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GEOCRES No. 32D-6

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 66

LOCATION O.N.R. O'PASS
KING KIRKLAND,

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS:

BA 727

32 D - 6

TROW, SODERMAN AND ASSOCIATES
SITE INVESTIGATIONS
AND
SOIL MECHANICS CONSULTATION

W. A. TROW, M.ASC., M.E.I.C., P.ENG.
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884 WILSON AVE., DOWNSVIEW
ST. 8-5921

Project: C108/J194

April 10, 1958.

Mr. A. M. Toye,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
Toronto, Ontario.

Attention: Mr. S. McCombie

Foundation Investigation
Ontario Northland Railway Overpass
King Kirkland, Ont.

Dear Sirs:

Submitted herewith is our report on the subsoil conditions existing at the above proposed overpass location. Field work associated with this investigation was carried out during the period March 10th to March 16th, 1958. The attached report has been prepared by our Mr. K. Peaker, P. Eng., who personally directed the field work and assisted in the taking of samples and the performance of field penetration tests.

The principal comments and recommendations contained in the report are summarized for your convenience as follows:

(1) Bedrock consisting of sound metamorphic rock was encountered at shallow depths at each proposed abutment location. Footings founded on the bedrock surface can be safely designed using an allowable footing pressure up to 10 tons/sq.ft.

(2) At the south abutment location bedrock is overlain by not more than 4 feet of medium to coarse dry sand. No excavation difficulties appear possible at the abutment location.

At the north abutment location however, the depth of overburden varied from 6 to 9 feet. Water table elevation coincides with existing ground surface and sheet piling with adequate interior bracing is considered necessary to facilitate footing excavation.

(3) The granular soil types underlying the approach embankments are considered competent to support the resultant embankment pressures. Foundation preparation for the embankment along the north approach should include removal of the shallow compressible muskeg layer. A dragline

operation carried on with immediate back filling appears to be the most expedient means of removal and replacement. Foundation preparation for the south approach embankment should consist of nothing more than normal topsoil stripping.

We are pleased to have had this opportunity of being of service to you. Should questions arise with respect to information contained in this report, do not hesitate to call.

Yours very truly,

L. G. Soderman

Lawrence G. Soderman (P. Eng.)

LGS/lt
Encls.

DEPARTMENT OF HIGHWAYS OF ONTARIO
280 DAVENPORT ROAD,
TORONTO, ONTARIO.

FOUNDATION INVESTIGATION
ONTARIO NORTHLAND RAILWAY OVERPASS
KING KIRKLAND, ONATRIO.

C108/J194 April 10, 1958.

Trow Soderman and Associates

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ENCLOSURES

FOUNDATION INVESTIGATION
ONTARIO NORTHLAND RAILWAY OVERPASS
KING KIRKLAND, ONT.

Reported herein are the results of a boring program recently completed at the above-noted site. Comments regarding the competence of the subsoil for the support of abutment footings and approach embankments have been given.

Description of Site

The site investigated is situated on the Ontario Northland Railway, approximately 3.4 miles east of the town of Kirkland Lake. At this point, which is one-half mile south of the hamlet of King Kirkland the railway runs in a general east-west direction. The site is accessible by means of a summer trail to the King Kirkland railway station located approximately 500 feet east of the site of the overpass. The approaches to the overpass site are lightly treed with willows and poplar. Rock out-crops are visible to the north of the site and in all probability are present on the hill located 600 feet to the south. There are no fences at the site in question but hydro and telegraph lines pass overhead. The area immediately north of the track is covered by a layer of muskeg which would prove extremely difficult to cross during the summer. A small creek fed by a shallow lake approximately 800 feet to the north-east of the site flows through the muskeg keeping it saturated at all times. Normal traffic on the railway consists of three or four freight trains per day with the occasional passenger train.

