

G.I.-30 SEPT. 1976

GEOCRES No. 31E-132DIST. 52 REGION W.P. No. 405/406-97-01GWP: 290-97-00CONT. No. W. O. No. STR. SITE No. 44-381 N/SHWY. No. 69LOCATION CNR OverheadNo. of PAGES -=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

**FOUNDATION INVESTIGATION REPORT
FOR
CNR OVERHEAD
W.P. 405-97-01 AND W.P. 406-97-01
G.W.P. 290-97-00, SITE 44-381N & S
HIGHWAY 69, DISTRICT 52
HUNTSVILLE, ONTARIO**

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Job No. 97TF088A
Geocres No. 31E-132

August, 1999

TABLE OF CONTENTS

| | |
|---|----------|
| INTRODUCTION..... | 1 |
| SITE DESCRIPTION | 1 |
| INVESTIGATION PROCEDURES | 2 |
| SUMMARIZED SUBSURFACE CONDITIONS | 3 |
| Peat..... | 3 |
| Topsoil | 3 |
| Clay | 3 |
| Sand..... | 5 |
| Bedrock..... | 5 |
| Groundwater | 6 |
| CLOSURE..... | 6 |

FOUNDATION INVESTIGATION REPORT

For

CNR Overhead

W.P. 405-97-01 and W.P. 406-97-01

G.W.P. 290-97-00, Site 44-381N & S

Highway 69, District 52, Huntsville

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for construction of the overpass to carry the proposed four-lane Highway 69 over the CNR (Station 19+255 NBL and Station 19+321 SBL, Highway 69 chainage).

The report pertains to the proposed bridge structures and approaches within about 20 m of the abutments, and includes data from approximate Stations 19+250 to 19+375 southbound lanes and Stations 19+200 to 19+325 northbound lanes, Highway 69 chainage.

SITE DESCRIPTION

The site is located about 17 km north of MacTier and approximately 1 km west of the existing Highway 69. The proposed structures will carry Highway 69 four-lane traffic over the CNR. At the overpass, the CNR runs approximately NNW-SSE.

The bridge location is primarily bush and swamp. Bedrock outcrops along the south side of the railway on the east portion of the proposed Highway 69 alignment.

The site is located in the Precambrian Laurentian peneplane. The topography is irregular in detail with many small lakes separated by ridges of Precambrian bedrock. The surface in general is relatively flat. The overburden in the region is typically shallow but can vary substantially in thickness over short distances. Swamp environments have developed in areas of poor drainage.

INVESTIGATION PROCEDURES

The fieldwork was carried out during the period March 3 to 13, 1998 and comprised 20 boreholes. The boreholes were drilled at the end of each abutment and 20 m beyond the end of each abutment of the bridge configuration proposed at the time the fieldwork was conducted. Boreholes were also drilled along the centreline of the northbound and southbound lanes. The borehole locations are shown on Drawings 1 and 2.

The boreholes were drilled to refusal on bedrock/inferred bedrock at depths of 0.0 to 4.5 m. Four of the boreholes were extended an additional 2.7 to 3.1 m into the bedrock using NQ rock coring equipment.

The boreholes were advanced using continuous flight hollow stem augers, powered by track-mounted CME-55 and CME-75 drillrigs, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Where an appreciable overburden thickness was encountered, samples were recovered using a conventional split spoon sampler as well as from the auger cuttings. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. The groundwater conditions in the boreholes were closely monitored during the course of the fieldwork.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Samples of the recovered rock core were subjected to unconfined compressive strength tests.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, standard penetration test "N" values, rock core descriptions, groundwater observations and the results of laboratory moisture content determinations. Stratigraphic profiles prepared from the borehole data are presented on Drawings 1 to 3.

The stratigraphy revealed north of the railway and near the south abutment of the southbound bridge typically comprised peat mantling bedrock or peat overlying a thin sand/clay layer mantling bedrock. The stratigraphy in the remaining area comprised a thin discontinuous topsoil/sand layer overlying bedrock. The strata encountered are summarized below:

Peat

Black, fibrous peat was encountered surficially in boreholes 381-1 to 3, 5 to 8, 15, 16 and 20. The top elevation of the peat ranged from 239.2 to 239.5. The thickness of the peat deposit ranged from 0.3 to 3.3 m. Moisture contents ranged between 151 to 1189%.

Topsoil

Topsoil was encountered surficially in boreholes 381-4, 10 to 14, 17 and 19. The topsoil layer was 200 to 400 mm thick, locally 80 mm thick in borehole 381-4. It comprised silty sand/sandy silt judged to have a medium to high organic content.

Clay

Very soft clay was encountered below the peat in boreholes 381-1 and 16, and below an intermediate sand layer in borehole 381-15. The clay layer was contacted at depths of 2.5 to 3.3 m and was 0.3 to 1.2 m thick. Moisture contents of 27 and 29% were determined in this material.

Sand

A sand deposit was encountered below the clay in borehole 381-1, below the peat in boreholes 381-2, 6 and 15, and below the topsoil in boreholes 381-4, 10 and 11. The sand was typically silty and fine-grained. The sand layer was 50 to 770 mm thick and generally mantled bedrock/inferred bedrock. Locally in borehole 381-15, it was underlain by clay.

Bedrock

Bedrock or inferred bedrock was contacted surficially in boreholes 381-9 and 18, and below the peat, topsoil or sand in the remaining boreholes at depths of 0.2 to 4.5 m (elevation 235.1 to 242.7). The bedrock surface ranged from elevation 235.0 to 343.4, typically rising towards the south.

A description of the rock cores recovered from boreholes 381-2, 4, 8 and 10 is presented on Table I. The bedrock consists of biotite migmatite, locally granite in the upper 870 mm in borehole 381-4 and granitic gneiss in the upper 1620 mm in borehole 381-10. Core recovery ranged from 92 to 100% and the RQD typically ranged from 83 to 95% (good to excellent quality). The upper 460 mm in borehole 381-2 was fair quality (RQD of 50%).

The unconfined compressive strength of selected core samples were as follows:

| Borehole No. | Depth (m) | Unconfined Compressive Strength (MPa) |
|--------------|-----------|---------------------------------------|
| 381-2 | 3.6 | 117.2 |
| 381-4 | 0.9 | 145.8 |
| 381-8 | 0.8 | 128.0 |
| 381-10 | 0.5 | 133.0 |

Groundwater

Boreholes 381-1 to 3, 5 to 8, 15, 16 and 20 were drilled in a swamp with water levels 0 to 250 mm above the ground surface. Free water was not observed in the remaining boreholes during the course of the fieldwork. Observed water levels are subject to seasonal fluctuations and rainfall patterns.

CLOSURE

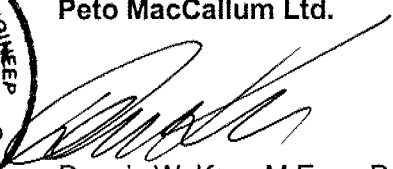
The fieldwork was carried out under the supervision of B.Garlick and L.Watson. The equipment was supplied by All-Terrain Drilling Limited and Longyear Canada Inc..

The report was written by M.R. Anderson, P.Eng., Project Engineer, and reviewed by D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton.


Yours very truly

Peto MacCallum Ltd.




Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services




Brian R. Gray, M.Eng., P.Eng.
Vice-President
Geotechnical and
Geo-Environmental Services

MRA:mmm

TABLE I

ROCK CORE DESCRIPTION
W.P. 405-97-01 and W.P. 406-97-01
GWP 290-97-00, Site No. 44-381 N & S

| CORE RECOVERY | | | | | CORE DESCRIPTION | |
|---------------|----------|-------------|--------------|---------|------------------|--|
| BOREHOLE | CORE NO. | DEPTH (m) | RECOVERY (%) | RQD (%) | DEPTH (m) | DESCRIPTION |
| 381-2 | 1 | 3.12 - 3.58 | 92 | 50 | 3.12 - 6.10 | BIOTITE MIGMATITE , light grey and black banded, high strength, unweathered; occ. layers/inclusions of pink granitic gneiss; close to moderate spaced discontinuities, fair to excellent quality. |
| | 2 | 3.58 - 5.10 | 100 | 90 | | |
| | 3 | 5.10 - 6.17 | 100 | 85 | 6.10 - 6.17 | Near vertical joint, irregular planar with red oxidation/scaling on surface. |
| 381-4 | 1 | 0.58 - 1.45 | 100 | 94 | 0.58 - 1.45 | GRANITE , light grey, medium to coarse grained, high strength, unweathered; with occ. bands of black biotite mica; close to moderate spaced discontinuities; excellent quality |
| | 2 | 1.45 - 2.97 | 97 | 90 | 1.45 - 2.97 | BIOTITE MIGMATITE , light grey and black banded, high strength, unweathered; very close to moderate spaced discontinuities; with 50 mm layer of pegmatite; good quality |
| | 3 | 2.97 - 3.71 | 100 | 93 | 2.97 - 3.71 | close to moderate spaced discontinuities, excellent quality |
| 381-8 | 1 | 0.43 - 1.32 | 100 | 83 | 0.43 - 3.50 | BIOTITE MIGMATITE , light grey to black banded, high strength, unweathered; occ. veins/layers of pink pegmatite; very close to moderate spaced discontinuities, good to excellent quality |
| | 2 | 1.32 - 2.90 | 100 | 95 | | |
| | 3 | 2.90 - 3.50 | 100 | 92 | | |

RQD = Rock Quality Designation

Logged by J. Wright

Our Ref: 97TF088A

TABLE I Cont'd

ROCK CORE DESCRIPTION
W.P. 405-97-01 and W.P. 406-97-01
GWP 290-97-00, Site No. 44-381 N & S

| CORE RECOVERY | | | | | CORE DESCRIPTION | |
|---------------|----------|-------------|--------------|---------|------------------|---|
| BOREHOLE | CORE NO. | DEPTH (m) | RECOVERY (%) | RQD (%) | DEPTH (m) | DESCRIPTION |
| 381-10 | 1 | 0.51 - 1.73 | 100 | 90 | 0.51 - 2.13 | GRANITIC GNEISS , pink, fine crystalline, high strength, unweathered; close to moderate spaced discontinuities, good quality |
| | 2 | 1.73 - 3.25 | 100 | 95 | 2.13 - 3.05 | BIOTITE MIGMATITE , black, homogeneous, high strength, unweathered; occ. inclusions/layers of white pegmatite, excellent quality |
| | | | | | 3.05 - 3.25 | light grey, banded |

RQD = Rock Quality Designation

Logged by J. Wright

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL. DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS. 0.3m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475 J PER BLOW.

