

DATE February 23, 2015**PROJECT No.** 12-1121-0193-1240**TO** Brad Craig, P.Eng.
Dillon Consulting Limited**FROM** Kevin Nelson, P.Eng.
Fin Heffernan, P.Eng.**EMAIL** Kevin_Nelson@golder.com
Fin_Heffernan@golder.com

**PRELIMINARY FOUNDATION INVESTIGATION (PHASE 1 DESKTOP STUDY) – DRAFT
HIGHWAY 7/115 CN RAIL EBL OVERPASS REHABILITATION
PETERBOROUGH, ONTARIO
SITE 26-081 – W.P. 4167-11-01**

PART A – PRELIMINARY FOUNDATION INVESTIGATION (DESKTOP STUDY)

Scope of Work

Golder Associates Ltd. (Golder) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to provide preliminary foundation engineering services associated with numerous culvert and bridge rehabilitations and/or replacements at various locations in the Eastern Region of Ontario as part of the 23 Structures MEGA 3 project.

This technical memorandum provides the results of a preliminary foundation investigation (desktop study) completed as input to Dillon's assessment of the rehabilitation strategies for the existing overpass structure located at Site No. 26-081 which carries the east-bound lanes (EBL) of Highway 7/115 over the CN Rail Line near Peterborough, Ontario (WP 4167-11-01).

The purpose of the preliminary foundation investigation (desktop study) was to carry out a site visit and compile and review existing information related to subsurface conditions at the site and provide preliminary foundation engineering input for use by Dillon and MTO to assess strategies for the detailed design stage of the overpass rehabilitation.

Site Description and Existing Bridge Structure

The existing overpass structure carries the EBL of Highway 7/115 over the a railway corridor and is located southeast of Peterborough, Ontario approximately 1 km to the southwest of the Highway 7/115 and Lansdowne Street East interchange as shown on Drawing 1. "CNR Overhead" is the original name of the rail overhead structure, as shown on the original contract drawings. It is understood that the rail corridor is currently owned by CP Rail and is not operational.

The original ground surface elevation at the site varied from approximately Elevation 198 m to 200.0 m. The Highway 7/115 overpass bridge deck is located at an approximate elevation of 207 m. The railway lines present below the overpass are at an elevation of approximately 199.4 m resulting in an overpass height of about 7.5 m.



Constructed in 1959, the existing overpass is a three-span structure with an overall length of about 47 m that has a southwest-northeast orientation. The deck accommodates two through lanes of traffic in the eastbound direction. The bridge has previously been rehabilitated/repared in 1986, 1988 and 1995.

Available drawings indicate that the northeast and southwest abutments are supported on a series of approximately 12 m long steel H-piles while the north and south piers are supported on approximately 4.3 m and 5.8 m long H-piles, respectively. The underside of the abutment and pier pile caps are located at elevations of approximately 204 m to 204.5 m and 196.5 m to 197 m, respectively.

During a site visit completed on November 13th, 2014, no significant differential settlement of the structure was noted. Cracking and/or spalling of concrete was observed at several locations.

The existing pavement is in fair condition with rutting and centreline cracking visible. The existing asphalt leading up to the bridge appeared to have been milled and resurfaced recently. The asphalt on the bridge appeared older and contained patches.

The existing approach embankment sideslopes were generally grass-covered and no signs of instability of these sideslopes were observed. An erosion protection system comprised of stone (often cobble-sized) surrounded by cement was present on the slope faces below the abutment foundations. Cracks were present between the stones and cement exposing sandy fill in many areas and loss of stone was also visible locally.

Previous Investigation

The subsurface information used in the preparation of this memorandum was obtained from previous Foundation Investigation Reports prepared by the Ministry of Transportation Ontario (MTO), available from MTO Pavement and Foundations Section's GEOCRES database, as described below:

- Racey, MacCallum and Associates Limited (RMAL) Report titled "Foundation Investigation for the Proposed C.N.R. Overpass in Ontonabee Township, near Peterborough, Ontario," dated October 25, 1957 (GEOCRES Reference 31D-54).
- A Ministry of Transportation and Communications report titled "Foundation Investigation and Design Report – C.N.R. Overhead (W.B.L) on Peterborough Bypass," W.P. 19-81-05, dated November 27, 1981 (GEOCRES Reference 31D-282).

Ten boreholes and four boreholes were advanced as part of the 1957 and 1981 investigations, respectively. Excerpts of information contained in the MTO GEOCRES system for this site, including borehole records, is included in Attachment A.

Co-ordinates, and some elevations, for the boreholes from the 1957 investigation were not provided in the GEOCRES report; the locations of these boreholes displayed on the Borehole Location and Soil Strata drawing have been estimated based on their locations shown on the Location Plan (structural drawing) for the overpass and plans included in the foundation investigation report. The northings and easting coordinates for these boreholes were then obtained from the current drawing. The co-ordinates of the boreholes from the 1981 investigation have been estimated in a similar manner as the co-ordinates on the 1981 borehole records were provided in a different co-ordinate system than currently being used. In this regard, the borehole locations, co-ordinates and some borehole elevations displayed on Drawing 1 should be considered to be approximate.

Subsurface Conditions

The following provides a summary of the subsurface conditions encountered during the 1957 investigation for the overpass structure. Additional details regarding the descriptions of the major soil strata as well as information on the depth to, and type of, bedrock present at the site has been supplemented based on the information contained in the 1981 foundation investigation report for the Highway 7/115 WBL overpass structure.

■ Silty Sand to Silty Sand Topsoil

A surficial layer of silty sand, sometimes described as silty sand topsoil, was encountered at all boreholes advanced during the 1957 investigation. This deposit was noted to contain gravel in some areas.

The surficial silty sand/silty sand topsoil was typically less than 1 m in thickness.

Standard Penetration Test (SPT) N' resistance values measured within the silty sand deposits varied from 3 to 25 blows per 0.3 m of penetration suggesting these materials are very loose to compact.

The silty sand topsoil unit has been displayed on the Soil Strata Section on Drawing 1; however, it is noted that topsoil materials may have been stripped as part of the highway embankment and overpass construction activities.

■ Sandy Clay/Clayey Sand (Inferred Glacial TILL)

The silty sand deposits are typically underlain by deposits of sandy clay and clayey sand containing varying amounts of gravel.

The 1957 foundation report does not describe these near-surface deposits as glacial till; however, the 1981 report identifies that the materials underlying the topsoil layer consist of glacial till and the gradation envelope for these materials suggests that these deposits contain clay to gravel sized particles and are generally well-graded. Based on this information, it is inferred that the sandy clay/clayey sand deposits represent glacial till materials which likely contain cobbles and boulders.

SPT N' resistance values measured within the sand clay/clayey sand till deposits varied from 8 to 100 blows per 0.3 m of penetration suggesting these materials have a stiff to hard consistency.

The sandy clay/clayey sand till deposits were typically encountered to depths of about 4 m to 5.5 m below ground surface except at Borehole BH2 where the base of these materials was encountered at a depth of 2.5 m below ground surface.

■ Silty Sand to Silty Sand and Gravel (Glacial TILL)

The sandy clay/clayey sand till deposits are underlain by coarser till deposits typically described as clayey silty sand and gravel in the 1957 report and as a heterogeneous mixture of silt, sand and gravel with a trace of clay in the 1981 report. The 1981 investigation report identifies an increase in the quantity of gravel as well as cobbles and boulders with depth, starting at an elevation of 191.2 m to 193.3 m.

SPT 'N' resistance values measured within the lower, coarser portion of the till deposits varied from 14 to greater than 100 blows per 0.3 m indicating these materials are compact to very dense.

All boreholes in the 1957 investigation were terminated within the glacial till deposits at final depths of between about 8 m and 11.5 m below ground surface. The base of the till deposits were encountered at depths of 13.3 m to 14 m below ground surface, corresponding to elevations of approximately 186 m to 186.3 m, within the boreholes advanced to the north of the site during the 1981 investigation.

■ **Sand and/or Gravel Interlayers**

Interlayers/zones of granular soils were encountered sporadically and at varying elevations within the till deposits. Where encountered, these granular soil zones were typically varied from less than 1 m to 3 m in total thickness and ranged in composition from sand to gravel.

SPT "N" values measured within the granular deposits varied from 32 to greater than 100 blows per 0.3 m of penetration indicating these materials are dense to very dense.

■ **Refusal and Bedrock**

Practical refusal to augering was encountered within the glacial till at two boreholes during the 1981 investigation. Refusal was encountered at depths varying between about 13.3 m to 14.0 m below the existing ground surface. Refusal likely indicates the bedrock surface; however, it could also represent cobbles and/or boulders within the overburden soils.

Bedrock, verified by coring, was encountered in the remaining two boreholes of the 1981 investigations. The bedrock was encountered at depths varying from about 13.3 m and 14.0 m below the existing ground surface corresponding to elevations of about 186 m to 187 m.

