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DIST. 11 REGION

W.P. No. 264-85-01

CONT. No. 91-220

W. O. No.

STR. SITE No. 44-55

HWY. No. 520

LOCATION Whiteshore River Bridge  
Humboldt

No. of PAGES -

=====  
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

# OVERSIZE DRAWING

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 91-220



Ministry of  
Transportation

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Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

# EXPLANATION OF TERMS USED IN REPORT

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**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

| $c_u$ (kPa) | 0 - 12    | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200  | > 200 |
|-------------|-----------|---------|---------|----------|------------|-------|
|             | VERY SOFT | SOFT    | FIRM    | STIFF    | VERY STIFF | HARD  |

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5      | 5 - 10 | 10 - 30 | 30 - 50 | > 50       |
|----------------|------------|--------|---------|---------|------------|
|                | VERY LOOSE | LOOSE  | COMPACT | DENSE   | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25    | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100  |
|---------|-----------|---------|---------|---------|-----------|
|         | VERY POOR | POOR    | FAIR    | GOOD    | EXCELLENT |

**JOINTING AND BEDDING:**

| SPACING  | 50mm       | 50 - 300mm | 0.3m - 1m  | 1m - 3m | > 3m       |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE      | MOD. CLOSE | WIDE    | VERY WIDE  |
| BEDDING  | VERY THIN  | THIN       | MEDIUM     | THICK   | VERY THICK |

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

|                        |                              |
|------------------------|------------------------------|
| SS SPLIT SPOON         | TP THINWALL PISTON           |
| WS WASH SAMPLE         | OS OSTERBERG SAMPLE          |
| ST SLOTTED TUBE SAMPLE | RC ROCK CORE                 |
| BS BLOCK SAMPLE        | PH TW ADVANCED HYDRAULICALLY |
| CS CHUNK SAMPLE        | PM TW ADVANCED MANUALLY      |
| TW THINWALL OPEN       | FS FOIL SAMPLE               |

### STRESS AND STRAIN

|                                      |     |                               |
|--------------------------------------|-----|-------------------------------|
| $u_w$                                | kPa | PORE WATER PRESSURE           |
| $r_u$                                | 1   | PORE PRESSURE RATIO           |
| $\sigma$                             | kPa | TOTAL NORMAL STRESS           |
| $\sigma'$                            | kPa | EFFECTIVE NORMAL STRESS       |
| $\tau$                               | kPa | SHEAR STRESS                  |
| $\sigma_1, \sigma_2, \sigma_3$       | kPa | PRINCIPAL STRESSES            |
| $\epsilon$                           | %   | LINEAR STRAIN                 |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | %   | PRINCIPAL STRAINS             |
| E                                    | kPa | MODULUS OF LINEAR DEFORMATION |
| G                                    | kPa | MODULUS OF SHEAR DEFORMATION  |
| $\mu$                                | 1   | COEFFICIENT OF FRICTION       |

### MECHANICAL PROPERTIES OF SOIL

|                |                   |                                      |
|----------------|-------------------|--------------------------------------|
| $m_v$          | kPa <sup>-1</sup> | COEFFICIENT OF VOLUME CHANGE         |
| $C_c$          | 1                 | COMPRESSION INDEX                    |
| $C_s$          | 1                 | SWELLING INDEX                       |
| $C_\alpha$     | 1                 | RATE OF SECONDARY CONSOLIDATION      |
| $c_v$          | m <sup>2</sup> /s | COEFFICIENT OF CONSOLIDATION         |
| H              | m                 | DRAINAGE PATH                        |
| $T_v$          | 1                 | TIME FACTOR                          |
| U              | %                 | DEGREE OF CONSOLIDATION              |
| $\sigma'_{v0}$ | kPa               | EFFECTIVE OVERBURDEN PRESSURE        |
| $\sigma'_p$    | kPa               | PRECONSOLIDATION PRESSURE            |
| $\tau_f$       | kPa               | SHEAR STRENGTH                       |
| $c'$           | kPa               | EFFECTIVE COHESION INTERCEPT         |
| $\phi'$        | -°                | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| $c_u$          | kPa               | APPARENT COHESION INTERCEPT          |
| $\phi_u$       | -°                | APPARENT ANGLE OF INTERNAL FRICTION  |
| $\tau_R$       | kPa               | RESIDUAL SHEAR STRENGTH              |
| $\tau_r$       | kPa               | REMOULDED SHEAR STRENGTH             |
| $S_f$          | 1                 | SENSITIVITY = $\frac{c_u}{\tau_r}$   |

### PHYSICAL PROPERTIES OF SOIL

|                |                   |                                |           |      |   |           |                   |   |
|----------------|-------------------|--------------------------------|-----------|------|---|-----------|-------------------|---|
| $\rho_s$       | kg/m <sup>3</sup> | DENSITY OF SOLID PARTICLES     | e         | 1, % | VOID RATIO                                | $e_{min}$ | 1, %              | VOID RATIO IN DENSEST STATE                             |
| $\gamma_s$     | kn/m <sup>3</sup> | UNIT WEIGHT OF SOLID PARTICLES | n         | 1, % | POROSITY                                  | $I_D$     | 1                 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| $\rho_w$       | kg/m <sup>3</sup> | DENSITY OF WATER               | w         | 1, % | WATER CONTENT                             | D         | mm                | GRAIN DIAMETER  |
| $\gamma_w$     | kn/m <sup>3</sup> | UNIT WEIGHT OF WATER           | $S_r$     | %    | DEGREE OF SATURATION                      | $D_n$     | mm                | n PERCENT - DIAMETER                                    |
| $\rho$         | kg/m <sup>3</sup> | DENSITY OF SOIL                | $w_L$     | %    | LIQUID LIMIT                              | $C_u$     | 1                 | UNIFORMITY COEFFICIENT                                  |
| $\gamma$       | kn/m <sup>3</sup> | UNIT WEIGHT OF SOIL            | $w_p$     | %    | PLASTIC LIMIT                             | h         | m                 | HYDRAULIC HEAD OR POTENTIAL                             |
| $\rho_d$       | kg/m <sup>3</sup> | DENSITY OF DRY SOIL            | $w_s$     | %    | SHRINKAGE LIMIT                           | q         | m <sup>3</sup> /s | RATE OF DISCHARGE                                       |
| $\gamma_d$     | kn/m <sup>3</sup> | UNIT WEIGHT OF DRY SOIL        | $I_p$     | %    | PLASTICITY INDEX = $w_L - w_p$            | v         | m/s               | DISCHARGE VELOCITY                                      |
| $\rho_{sat}$   | kg/m <sup>3</sup> | DENSITY OF SATURATED SOIL      | $I_L$     | 1    | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$   | i         | 1                 | HYDRAULIC GRADIENT                                      |
| $\gamma_{sat}$ | kn/m <sup>3</sup> | UNIT WEIGHT OF SATURATED SOIL  | $I_C$     | 1    | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k         | m/s               | HYDRAULIC CONDUCTIVITY                                  |
| $\rho'$        | kg/m <sup>3</sup> | DENSITY OF SUBMERGED SOIL      | $e_{max}$ | 1, % | VOID RATIO IN LOOSEST STATE               | j         | kn/m <sup>3</sup> | SEEPAGE FORCE   |
| $\gamma'$      | kn/m <sup>3</sup> | UNIT WEIGHT OF SUBMERGED SOIL  |           |      |   |           |                   |   |

For

Whitestone River Bridge  
Hwy. #520 at Whitestone  
W.P. 264-85-01; Site: 44-55  
District #11, Huntsville

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### INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the above-noted site in two stages: 87 03 04 to 87 03 06 and 87 05 08 to 87 05 20. The fieldwork consisted of eleven sampled boreholes and four dynamic cone penetration tests. A muskeg vehicle mounted auger machine (equipped with hollow and solid stem augers) was used in the first stage of the fieldwork, while in the second stage a raft mounted conventional diamond drill adapted for soil sampling purposes and equipped with NX and BX size casings was employed.

### SITE DESCRIPTION

The site is located some 15 km NW of Jct. Hwy. #520 and Hwy. #124 on Hwy. #520 at the crossing of Whitestone River just east of Whitestone. The surrounding terrain is relatively flat and swampy on the north side of the existing structure. The river at the crossing is 24 m wide and about 4 m deep. It appears that the river channel was narrowed considerably at the time of the original construction.

### SUBSURFACE CONDITIONS

The field investigation carried out at this site, in general revealed the presence of organic material (peat), soft silty clay, silty sand and biotite-gneiss bedrock. A bouldery layer was also encountered over the bedrock.

Borehole #2 which was advanced through the existing east approach indicated that the fill material was placed on the peat deposit. Owing to the complexity of the various deposits encountered (i.e. location, elevation, thickness, composition etc.), it is not practical to give description here for each individual stratum. References should be made to the Record of Borehole Sheets contained in the Appendix for details of the stratification at each boring location. These sheets also contain the results of all field and laboratory tests performed. The stratigraphical sections and profiles are plotted on Dwg. No. 2648501-A.\*

### GROUNDWATER CONDITIONS

The groundwater level was found to be at or slightly below the ground surface in those boreholes which are located on the original ground. The groundwater level is controlled by the level of water in the river. The observed high water (river) level is reported to be at El. 241.3. During the time of the second field investigation (May 1987) the river water level was observed to be at El. 239.7.

### MISCELLANEOUS

The fieldwork for the project was supervised by Mrs. B. Bennett, Junior Foundation Engineer and Mr. D. Protulipac, Co-op Student. The equipment used was owned and operated by Longyear Canada Ltd. and Johnson Drilling Co. Ltd. This report was prepared by Mr. P. Payer.



*P. Payer*  
P. Payer, P. Eng.  
Senior Foundation Engineer

*M. Devata*  
M. Devata, P. Eng.  
Chief Foundation Engineer

APPENDIX









# RECORD OF BOREHOLE No 1

METRIC

W P 264-85-01 LOCATION Sta. 9 + 317.0 O/S 2.0 m Rt ORIGINATED BY BB  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S., BQ Rock Core COMPILED BY JM  
DATUM Geodetic DATE 87 03 04 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                                      |   | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |  |  |  | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--------------------------------------|---|---------|------|------------|----------------------------|-----------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                          | STRAT PLOT  | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20 40 60 80 100                             |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |                                      |   |         |      |            |                            |                 | SHEAR STRENGTH                              |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |                                      |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 242.0         | Ground Level                         |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.0           | Silt to Silty Clay                   |  |         |      |            | **                         |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 241.0         | Some Sand                            |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | Hard Fill Material                   |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 240.6         | Sand Some Silt *                     |  | 1       | SS   | 101        | 23 cm                      |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 1.4           | Biotite Gneiss                       |  | 3       | RC   | 100%       |                            | 240             |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | Sound                                |   | 4       | RC   | 100%       |                            | 238             |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 237.2         | Bedrock                              |  |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 4.8           | End of Borehole                      |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | * Very Dense                         |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | ** Groundwater Level<br>not observed |   |         |      |            |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 264-85-01 LOCATION Sta. 9 + 392.6 O/S 2.0 m Rt ORIGINATED BY BB  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY JM  
DATUM Geodetic DATE 87 03 04 CHECKED BY

| SOIL PROFILE  |  | SAMPLES    |        |      | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |
|---------------|--|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER | TYPE |                            |                 | 20  | 40 | 60 | 80 | 100 |                                    |                                     |                                   |                     |   |
| 241.5         | Roadway Level  |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 0.0           | Silty Sand<br>Trace of Clay<br>Occ. Gravel Zones<br>Occ. Boulders<br>Some Organics<br>Compact<br>Fill Material |            | 1      | SS   | 60                         | 0 cm            |   |    |    |    |     |                                    |                                     |                                   |                     |   |
|               |  |            | 2      | SS   | 1                          |                 |   |    |    |    |     |                                    |                                     |                                   |                     | 0 79 20 1   |
|               |  |            | 3      | SS   | 30                         |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
|               |  |            | 4      | SS   | 60                         | 15 cm           |   |    |    |    |     |                                    |                                     |                                   |                     | 37 55 7 1   |
| 237.5         |  |            | 5      | SS   | 2                          |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 4.0           | Peat<br>With Sand<br>Very Soft to Soft   |            | 6      | SS   | 3                          |                 |   |    |    |    |     |                                    |                                     |                                   |                     | 0 22 73 5   |
| 236.3         |  |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 5.2           | Silty Clay to Silt<br>Some Sand<br>Trace of Gravel<br>Soft to Firm   |            | 7      | SS   | 5                          |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
|               |  |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 233.6         |  |            | 8      | SS   | 1                          | 30 cm           |   |    |    |    |     |                                    |                                     |                                   |                     | 2 17 67 14  |
| 7.9           | Silty Sand<br>Some Gravel<br>Trace of Clay   |            | 9      | SS   | 60                         | 8 cm            |   |    |    |    |     |                                    |                                     |                                   |                     | 28 39 32 1  |
|               | Boulders   |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 230.8         |  |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
| 10.7          | End of Borehole<br>Refusal to Auger<br>Probable Bedrock  |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |
|               | * NOTE<br>Ground Water Level<br>not observed   |            |        |      |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |   |

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 3

METRIC

W P 264-85-01 LOCATION Sta. 9 + 370.5 O/S 17.5 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S. COMPILED BY JM  
DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_


| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE | PLASTIC<br>LIMIT<br>W <sub>p</sub><br>NATURAL<br>MOISTURE<br>CONTENT<br>W<br>LIQUID<br>LIMIT<br>W <sub>L</sub> | WATER CONTENT (%)<br>25 50 75 | UNIT<br>WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |           |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|--|-------------------------------|---------------------|--|-----------|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 |  |  |                               |                     |  |           |
| 240.0         | Ground Level   |            |         |      |            |                            |                 |  |  |                               |                     |  |           |
| 0.0           | Peat<br>Some Sand<br>Very Soft   |            | 1A      | SS   | 1/         | 30 cm                      |                 |  |  |                               |                     |  |           |
| 237.9         |  |            | 2A      | SS   | 1/         | 30 cm                      |                 |  |  |                               |                     |  | 0 29 67 4 |
| 2.1           | Silty Clay<br>Trace/Some Sand<br>Very Soft                                 |            | 3A      | SS   | 1/         | 30 cm                      |                 |  | H  | O                             |                     |  | 0 26 65 9 |
|               |  |            | 4A      | SS   | 1/         | 30 cm                      |                 |  |  |                               |                     |  |           |
| 235.6         |  |            | 2       | SS   | 1/         | 30 cm                      |                 |  |  |                               |                     |  | 0 2 59 39 |
| 4.4           | Silty Sand<br>Some Gravel<br>Compact                                       |            | 3       | SS   | 28         |                            |                 |  |  |                               |                     |  |           |
| 234.7         |  |            |         |      |            |                            |                 |  |  |                               |                     |  |           |
| 5.3           | Refusal to Auger<br>Probable Boulders or<br>Bedrock<br><br>End of Borehole |            |         |      |            |                            |                 |  |  |                               |                     |  |           |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 4