DESCRIPTION OF SOIL

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

| <u>CONSISTENCY</u> | <u>'N' BLOWS/0.3 m</u> | <u>c kPa</u> | <u>DENSENESS</u> | <u>'N' BLOWS/0.3 m</u> | |
|--------------------|----------------------------|--------------|------------------|--------------------------|--|
| VERY SOFT | 0 - 2 | 0 - 12 | VERY LOOSE | 0 - 4 | |
| SOFT | 2 - 4 | 12 - 25 | LOOSE | 4 - 10 | |
| FIRM | 4 - 8 | 25 - 50 | COMPACT | 10 - 30 | |
| STIFF | 8 - 15 | 50 - 100 | DENSE | 30 - 50 | |
| VERY STIFF | 15 - 30 | 100 - 200 | VERY DENSE | > 50 | |
| HARD | > 30 | > 200 | | | |
| W.T.P.L. | WETTER THAN PLASTIC LIMIT | | D.T.P.L. | DRIER THAN PLASTIC LIMIT | |
| | A.P.L. ABOUT PLASTIC LIMIT | | | | |

TYPE OF SAMPLE

| | | | |
|-----|------------------------------------|-----|-------------------|
| S.S | SPLIT SPOON | T.W | THINWALL OPEN |
| W.S | WASHED SAMPLE | T.P | THINWALL PISTON |
| S.B | SCRAPER BUCKET SAMPLE | O.S | OESTERBERG SAMPLE |
| A.S | AUGER SAMPLE | F.S | FOIL SAMPLE |
| C.S | CHUNK SAMPLE | R.C | ROCK CORE |
| S.T | SLOTTED TUBE SAMPLE | | |
| | P.H. SAMPLE ADVANCED HYDRAULICALLY | | |
| | P.M. SAMPLE ADVANCED MANUALLY | | |

SOIL TESTS

| | | | |
|-----------------|---------------------------------|-----|-----------------|
| Q _u | UNCONFINED COMPRESSION | L.V | LABORATORY VANE |
| Q | UNDRAINED TRIAXIAL | F.V | FIELD VANE |
| Q _{cu} | CONSOLIDATED UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| Q _d | DRAINED TRIAXIAL | | |

▲,Δ - Undisturbed and remoulded shear strength determined from in situ vane test.

■ - Undrained shear strength determined from pocket penetrometer test.

LOG OF BOREHOLE NO. 381-1

N 5 011 323

E 278 792

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE

OUR PROJECT 97TF088A

SITE CNR Overhead, Site 44-381 SBL

BORING DATE March 11, 1998 ENGINEER M. R. Anderson

LOCATION Station 19+355 (Highway 69) 25 m Lt. of Centreline

BORING METHOD Continuous Flight Hollow Stem Augers

TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L | | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|----|----|--------------------|-----------------|----|-----|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST | | | | WATER CONTENT % | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | |
| 0 | GROUND ELEVATION 239.35 | | | | | | | | | | | | | Free water at surface | |
| | <u>PEAT</u> : Very loose, black, fine fibrous peat, saturated | | 239 | | | | | | | | | | | | |
| 1.5 | | | 238 | | | | | | | | | | | | |
| | | 1 | SS | 0 | | | | | | | | | 80% | | |
| 2.50 | | | 237 | | | | | | | | | | | | |
| 3.0 | <u>CLAY</u> : Very soft, grey silty clay, W.T.P.L. | | 236 | 2 | SS | 0 | | | | | | | | | |
| 3.50 | | | | | | | | | | | | | | | |
| | <u>SAND</u> : Grey fine sand | | 235 | | | | | | | | | | | Upon completion of augering, cave at 2.15 m. | |
| 4.27 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 4.27m. BEDROCK ASSUMED. | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *hmk*

LOG OF BOREHOLE NO. 381-2

N 5 011 304
E 278 797

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+338 (Highway 69) 15m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers & NQ Rock Coring

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L | | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|-----------------|------------|---------------------------|---------------------|-----|-------|--|----|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ● | | | | PLASTIC LIMIT W_P | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | W_P | W | W_L | | 10 |
| 0 | GROUND ELEVATION 239.38 | | | | | | | | | | | | | Free water at surface | |
| | <u>PEAT</u> : Very loose, black, fine fibrous peat, saturated | | 239 | | | | | | | | | | | | |
| | | | 238 | | | | | | | | | | | | |
| 1.5 | | | | 1 | SS | 0 | | | | | | | 90% | | |
| | | | 237 | | | | | | | | | | | | |
| 2.90 | | | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | |
| 3.12 | <u>SAND</u> : Grey, fine sand, saturated | | 236 | 2 | RC | | 457 | 92 | 50 | 100 | | | | | |
| | <u>BEDROCK</u> : Biotite Migmatite | | 235 | 3 | RC | | 1524 | 100 | 90 | 100 | | | | | |
| 4.5 | | | 234 | | | | | | | | | | | | |
| | | | | 4 | RC | | 1067 | 100 | 85 | 100 | | | | | |
| 6.0 | BOREHOLE TERMINATED AT 6.17m. | | 233 | | | | | | | | | | | | |
| | | | | | | | RUN (mm) | RECOVERY (%) | ROD (%) | DRILL WATER RETURN (%) | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-3

N 5 011 279
E 278 803

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead Site 44-381 SBL
LOCATION Station 19+315 (Highway 69) 2 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN M. Rapsey

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|--|--------|-----------|--------|----------------------|--|--|--|--|--|--|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • BLOWS/0.3M 20 40 60 80 | | | | WATER CONTENT % W_P W W_L 10 20 30 | | | |
| 0 | GROUND ELEVATION 239.38 | | 239 | | | | | | | | | | |
| 0.33 | PEAT : Black, coarse fibrous peat, saturated | | | | | | | | | | | | |
| | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 0.33m. BEDROCK ASSUMED. | | 238 | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-4

N 5 011 262
E 278 807

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+300 (Highway 69) 7 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
BORING DATE March 11, 1998 **ENGINEER** M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_p WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|-----------------|------------|--|-----------------|----|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | | | WATER CONTENT % | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | |
| 0 | GROUND ELEVATION 239.62 | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | Upon completion of augering no free water, no cave |
| 0.08 | TOPSOIL : Black silty sand | | 239 | | | | | | | | | | | |
| 0.58 | SAND : Dark reddish brown silty sand, moist | | | 1 | RC | | 864 | 100 | 94 | 100 | | | | |
| 1.45 | BEDROCK : Granite | | 238 | | | | | | | | | | | |
| 1.5 | Biotite Migmatite | | 237 | 2 | RC | | 1524 | 97 | 90 | 100 | | | | |
| 3.0 | | | 236 | 3 | RC | | 737 | 100 | 93 | 100 | | | | |
| 3.71 | BOREHOLE TERMINATED AT 3.71m | | 235 | | | | RUN (mm) | RECOVERY (%) | ROD (%) | DRILL WATER RETURN (%) | | | | |
| 4.5 | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-5


N 5 011 235
E 278 813

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+276 (Highway 69) 20 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
BORING DATE March 11, 1998 ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % | | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|------------------------|--|--|----------|--|--|-------------------------|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | | | | | | | | |
| | | | | | | | BLOWS/0.3M 20 40 60 80 | | | | 10 20 30 | | | | | |
| 0 | GROUND ELEVATION 239.26 | | 239 | 1 | AS | | | | | | | | | 150mm standing water | | |
| 0.79 | PEAT : Black, coarse fibrous peat, saturated | | | | | | | | | | | | | | | |
| | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 0.79m. BEDROCK ASSUMED. | | 238 | | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: 

LOG OF BOREHOLE NO. 381-6

N 5 011 216
E 278 818

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead Site 44-381 NBI.
LOCATION Station 19+259 (Highway 69) 30 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|----|----|----|--|----|----|--|------------|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N = VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ■ | | | | WATER CONTENT % | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | GROUND ELEVATION 239.23 | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | |
| 0 | PEAT : Very loose, black, fine fibrous to amorphous peat, saturated | | 239 | | | 0 | | | | | | | | | |
| | | | | | | | | | | | | | | | 527% ●→ |
| | | | | | | | | | | | | | | | 151% ●→ |
| 1.5 | | | 238 | 1 | SS | | | | | | | | | | |
| | | | | 2 | AS | | | | | | | | | | |
| 2.25 | | | 237 | | | | | | | | | | | | |
| 2.39 | SAND : Grey, medium sand, trace of silt, saturated | | | | | | | | | | | | | | |
| 3.0 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 2.39m. BEDROCK ASSUMED. | | 236 | | | | | | | | | | | | |
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| 4.5 | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

PetoMacCallum Ltd.

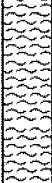
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 381-7

N 5 011 289
E 278 779

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+318 (Highway 69) 28 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN L. Watson

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30 | | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|---|-----------|---------|------|-----------------------------|--|------------------------|--|--|--|--|--|------------------------|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 0 | GROUND ELEVATION 239.53 | | | | | | | | | | | | | | | |
| | PEAT : Black, fine fibrous peat, saturated |  | 239 | | | | | | | | | | | 80mm standing water | | |
| 1.5 | | | 238 | | | | | | | | | | | | | |
| 2.31 | | | 237 | | | | | | | | | | | | | |
| 3.0 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 2.31m. BEDROCK ASSUMED. | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | | |
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NOTES:

CHECKED BY: *[Signature]*


LOG OF BOREHOLE NO. 381-8

N 5 011 269
E 278 785

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+301(Highway 69) 17 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

BORING DATE March 4, 1998

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN L. Watson

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|---|-----------|---------|------|--------------------------|---|----------------------|------------|---------------------------|------------------------------------|--|----|----------------------|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • BLOWS/0.3M | | | | WATER CONTENT % W_P W W_L | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | |
| 0 | GROUND ELEVATION 239.42 | | | | | | | | | | | | | | |
| 0.43 | PEAT : Black, fine fibrous peat, saturated |  | 239 | 1 | RC | | 889 | 100 | 83 | 100 | | | | 200mm standing water | |
| | BEDROCK : Biotite Migmatite | | 238 | | | | | | | | | | | | |
| 1.5 | | | 237 | 2 | RC | | 1574 | 100 | 95 | 100 | | | | | |
| 3.0 | | | 236 | 3 | RC | | 610 | 100 | 92 | 100 | | | | | |
| 3.50 | BOREHOLE TERMINATED AT 3.50m | | | | | | RUN (mm) | RECOVERY (%) | ROD (%) | DRILL WATER RETURN (%) | | | | | |
| 4.5 | | | 235 | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-9

N 5 011 245
E 278 791

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+278 (Highway 69) 4 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN L. Watson

| SOIL PROFILE | | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS | |
|-----------------------|-------------------------|--------|-----------|---------|------|--------------------------|---|----|----|--|-----------------|----|--|----|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | | | WATER CONTENT % | | | |
| | | | | | | | BLOWS/0.3M | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | | 30 |
| 0 | GROUND ELEVATION 241.53 | | | | | | | | | | | | | |
| | BEDROCK AT SURFACE | | 241 | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-10

N 5 011 226
E 278 794

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+262 (Highway 69) 4 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