These two boreholes were extended into the bedrock using rotary diamond drilling techniques. The bedrock was described as light grey, fine grained to lithographic, sound limestone bedrock containing irregular very thin seams of dark grey shale.

■ **Groundwater Conditions**

Water levels measured during the 1957 investigation were generally in the range of 2 m to 3 m below ground surface. Measurements taken in October 1981 indicated water levels to be at elevations of approximately 198.5 m.

It should be noted that groundwater levels are expected to fluctuate seasonally and over time. Higher groundwater levels are expected during wet periods of the year, such as spring. Further, current groundwater levels at the site may vary significantly from the measurements taken more than 30 years ago.

PART B – PRELIMINARY FOUNDATION DESIGN

This section of the technical memorandum provides preliminary foundation design recommendations for the proposed rehabilitation of the overpass structure located at the crossing of Highway 7/115 over the CN Rail Line southeast of Peterborough, Ontario (Site No. 26-081).

The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the previous subsurface investigation at the site, information contained on the available structural drawings for the underpass structure as well as information provided to us by Dillon. The interpretation and recommendations provided in this report are intended only to provide the designers with information to assess the feasible foundation alternatives for the proposed overpass rehabilitation. As such, where comments are made on construction they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

Existing Structure and Proposed Rehabilitation

Based on information contained on available structural design drawings, the following provides details on the foundations of the existing structure:

- The existing underpass is a three-span structure constructed in the late 1950's which has an overall length of approximately 47 m and a width of approximately 10 m.
- The abutment and associated wingwalls on each side of the structure are supported on a series of eighteen, BP 12 x 53 (HP 310x79) steel piles that are situated in a u-shaped pattern with two lines of piles. The tips of the piles in the front line (nearest the rail corridor) are inclined/battered towards the rail tracks at an angle of 3 horizontal to 12 vertical (1H:4V). The underside of the abutment pile caps are located at elevations of approximately 204 m to 204.5 m. The northeast abutment piles are understood to be 38 feet (~11.6 m) in length while the southwest abutment piles are understood to be 40 feet (~12.2 m) long.
- The pier foundations are each supported on a series of 24, BP 12 x 53 (HP 310x79) steel piles situated in three lines. The tips of the exterior lines of piles are inclined away from the piers at angles of 1 horizontal to 12 vertical (1H:12V). The underside of the pile caps for the piers are located at elevations of approximately 196.5 m to 197 m. The northeast pier piles are understood to be 14 feet (~4.3 m) in length while the southwest pier piles are understood to be 19 feet (~5.8 m) long.

The 1957 RMAL Foundation Report suggests that the soils below a depth of approximately 2.4 m could support a bearing value of 4000 p.s.f. (~192 kPa) and provided recommended founding elevations of between about 194.5 m and 198 m for shallow foundations. The RMAL report did not discuss pile foundation options. The available structural drawings do not indicate the design loads of the piles or information related to the pile driving operations (e.g., pile driving records, hammer energy requirements/specifications, set final set requirements, etc.).

Based on information provided by Dillon, it is understood that consideration is being given to the following improvements to the structure:

- Removing existing barriers, asphalt, deck, approach slabs, steel girders and bearings;
- Conducting patch repairs on the piers and abutments;
- Retrofitting the existing abutments for a semi-integral deck;
- Installing new bearings and girders;
- Constructing a new deck and barrier walls; and,
- Constructing new approach slabs.

Dillon has provided the following preliminary information regarding the existing and post-rehabilitation loading conditions (based on Section 3 load factors) for the piers of the underpass structure:

	Original Conditions Maximum Axial Pile Loads	Existing Conditions (1986 Rehabilitation) Maximum Axial Pile Loads	Rehab – Continuous Structure Maximum Axial Pile Loads	Rehab – Simply Supported Structure Maximum Axial Pile Loads
SLS	247 kN	302 kN	360 kN	338 kN
ULS1	397 kN	449 kN	478 kN	452 kN
ULS2	387 kN	456 kN	542 kN	507 kN

It is further understood that the maximum loads to be supported by the abutment piles at Serviceability Limit States (SLS) will increase from about 242 kN per pile (existing conditions) to 267 kN per Pile (post rehabilitation conditions) while the maximum factored load to be supported by an individual abutment pile at Ultimate Limit States (ULS) conditions will increase from 329 kN (existing conditions) to 365 kN (post rehabilitation conditions for a simply supported structure).

Preliminary Foundation Engineering Design Input

The following provides preliminary comments regarding the geotechnical resistance values that can be supported by the existing underpass foundations. The information in this memo is preliminary in nature and should be reviewed, and modified as necessary during detailed design, once the loading conditions for the rehabilitation works have been finalized.

Abutment Foundations

The abutment and associated wingwalls on each side of the structure are supported on a series of eighteen, BP 12 x 53 (HP 310x79) steel piles that are situated in a u-shaped pattern with two lines of piles.

The underside of the abutment pile caps are located at elevations of approximately 204 m (northeast abutment) to 204.4 m (southwest abutment). The northeast abutment piles are understood to be 38 feet (~11.6 m) in length while the southwest abutment piles are understood to be 40 feet (~12.2 m) long.

Glacial till deposits were typically encountered above an elevation of 198 m with the till deposit below an elevation of about 195 m comprised of dense to very dense silty sand and gravel. Based on this information, the piles are inferred to have been driven up to 6 m into the till deposits (including 2 m to 3 m into the dense to very dense sand and gravel till) or to have encountered effective refusal to driving in the till.

Based on the available information, the existing 12.2 m long, HP 310x79 piles that are understood to have been driven into the dense to very dense till are considered capable of supporting a factored geotechnical resistance at Ultimate Limit States (ULS) in excess of 800 kN which is significantly larger than the maximum proposed load of 365 kN at ULS.

The geotechnical reaction at SLS will not govern and may be higher than the factored geotechnical resistance at ULS. Furthermore, it is understood that the proposed rehabilitation will result in a load increase of about 25 kN per abutment pile under SLS conditions. The incremental settlement of the abutment pile foundations resulting from this proposed load increase is expected to be less than 5 mm for these piles founded in the very dense till.

Based on the above, the existing abutment piles are considered capable of support of the loadings at SLS and ULS that are required for the rehabilitated structure.

Existing Pier Foundations

The foundations for the piers of the existing underpass structure consist of 13.4 m long by 2.6 m wide pile caps each supported by a series of 24 HP 310x79 piles. The underside of the pile caps for the piers are located at elevations of approximately 196.5 m to 197 m. The northeast pier piles are understood to be 14 feet (~4.3 m) in length while the southwest pier piles are understood to be 19 feet (~5.8 m) long.

Based on this information, the piles for the piers are inferred to have been driven around 4 m to 5.5 m into the till deposits (including about 2 m or more into the dense to very dense sand and gravel till) or to have encountered effective refusal to driving in the till.

The maximum post-rehabilitation pile loads for the pier piles under ULS conditions are understood to range from 507 kN (for a simply supported structure) to 542 kN (for a continuous structure) with the maximum pile load under ULS conditions for the existing bridge configuration being about 456 kN.

Based on the available information, the existing 4 m long, HP 310x79 piles that are understood to have been driven into the dense to very dense till are considered capable of supporting an unfactored geotechnical resistance at Ultimate Limit States (ULS) of about 1200 kN.

Typically, a geotechnical resistance factor of 0.4 is applied to the unfactored resistances calculated using static analysis methods for piles in compression. This would result in a factored geotechnical resistance at ULS of approximately 480 kN which is about 95 percent of the proposed maximum post-rehabilitation loads for the proposed simply supported structure configuration. A geotechnical resistance factor of approximately 0.425 would result in the factored resistances at ULS being larger than the maximum proposed pile load for the continuous structure configuration.

Given the relatively limited load increase (over existing conditions) planned and the satisfactory foundation performance of the bridge to date, the existing pier foundations are considered suitable for support of the loadings required for the rehabilitated structure. It is recommended that the additional loads associated with the rehabilitation be minimized and, as such, the use of a simply supported structure is recommended over the continuous structure.

The geotechnical reaction at SLS will not govern and may be higher than the factored geotechnical resistance at ULS. Furthermore, it is understood that the proposed rehabilitation, assuming a simply supported structural configuration, will result in a load increase of about 25 kN per abutment pile under SLS conditions. The incremental settlement of the pier pile foundations resulting from this proposed load increase is expected to be less than 5 mm for these piles founded in the very dense till.

The founding levels of the existing pile cap foundations are in the range of 2 m or more below the railway grade, and therefore, satisfy the minimum founding depth for frost protection purposes.

OTHER CONSIDERATIONS

Deformation of the existing stone and concrete embankment slope face protection beneath the structure, including cracking and occasional loss of stone, was noted during the site reconnaissance.