METRIC

W P 264-85-01 LOCATION Sta. 9 + 312.0 O/S 12.0 m Lt ORIGINATED BY JM  
 DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-S.S. COMPILED BY JM  
 DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                                      | SAMPLES |        |      | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT  |    |    |    |    | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--------------------------------------|---------|--------|------|----------------------------|-----------------|--|----|----|----|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                          | STRAT   | NUMBER | TYPE |                            |                 | 'N' VALUES   | 20 | 40 | 60 | 80 |                                    |                                     |                                   |                     |  |
| 240.0         | Ground Level                         |         |        |      |                            |                 |  |    |    |    |    |                                    |                                     |                                   |                     |  |
| 0.0           | Sand and Organics                    |         | 1      | AS   |                            |                 |  |    |    |    |    |                                    |                                     |                                   |                     |  |
| 239.2         | Refusal to Auger<br>Probable Bedrock |         |        |      |                            |                 |  |    |    |    |    |                                    |                                     |                                   |                     |  |
| 0.8           | End of Borehole                      |         |        |      |                            |                 |  |    |    |    |    |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE No 5

METRIC

W P 264-85-01 LOCATION Sta. 9 + 365.2 O/S 18.0 m Lt ORIGINATED BY JM  
DST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY JM  
DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 6

METRIC

W P 264-85-01 LOCATION Sta. 9 + 390.8 O/S 19.6 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY BB  
DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                                   | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 |  |                                    |                                     |                                   |                     |  |
| 240.0         | Ground Level                                  |            |         |      |            |                            |                 |  |                                    |                                     |                                   |                     |  |
| 0.0           | Probable Peat<br>Silty Clay and<br>Silty Sand |            |         |      |            |                            | 238             |  |                                    |                                     |                                   |                     |  |
| 236.2         | End of Cone Test                              |            |         |      |            |                            |                 |  |                                    |                                     |                                   |                     |  |
| 3.8           | Probable Boulders<br>or Bedrock               |            |         |      |            |                            |                 | 120/15 cm  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 7

METRIC

W P 264-85-01 LOCATION Sta. 9 + 410.8 O/S 17.6 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY JM  
DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE |   | SAMPLES |             |      | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |  |  |  | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>Y | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
|--------------|---|---------|-------------|------|-------------------------|-----------------|--|--|--|--|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV DEPTH   | DESCRIPTION   | STRAT   | PLOT NUMBER | TYPE |                         |                 | 'N' VALUES                               | SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE |  |  |                                 |                               |                                |                  |  |
| 240.0        | Ground Level  |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |
| 0.0          | Probable Peat<br>Silty Clay and<br>Silty Sand       |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |
|              |   |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |
|              |   |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |
| 235.2        |   |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |
| 4.8          | End of Cone Test<br>Probable Boulders or<br>Bedrock |         |             |      |                         |                 |  |  |  |  |                                 |                               |                                |                  |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 8

METRIC

W P 264-85-01 LOCATION Sta. 9 + 375.8 O/S 8.3 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S., BQ Rock Core COMPILED BY JM  
DATUM Geodetic DATE 87 03 06 CHECKED BY

| SOIL PROFILE  |  |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--|------------|---------|----------|-------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                 | 20  | 40 | 60 | 80 | 100 |                                    |                                     |                                   |                     |  |
| 239.8         | Ground Level   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 0.0           | Peat<br>With Silt<br>Some Sand<br>Trace of Clay<br>Very Soft |            | 1B      | SS       | 1/          | 30 cm                      |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |  |            | 2B      | SS       | 1/          | 30 cm                      |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 236.9         |  |            | 3B      | SS       | 1/          | 30 cm                      |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 2.9           | Silty Clay to<br>Silt, Trace of Sand<br>Very Soft to Soft    |            | 4B      | SS       | 1/          | 30 cm                      |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 235.6         |  |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 4.2           | Biotite Gneiss<br>Sound                                      |            | 5B      | RC<br>BQ | REC<br>100% |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 233.4         | Bedrock  |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 6.4           | End of Borehole  |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 9

METRIC

W P 264-85-01 LOCATION Sta. 9 + 342.0 O/S 7.0 m Rt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-S.S., BQ Rock Core COMPILED BY JM  
DATUM Geodetic DATE 87 03 06 CHECKED BY

| SOIL PROFILE  |                                     |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT                                |  |  |  |  | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|-------------------------------------|------------|---------|------|------------|----------------------------|-----------------|--|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                         | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE |  |  |  |  |                                    |                                     |                                   |                     |  |
| 240.0         | Ground Level                        |            |         |      |            |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.0           | Peat                                |            | 1       | AS   |            |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |
| 239.2         | Some Sand                           |            |         |      |            |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.8           | Boulders<br>Sound<br>Biotite Gneiss |            | 2       | RC   | 83%<br>REC |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |
| 237.0         | Bedrock                             |            |         |      |            |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |
| 3.0           | End of Borehole                     |            |         |      |            |                            |                 |  |  |  |  |  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 10

METRIC

W P 264-85-01 LOCATION Sta. 9 + 350 O/S 2.2 m Lt ORIGINATED BY DP  
 DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
 DATUM Geodetic DATE 87 05 08 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                      |            | SAMPLES |       |            | GROUND WATER<br>CONDITIONS | ELEVATION<br>SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT   |  |  |  |  | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|----------------------|------------|---------|-------|------------|----------------------------|--------------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION          | STRAT PLOT | NUMBER  | TYPE  | 'N' VALUES |                            |                    | SHEAR STRENGTH<br>20 40 60 80 100<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE |  |  |  |  |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level    |            |         |       |            |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.0           |                      |            |         |       |            |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 237.3         | River Bed            |            |         |       |            |                            | 238                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 2.4           | Peat With Sand Firm  |            | 1       | SS    | 7          |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 235.4         | Boulders             |            | 2       | SS    | 63         |                            | 236                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 4.3           | Biotite Gneiss Sound |            | 3       | RC BX | REC 100%   |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |                      |            | 4       | RC BX | REC 100%   |                            | 234                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 232.4         | Bedrock              |            |         |       |            |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 7.3           | End of Borehole      |            |         |       |            |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |

# RECORD OF BOREHOLE No 10A

METRIC

W P 264-85-01 LOCATION Sta. 9 + 344 O/S 7.0 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
DATUM Geodetic DATE 87 05 12 and 13 CHECKED BY

| SOIL PROFILE  |  | SAMPLES    |        |          | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--|------------|--------|----------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                                    | STRAT PLOT | NUMBER | TYPE     | 'N' VALUES                 |                 | 20  | 40 | 60 | 80 | 100 |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level                              |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 0.0           |  |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 238.5         | River Bed                                      |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 1.2           | Sand<br>With Organics<br><br>Loose<br>Boulders |            | 1A     | SS       | 6                          | 10 cm           |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |  |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 235.7         |  |            | 1      | SS       | 3/                         |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 4.0           | Biotite Gneiss<br>Sound                        |            | 2      | RC<br>BX | REC<br>100%                |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |  |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 232.7         | Bedrock  |            | 3      | RC<br>BX | REC<br>100%                |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |  |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 7.0           | End of Borehole                                |            |        |          |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 11

METRIC

W P 264-85-01 LOCATION Sta. 9 + 367 O/S 4.7 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
DATUM Geodetic DATE 87 05 09 CHECKED BY

| SOIL PROFILE  |                                |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION<br>SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC NATURAL LIQUID<br>LIMIT MOISTURE CONTENT LIMIT |   |                | UNIT<br>WEIGHT<br>$\gamma$ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--------------------------------|------------|---------|----------|-------------|----------------------------|--------------------|---|----|----|----|-----|--|---|----------------|----------------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                    | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                    | 20  | 40 | 60 | 80 | 100 | W <sub>p</sub>   | W | W <sub>L</sub> |                            |  |
| 239.7         | River Water Level              |            |         |          |             |                            |                    |   |    |    |    |     |  |   |                |                            |  |
| 0.0           |                                |            |         |          |             |                            |                    |   |    |    |    |     |  |   |                |                            |  |
| 237.0         | River Bed                      |            |         |          |             |                            | 238                |   |    |    |    |     |  |   |                |                            |  |
| 2.7           | Peat<br>With Sand<br>Very Soft |            | 1       | SS       | 2           |                            |                    |   |    |    |    |     |  |   |                |                            |  |
|               |                                |            | 2       | SS       | 43/         | 12 cm                      | 236                |   |    |    |    |     |  |   |                |                            |  |
| 235.3         | Boulders                       |            |         |          |             |                            |                    |   |    |    |    |     |  |   |                |                            |  |
| 4.4           | Biotite Gneiss                 |            | 3       | RC<br>BX | REC<br>100% |                            | 234                |   |    |    |    |     |  |   |                |                            |  |
|               | Sound                          |            | 4       | RC<br>BX | REC<br>100% |                            |                    |   |    |    |    |     |  |   |                |                            |  |
| 232.3         | Bedrock                        |            |         |          |             |                            |                    |   |    |    |    |     |  |   |                |                            |  |
| 7.4           | End of Borehole                |            |         |          |             |                            |                    |   |    |    |    |     |  |   |                |                            |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 12

METRIC

W P 264-85-01 LOCATION Sta. 9 + 352 O/S 19 m Lt ORIGINATED BY DP  
 DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
 DATUM Geodetic DATE 87 05 10 and 11 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |  |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION<br>SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |  |  |  | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--|------------|---------|----------|-------------|----------------------------|--------------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                              | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                    | 20 40 60 80 100                             |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |  |            |         |          |             |                            |                    | SHEAR STRENGTH                              |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |  |            |         |          |             |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level                        |            |         |          |             |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.0           |  |            |         |          |             |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 238.2         | River Bed                                |            |         |          |             |                            | 238                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 1.5           | Peat<br>With Sand<br>Very Soft           |            | 1       | SS       | 0           |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 236.7         |  |            | 2       | SS       | 0           |                            | 236                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 3.0           | Silty Clay<br>Trace of Sand<br>Very Soft |            | 3       | TW       | PM          |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 233.6         | Boulders                                 |            |         |          |             |                            | 234                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 6.1           | Biotite Gneiss                           |            | 4       | RC<br>BX | REC<br>100% |                            | 232                |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | Sound                                    |            | 5       | RC<br>BX | REC<br>100% |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 230.6         | Bedrock                                  |            |         |          |             |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 9.1           | End of Borehole                          |            |         |          |             |                            |                    |   |  |  |  |  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 14

METRIC

W P 264-85-01 LOCATION Sta. 9 + 321 O/S 20 m Lt ORIGINATED BY DP  
 DIST 11 HWY 520 BOREHOLE TYPE Washbore - BX Casing COMPILED BY PP  
 DATUM Geodetic DATE 87 05 13 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                   |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |  |  |  |  | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|-------------------|------------|---------|----------|-------------|----------------------------|-----------------|---|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION       | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                 | 20 40 60 80 100                             |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |                   |            |         |          |             |                            |                 | SHEAR STRENGTH                              |  |  |  |  |                                    |                                     |                                   |                     |  |
|               |                   |            |         |          |             |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level |            |         |          |             |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 0.0           |                   |            |         |          |             |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 237.3         | River Bed         |            |         |          |             |                            | 238             |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 237.0         | Sand              |            |         |          |             |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 2.7           | Biotite Gneiss    |            | 1       | RC<br>BX | REC<br>100% |                            | 236             |   |  |  |  |  |                                    |                                     |                                   |                     |  |
|               | Sound             |            | 2       | RC<br>BX | REC<br>100% |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 233.9         | Bedrock           |            |         |          |             |                            | 234             |   |  |  |  |  |                                    |                                     |                                   |                     |  |
| 5.8           | End of Borehole   |            |         |          |             |                            |                 |   |  |  |  |  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 15

METRIC

W P 264-85-01 LOCATION Sta. 9 + 368 O/S 5 m Rt ORIGINATED BY DP  
 DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
 DATUM Geodetic DATE 87 05 14 to 87 05 20 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|----------|-------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE     | N' VALUES   |                            |                 | 20  | 40 | 60 | 80 | 100 |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 0.0           |   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 237.6         | River Bed   |            |         |          |             |                            | 238             |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 2.1           |   |            |         | *        |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               | Boulders and<br>Sand and Silt   |            |         |          |             |                            | 236             |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |   |            |         |          |             |                            | 234             |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 231.8         |   |            |         |          |             |                            | 232             |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 7.9           | Biotite Gneiss  |            | 1       | RC<br>BX | REC<br>100% |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               | Sound   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               |   |            | 2       | RC<br>BX | REC<br>100% |                            | 230             |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 228.7         | Bedrock   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
| 11.0          | End of Borehole   |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |
|               | * NOTE<br>Diamond Drilling<br>Tools (BX Casing<br>and BX Core Barrel)<br>were used to advance<br>the borehole. Up<br>to 30 cm long pieces<br>of rock were<br>recovered. |            |         |          |             |                            |                 |   |    |    |    |     |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

