

#56-F-203C

Hwy #40

BETWEEN

CHATHAM &

WALLACEBURG

77-
RACEY, MACCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

B.A. 557
Bridge Office
TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-463

4 December 1956.

A.M. Toye, Esq.,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
TORONTO, Ontario.

56 F 203C

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION FOR SEVEN
BRIDGE SITES ON HIGHWAY NO. 40, BETWEEN
CHATHAM AND WALLACEBURG, ONTARIO.

Dear Sirs:

In conformance with our recent agreement, a drill was moved to two of the above noted bridge sites, in order to confirm the elevation of bedrock approximately indicated in our investigation of October this year, and recorded in our report of 20 November. In this investigation, the depth to bedrock was determined by penetration measurements and by reference to local well drilling records.

This confirmation of bedrock was confined to two bridge sites designated WP677-56 and WP679-56. At each site approximately ten feet of black shale core was obtained, and the surface elevation of this shale essentially confirmed previous measurements. The revised engineering data sheets for the above mentioned borings, are enclosed herewith.

There is little doubt left that sufficient support for the weight of the proposed bridges will be found at the depths indicated in our report. The bedrock encountered is a sound, blue to black shale. We are, therefore, of the opinion that the results of the three borings carried out into bedrock, together with our original report, give sufficient information concerning all sites.

Yours very truly,
RACEY, MACCALLUM AND ASSOCIATES LIMITED


J.J. Schoustra.

JJS/MD
In quadruplicate

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N-E corner of bridge WP-677-56Hole Elevation and Datum: 584.1' Dept. HighwaysField Work Begun: 6-10-56 Ended: 6-10-56Field Supervision: J. S.Driller: HockePrep.: J. S.

Checked:

Date:

LEGENDSampling Method
2" Dia. split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. ConeCasing
2" F.W. sampler

Strength

Unconfined compression
Vane test and sensitivity

Consistency

Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F.				
				100	200	300	400	500
				BLOWS/FT.				
				20	40	60	80	100
	soft brown-grey sandy silty clay with organic matter, probably fill.	587.1	0					
		580.6	5					
	loose, coarse to medium grey sand.	576.1	10					
		565.6	15					
	very soft grey marl clay with silt partings and odd silt layers, some fine gravel.		20					
			25					
	dense to very dense grey fine sand with blue shale.	537.2	30					
			35					
	dense, fine gravel and weathered shale.	520.1	40					
			45					
	bedrock; blue and black shale.		50					
			55					
		516.1	60					
			65					
			70					

CONSISTENCY AND UNIT WEIGHT						P.C.F.	SAMPLE NO.
100	110	120	130	140	150		
% DRY WEIGHT							
0	10	20	30	40	50		
						TW ₁	
						TW ₂	
						SS ₃	
						TW ₄	
						TW ₅	
						TW ₆	
						TW ₇	
						TW ₈	
						SS ₉	
						SS ₁₀	

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location S-W corner of bridge WP-677-56

Hole Elevation and Datum: 584.4' Dept. H. 340-75

Field Work Begun 7-10-56 Ended 7-10-56

Field Supervision: *J.S.*

Driller: Hoelke

Prep.: 7.5'

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

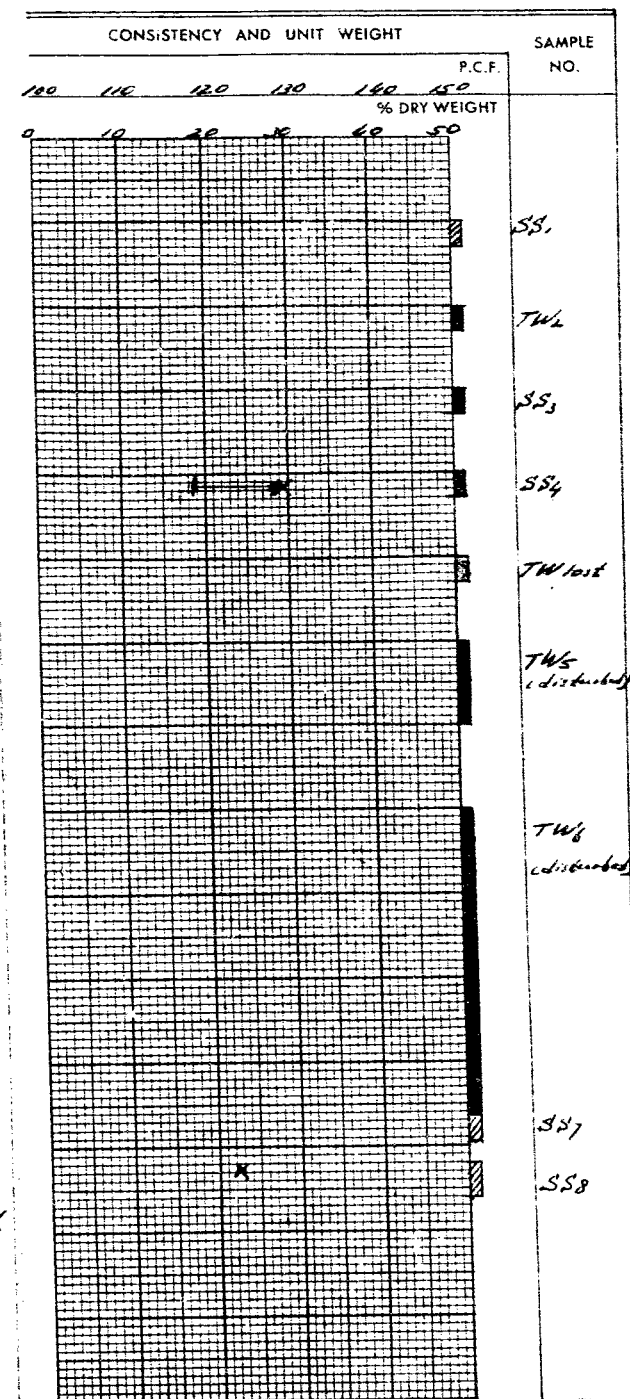
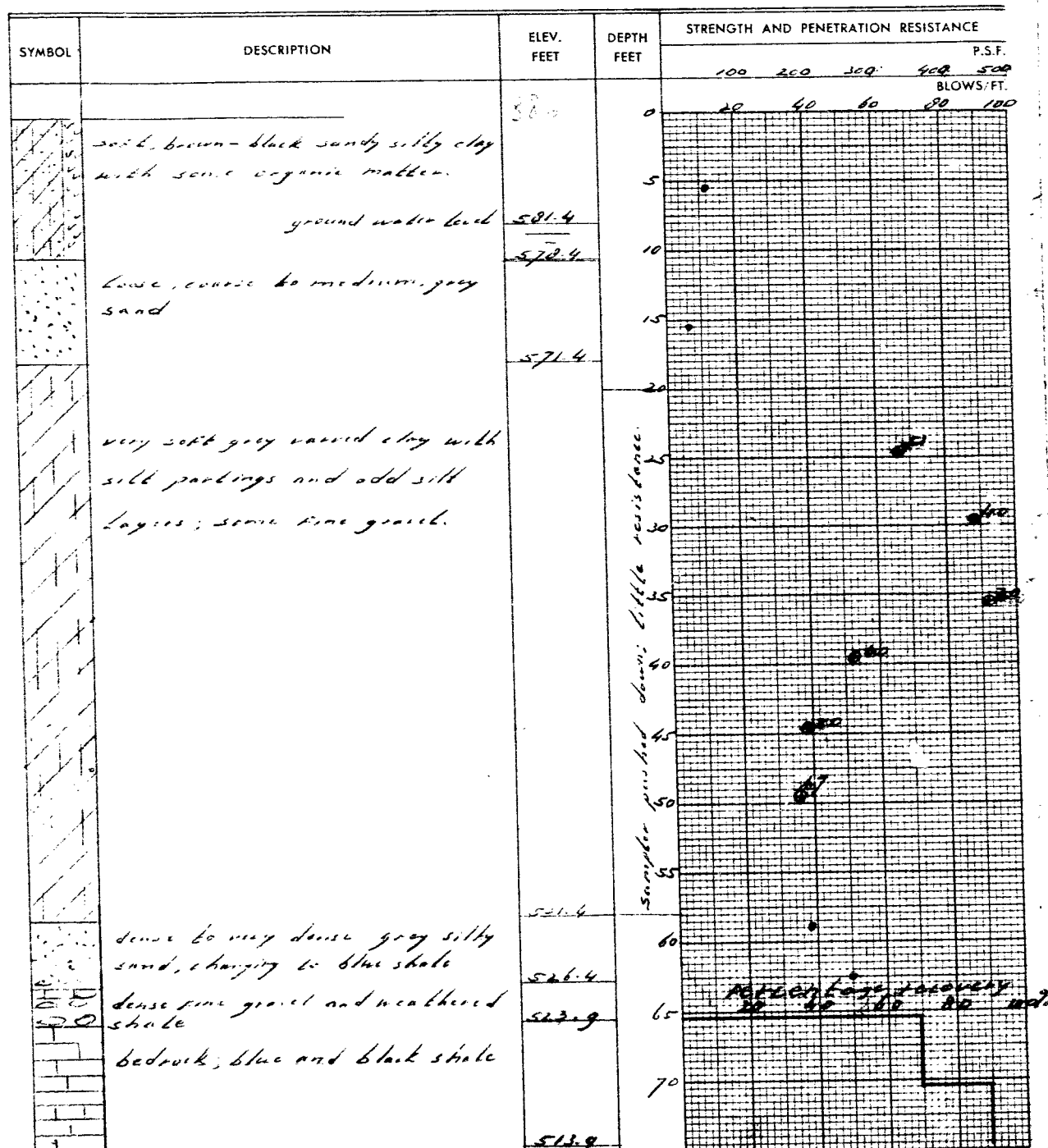
Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: gProject: Bridge sites at ChathamLocation: Highway 40Hole Location N.E. corner of bridge WP679-56Hole Elevation and Datum: 527.9' Dept. Highways.Field Work Begun 10-10-56 Ended 10-10-56Field Supervision: J. S.Driller: HoekePrep.: J. S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

