very Dense. Brown		1	SS	95	
5.0	Glacial Till					
	Het.mix.of silt, sand & gravel, trace of clay.		2	SS	155/11"	960
			3	SS	125	
			4	SS	170/11"	
952.0	Very Dense. Reddish Brown					
15.0			5	SS	155/9"	
	Het.mix.of clayey silt sand and gravel		6	SS	160/6"	950
			7	SS	150/3"	
	Hard					940
936.2	Grey		8	SS	100/9"	
30.8	End of Borehole					930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

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

100/4"

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

w_p w w_L

WATER CONTENT %
10 20 30

○ 25 31 34 10
○ 9 37 44 10
○ 5 20 59 16

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	▼ 964.5 Mar. 2/71
	25 31 34 10
	9 37 44 10
	5 20 59 16

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB	71-21013	LOCATION Sta. 229 + 75 ℄ Hwy. 7 o/s 24' Rt.	ORIGINATED BY WH
W.P.	194-63	BORING DATE March 2, 1971	COMPILED BY HR
DATUM	Geodetic	BOREHOLE TYPE NX & HX Casing, Bicone & Tricone Bits	CHECKED BY [illegible]

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
965.4	Ice Level					
963.9	Ice					
1.5						
960.4	Water					
5.0	Sand and gravel		1	SS	76	960
6.0	Glacial Till					
	Het.mix.of silt,sand & gravel, trace of clay		2	SS	105/8"	
			3	SS	162	
	Very Dense		4	SS	150	950
948.4	Reddish Brown					
17.0			5	SS	150/4"	
	Het.mix.of clayey silt sand and gravel		6	SS	150/5"	
			7	SS	100/1"	940
	Hard					
934.4	Grey		8	SS	167	
31.0	End of Borehole					
						930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

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

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

w_p w w_L

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR.	SA.	SI.	CL.
	38	25	28	9
	5	22	50	23

FORM DE [illegible] 26 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

[illegible]-11013	LOCATION Sta. 104 + 85 ℄ Detour 18' Rt.	ORIGINATED BY	WH
[illegible]94-63	BORING DATE March 3 & 4 1971	COMPILED BY	HR
DATUM Geodetic	BOREHOLE TYPE NX & BX Casing, BiCone Bit, AXT Core	CHECKED BY	

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L — PLASTIC LIMIT w_p — WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
965.4	Ice Level									
963.9	Ice									
1.5										
960.4	Water									
3.0	Sand and Gravel		1	SS	69	960				
5.8	Glacial Till		2	SS	200/11"					16 31 44 9
	Het.mix.of silt,sand & gravel, trace of clay.		3	SS	125					
	Very Dense									
948.4	Reddish Brown		4	SS	185	950				
			5	SS	130/6"					
17.0										
	Het.mix.of clayey silt, sand & gravel.		6	SS	150/6"					8 41 41 10
			7	SS	150/6"	940				
	Hard		8	SS	135/6"					0 9 70 21
	Grey									
930.4			9	SS	150/0"	930				
35.0	Bedrock - sandy									
927.9	dolomite. Sound		10	AXT	5%					
37.5	End of Borehole									
						920				

FORM 08-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 72-1013 LOCATION Sta. 106 + 68 ℄ Detour 14' Lt. ORIGINATED BY JW
W P 324-63 BORING DATE March 18, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Bi & Tri Cone Bits, Cone Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS/FOOT	REMARKS GR. SA. SI. CL.
963.9	Ice Level					
	Ice					
961.0	Water					
3.0	Sand & gravel, trace of silt. Compact to Very Dense.		1	SS	36	
			2	SS	12	
953.0	Black		3	SS	77	
10.9	Uniform sand					
950.4	Very Dense Brown		4	SS	88	
13.5	Glacial Till Het.mix.of silt, sand & gravel. V.Dense. Reddish		5	SS	166	0 76 (24) 42 46 (12)
946.0	Brown		6	SS	126/8"	
17.9	Het.mix.of clayey silt sand & gravel		7	SS	150/8"	9 32 49 10
			8	SS	125/5"	
	Hard			SS	150/3"	
932.0	Grey		9	SS	105/5"	
31.9	End of Borehole Probable Bedrock					

ELEV. SCALE: 960, 950, 940, 930

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

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

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

BULK DENSITY γ P.C.F.

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 107 + 19 ℄ Detour 20' Rt. ORIGINATED BY HW
W P 194-63 BORING DATE March 19, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Tri & Bi Cone Bits, AXT Core, Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT
968.0	Ground Level				
0.0	Traces of Organic Silt				
964.0			1	SS	18
4.0	Sand & Gravel		2	SS	14
	Loose to Compact			SS	7
			3	SS	6
953.0	Brown		4	SS	8
15.0	Glacial Till Het.mix.of silt,sand & gravel.		5	SS	83
948.0	Very Dense Brown		6	SS	155/11"
20.0	Het.mix.clayey silt, sand and gravel.		7	SS	156/8"
			8	SS	152/8"
	Hard		9	SS	155/8"
932.5	Grey			SS	100/8"
35.5	Bedrock - Dolomite Pitted in upper 18"		10	AXT	80%
928.0	Sound				
40.0	End of Borehole				

ELEV SCALE: 960, 950, 940, 930, 920

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

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

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

WATER CONTENT %: 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

964. ▼

51 45 (4)

47 42 (11)

5 30 55 10

GR. SA. SI. CL.

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6A

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 107 + 19 Ø Detour 20' Lt. ORIGINATED BY J.W.

W P 194-63 BORING DATE March 22, 1971 COMPILED BY HR

DATUM Geodetic BOREHOLE TYPE Dynamic Cone Test CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L / STIC LIMIT w_p / ATER CONTENT w / w_p w w_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
968.5	Ground Level									
0.0	Probably Sand & Gravel					960				
957.0										
953.5	Probably Glacial Till									
15.0	End of Cone Test					950				

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 231 + 91 ℄ Hwy. 7 o/s 19' Lt. ORIGINATED BY JW

W P 194-63 BORING DATE March 16, 1971 COMPILED BY HR

DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Tri & Bi Cone Bits, AXT Core, Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT
967.0	Ground Level				
	Sandy silt, trace of shells.				
962.5	Very Loose Brown		1	SS	2
4.5	Sand & gravel, trace of silt. Compact to Very Dense Grey		2	SS	10
			3	SS	64
	Uniform Sand		4	SS	112
951.5	Very Dense Brown		5	SS	153/10"
15.5	Glacial Till Het.mix.silt,sand and gravel,trace of clay.		6	SS	185
946.0	Very Dense. Brown		7	SS	123/5"
21.0	Het.mix. of clayey silt, sand & gravel.		8	SS	150/4"
			9	SS	150/6"
933.0	Hard Grey				
34.0	Bedrock Pitted Dolomite		10	AXT	35%
929.0	Fractured. Grey				
38.0	Shaley Dolomite		11	AXT	35%
925.0	Fractured Grey				
42.0	End of Borehole				