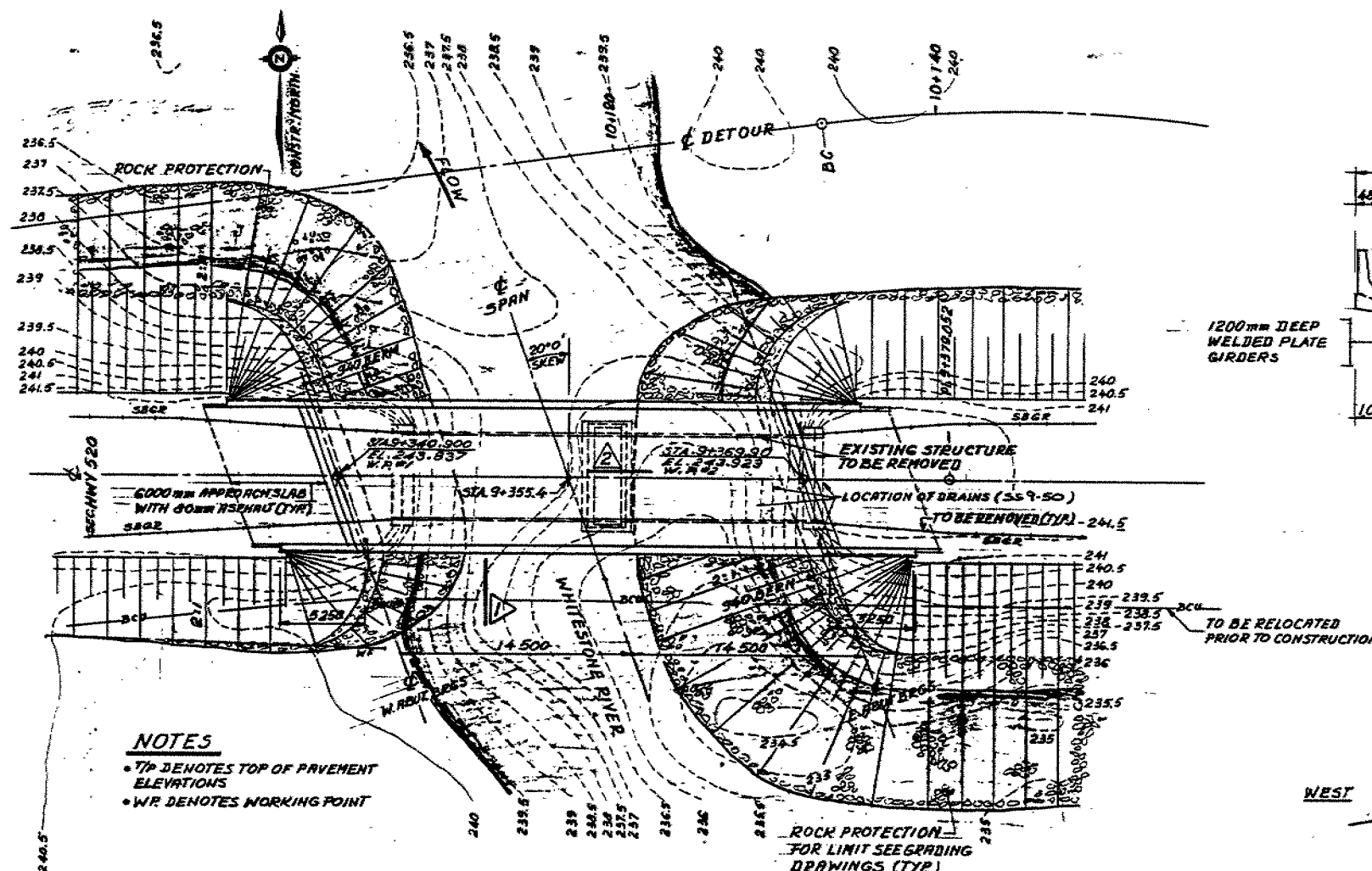


**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

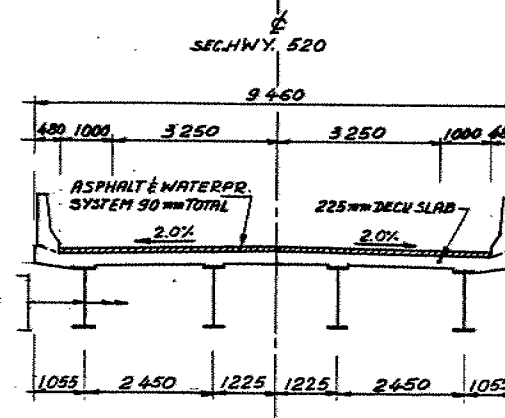
DISTRICT No 11  
CONT No 91-220  
WP No 264-85-01

WHITESTONE RIVER BRIDGE  
GENERAL ARRANGEMENT

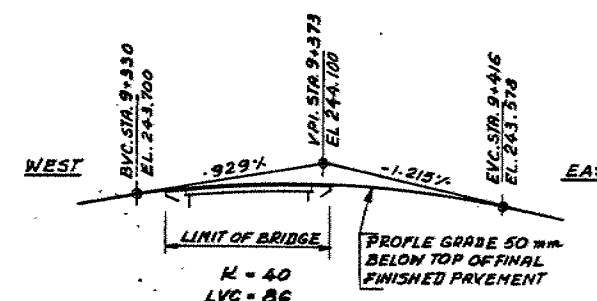
SHEET  
15



**NOTES**  
• TP DENOTES TOP OF PAVEMENT ELEVATIONS  
• WP DENOTES WORKING POINT



1200mm DEEP  
WELDED PLATE  
GIRDERS



## NOTES

**CLASS OF CONCRETE** ..... 30 MPa (EXCEPT TREMIE CONC.)

## REINFORCING STEEL GRADE

GRADE 400 UNLESS OTHERWISE SPECIFIED,  
BAR MARKS WITH SUFFIX 'C' DENOTE COATED  
BARS.

## CLEAR COVER TO REINFORCING STEEL

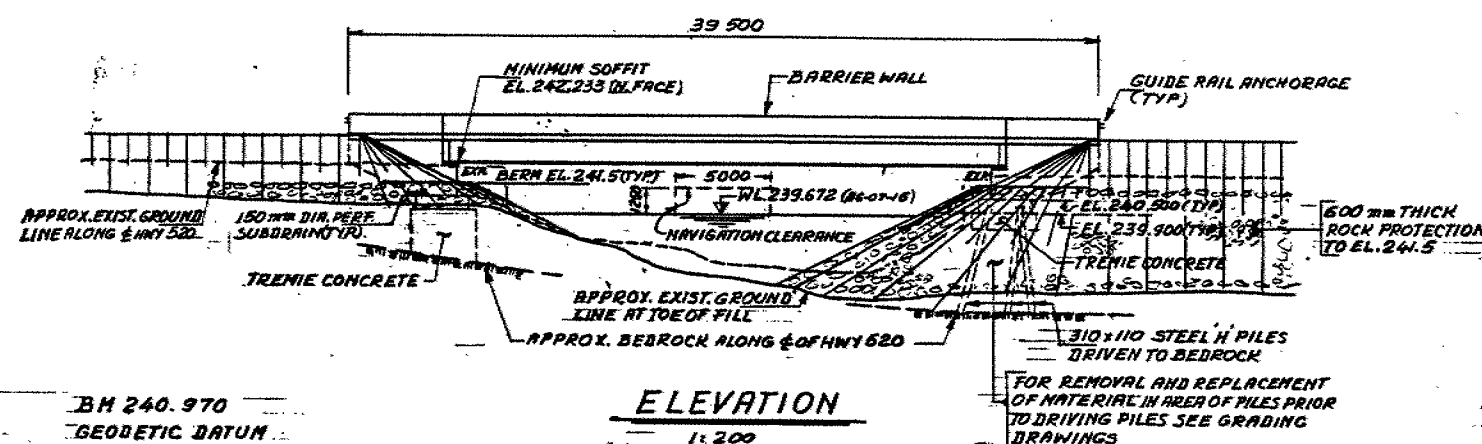
FOOTINGS ..... 100 ± 25 mm  
ABUTMENTS; FRONT FACE ..... 70 ± 20 mm  
BACK FACE ..... 70 ± 20 mm  
DECK TOP ..... 70 ± 20 mm  
BOTTOM ..... 40 ± 10 mm  
REMAINDER; UNLESS OTHERWISE NOTED ..... 70 ± 20 mm

## CONSTRUCTION NOTES

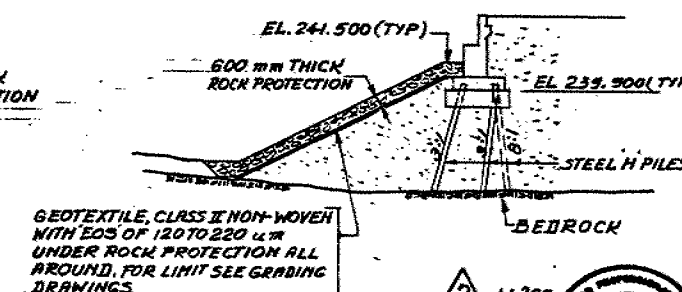
BEARING SEATS SHALL BE FINISHED DEAD LEVEL  
TO THE SPECIFIED ELEVATIONS

## LIST OF DRAWINGS

- 45-55-1 GENERAL ARRANGEMENT
- 2 BOREHOLE LOCATIONS & SOILS STRATA
- 3 FOOTINGS
- 4 ABUTMENTS
- 5 STRUCTURAL STEEL DETAILS
- 6 BEARING DETAILS
- 7 DECK
- 8 BARRIER WALL
- 9 6000 mm APPROACH SLAB
- 10 JOINT ANCHORAGE AND ARMOURING
- 11 DETAIL OF DRAINS AT EXP. JOINTS
- 12 STANDARD DETAILS
- 13 AS CONSTRUCTED ELEV. & DIM.
- 14 QUANTITIES STRUCTURE I
- 15 QUANTITIES STRUCTURE II



BH 240.970  
GEODETIC DATUM  
CUT CROSS ON BEDROCK  
34.70 R.L. 9+342.5

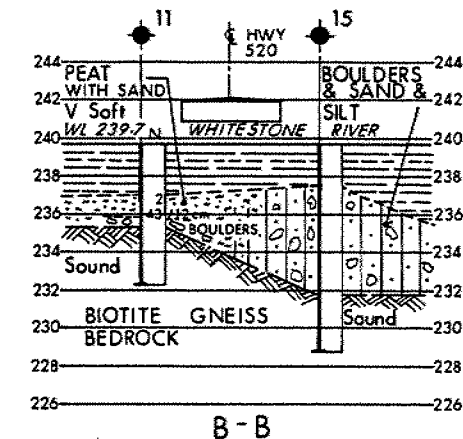
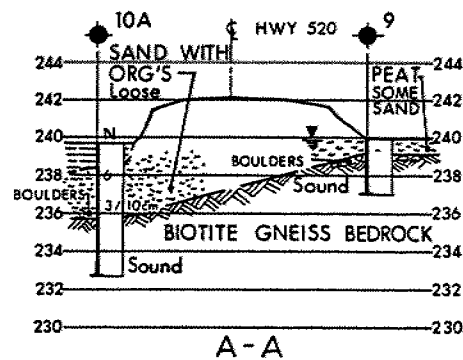


GEOTEXTILE, CLASS II NON-WOVEN  
WITH EOS OF 120 TO 220 g/m<sup>2</sup>  
UNDER ROCK PROTECTION ALL  
AROUND, FOR LIMIT SEE GRADING  
DRAWINGS

2 1:200

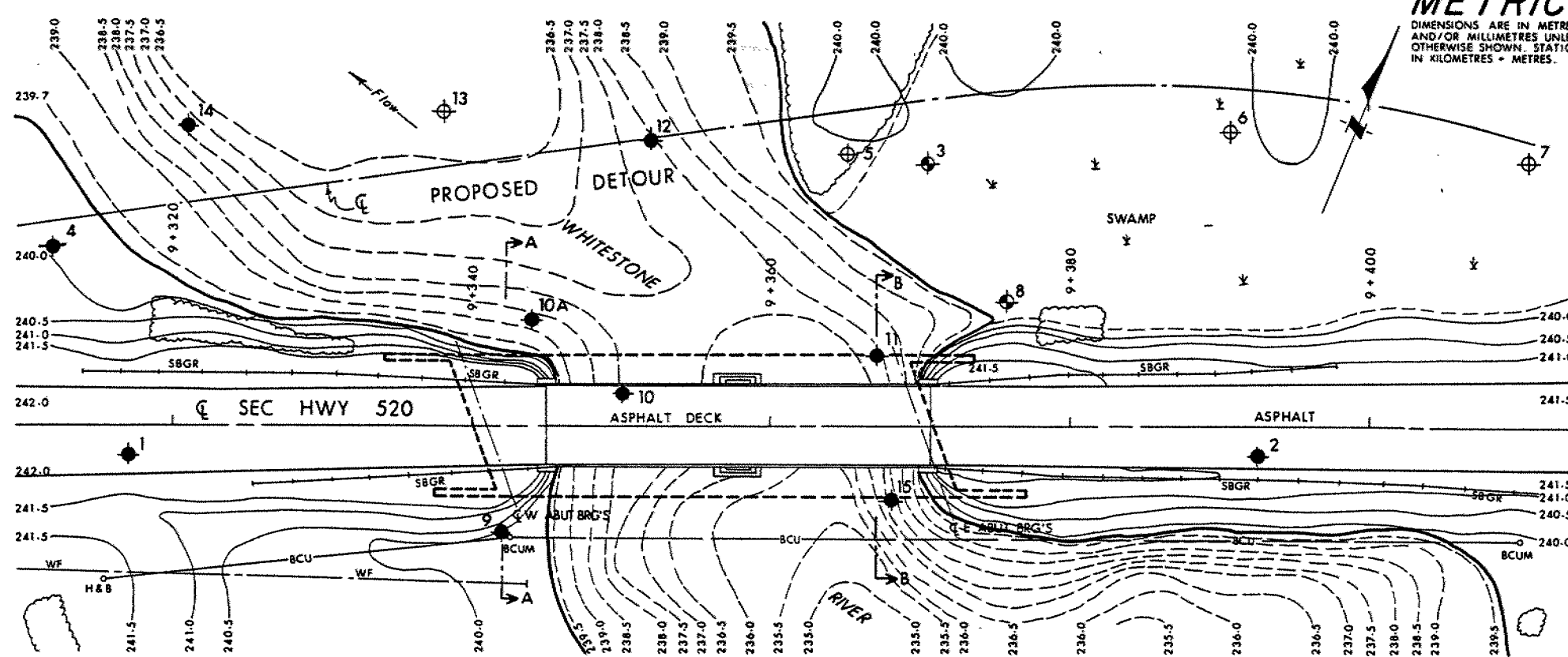
DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

| DATE    | BY         | DESCRIPTION |
|---------|------------|-------------|
| DESIGN  | J. Bz      | CHECK       |
| DRAWING | J. Bz      | CHECK       |
| LOADING | ONBDC-C-83 | DATE        |
| SITE    | No 44-55   | DWG         |