Description of Field Work

The field work associated with this investigation was carried out during the period March 11th to March 15th. Five boreholes were put down and six dynamic cones were driven to refusal. The locations of these borings are shown in drawing No.1. Drilling was carried out using a conventional diamond drill adapted for soil sampling. In all the boreholes, except No. 5, the 3" casing was driven to a desired depth and then extracted. The soil retained inside the pipe yielded a continuous sample of the strata intersected. This sampling method proved satisfactory for depths up to 15 feet in materials having sufficient cohesion to prevent the borehole from caving in on withdrawal of the casing. Borehole No. 5 was terminated at a depth of 20½ feet and was advanced by alternately driving and washing 3" pipe. A standard 2" O.D. Split spoon driven with an energy equal to that specified in the Standard Penetration Test was used to obtain disturbed samples. No undisturbed samples or insitu vane tests were taken because of the granular nature of the soil.

Boreholes Nos. 1 and 2 encountered bedrock approximately 3½ feet below the surface. Core was taken in hole 1 to positively prove bedrock and to indicate the type of rock encountered. No core was obtained from boreholes Nos. 2 to 5. Refusal depth noted at these borehole locations is assumed bedrock contact.

Cone A was located between holes Nos. 3 and 4 to show that refusal depth was at consistent elevation underlying the north abutment location.

A borehole was not considered necessary on the southern approach because of the rise in the natural ground level an. the presence of rock near the surface. The granular material found in each of the boreholes indicates that embankment foundation instability will not be a problem.

No ground water was encountered in boreholes 1 and 2; in holes 3, 4, and 5, however, ground water was encountered at, or very near, the surface. The elevations of the boreholes were obtained by means of a hand level. All elevations were referenced to the top of rail at the proposed road and railway intersection.

The access road to the railway station was not in use at the time of the investigation and as a consequence, it was necessary to hire a bulldozer to clear the snow in order to bring the drilling equipment in to the site, the last 500 feet being covered by winch and cable.

Description of Soil Types

Descriptions of the soil types encountered are presented in drawings 3 to 7 and are summarized in the stratigraphical profile shown on drawing No. 2.

Organic Vegetation

This saturated partly decomposed organic layer was the predominant surface covering to the north of the railway track, and extended from the surface to a depth of 3 to 5 feet. In all probability this area is not passable in the summer months because of the soft nature of the material. The resistance to penetration offered by this stratum was almost nil; rods used to drive the cone sank under their own weight or were easily pushed to the contact of the underlying sand. The surface of this material would support light loadings because of the network of roots and plant life. Once the surface mantle was broken, however, the decomposed area beneath would offer little more than bouyant support.

Fine Sand and Coarse Silt

This layer of fine sand and coarse silt underlies the above described surface layer of organic vegetation. The stratum varies in depth from zero on the south side of the track to 14 feet at borehole No. 5. Evidence of oxidation in this layer was found in the borings adjacent to the railway track. The fine sand appears near the top of the stratum and gradually changes to a coarse silt near the bottom. The material exists in a dense state below elevation 1100.0 where the number of blows, "N", required to drive the cone averaged approximately 20. Above elevation 1100.0, a looser state was found to exist with "N" values ranging from 4 to 15. In this region occasional seams of medium grained sand were noted.

Medium and Coarse Sand

Medium and coarse sands were encountered from the ground surface to bed rock on the south side of the track. This sand was not saturated and was virtually free of silt and clay sizes except for the upper 6 to 8 inches where organics and fine silts existed as top soil. This stratum partially overlies (see Dwg. No.2) the fine sand and coarse silt and in all probability the transition from one layer to another is not abrupt. The medium and coarse sand exists in a loose to medium dense condition, as evidenced by penetration resistance measurements.

Coarse Grey Sand and Fine Gravel

This soil type was encountered at the bottom of borehole No.5, corresponding to elevation 1097.0 feet. It exists in a dense state and is believed to overlie the bedrock.