BORING DATE March 3, 1998

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN L. Watson

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|---|--------|-----------|---------|------|--------------------------|---|----------------------|----|-----|------------------------------------|--|----|--|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • BLOWS/0.3M | | | | WATER CONTENT % W_P W W_L | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | | |
| 0 | GROUND ELEVATION 242.49 | | | | | | | | | | | | | Upon completion of augering, no free water, no cave. | | |
| 0.20 | TOPSOIL : Dark brown sandy silt, medium organic | | 242 | | | | 1219 | 100 | 90 | 100 | | | | | | |
| 0.51 | SAND : Brown fine silty sand, with weathered bedrock fragments | | 241 | | | | | | | | | | | | | |
| 1.5 | BEDROCK : Granitic Gneiss | | 240 | | | | 1524 | 100 | 95 | 100 | | | | | | |
| 2.13 | Biotite Migmatite | | 239 | | | | | | | | | | | | | |
| 3.0 | BOREHOLE TERMINATED AT 3.25m | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | | |

NOTES:

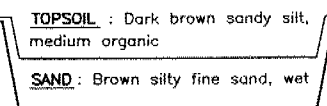
CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-11


N 5 016 201
E 276 801

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+239 (Highway 69) 17 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN L. Watson

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|---|-----------|--------|----------------------|--------------------------|--|--|------------------------------------|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST • | | WATER CONTENT % W_P W W_L | |
| | | | | | | | BLOWS/0.3M 20 40 60 80 | | | |
| 0 | GROUND ELEVATION 240.69 | | | | | | | | | Upon completion of augering, no free water, no cave. |
| 0.23 | TOPSOIL : Dark brown sandy silt, medium organic SAND : Brown silty fine sand, wet |  | 240 | | | | | | | |
| 0.28 | | | | | | | | | | |
| 1.5 | | | | | | | | | | |
| 3.0 | | | | | | | | | | |
| 4.5 | | | | | | | | | | |
| 6.0 | | | | | | | | | | |
| 7.5 | | | | | | | | | | |
| 9.0 | | | | | | | | | | |
| 10.5 | | | | | | | | | | |
| 12.0 | | | | | | | | | | |
| 13.5 | | | | | | | | | | |
| 15.0 | | | | | | | | | | |
| 16.5 | | | | | | | | | | |

NOTES:

CHECKED BY: 

E 278 807

BORING METHOD Continuous Flight Hollow Stem Augers

NOTES:

CHECKED BY: *ms*

LOG OF BOREHOLE NO. 381-13

N 5 011 220
E 278 769

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+250(Highway 69) 18.8 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
BORING DATE March 13, 1998 ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L | | | GROUNDWATER OBSERVATIONS AND REMARKS | | |
|-----------------------|--|--------|-----------|--------|----------------------|--------------------------|---|--|--------------------|--|-----------------|--|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • BLOWS/0.3M | | | | WATER CONTENT % | | | |
| | | | | | | | 20 40 60 80 | | | | 10 20 30 | | | |
| | | | | | | | | | | | | | | |
| 0 | GROUND ELEVATION 242.9 | | | | | | | | | | | | | |
| 0.20 | <p>TOPSOIL : Black sandy silt, high organic</p> <p>BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 0.20m. BEDROCK ASSUMED.</p> | | 242 | | | | | | | | | Upon completion of augering, no free water, no cave. | | |
| 0.40 | | | | | | | | | | | | | | |
| 0.60 | | | | | | | | | | | | | | |
| 0.80 | | | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | | | |
| 1.20 | | | | | | | | | | | | | | |
| 1.40 | | | | | | | | | | | | | | |
| 1.60 | | | | | | | | | | | | | | |
| 1.80 | | | | | | | | | | | | | | |
| 2.00 | | | | | | | | | | | | | | |
| 2.20 | | | | | | | | | | | | | | |
| 2.40 | | | | | | | | | | | | | | |
| 2.60 | | | | | | | | | | | | | | |
| 2.80 | | | | | | | | | | | | | | |
| 3.00 | | | | | | | | | | | | | | |
| 3.20 | | | | | | | | | | | | | | |
| 3.40 | | | | | | | | | | | | | | |
| 3.60 | | | | | | | | | | | | | | |
| 3.80 | | | | | | | | | | | | | | |
| 4.00 | | | | | | | | | | | | | | |
| 4.20 | | | | | | | | | | | | | | |
| 4.40 | | | | | | | | | | | | | | |
| 4.60 | | | | | | | | | | | | | | |
| 4.80 | | | | | | | | | | | | | | |
| 5.00 | | | | | | | | | | | | | | |
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| 5.40 | | | | | | | | | | | | | | |
| 5.60 | | | | | | | | | | | | | | |
| 5.80 | | | | | | | | | | | | | | |
| 6.00 | | | | | | | | | | | | | | |
| 6.20 | | | | | | | | | | | | | | |
| 6.40 | | | | | | | | | | | | | | |
| 6.60 | | | | | | | | | | | | | | |
| 6.80 | | | | | | | | | | | | | | |
| 7.00 | | | | | | | | | | | | | | |
| 7.20 | | | | | | | | | | | | | | |
| 7.40 | | | | | | | | | | | | | | |
| 7.60 | | | | | | | | | | | | | | |
| 7.80 | | | | | | | | | | | | | | |
| 8.00 | | | | | | | | | | | | | | |
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| 8.40 | | | | | | | | | | | | | | |
| 8.60 | | | | | | | | | | | | | | |
| 8.80 | | | | | | | | | | | | | | |
| 9.00 | | | | | | | | | | | | | | |
| 9.20 | | | | | | | | | | | | | | |
| 9.40 | | | | | | | | | | | | | | |
| 9.60 | | | | | | | | | | | | | | |
| 9.80 | | | | | | | | | | | | | | |
| 10.00 | | | | | | | | | | | | | | |
| 10.20 | | | | | | | | | | | | | | |
| 10.40 | | | | | | | | | | | | | | |
| 10.60 | | | | | | | | | | | | | | |
| 10.80 | | | | | | | | | | | | | | |
| 11.00 | | | | | | | | | | | | | | |
| 11.20 | | | | | | | | | | | | | | |
| 11.40 | | | | | | | | | | | | | | |
| 11.60 | | | | | | | | | | | | | | |
| 11.80 | | | | | | | | | | | | | | |
| 12.00 | | | | | | | | | | | | | | |
| 12.20 | | | | | | | | | | | | | | |
| 12.40 | | | | | | | | | | | | | | |
| 12.60 | | | | | | | | | | | | | | |
| 12.80 | | | | | | | | | | | | | | |
| 13.00 | | | | | | | | | | | | | | |
| 13.20 | | | | | | | | | | | | | | |
| 13.40 | | | | | | | | | | | | | | |
| 13.60 | | | | | | | | | | | | | | |
| 13.80 | | | | | | | | | | | | | | |
| 14.00 | | | | | | | | | | | | | | |
| 14.20 | | | | | | | | | | | | | | |
| 14.40 | | | | | | | | | | | | | | |
| 14.60 | | | | | | | | | | | | | | |
| 14.80 | | | | | | | | | | | | | | |
| 15.00 | | | | | | | | | | | | | | |
| 15.20 | | | | | | | | | | | | | | |
| 15.40 | | | | | | | | | | | | | | |
| 15.60 | | | | | | | | | | | | | | |
| 15.80 | | | | | | | | | | | | | | |
| 16.00 | | | | | | | | | | | | | | |
| 16.20 | | | | | | | | | | | | | | |
| 16.40 | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

E 278 777

TECHNICIAN B. Garlick

[illegible]

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-15

N 5 011 317
E 278 797

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+350 (Highway 69) 18.8 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_p WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS | | |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|----|----|--|-----------------|----|--|------------------------|------|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | | | WATER CONTENT % | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | GROUND ELEVATION 239.5 | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | |
| 0 | <u>PEAT</u> : Black, fine fibrous peat, saturated | | 239 | | | | | | | | | | | 80mm standing water | |
| 1.5 | | | 238 | 1 | SS | 0 | | | | | | | | | 806% |
| | | | 237 | | | | | | | | | | | | |
| 2.65 | | | | | | | | | | | | | | | |
| 3.0 | <u>SAND</u> : Very loose, brown sand, trace of silt, saturated | | | | | | | | | | | | | | |
| 3.43 | | | 236 | 2 | SS | 0 | | | | | | | | | |
| | <u>CLAY</u> : Very soft, grey silty clay, W.T.P.L. | | | | | | | | | | | | | | |
| 4.5 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 3.43m. BEDROCK ASSUMED. | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

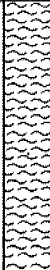

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-16

N 5 011 341
E 278 804

PROJECT W. P. 406-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 SBL
LOCATION Station 19+375 (Highway 69) 18.8 m Lt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|---|-----------|---------|------|--------------------------|---|------------------------|----|----|-----------------|--|----|------------------------|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ● | | | | WATER CONTENT % | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | 30 | | |
| 0 | GROUND ELEVATION 239.5 | | | | | | | | | | | | | 80mm standing water | |
| | PEAT : Black, fine fibrous peat, saturated; occ decayed wood |  | 239 | | | | | | | | | | | | |
| | | | 238 | | | | | | | | | | | | |
| | | | 237 | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | |
| 3.30 | | | | | | | | | | | | | | | |
| | CLAY : Very soft, grey silty clay, W.T.P.L. |  | 236 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 4.50 | | | 235 | | | | | | | | | | | | |
| 4.5 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 4.50m. BEDROCK ASSUMED. | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *[Signature]*

LOG OF BOREHOLE NO. 381-17

N 5 011 163
E 278 793

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+200 (Highway 69) 18.8 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L | | | GROUNDWATER OBSERVATIONS AND REMARKS | | |
|-----------------------|--|--------|-----------|--------|----------------------|--------------------------|---|----|--------------------|----|-----------------|--|--|-------|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST • | | | | WATER CONTENT % | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | |
| | | | | | | | 20 | 40 | 60 | 80 | W_p | | W | W_L |
| 0 | GROUND ELEVATION 242.1 | | | | | | | | | | | | | |
| 0.35 | TOPSOIL : Black sandy silt, medium organic | | 241 | | | | | | | | | | Upon completion of augering, no free water, no cave. | |
| 1.5 | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 0.35m. BEDROCK ASSUMED. | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *mm*

LOG OF BOREHOLE NO. 381-18

N 5 011 182
E 278 798

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+220 (Highway 69) 18.8 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | LIQUID LIMIT W_L | | | GROUNDWATER OBSERVATIONS AND REMARKS | | |
|-----------------------|---------------------------|--------|-----------|--------|----------------------|--------------------------|---|----|-----------------|--------------------------------------|----|----|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N = VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | WATER CONTENT % | | | |
| | | | | | | | BLOWS/0.3M | | WATER CONTENT % | | | |
| | | | | | | | 20 | 40 | 60 | | 80 | 10 |
| 0 | GROUND ELEVATION 243.4 | | | | | | | | | | | |
| | <u>BEDROCK AT SURFACE</u> | | 243 | | | | | | | | | |
| 1.5 | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | |

NOTES:

CHECKED BY: *Amey*

LOG OF BOREHOLE NO. 381-19

N 5 011 258
E 278 819

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+300 (Highway 69) 18.8 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | SAMPLES | | SHEAR STRENGTH C_u | | | | LIQUID LIMIT W_L | | | | GROUNDWATER OBSERVATIONS AND REMARKS | | |
|-----------------------|---|--------|-----------|--------|----------------------|--------------------------|---|----|--------------------|----|---------------------|----|--|----|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST • | | | | PLASTIC LIMIT W_p | | | | |
| | | | | | | | BLOWS/0.3M | | | | WATER CONTENT % | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 10 | 20 | | 30 | |
| 0 | GROUND ELEVATION 239.4 | | | | | | | | | | | | | | |
| 0.30 | <div> <div>TOPSOIL : Black sand and silt, medium organic</div> <div>BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 0.30m. BEDROCK ASSUMED.</div> </div> | | 239 | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | |

NOTES:

CHECKED BY: *MR*

LOG OF BOREHOLE NO. 381-20

N 5 011 282
E 278 826

PROJECT W. P. 405-97-01, HIGHWAY 69, DISTRICT 52, HUNTSVILLE
SITE CNR Overhead, Site 44-381 NBL
LOCATION Station 19+325 (Highway 69) 18.8 m Rt. of Centreline
BORING METHOD Continuous Flight Hollow Stem Augers

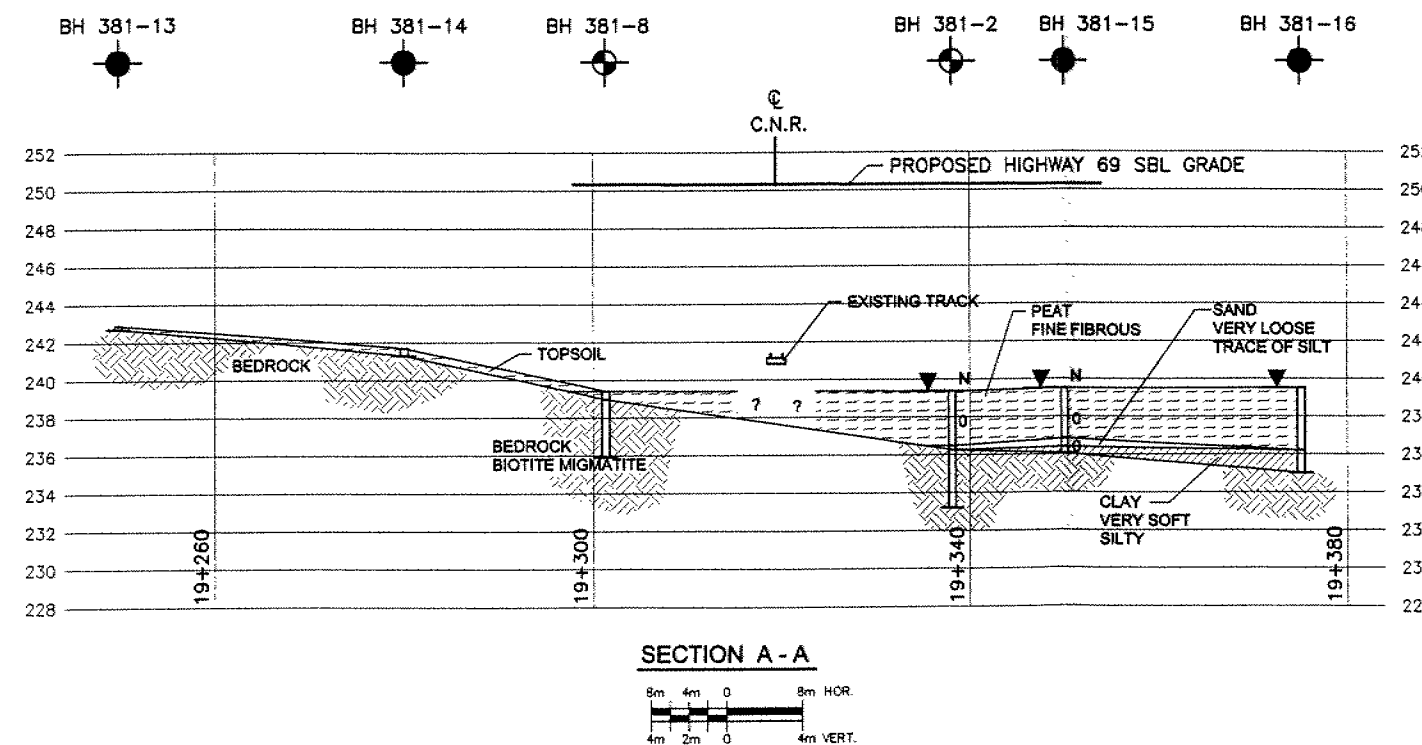
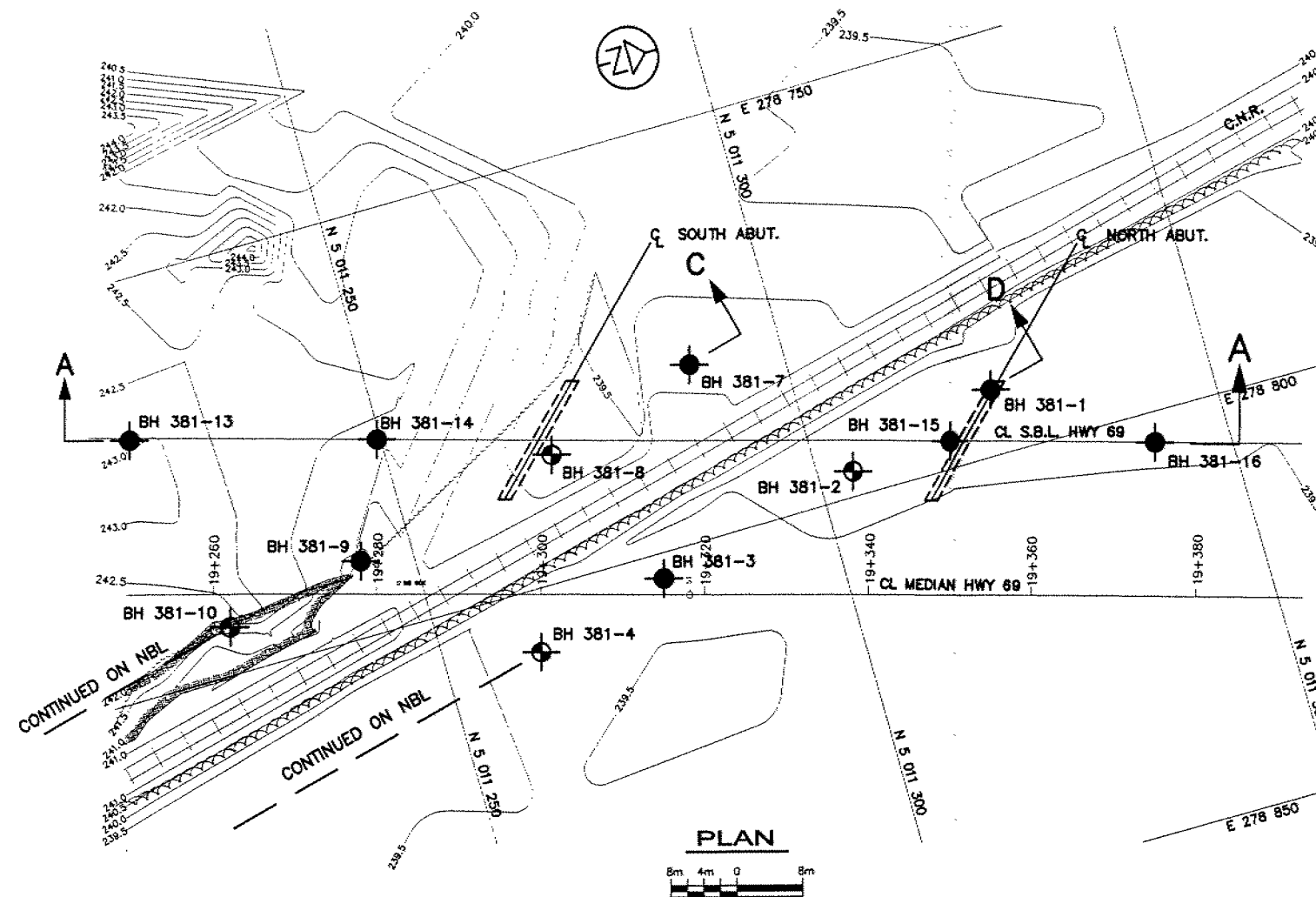
OUR PROJECT 97TF088A
ENGINEER M. R. Anderson
TECHNICIAN B. Garlick

| SOIL PROFILE | | | | SAMPLES | | | | SHEAR STRENGTH C_u ▲ | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L | | | | GROUNDWATER OBSERVATIONS AND REMARKS |
|-----------------------|--|--------|-----------|---------|------|--------------------------|---|------------------------|--|--|-----------------|---|--|-------------------------|--|--|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | DYNAMIC CONE PENETRATION x STANDARD PENETRATION TEST ● | | | | WATER CONTENT % | | | | | |
| | | | | | | | BLOWS/0.3M 20 40 60 80 | | | | 10 20 30 | | | | | |
| 0 | GROUND ELEVATION 239.5 | | | | | | | | | | | | | | | |
| | PEAT : Black, fine fibrous peat, saturated | | 239 | | | | | | | | | | | 130mm standing water | | |
| 1.5 | -1.63 | | 238 | | | | | | | | | | | | | |
| | BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 1.63m. BEDROCK ASSUMED. | | 237 | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | | | | |

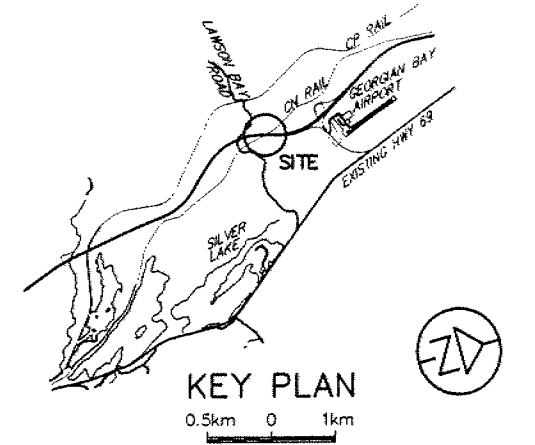
NOTES:

CHECKED BY:

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



DISTRICT MUNICIPALITY OF PARRY SOUND
GEOG TWP CONGER



| BOREHOLE | NORTHING | EASTING | ELEVATION |
|-----------|-------------|-----------|-----------|
| BH 381-1 | N 5 011 323 | E 278 792 | 239.35 |
| BH 381-2 | N 5 011 304 | E 278 797 | 239.38 |
| BH 381-3 | N 5 011 279 | E 278 803 | 239.38 |
| BH 381-4 | N 5 011 262 | E 278 807 | 239.62 |
| BH 381-7 | N 5 011 289 | E 278 779 | 239.53 |
| BH 381-8 | N 5 011 269 | E 278 785 | 239.42 |
| BH 381-9 | N 5 011 245 | E 278 791 | 241.53 |
| BH 381-10 | N 5 011 226 | E 278 794 | 242.49 |
| BH 381-13 | N 5 011 220 | E 278 769 | 242.9 |
| BH 381-14 | N 5 011 249 | E 278 777 | 241.7 |
| BH 381-15 | N 5 011 317 | E 278 797 | 239.5 |
| BH 381-16 | N 5 011 341 | E 278 804 | 239.5 |

- LEGEND**
- BOREHOLE
 - BOREHOLE & ROCK CORE
 - OBSERVED WATER LEVEL (DURING OR UPON COMPLETION OF DRILLING)
- NOTE**
- REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.
 - THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES, THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
 - REFER TO DRAWING 3 FOR SECTION C - C AND D - D.