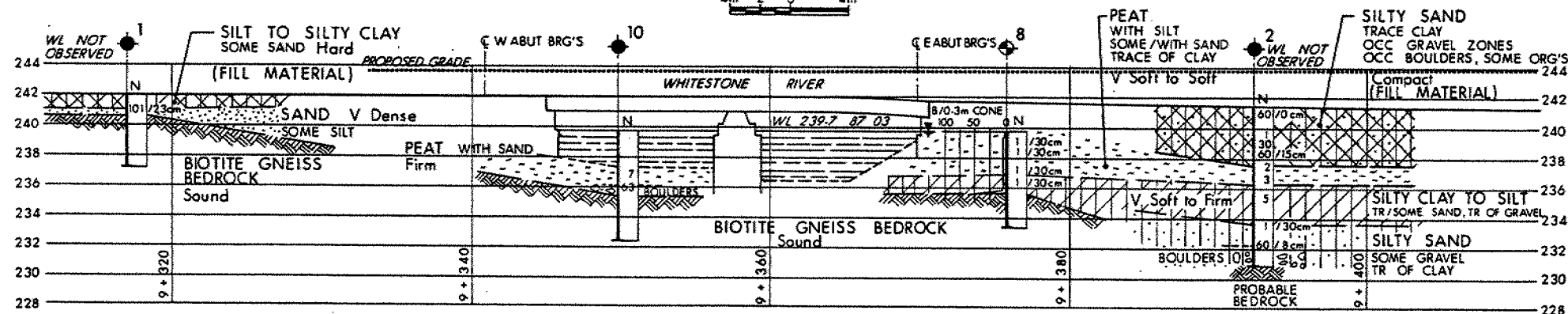
# SECTIONS

SCALE  
4m 2 0 4m



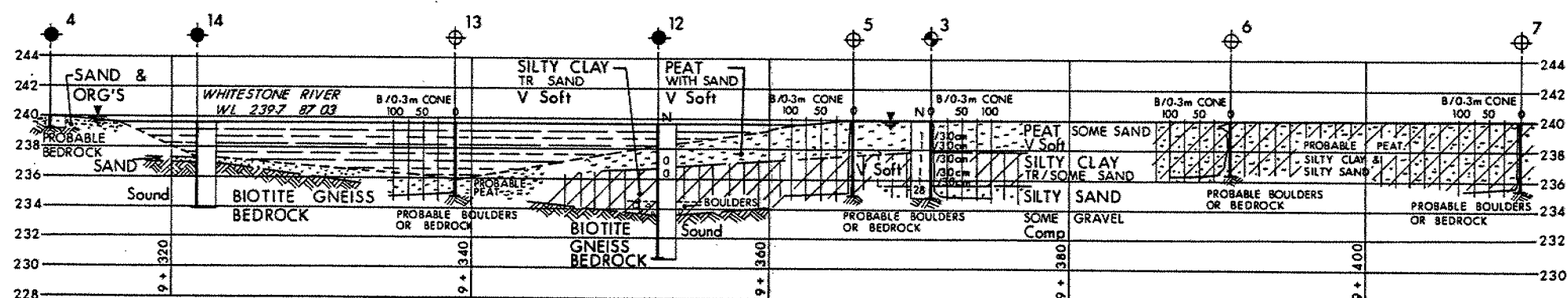
# PLAN

SCALE  
4m 2 0 4m



# PROFILE HWY 520

SCALE  
4m 2 0 4m



# PROFILE DETOUR

SCALE  
4m 2 0 4m

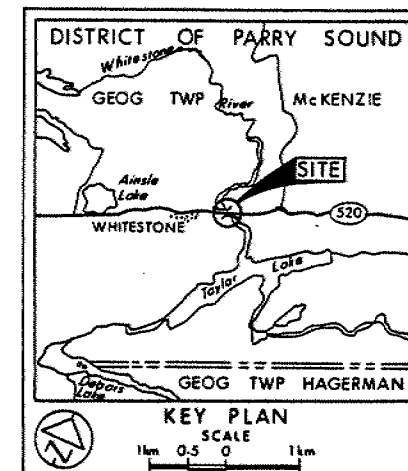
**METRIC**

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

CONT No 91-220  
WP No 264-85-01

WHITESTONE RIVER  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET  
16



# LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- ✦ WL at time of investigation 87 03 & 87 05

| No  | ELEVATION | STATION | OFFSET   |
|-----|-----------|---------|----------|
| 1   | 242.0     | 9+317.0 | 2.0m Rt  |
| 2   | 241.5     | 9+392.6 | 2.0m Rt  |
| 3   | 240.0     | 9+370.5 | 17.5m Lt |
| 4   | 240.0     | 9+312.0 | 12.0m Lt |
| 5   | 240.0     | 9+365.2 | 18.0m Lt |
| 6   | 240.0     | 9+390.8 | 19.6m Lt |
| 7   | 240.0     | 9+410.8 | 17.6m Lt |
| 8   | 239.8     | 9+375.8 | 8.3m Lt  |
| 9   | 240.0     | 9+342.0 | 7.0m Rt  |
| 10  | 239.7     | 9+350.0 | 2.2m Lt  |
| 10A | 239.7     | 9+344.0 | 7.0m Lt  |
| 11  | 239.7     | 9+367.0 | 4.7m Lt  |
| 12  | 239.7     | 9+352.0 | 19.0m Lt |
| 13  | 239.7     | 9+338.0 | 21.0m Lt |
| 14  | 239.7     | 9+321.0 | 20.0m Lt |
| 15  | 239.7     | 9+368.0 | 5.0m Rt  |

# NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

| REV.               | DATE    | BY            | DESCRIPTION |
|--------------------|---------|---------------|-------------|
| Geocres No 31E-102 |         |               |             |
| HWY No 520         |         |               | DIST 11     |
| SUBAPP PP          | CHECKED | DATE 87 07 22 | SITE 44-55  |
| DRAWN DT           | CHECKED | APPROVED      | DWG 2       |

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 264-85-01

DIST 11

HWY

STR SITE 44-55

Whitestone River Bridge

*CONT 91-220*

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# FOUNDATION INVESTIGATION REPORT

For

Whitestone River Bridge

Hwy. #520 at Whitestone

W.P. 264-85-01; Site: 44-55

District #11, Huntsville

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## INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the above-noted site in two stages: 87 03 04 to 87 03 06 and 87 05 08 to 87 05 20. The fieldwork consisted of eleven sampled boreholes and four dynamic cone penetration tests. A muskeg vehicle mounted auger machine (equipped with hollow and solid stem augers) was used in the first stage of the fieldwork, while in the second stage a raft mounted conventional diamond drill adapted for soil sampling purposes and equipped with NX and BX size casings was employed.

## SITE DESCRIPTION

The site is located some 15 km NW of Jct. Hwy. #520 and Hwy. #124 on Hwy. #520 at the crossing of Whitestone River just east of Whitestone. The surrounding terrain is relatively flat and swampy on the north side of the existing structure. The river at the crossing is 24 m wide and about 4 m deep. It appears that the river channel was narrowed considerably at the time of the original construction.

## SUBSURFACE CONDITIONS

The field investigation carried out at this site, in general revealed the presence of organic material (peat), soft silty clay, silty sand and biotite-gneiss bedrock. A bouldery layer was also encountered over the bedrock.

Borehole #2 which was advanced through the existing east approach indicated that the fill material was placed on the peat deposit. Owing to the complexity of the various deposits encountered (i.e. location, elevation, thickness, composition etc.), it is not practical to give description here for each individual stratum. References should be made to the Record of Borehole Sheets contained in the Appendix for details of the stratification at each boring location. These sheets also contain the results of all field and laboratory tests performed. The stratigraphical sections and profiles are plotted on Dwg. No. 2648501-A located in the Appendix.

GROUNDWATER CONDITIONS

The groundwater level was found to be at or slightly below the ground surface in those boreholes which are located on the original ground. The groundwater level is controlled by the level of water in the river. The observed high water (river) level is reported to be at El. 241.3. During the time of the second field investigation (May 1987) the river water level was observed to be at El. 239.7.

## DISCUSSION AND RECOMMENDATIONS

It is proposed to replace the existing two span simple steel girder bridge with a 25 m long single span structure on the same alignment. The proposed new structure will be about 2.5 m wider on each side than the existing one.

The new profile grade will be about 2.0 m higher, at El. 243.8.

In addition to the replacement, a temporary detour is proposed some 14 m to 19 m downstream of the existing structure. The deck level of the bailey bridge is set at El. 242.2. Our recommendations concerning the new structure foundations, detour construction and other aspects are as follows.

### Structure Foundation

The borings (refer to BH #9, #10A, for west abutment and BH #8, #11, #15 for east abutment) at the abutment locations have indicated the complexity of the overburden material and the irregularity of the bedrock surface level. In view of these facts it is recommended that the abutments of the proposed single-span structure be founded on spread footings placed within rock fill approach embankments. The following design values are recommended.

- 1) Allowable bearing pressures of 250 kPa may be used for the design of footings. For purposes of the O.H.B.D.C., the following values are recommended:

Factored Capacity at U.L.S.: 625 kPa

Capacity at S.L.S. Type II : 250 kPa

- 2) Friction coefficient between rock fill and footing:  $\tan 30^\circ$
- 3) Earth pressures should be computed as per subsection 6.6.1.2.2 of the code. A yielding foundation condition may be assumed.
- 4) The Granular 'A' or 'B' backfill to the abutments should be in accordance with Special Provision No. 121 (dated Oct., 1983). The following parameters are recommended for the granular backfill.

|                                   | <u>Gran. 'A'</u>  | <u>Gran. 'B'</u> |
|-----------------------------------|-------------------|------------------|
| Angle of internal friction:       | $\phi = 35^\circ$ | $30^\circ$       |
| Unit weight ( $\text{kN/m}^3$ ) : | $\gamma = 22.8$   | 21.2             |

- 5) The footings should be placed so as to have at least 2.1 m of cover to provide for frost protection. This protection is required due to the following reasons:

a) FLUCTUATION OF RIVER WATER LEVEL

If the footings are located at or a certain distance below the prevailing water level at the time of freeze-up, the base of the footings may be subjected to heave due to the freezing of water within the rock fill.

b) SEDIMENTS WITHIN THE ROCK FILL

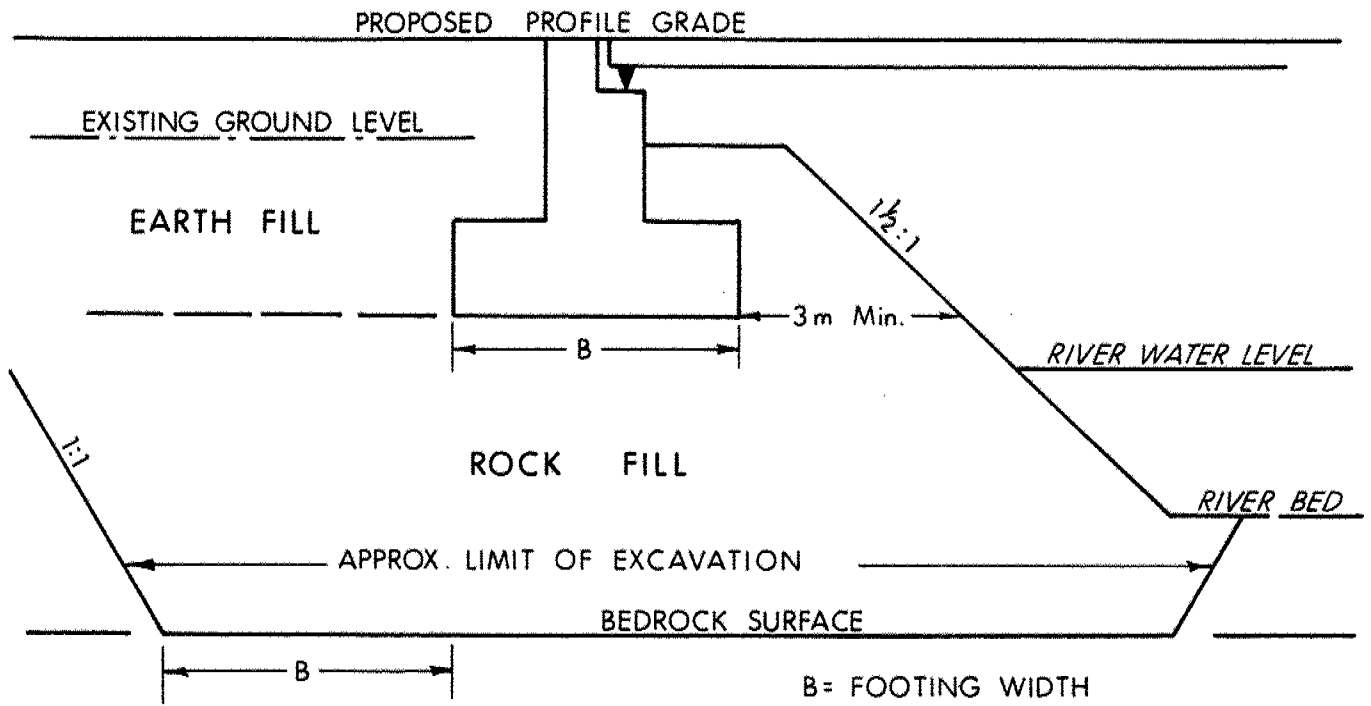
It should be noted that with time the voids in the rock fill may be filled with rock fragments, sand, silt and clay particles from the river water. In such a case the rock fill may not act as a free draining material and consequently a perched water condition will prevail.

- 6) It would be advantageous to provide for 'shimming up' the bridge deck to accommodate any settlements which may occur due to the re-orientation of the rock fill after the bridge construction is completed.

In order to ensure the integrity of the footings, the following construction procedures and slopes are recommended:

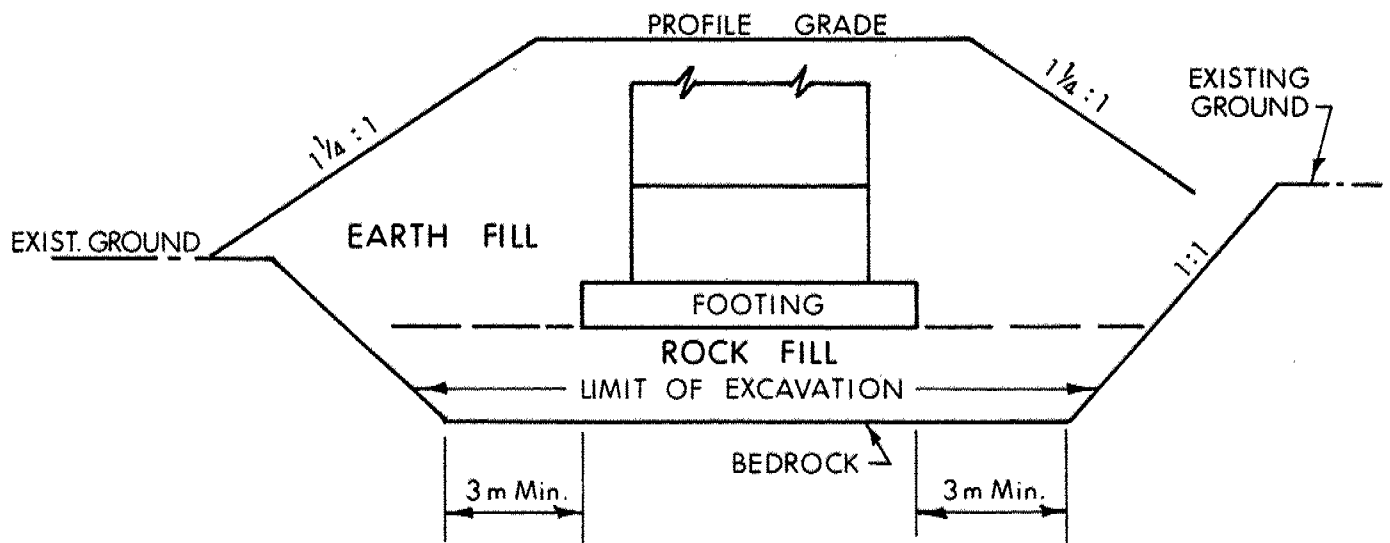
- 1) Excavate the existing overburden material to its full vertical and horizontal extent.
- 2) The new rock fill embankments (at footing locations) should be built initially to profile grade with 1-1/2:1 forward and 1-1/4:1 side slopes.
- 3) The minimum excavation and backfill requirements are outlined on the following sketches

LONGITUDINAL DIRECTION



N.T.S.

TRANSVERSE DIRECTION



N.T.S.



- 4) Re-excavate the earth fill after a period of 6 weeks to the footing level.
- 5) The surface of the rock fill should be 'chinked'.
- 6) For easier excavation, the material above the footing location should be earth material
- 7) Construct abutments.
- 8) No dewatering problems are anticipated if the footings are located above the prevailing river water level.