Bedrock

Bedrock appears near the surface on the south side of the track and dips downward towards the north, coming to the surface again at a distance of approximately 1500 feet north of the track. Samples of the bedrock were obtained by coring in borehole No.1. This core revealed a rock of medium hardness with a slate type cleavage. The cleavage is in the vertical direction and very irregular. The bedrock has been classified as metaphoric in origin and identified as mica-schist.

Discussion of Subsoil Competence

The abutment footings for the overpass will undoubtedly rest directly on the bedrock since the depth to the rock is under 10 feet. The construction of the south abutment will offer little or no problem since the 3 to 4 feet of sand on top of the rock is easily removable. Little trouble with water is to be expected since no ground water was encountered in this area during the investigation. Therefore, at the south abutment location, footings can be founded directly on the underlying bedrock at an elevation of approximately 1119.0 ft. The north abutment footings can also be founded on the bedrock, but problems associated with ground water are to be expected. At this location, the ground water is near the surface at elevation approximately 1118.0 ft. Precise bedrock elevation beneath the north abutment will vary slightly with the abutment positioning since in this area the bedrock dips to the north at a slope approximating 6:1. The bedrock at both abutment locations is capable of supporting considerable loads, but in view of the cleavage in the vertical direction, it is recommended that the allowable bearing value does not exceed 10 tons per square foot.

The ground water problem during construction of the north abutment may be alleviated by the use of a sheet pile coffer dam. Care should be taken to ensure that adequate interior bracing is present since no lateral support from the rock can be expected at the toe of the coffer dam. If other materials such as timber are used for the coffer dam, an impermeable cover (e.g. clay) should be placed on the outside to prevent excessive leakage. Before placing the abutment on top of the bedrock, the rock should be inspected to ensure that an adequate key will result. In this case, with broken rock over the bedrock, and vertical cleavage, this key should be readily obtainable.

The construction of the south approach embankment offers no difficulty, but removal of the top layer of muskeg, where present, is recommended. In the case of the north approach, the 3 to 5 foot layer of muskeg must be removed or large and unequal settlements will result. This removal may best be carried out using drag-line excavators sitting on pads. If fill is placed to the water level as the excavation proceeds any possibility of the sides slipping in will be prevented.

Conclusions

The foregoing comments and observations can be summarized briefly as follows:

(1) The abutments for the overpass will be founded on bedrock, which exists 3 to 9 feet below the existing surface. An allowable bearing value of 10 tons per square foot may be used, provided the rock is cleared of weathered and broken patches. The rock should provide an adequate key to the abutment because of its uneven surface.

(2) No trouble is anticipated in the construction of the south abutment or approach embankment.

(3) The construction of the north embankment will require a coffer dam to keep out water. The removal of 3 to 5 feet of muskeg is necessary, on the north approach embankment. This may most easily be accomplished using a drag-line excavator followed immediately by fill placed to water level.