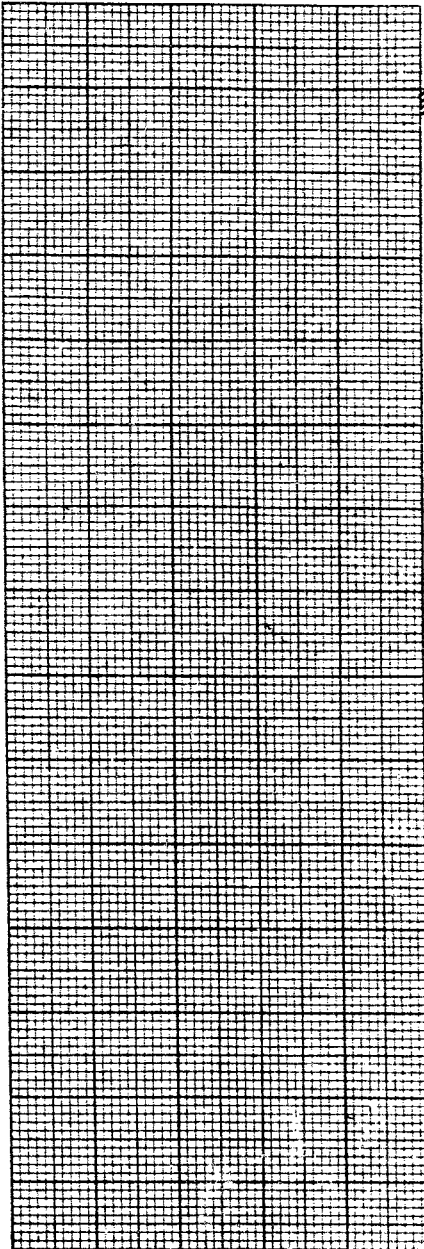
Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	BLOWS/FT.
	loose brown clayey sand, changing to loose brown-gray clayey silt. some organic matter.		0		20 40 60 80 100
	loose, coarse to medium, gray sand	529.4'	5		
	very soft, gray silty clay. (description from material brought up by auger)	518.9'	10		
	dense clayey sand and shale	524.9 523.9	65		
	bedrock; blue and black shale.	517.4	70		

CONSISTENCY AND UNIT WEIGHT		SAMPLE NO.
P.C.F.		
% DRY WEIGHT		
		55,

B.A. 557

RACEY, MacCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-463

4 December 1956.

A.M. Toye, Esq.,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
TORONTO, Ontario.

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION FOR SEVEN
BRIDGE SITES ON HIGHWAY NO. 40, BETWEEN
CHATHAM AND WALLACEBURG, ONTARIO.

Dear Sirs:

In conformance with our recent agreement, a drill was moved to two of the above noted bridge sites, in order to confirm the elevation of bedrock approximately indicated in our investigation of October this year, and recorded in our report of 20 November. In this investigation, the depth to bedrock was determined by penetration measurements and by reference to local well drilling records.

This confirmation of bedrock was confined to two bridge sites designated WP677-56 and WP679-56. At each site approximately ten feet of black shale core was obtained, and the surface elevation of this shale essentially confirmed previous measurements. The revised engineering data sheets for the above mentioned borings, are enclosed herewith.

There is little doubt left that sufficient support for the weight of the proposed bridges will be found at the depths indicated in our report. The bedrock encountered is a sound, blue to black shale. We are, therefore, of the opinion that the results of the three borings carried out into bedrock, together with our original report, give sufficient information concerning all sites.

Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED


J.J. Schoustra.

JJS/MD
In quadruplicate

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N.E. corner of bridge WP-677-56Hole Elevation and Datum: 589.1' Dept. HighwaysField Work Begun: 6-10-56 Ended: 6-10-56Field Supervision: J. S.Driller: HoelkePrep.: J. S.

Checked:

Date:

LEGEND**Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

2" T.W. sampler

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	BLOWS/FT.
				100 200 300 400 500	
				20 40 60 80 100	
			0		
			5		
			10		
			15		
			20		
			25		
			30		
			35		
			40		
			45		
			50		
			55		
			60		
			65		
			70		

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.
100	110	120	130	140	150	
% DRY WEIGHT						
0	10	20	30	40	50	
						TW1
						TW2
						SS3
						TW4
						TW5
						TW6
						TW7
						TW8
						SS9
						SS10

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: *Bridge sites at Charlhorn*

Location: Highway 40

Hole Location *S-W corner of bridge WP-677-56*

Hole Elevation and Datum: 509.4' Dept. Highway

Field Work Begun 7-10-56 Ended 7-10-56

Field Supervision: *J.S.*

Driller: Hoalke

Prep.: 7.5

Checked: _____

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS/FT.				
				100	200	300	400	500
			0	20	40	60	80	100
	sett. brown-black sandy silty clay with some organic matter.	581.4	5					
	ground water level	578.4	10					
	lowe, coarse to medium gray sand	571.4	15					
	very soft gray varved clay with silt partings and odd silt layers; some fine gravel.		20					
			25					
			30					
			35					
			40					
			45					
			50					
			55					
	dense to very dense gray silty sand, changing to blue shale.	561.4	60					
	dense fine gravel and weathered shale	561.4	65					
	bedrock; blue and black shale	552.9	70					
		542.9						

CONSISTENCY AND UNIT WEIGHT						P.C.F.	SAMPLE NO.
120	110	120	130	140	150		
% DRY WEIGHT							
0	10	20	30	40	50		
							SS ₁
							TW ₂
							SS ₃
							SS ₄
							TW _{lost}
							TW ₅ (disturbed)
							TW ₆ (disturbed)
							SS ₇
							SS ₈

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 9Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N.E. corner of bridge WP679-56Hole Elevation and Datum: 507.9' Dept. Highways.Field Work Begun 10-10-56 Ended 10-10-56Field Supervision: J.S.Driller: HoltkePrep.: J.S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

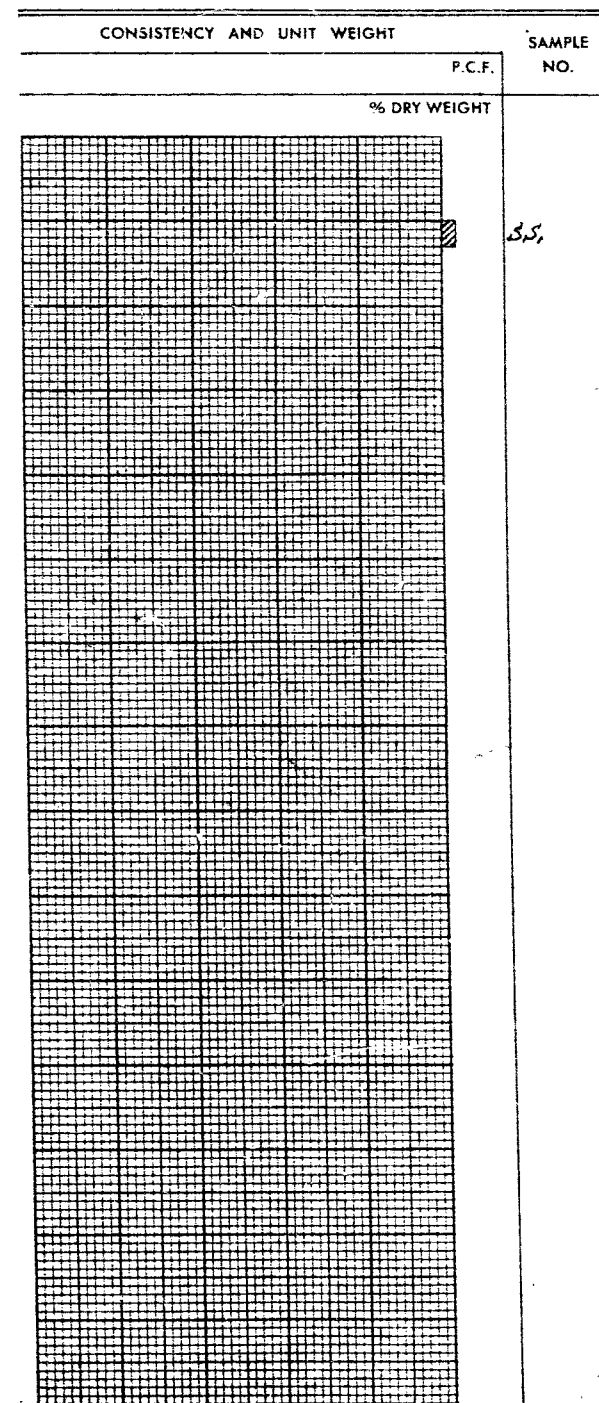
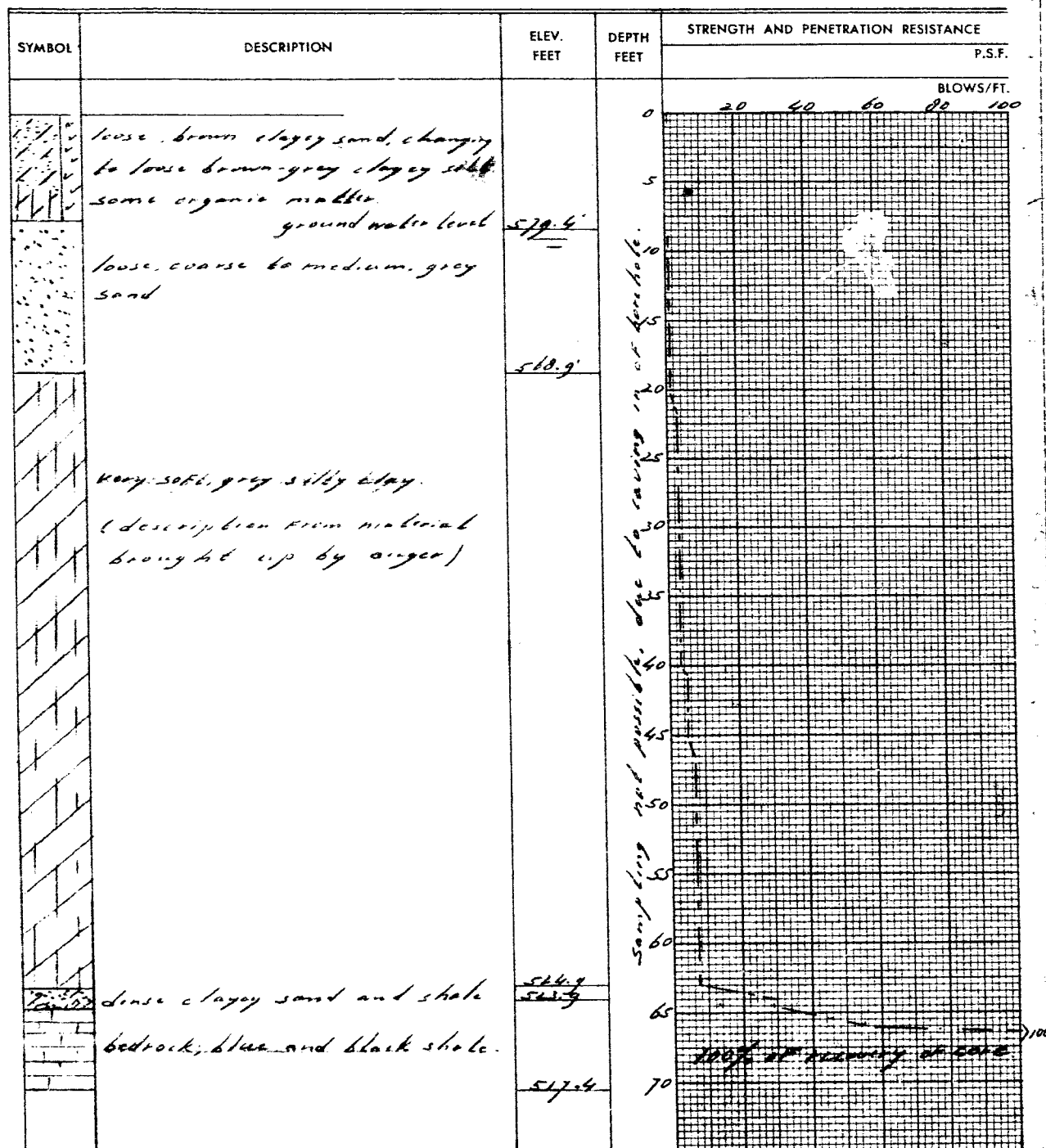
Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



