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Trow

Foundation Investigation and Design Report Highway 69 Pickerel River Bridge Replacement and Re-alignment for 1.2 km W.P. 330-85-00 MTO District 54, Sudbury

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PREFACE

Group Work Project No. 330-85-00 encompasses the replacement of the Pickerel River Bridge on Highway 69. As a result of this replacement, an approximately 1.2 km section of new horizontal alignment with improvements to the vertical alignment will be constructed. This new alignment will involve the construction of new approaches to the structure, the construction of a northbound left turn lane and a southbound right turn taper to the Pickerel and Lower French River Road, and the reconstruction of all side roads and existing entrances to fit the new alignment. Upon construction completion of the new structure and alignment, the existing structure and highway infrastructure will be removed and rehabilitated.

This project commences approximately 470 m south of the Pickerel River and extends northerly to approximately 700 m north of the river, for a length of about 1.2 km (including the new structure over the Pickerel River). The project is located within the Geographic Township of Mowat, approximately 14.7 km south of Highway 64, in the District of Parry Sound, in the MTO Northern Region, District 54, Sudbury.

The following report addresses the foundation investigation and design implications of a proposed two span bridge at the Pickerel River crossing. A separate report prepared by Trow Consulting Engineers Ltd. addresses the pavement and geotechnical concerns of the assignment.

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PART 1 - FOUNDATION INVESTIGATION

1.0 INTRODUCTION

This submission presents the results of a foundation investigation completed by Trow Consulting Engineers Ltd. ("Trow") for the proposed two span replacement bridge at the Pickerel River and Highway 69 crossing. It is Trow's understanding that a two span replacement structure consisting of a 39.0 m south span and a 77.5 m north span is proposed at this site. This proposed layout will require a pier to be constructed within the river channel, approximately 10 m north of the south shore. This portion of the report contains factual information (obtained from the field investigation) pertaining to the design parameters required for the bridge foundations.

1.1 SITE DESCRIPTION AND GEOLOGICAL SETTING

1.1.1 Site Description

The proposed bridge site is located along Highway 69, approximately 25 m to the west of the existing bridge at the Pickerel River. The approximate stationing of the proposed bridge site is from Station 19+825 to Station 19+975, Mowat Township, District of Parry Sound. Appendix A contains a site plan, sections and four (4) photographs of the site.

Numerous bedrock outcrops are exposed within the vicinity of the proposed replacement structure location and large, surficial cobbles and boulders are visible along the northern shoreline At the crossing, the terrain on the south side of the river is undulating corresponding with the bedrock ridges and valleys, while a rise in elevation on the north side of the river is noted. The surrounding area to the south of the river has occasional small coniferous trees and shrubs, with marshy areas located within the bedrock valleys. The northern shoreline of the river contains mature coniferous and deciduous trees.

1.1.2 Geological Setting

Published geological information confirms that the site, located within the Central Gneiss Belt, comprises of bedrock consisting of Mesoproterozoic Gneisses of metasedimentary origin. As previously noted, the topography in the area is undulating, and appears to consist primarily of exposed bedrock.

1.2 Investigative Procedures

1.2.1 General

Part 1 of this report describes the investigative procedures adopted for the geotechnical assessment of the proposed replacement bridge for the Pickerel River crossing. Properties of the overburden soils and recovered bedrock samples were obtained by in-situ and laboratory testing. The procedures, used during the investigation, are described below.

1.2.2 Field Investigation

The field work for the investigation was carried out between October 24, 2000 and October 27, 2000, and consisted of twenty three (23) boreholes.