Ongoing deterioration of the slope face protection could eventually impact the performance of the structure or result in downslope movement of soils on the slope face with the potential to impact the performance of the railway drainage ditches at the toe of the slopes. Therefore, it is recommended that slope protection measures be repaired or reinstated.

CLOSURE

This technical memorandum was prepared by Mr. Kevin Nelson, P.Eng. Mr. Fin Heffernan, P.Eng., a Designated MTO contact for Golder, conducted an independent review of the technical memorandum.

We trust this memo meets with your current requirements. If you have any questions concerning this memo, please contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

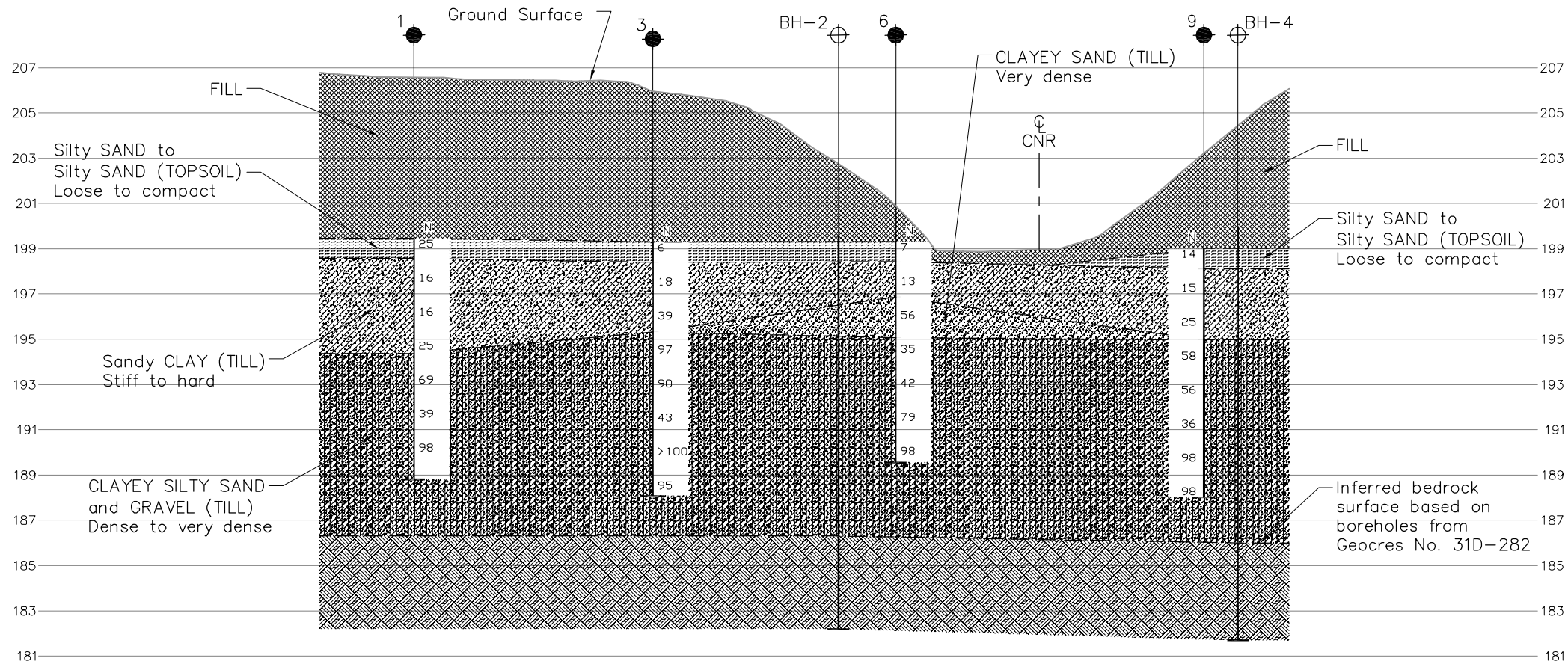
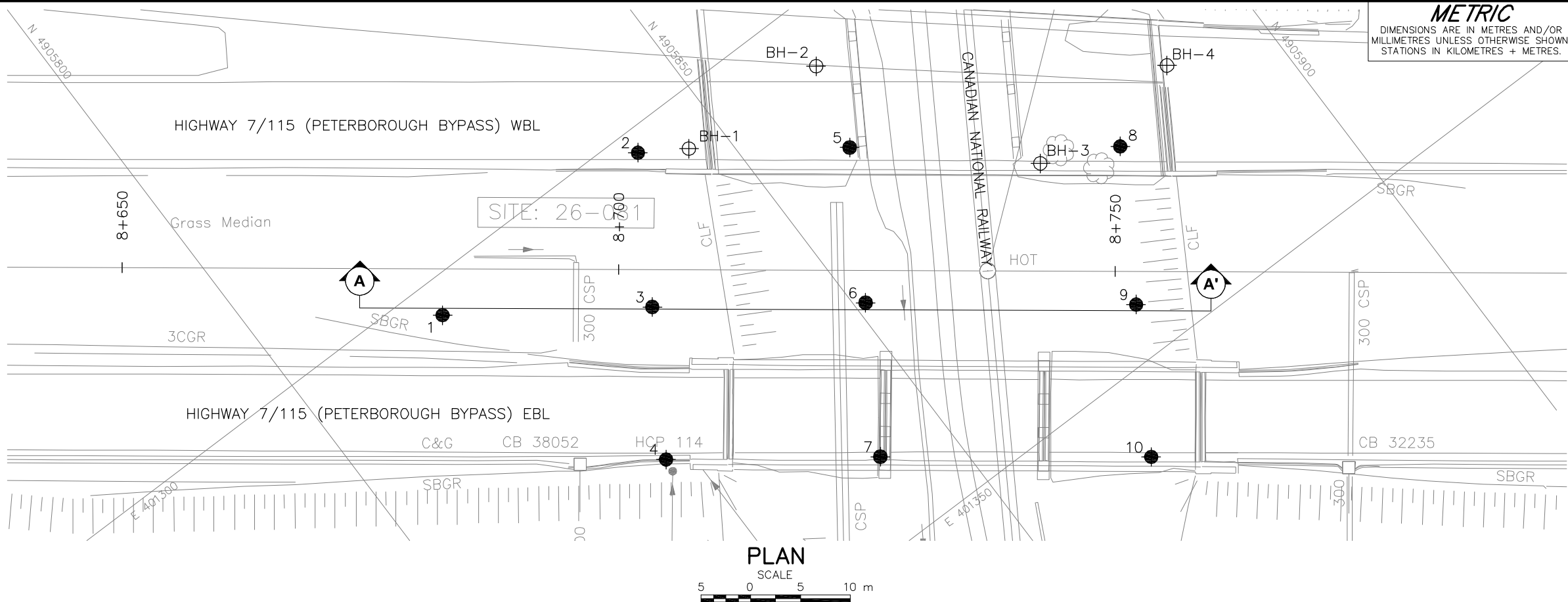
Kevin Nelson, P.Eng.
Associate, Geotechnical Engineer

Fintan Heffernan, P.Eng.
Designated MTO Foundations Contact

KN/FJH/md

n:\active\2012\1121 - geotechnical\12-1121-0193 dillon mega 3 eastern region\foundations\5 - reports\contract j - cnr overhead 26-081\12-1121-0193-1240 tm-001 dillon mega 3 cnr hwy 7&115 overhead february 2015.docx

Attachments: Drawing 1 – Bridge Rehabilitation – CNR Overpass Highway 7/115 – Borehole Locations and Soil Strata
Attachment A – MTO GEOCRETS Information



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

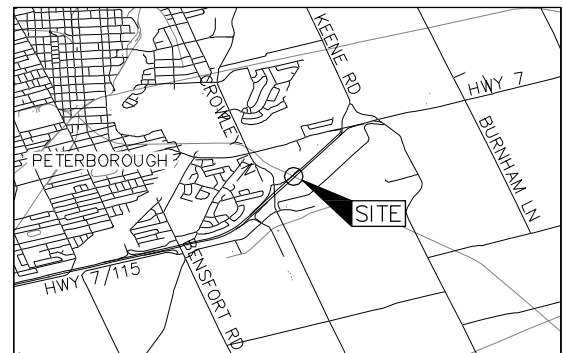
CONT No.
WP No. 4167-11-01

BRIDGE REHABILITATION
C.N.R. OVERPASS - HIGHWAY 7/115
BOREHOLE LOCATIONS AND SOIL
STRATA

SHEET



Golder Associates Ltd.
OTTAWA ONTARIO, CANADA



KEY PLAN



LEGEND

- Approximate Borehole Location - 1957 Investigation (Geocres No. 31D-54)
- Approximate Borehole Location - 1981 Investigation (Geocres No. 31D-282)
- N Standard Penetration Test Value
- Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
1	199.5	4905816.4	401303.5044
2	199.7	4905841.9	401302.3361
3	199.3	4905833.7	401315.5969
4	198.7	4905825.5	401328.6825
5	199.5	4905859.2	401314.7896
6	199.3	4905851.1	401328.2256
7	198.8	4905842.9	401341.4865
8	200.0	4905881.0	401331.1524
9	199.0	4905872.7	401344.8222
10	198.6	4905864.6	401357.9662
BH-1	199.7	4905846.3	401305.1087
BH-2	199.6	4905861.5	401306.2257
BH-3	199.4	4905873.6	401327.6640
BH-4	200.0	4905889.7	4905889.6901

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plan provided in digital format by Dillon, drawing file no. B Plan.dwg and 4167_4168-Photogrammetry.dwg, received April 7, 2014.