B.A. 557

RACEY, MacCALLUM AND ASSOCIATES LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-463

4 December 1956.

A.M. Toye, Esq.,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
TORONTO, Ontario.

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION FOR SEVEN
BRIDGE SITES ON HIGHWAY NO. 40, BETWEEN
CHATHAM AND WALLACEBURG, ONTARIO.

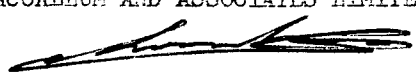
Dear Sirs:

In conformance with our recent agreement, a drill was moved to two of the above noted bridge sites, in order to confirm the elevation of bedrock approximately indicated in our investigation of October this year, and recorded in our report of 20 November. In this investigation, the depth to bedrock was determined by penetration measurements and by reference to local well drilling records.

This confirmation of bedrock was confined to two bridge sites designated WP677-56 and WP679-56. At each site approximately ten feet of black shale core was obtained, and the surface elevation of this shale essentially confirmed previous measurements. The revised engineering data sheets for the above mentioned borings, are enclosed herewith.

There is little doubt left that sufficient support for the weight of the proposed bridges will be found at the depths indicated in our report. The bedrock encountered is a sound, blue to black shale. We are, therefore, of the opinion that the results of the three borings carried out into bedrock, together with our original report, give sufficient information concerning all sites.

Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED


J. J. Schoustra.

JJS/MD
In quadruplicate

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N-E. CORNER OF bridge WP-677-56Hole Elevation and Datum: 589.1' Dept. Highways.Field Work Begun: 6-10-56 Ended: 8-10-56Field Supervision: J. S.Driller: HoelkePrep.: J. S.

Checked:

Date:

LEGENDSampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

2" T.W. sampler

Strength

Unconfined compression

Vane test and sensitivity

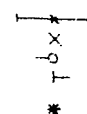
Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F.				
				100	200	300	400	500
				BLOWS/FT.				
				10	40	60	80	100
	soft brown-grey sandy silty clay with organic matter, probably fill.	587	0					
	ground water level.	580.6						
	loose, coarse to medium grey sand.	576.1	5					
			10					
	very soft grey marred clay with silt partings and odd silt layers, some fine gravel.	565.6	15					
			20					
	dense to very dense grey fine sand with blue shale.	537.2	25					
	dense fine gravel and weathered shale	512.1	30					
	bedrock; blue and black shale.	516.1	35					
			40					
			45					
			50					
			55					
			60					
			65					
			70					

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.
P.C.F.						
100	110	120	130	140	150	
% DRY WEIGHT						
0	10	20	30	40	50	
						TW ₁
						TW ₂
						SS ₃
						TW ₄
						TW ₅
						TW ₆
						TW ₇
						TW ₈
						SS ₉
						SS ₁₀

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location *S-W corner of bridge WP-677-56*

Hole Elevation and Datum: 584.4' Dept. Highway

Field Work Begun 7-10-56 Ended 7-10-56

Field Supervision: *J.S.*

Driller: Hoelke

Prep.: 7.5'

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS/FT.				
				100	200	300	400	500
				20	40	60	80	100
	soft, brown-black sandy silty clay with some organic matter.	581.4	0					
	ground water level	578.4	5					
	loose, coarse to medium, gray sand	571.4	10					
	very soft gray varved clay with silt partings and odd silt layers; some fine gravel.		15					
			20					
			25					
			30					
			35					
			40					
			45					
			50					
			55					
			60					
			65					
			70					

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.
180	160	140	120	100	80	P.C.F.
% DRY WEIGHT						
0	10	20	30	40	50	
						SS ₁
						TW ₂
						SS ₃
						SS ₄
						TW lost
						TW ₅ (distributed)
						TW ₆ (distributed)
						SS ₇
						SS ₈

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 9Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N.E. corner of bridge WP679-56Hole Elevation and Datum: 507.9' Ditch HighwaysField Work Begun: 10-10-56 Ended: 10-10-56Field Supervision: J.S.Driller: HockePrep.: J.S.

Checked:

Date:

LEGEND**Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

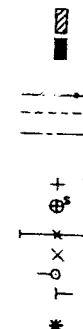
Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE P.S.F.
				BLOWS/FT.
	loose brown clayey sand, changing to loose brown-gray clayey silt. some organic matter		0	20 40 60 80 100
	loose coarse to medium gray sand	579.4'	5	
	very soft gray silty clay (description from material brought up by auger)	510.9'	10	
	dense clayey sand and shale bedrock; blue and black shale.	517.4'	65	

CONSISTENCY AND UNIT WEIGHT	SAMPLE NO.
P.C.F.	
% DRY WEIGHT	
	SS

BA-557

Bridge
Office

56F203c

RACEY, MACCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-463

20 November, 1956.

A.M. Toye, Esq.,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
TORONTO, Ontario.

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION FOR
SEVEN BRIDGE SITES ON HIGHWAY
NO. 40, BETWEEN CHATHAM AND
WALLACEBURG, ONTARIO.

Dear Sirs:

We have completed our investigation of the subsoil conditions at the site of seven bridges crossing Big Creek along Highway 40, between Chatham and Wallaceburg, and our report on the subject prepared by our Mr. J. J. Schoustra, is attached hereto. A review of this report indicates that the soil overlying bedrock exists in an extremely soft compressible condition and, as such, would be quite subject to objectionable settlement under spread footing loads of any consequence. The maintenance record of the existing small bridges along this highway confirms this view. It would therefore appear desirable to found the structures directly on to bedrock, which was found at elevations ranging from 510 to 541 feet below the present road surface. In some borings undisturbed samples were very difficult to recover but, in our view, sufficient information was obtained to justify the opinions expressed above.

Although the continuous flight auger rig used in this investigation greatly expedited the field programme, and provided a clear picture of the subsoil profile, it was not equipped to core bedrock. Despite the fact that

- 2 -

20 November 1956.

well drilling records essentially confirm the bedrock depths noted, it would appear desirable to check the competency of bedrock in at least two locations, using a drill currently in the vicinity of this site. Of particular concern in this regard is the possible difference in bedrock elevation of ten feet noted in holes 1 and 2 for the bridge designated W.P.677. We understand that you are in agreement with this proposal and we shall, therefore, advise you of this information as soon as it has been obtained.

We thank you for this opportunity to be of service to you and shall be pleased to discuss any matters that may come to mind, after reviewing the report.

Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED

W. A. Trew

W.A. Trew, P. Eng.,
Divisional Soils Engineer.

Department of Highways of Ontario.

FOUNDATION INVESTIGATION
FOR
SEVEN BRIDGE SITES ON HIGHWAY NO.40
BETWEEN
CHATHAM AND WALLACEBURG, ONTARIO.

Report No.S-500/T-463

Racey, MacCallum and Associates Limited

20 November 1956

C O N T E N T S

	<u>Page</u>
LOCATION OF THE SITES AND OF THE BOREHOLES	1
SCOPE OF THE FIELD INVESTIGATION	1
DESCRIPTION OF THE SUBSOIL	2
DISCUSSION OF THE RESULTS	4
1. Spread Foundation	4
2. End-bearing Pile Foundation	5
CONCLUSIONS	6

E N C L O S U R E S

	<u>Number</u>
LOCATION OF THE BOREHOLES	1
PHOTOGRAPHS	
1. Bridge Site W.P.-679	1A
2. Bridge Site W.P.-508	1A
3. Bridge Site W.P.-682	1A
ENGINEERING DATA SHEETS	2 - 15

20 November 1956.

FOUNDATION INVESTIGATION FOR SEVEN
BRIDGE SITES ON HIGHWAY NO.40,
BETWEEN CHATHAM AND WAINFORD, ONTARIO.

This report contains the results of the foundation investigation carried out for seven proposed new bridges, to replace the existing structures over the Big Creek, on Highway No.40. It also includes estimates of the ultimate and the safe bearing capacity of the subsoil and contains suggestions regarding the most suitable method of foundation support.