Six (6) boreholes were completed at the south abutment area (BH-1 to BH-6, inclusive), to depths varying from 400 mm to 3.2 m. Ten (10) boreholes were completed at the north abutment location (BH-20 to BH-29, inclusive), to depths varying from 200 mm to 3.2 m. All boreholes at both the south and north abutment locations were advanced by hand powered soils augering equipment until auger refusal was met. As a result of access limitations, it was not feasible to mobilize track mounted equipment (bulldozer, excavator or drill rig) to the abutment locations. Upon meeting auger refusal, two boreholes at each abutment location (BH-1 and BH- 5 at the southern location and BH-20 and BH-24 at the northern location) were cored ("NQ" size) a minimum of 3.2 m into the encountered bedrock. A senior Trow geotechnical drill rig technician supervised and logged the soil drilling and rock coring, which was performed by an approved soils drilling contractor, Colbar Resources.

Seven (7) boreholes (BH-10 through BH-15, inclusive and BH-11B) located near the pier location of the proposed structure were advanced through the overburden soils using a skid-mounted BBS1 drill, positioned into place through the use of a barge, and equipped with solid and hollow stem augers. The drill was operated by an approved soils drilling contractor, Marathon Drilling Co. Ltd. Soil samples were obtained by using a 51 mm O.D. split-spoon sampler in conjunction with standard penetration tests (ASTM D1586). The standard penetration (N) values were recorded and used to provide an assessment of the relative density of the overburden soils encountered within the river channel. Upon meeting auger refusal at the pier location, three (3) of the seven boreholes (BH-11, BH-11B and BH-14) were cored between 1.6 m to 3.1 m into the encountered bedrock. A "BQ" size core barrel and casing were used, and core samples of the bedrock were retrieved for rock quality determination and classification. The recovered soil samples and rock cores were used for identification and laboratory testing.

The borehole locations are shown on the attached site plan, Drawing 1, in Appendix A. These locations in the field were established by chaining off WP markers provided by DS-Lea Associates Ltd.'s ("LEA") survey crew. The surface elevations were established by interpolating the ground surface spot elevations and contours from a plan provided by LEA and are referenced to geodetic datum. As it was not possible to place stakes within the river channel at the location of the pier, LEA provided the station for WP2 as an offset on the existing bridge. In an attempt to place the boreholes within the pier location, our field staff lined the barge into position with the provided offset on the existing bridge and the staked out centreline of the proposed alignment on the slopes. Once the barge was positioned, it was both anchored to the river bottom and tied to three points along the southern shore. Upon review of the field sounding depths obtained during the drilling process, and the river bathymetry data provided by LEA, we now suspect that the actual locations of the boreholes advanced within the river channel vary between 1 to 7 m north of the proposed pier location.

Details of the soil and bedrock conditions encountered in the boreholes are included on the logs and the Rock Core Description Table in Appendix B. Further details on soil descriptions for classification purposes may be found on Figure 2, also included in Appendix B.

1.2.3 Laboratory Testing

The laboratory testing program for this assignment was limited to a detailed visual assessment of the recovered soil samples and rock cores.

The results of the visual assessment are summarized on the attached borehole logs and Rock Core Description Table in Appendix B.

1.2.4 Subsurface Conditions

The borehole locations are shown on the site plan and soil sections along the proposed centreline of the three foundation elements, and are plotted on Drawing 1, located in Appendix A. Soil sections at each of the three foundation elements are plotted on Drawing 2, also located in Appendix A. Based on this information, the following different soil layers were encountered:

- Topsoil/Surficial Boulders and Cobbles
- Silty Sand/Sandy Silt
- Alluvial Sand
- Bedrock/Boulders

A summary of the above soil strata encountered in the boreholes, and inferred from the boreholes is presented below.

1.2.4.1 Topsoil/Surficial Boulders and Cobbles

A surficial layer of topsoil, 80 mm to 150 mm thick, was encountered in boreholes BH-2, BH-3, BH-4 and BH-6 and a layer of surficial boulders and cobbles contained within an organic matrix, varying in thickness from 200 mm to 660 mm, was observed in boreholes BH-21, BH-22, BH-23, BH-25, BH-26, BH-27, BH-28 and BH-29.