PROPOSED CROSSING
AT
C. N. R. TRACKS
AND
S.B.L. KING'S HIGHWAY 69
LOT 5 DISTRICT MUNICIPALITY OF PARRY SOUND CON 1
GEOG TWP CONGER TWP OF HUMPHREY

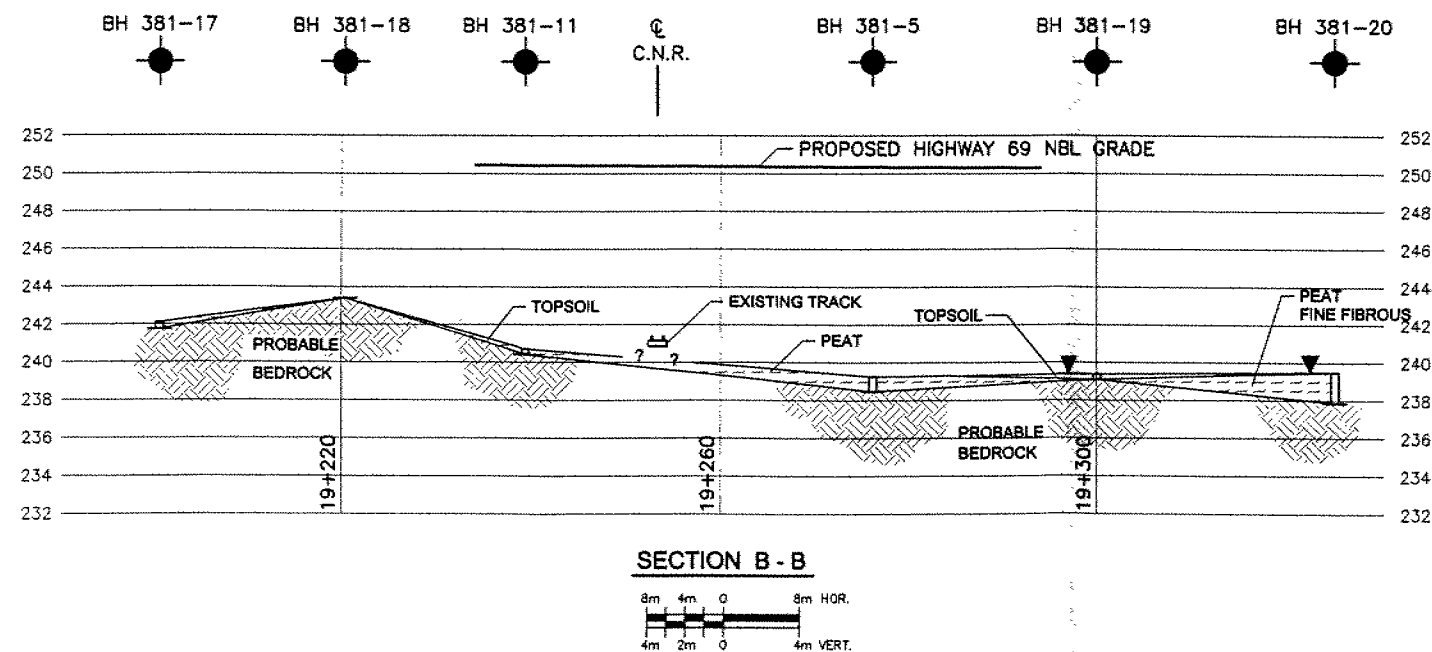
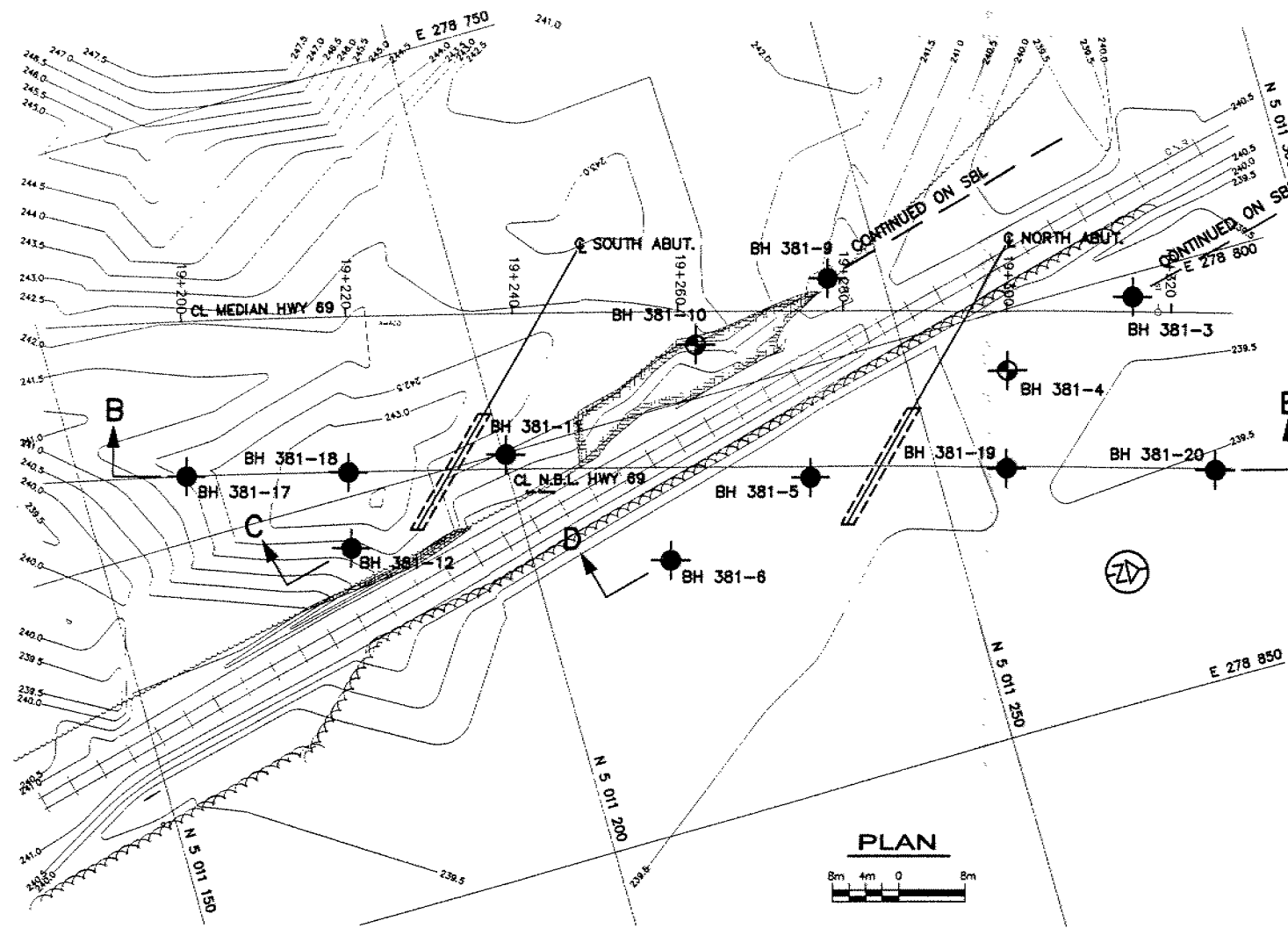
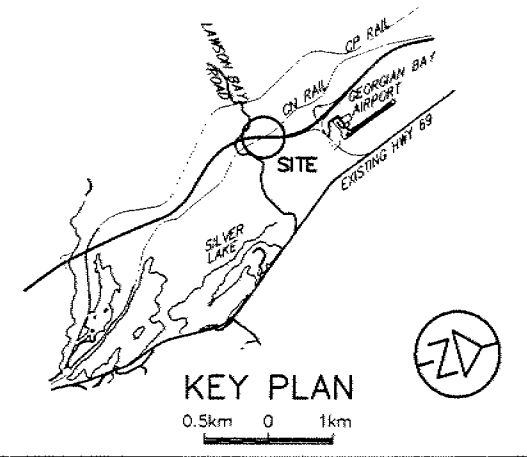
| | | |
|--------------------|---------------------------|--------------------|
| SCALE AS SHOWN | DISTRICT 52 HUNTSVILLE | REGION NORTHERN |
| WP/WO 406-97-01 | PLAN B-774-69/047 | |
| SURVEY 97 12 | PLAN 97 12 | |
| SITE 44-381 | PLAN E-774-69-111 | |

| | | | | | |
|---|-------------|----------|----------|-------------|--|
| Peto MacCallum Ltd. CONSULTING ENGINEERS 45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C8 | | | | | |
| DRAWN CB | DATE | SCALE | JOB NO. | DRAWING NO. | |
| CHECKED MRA | AUGUST 1999 | AS SHOWN | 97TF088B | 1 | |
| APPROVED DWK | | | | | |

**BOREHOLE LOCATION PLAN
AND SOIL PROFILE**

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DISTRICT MUNICIPALITY OF PARRY SOUND
GEOG TWP CONGER



| BOREHOLE | NORTHING | EASTING | ELEVATION |
|-----------|-------------|-----------|-----------|
| BH 381-3 | N 5 011 279 | E 278 803 | 239.38 |
| BH 381-4 | N 5 011 262 | E 278 807 | 239.62 |
| BH 381-5 | N 5 011 235 | E 278 813 | 239.26 |
| BH 381-6 | N 5 011 216 | E 278 818 | 239.23 |
| BH 381-9 | N 5 011 245 | E 278 791 | 241.53 |
| BH 381-10 | N 5 011 226 | E 278 794 | 242.49 |
| BH 381-11 | N 5 011 201 | E 278 801 | 240.69 |
| BH 381-12 | N 5 011 181 | E 278 807 | 242.50 |
| BH 381-17 | N 5 011 163 | E 278 793 | 242.1 |
| BH 381-18 | N 5 011 182 | E 278 798 | 243.4 |
| BH 381-19 | N 5 011 258 | E 278 819 | 239.4 |
| BH 381-20 | N 5 011 282 | E 278 826 | 239.5 |

- LEGEND**
- BOREHOLE
 - BOREHOLE & ROCK CORE
 - OBSERVED WATER LEVEL (DURING OR UPON COMPLETION OF DRILLING)
- NOTE**
- REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.
 - THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES, THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
 - REFER TO DRAWING 3 FOR SECTION C-C AND D-D.