LOCATION OF THE SITES AND OF THE BOREHOLES

The sites are located at the existing bridges over the Big Creek, on Highway No.40, between station 282.00 and station 600.00. The locations of these sites and of the borings made at each bridge are given in enclosure no.1. All borings are within six feet of the footings of the existing bridges, and just off the road.

The area surrounding the sites is mainly flat farm land; the highway is kept approximately at ground level, with no change in elevation at the bridges. The water level in the creek, at the time of the field investigation, was between seven and eleven feet below ground level. According to local information, the water may rise in the Spring, to the under surface of the existing bridges, causing occasional flooding.

SCOPE OF THE FIELD INVESTIGATION

The drilling work was commenced on 6 October and completed on 21 October 1956. Two borings were carried out at each site, to a depth where further penetration without diamond drill equipment was impossible. The work was performed by means of a three inch diameter jeep-mounted continuous flight auger, which equipment incorporates the use of uncased borings and, therefore, is restricted to cohesive soils. Despite the fact that some sampling difficulties were encountered in a water-bearing stratum of sand, existing at about ten feet below the present highway grade, the equipment provided a very efficient means for obtaining an accurate subsoil profile and for determining the strength and consistency of the soil in its present state. Although the recovery of samples in some of the borings was very poor, because of the extremely soft nature of the soil, sufficient information was obtained to confirm its very low capacity for supporting load.

20 November 1956.

Sampling at the site was carried out using a split spoon sampler and thin walled shelly tubes; the former provided information regarding the density of granular materials encountered, and the latter were used to obtain undisturbed samples of the clay. Additional measurements were made with a vane borer and with a two inch sounding cone. Some difficulties were encountered with sampling, due to the soft and wet condition of the subsoil. To prevent losing samples under those conditions, a spring trap was used with the split spoon sampler, and a piston was used for taking samples in shelly tubes.

A survey was made of the elevations of the boreholes and of the natural ground water level on the sites. Some photographs were taken, to demonstrate the rather poor conditions of the existing bridges and the adjoining embankments. These are shown in enclosure 1A.

Some information concerning the situation of bedrock was acquired from the local farmers, who have rock wells on their properties. It was checked and proved to be correct by the files of well drilling in this area, at the Department of Mines of Ontario.

DESCRIPTION OF THE SUBSOIL

Although the seven sites are spread over approximately six miles of Highway No.40, the main features of the subsoil conditions show a great similarity. Therefore it seems unnecessary to discuss each site separately. A detailed description of the subsoil characteristics is presented in the engineering data sheets for boreholes 1 to 28, shown in enclosures 2 to 15.

As the locations of the borings are within six feet of the footings of the existing bridges, the top layer of six to fifteen feet of soil probably consists of fill. In fact, at all borings this layer was found to be comprised of the same material; a soft, brown, sandy silty clay with organic matter, some of it still distinguishable as timber. This material will have to be excavated and backfilled again, when the new bridges are to be constructed, and need not be considered as a possible base.

20 November 1956

This top layer of fill is underlain by a layer of loose grey sand, which varies in thickness between one foot and ten feet. This stratum is below the ground water table and, therefore, may become unstable or "quick" if excavations are carried into it during construction. At borehole no.2 a second hole was augered eighteen inches from the finished borehole. As soon as the sand layer was reached, at El.578.4, the wet sand poured into the existing hole, creating an air gap between the two holes. Holes nos. 9 and 10 continued caving in after the sand was reached, and it was impossible to acquire samples below this depth. Since the soil brought up by the auger did not show any differences from the soil at the other sites, the information from vane tests and sounding cone penetration tests on this site, are considered to be sufficient. At the other holes, where the sand layer was not as thick, caving was no serious problem, since the underlying clay tended to line the hole and stabilise the sand. At boreholes 22 and 28 no sand layer was encountered.

The sand layer is followed by a layer of very soft varved clay with the appearance of a glacial lake deposit, typical for this area.* The top half of this layer seems to be slightly more silty than the lower half, but the varving stretches through the full depth of the layer. The thickness of the clay and silt layers varies from two inches to one quarter of an inch.

Below this layer of varved clay, which extends between El.541 and El.513 on the different sites, a one to four foot layer of dense granular material overlies what can be expected to be bedrock. As there was no diamond drilling equipment available, it was only possible to penetrate into this rock for one or two inches with the split spoon sampler, and to bring up a few blue or black shale chippings. However, the files of well drilling in the Chatham area, at the Department of Mines of Ontario, showed that bedrock consisting of shale, was proved at about twelve locations within a mile distance of the various bridge sites, at depths varying between 53 feet and 70 feet, below ground level. It is therefore more than likely that the encountered stratum that could not be penetrated with the available equipment, is bedrock.

* Chapman and Putnam - "The Physiography of Southern Ontario"

20 November 1956.

DISCUSSION OF THE RESULTS

In order to reach some decision regarding the suitable depth for carrying the vertical and horizontal loads from the bridge abutments, an examination of the foundation proposals would appear warranted. The alternatives that could be considered are:- 1. A spread foundation bearing on the top layer of varved clay, and 2. An end-bearing pile foundation, driven to bedrock.

1. Spread Foundation

A spread foundation on the very soft varved clay encountered here, cannot be considered without making an estimate of the expected settlement during and after construction. Therefore, a consolidation test was carried out on a typical sample of this material, taken from borehole no.22. The results of this test, are shown in enclosure 16. An examination of them indicates that the varved clay has reached equilibrium under present overburden pressures and, hence, any additional load will induce settlement. The amount of settlement to be anticipated is expressed by the final slope or compression index, C_c , of the present void ratio line. The value of C_c as determined from this test, is 0.28. The coefficient of consolidation corresponding to present overburden pressures is equal to 0.045 sq. ft. per day. This latter term is used to compute the rate of settlement under any given load, assuming that the water in the clay is squeezed out in a vertical direction only.

The average liquid limit of the soil at the sample depth of fifty feet, and the compression index of 0.28, are in agreement with the relation: $C_c = 0.009(L_w - 10\%)$, noted by A.W. Skempton and others. Therefore the compression indices at other depths can be found from the liquid limit values recorded in the engineering data sheets. On the basis of this test information, the approximate settlement of a forty five foot layer of this varved clay, assuming a footing ten feet wide and fifty feet long and a bearing pressure of 1000 p.s.f., can be calculated, and is found to be 0.45 feet. Because of the presence of numerous silt layers in the clay, the period of consolidation on the site will not be in accordance with the coefficient of consolidation found in the laboratory. Without in situ measurements of the horizontal permeability of these layers, it is not possible to calculate the period involved. A more detailed research of the problem of settlement will only be required if a construction on spread footings is proved to be possible within the limit of the ultimate safe bearing capacity.

20 November 1956.

The ultimate bearing capacity of the varved clay is determined on the basis of unconfined compression and field vane tests, which provide a measure of the shearing resistance of saturated cohesive soils. As a rule the field vane test is the more reliable guide to the shearing strength of cohesive soils in situ, since the errors due to soil disturbance and changing of natural stress conditions are kept to a minimum. The averages of the shearing strength of the top ten feet of varved clay on all sites measured, on the basis of unconfined compression and field vane tests, are 500 p.s.f. and 375 p.s.f. respectively. The corresponding ultimate bearing capacity of a rectangular footing for each value, neglecting the overlying soil surcharge effect, would be 3000 p.s.f. and 2150 p.s.f. respectively.* In this case, the effect of the overlying soil should be neglected, since it is only present at the back of the footing and not at the front. For soft compressible soils of this nature, it is customary to apply a factor of safety greater than three to such computations, in order to keep settlement within reasonable limits. The application of such a safety factor at this site would result in a permissible bearing pressure well below economic limits and, hence, some more permanent method of foundation support would appear warranted. This observation proves also that the existing bridges have been in danger of collapsing since the day of completion, and it explains why these bridges required so much maintenance.

2. End-bearing Pile Foundation

As the bottom of the creek is approximately thirteen feet below ground level on all sides, the footings of the proposed bridges will probably extend to at least fifteen feet below ground level. The approximate bedrock elevation for pile support at the different sites, is as follows:-

W.P.677	El.526 feet
W.P.678	El.521 feet
W.P.679	El.521 feet
W.P.680	El.527 feet
W.P.681	El.541 feet
W.P.508	El.524 feet
W.P.582	El.510 feet.

* The Ultimate Bearing Capacity of Foundations -
G.G.Meyerhof, Geotechnique No.4, 1951.

20 November 1956.

The capacity of piles founded at these depths will be governed by structural considerations. Although the soil surrounding the piles will be quite soft, it should provide sufficient lateral restraint to prohibit any column action in the piles.

Although this may not seem within the scope of a foundation investigation, it may be useful to add that, in this case, where the spans of the bridges will be between two and three times the height of the legs, a rigid frame construction will prove to be very adequate.* A construction of this type, that can carry a bending moment from one leg to the other, will have a reducing effect on the lateral thrust to the piles, hence, fewer batter piles in this very soft clay will be needed with this type of construction.

CONCLUSIONS

1. On all of the seven bridge sites, the soil conditions are alike. Below a ten foot surface layer of fill and a one to ten foot layer of loose grey sand, the subsoil consists of soft, varved clay, and is underlain by a one to four foot layer of dense, granular material on top of bedrock.

2. The bearing capacity of the varved clay and of the overlying materials at all locations, is too low to support spread foundations without incurring objectionable settlement.

3. A foundation on end-bearing piles to bedrock will give sufficient support to the weight of the bridges. To reduce the lateral thrust on the piles and, consequently, the need of batter piles, a rigid frame construction would appear preferable.



J.J. Schoustra.