ELEV. SCALE: 960, 950, 940, 930, 920

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

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

100.9"

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR.	SA.	SI.	CL.
964.0 ▼ Mar. 23/71				
	0	59	35	6
	50	40	(10)	
	2	81	(17)	
	7	25	53	15

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 108 + 19 ℄ Detour 14' Lt. ORIGINATED BY JW
W P 104-63 BORING DATE March 22, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Tri & Bi Cone, Cone CHECKED BY

ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
964.0	Ground Level					
0.0	Traces of organic silt					
958.0	Compact Black		1	SS	23	960
6.0	Sand & gravel		2	SS	76	
			3	SS	79/9"	
	Very Dense Brown		4	SS	79	950
948.0						
16.0	Het.mix.silt,sand and gravel.Very Dense.Brown		5	SS	135	
945.0						
19.0	Glacial Till		6	SS	150/4"	
	Het.mix.of clayey silt Sand and gravel		7	AXT		940
			8	SS	160/6"	
	Hard					
932.5	Grey		9	SS	100/6"	
31.5	End of Borehole Probable Bedrock					930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P S F
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

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

BULK DENSITY γ P.C.F.

REMARKS	GR	SA	SI	CL
▼ 962.7 Mar.22/71				
	54	39	(7)	
	50	39	(11)	
	13	35	41	11

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 233 + 46 ℄ Hwy. 7 o/s 2' Rt. ORIGINATED BY JW
W.P 194-73 BORING DATE March 15, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, Tri & Bi Cone Bits, Dynamic Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100	LIQUID LIMIT w_L / PLASTIC LIMIT w_p / WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
964.3	Top of Ice									
962.8	Ice									
1.5	Fill material-Clayey silt with sand & grav.									
959.3	Very Dense. Grey		1	SS	70	960		o		
5.0	Sand and gravel		2	SS	52					
952.8	Very Dense Brown		3	SS	82		115/10"			66 27 (7)
13.5	Layers of clayey silt up to 4" thick		4	SS	170/11"					
948.8	Glacial Till		5	SS	150	950				
15.5	Het.mix.silt,sand & gravel,trace of clay		6	SS	185/8"			o ⊢		8 39 41 12
943.8	V.Dense. Reddish Brown		7	SS	135/7"					
20.5	Het.mix.of clayey silt sand and gravel Hard		8	SS	153/11"	940		o ⊢		7 20 53 20
933.5	Grey		9	SS	345/10"					
30.8	End of Borehole Probable Bedrock					930				

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

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 109 + 10 ℄ Detour 18' Rt. ORIGINATED BY JW
W P 194-63 BORING DATE March 23, 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX Casing, Tri & Bi Cone Bits. BXT Core, Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT
969.0	Ground Level				
965.0	Traces of organic silt		1	SS	24
4.0	Sand and gravel some gilt		2	SS	69
	Compact to Very Dense		3	SS	84
			4	SS	130
952.5	Brown		5	SS	60
16.5	Layers of uniform sand up to 8" thick		6	SS	154
948.0					
21.0	Glacial Till Het.mix.silt,sand and gravel.Very Dense.		7	SS	140/4"
943.5	Brown		8	SS	150/5"
25.5	Het.mix.clayey silt, sand and gravel occasional boulders up to 12" in size throughout		9	SS	100/1"
			10	BX	50%
932.0	Hard Grey		11	BX	17%
931.0	Bedrock Dolomite		12	BX	
38.0	End of Borehole				

ELEV. SCALE: 960, 950, 940, 930, 920

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

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

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

w_p w w_L

WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

965.0 ▼ Mar.29/71

50 38 (12)

56 37 (7)

9 39 40 12

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 105 + 18 ℄ Detour o/s 12' Lt. ORIGINATED BY JW
W.P 194-63 BORING DATE March 31, April 1 , 1971 COMPILED BY WH
DATUM Geodetic BOREHOLE TYPE Diamond Drill - Washboring CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
964.0	Water Level					
0.0	Water					
959.0						960
5.0	Sand and Gravel Very Dense Brown		1	SS	161	
958.5	Glacial Till		2	SS	83	
7.5	Het.mix.silt,sand and gravel, trace of clay Very Dense Reddish Brown		3	SS	150	
950.5			4	SS	30/3"	950
13.5	Het.mix. clayey silt, sand & gravel occ. boulders up to 16" in size below el. 943. Hard Grey		5	SS	150/4"	
			6	SS	150/5"	
			7A	BX	-	
			7	SS	125/6"	940
			8	BX	5%	
933.5			9	BX	-	
30.5	End of Borehole Probable Bedrock					930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

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

BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL.
Artesian Head Encountered

FORM OB-MT 126 (REV 1969)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 71-1101J | LOCATION Sta. 106 + 19 Ø Detour o/s 20' Rt. | ORIGINATED BY JW
W.P 134-63 | BORING DATE March 30 - 31, 1971 | COMPILED BY WH
DATUM Geodetic | BOREHOLE TYPE Diamond Drill - Washboring | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE
964.0	Water Level					
0.0						
960.7	Water					
3.3	Sand & Gravel Some silt		1	SS	60	960
			2	SS	36	
			3	SS	32	
	Dense to Very Dense		4	WS	-	
			5	SS	142	950
948.2	Brown					
15.8	Glacial Till		6	SS	190/9"	
			7	SS	150/3"	
	Het.mix.of clayey silt, sand & gravel		8	BX	25%	
			9	SS	-	940
	occ. boulders up to 4" in size					
934.0	Hard Grey		10A	SS	159/5"	
932.9	Bedrock Dolomite		10	BX	80%	
31.1	End of Borehole					930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH PSF
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

100/8"