NO.	DATE	BY	REVISION
Geocres No. PROJECT NO. 12-1121-0193-1240 DIST.			
HWY. 401	CHKD. KN	DATE: 7/30/2014	SITE: 26-081
SUBM'D. KN	CHKD. KN	APPD. FJH	DWG. 1
DRAWN: JM	CHKD. KN	APPD. FJH	DWG. 1

DRAFT

ATTACHMENT A

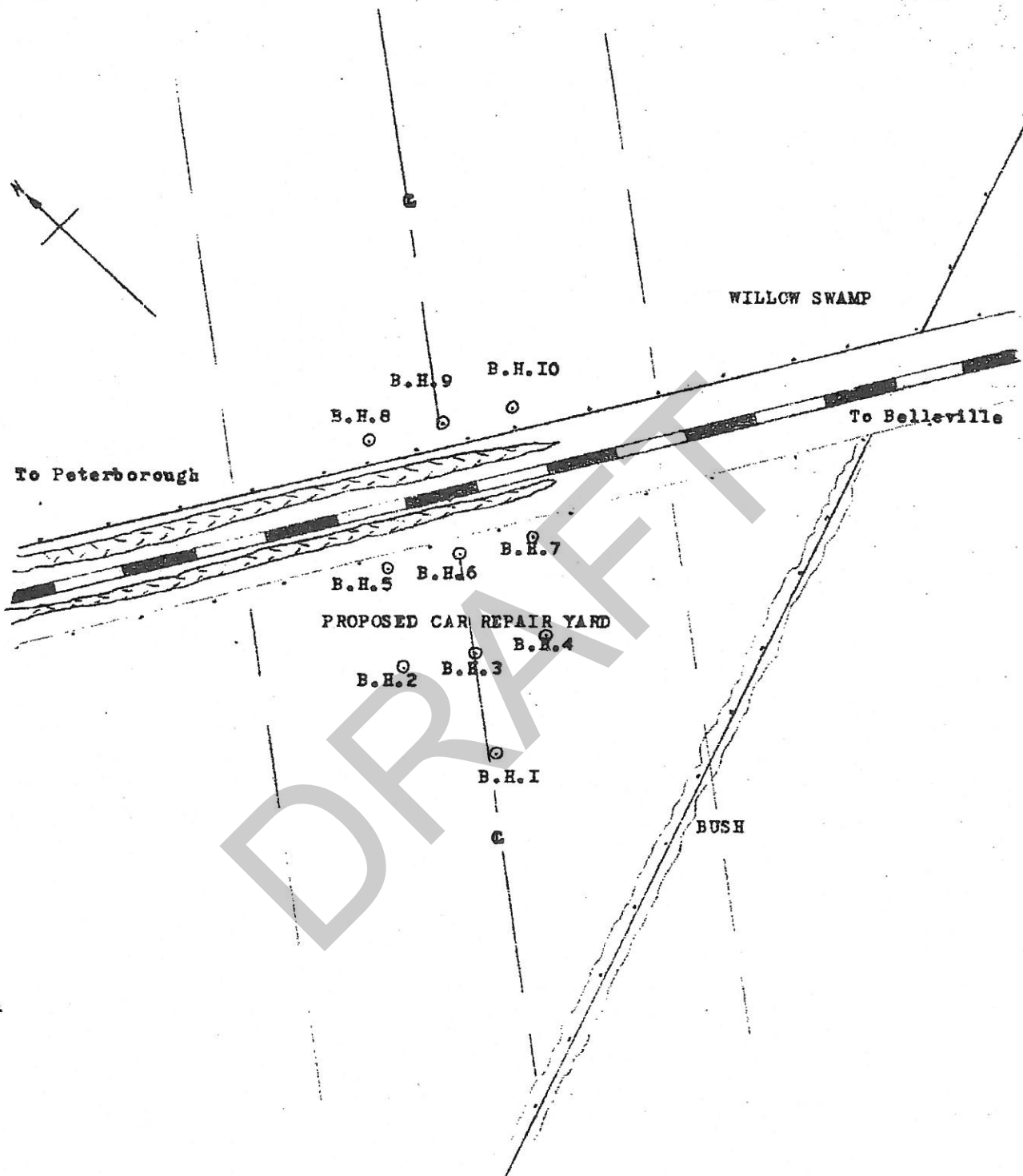
MTO GEOCRES Information

DRAFT

Order No. S 500/T-862

Enclosure No. I

Prep. By P.M.



Scale 1" to 100'

PLAN SHOWING LOCATION
OF BOREHOLES AT SITE
OF PROPOSED CNR OVERPASS
IN OTONABEE TOWNSHIP
NEAR PETERBOROUGH

Racey, MacCallum & Associates Ltd.

Order S-500/T 862 RACEY, MACCALLUM AND ASSOCIATES

P.V.

LIMITED

Hole Begun 4/9/57

Foundation Engineering Division

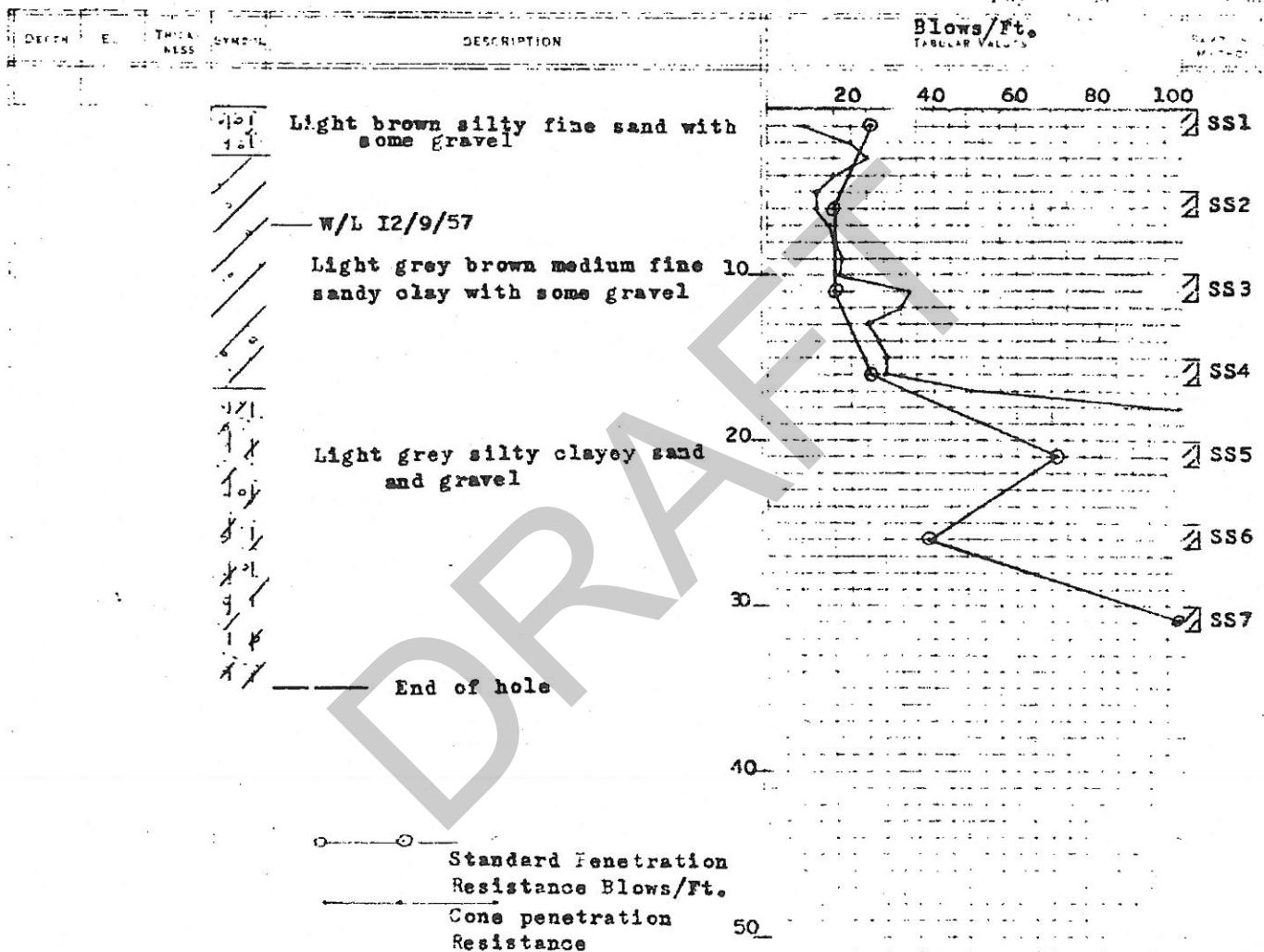
Hole Ended 5/9/57 Engineering Data Sheet for Borehole: # I

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: OTONABEE TOWNSHIP NEAR BETERBOROUGH, ONTARIO.