At the south side of the west abutment, the encountered bedrock surface is about 3 m higher than on the north side. Nevertheless, it may be possible to place the footing directly on the bedrock (south side) and on a suitable pedestal of tremie concrete on the north side.

A friction coefficient of 0.6 between bedrock and footing may be assumed.

Factored Bearing Capacity at U.L.S.: 10 000 kPa  
Bearing Capacity at S.L.S. Type II : DOES NOT APPLY

The bedrock on the east side is considered to be too deep for spread footing.

#### Approach Embankments

As mentioned above, the new approaches will be higher and wider than the existing fills. Therefore, some of the fill material will be placed on 'virgin' ground. In order to accelerate the anticipated displacement and settlement, it is recommended that an about 1 m thick surcharge (over the proposed grade) be placed for the entire length of the east approach and left in place for minimum duration of 3 months prior to construction of the abutment. If localized failures should occur, these should be repaired by restoring the pre-failure geometry.

No special measures are required for the west approach.

The embankment should be constructed with slopes not steeper than 1-1/2:1 (forward) and 1-1/4:1 (side) for rock fill and not steeper than 2:1 for earth fill. If earth fill is used the material should be non-cohesive up to the H.W.L. plus 1.0 m. Rip-rap should also be provided according to hydrology recommendations.

#### Detour Construction

A detour, consisting of embankments and bailey bridge will be required for the duration of the new structure construction. The profile grade of the detour will be about 2.2 m above the swamp level. The swamp (peat material) is about 2.5 m in thickness, followed by an up-to 2.7 m of very soft silty clay.

In view of the encountered subsoil conditions it is recommended that the detour embankments be constructed by 'partial removal and displacement' of the weak material.

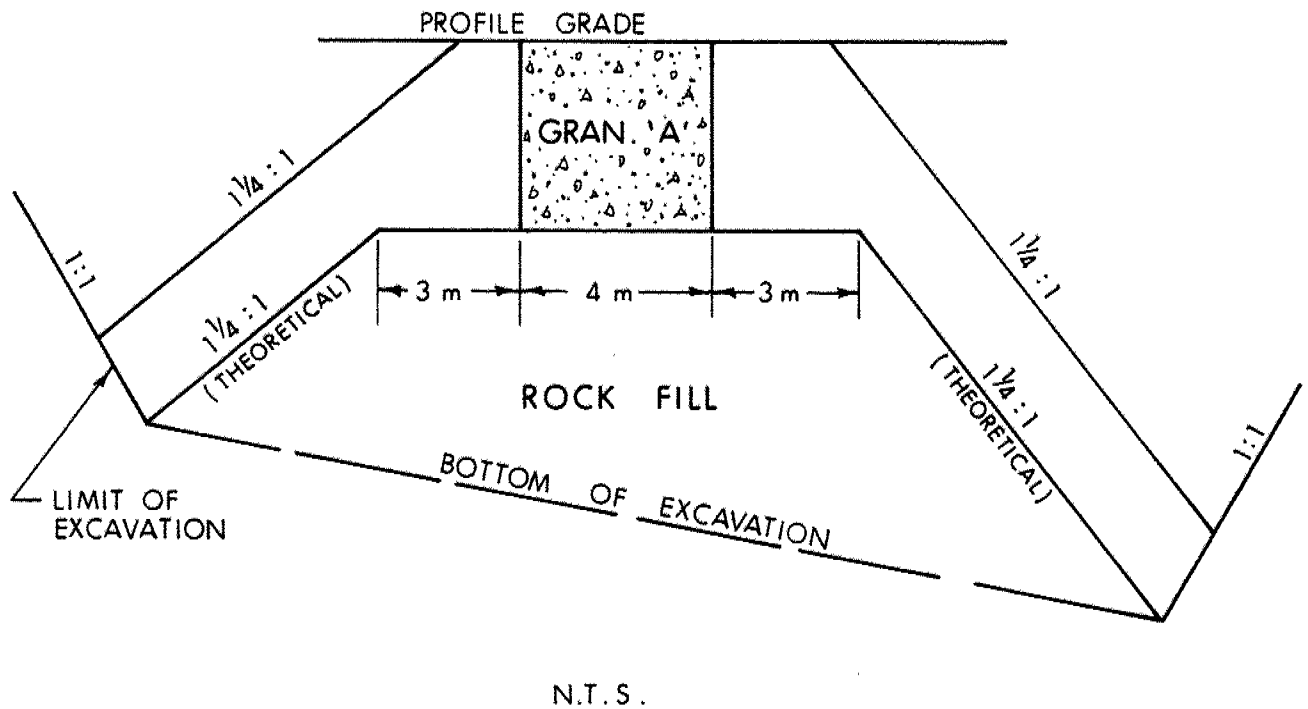
This method requires that non-cohesive fill material placed directly on the surface of the swamp which will begin to settle and displace due to the weight of the fill material. Mud waves will begin to form in front of and at the sides of the fill. Settlement and displacement will occur until a stable situation is reached. The process can be accelerated somewhat by surcharging the loaded area and by excavating the mud wave in front of the fill. This method has the disadvantage that the total amount of fill required cannot be estimated accurately and also, that some soft material may become trapped under the fill and continue to settle for a long period after construction is completed.

We are recommending that the embankment east of the river be built in sections about 15 m long, and surcharged by about a 2 m thick fill material. When the displacement is stopped, the surcharge can be pushed forward to the next section. This procedure should begin at the 'link-up' of the highway and the detour and continued to 'L' distance from the C of the crib. (The term 'L' is explained in this report).

The Bailey Bridge should be founded on timber cribs of 4 m width and 3 m length. The cribs should be backfilled with granular 'A' material. At the time of the report writing, the location of these cribs are not known, but it is evident that the east crib will require different treatment.



## TRANSVERSE DIRECTION



The bottom (limit) of subexcavation at a given station ( $Q_c$ ) may be obtained from the drawing contained in the appendix.

It is also recommended, that the excavation for the crib be carried out in 'strips' not wider than 5 m measured at  $90^\circ$  to the  $Q_c$  of the detour. These measures apply only for the area south of the detour  $Q_c$ .

### West Crib

No special treatments are required at this location. It is assumed that all the encountered weak subsoil will be displaced as described above ('partial removal and displacement'), west of Sta. 9 + 338. The crib (4 m x 3 m) should be built on rock fill 3 m wider than the configuration of the crib, having slopes not less than 1.5:1 in the forward direction and 1.25:1 in the transverse direction.

General Comments for Detour

The width of the river along the detour is about 40 m. Should the bailey bridge proposed to be less than 40 m, the river channel has to be narrowed. If this is the case a causeway should be constructed on the west side of the river.

MISCELLANEOUS

The fieldwork for the project was supervised by Mrs. B. Bennett, Junior Foundation Engineer and Mr. D. Protulipac, Co-op Student. The equipment used was owned and operated by Longyear Canada Ltd. and Johnson Drilling Co. Ltd. This report was prepared by Mr. P. Payer and reviewed by Mr. K. G. Selby.



*P. Payer*

P. Payer, P. Eng.  
Senior Foundations Engineer

*K. G. Selby*

K. G. Selby, P. Eng.  
Chief Foundations Engineer (West)

## **APPENDIX**

## EXPLANATION OF TERMS USED IN REPORT

**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

| $c_u$ (kPa) | 0 - 12    | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200  | > 200 |
|-------------|-----------|---------|---------|----------|------------|-------|
|             | VERY SOFT | SOFT    | FIRM    | STIFF    | VERY STIFF | HARD  |

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5      | 5 - 10 | 10 - 30 | 30 - 50 | > 50       |
|----------------|------------|--------|---------|---------|------------|
|                | VERY LOOSE | LOOSE  | COMPACT | DENSE   | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25    | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100  |
|---------|-----------|---------|---------|---------|-----------|
|         | VERY POOR | POOR    | FAIR    | GOOD    | EXCELLENT |

**JOINTING AND BEDDING:**

| SPACING  | 50mm       | 50 - 300mm | 0.3m - 1m  | 1m - 3m | > 3m       |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE      | MOD. CLOSE | WIDE    | VERY WIDE  |
| BEDDING  | VERY THIN  | THIN       | MEDIUM     | THICK   | VERY THICK |

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

|     |                     |     |                            |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON         | T P | THINWALL PISTON            |
| W S | WASH SAMPLE         | O S | OSTERBERG SAMPLE           |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE                  |
| B S | BLOCK SAMPLE        | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE        | P M | T W ADVANCED MANUALLY      |
| T W | THINWALL OPEN       | F S | FOIL SAMPLE                |

### MECHANICAL PROPERTIES OF SOIL

|                |                       |                                      |
|----------------|-----------------------|--------------------------------------|
| $m_v$          | $\text{kPa}^{-1}$     | COEFFICIENT OF VOLUME CHANGE         |
| $C_c$          | 1                     | COMPRESSION INDEX                    |
| $C_s$          | 1                     | SWELLING INDEX                       |
| $C_\alpha$     | 1                     | RATE OF SECONDARY CONSOLIDATION      |
| $c_v$          | $\text{m}^2/\text{s}$ | COEFFICIENT OF CONSOLIDATION         |
| H              | m                     | DRAINAGE PATH                        |
| $T_v$          | 1                     | TIME FACTOR                          |
| U              | %                     | DEGREE OF CONSOLIDATION              |
| $\sigma'_{vo}$ | kPa                   | EFFECTIVE OVERBURDEN PRESSURE        |
| $\sigma'_p$    | kPa                   | PRECONSOLIDATION PRESSURE            |
| $\tau_f$       | kPa                   | SHEAR STRENGTH                       |
| $c'$           | kPa                   | EFFECTIVE COHESION INTERCEPT         |
| $\phi'$        | -°                    | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| $c_u$          | kPa                   | APPARENT COHESION INTERCEPT          |
| $\phi_u$       | -°                    | APPARENT ANGLE OF INTERNAL FRICTION  |
| $\tau_R$       | kPa                   | RESIDUAL SHEAR STRENGTH              |
| $\tau_r$       | kPa                   | REMOULDED SHEAR STRENGTH             |
| $S_t$          | 1                     | SENSITIVITY = $\frac{c_u}{\tau_r}$   |

### STRESS AND STRAIN

|                                      |     |                               |
|--------------------------------------|-----|-------------------------------|
| $u_w$                                | kPa | PORE WATER PRESSURE           |
| $r_u$                                | 1   | PORE PRESSURE RATIO           |
| $\sigma$                             | kPa | TOTAL NORMAL STRESS           |
| $\sigma'$                            | kPa | EFFECTIVE NORMAL STRESS       |
| $\tau$                               | kPa | SHEAR STRESS                  |
| $\sigma_1, \sigma_2, \sigma_3$       | kPa | PRINCIPAL STRESSES            |
| $\epsilon$                           | %   | LINEAR STRAIN                 |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | %   | PRINCIPAL STRAINS             |
| E                                    | kPa | MODULUS OF LINEAR DEFORMATION |
| G                                    | kPa | MODULUS OF SHEAR DEFORMATION  |
| $\mu$                                | 1   | COEFFICIENT OF FRICTION       |

### PHYSICAL PROPERTIES OF SOIL

|                       |                        |                                |            |      |   |            |                        |  |
|-----------------------|------------------------|--------------------------------|------------|------|---|------------|------------------------|--|
| $\rho_s$              | $\text{kg}/\text{m}^3$ | DENSITY OF SOLID PARTICLES     | e          | 1, % | VOID RATIO                                | $e_{\min}$ | 1, %                   | VOID RATIO IN DENSEST STATE                                |
| $\gamma_s$            | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF SOLID PARTICLES | n          | 1, % | POROSITY                                  | $I_D$      | 1                      | DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$ |
| $\rho_w$              | $\text{kg}/\text{m}^3$ | DENSITY OF WATER               | w          | 1, % | WATER CONTENT                             | D          | mm                     | GRAIN DIAMETER   |
| $\gamma_w$            | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF WATER           | $S_r$      | %    | DEGREE OF SATURATION                      | $D_n$      | mm                     | n PERCENT - DIAMETER                                       |
| $\rho$                | $\text{kg}/\text{m}^3$ | DENSITY OF SOIL                | $w_L$      | %    | LIQUID LIMIT                              | $C_u$      | 1                      | UNIFORMITY COEFFICIENT                                     |
| $\gamma$              | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF SOIL            | $w_p$      | %    | PLASTIC LIMIT                             | h          | m                      | HYDRAULIC HEAD OR POTENTIAL                                |
| $\rho_d$              | $\text{kg}/\text{m}^3$ | DENSITY OF DRY SOIL            | $w_s$      | %    | SHRINKAGE LIMIT                           | q          | $\text{m}^3/\text{s}$  | RATE OF DISCHARGE  |
| $\gamma_d$            | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF DRY SOIL        | $I_p$      | %    | PLASTICITY INDEX = $w_L - w_p$            | v          | m/s                    | DISCHARGE VELOCITY   |
| $\rho_{\text{sat}}$   | $\text{kg}/\text{m}^3$ | DENSITY OF SATURATED SOIL      | $I_L$      | 1    | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$   | i          | 1                      | HYDRAULIC GRADIENT   |
| $\gamma_{\text{sat}}$ | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF SATURATED SOIL  | $I_C$      | 1    | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k          | m/s                    | HYDRAULIC CONDUCTIVITY                                     |
| $\rho'$               | $\text{kg}/\text{m}^3$ | DENSITY OF SUBMERGED SOIL      | $e_{\max}$ | 1, % | VOID RATIO IN LOOSEST STATE               | j          | $\text{kN}/\text{m}^3$ | SEEPAGE FORCE  |
| $\gamma'$             | $\text{kN}/\text{m}^3$ | UNIT WEIGHT OF SUBMERGED SOIL  |            |      |   |            |                        |  |

# RECORD OF BOREHOLE No 1

METRIC

W P 264-85-01 LOCATION Sta. 9 + 317.0 O/S 2.0 m Rt ORIGINATED BY BB  
 DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S., BQ Rock Core COMPILED BY JH  
 DATUM Geodetic DATE 87 03 04 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                                      |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC NATURAL LIQUID<br>LIMIT MOISTURE CONTENT LIMIT |   |                | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|--|---|----------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                          | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20  | 40 | 60 | 80 | 100 | W <sub>p</sub>   | W | W <sub>L</sub> |                     |  |
| 242.0         | Ground Level                         |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |
| 0.0           | Silt to Silty Clay<br>Some Sand      |            |         |      |            | **                         |                 |   |    |    |    |     |  |   |                |                     |  |
| 241.0         | Hard Fill Material                   |            | 1       | SS   | 101        | 23 cm                      |                 |   |    |    |    |     |  |   |                |                     |  |
| 240.6         | Sand Some Silt *                     |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |
| 1.4           | Biotite Gneiss                       |            | 3       | RC   | 100%       |                            |                 |   |    |    |    |     |  |   |                |                     |  |
|               | Sound                                |            | 4       | RC   | 100%       |                            |                 |   |    |    |    |     |  |   |                |                     |  |
| 237.2         | Bedrock                              |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |
| 4.8           | End of Borehole                      |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |
|               | * Very Dense                         |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |
|               | ** Groundwater Level<br>not observed |            |         |      |            |                            |                 |   |    |    |    |     |  |   |                |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\diamond$  5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 2