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w

w_P w w_L

WATER CONTENT % 10 20 30

o

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 232 + 74 ℄ Hwy 7 o/s 21' LT ORIGINATED BY JW
W P 194-63 BORING DATE April 5 - 6, 1971 COMPILED BY WH
DATUM Geodetic BOREHOLE TYPE Diamond Drill - Washboring CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
968.0	**Ground Level**					
0.0	Sandy Silt - Traces					
965.0	of Organic Silt					
3.0			1	SS	12	
	Sand & Gravel					
	Trace of White Shells		2	SS	1	960
	Very Loose to Compact					
			3	SS	16	
			4	SS	-	
953.5	Brown					
14.5	Uniform Sand. Trace		5	SS	115	
	of Gravel					950
			6	SS	108	
947.0	Very Dense Brown		7	SS	150/4"	
21.0	Glacial Till					
	Het.mix.of silt,sand					
943.0	and gravel Trace of clay Very Dense		8	SS	150/6"	
25.0	Het.mix.of Clayey					
	Silt. Sand & Gravel					940
938.0	Hard Grey		9	SS	130/6"	
30.0	End of Borehole					
						930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

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

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

w_p w w_L
WATER CONTENT %

BULK DENSITY γ P C F

REMARKS
GR SA SI CL
EL. 965

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 228 + 67 ℄ Hwy. 7, 25'LT ORIGINATED BY WH
W.P. 194-63 BORING DATE 4,5,8 & 9 March 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, HI & Tricone BIT, AXT CORE CONE PENETRATION CHECKED BY AL

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
986.3	Ground Level					
0.0	Fill Material					
			1	SS	14	
	Sand & Gravel, Some Silt		2	SS	11	980
			3	SS	15	
	Compact to Dense		4	SS	15	
971.3	Brown					
15.0	Sand & Gravel		5	SS	42	970
	Dense to Very Dense		6A	SS	107	
965.3	Brown		6	SS	56	
21.0	Glacial Till					
	Het.mix. of silt, sand & gravel, trace of clay		7	SS	174/10"	960
	Very Dense		8	SS	151	
950.8	Reddish Brown		9	SS	205/10"	950
35.5	Het.Mix. of Clayey, Silt, Sand & Gravel		10	SS	200/4"	
			11A	SS	200/5"	
	Hard		11	SS	155/6"	940
			12	SS	220/1"	
	Grey		13A	SS	100/1"	
934.5			13	AXT RC.	67%	
51.8	Bedrock-Dolomite Chertified Layers up to 2" thick		14	RC.	100%	
			15	RC.	100%	930
927.6	Sound Grey		16	RC.	80%	
58.7	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

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

100/8"

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

WATER CONTENT % — 10 20 30

○ n.p.

BULK DENSITY γ P.C.F.

REMARKS	GR.SA.SI.CL.
	41,40,18,1
▼ 968.5 Mar.9/71	
	33,29,30,8
	7,32,49,1
	26,16,47,1

% STRAIN AT FAILURE
20
15 5
10

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 15

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 234 + 05 26' RT ORIGINATED BY WH
W.P. 194-63 BORING DATE 10,11 & 12 March 1971 COMPILED BY HR
DATUM Geodetic BOREHOLE TYPE NX & BX Casing, TRI & BI Cone Bits, Axt Core DYNAMIC CONE PENETRATION CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
986.6	Ground Level									
	Fill Material		1	SS	16					
	Sand & Gravel, Trace of Silt		2	SS	8	980				37 50 (13)
	Loose to Compact		3	SS	15					
			4	SS	14					
			5	SS	11	970				45 46 (9)
968.6 18.0	Brown to Grey Sand & Gravel Trace of Silt		6	SS	39					▼57,33,9,3
			7	SS	145/11"		160	○		WL 966.5 March 15/71
			8	SS	107	960		○		46 40 13 1
958.6 28.0	Dense to Very Dense Clayey Silt, Trace of Sand & Gr.									
955.1 31.5	Hard Reddish Brown Occ Clayey Silt Layers up to ½" thick		9	SS	46			⊖		
	Grey		10	SS	141/9"	950				
949.6 37.0	Het.Mix. of silt sand & gr.Trace of clay		11	SS	200			○ H		17 48 31 4
946.6 40.0	Very dense-Reddish Brn. Glacial Till		12	SS	205/10"			○ ⊖		9 35 40 16
	Het.Mix.of Clayey Silt,Sand&Gravel		13	RC	28%Rec					
			14	SS	197/9"					
	Boulder 6" in size at Elev.943		15	SS	150/6"	940				
			16	SS	195/11"			○ ⊖		5 32 49 14
934.6 52.0	Hard Grey Bedrock - Dolomite Ditted in Upper 2ft.		17	AXT RC	85%					
930.1 56.5	Sound Grey End of Borehole					930				
						920				

15 20 10 5 % STRAIN AT FAILURE

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 16

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 108 + 02 ℄ Detour o/s 23' RT ORIGINATED BY JDW
W.P. 194-63-00 BORING DATE April 7 - 8, 1971 COMPILED BY JDW
DATUM Geodetic BOREHOLE TYPE Diamond Drill - BX WASHBORING CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
971.0	**Ground Level**					
0.0	**Silty sand to sand and gravel, trace silt Loose**		1	SS	7	970
963.0	**Brown**		2	SS	7	
8.0	**Pockets-Grey Sandy Silt**					
961.0			3	SS	23	960
10.0	**Sand & gravel, trace silt. Compact to very dense**		4	SS	47	
955.5	**Uniform sand**		5	SS	55	
953.0	**Brown**		6	SS	81	
18.0	**Glacial Till Het.mix.silt,sand&gr.**		7	SS	145	950
	Very dense					
945.5	**Brownish**		8	SS	160/9"	
25.5	**Het.mix.clayey silt, sand & gravel**		9	SS	140/8"	
			10	SS	170/7"	940
	Hard		11	SS	125	
932.0	**Grey**					
39.0	**Probable Bedrock End of Borehole**					930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

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

100/6"

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

w_p w w_L

WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL.

968

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 17

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 230 + 99 ℄ Hwy. 7 o/s 19' RT ORIGINATED BY JDW
W P 194-63 BORING DATE April 12-13, 1971 COMPILED BY JDW
DATUM Geodetic BOREHOLE TYPE Diamond Drill - BX WASHBORING CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w / w_P w w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
968.0	Water Level Apr 12/71									
						960				
956.0	River Bottom									
955.0	Sand & Gravel Brown Silty sand to sand & gravel, some silt. Dense to very dense.		1	SS	52					
			2	SS	89	950				
949.0	Red to Brown Glacial Till Het.mix.clayey silt, sand and gravel Hard		3	SS	111		100/12"			
			4	SS	150/7"					
			5	SS	150/6"					
940.7	Grey		6	SS	150/3"	940				
27.3	End of Borehole.									