Hole Located: SEE ENCLOSURE NO. 1

Hole Elevation: SEE REPORT Datum: GEODETIC



Order No.: S-500/T-862

RACEY, MacCALLUM AND ASSOCIATES

ENCLOSURE NO. 4
P. VIDAL

LIMITED

Hole Begun 5/9/57

Foundation Engineering Division

Hole Ended 6/9/57

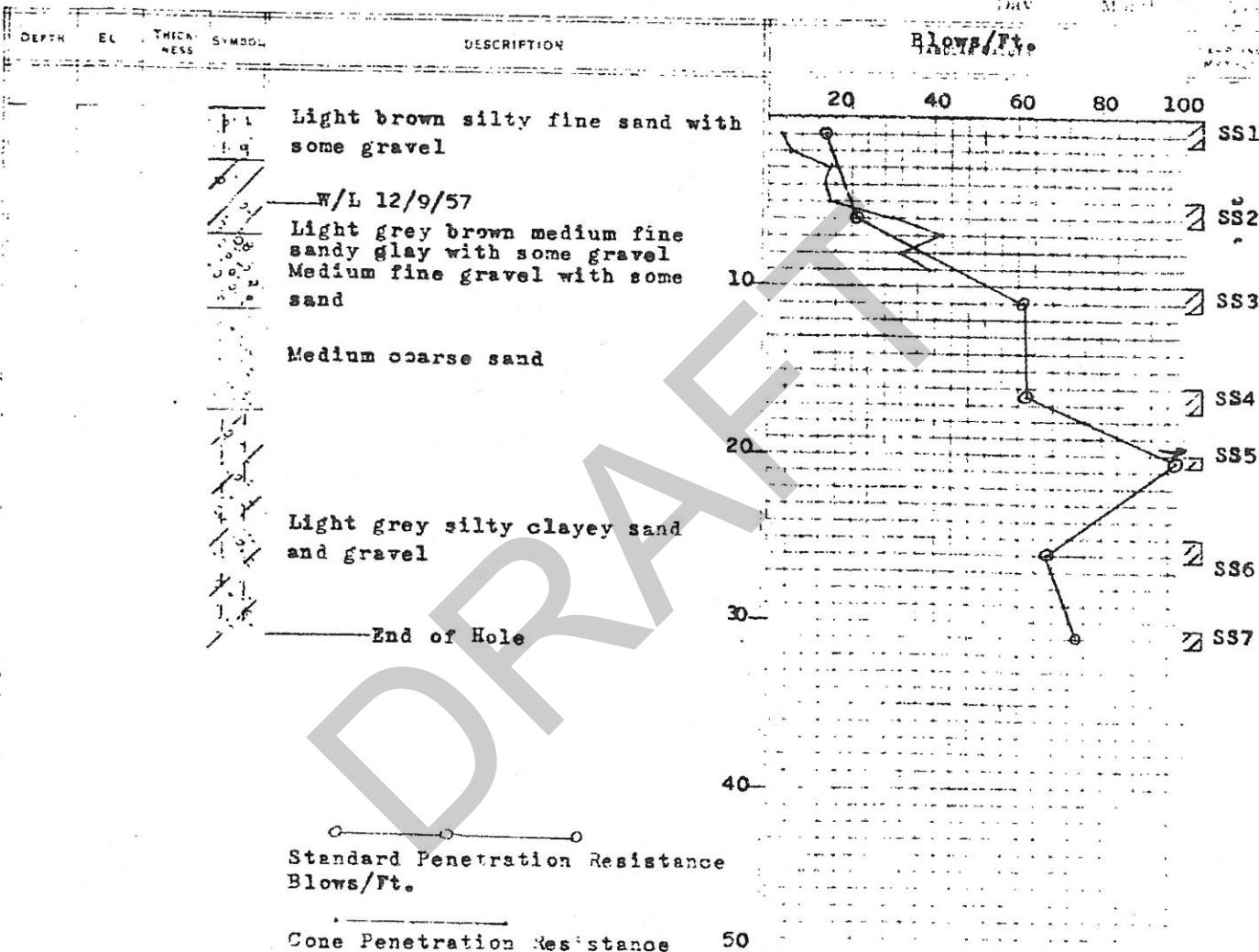
Engineering Data Sheet for Borehole: 2

Job Name: CNR OVERPASS FOUNDATION INVESTIGATION

Job Located: NEAR PETERBOROUGH ONTARIO, OTONABEE TOWNSHIP

Hole Located: SEE ENCLOSURE NO. 1

Hole Elevation: SEE REPORT Datum: GEODETIC



Order No. S-500/T-862

RACEY, MACCALLUM AND ASSOCIATES

LIMITED

Hole Begun 9/9/57

Foundation Engineering Division

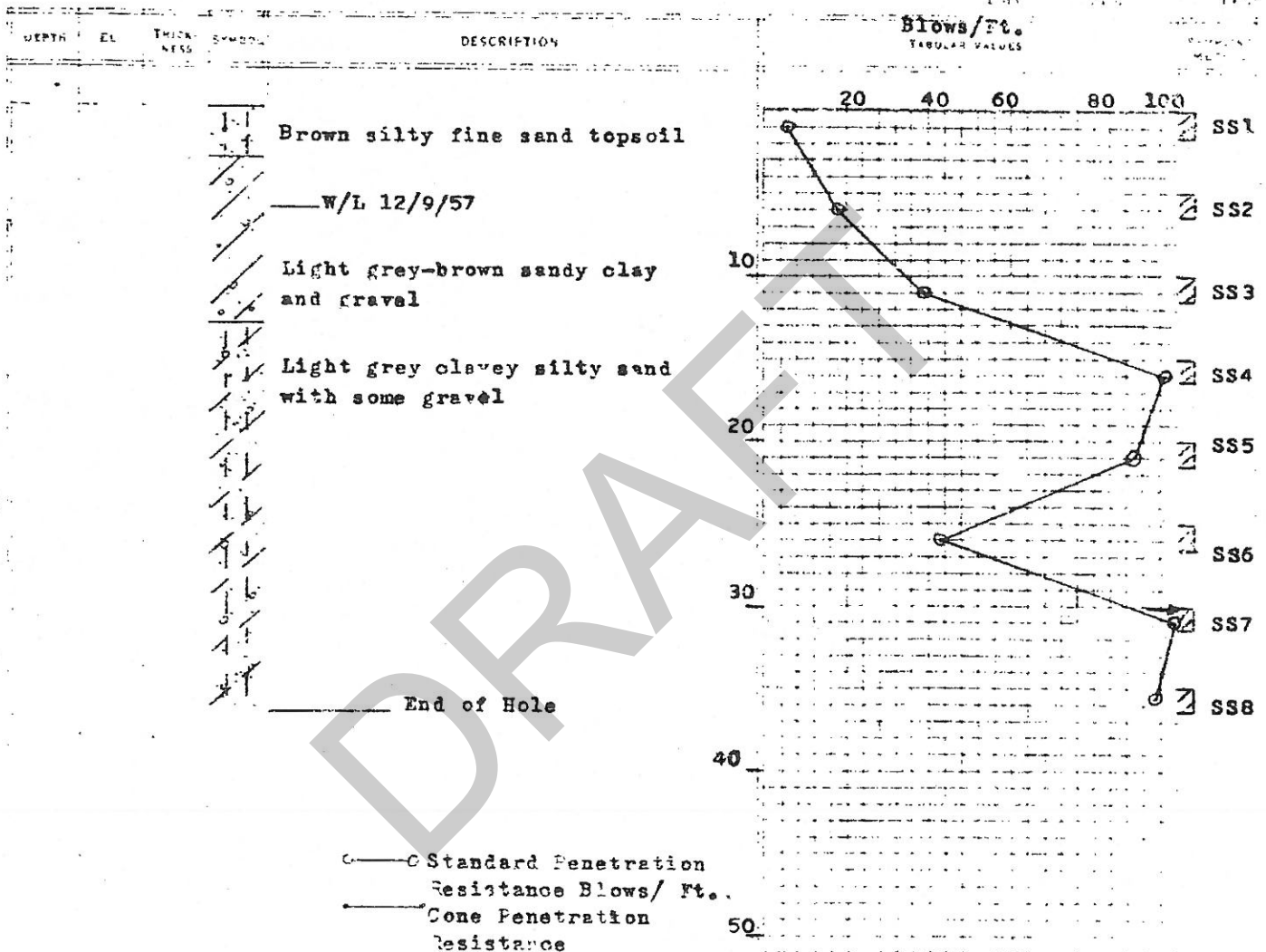
Hole Ended 9/9/57 Engineering Data Sheet for Borehole: 3