PROPOSED CROSSING
AT
C. N. R. TRACKS
AND
N.B.L. KING'S HIGHWAY 69
DISTRICT MUNICIPALITY OF PARRY SOUND
LOT 5 GEOG TWP CONGER CON 1 TWP OF HUMPHREY

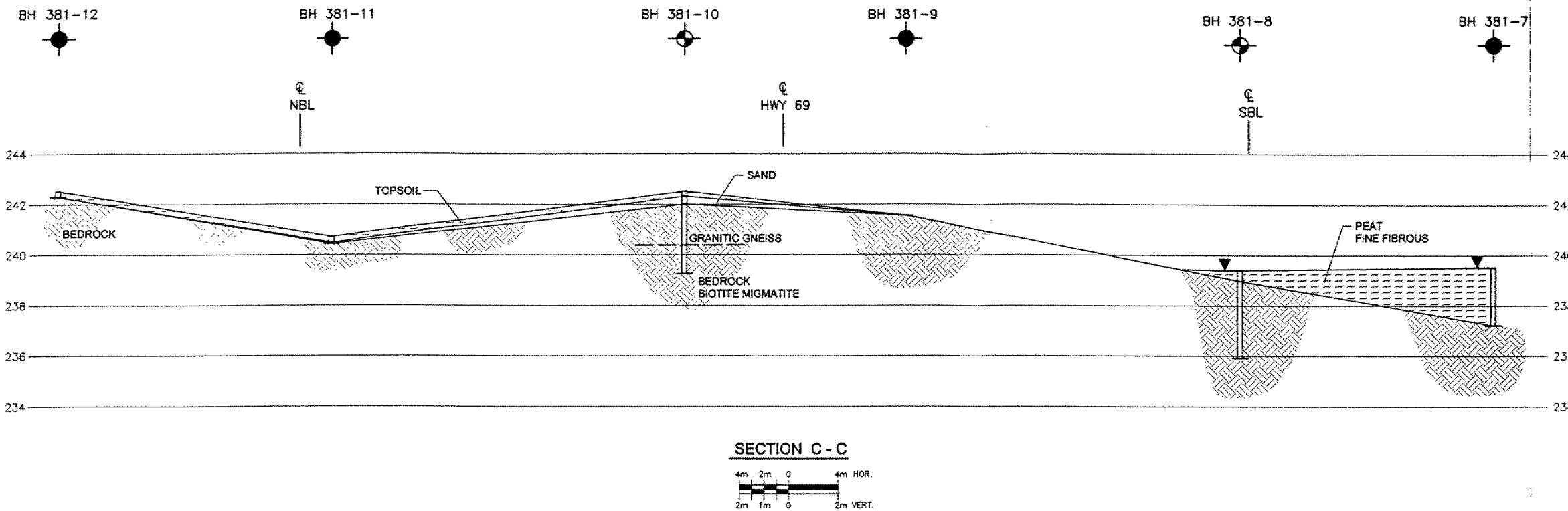
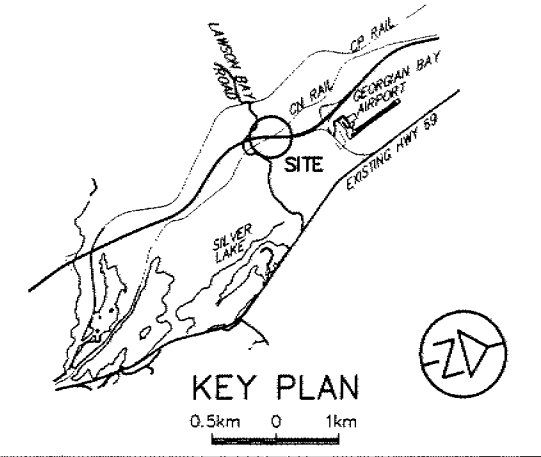
| | | |
|--------------------|---------------------------|--------------------|
| SCALE AS SHOWN | DISTRICT 52 HUNTSVILLE | REGION NORTHERN |
| WP/WO 405-97-01 | PLAN B-774-69/047 | |
| SURVEY 97 12 | PLAN 97 12 | |
| SITE 44-381 | PLAN E-774-69-109 | |

| | | | | |
|--|-------------|----------|----------|-------------|
| Peto MacCallum Ltd. CONSULTING ENGINEERS 45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C8 | | | | |
| DRAWN CB | DATE | SCALE | JOB NO. | DRAWING NO. |
| CHECKED MRA | AUGUST 1999 | AS SHOWN | 97TF088B | 2 |
| APPROVED DWK | | | | |

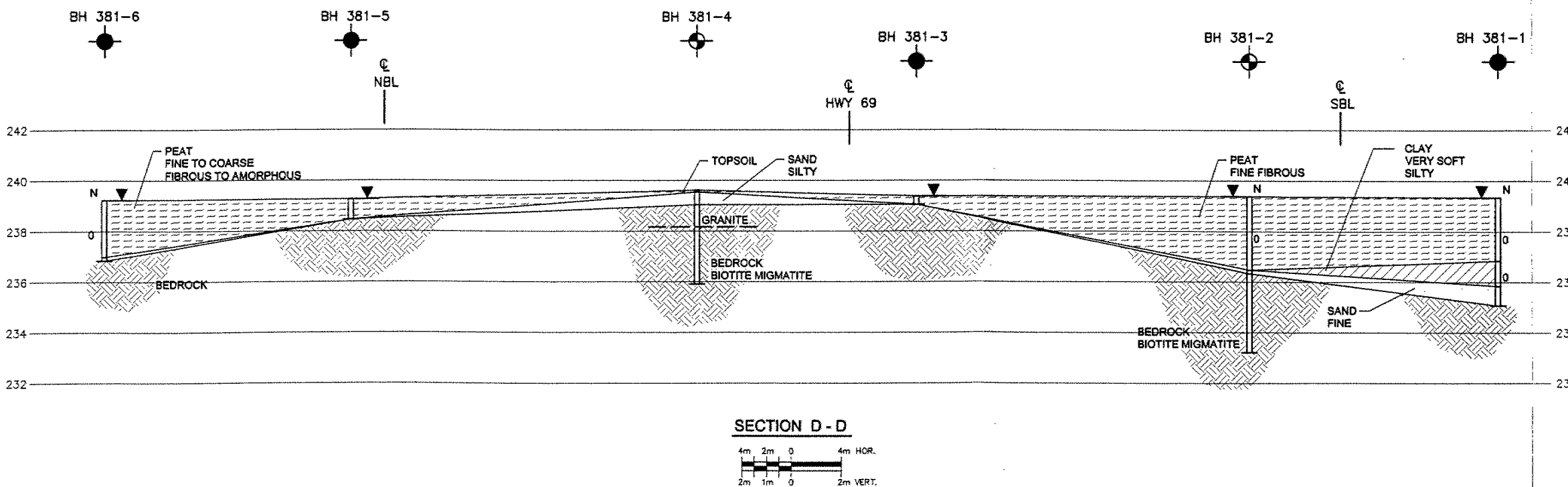
**BOREHOLE LOCATION PLAN
AND SOIL PROFILE**

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DISTRICT MUNICIPALITY OF PARRY SOUND
GEOG TWP CONGER



| BOREHOLE | NORTHING | EASTING | ELEVATION |
|-----------|-------------|-----------|-----------|
| BH 381-1 | N 5 011 323 | E 278 792 | 239.35 |
| BH 381-2 | N 5 011 304 | E 278 797 | 239.38 |
| BH 381-3 | N 5 011 279 | E 278 803 | 239.38 |
| BH 381-4 | N 5 011 262 | E 278 807 | 239.62 |
| BH 381-7 | N 5 011 289 | E 278 779 | 239.53 |
| BH 381-8 | N 5 011 269 | E 278 785 | 239.42 |
| BH 381-9 | N 5 011 245 | E 278 791 | 241.53 |
| BH 381-10 | N 5 011 226 | E 278 794 | 242.49 |
| BH 381-13 | N 5 011 220 | E 278 769 | 242.9 |
| BH 381-14 | N 5 011 249 | E 278 777 | 241.7 |
| BH 381-15 | N 5 011 317 | E 278 797 | 239.5 |
| BH 381-16 | N 5 011 341 | E 278 804 | 239.5 |



LEGEND

● BOREHOLE ● BOREHOLE & ROCK CORE

▼ OBSERVED WATER LEVEL
(DURING OR UPON COMPLETION OF DRILLING)

NOTE

1. REFER TO LOG OF BOREHOLE SHEETS FOR DETAILED SUBSURFACE CONDITIONS.
2. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES, THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
3. REFER TO DRAWING 1 FOR BOREHOLE AND SECTION LOCATIONS.

PROPOSED CROSSING
AT
C. N. R. TRACKS
AND
KING'S HIGHWAY 69
DISTRICT MUNICIPALITY OF PARRY SOUND
LOT 5 GEOG TWP CONGER CON 1 TWP OF HUMPHREY

| | | |
|--------------------|---------------------------|--------------------|
| SCALE AS SHOWN | DISTRICT 52 HUNTSVILLE | REGION NORTHERN |
| WP/VO 406-97-01 | PLAN B-774-69/047 | |
| SURVEY 97 12 | PLAN 97 12 | |
| SITE 44-381 | PLAN E-774-69-111 | |

Peto MacCallum Ltd.
CONSULTING ENGINEERS
45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6

| | | | | |
|--------------|-------------|----------|----------|-------------|
| DRAWN CB | DATE | SCALE | JOB NO. | DRAWING NO. |
| CHECKED MRA | AUGUST 1999 | AS SHOWN | 97TF088B | 3 |
| APPROVED DWK | | | | |

SOIL PROFILES

**FOUNDATION DESIGN REPORT
FOR
CNR OVERHEAD
W.P. 405-97-01 AND W.P. 406-97-01
G.W.P. 290-97-00, SITE 44-381N & S
HIGHWAY 69, DISTRICT 52
HUNTSVILLE, ONTARIO**

Distribution:

13 cc: Highway 69 Joint Venture c/o McCormick Rankin Corporation for distribution to MTO
2 cc: Highway 69 Joint Venture c/o McCormick Rankin Corporation
1 cc: PML Hamilton
1 cc: PML Toronto
1 cc: PML Barrie

Job No. 97TF088A
Geocres No. 31E-132

August, 1999

TABLE OF CONTENTS

| | |
|--|----------|
| INTRODUCTION..... | 1 |
| FOUNDATIONS..... | 1 |
| Integral Abutments on Piles | 1 |
| Spread Footings | 4 |
| ABUTMENT WALLS | 5 |
| APPROACH FILL..... | 7 |
| EXCAVATION AND GROUNDWATER CONTROL..... | 7 |
| CLOSURE..... | 8 |

Peto MacCallum Ltd.

C O N S U L T I N G E N G I N E E R S

FOUNDATION DESIGN REPORT

For

CNR Overhead

W.P. 405-97-01 and W.P. 406-97-01

G.W.P. 290-97-00, Site 44-381N & S

Highway 69, District 52, Huntsville

INTRODUCTION

This report provides geotechnical comments and recommendations regarding design and construction of foundations, abutments and approaches at the proposed Highway 69 overpass structure at the CNR railway.

Construction of two single span overpass structures is planned. At the overpass location, the proposed four-lane Highway 69 will be constructed approximately 10.0 m above existing grades (road grade at elevation 250.6 to 250.9 based on General Arrangement drawings dated February 1999 and existing ground surface elevations determined at borehole locations). The CNR track is near elevation 241.