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 18

FOUNDATION SECTION

JOB 71-11013 LOCATION Sta. 230 + 08 ℄ Hwy.7 o/s 19'RT ORIGINATED BY JDW
W P 194-63 BORING DATE April 13 - 14, 1971 COMPILED BY JDW
DATUM Geodetic BOREHOLE TYPE Diamond Drill - BK WASHBORING CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
969.0	Water Level Apr 13/71					
						960
954.0	River Bottom					
953.0	Silt to Sand & Gravel Very Dense - Brown Glacial Till Het.mix.silt,sand & gra.Trace of clay		1	SS	56	
			2	BRT	30"	
			3	SS	140	950
948.0	Very Dense - Red Het.mix.clayey silt, sand and gravel		4	SS	150/9"	
			5	SS	150/4"	
	Hard		6	SS	150/5"	940
938.4	Grey		7	SS	150/7"	
30.6	End of Borehole.					
						930

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

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

100/8"

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w

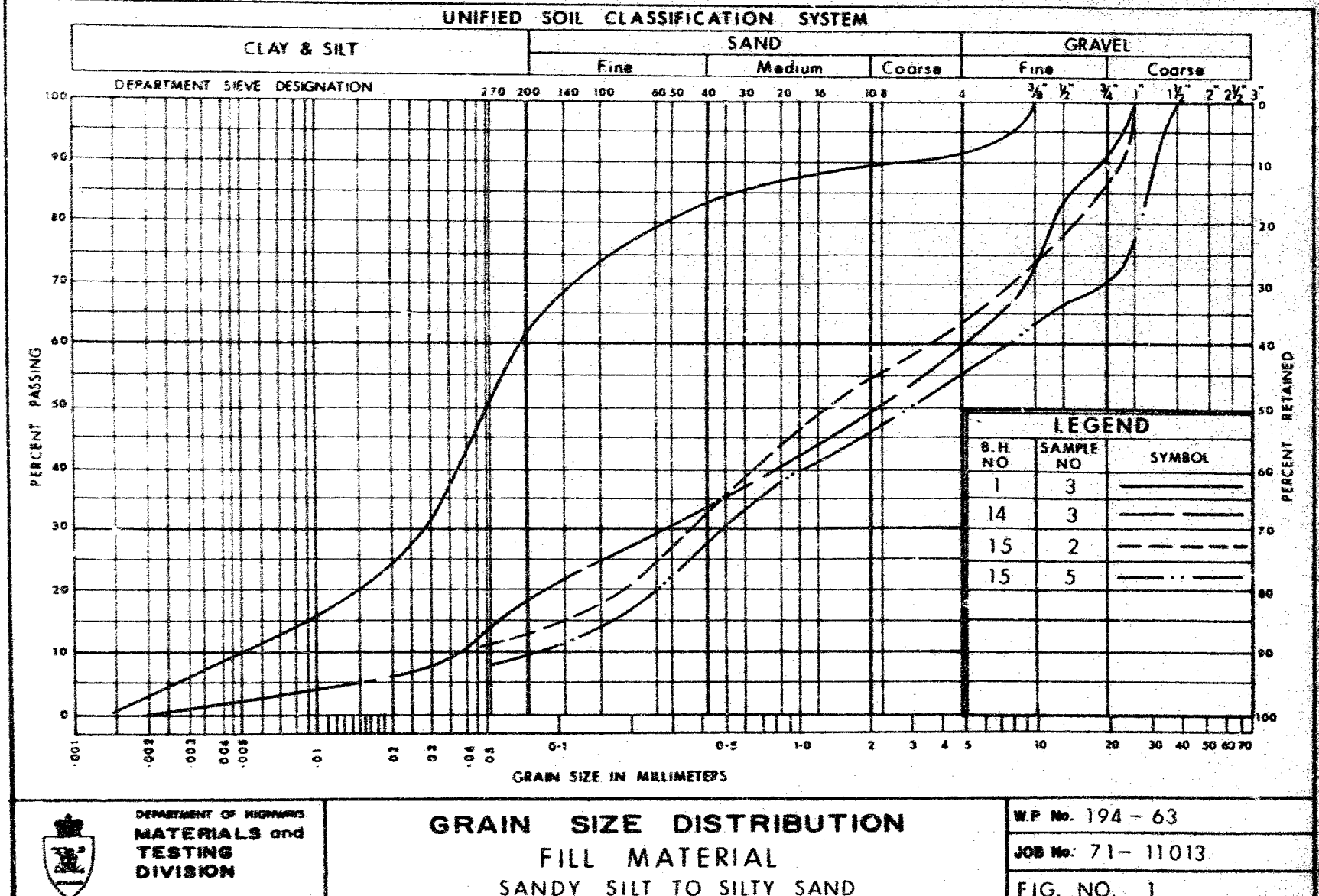
w_P w w_L

WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL.