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: NEAR PETERBOROUGH ONTARIO. OTONABEE TOWNSHIP

Hole Located:

Hole Elevation: SEE REPORT Datum: GEODETIC



Order No: S-500/T-862 RACEY, MACCALLUM AND ASSOCIATES

Enclosure No. 6

LIMITED

Hole Begun 9/9/57

Foundation Engineering Division

Hole Ended 9/9/57

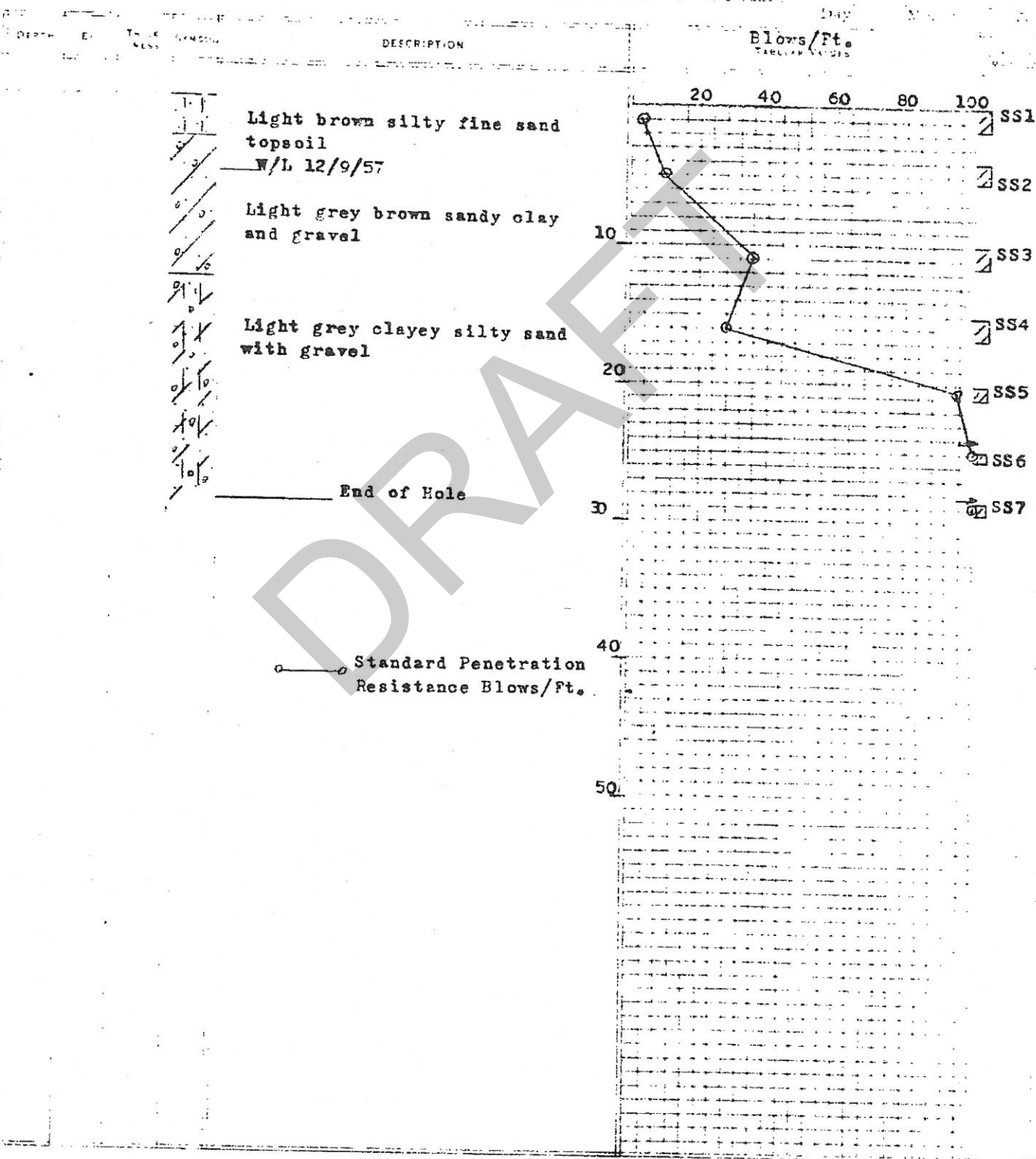
Engineering Data Sheet for Borehole: 4

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Location: NEAR E. TEBBOROUGH ONTARIO. OTCHABEE TOWNSHIP

Hole Located:

Hole Elevation: SEE REPORT Datum: GEODETIC



Order No.: S-500/T-862 RACEY, MACCALLUM AND ASSOCIATES

Enclosure No. 7

LIMITED

Hole Begun 11/9/57

Foundation Engineering Division

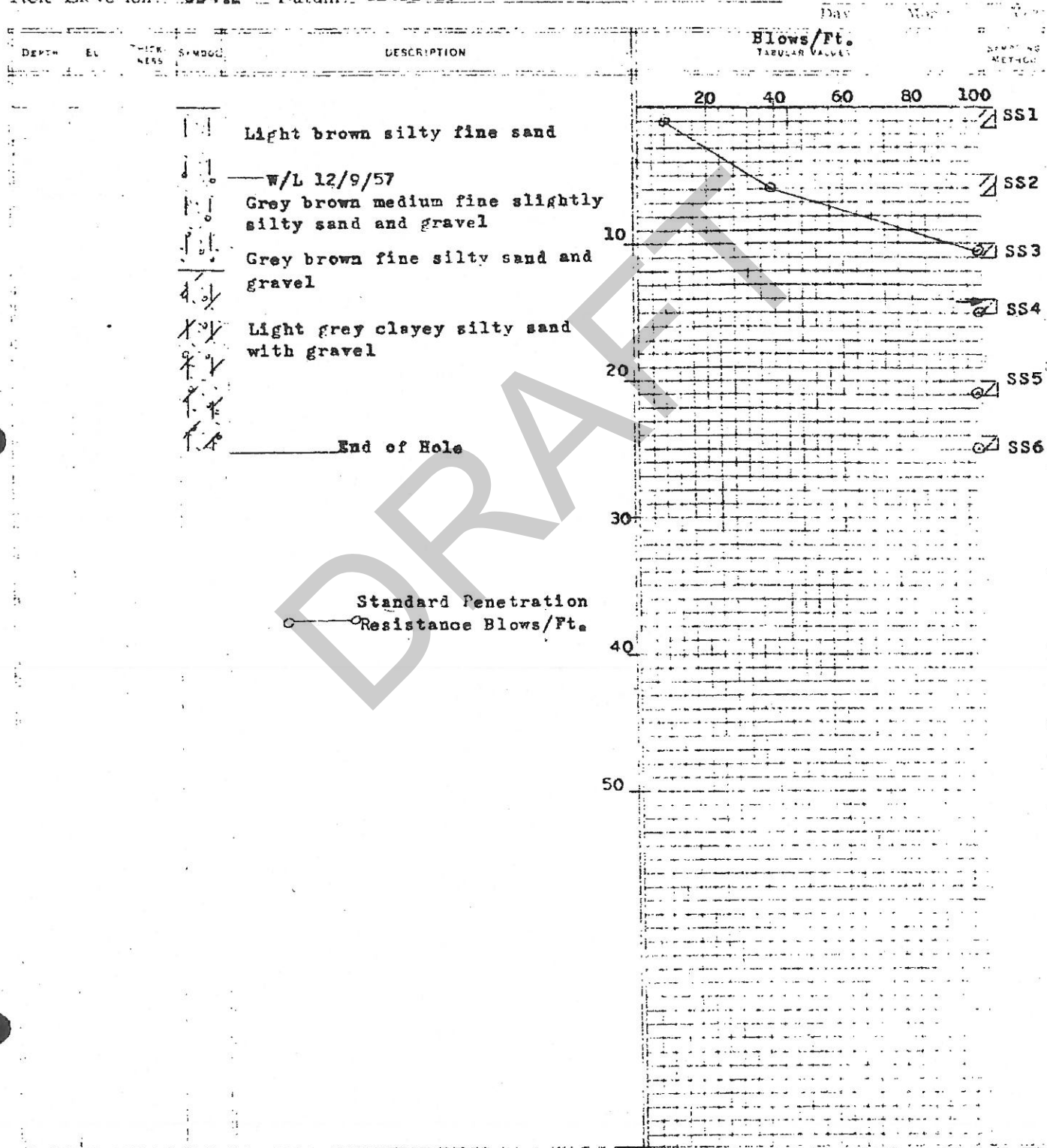
Hole Ended 11/9/57 Engineering Data Sheet for Borehole: 5

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: NEAR PETERBOROUGH, ONTARIO, OTONABEE TOWNSHIP

Hole Located:

Hole Elevation: 654.2 Datum: GEODETIC



Order No.: S-500/T-862

Enclosure No. 8

RACEY, MACCALLUM AND ASSOCIATES

LIMITED

Hole Begun 10/9/57

Foundation Engineering Division

Hole Ended 10/9/57Engineering Data Sheet for Borehole: 6

Hole No.