1.2.4.2 Silty Sand/Sandy Silt

A thin deposit (i.e. less than 500 mm thick) of wet, brown silty sand/sandy silt was encountered beneath the topsoil layer in boreholes BH-2, BH-3, BH-4 and BH-6. This layer was described as loose to compact.

1.2.4.3 Alluvial Sand

A thin veneer (i.e. less than 130 mm thick) of overburden comprised of coarse, brown, alluvial sand was encountered surficially at the locations of boreholes BH-12, BH-13 and BH-14, within the river channel.

1.2.4.4 Bedrock/Boulders

Surficial bedrock was noted at the locations of boreholes BH-1, BH-5, BH-10, BH-11, BH-11B, BH-15, BH-20 and BH-24. The auger refusal was met on probable bedrock (possible boulders) beneath the silty sand/sandy silt layer in boreholes BH-2, BH-3, BH-4, BH-6, BH-26 and BH-27 and below the alluvial sand deposit in BH-12, BH-13 and BH-14. Auger refusal was met on probable boulders (possible bedrock) in boreholes BH-21, BH-22, BH-23, BH-25, BH-28 and BH-29 beneath the surficial boulder and cobble layer.

Bedrock was confirmed by retrieving "NQ" size cores in boreholes BH-1, BH-5, BH-20 and BH-24, i.e. at two locations beneath each of the two abutments and by retrieving "BQ" size cores in boreholes BH-11, BH-11B and BH-14, i.e. at three locations beneath the proposed pier.

The following table summarizes the location, depth to refusal, type of refusal, etc. of each borehole.

Borehole	Depth to Refusal (m)	Elevation of Refusal	Type of Refusal
South Abutment			
BH-1	0.00 (Bedrock outcropping)	179.9	Bedrock proven by coring
BH-2	0.51	179.3	Probable bedrock *
BH-3	0.41	179.6	Probable bedrock *
BH-4	0.36	180.7	Probable bedrock *
BH-5	0.00 (Bedrock outcropping)	180.6	Bedrock proven by coring
BH-6	0.61	179.2	Probable bedrock *
Pier			
BH-10	4.57 (water depth)	172.8	Probable bedrock *
BH-11	5.79 (water depth)	171.6	Bedrock proven by coring
BH-11B	5.79 (water depth)	171.6	Bedrock proven by coring
BH-12	5.61 (water depth plus 50 mm overburden)	171.8	Probable bedrock *
BH-13	5.79 (water depth plus 130 mm overburden)	171.6	Probable bedrock *
BH-14	3.05 (water depth plus 100 mm overburden)	174.3	Bedrock proven by coring
BH-15	5.84 (water depth)	171.6	Probable bedrock *

Borehole	Depth to Refusal (m)	Elevation of Refusal	Type of Refusal
North Abutment			
BH-20	0.00 (Bedrock outcropping)	178.5	Bedrock proven by coring
BH-21	0.36	179.3	Probable boulder
BH-22	0.23	179.0	Probable boulder
BH-23	0.41	179.3	Probable boulder
BH-24	0.00 (Bedrock outcropping)	179.5	Bedrock proven by coring
BH-25	0.66	179.6	Probable boulder
BH-26	0.30	180.2	Probable bedrock *
BH-27	0.18	180.5	Probable bedrock *
BH-28	0.48	180.9	Probable boulder
BH-29	0.28	180.9	Probable boulder

*Bedrock levels were inferred from 'grinding' refusal to the machine augers. This refusal could, however, also represent a boulder obstruction in some instances.

As noted above, bedrock either outcrops or is relatively shallow beneath the proposed pier and two abutment locations.

The above elevations were estimated, based on the boreholes drilled at the pier and abutment locations. Interpolation between boreholes is approximate, and, as such, actual footing elevations will depend on the conditions encountered at the time of construction. The bedrock surface in Northern Ontario is known to be erratic and hence may vary between explorations.