FORM OB MT - 17
REV. APR 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

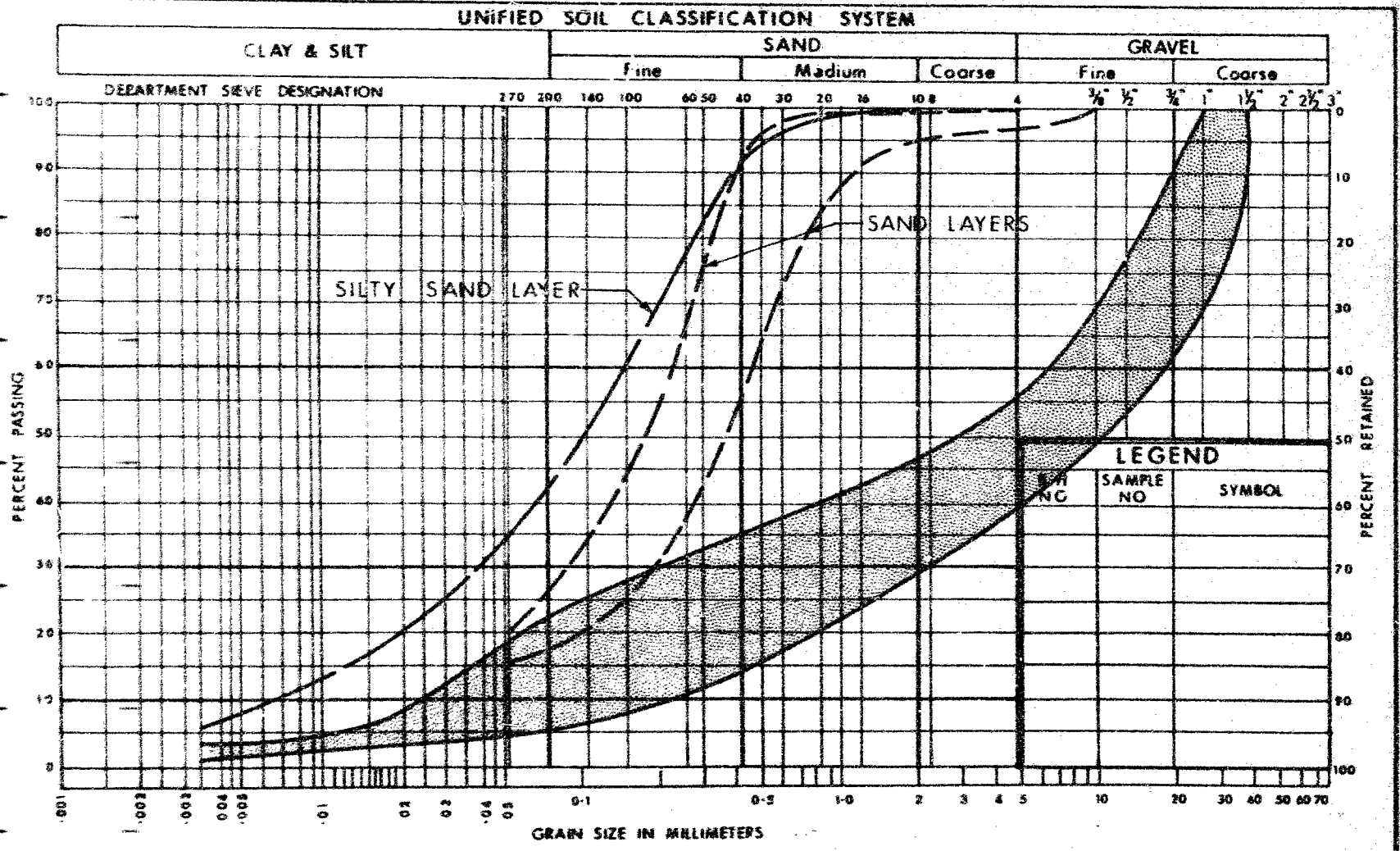
FILL MATERIAL

SANDY SILT TO SILTY SAND

W.P. No. 194 – 63

JOB No: 71– 11013

FIG. NO. 1



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

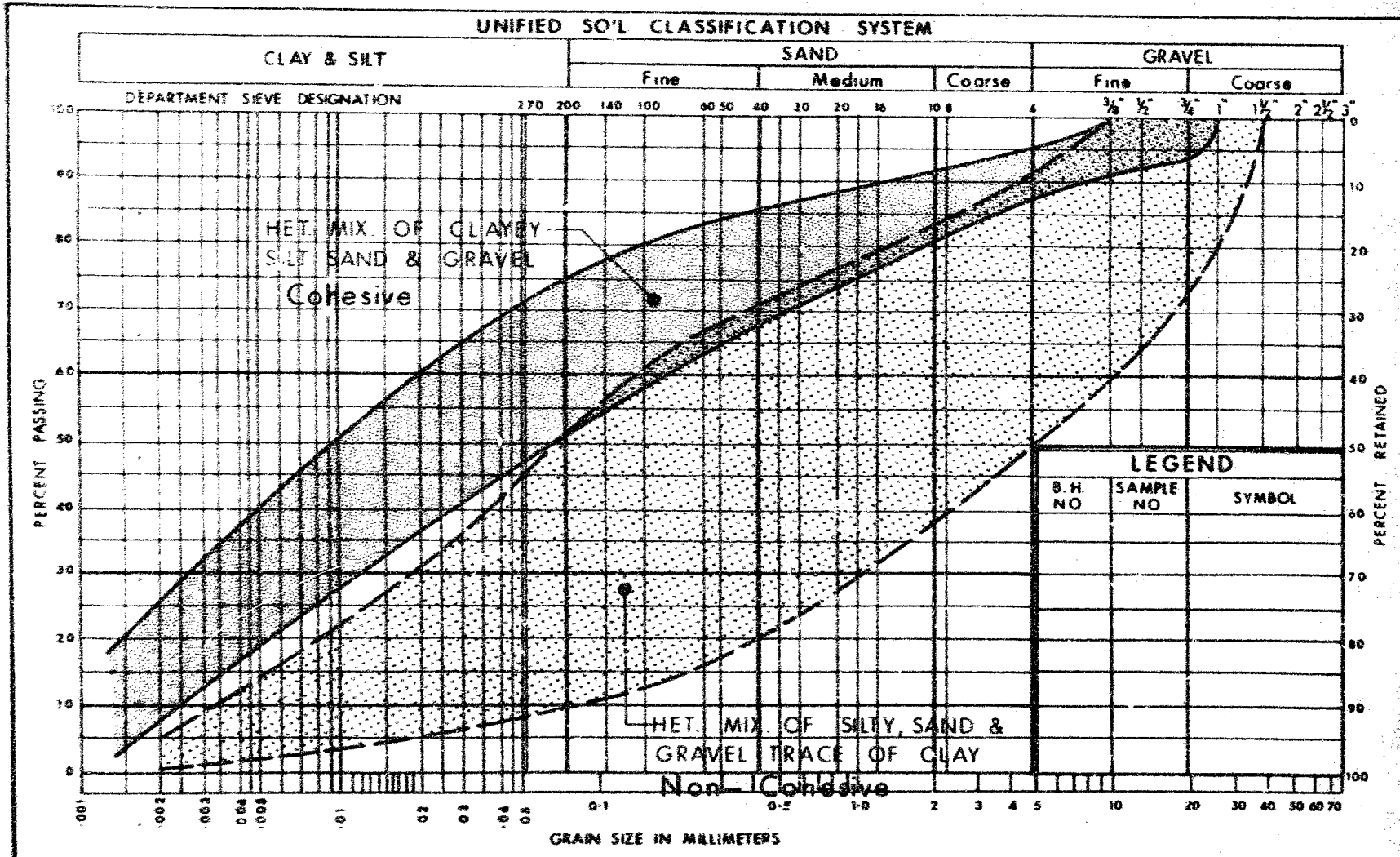
SAND & GRAVEL

W.P. No. 194 – 63

JOB No: 71-11013

FIG. NO. 2

FORM 06 MT - 17
REV. APR 1983



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

GLACIAL TILL

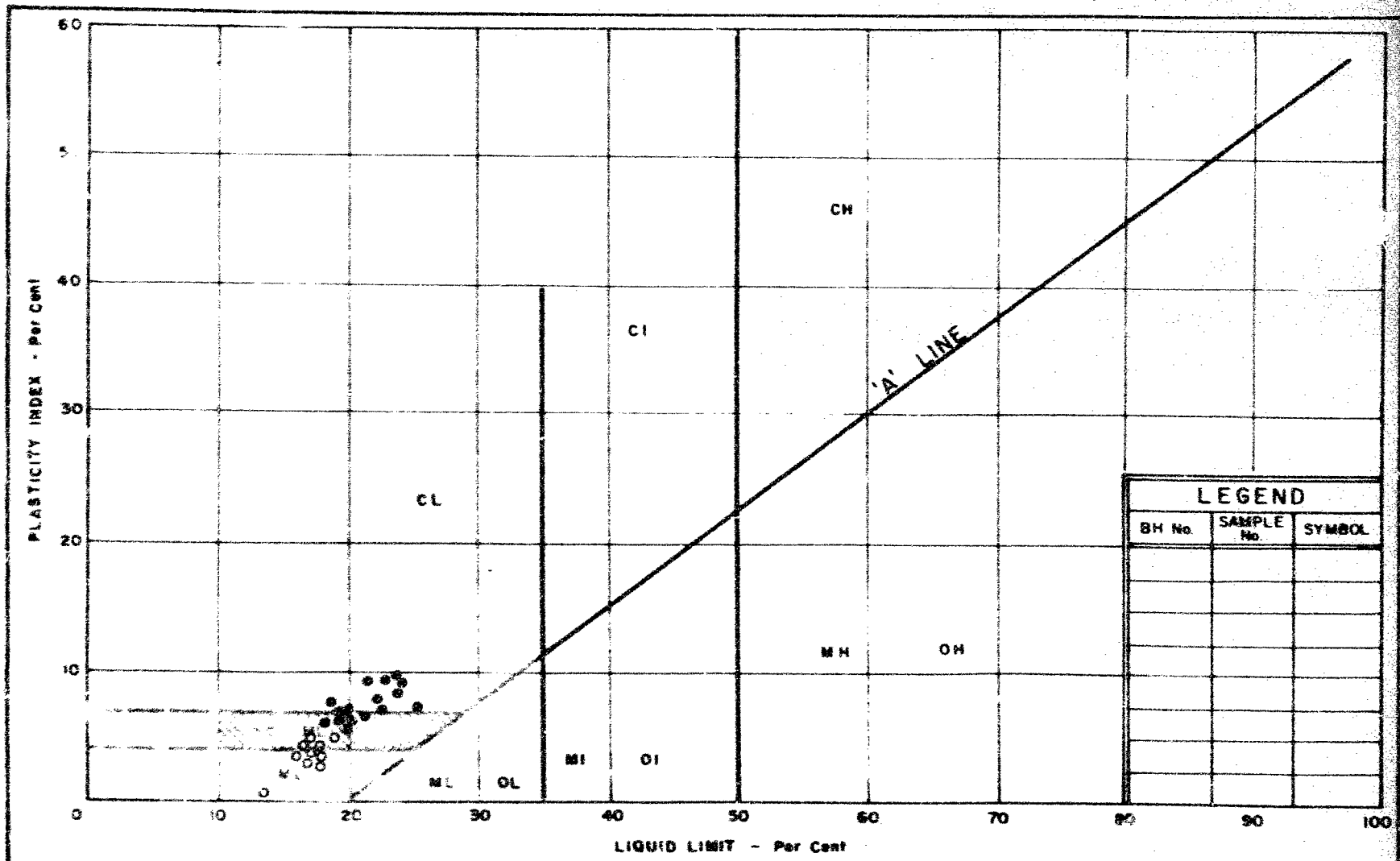
W.P. No. 194 - 63

JOB No: 71 - 11013

FIG. NO. 3

FORM 08-MT-252

REVISED JU[illegible] 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

GLACIAL TILL

● COHESIVE o NON - COHESIVE

W.P. No. 194 - 63

JOB No. 71 - 11013

FIG. NO. 4

SUMMARY OF PILE DRIVING RECORDS

W.O. 71-11013 W.P. 194-63-00 CONT. 72-13 DIST. 3

SITE GRAND RIV & HWY #7