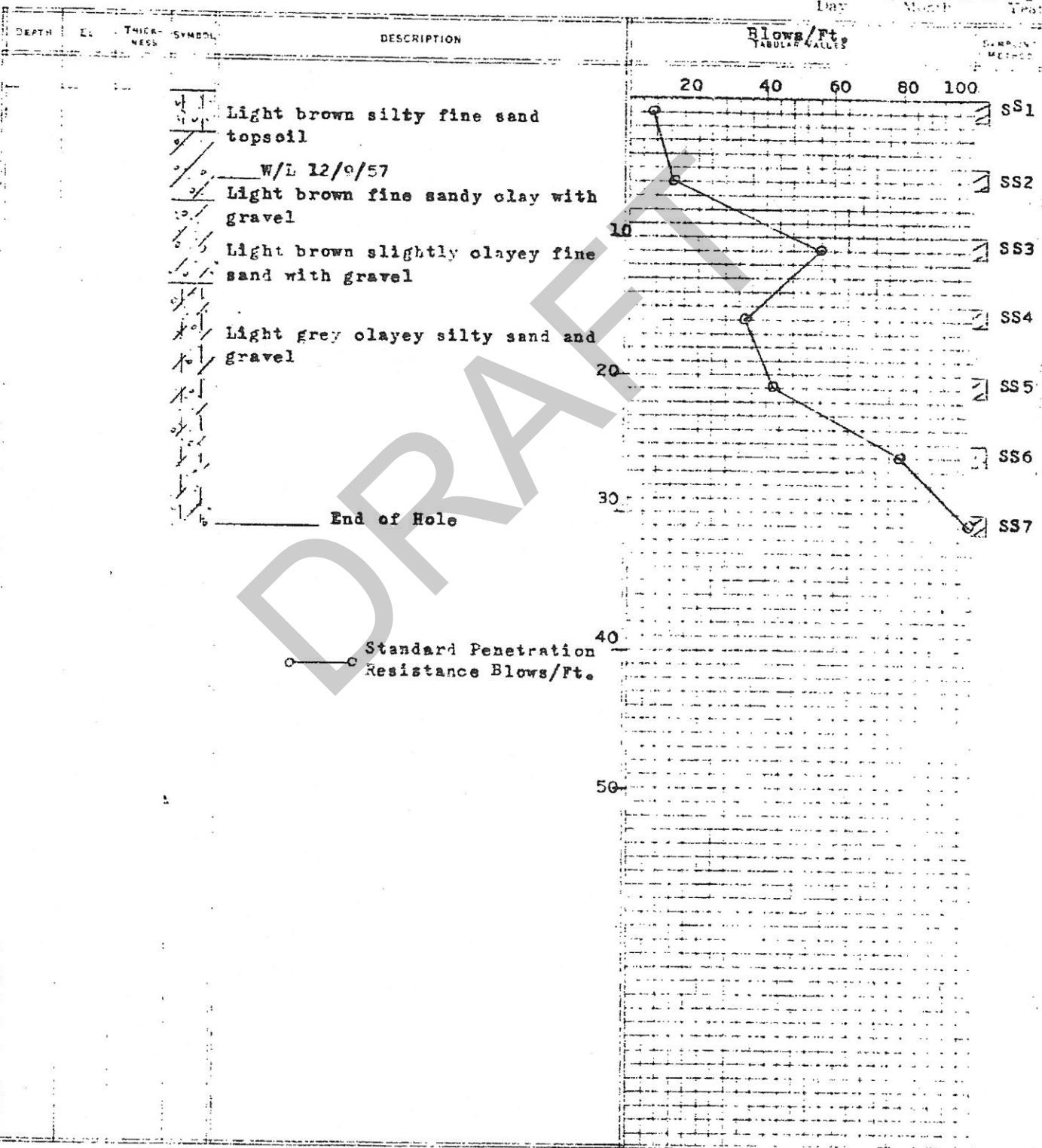
Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASSJob Located: NEAR PETERBOROUGH, ONTARIO, OTONABEE TOWNSHIP

Hole Located: _____

Hole Elevation: 653.5 Datum: GEODETTIC

Checked by _____

Day _____ Month _____ Year _____



Order No.: S-500/T-862 RACEY, MACCALLUM AND ASSOCIATES

Enclosure No. 9

LIMITED

Hole Begun 10/9/57

Foundation Engineering Division

Hole Ended 10/9/57

Engineering Data Sheet for Borehole: 7

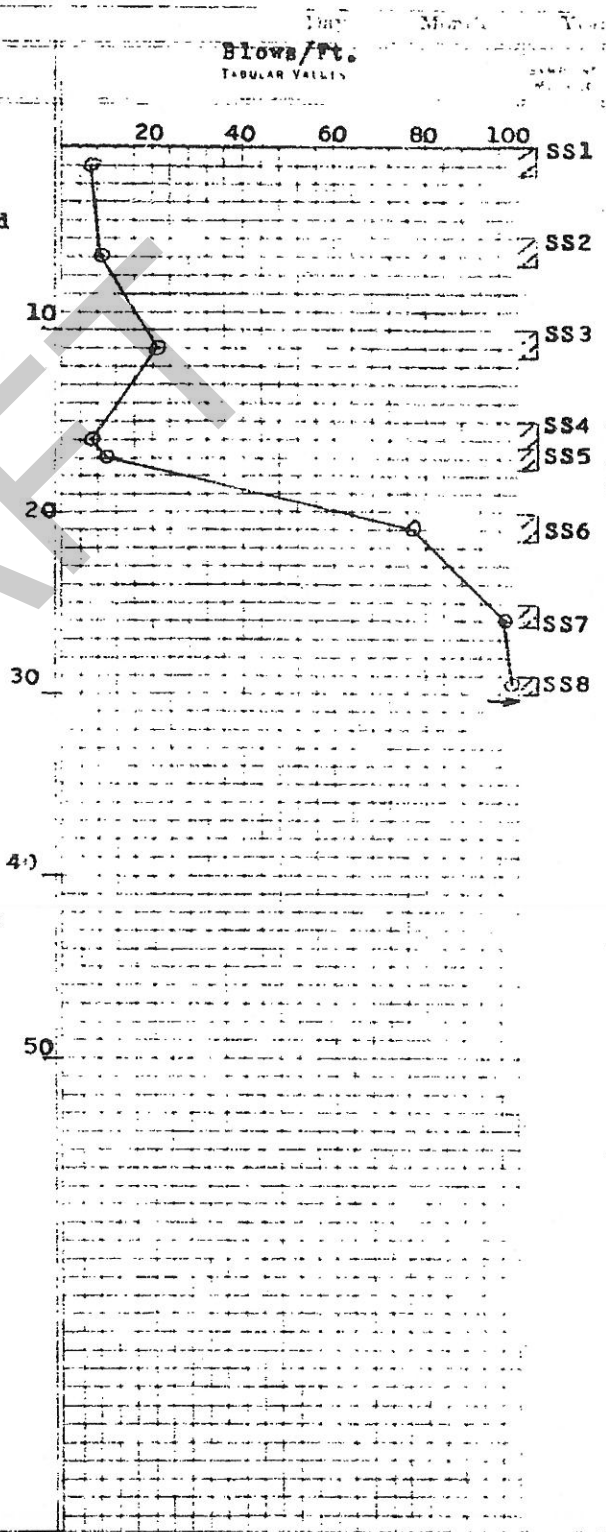
Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: NEAR PETERBOROUGH, ONTARIO. OTONABEE TOWNSHIP

Hole Located: _____

Hole Elevation: 651.9 Datum: GEODETIC

DEPTH	THICKNESS	SYMBOL	DESCRIPTION
			Light brown silty sand topsoil
			Dark brown clayey med-fine sand and fine gravel
			W/L 12/9/57
			Light brown medium fine sandy clay and gravel
			Light grey clayey silty sand and gravel
			Medium coarse sand
			End of Hole