JJS/MD

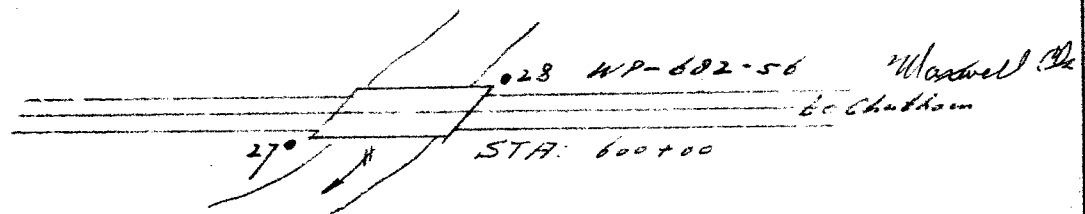
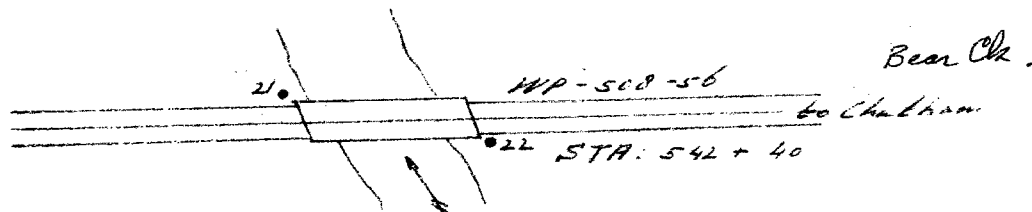
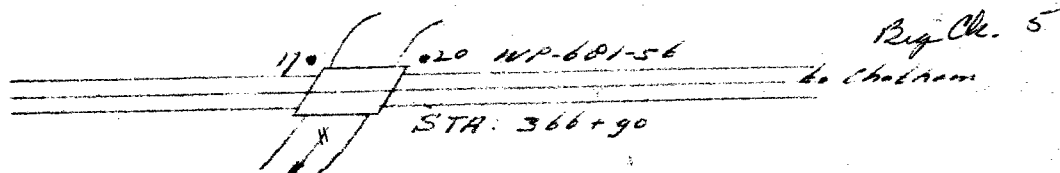
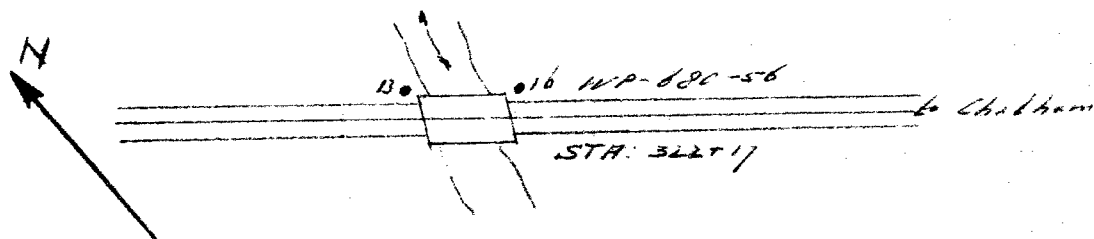
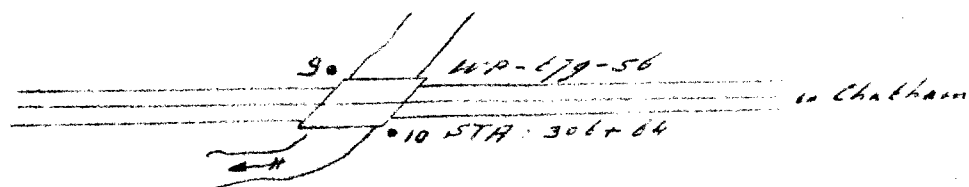
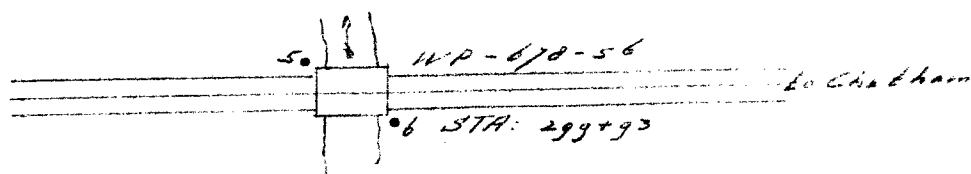
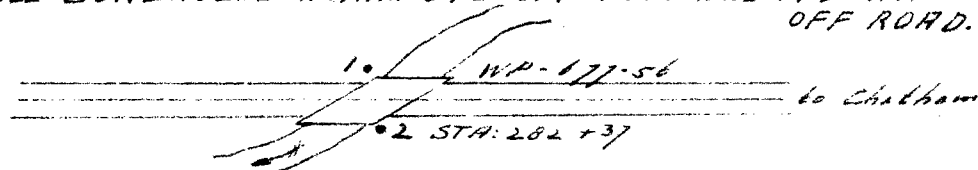
In quadruplicate

* Professor Kleinlogel - "Rahmenformeln"
Legat, Dunn, Fairhurst - "Reinforced concrete bridges".

Prep. By J.S.

LOCATION OF BOREHOLES.

ALL BOREHOLES WITHIN 6 FEET OFF FOOTINGS AND WITHIN 10 FEET OFF ROAD.



Enclosure no.1A



No.1 Bridge site
W.P.-679-56. South
corner. Failure of
backfill, probably
due to too steep an
original slope.

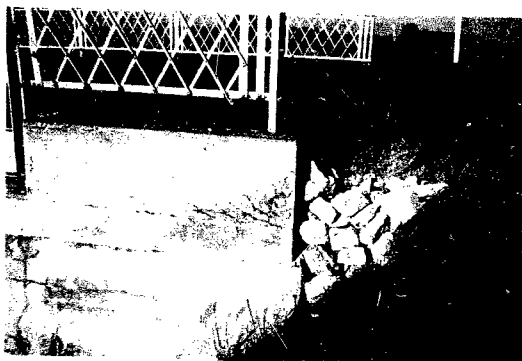


No.2 Bridge site
W.P.-508-56. South
corner. Failure of
backfill, probably
due to too steep an
original slope, with
a badly repaired
abutment.



No.3 Bridge site
W.P.-682-56. South
side. Probable frost
damage to centre pier.

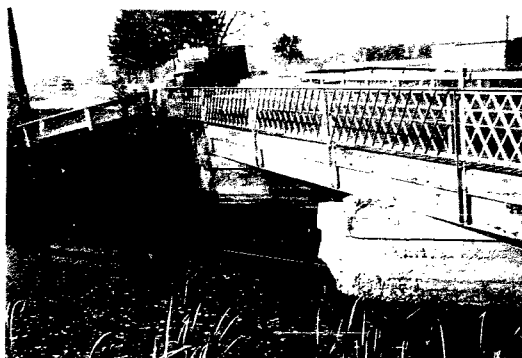
Enclosure no.1A



no.1 Bridge site
P.L.-679-56. South
corner. Failure of
backfill, probably
due to too steep an
original slope.



no.2 Bridge site
P.L.-508-56. South
corner. Failure of
backfill, probably
due to too steep an
original slope, with
a badly repaired
abutment.



no.3 Bridge site
P.L.-646-56. South
side. Possible frost
damage to centre pier.

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N-E corner of bridge WP-677-56Hole Elevation and Datum: 589.1' Dept. HighwaysField Work Begun: 6-10-56 Ended: 6-14-56Field Supervision: J. S.Driller: HoulkePrep.: J. S.

Checked:

Date:

LEGEND**Sampling Method**

2" Dia split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

2" TW sampler

Strength

Unconfined compression

Vane test and sensitivity

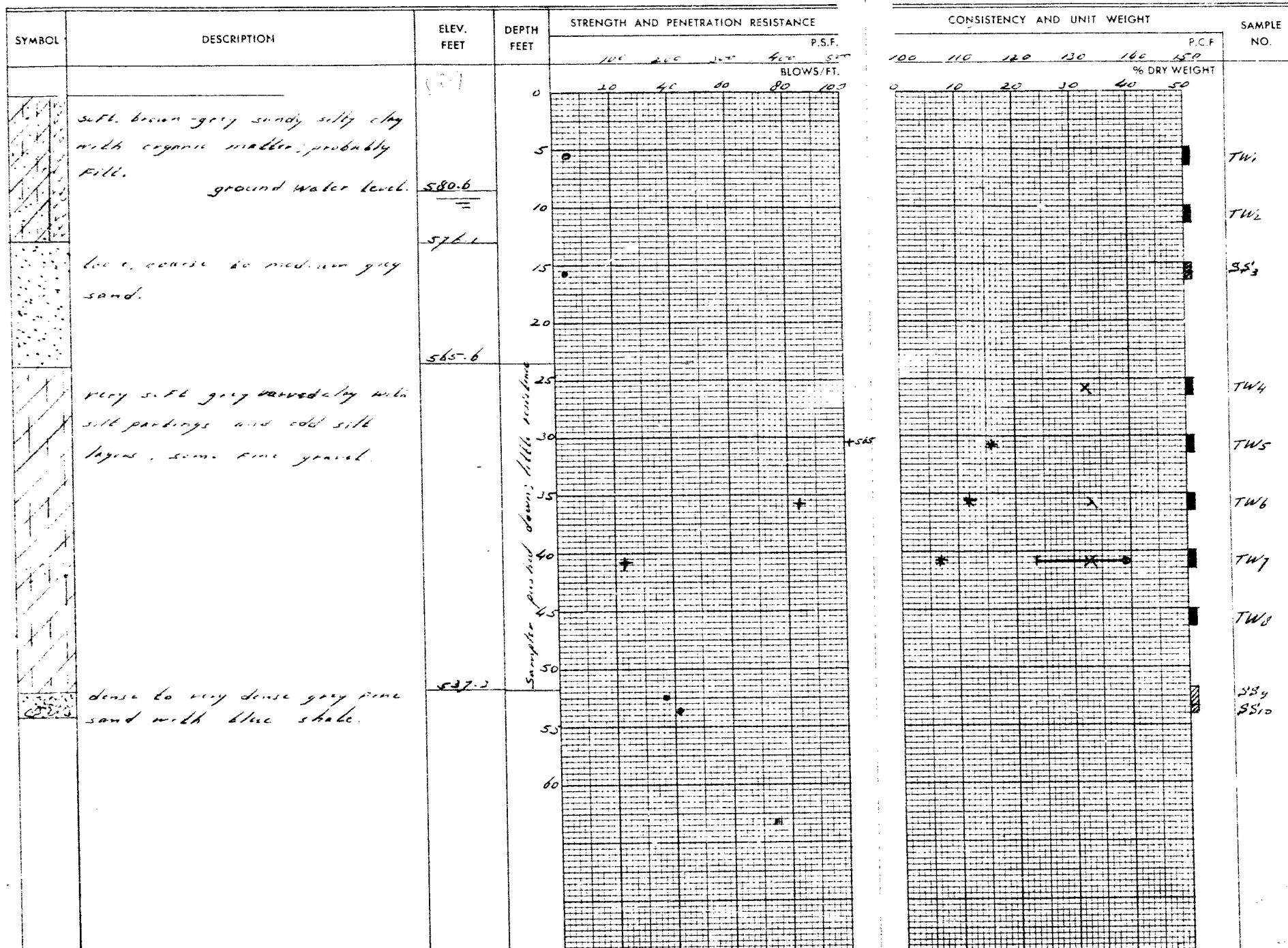
Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location S-W corner of bridge WP-677-56