DATE DRIVEN JUNE 13-15 /72 WEIGHT OF ANVIL 1100 LBS.

HAMMER TYPE B-225 WEIGHT ______ ENERGY 85,000 ft.LBS.

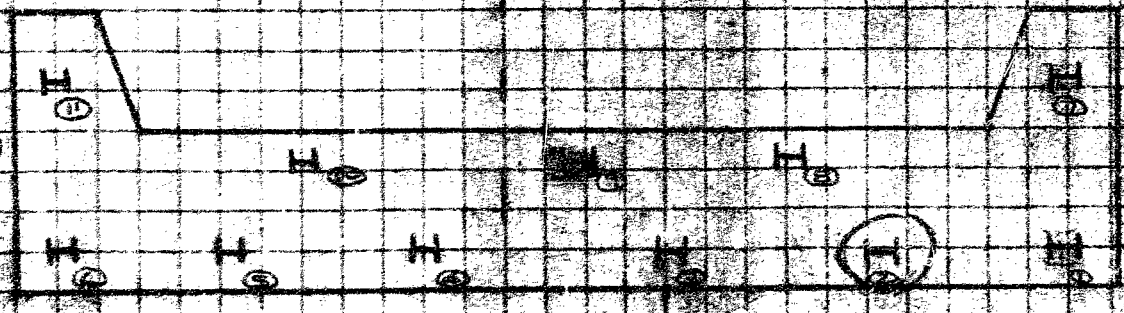
LOCATION OF PILES	PILE				ESTIMATED TIP EL. (ft.)	DIFFERENCE Longer(+) Shorter(-) Than Estimated (ft.)	REMARKS
	TYPE	NO.	LENGTH (ft)	TIP EL. (ft.)			
WEST ABUTMENT	12-BP-74	7	30	944	948-950	+ 4.0	DRIVEN TO GLACIAL TILL
EAST -"-	-"-	7	23	950.5	955-957	+ 4.5	

CONT 72-13 HWY #7

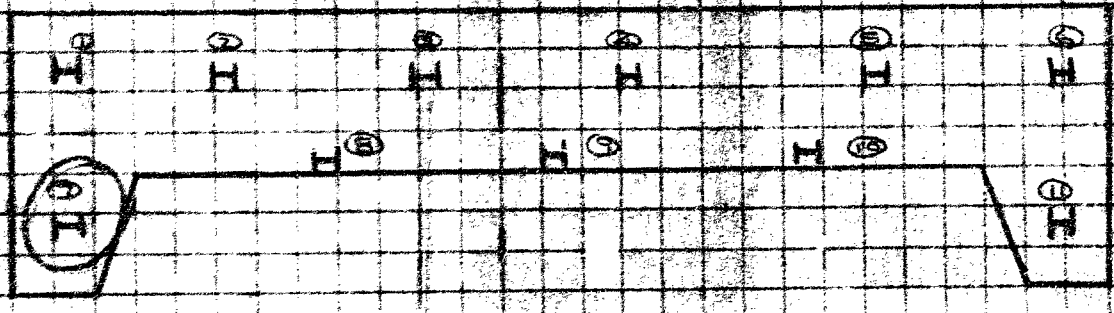
GRAND RIVER BRIDGE

PILE DRIVING NUMBER SYSTEM

WEST ABUTMENT



EAST ABUTMENT



P. [illegible]
Construction Engineer
[illegible] Stratford

Foundations Office, West Bldg.
Design Services Branch

March 19, 1973

Pile Driving Record
Contract No. 72-13

70-11-013

Attached please find the pile driving record of Pile #7 at the East Abutment of the Grand River Structure (Cont. 72-13) which you previously submitted to our office.