The subsurface stratigraphy revealed at the bridge sites generally comprised peat overlying bedrock north of the CNR and the south abutment of the southbound bridge, and discontinuous topsoil overlying bedrock south of the CNR. Sand and clay layers were encountered locally. Bedrock/inferred bedrock was contacted at depths of 0.0 to 4.5 m.

FOUNDATIONS

Integral Abutments on Piles

The preliminary profile drawings indicate that road grades along Highway 69 at the overpass location will be some 10 m above existing grade. Construction of integral abutments supported on

steel H-piles is therefore considered feasible. The general arrangement drawing calls for the piles to be placed in concrete filled sockets extended into bedrock below the following elevations:

| Location | Bedrock/Inferred Bedrock Elevation |
|----------------------------------|---------------------------------------|
| Southbound Lanes, North Abutment | 235.1 to 239.1 |
| Southbound Lanes, South Abutment | 237.2 to 241.5 |
| Northbound Lanes, North Abutment | 236.8 to 239.0 |
| Northbound Lanes, South Abutment | 240.4 to 242.3 |

Factored axial resistances at the ultimate limit state for selected pile sections are presented below.

| H-Pile Section | Factored Resistance at ULS (kN) |
|----------------|------------------------------------|
| HP 310 x 79 | 1450 |
| HP 310 x 110 | 2000 |

The resistance at serviceability limit states normally allows for 25 mm of compression of the pile and founding medium. Considering the bedrock to be non-yielding and the relatively short pile length required, the design is not expected to be governed by settlement since the loading required to produce deformation of the pile will be much larger than the factored capacity at ULS.

The type of equipment required to install the piles will be somewhat dictated by the design capacity. Since the piles will bear on hard rock, a specific set for this project is not provided. The installation operations should be inspected on a full-time basis by qualified geotechnical personnel to confirm the toe elevation, alignment, plumbness, and quality of splices.

Pile caps should be provided with the normal 1.8 m of earth cover or equivalent thermal insulation as protection against frost action. A 25 mm thick layer of polystyrene insulation is thermally equivalent to 600 mm of soil cover.

The soil adjacent to the upper portion of the piles is expected to comprise well compacted approach fill placed directly on bedrock or thin overburden deposits. To accommodate movement of the integral abutments, it is recommended that a CSP filled with loose sand be provided around the piles. The CSP should be at least 600 mm diameter and extend 3.0 m below the bottom of the abutment. The gradation of the loose sand should be as specified on Table I. Refer to MTO report SO-96-01 for further details.

The coefficient of horizontal subgrade reaction, k_s , for rock fill and Granular "B" backfill may be computed using the following equation:

$$k_s = n_h z/b$$

$$\begin{aligned} \text{where } z &= \text{depth (m)} \\ b &= \text{pile width (m)} \end{aligned}$$

The recommended values for n_h in kN/m^3 are as follows:

| | Above Groundwater | Below Groundwater |
|--------------|-------------------|-------------------|
| Granular "B" | 12,000 | 8,000 |
| Rock Fill | 15,000 | 9,000 |

Spread Footings

Based on the borehole information, it is considered that the structure may be supported on conventional spread footings or short augered caissons founded on bedrock. It must be noted however that excavation for footing construction in the swamp environment may be problematic due to groundwater conditions.

Foundations bearing on the sound bedrock at elevations 235.1 to 242.3 may be designed using a factored bearing resistance of 10,000 kPa at the ultimate limit state.

The capacity at serviceability limit states normally allows for 25 mm of compression of the founding medium. Considering the bedrock to be non-yielding, the design is not expected to be governed by settlement since the loading required to produce deformation will be much larger than the factored capacity at ULS.

The bedrock surface along the proposed abutments slopes at inclinations of less than 6° to the horizontal, based on the borehole information. Mass concrete should be placed to provide a level founding surface for the footings. Alternatively, the bedrock surface below the footings should be benched or socketed.

Spread footings could be constructed on structural fill placed in the approaches. The structural fill should comprise OPSS Granular "A" material placed in maximum 200 mm thick lifts, compacted to 100% standard Proctor maximum dry density, and extended laterally to a line inclined outwards at 1:1 (H:V) originating at least 1 m from the top of footing. This scheme is illustrated on Figure 1. The fill should be placed directly on bedrock.

The recommended bearing resistances for footings constructed on structural fill are as follows:

| Condition | Assumed Footing Width (m) | Factored Bearing Resistance at ULS (kPa) | Bearing Resistance at SLS (kPa) |
|-----------|---------------------------|--|---------------------------------|
| ULS | 2 | 920 | 250 |
| ULS | 3 | 1110 | 250 |

The recommended capacity at SLS allows for 25 mm of total settlement; differential settlement is expected to be less than 75% of this value. A footing embedment depth of 1.8 m was assumed for computation of the ULS capacities.

All footings subject to frost action should be provided with the normal 1.8 m of earth cover or equivalent thermal insulation. A 25 mm thick layer of polystyrene insulation is thermally equivalent to 600 mm of soil cover. Footings bearing on sound bedrock should not require protection from frost.

Prior to placement of structural concrete, all foundation excavations should be examined by qualified geotechnical personnel to verify the competency of the founding surface.

ABUTMENT WALLS

The abutment walls should be designed to resist the unbalanced lateral earth pressure imposed by the backfill adjacent to the wall. The lateral earth pressure, p , may be computed using the equivalent fluid pressures presented in Section 6-7.4 of the Ontario Highway Bridge Design Code (OHBDC, 3rd Edition, 1991) or employing the following equation, assuming a triangular pressure distribution:

$$p = K (\gamma h + q)$$

where K = coefficient of lateral earth pressure

γ = unit weight of free-draining
granular material (kN/m³)

h = depth below final grade (m)

q = surcharge load (kPa), if present

Free-draining granular material or rock fill should be used as backfill behind the wall. The following parameters are recommended for design:

| | Granular "A" | Granular "B" | Rock Fill |
|--|--------------|--------------|-----------|
| Angle of Internal Friction (degrees) | 35 | 32 | 35 |
| Unit Weight (kN/m ³) | 22.8 | 21.2 | 18.0 |
| Active Earth Pressure Coefficient (K_a) | 0.27 | 0.31 | 0.27 |
| At Rest Earth Pressure Coefficient (K_o) | 0.43 | 0.47 | 0.43 |
| Passive Earth Pressure Coefficient (K_p) | 3.69 | 3.25 | 3.69 |

Refer to MTO Report SO-96-01 for procedures to determine the earth pressure coefficient to be employed to design integral abutments. The coefficient of earth pressure at-rest should be used for design of rigid and unyielding walls, the active earth pressure coefficient for unrestrained structures.

A weeping tile system and/or weeping holes should be installed to minimize the build-up of hydrostatic pressure behind the wall. The weeping tiles should be surrounded by a properly designed granular filter or geotextile to prevent migration of fines into the system. The drainage pipe should be placed on a positive grade and lead to a frost-free outlet.

If spread footings are employed, the horizontal force will be resisted in part by the friction force developed between the underside of footing and the bedrock/structural fill. Unfactored friction factors of 0.6 and 0.45 are recommended for footings on bedrock and granular fill, respectively. A value of 0.7 may be used if the bedrock is roughened (asperity height of at least 25 mm) by mechanical means.

The lateral resistance of footings founded on bedrock could be increased by installing anchors into the bedrock. The increased lateral resistance will be provided by the shear strength of the steel dowels, the horizontal component of tensile forces developed in any inclined anchors, and/or increased frictional resistance between the footing and rock if the anchors are prestressed to increase the vertical pressure.

A factored rock-grout bond stress of 1.4 MPa at the ultimate limit state (resistance factor of 0.4 applied, minimum 35 MPa grout) is recommended for design. The anchors should extend a minimum 30 bar diameters into sound bedrock and be spaced a distance of at least four times the diameter of the anchor. The total capacity of a group of closely spaced anchors may be less than the summed capacities of the individual anchors; the impact of anchor interaction should be assessed if the spacing is less than one-fifth of the anchor length.

A retained soil system could also be employed. The founding material is expected to comprise bedrock and/or structural fill. The supplier of the retained soil system should be responsible for design of the structure (backfill, reinforcement, internal and external stability) and provide drawings to show pertinent information such as location, length, height, elevations, performance level, appearance, etc.

APPROACH FILL

Backfilling adjacent to the structure should be carried out in conformance with Ontario Provincial Standards specifications for granular or rock backfill. The topsoil and peat should be stripped prior to fill placement.

The embankment should be constructed in accordance with OPSD 201.02, 202.010 and 203.010. The side slopes of approach fills should be inclined no steeper than 2:1 (H:V) for earth fill and 1.25:1 for rock fill. For high rock fill embankments, provide 2.0 m wide berms so that no uninterrupted rock fill slope is greater than 6 m high in accordance with the Northern Region Pavement Design Practices and Guidelines.

EXCAVATION AND GROUNDWATER CONTROL

Excavation for construction of footings, if employed, is expected to be carried out primarily within peat. The peat is classified as a Type 4 soil; temporary cut slopes inclined at 3 horizontal to 1 vertical, or flatter, will be required.

Control of groundwater in the swamp environment is expected to be difficult.

All work should be carried out in accordance with the Occupational Health and Safety Act (Ontario Regulation 213/91) and with local/MTO regulations.

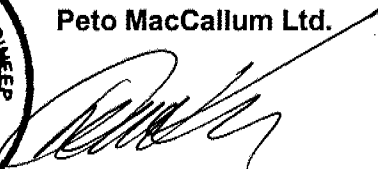
CLOSURE

This report was written by M.R. Anderson, P.Eng., Project Engineer and reviewed by D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton.


Yours very truly

Peto MacCallum Ltd.