L. G. Soderman

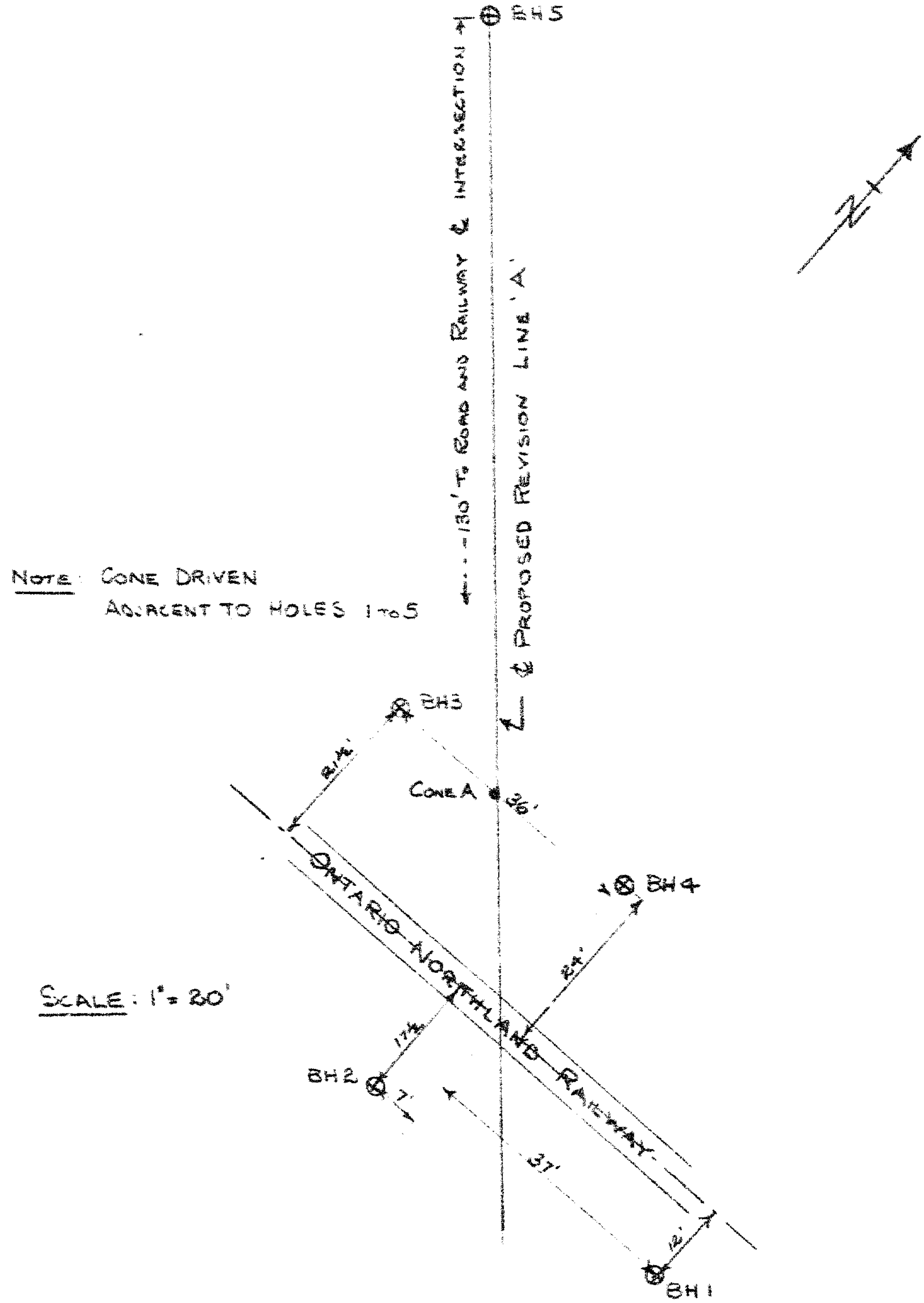
for Kenneth R. Peaker (P.Eng.)