Hole Elevation and Datum: 589.4' Dept. Ag. Re-ays

Field Work Begun 7-10-56 Ended 7-10-56

Field Supervision: *J.S.*

Driller: Hoelke

Prep.: 7.5'

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS/FT.				
				100	200	300	400	500
			0	20	40	60	80	100
	soft brown-black sandy silty clay with some organic matter.		5					
	ground water level	581.4						
		578.4	10					
	loose, coarse to medium, gray sand		15					
		571.4	20					
	very soft gray varved clay with silt partings and odd silt layers; some fine gravel.		25					
			30					
			35					
			40					
			45					
			50					
			55					
		566.4	60					
	dense to very dense gray silty sand, changing to blue shale							

CONSISTENCY AND UNIT WEIGHT						P.C.F.	SAMPLE NO.
100	110	120	130	140	150		
% DRY WEIGHT							
0	10	20	30	40	50		
							SS ₁
							TW ₂
							SS ₃
			*				SS ₄
							TW lost
							TW ₅ (disturbed)
							TW ₆ (disturbed)
							SS ₇
			*				SS ₈

Order No. S-500/T-463Enclosure No. 4**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 5Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N. corner of bridge W.P. 670-56Hole Elevation and Datum: 588.6 O.C. HighwayField Work Begun: 7-12-56 Ended: 8-16-56Field Supervision: J.S.Driller: HochkePrep.: J.S.

Checked:

Date:

LEGENDSampling Method
2" Dia. split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. Cone
Casing

2" TW sampler

Strength

Unconfined compression
Vane test and sensitivity

Consistency

Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F.				
				100	200	300	400	500
				BLOWS, FT				
				20	40	60	80	100
			0					
			5					
			10					
			15					
			20					
			25					
			30					
			35					
			40					
			45					
			50					
			55					
			60					
			65					
			70					

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.					
P.C.F.											
100	110	120	130	140	150						
% DRY WEIGHT											
0	10	20	30	40	50						
						SS ₁					
						TW ₁₀₁					
						TW ₂					
						TW ₃					
						TW ₃ (disturbed)					
						TW ₄					
						SS ₅					
						(disturbed)					
						SS ₆					
						(disturbed)					
						TW ₇					
						TW ₁₀₂					
						TW ₈					
						TW ₉					
						SS ₁₀					

Order No. S-500/T-463Enclosure No. 5**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

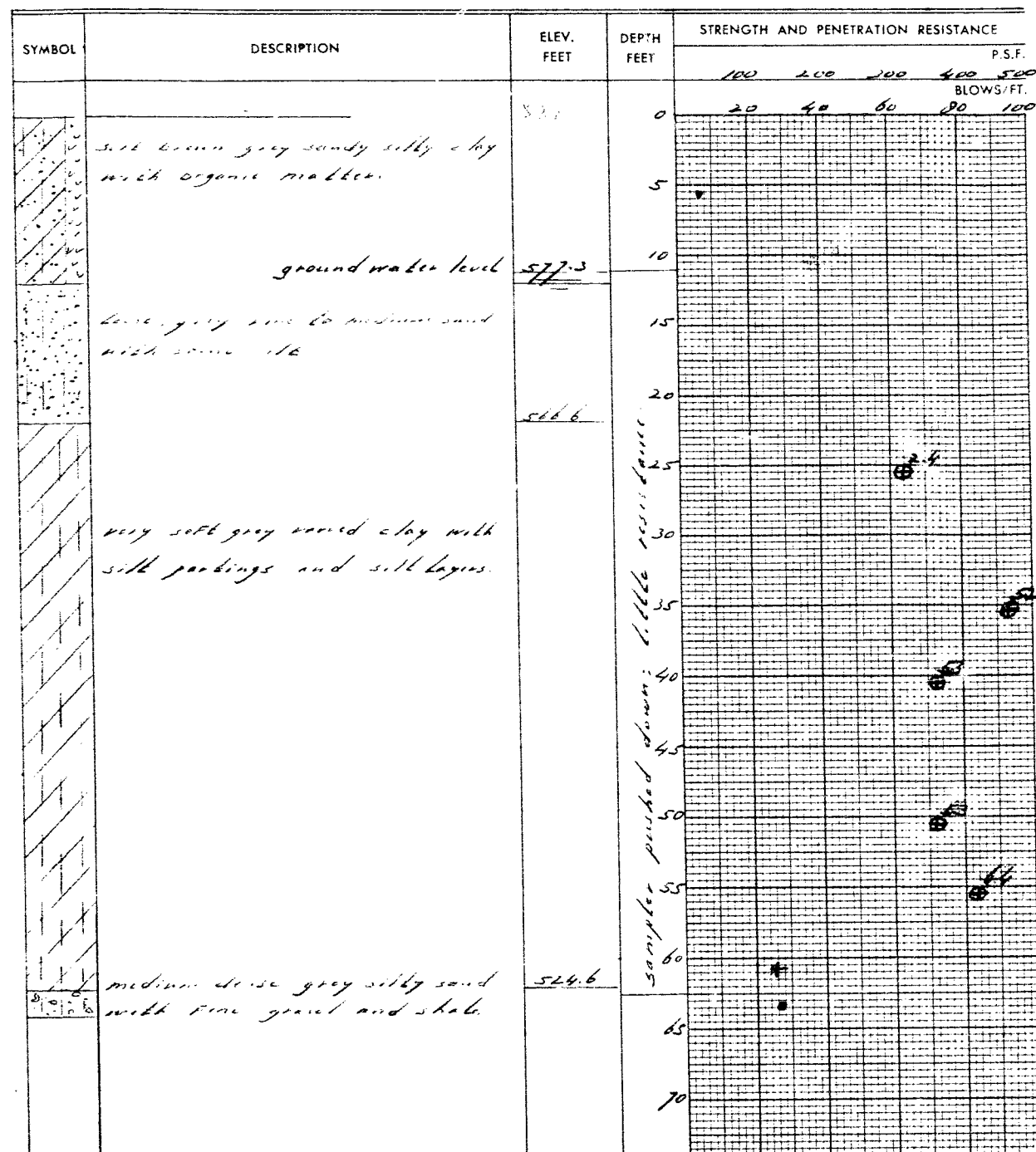
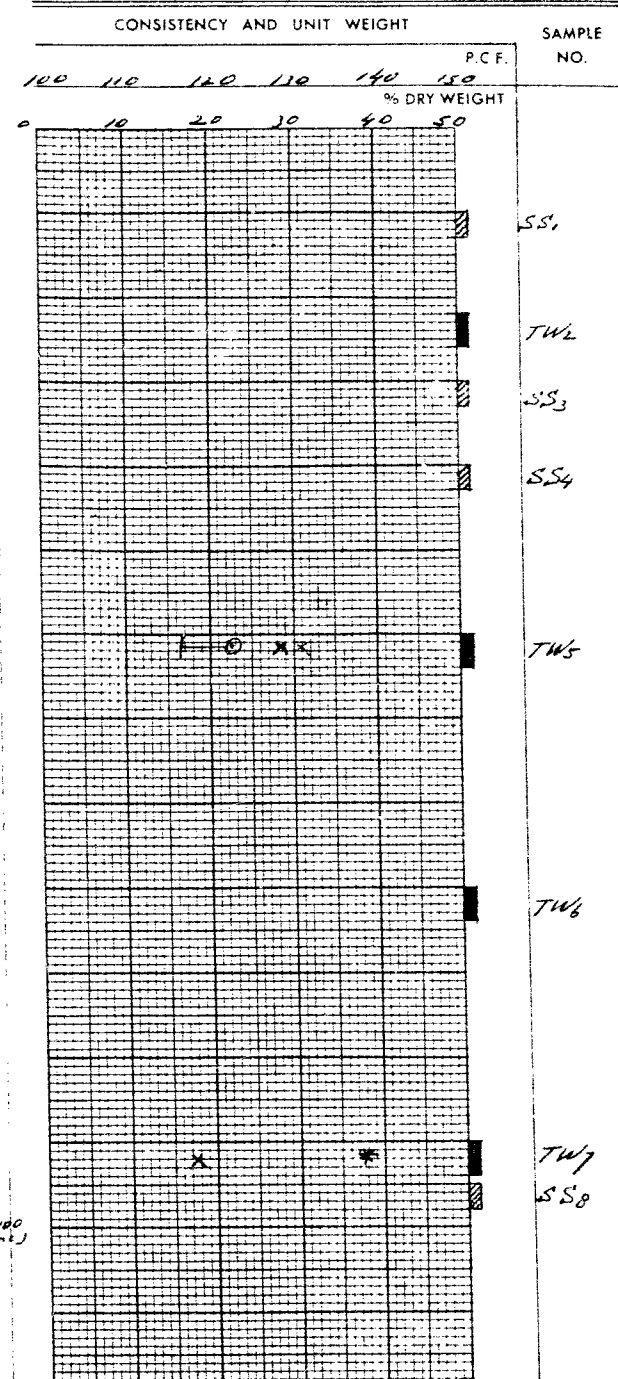
Engineering Data Sheet for Borehole: 6Project: Bridge sites at ChathamLocation: Highway 40Hole Location: S-corner of bridge WP 178-56Hole Elevation and Datum: 588.6 Dept. HighwaysField Work Begun: 8-12-56 Ended: 9-12-56Field Supervision: J.S.Driller: HuelkePrep.: J.S.