METRIC

W P 264-85-01 LOCATION Sta. 9 + 392.6 O/S 2.0 m Rt  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger (S.S.)  
DATUM Geodetic DATE 87 03 04  
ORIGINATED BY BB  
COMPILED BY JM  
CHECKED BY

| SOIL PROFILE |  | STRAT PLOT | SAMPLES |      |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |    |    |    | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|--|------------|---------|------|------------|-------------------------|-----------------|--|----|----|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV DEPTH   | DESCRIPTION  |            | NUMBER  | TYPE | 'N' VALUES |                         |                 | 20                                       | 40 | 60 | 80 | 100                             |                               |                                |                  |                                       |
| 241.5        | Roadway Level  |            |         |      |            |                         |                 |  |    |    |    |                                 |                               |                                |                  | GR SA SI CL                           |
| 0.0          | Silty Sand<br>Trace of Clay<br>Occ. Gravel Zones<br>Occ. Boulders<br>Some Organics<br>Compact<br>Fill Material |            | 1       | SS   | 60/10      | 0 cm                    |                 |  |    |    |    |                                 |                               |                                |                  | 0 79 20 1                             |
|              |  |            | 2       | SS   | 1          |                         | 240             |  |    |    |    |                                 |                               |                                |                  |                                       |
|              |  |            | 3       | SS   | 30         |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |
|              |  |            | 4       | SS   | 60/15      | 15 cm                   |                 |  |    |    |    |                                 |                               |                                |                  | 37 55 7 1                             |
| 237.5        |  |            | 5       | SS   | 2          |                         | 238             |  |    |    |    |                                 |                               |                                |                  |                                       |
| 4.0          | Peat<br>With Sand  |            | 6       | SS   | 3          |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |
| 236.3        | Very Soft to Soft  |            |         |      |            |                         |                 |  |    |    |    |                                 |                               |                                |                  | 0 22 73 5                             |
| 5.2          |  |            |         |      |            |                         | 236             |  |    |    |    |                                 |                               |                                |                  |                                       |
|              | Silty Clay to Silt<br>Some Sand<br>Trace of Gravel<br>Soft to Firm   |            | 7       | SS   | 5          |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |
| 233.6        |  |            | 8       | SS   | 1/30       | 30 cm                   | 234             |  |    |    |    |                                 |                               |                                |                  | 2 17 67 14                            |
| 7.9          | Silty Sand<br>Some Gravel<br>Trace of Clay   |            | 9       | SS   | 60/8       | 8 cm                    | 232             |  |    |    |    |                                 |                               |                                |                  | 28 39 32 1                            |
| 230.8        | Boulders   |            |         |      |            |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |
| 10.7         | End of Borehole<br>Refusal to Auger<br>Probable Bedrock  |            |         |      |            |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |
|              | * NOTE<br>Ground Water Level<br>not observed   |            |         |      |            |                         |                 |  |    |    |    |                                 |                               |                                |                  |                                       |

OFFICE REPORT ON SOIL EXPLORATION

+3, x<sup>5</sup>: Numbers refer to Sensitivity  
20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 3

METRIC

W P 264-85-01 LOCATION Sta. 9 + 370.5 O/S 17.5 m Lt  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S.  
DATUM Geodetic DATE 87 03 05  
ORIGINATED BY JM  
COMPILED BY JM  
CHECKED BY

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                                    |                                     |                                   | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20 40 60 80 100                             | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> |                     |   |
| 240.0         | Ground Level   |            |         |      |            |                            |                 |   |                                    |                                     |                                   |                     |   |
| 0.0           | Peat<br>Some Sand<br>Very Soft   |            | 1A      | SS   | 1/         | 30 cm                      |                 |   |                                    |                                     |                                   |                     |   |
| 237.9         |  |            | 2A      | SS   | 1/         | 30 cm                      |                 |   |                                    |                                     |                                   |                     |   |
| 2.1           | Silty Clay<br>Trace/Some Sand<br>Very Soft                             |            | 3A      | SS   | 1/         | 30 cm                      |                 |   |                                    |                                     |                                   |                     |   |
|               |  |            | 4A      | SS   | 1/         | 30 cm                      |                 |   |                                    |                                     |                                   |                     |   |
| 235.6         |  |            | 2       | SS   | 1/         | 30 cm                      |                 |   |                                    |                                     |                                   |                     |   |
| 4.4           | Silty Sand<br>Some Gravel<br>Compact                                   |            | 3       | SS   | 28         |                            |                 |   |                                    |                                     |                                   |                     |   |
| 234.7         |  |            |         |      |            |                            |                 |   |                                    |                                     |                                   |                     |   |
| 5.3           | Refusal to Auger<br>Probable Boulders or<br>Bedrock<br>End of Borehole |            |         |      |            |                            |                 |   |                                    |                                     |                                   |                     |   |

OFFICE REPORT ON SOIL EXPLORATION


+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 4

METRIC

W P 264-85-01 LOCATION Sta. 9 + 312.0 O/S 12.0 m Lt ORIGINATED BY JM  
 DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-S.S. COMPILED BY JM  
 DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT  |    |    |    | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20  | 40 | 60 | 80 |                                    |                                     |                                   |                     |  |
| 240.0         | Ground Level  |            |         |      |            |                            |                 |   |    |    |    |                                    |                                     |                                   |                     |  |
| 0.0           |   |            |         |      |            |                            |                 |   |    |    |    |                                    |                                     |                                   |                     |  |
| 239.2         | Sand and Organics                                       |            | 1       | AS   |            |                            |                 |   |    |    |    |                                    |                                     |                                   |                     |  |
| 0.8           | Refusal to Auger<br>Probable Bedrock<br>End of Borehole |            |         |      |            |                            |                 |   |    |    |    |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10

## METRIC

W P 264-85-01

LOCATION Sta. 9 + 365.2 O/S 18.0 m Lt

ORIGINATED BY JM

DIST 11

HWY 520

BOREHOLE TYPE Dynamic Cone Penetration Test

COMPILED BY JM

DATUM Geodetic

DATE 87 03 05

CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            |        |      |            |                            | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                 | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT |           |                | UNIT<br>WEIGHT<br><br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>[%]<br><br>GR SA SI CL |
|---------------|---|------------|--------|------|------------|----------------------------|---|-----------------|---|-----------|----------------|-------------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                                   | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | GROUND WATER<br>CONDITIONS | ELEVATION SCALE                             | 20 40 60 80 100 | W <sub>p</sub>                                      | W         | W <sub>L</sub> |                         |  |
| 240.0         | Ground Level                                  |            |        |      |            |                            |   |                 | SHEAR STRENGTH                                      |           |                | WATER CONTENT (%)       |  |
| 0.0           |   |            |        |      |            |                            |   |                 | ○ UNCONFINED + FIELD VANE                           |           |                |                         |  |
|               |   |            |        |      |            |                            |   |                 | ● QUICK TRIAXIAL × LAB VANE                         |           |                |                         |  |
|               | Probable Peat<br>Silty Clay and<br>Silty Sand |            |        |      |            |                            | 238   |                 |   |           |                |                         |  |
|               |   |            |        |      |            |                            | 236   |                 |   |           |                |                         |  |
| 234.8         | End of Cone Test                              |            |        |      |            |                            |   |                 |   |           |                |                         |  |
| 5.2           | Probable Boulders or<br>Bedrock               |            |        |      |            |                            |   |                 |   | 120/13 cm |                |                         |  |

+3, x5: Numbers refer to Sensitivity

15-20 (5%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 6

METRIC

W P 264-85-01 LOCATION Sta. 9 + 390.8 O/S 19.6 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY BB  
DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 |  |                                    |                                     |                                   |                     |  |
| 240.0<br>0.0  | Ground Level  |            |         |      |            |                            |                 |  |                                    |                                     |                                   |                     |  |
| 236.2<br>3.8  | Probable Peat<br>Silty Clay and<br>Silty Sand       |            |         |      |            |                            | 238             |  |                                    |                                     |                                   |                     |  |
|               | End of Cone Test<br>Probable Boulders<br>or Bedrock |            |         |      |            |                            |                 | 120/15 cm  |                                    |                                     |                                   |                     |  |

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 7

METRIC

W P 264-85-01 LOCATION Sta. 9 + 410.8 O/S 17.6 m Lt ORIGINATED BY JM  
 DIST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY JM  
 DATUM Geodetic DATE 87 03 05 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |   |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION   | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 |  |                                    |                                     |                                   |                     |  |
| 240.0         | Ground Level  |            |         |      |            |                            |                 |  |                                    |                                     |                                   |                     |  |
| 0.0           | Probable Peat<br>Silty Clay and<br>Silty Sand       |            |         |      |            |                            | 238             |  |                                    |                                     |                                   |                     |  |
| 235.2         | End of Cone Test<br>Probable Boulders or<br>Bedrock |            |         |      |            |                            | 236             |  |                                    |                                     |                                   |                     |  |
| 4.8           |   |            |         |      |            |                            |                 |  |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 8

METRIC

W P 264-85-01 LOCATION Sta. 9 + 375.8 O/S 8.3 m Lt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-H.S., BQ Rock Core COMPILED BY JM  
DATUM Geodetic DATE 87 03 06 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |  |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE<br>5 10 | PLASTIC LIMIT<br>Wp | NATURAL MOISTURE<br>CONTENT<br>W | LIQUID LIMIT<br>WL | UNIT WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |           |
|---------------|--|------------|---------|----------|-------------|----------------------------|-----------------|--|---------------------|----------------------------------|--------------------|------------------|--|-----------|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                 |  |                     |                                  |                    |                  |  |           |
| 239.8         | Ground Level   |            |         |          |             |                            |                 |  |                     |                                  |                    |                  |  |           |
| 0.0           | Peat<br>With Silt<br>Some Sand<br>Trace of Clay<br>Very Soft |            | 1B      | SS       | 1/          | 30 cm                      | 238             |  |                     |                                  |                    |                  |  |           |
|               |  |            | 2B      | SS       | 1/          | 30 cm                      |                 |  |                     |                                  |                    |                  |  |           |
| 236.9         |  |            | 3B      | SS       | 1/          | 30 cm                      |                 |  |                     |                                  |                    |                  |  |           |
| 2.9           | Silty Clay to<br>Silt. Trace of Sand<br>Very Soft to Soft    |            | 4B      | SS       | 1/          | 30 cm                      | 236             |  |                     |                                  |                    |                  |  | 0 41 54 3 |
| 235.6         |  |            |         |          |             |                            |                 |  |                     |                                  |                    |                  |  | 0 7 64 29 |
| 4.2           | Biotite Gneiss<br>Sound                                      |            | 5B      | RC<br>BQ | REC<br>100% |                            | 234             |  |                     |                                  |                    |                  |  |           |
| 233.4         | Bedrock  |            |         |          |             |                            |                 |  |                     |                                  |                    |                  |  |           |
| 6.4           | End of Borehole  |            |         |          |             |                            |                 |  |                     |                                  |                    |                  |  |           |

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 9

METRIC

W P 264-85-01 LOCATION Sta. 9 + 342.0 O/S 7.0 m Rt ORIGINATED BY JM  
DIST 11 HWY 520 BOREHOLE TYPE Continuous Flight Auger-S.S., BQ Rock Core COMPILED BY JM  
DATUM Geodetic DATE 87 03 06 CHECKED BY

| SOIL PROFILE  |                                     |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                |   |                | PLASTIC NATURAL LIQUID<br>LIMIT MOISTURE CONTENT LIMIT |  |  | UNIT<br>WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|-------------------------------------|------------|---------|------|------------|----------------------------|-----------------|---|----------------|---|----------------|--|--|--|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION                         | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20 40 60 80 100                             | W <sub>p</sub> | W | W <sub>L</sub> | WATER CONTENT (%)                                      |  |  |                     |  |
| 240.0         | Ground Level                        |            |         |      |            |                            |                 |   |                |   |                |  |  |  |                     |  |
| 0.0           | Peat                                |            | 1       | AS   |            |                            |                 |   |                |   |                |  |  |  |                     |  |
| 239.2         | Some Sand                           |            |         |      |            |                            |                 |   |                |   |                |  |  |  |                     |  |
| 0.8           | Boulders<br>Sound<br>Biotite Gneiss |            | 2       | RC   | 83%<br>REC |                            |                 |   |                |   |                |  |  |  |                     |  |
| 237.0         | Bedrock                             |            |         |      |            | 238                        |                 |   |                |   |                |  |  |  |                     |  |
| 3.0           | End of Borehole                     |            |         |      |            |                            |                 |   |                |   |                |  |  |  |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 10

METRIC

W P 264-85-01 LOCATION Sta. 9 + 350 O/S 2.2 m Lt  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing  
DATUM Geodetic DATE 87 05 08  
ORIGINATED BY DP  
COMPILED BY PP  
CHECKED BY

| SOIL PROFILE  |                      |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION<br>SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                | PLASTIC<br>LIMIT<br>W <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>W | LIQUID<br>LIMIT<br>W <sub>L</sub> | UNIT<br>WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|----------------------|------------|---------|----------|-------------|----------------------------|--------------------|---|----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV<br>DEPTH | DESCRIPTION          | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                    | 20 40 60 80 100                             | SHEAR STRENGTH |                                    |                                     |                                   |                     |  |
| 239.7         | River Water Level    |            |         |          |             |                            |                    |   |                |                                    |                                     |                                   |                     |  |
| 0.0           |                      |            |         |          |             |                            |                    |   |                |                                    |                                     |                                   |                     |  |
| 237.3         | River Bed            |            |         |          |             |                            | 238                |   |                |                                    |                                     |                                   |                     |  |
| 2.4           | Peat With Sand Firm  |            | 1       | SS       | 7           |                            |                    |   |                |                                    |                                     |                                   |                     |  |
| 235.4         | Boulders             |            | 2       | SS       | 63          |                            | 236                |   |                |                                    |                                     |                                   |                     |  |
| 4.3           | Biotite Gneiss Sound |            | 3       | RC<br>BX | REC<br>100% |                            |                    |   |                |                                    |                                     |                                   |                     |  |
|               |                      |            | 4       | RC<br>BX | REC<br>100% |                            | 234                |   |                |                                    |                                     |                                   |                     |  |
| 232.4         | Bedrock              |            |         |          |             |                            |                    |   |                |                                    |                                     |                                   |                     |  |
| 7.3           | End of Borehole      |            |         |          |             |                            |                    |   |                |                                    |                                     |                                   |                     |  |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

W P 264-85-01 LOCATION Sta. 9 + 344 O/S 7.0 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
DATUM Geodetic DATE 87 05 12 and 13 CHECKED BY \_\_\_\_\_

[illegible]