KRP/lt
April 10 1958
C108/J194

REGISTERED PROFESSIONAL ENGINEER
CIVIL
L. G. SODERMAN
PROVINCE OF ONTARIO

PROJECT NO. C108/J194 DRAWING NO. 1

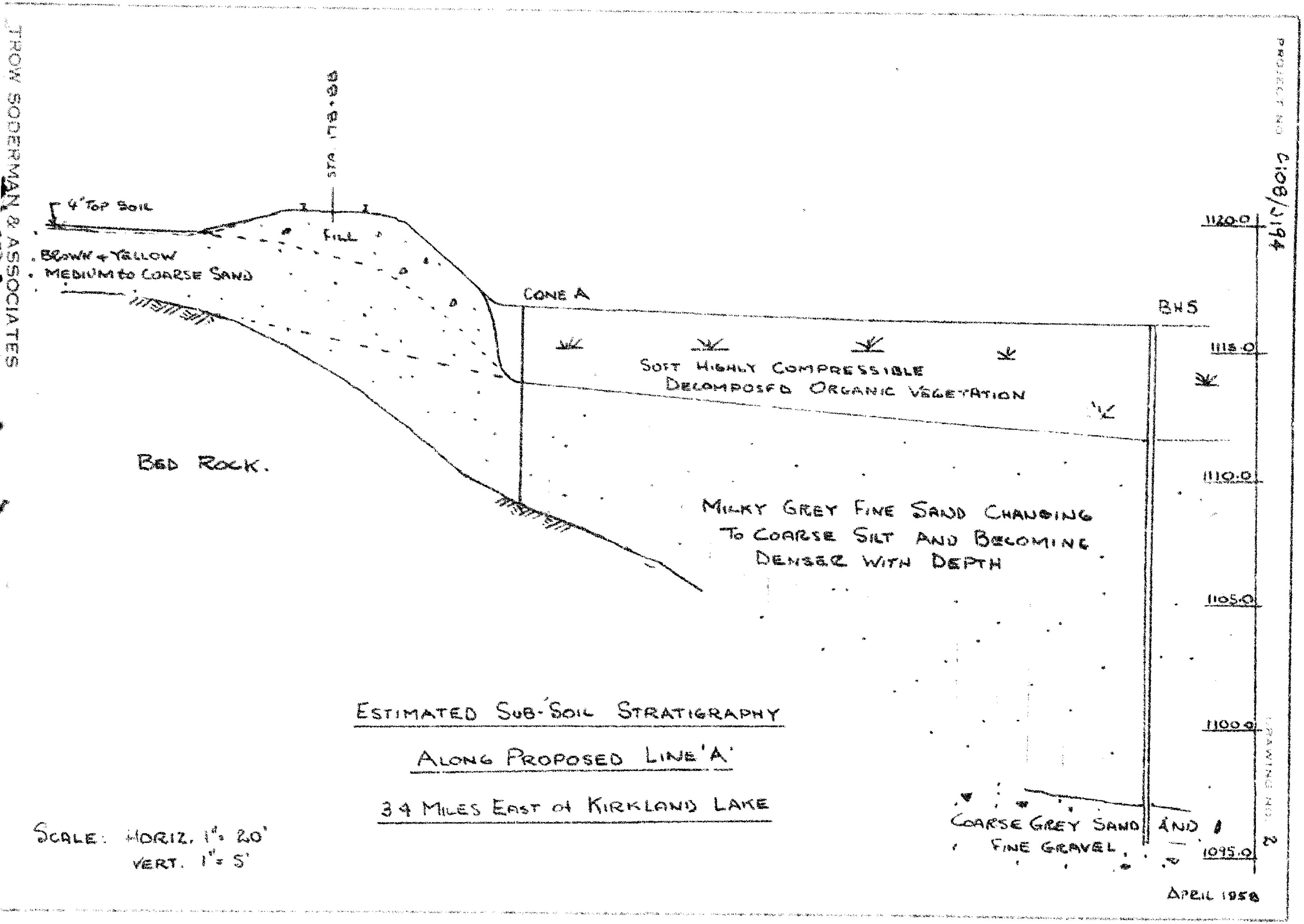
BORE HOLE LOCATION



PROPOSED CROSSING - HIGHWAY Nº 66 AND ONTARIO NORTHLAND RAILWAY

TROW SODERMAN & ASSOCIATES

APRIL 1958



ESTIMATED SUB-SOIL STRATIGRAPHY

ALONG PROPOSED LINE 'A'

34 MILES EAST of KIRKLAND LAKE

SCALE: HORIZ. 1" = 20'
VERT. 1" = 5'