Checked:

Date:

LEGENDSampling Method
2" Dia split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. Cone
Casing
2" TW sampler**Strength**1/2 Unconfined compression
Vane test and sensitivity**Consistency**Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight



Order No. 5-500/T-463

Enclosure No. 1

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 7

Project: *Bridge sites at Chatham.*

Location: Highway 40

Hole Location *N-E corner of bridge WP 679-56*

Hole Elevation and Datum: 507.9' Depth Highways

Field Work Begun 10-10-56 Ended 10-10-56

Field Supervision: 7.5'

Driller: Hochke

Prep.: J.S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Yone test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F.				
				BLOWS/FT.				
			0	20	40	60	80	100
	loose brown clayey sand, changing to loose brown-gray clayey silt some organic matter		5					
	ground water level	579.4'						
	loose, coarse to medium, grey sand		10					
		568.9'						
	very soft, grey silty clay. (describ. from material brought up by auger)		20					
			25					
			30					
			35					
			40					
			45					
			50					
			55					
			60					
	dense clayey sand and shale blue shale.	564.9'	65					
			70					

CONSISTENCY AND UNIT WEIGHT		SAMPLE NO.
		% DRY WEIGHT
		25

Order No. 5-500/T-463

Enclosure No. 7

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 10

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location *S-W corner of bridge WWP 679-56*

Hole Elevation and Datum: 506.0 Dent High 50-92

Field Work Begun 10-10-56 Ended 11-10-56

Field Supervision: 7.5'

Driller: *HCC Inc*

Prep.: *1.5!*

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Strength

Strength
Unconfined compression

Vane test and sensitivity

Consistency

Consistency
Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS FT.				
				100	200	300	400	500
		586	0	20	40	60	80	100
	loose brown clayey sand, changing to soft brown-grey sandy silty clay; some organic matter.	577.0	10					
	loose medium grey sand	567.0	20					
	very soft grey silty clay.		25					
	(Description from material brought up by auger)		30					
			40					
			50					
		566.0	60					
	medium dense sandy silty clay to sandy clayey silt with fine gravel; glacial till.	561.0	65					
	blue shale		70					

[illegible]

Order No. 5-500/T-463

Enclosure No. 14

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 27

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location *N.W. corner of bridge Wp 682-56*

Hole Elevation and Datum: 506.9' Dept. Highway.

Field Work Begun 10-10-56 Ended 10-10-56

Field Supervision: 7.5

Driller: *Hucik*

Prep.: J.S.

Checked: _____

. Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2'' Split tube

2" Dia. Cone

Casing

Strength.

$\frac{1}{2}$ Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS/FT.				
				100	200	300	400	500
		583	0	20	40	60	80	100
	soft, brown-grey sandy silty clay with organic matter.		5					
	loose grey medium sand, changing to loose grey silt.	574.9	10					
	very soft grey varved clay with silt partings and silt layers.	564.9	15					
			20					
			25					
			30					
			35					
			40					
			45					
			50					
			55					
			60					
			65					
			70					
	dense black silty sand with fine gravel, changing to shale	516.9						
		510.4						

CONSISTENCY AND UNIT WEIGHT

SAMPLE
NO.

P.C.F.

100 110 120 130 140 150
% DRY WEIGHT

0 10 20 30 40 50

SS.

TW₁₀₀

TW₂

TW₃

TW₄

SS-

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

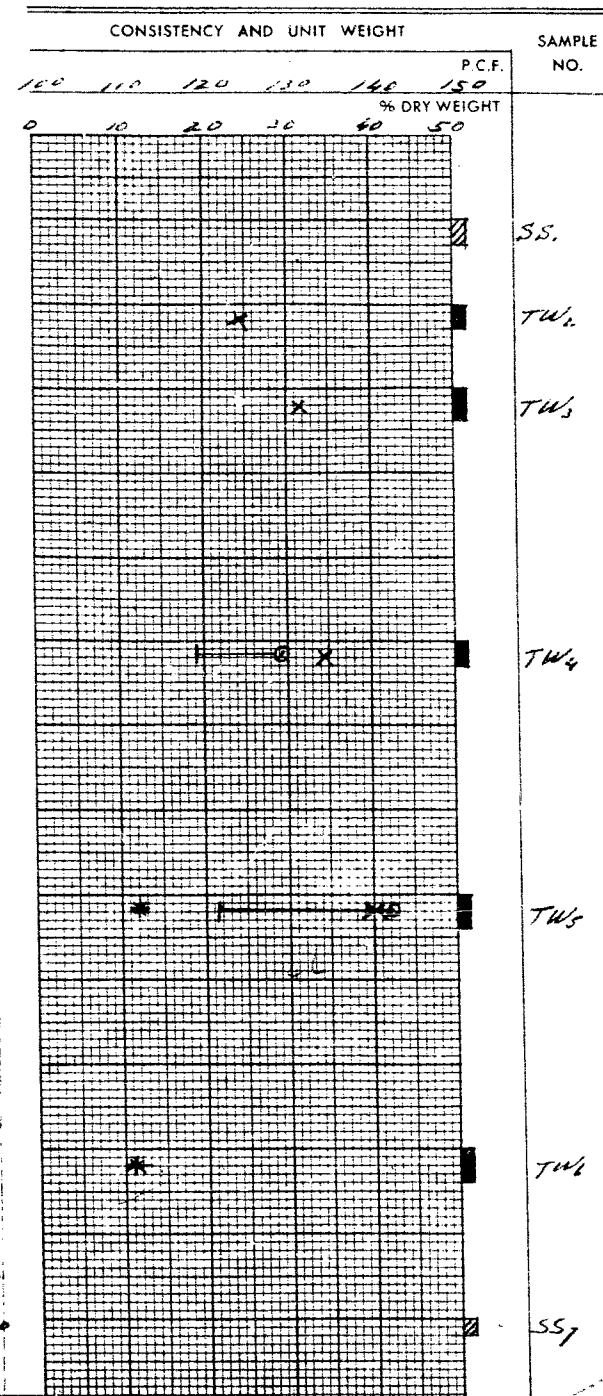
Engineering Data Sheet for Borehole: 28Project: Bridge sites at Chatham.Location: Highway 40Hole Location: S-E corner of Bridge W1602-56Hole Elevation and Datum: 581.3' Dept Highways.Field Work Begun: 17-10-56 Ended: 18-10-56Field Supervision: J.S.Driller: HuckePrep.: J.S.

Checked:

Date:

LEGENDSampling Method
2" Dia. split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. Cone
CasingStrength
Unconfined compression
Vane test and sensitivityConsistency
Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE					
				P.S.F.					
				100	200	300	400	500	
				BLOWS/FT.					
				20	40	60	80	100	
		581	0						
			5						
			10						
			15						
			20						
			25						
			30						
			35						
			40						
			45						
			50						
			55						
			60						
			65						
			70						
		581.3							
		580.2							

soft, brown-grey sandy silty clay
with some organic matter.ground water level 578.2'very soft grey varved clay with
silt partings and silt layers.

Samples pushed down, little resistance.

dense black silty sand with fine
gravel, changing to shale.

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 16Project: Bridge sites at Chatham.Location: Highway 40Hole Location: W-corner of bridge WP 680-56Hole Elevation and Datum: 506.9 D.P.L. HighwaysField Work Begun: 12-12-56 Ended: 12-12-56Field Supervision: J.S.Driller: HockePrep.: J.S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				100	200	300	400	500
				P.S.F.				
				BLOWS FT.				
				20	40	60	80	100
		587	0					
	soft brown sandy silty clay with some organic matter.		5					
		570.9						
	ground water level	576.9	10					
	Loose, brown to gray, medium sand with some silt.		15					
		564	20					
			25					
	very soft gray silty clay with silt partings.		30					
			35					
			40					
			45					
		532.9	50					
			55					
	dark gray clayey sand with some gravel	527.9	60					
	blue shale		65					
			70					

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.
100	110	120	130	140	150	
P.C.F.						
% DRY WEIGHT						
0	10	20	30	40	50	
						TW ₁
						TW ₂
						TW ₃
						SS ₄
						TW ₅
						TW ₁₀
						SS ₆

Order No. S-500/T-463Enclosure No. 10**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 17Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N-E corner of bridge WP 681-56Hole Elevation and Datum: 586.1 Dept Highways.Field Work Begun: 15-10-56 Ended: 16-10-56Field Supervision: J.S.Driller: HoelkePrep.: J.S.Checked: X

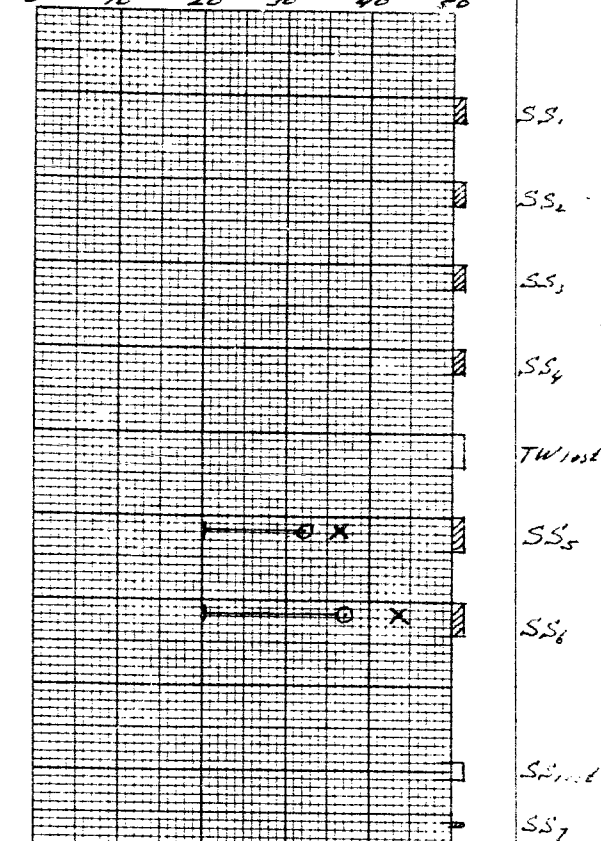
Date:

LEGENDSampling Method
2" Dia. split tube
2" Shelby tubePenetration Resistance
2" Split tube
2" Dia. Cone
Casing**Strength**Unconfined compression
Vane test and sensitivity**Consistency**Natural moisture
Liquid limit
Plastic limit

Natural Unit Weight

CONSISTENCY AND UNIT WEIGHTSAMPLE
NO.