You will note that the final length of pile is missing in the record, and without this information we are unable to compute the pile tip elevation.

Would you please instruct your Mr. Payne, who was in charge of compiling the report, to fill out the missing data.

Please resubmit the completed record at your earliest convenience.

Thank you very much.

A K B

AKB/AS/mt

A. K. Barsvary
Office Engineer

for: A. G. Stermac
Principal Foundation Engineer

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. K. Barsvary,
Office Engineer,
Design Services Branch,
M.T.C., DOWNSVIEW.

ATTENTION:

FROM: District #3,
STRATFORD, Ontario.

DATE: March 21, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT: Re: Pile Driving Record - Contract 72-13.

In reply to your letter of March 19, 1973, the final length of Pile #7 in the east abutment is 23.0 L.F.

Attached is the completed pile driving record form.

P. H. Peacock,
Dist. Construction Engineer,
For:
W. D. Neilipovitz,
District Engineer.

PHP:EBU:th
Attachment

file H43

Mr. F.E. Peacock,
District Construction Engineer,
Stratford.

Construction Branch,
Operations Division,
3rd Floor, Central Bldg.

June 16, 1972.

Contract 72-13, Grand River at Breslau,
Site 33-100, Hwy. 7, District 3. 71-11-013

This memo will confirm discussions and recommendations made during my visit to the above site on Tuesday, June 13th.

The contractor was driving piles in the west abutment and the resistance was much less than had been anticipated. One pile was driven full length while I was there and the penetration over the last 12 inches was approximately 5 blows/inch with a rebound of 1/4 inch. The contractor was using a Kerninghammer B225, and the Hiley Formula gives an ultimate load of 240 tons. On the design load of 95 tons this gives a factor of safety of 2.53 which is less than the 3 which we usually obtain. On discussing this with Mr. A. Stermac, Principal Foundations Engineer, we concluded that this would be satisfactory. The piles are driven into the very dense layer overlying the bedrock, and if spliced would probably drive only a few feet farther before a factor of safety of 3 would be reached. Therefore, the field staff were instructed that provided the penetration did not go below 5 blows per inch with 1/4 inch rebound the piles could be driven to cut-off and left.

A. F. McKim,
Assistant Construction Engineer,
-Structures-

AFMcK/ml
cc: Messrs. C.S. Crebski,
A.G. Stermac.

Note

Al [illegible] phoned and advised that piles according to the Hiley formula have a factor of safety of only about 2.5 for 95T/pile

Tip elevation is around 944. Driving is 5-6 blows/inch with about ~~a~~ 1/4 inch rebound. These piles are on the west abutment

The subsoil is very dense and I told [illegible] that we are not worried and that a F.S. of 2.5 is adequate

He accepted my statement and is to advise the Contractor that everything is O.K. The piles are H BP74 30 feet long If further driving would be required the piles would have to be spliced

June 13/72

[signature]

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

Feb 3rd 1972

MEMORANDUM

TO: Mr. D.W. Farren,
Director,
Systems Design Branch,
E. Bldg., Downsview.

ATTENTION: J.R. Wear

FROM: Mr. P. Bryar,
Sr. Project Design Engineer,
Road Design Office,
London Region.

DATE: February 1, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: W.P. 194-63-01, Structure and Approaches,
Grand River Bridge at Bresleau, Hwy. #7,
District #3 - Stratford.

71-11-013

Under separate cover I enclose one set of prints and original contract drawings for the above project, together with calculations and documents.

The west abutment of the proposed structure is east of the old abutment and an extension of the approaches is required. This work requires earth borrow since material from the detour is not available until completion of the new structure and approaches.

Detour fill material is required on the east bank to backfill the detour cut and surplus material is regraded to flatten the north side slopes of the west approach. This work was originally set up as equipment rental due to differing nature of the two operations. At the request of the District this work now shows as an earth cut and fill requirement.

No Granular 'B' is required for the approach work; therefore, Granular 'A' has been used as structure backfill and frost treatment. Due to a plentiful commercial supply of Granular 'A' in the area this requirement has been measured in tons rather than cubic yards despite the small quantity involved.

The long Bailey Bridge detour has steel pile bents in the river and a special provision is included to cover their removal.

Other special provisions are included to cover the removal of the sidewalk on the Bailey Bridge, salvage of guide rail on approaches and saw cutting of pavement on the east approach as recommended by the Traffic Office. Full depth saw cutting was requested by the District Office.

Contact has been made with the Department of Energy & Resources Management regarding the use of Special Provision #7043. You will be informed once a reply is received.

P. Bryar,
Sr. Project Design Engineer.

PB/cp

c.c. B. Giroux
W. Zonnenberg
W. Neilipovitz
A. Crowley
A. G. Stermac
M. Stoyanoff

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Foundation Office,
Central Building.

FROM: Structural Office,
West Building.

ATTENTION:

DATE: October 28, 1971.

OUR FILE REF.

IN REPLY TO

SUBJECT: Grand River Bridge,
0.3 Miles West of Breslau,
W.P. #194-63-02, Site #33-100,
Highway #7, District #3.

71-11-013

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,
Structural Design Engineer.

CSG/mh
ENCL*
cc: Foundation Office.

horizontal distance between the existing and proposed spread footings is only 2 ft. This will require an almost vertical cut in sand, which may be as much as 18 ft at its maximum

2. At the east abutment location, the existing pier will be demolished, because it is in the way of the proposed abutment. At the location of the west abutment there is an existing pier which is only 3 ft away from the proposed abutment. It is quite possible that the buried dimensions of the footing could be in error by a foot or two. At the same time the pier may be out of its intended alignment by a foot or so. In that case the existing footing <u>may</u> become an obstruction. Therefore, the note regarding the east abutment should be re-written so

to include the west abutment if necessary.