APRIL 1958

TROW SODERMAN & ASSOCIATES

PROJECT NO. C108/J194

DRAWING NO. 2

PROJECT NO. C108/J194

DRAWING NO. 3

TROW SODERMAN AND ASSOCIATES

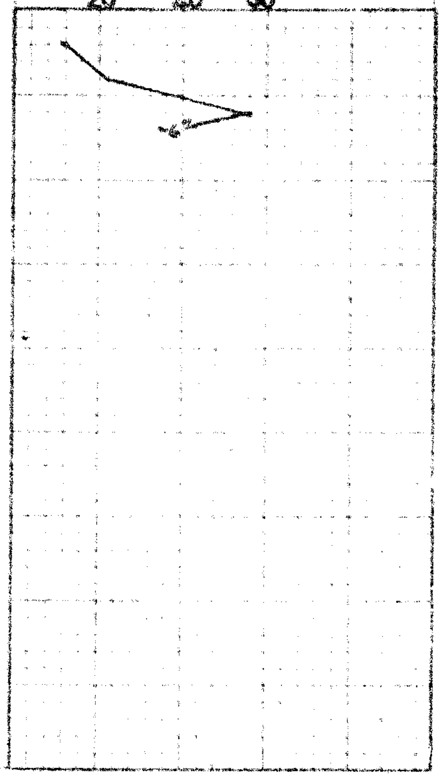
SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND
2" DIA. SPLIT TUBE
2" SHELBY TUBE
7" SPLIT TUBE
2" DIA. CONE
CASING
2" SHELBY
1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

PROJECT Railway Overpass
LOCATION near King Kirkland
HOLE LOCATION See plan
HOLE ELEVATION AND DATUM Elev. 1123.0

BOREHOLE NO. 1
FIELD SUPERVISOR KP
DRILLER RC
PREP. KP

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE (P.S.F. / BLOWS FT.)	CONSISTENCY (MOIST. CONTENT % DRY WT.)	SAMPLE	NATURAL UNIT WT. P.C.F.
SPLIT	Ground surface	1123.0	0	20 40 60			
	Top soil and grass roots Clean yellow & brown loose to dense medium to coarse sand	1119.5					
	Bed rock. Grey and white mica schist.		5				
	End of hole	1113.0	10				



Core BX from 1119.5 to 1113.0
Top 6" weathered and broken rock.
No sign of ground water during boring.
Continuous samples obtained by extracting pipe in overburden

PROJECT NO. G108 J194

DRAWING NO. 4

TROW SODERMAN AND ASSOCIATES

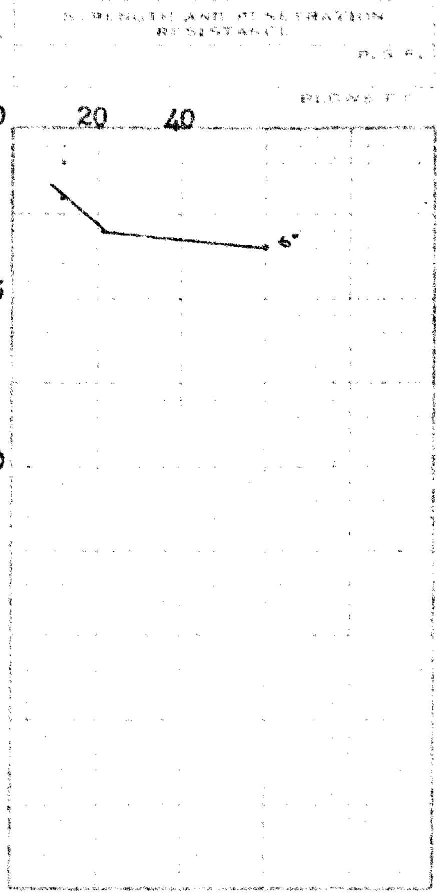
SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