P.C.F.					
100	110	120	130	140	150
% DRY WEIGHT					
0	10	20	30	40	50



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				100	200	300	400	500
				P.S.F.				
				BLANK FT.				
		586	0	20	40	60	80	100
	brown sandy silty clay with some organic matter.		5					
	ground water level	575.6	10					
	loose, grey, medium to fine sand; some organic matter		15					
	very soft, grey, varved clay with silt partings.	566.1	20					
			25					
			30					
			35					
			40					
		541.1	45					
	blue shale		50					
			55					
			60					
			65					
			70					

Order No. 15-500/T-463

Enclosure No. 11

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 20

Project: *Bridge sites at Chatham*

Location: Highway 40

Hole Location *E-corner of bridge WP 681-56*

Hole Elevation and Datum: 506.5 Dept. Highway 95.

Field Work Begun 12-19-56 Ended 12-19-56

Field Supervision: *J.S.*

Driller: *Hockey*

Prep.: 7.5

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

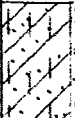
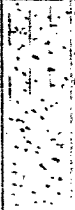


Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				P.S.F. BLOWS FT.				
				100	200	300	400	500
				20	40	60	80	100
	soft, brown-grey sandy silt, clay with some organic matter	587	0					
		574.0	5	*				
	ground water level	577.0	10	*				
	loose grey silty sand changing to medium sand some organic matter		15					
		566.5	20					
	very fine grey silty clay with silt layers		25					
			30	*				
			35					
			40					
			45					
	dense grey clayey silt with some gravel blue shade	541.5	45					
		539.5	50					
			55					
			60					
			65					
			70					

CONSISTENCY AND UNIT WEIGHT						P.C.F.	SAMPLE NO.
100	110	120	130	140	150	% DRY WEIGHT	
0	10	20	30	40	50		
							SS ₁
							SS ₂
							TW ₃
							TW ₄
							TW ₅
							TW ₆ disturbed bed
							SS ₇

Order No. S-500/F-463Enclosure No. 12**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 21Project: Bridge sites at ChathamLocation: Highway 40Hole Location N. corner of bridge W.P. 500-56Hole Elevation and Datum: 584.1 Dist. Highways.Field Work Begun 16-10-56 Ended 17-10-56Field Supervision: J.S.Driller: HuckePrep.: J.S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression

Vane test and sensitivity

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE					
				P.S.F.					
				100	200	300	400	500	
				BLOWS FT.					
				20	40	60	80	100	
			0						
			5						
			10						
			15						
			20						
			25						
			30						
			35						
			40						
			45						
			50						
			55						
			60						
			65						
			70						

CONSISTENCY AND UNIT WEIGHT						SAMPLE NO.
P.C.F.						
100	110	120	130	140	150	
% DRY WEIGHT						
0	10	20	30	40	50	
						SS ₁
						TW ₂
						TW ₃
						TW ₄
						TW ₅
						TW ₆
						TW ₇
						TW ₈
						TW ₉
						TW ₁₀
						SS ₆
						SS ₇
						SS ₈
						SS ₉
						SS ₁₀
						SS ₁₁
						SS ₁₂
						SS ₁₃
						SS ₁₄
						SS ₁₅

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 13Project: Bridge sites at ChathamLocation: Highway 40Hole Location: N corner of bridge WP 680-56Hole Elevation and Datum: 586.4' Dept. HighwayField Work Begun: 11-18-56 Ended: 12-10-56Field Supervision: J.S.Driller: HoelkePrep.: J.S.

Checked:

Date:

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

S: length

Unconfined compression

Vane test and sensitivity

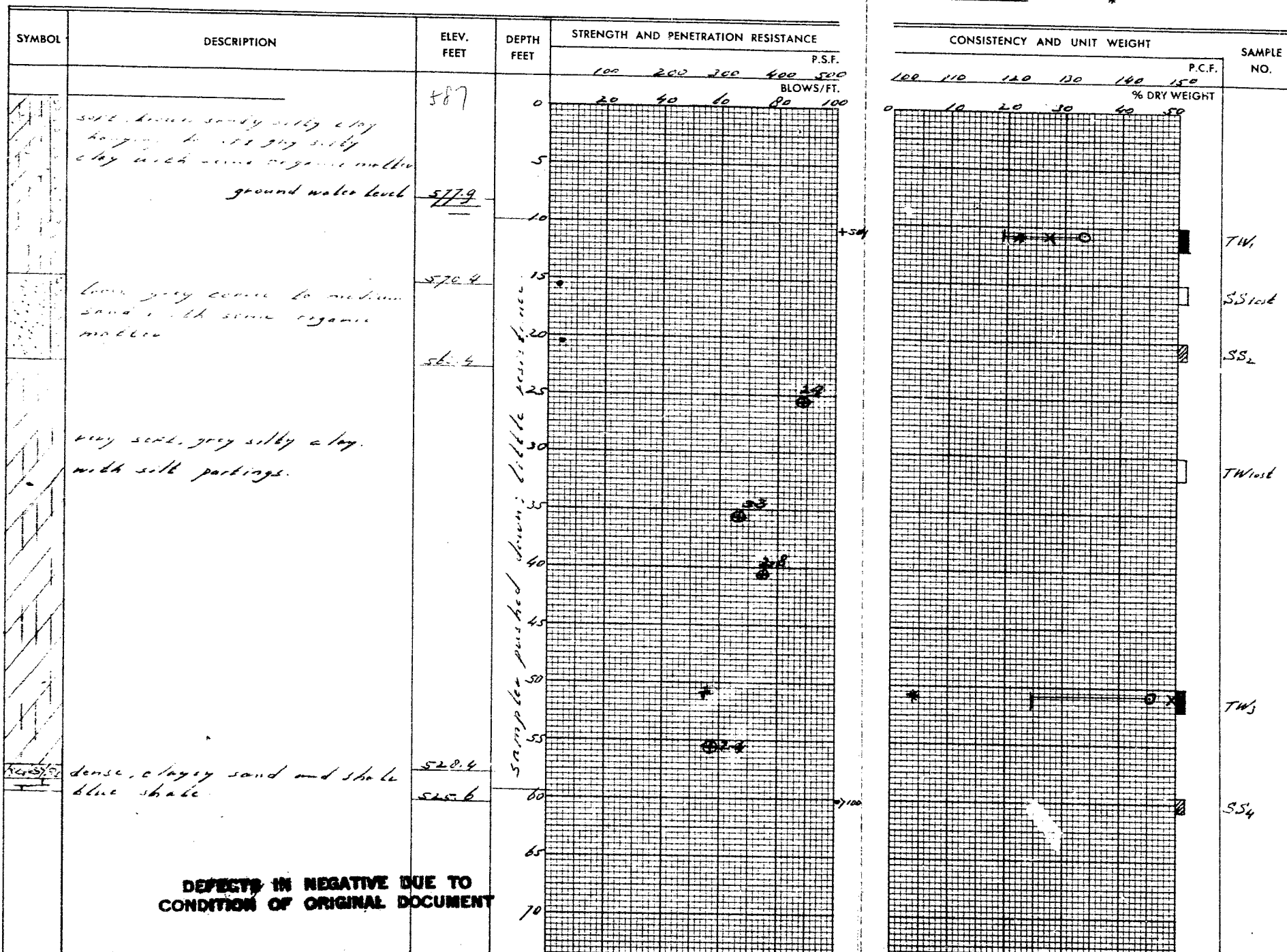
Consistency

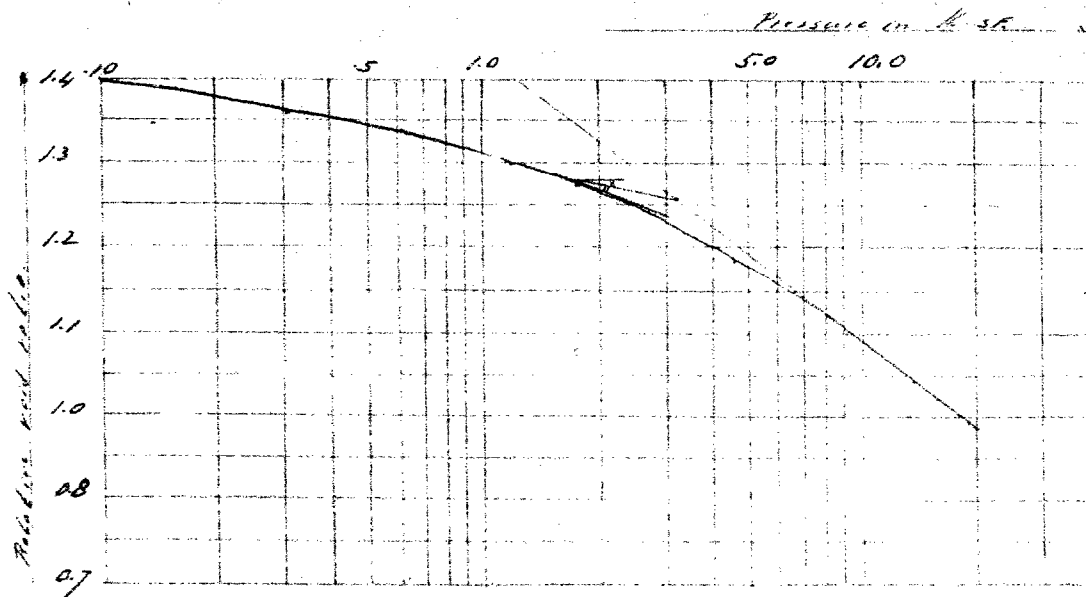
Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

Prep. By J.S.

CONSOLIDATION TEST ON SAMPLE
OF VARVED CLAY FROM HOLE 22 AT
50-52 FEET

Approx. preconsolidation load: 2200 lbs/sq.ft.Approx. overburden pressure: 5200 lbs/sq.ft.