+3, x5: Numbers refer to Sensitivity

15  $\phi$  5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 11

METRIC

W P 264-85-01 LOCATION Sta. 9 + 367 O/S 4.7 m Lt ORIGINATED BY DP  
 DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
 DATUM Geodetic DATE 87 05 09 CHECKED BY

| SOIL PROFILE  |                          |            | SAMPLES |       |            | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT |    |    |    |     | PLASTIC LIMIT<br>W <sub>p</sub> | NATURAL MOISTURE CONTENT<br>W | LIQUID LIMIT<br>W <sub>L</sub> | UNIT WEIGHT<br>γ | REMARKS & GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
|---------------|--------------------------|------------|---------|-------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV<br>DEPTH | DESCRIPTION              | STRAT PLOT | NUMBER  | TYPE  | 'N' VALUES |                         |                 | 20                                       | 40 | 60 | 80 | 100 |                                 |                               |                                |                  |  |
| 239.7         | River Water Level        |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 0.0           |                          |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 237.0         | River Bed                |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 2.7           | Peat With Sand Very Soft |            | 1       | SS    | 2          |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
|               |                          |            | 2       | SS    | 437        | 12 cm                   |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 235.3         | Boulders                 |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 4.4           | Biotite Gneiss           |            | 3       | RC BX | REC 100%   |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
|               | Sound                    |            | 4       | RC BX | REC 100%   |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 232.3         | Bedrock                  |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |
| 7.4           | End of Borehole          |            |         |       |            |                         |                 |  |    |    |    |     |                                 |                               |                                |                  |  |

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15  
 10  
 5 (%) STRAIN AT FAILURE

**METRIC**

W P 264-85-01 LOCATION Sta. 9 + 352 O/S 19 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing COMPILED BY PP  
DATUM Geodetic DATE 87 05 10 and 11 CHECKED BY \_\_\_\_\_

[illegible]

+3, x5; Numbers refer to Sensitivity

OFFICE REPORT ON SOIL EXPLORATION

## METRIC

W P 264-85-01 LOCATION Sta. 9 + 338 O/S 21 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY PP  
DATUM Geodetic DATE 87 05 12 CHECKED BY \_\_\_\_\_

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity



# RECORD OF BOREHOLE No 14

METRIC

W P 264-85-01 LOCATION Sta. 9 +.321 O/S 20 m Lt ORIGINATED BY DP  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - BX Casing COMPILED BY PP  
DATUM Geodetic DATE 87 05 13 CHECKED BY \_\_\_\_\_

| SOIL PROFILE  |                   |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH<br>○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT<br>W <sub>p</sub><br>NATURAL MOISTURE CONTENT<br>W<br>LIQUID LIMIT<br>W <sub>L</sub><br>WATER CONTENT (%) | UNIT WEIGHT<br>γ | REMARKS<br>&<br>GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
|---------------|-------------------|------------|---------|----------|-------------|----------------------------|-----------------|--|---|------------------|--|
| ELEV<br>DEPTH | DESCRIPTION       | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                 |  |   |                  |  |
| 239.7         | River Water Level |            |         |          |             |                            |                 |  |   |                  |  |
| 0.0           |                   |            |         |          |             |                            |                 |  |   |                  |  |
| 237.3         | River Bed         |            |         |          |             |                            | 238             |  |   |                  |  |
| 237.0         | Sand              |            |         |          |             |                            |                 |  |   |                  |  |
| 2.7           | Biotite Gneiss    |            | 1       | RC<br>BX | REC<br>100% |                            | 236             |  |   |                  |  |
|               | Sound             |            | 2       | RC<br>BX | REC<br>100% |                            |                 |  |   |                  |  |
| 233.9         | Bedrock           |            |         |          |             |                            | 234             |  |   |                  |  |
| 5.8           | End of Borehole   |            |         |          |             |                            |                 |  |   |                  |  |

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 15

METRIC

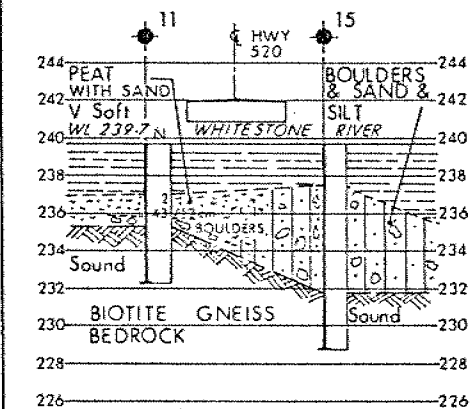
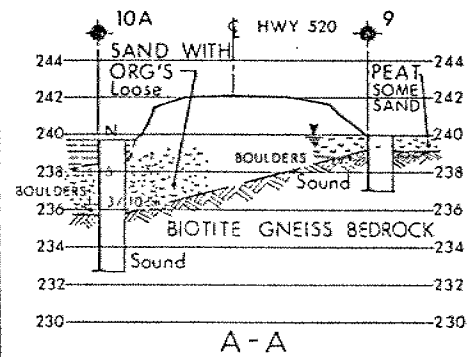
W P 264-85-01 LOCATION Sta. 9 + 368 O/S 5 m Rt  
DIST 11 HWY 520 BOREHOLE TYPE Washbore - NX & BX Casing  
DATUM Geodetic DATE 87 05 14 to 87 05 20  
ORIGINATED BY DP  
COMPILED BY PP  
CHECKED BY

| SOIL PROFILE  |  |            | SAMPLES |          |             | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                |   |                | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT |  |  | UNIT WEIGHT<br>Y | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--|------------|---------|----------|-------------|----------------------------|-----------------|---|----------------|---|----------------|---|--|--|------------------|--|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE     | 'N' VALUES  |                            |                 | 20 40 60 80 100                             | W <sub>p</sub> | W | W <sub>L</sub> | WATER CONTENT (%)                                   |  |  |                  |  |
| 239.7         | River Water Level  |            |         |          |             |                            |                 |   |                |   |                |   |  |  |                  |  |
| 0.0           |  |            |         |          |             |                            |                 |   |                |   |                |   |  |  |                  |  |
| 237.6         | River Bed  |            |         |          |             |                            | 238             |   |                |   |                |   |  |  |                  |  |
| 2.1           |  |            |         | *        |             |                            | 236             |   |                |   |                |   |  |  |                  |  |
|               | Boulders and<br>Sand and Silt  |            |         |          |             |                            | 234             |   |                |   |                |   |  |  |                  |  |
| 231.8         |  |            |         |          |             |                            | 232             |   |                |   |                |   |  |  |                  |  |
| 7.9           | Biotite Gneiss   |            | 1       | RC<br>BX | REC<br>100% |                            | 230             |   |                |   |                |   |  |  |                  |  |
|               | Sound  |            | 2       | RC<br>BX | REC<br>100% |                            |                 |   |                |   |                |   |  |  |                  |  |
| 228.7         | Bedrock  |            |         |          |             |                            |                 |   |                |   |                |   |  |  |                  |  |
| 11.0          | End of Borehole  |            |         |          |             |                            |                 |   |                |   |                |   |  |  |                  |  |
|               | <p>* NOTE<br/>Diamond Drilling<br/>Tools (BX Casing<br/>and BX Core Barrel)<br/>were used to advance<br/>the borehole. Up<br/>to 30 cm long pieces<br/>of rock were<br/>recovered.</p> |            |         |          |             |                            |                 |   |                |   |                |   |  |  |                  |  |

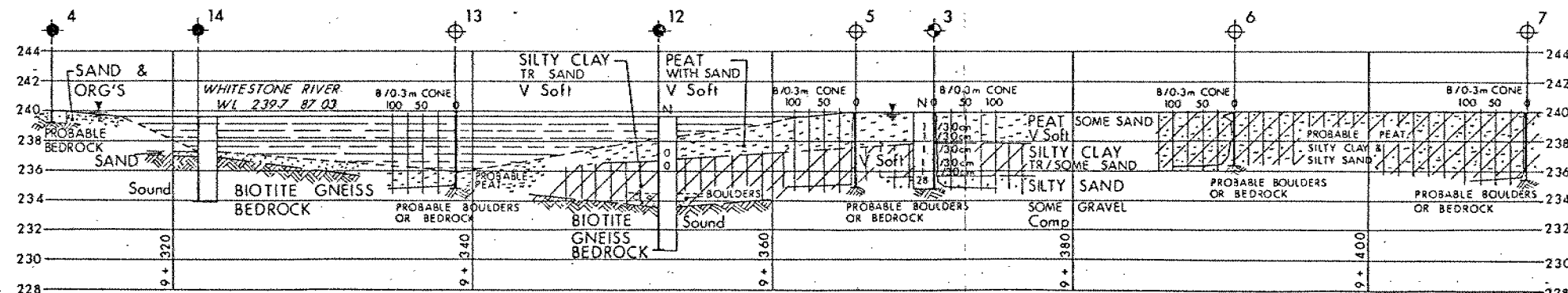
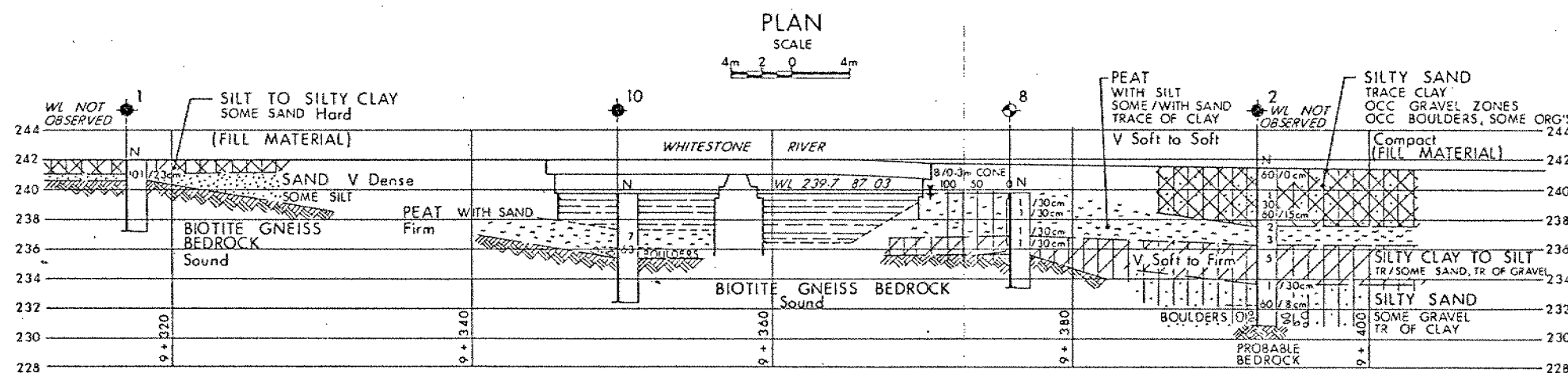
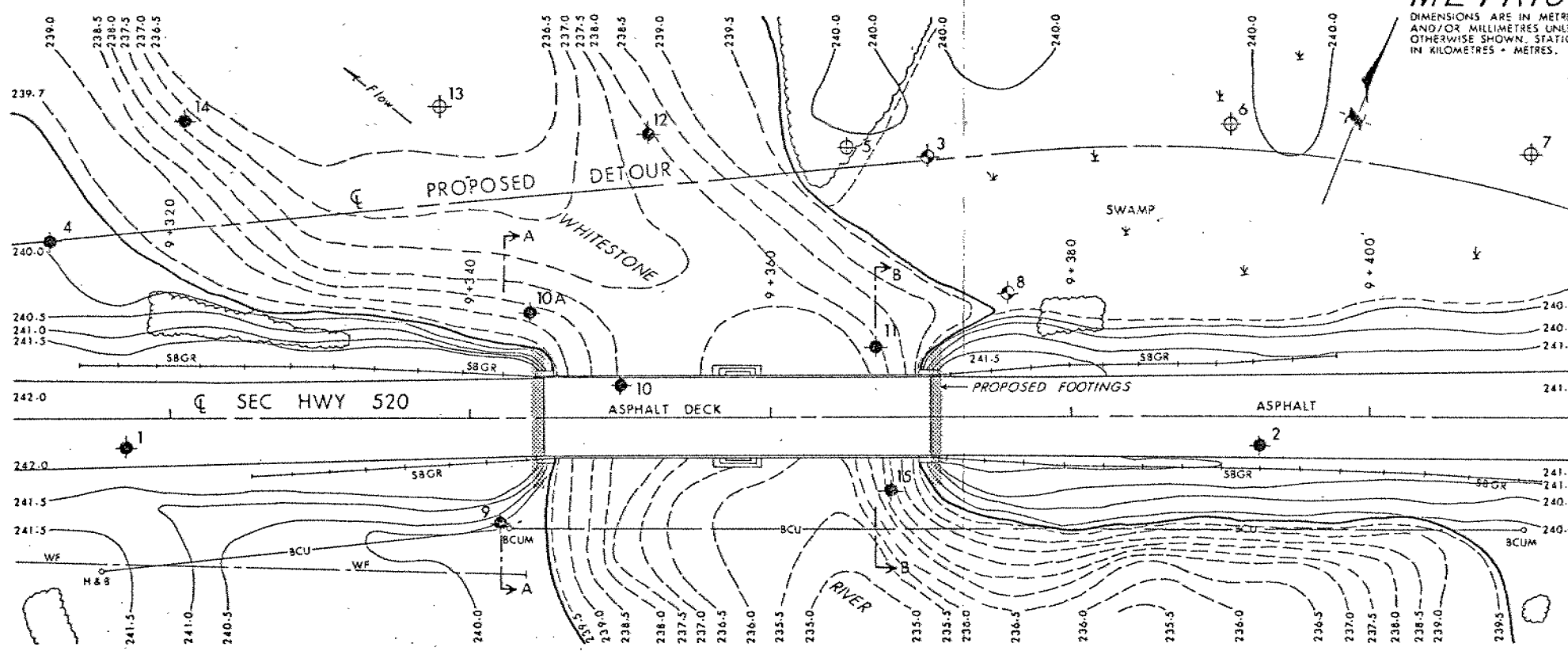
OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



SECTIONS  
SCALE  
4m 2 0 4m



**METRIC**

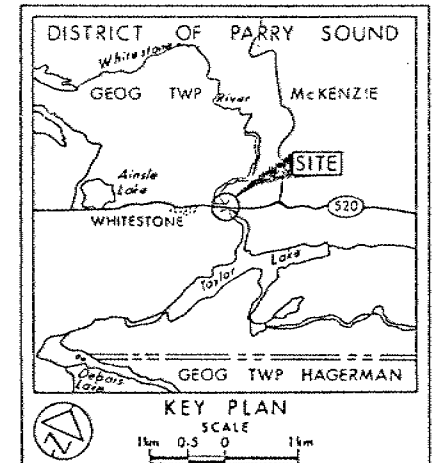
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 264-85-01