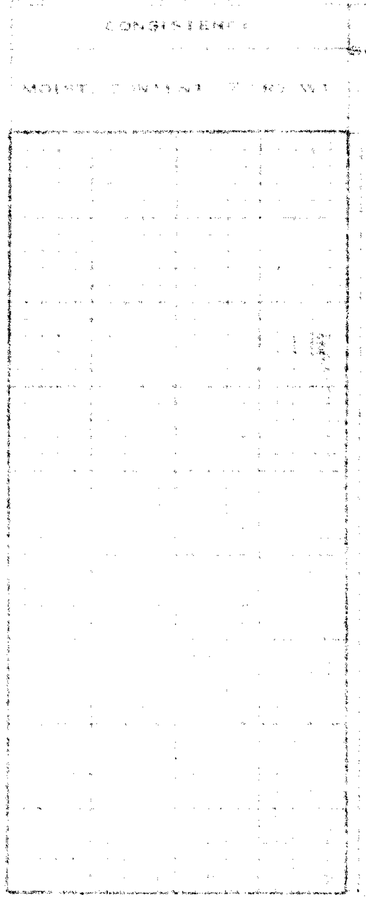
LEGEND
- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

PROJECT Railway Overpass
LOCATION near King Kirkland
HOLE LOCATION See plan
HOLE ELEVATION AND DATUM Elev. 1122.6

BOREHOLE NO. 2
FIELD SUPERVISOR KP
DRILLER RC
PREP. KP

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground surface	1122.6	0
	4" peaty top soil Clean yellow-brown loose to dense medium to coarse sand	1118.9	
	Bed rock - End of hole.		5
	No sign of ground water during boring.		
	Continuous samples obtained by extracting pipe in overburden.		10





SAMPLE | NATURAL UNIT WT. P.C.F.

PROJECT NO. C108 J194

DRAWING NO. 5

TROW SODERMAN AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND

- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

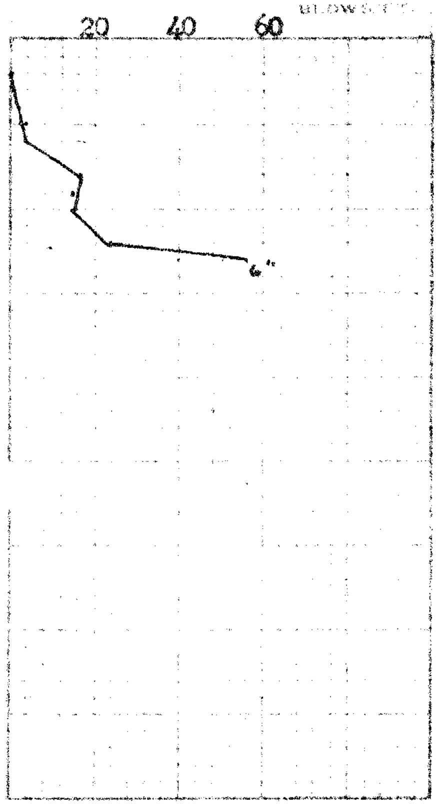
PROJECT Railway overpass
LOCATION Near King Kirkland
HOLE LOCATION See plan
HOLE ELEVATION AND DATUM Elev. 1117.5

BOREHOLE NO. 3
FIELD SUPERVISOR KP
DRILLER RC
PREP. KP

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground surface ▽ WT	1117.5	0
	Soft highly compressible decomposed organic vegetation.	1114.5	
	Clean yellow and green medium dense medium to coarse sand. Top 1 ft. stained by organic material.	1111.0	5
	Bed rock. End of hole.		
			10

Ground water at surface.
Continuous samples obtained by extracting pipe.

STRENGTH AND PENETRATION RESISTANCE — P.S.F. / BLOWS/FT.



CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT % DRY WT.		