Order No.: S-500/T-862

Enclosure No. 10

RACEY, MacCALLUM AND ASSOCIATES

LIMITED

Hole Begun 11/9/57

Foundation Engineering Division

Hole Ended 11/9/57

Engineering Data Sheet for Borehole: 8

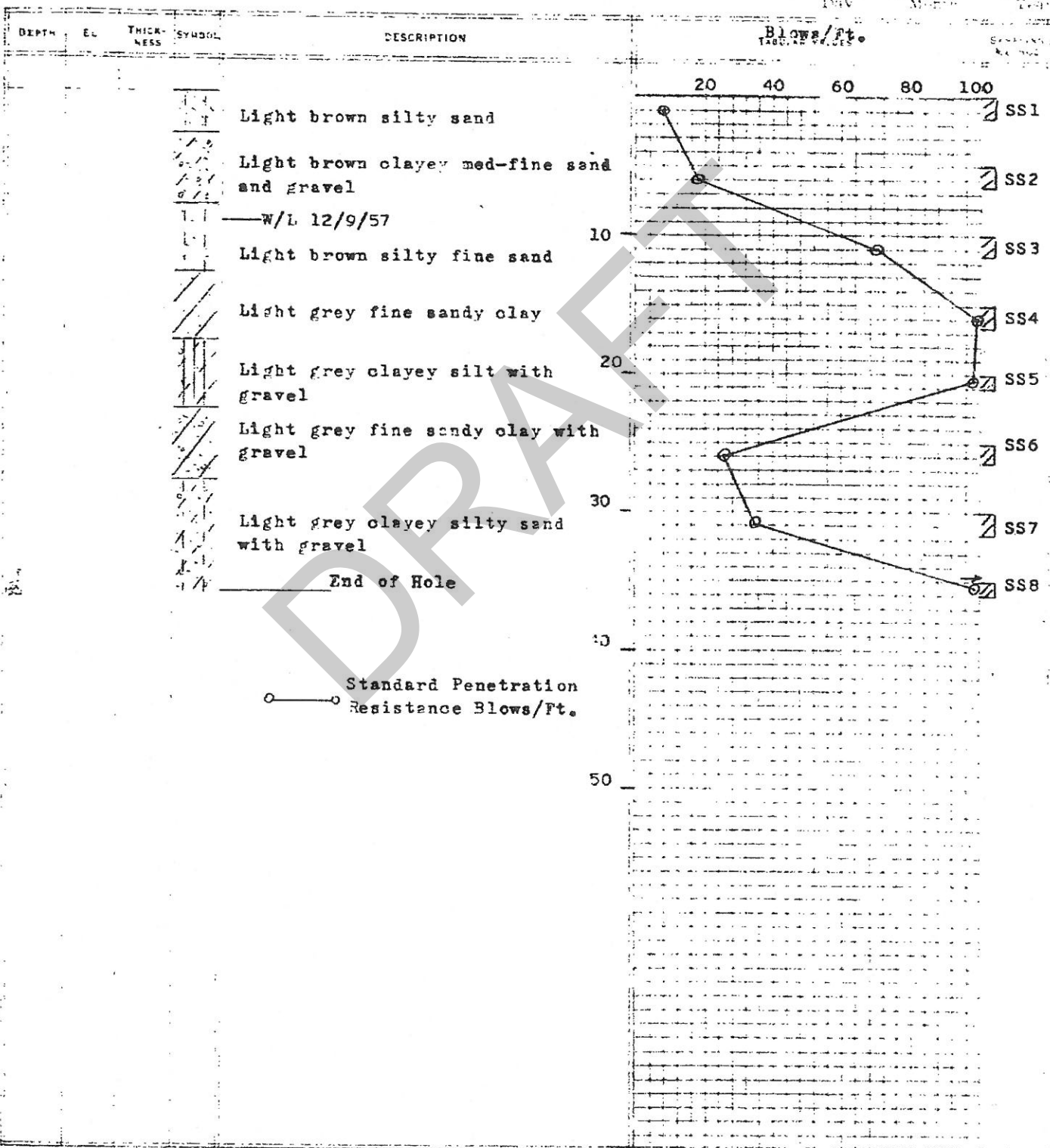
Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: ORONABEE TOWNSHIP PETERBOROUGH, ONTARIO

Hole Located:

Hole Elevation: 655.6 Datum: GEODETIC

Checked by



Order No. S-500/T-862

Enclosure No. 11

RACEY, MACCALLUM AND ASSOCIATES
LIMITED

Hole Begun 12/9/57

Foundation Engineering Division

Hole Ended 12/9/57

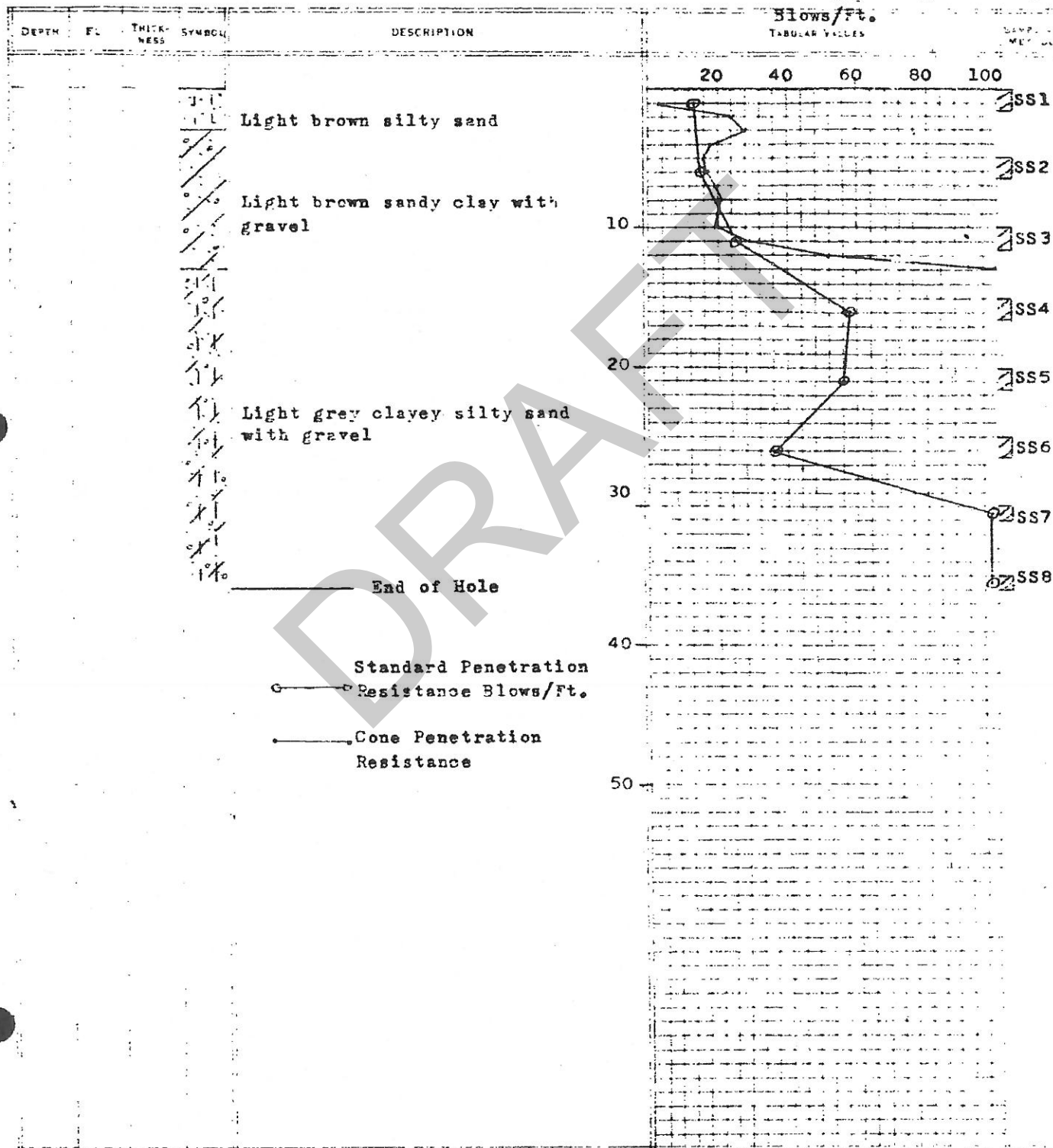
Engineering Data Sheet for Borehole: 9

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: OTONABEE TOWNSHIP NEAR PETERBOROUGH, ONTARIO

Hole Located: _____

Hole Elevation: 652.5 Datum: GEODETTIC



Order No. S-500/T-862 RACEY, MACCALLUM AND ASSOCIATES

Enclosure No. 12

LIMITED

Hole Begun 12/9/57

Foundation Engineering Division

Hole Ended 12/9/57 Engineering Data Sheet for Borehole: 10

Job Name: FOUNDATION INVESTIGATION FOR C.N.R. OVERPASS

Job Located: OTONABEE TOWNSHIP NEAR PETERBOROUGH, ONTARIO

Hole Located: _____

Hole Elevation: 651.2 Datum: GEODETIC

Checked by _____