WHITESTONE RIVER  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- Wt at time of investigation 87 03 & 87 05

| No  | ELEVATION | STATION | OFFSET   |
|-----|-----------|---------|----------|
| 1   | 242.0     | 9+317.0 | 2.0m Rt  |
| 2   | 241.5     | 9+392.6 | 2.0m Rt  |
| 3   | 240.0     | 9+370.5 | 17.5m Lt |
| 4   | 240.0     | 9+312.0 | 12.0m Lt |
| 5   | 240.0     | 9+365.2 | 18.0m Lt |
| 6   | 240.0     | 9+390.8 | 19.6m Lt |
| 7   | 240.0     | 9+410.8 | 17.6m Lt |
| 8   | 239.8     | 9+375.8 | 8.3m Lt  |
| 9   | 240.0     | 9+342.0 | 7.0m Rt  |
| 10  | 239.7     | 9+350.0 | 2.2m Lt  |
| 10A | 239.7     | 9+344.0 | 7.0m Lt  |
| 11  | 239.7     | 9+367.0 | 4.7m Lt  |
| 12  | 239.7     | 9+352.0 | 19.0m Lt |
| 13  | 239.7     | 9+338.0 | 21.0m Lt |
| 14  | 239.7     | 9+321.0 | 20.0m Lt |
| 15  | 239.7     | 9+368.0 | 5.0m Rt  |

**NOTE**

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

| REV | DATE | BY | DESCRIPTION |
|-----|------|----|-------------|
|     |      |    |             |

Geocres No 31E-102

|                     |               |
|---------------------|---------------|
| HWY No 520          | DIST 11       |
| SUBM'D PP [CHECKED] | DATE 87 07 22 |
| DRAWN DT [CHECKED]  | SITE 44-55    |
|                     | OWG 2648501-A |

REF No E-9035-1, 86 10



# memorandum

Betty



To: Don Zimmerman  
Construction Supervisor  
Construction Office  
Northern Region

Date: September 17, 1991  
(705) 497-5426  
Ext 6256

RE: Whitestone River Bridge  
Contract 91-220, Site 44-55  
Highway 20, District 11 - Huntsville

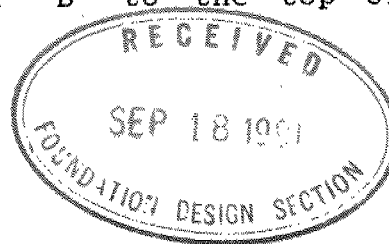
The following clarifications are made to sheet 2 of the contract drawings. The clarifications are the result of discussions with Ms. B. Bennett of the Foundation Design Section and Mr. B. Farago of the Design Section, Structural Office.

- 1) Section B-B, Excavation at Structure - West Approach:  
The profile of granular "B" Type I backfill indicated on the drawing can not be accomplished. The backfill should be sloped, then protected with geotextile and rock protection similar to details of the east abutment. The extent of rock protection is indicated on sheet 15 of the contract drawings.
- 2) Section D-D, Excavation at Structure - East Approach:  
There is a blank (unidentified) area between the geotextile/rock protection and the granular "B" Type I backfill. This area should also read granular "B" Type I backfill.
- 3) In general the specified 600 mm thick rock protection should be in place before the winter.
- 4) Sequence of Construction - East Abutment:  
The current sequence of construction as specified on the contract drawings is as follows:
  - a) Excavate area to bedrock.
  - b) Backfill area with granular "B" to grade.
  - c) Place 1.15 m surcharge for a minimum period of three months to accelerate the anticipated settlement in the approaches.
  - d) Re-excavate area to approximately the top of pile elevations, drive piles, then pour footing and abutment.

The above scenario, in addition to the restricted construction period (environmental), might cause unacceptable delays. The following sequence can provide for a speedier delivery:

- a) Excavate area to bedrock.
- b) Backfill area with granular "B" to the top of pile elevation.

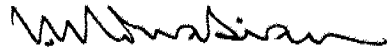
.../2



- c) Drive piles.
- d) Pour footings and optionally pour abutment.
- e) Backfill to final elevations.
- f) Place 1.15 m surcharge on approach.

Should the contractor opt for pouring the footings and the abutments in step d) above, then the extent of the backfill and the 1.15 m thick surcharge should be as indicated on the attached sketch. This will ensure that the backfill or the surcharge will not cause any structural and/or stability concerns to the abutment.

Please advise if additional information is required.



Vatche Minassian  
Senior Structural Engineer  
Structural Section  
Northern Region

VM:dc

Attachment

cc. P. Furst  
B. Bennett  
B. Farago

ABT  
BRG.

1.15m. Surcharge

SURCHARGE

EL. 241.50

EL. 241.50

EL. 240.5

239.9

600 mm  
ROCK PROTECTION  
OVER GEOTEXTILE

(PLACED BEFORE WINTER)

3.4m

BACKFILL  
GRAN. 'B'  
TYPE I.

BACKFILL  
GRAN. 'B' - TYPE I

4.0m

3.0m

BEDROCK EL. 232 → 235

TOP OF UNDISTURBED SOIL  
EL. APPROX. 241.8

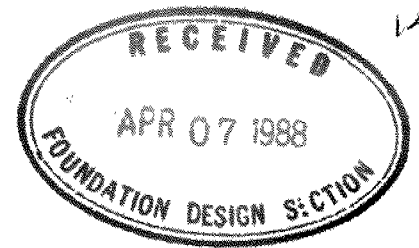
WHITESTONE RIVER BRIDGE

CONT. No. 91-220

EAST APPROACH

TEMP. BACKFILL & SURCHARGE LIMITS

WHITESTONE RIVER BRIDGE  
W.P. 264-85-01, SITE 44-55




Record of meeting at the Structural Office on Wednesday,  
March 30, 1988

Present: ✓ K. Selby, Chief Foundation Engineer, West  
B. Farago, Structural Office  
J. Szekeres, Structural office

Purpose of the meeting was to discuss proposed changes to the  
foundation of the east abutment.

1. The Foundation Section originally recommended to place footings  
on rock fill.
2. It was resolved early on, that using rock-fill under the  
footing might result in long term settlement and tilting  
of the abutment due to the variable depth of fill.  
Corrective measures are very expensive due to the fact  
that expansion joints have to be removed and after jacking  
the beams up, new joint has to be installed. At a meeting  
with Mr. P. Payer the foundation design was changed to  
tremie concrete at both abutments and this design was  
incorporated in the Preliminary General Arrangement  
drawing and subsequently approved by all parties.
3. The regional construction office is opposed to the use of  
tremie concrete, because of the substantial depth involved.
4. It was resolved that the designer will change the foundation  
of the east abutment from tremie concrete to steel H piles.  
  
Steel H piles will be 310 x 110, driven with rock points  
through granular fill.
5. Mr. Selby agreed with this approach.

  
BF/sl

c.c. All present  
K. Bassi  
P. Stuart

# memorandum

235-3696



To: K.G. Selby  
Chief Foundation Engineer  
Foundation Design Section  
Room 315, Central Building

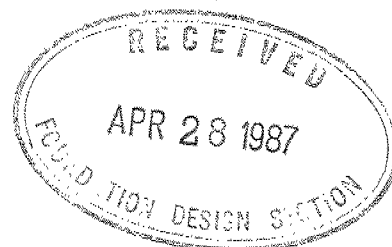
Attn: B. Bennett

From: Soils and Aggregates Section  
Engineering Materials Office  
Room 309, Central Building

Date: 87 04 27

File No.: 3162-2-4-113


Re: Borehole Core Descriptions  
Hwy. 520, Whitestone River, Whitestone  
W.P. 264-85-01



As requested by your section, core from three (3) boreholes was logged, and descriptions are appended. Depth to top of bedrock and depth to top of unweathered rock in each borehole are tabulated below:

| Borehole<br>Number | Depth to Bedrock<br>in metres below<br>ground surface | Depth to Unweathered Rock<br>(including slightly weathered)<br>in metres below ground surface |
|--------------------|---|---|
| 1                  | 1.40  | 1.40  |
| 8                  | 4.24  | 4.24  |
| 9                  | 0.76  | 0.76  |

Bedrock is gneiss of Late Precambrian Age.  
If you have any questions, please contact me.

  
S.A. Senior,  
Geological Engineer.

SAS/jlo  
Attachment

# DESCRIPTION OF ROCK CORE - W.P.

264-85-01

| BOREHOLE<br>NUMBER |             |        |         | CORE DESCRIPTION |  |
|--------------------|-------------|--------|---------|------------------|--|
|                    | DEPTH (m)   | % CR * | % RQD * | DEPTH (m)        | DESCRIPTION  |
| 1                  | 1.40 - 2.69 | 100    | 61      | 1.40 - 4.83      | HORNBLLENDE GNEISS, black, streaked white, spotted red; medium grained (1-3 mm), foliated very thickly banded; closely to moderately spaced fractures, joint surfaces rust stained, rough; medium strength rock; unweathered to slightly weathered |
|                    | 2.69 - 4.83 | 100    | 95      |                  |  |
| 8                  | 4.24 - 6.38 | 100    | 96      | 4.24 - 6.38      | BIOTITE GNEISS, black, streaked white, grey; medium to coarse grained (2-6 mm), thin to thickly banded, foliated; closely spaced to moderately spaced fractures, clay coated, unstained; medium strength rock; unweathered to slightly weathered   |
| 9                  | 0.76 - 2.97 | 86     | 74      | 0.76 - 2.39      | QUARTZ GNEISS, white, streaked black, spotted red; medium grained (1-3 mm), foliated, thickly banded; moderately spaced fractures, clean, rough; medium strength rock, unweathered   |
|                    |             |        |         | 2.39 - 2.97      | HORNBLLENDE GNEISS, black, mottled white, red; medium to coarse grained (3-6 mm), weakly foliated, massive; moderately spaced fractures, clay coated, unstained; medium strength rock; unweathered to slightly weathered                           |
|                    |             |        |         |                  |  |

\* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

# DESCRIPTION OF ROCK CORE - W.P.

264-85-01

| BOREHOLE<br>NUMBER |             |        |         | CORE DESCRIPTION |  |
|--------------------|-------------|--------|---------|------------------|--|
|                    | DEPTH (m)   | % CR * | % RQD * | DEPTH (m)        | DESCRIPTION  |
| 1                  | 1.40 - 2.69 | 100    | 61      | 1.40 - 4.83      | HORNBLLENDE GNEISS, black, streaked white, spotted red; medium grained (1-3 mm), foliated very thickly banded; closely to moderately spaced fractures, joint surfaces rust stained, rough; medium strength rock; unweathered to slightly weathered |
|                    | 2.69 - 4.83 | 100    | 95      |                  |  |
| 8                  | 4.24 - 6.38 | 100    | 96      | 4.24 - 6.38      | BIOTITE GNEISS, black, streaked white, grey; medium to coarse grained (2-6 mm), thin to thickly banded, foliated; closely spaced to moderately spaced fractures, clay coated, unstained; medium strength rock; unweathered to slightly weathered   |
| 9                  | 0.76 - 2.97 | 86     | 74      | 0.76 - 2.39      | QUARTZ GNEISS, white, streaked black, spotted red; medium grained (1-3 mm), foliated, thickly banded; moderately spaced fractures, clean, rough; medium strength rock, unweathered   |
|                    |             |        |         | 2.39 - 2.97      | HORNBLLENDE GNEISS, black, mottled white, red; medium to coarse grained (3-6 mm), weakly foliated, massive; moderately spaced fractures, clay coated, unstained; medium strength rock; unweathered to slightly weathered                           |
|                    |             |        |         |                  |  |

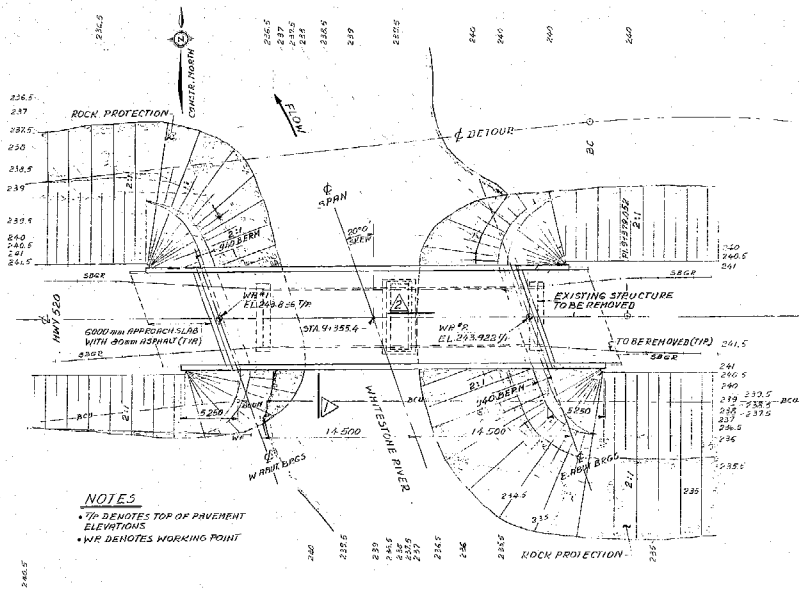
\* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

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

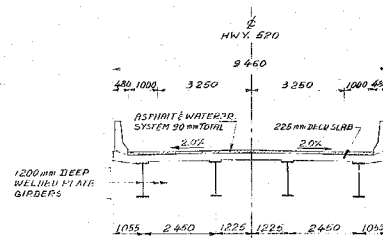
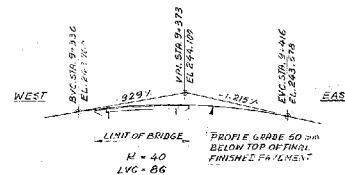
DISTRICT No 11  
CONT No  
WP No 264-85-01

WHITESTONE RIVER BRIDGE  
GENERAL ARRANGEMENT

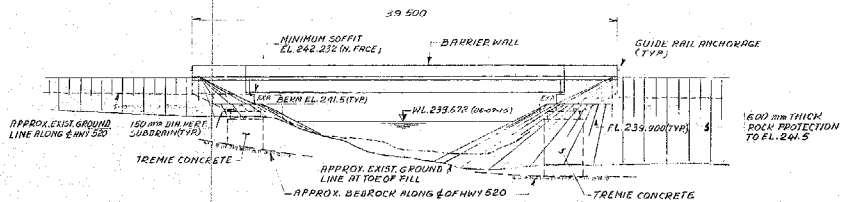
**SHEET**



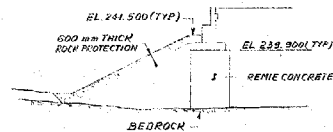
PLAN  
1:200

 1:75

PROFILE OF HWY 520  
N.T.S.



ELEVATION  
1:200



2 1:200

BM 240.970  
GEODETIC DATUM  
CUT CROSS ON BEDROCK  
34.70 Rt - 9+342.9

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

|     |      |    |               |            |
|-----|------|----|---------------|------------|
| NO. | DATE | BY | DESCRIPTION   |            |
|     |      |    | LOADING       | DATE       |
|     |      |    | CH/BDC-C, -B3 | DATE BDC/B |
|     |      |    | SITE No 44-55 | DWG P1     |