PROJECT NO. C109/J194

DRAWING NO. 6

TROW SODERMAN AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Railway Overpass

LOCATION near King Kirkland

HOLE LOCATION see plan

HOLE ELEVATION AND DATUM Elev.1119.0

BOREHOLE NO. 4 and Cone "A"

FIELD SUPERVISOR KP

DRILLER RC

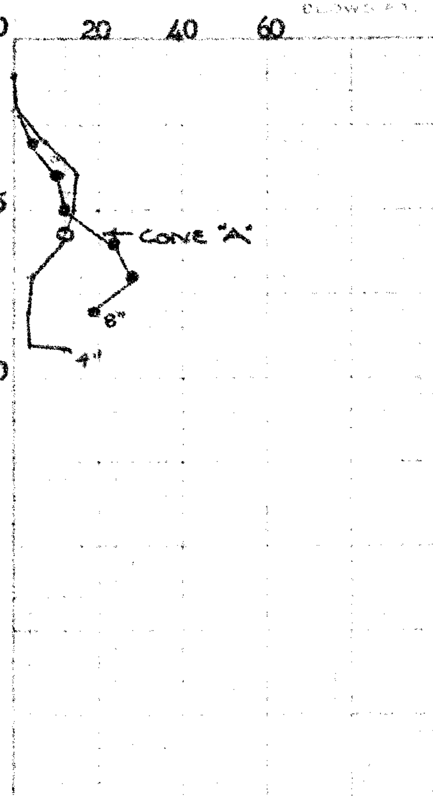
KP

LEGEND

- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE (P.S.F. / BLOWS FT.)	CONSISTENCY (MOIST. CONTENT / DRY WT.)	SAMPLE	NATURAL UNIT WT. P.C.F.
	Ground surface ▽ WT	1119.0	0				
	Soft highly compressible decomposed organic vegetation	1116.0					
	Yellow & brown medium sand with layers of yellow and brown silt.	1109.7	5			SS1	
	Bed Rock - End of hole.		10				

Ground water 6" below surface continuous samples obtained by extracting pipe



PROJECT NO. C108 J194

DRAWING NO. 7

TROW SODERMAN AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

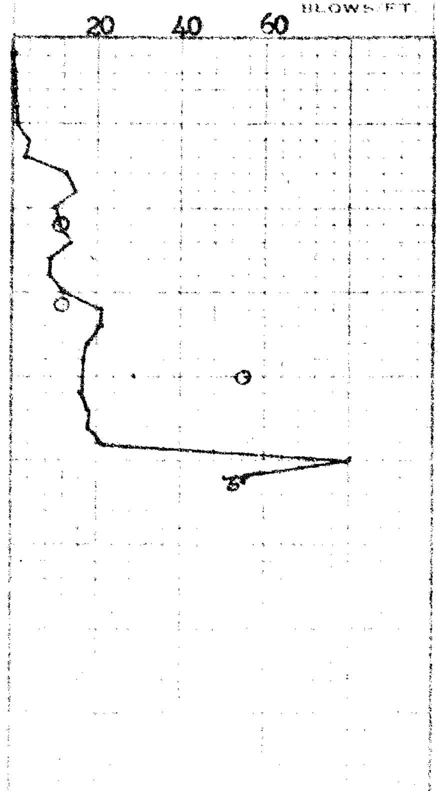
LEGEND
2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
CASING
2" SHELBY
1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

PROJECT Railway Overpass
LOCATION Near King Kirkland
HOLE LOCATION See plan
HOLE ELEVATION AND DATUM Elev.1116.0

BOREHOLE NO. 5
FIELD SUPERVISOR KP
DRILLER RC
PREP. KP

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground surface WT▽	1116.0	0
	Soft highly compressible decomposed organic vegetation	1111.5	
	Grey fine sand changing to coarse silt and becoming denser with depth	1097.0	10
	End of hole	1095.5	20
	Coarse grey sand and fine gravel.		
	Water level at surface		30

STRENGTH AND PENETRATION RESISTANCE P.S.F. BLOWS/FT.



CONSISTENCY

MOIST. CONTENT - % DRY WT.

SAMPLE: SS1, SS2, SS3

NATURAL UNIT WT. P.C.F.

1. South Abutment location and view of south approach.

View of bridge site looking west. 2.

3. North abutment location and view of north approach.