Dennis W. Kerr, M.Eng., P.Eng.
Manager Geotechnical and
Geo-Environmental Services




Brian R. Gray, M.Eng., P.Eng.
Vice-President
Geotechnical and
Geo-Environmental Services

MRA:mma

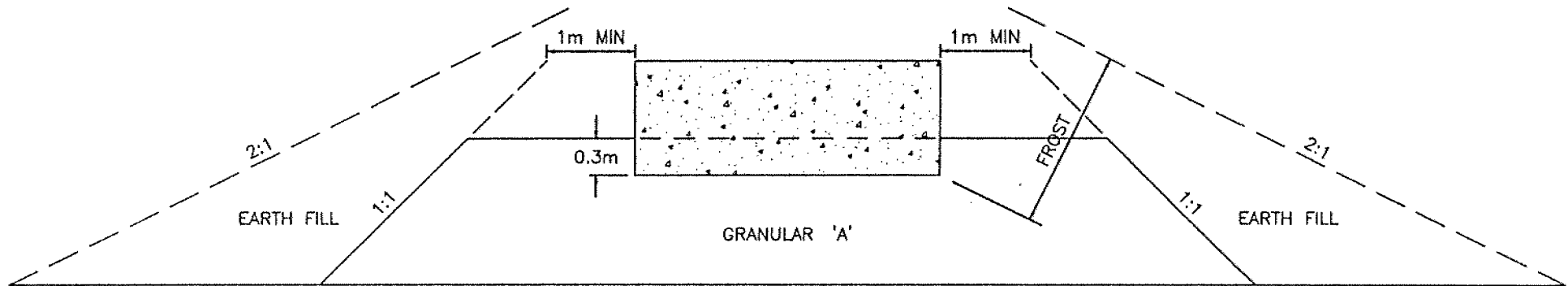
TABLE I

**Gradation Specification for Sand Fill in
Pre-Augered Holes at Integral Abutments**

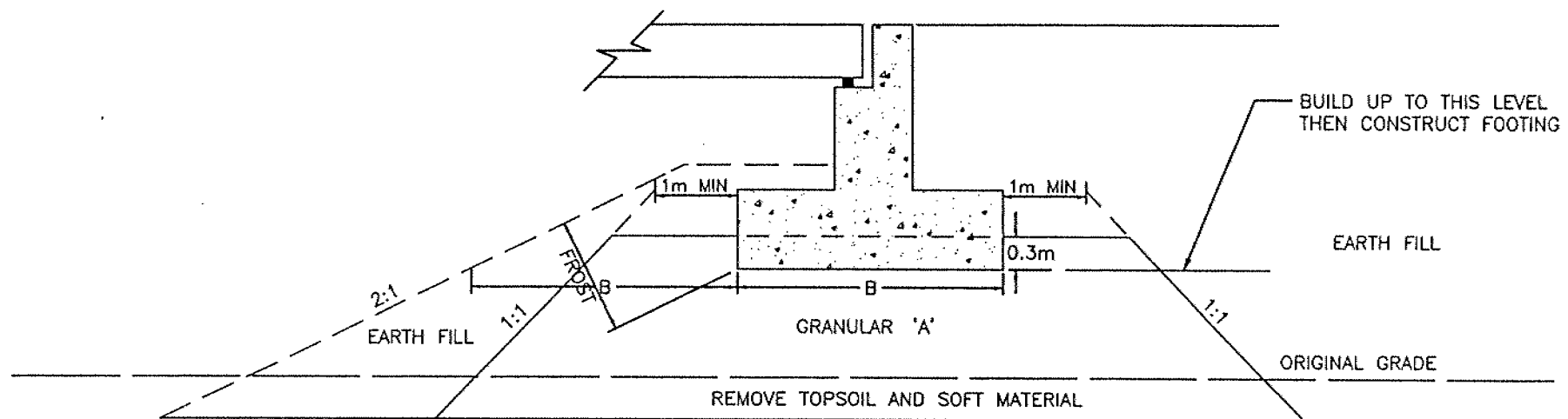
| MTO Sieve Designation | | Percentage Passing by Mass |
|-----------------------|------|----------------------------|
| 2 mm | #10 | 100 |
| 600 µm | #30 | 80 - 100 |
| 425 µm | #40 | 40 - 80 |
| 250 µm | #60 | 5 - 25 |
| 150 µm | #100 | 0 - 6 |

From MTO Report S0-96-01, Revision 1 - July, 1996.

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



CROSS SECTION



LONGITUDINAL SECTION

NOTES

1. REMOVE TOPSOIL AND/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' AND EARTH FILL.
2. PLACE GRANULAR 'A' AND EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.O. STANDARDS.
3. CONSTRUCT CONCRETE FOOTING
4. PLACE REMAINDER OF GRANULAR 'A' AND EARTH FILL AS REQUIRED
5. REFER TO TEXT OF REPORT FOR FROST DEPTH

Peto MacCallum Ltd.
CONSULTING ENGINEERS

45 BURFORD ROAD, HAMILTON, ONTARIO L8E 3C6
Tel: (905) 561-2231 Fax: (905) 561-6363

| DATE | SCALE | JOB NO. | FIGURE NO. |
|-----------|-------|---------|------------|
| MAR. 1998 | NTS | — | 1 |



memorandum

To: Mike Pearsall, P. Eng. 1999 10 20
Senior Project Manager
Planning & Design Section
Northern Region

From: Pavements and Foundation Section
Room 232, Central Building
Downsview, Ontario

Re: Final Foundation Investigation Reports
Hwy 69 - Four Laning From Tower Rd. Northerly 26.5 km to North of Hwy 141
Blackstone/Crane Lake Underpass, W.P. 408-97-01, Site 44-383
CNR Overhead, W.P. 405/406-97-01, Site 44-381 N&S
Healey Lake Road Underpass, W.P. 400-97-01, Site 44-377
Tower Road Underpass, W.P. 399-97-00, Site 44-321
Airport Road Underpass, W.P. 407-97-01, Site 44-382
G.W.P. 290-97-00, Hwy 69, District 52, Huntsville

We have conceptually reviewed the final Foundation reports for the above projects, dated August 1999 produced by Peto MacCallum Ltd. Consulting Engineers for McCormick Rankin Corporation to determine the consultant's performance in providing the deliverables as would be required by MTO for similar consultant assignments. The accuracy of the subsurface information and the adequacy and technical aspects of the recommendations remain the responsibility of the consultant. The Ministry assumes no responsibility or liability for these aspects of the reports. These aspects will be reviewed in order to assess the consultant's performance in this assignment upon implementation of the recommendation in the design and upon review of the performance of the foundations for the completed project.

Most of the comments made in the preliminary foundation report review are incorporated in the final report. However, following are our comments:

Healey Lake Road Underpass, Site 44-377; Section II, Page 8, Second Paragraph: The phrase "earth rock" should be changed to "earth fill".

Blackstone/Crane Lake Underpass, Site 44-383: It should be noted in the report that for excavation below water table, an NSSP for dewatering should be included in the contract.

CNR Overhead, Site 44-381 N&S: The following comments were made in our previous memo dated May 26, 1999, but not incorporated in the final report:

“at this location piles will be driven through the engineered fill. It should be specified in the Foundation report that the engineered fill will be constructed prior to pile driving. In order to drive the piles through the engineered fill, the fill should be constructed of granular material. It should also be specified that the particle size of the granular fill should not be larger than 75 mm for H-piles and 50 mm for pipe piles driving.”

If you have any other questions, please advise.

A handwritten signature in black ink, appearing to read 'K. Ahmad', with a stylized flourish at the end.

K. Ahmad, P. Eng.
Foundation Engineer
For
T.C. Kim, P. Eng.
Senior Foundation Engineer

cc: T. Kazmierowski

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memorandum

To: Bruce Sedgwick, P. Eng.
Senior Project Engineer
Planning and Design Section
Northern Region

1999 05 26

From: Pavements and Foundations Section
Room 232, Central Building
Downsview, Ontario

Re: Draft Foundation Investigation Reports
Highway 69 - Four Laning
From Tower Road Northerly 26.5 km to 2 km North of Hwy 141
Blackstone/Crane Lake Underpass, W.P. 408-97-01, Site 44-383
CNR Overhead, W.P. 405/406-97-01, Site 44-381 N&S
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G.W.P. 290-97-00, Hwy 69, District 52, Huntsville

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General Comments for all projects

1. MTO has established the frost depth for the Huntsville District as 1.8m. The frost depth in all the Foundation reports for this project should be specified as 1.8 m.
2. Recommendation should be given for the side slopes of the approach fills.
3. The Key Plan, northing and easting and the stations shown on the plan are very small. After the drawings are reproduced to include in the contract package, they would not be legible.
4. The cross sections are very small (some of them are thumb size) and should be enlarged. These cross sections will be included in the contract package. When they are reproduced for the contract package, they would not be legible. The plan is produced in 1:500 scale. The cross sections are normally 100 percent larger than the plans to show the details. But in the report the cross sections are 50 percent reduced. Ideally the cross sections should be in true scale, i.e. same horizontal and vertical scales. If the true scale is not feasible, then the ratio of horizontal and vertical scales should be 2. The ratio of the horizontal and vertical scale in the foundation reports are 5. The cross sections, therefore, are very distorted. All the cross sections do not have to fit on one drawing. Cross sections can be produced on more than one drawings. A sample copy of the standard drawing can be obtained from the Pavements and Foundations office.
5. A bar scale, similar to the one provided on the plan should also be provided on the cross sections
6. The Pavements and Foundations Section has assigned Geocres Numbers for these projects. The Consultant should provide the Geocres numbers on the Final Reports. The Geocres number shall be shown on the lower left corner of the Title Page of the Foundation reports.

Blackstone/Crane Lake Road, Site 44-383

1. Page 2 (Section II): The recommended pile resistance on bedrock is conservative and should be revised. Due to the high grade steel of the H-Piles, The pile resistance on sound bedrock has been increased. For example the pile resistance at ULS for HP 310X110 piles is 2000 kN. The term "Pile Capacity" is not used any more in OHBDC. The Consultant should refer to the OHBDC 91, 3rd Edition.
2. The Geocres Number for this project is 31E-131.

CNR Overhead, Site 44-381, N&S

- 1 Page 2 (Section II): We understand that at this location piles will be driven through the engineered fill. It should be specified in the Foundation report that the engineered fill will be constructed prior to pile driving. In order to drive the piles through the engineered fill, the fill should be constructed of granular material. It should also be specified that the particle size of the granular fill should not be larger than 75 mm for H-piles and 50 mm for pipe piles.
- 2 Page 2 (Section II): The recommended pile resistance on bedrock is conservative and should be revised. Due to the high grade steel of the H-Piles, The pile resistance on sound bedrock has been increased. For example the pile resistance at ULS for HP 310X110 piles is 2000 kN. The term "Pile Capacity" is not used any more in OHBDC. The Consultant should refer to the OHBDC 91, 3rd Edition.
- 3 The Geocres Number for this project is 31E-132.

Healey Lake Rd. Underpass, Site 44-377

- 1 Page 1 (Section II): The proposed abutment and pier locations are underlain by peat. The report did recommend removing peat from these locations. It should also be mentioned in the report that the engineered fill should be constructed prior to pile driving. In order to drive the piles through the engineered fill, the fill should be constructed of granular material. It should be specified that the particle size of the granular fill should not be larger than 75 mm for H-piles and 50 mm for pipe piles.
- 2 Page 2 (Section II): The recommended pile resistance on bedrock is conservative and should be revised. Due to the high grade steel of the H-Piles, The pile resistance on sound bedrock has been increased. For example the pile resistance at ULS for HP 310X110 piles is 2000 kN. The term "Pile Capacity" is not used any more in OHBDC. The Consultant should refer to the OHBDC 91, 3rd Edition.
- 3 The Geocres Number for this project is 31E-133.

Tower Road Underpass, Site 44-321

- 1 The Geocres Number for this project is 31E-134.

Airport Road Underpass, Site 44-382

1 The Geocres Number for this project is 31E-135.

If you have any questions, please advise.

A handwritten signature in black ink, appearing to read 'K. Ahmad', with a large circular flourish at the beginning.

K. Ahmad, P. Eng
Foundation Engineer

For

T.C. Kim, P. Eng.
Senior Foundation Engineer

cc: P. Furst
W. Roy
D. Yeo
I. Hussain
T. Kazmierowski

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