3. A consideration note allows the contractor to use a suitable dewatering scheme, which is O.K.

4. The drawings do not show any pile arrangement for the abutments. No Table of Piles is included, Therefore the pile lengths cannot be checked.

Approved
Nov. 3, 71

artment of Highways Ontario
opy for the information of

Mr. A. Stermac.
Mr. A. F. Kath,
Regional Bridge Planning Engineer,
Southwestern Region, London.

Structural Office,
West Building,
Downsview.

September 17, 1971.

Grand River Bridge,
0.3 Miles West of Brealea,
W.P. 194-63-02, Site #33-109,
Highway #7, District #3.

71-11-013

Attached herewith are prints of the Preliminary Bridge Plan Drawing S-6967-P2 for the above-mentioned structure.

The estimated cost of the proposed structure is $335,000 which includes tender, materials, engineering and sundry construction.

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

C. S. Grabski,
Structural Design Engineer.

CSG/mh
ENCL.
cc: A. McKim,
B. Davis,
A. Stermac (2),
J. Anderson,
A. Crowley.

of the west structure

Both abutments are supported on end bearing steel H-Piles and all piers are supported on spread footings placed on rock concrete 7 to 9 ft in thickness. No details for the detours are given. No comments.

AR.
21/9/71

71-11-013

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. M. Devata,
Foundation Office,
Room 107, Lab. Bldg.

FROM: J.L. Keen,
Bridge Office

ATTENTION:

DATE: April 29, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT: Grand River Bridge, Hwy. 7
0.3 Miles West of Breslau
W.P. 194-63-00, Site 33-100
District No. 3

We have reviewed the cost estimates for the caissons of the above structure, per your correspondence received by us April 26, 1971, and request that you provide us with some additional information.

Since our last meeting we have investigated the design of the piers in greater detail and consider that 24 inch diameter caissons are better suited to our structural requirements than caissons having a larger diameter. Accordingly, would you kindly have cost estimates prepared on the basis of all caissons having a diameter of 24 inches and a design load of 150 tons.

Enclosed are 3 copies of the design sketches for the piers and 3 copies of D6987-P1, the unissued Preliminary drawing for the Grand River Bridge. Please note that the Preliminary was drawn for the scheme requiring a new deck to be placed on the renovated existing piers, while the scheme we are investigating using caissons is for an entirely new structure along the north side of the structure shown on the plan view of the Preliminary drawing. The location of the piers for the new structure will be about opposite the piers for the arrangement shown on D6987-P1. The number and length of spans will also be similar to the arrangement shown on D6987-P1.

Please note that we have not shown an elevation for the base of the caissons as we consider that it would be preferable to have you recommend base elevations for each pier.

Please note that there will be reinforcing in the top 15 feet of the caisson. We cannot say how much reinforcing will be required as this has not been determined. The reinforcing will quite likely be a single circular layer of vertical bars reinforced with a spiral.

..... 2

RE: Grand River Bridge, Hwy. 7
0.3 Miles West of Breslau
W.P. 194-63-00, Site 33-100
District No. 3

Also, please note we are calling for a steel liner (3/8" wall) for the full length of the caisson. This liner should be tight to the surrounding undisturbed ground and left in place.

I would prefer to have the estimates prepared on an all inclusive basis so that the caisson contractor supplies all material except perhaps the reinforcing in the top of the caissons. Should this cause any difficulties please let me know. In any event, please have the estimates prepared on a basis common to each firm as this is far more convenient to us.

We will likely stay with our H-pile design for the abutments so that the estimates should be prepared for the six piers only.

Should you require further information please do not hesitate to contact us. In view that our completion date is still June 11, 1971, an early reply would be most appreciated.

J.L. Keen,
Regional Bridge Design Engineer

JLK:rd

R68

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

P. Watt,
Bridge Planning Engr.,
Bridge Office -
Western Region - London.

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

ATTENTION:

DATE: April 13, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT: Grand River Bridge, 0.3 Miles West of Breslau
Hwy. #7, District #3 (Stratford)
W.P. 194-63-00 -- W.O. 71-11013

A meeting was held recently at the Foundation Section to discuss the foundation requirements for the proposed new structure as well as detour at the above mentioned location. The undersigned presented the subsoil conditions and discussed foundation recommendations for the detour with Mr. E. Van Beilen, Bridge Maintenance Design Engineer, and for the bridge structure with Mr. J. Keen, Regional Bridge Design Engineer.

This Section is, at present, investigating the possibility of bored-in caissons for the above structure with Western Caissons Ltd., and Franki of Canada Ltd. As soon as we receive the proposals including estimated costs from the aforementioned organizations, we will submit all the necessary information pertaining to caissons to the Bridge Office.

The field work for the above project will be completed by April 14, 1971, and a detailed foundation report will be submitted within the next two weeks.

M. Devata

MD/MdeP

M. Devata
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. C. S. Grebski
S. McCombie
A. Crowley
E. Van Beilen
J. Keen

Foundations Files ✓
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Planning,
Southwestern Region,
London, Ontario.

Date: February 10, 1971.

Our File Ref.

In reply to

Subject:

W.P. 194-63-00, Bridge Site 33-100
Grand River Bridge - Deck Replacement
0.3 miles west of Breslau
Hwy 7
District 3, Stratford

71-11013

Would you kindly arrange to have a foundation investigation conducted at the above location for the new abutments of the proposed deck replacement and the bailey bridge detour.

Enclosed please find two copies of the plan number B-164-51 showing the alignment of the proposed detour. Also attached please find two copies of the bridge site plan E-4811-1 showing the location of the proposed abutment footing for the deck replacement and the alignment for the bailey bridge detour.

For the pile bent locations on the detour, would you kindly contact Mr. E. Van Beilen, Bridge Maintenance Design Engineer, Bridge Office, local 3679. Since the bridge design completion date is June 11, 1971, and Road Design completion date is August 25, 1971, the foundation report recommendations are requested as soon as possible by letter form with the foundation report available in the normal two to three months.

Would you also consider taking one borehole near each of the existing pier locations just in case one of the piers is damaged during demolition of the existing deck and beams and requires replacement.

To have the proposed detour alignment run in field, please contact Mr. F. E. Loscombe, Superintendent of Engineering Surveys, London, telephone number 451-5400, local 200

A P Watt

APW/cc
Encl.

A. P. Watt,
Regional Bridge Planning Engineer,
Southwestern Region.

cc: Mr. S. McCombie
Mr. A. Crowley
Mr. E. Van Beilen
Mr. P. Peacock
Mr. J. Switzer