The reader is referred to Table 1 in Appendix B for detailed descriptions (i.e. RQD, discontinuities, etc.) of the recovered bedrock cores. Descriptions of the recovered bedrock cores are summarized within the following paragraphs.

The bedrock at the Highway 69 Pickerel River crossing belongs to the Rutter pluton, an igneous rock of syenitic to monzonitic composition. It is one of many granitic and anorthositic intrusions in the Central Gneiss Belt of the Grenville Province. The pluton is elongated and can be traced from west of Alban, parallel to Highway 69, and southeast to several kilometres south of Pickerel River.

At Pickerel River, the syenite / monzonite consists of about 60% reddish brown alkali and grey plagioclase feldspar. Mafic minerals constitute about 35% to 40%. The mafic minerals are soft and are most probably chloritized amphiboles. Biotite was not megascopically identified. Other minerals present in the low percent range are glassy quartz, disseminated grains and small aggregations of ruby red garnets, calcite as interstitial grains or on fracture planes, hematite, and specks of sulphides. There are no clay minerals present to cause rock swelling, and the widely disseminated specks of sulphides are not enough to cause concerns of acid rock drainage. The

rock is non-magnetic. Visually, the rock has a coarse grained appearance, but microscopically is seen to be fine to medium grained.

The pluton is deformed and was subjected to deep burial metamorphism. However, metamorphic reconstitution and segregation of minerals has been minimal. Gneissosity is weakly to moderately well developed. Mafic minerals cluster in disconnected aggregates which are mostly near planar, but may also be irregularly shaped. The mafic aggregates are aligned on planes inclined at a modest 10 to 15 degrees from the horizontal, rarely steeper. Individual mafic minerals mostly lie in the planes of these aggregates, but many grains deviate from this general alignment. The result is that the rock has maintained much of its original igneous texture, and with that good grain interlocking. Such an interlocking mineral fabric gives the rock structural integrity and strength. The drill cores do not preferentially break on compositional foliation. There is thus no inherent weakness in the rock mass due to the gneissic fabric.

The drill cores from the south abutment foundation (boreholes BH-1 and BH-5), and north abutment foundation (boreholes BH-20 and BH-24) are solid with little tectonic disturbance. Hairline cracks and narrow, well sealed, fractures are widely spaced. They are planar to irregular shaped, with rough surfaces, and with no signs of slippage or fault movement. Most core breaks have occurred on these fractures. However, they are not unidirectionally orientated, and in total do not impart a directional weakness on the rock mass. Except for minor and not significant differences, the four cores are much the same.

The drill cores from the mid-river pier site, boreholes BH-11, BH-11B and BH-14, are more highly fractured and mineralogically altered than those from the north and south abutment sites. Even the cores of boreholes BH-11 and BH-11B, which were drilled within 700 mm of each other, differ from one another in their intensity of rock fracturing and mineral alteration. This higher intensity of fracturing and alteration lends support to the idea that a now inactive east-west fault zone, parallel to the French River fault, may also lie along the water course of the Pickerel River.

1.2.4.5 Groundwater Conditions

Groundwater, perched on the bedrock surface, was encountered during the field work at a depth of 300 mm below the existing grade at borehole BH-3. Otherwise, groundwater was not encountered within the boreholes advanced for the abutments.

The river water elevation, based on survey data provided by LEA, was at El. 177.40 m, at the time of the field investigation.

PART 2 - ENGINEERING DISCUSSION AND RECOMMENDATIONS

The following sections address geotechnical considerations pertaining to the proposed two span replacement bridge at the Highway 69 and Pickerel River crossing. The discussions and recommendations are based upon our present understanding of the proposed design, as indicated below.

Trow understands that the proposed new bridge will be a two span structure consisting of a 39.0 m south span, and a 77.5 m north span. The proposed structure will require a pier to be constructed within the river channel, approximately 10 m north of the south shore. The proposed alignment grade at the site will be raised approximately 2 m from the present grade to accommodate a design speed of 110 km/hr. The new alignment will also contain a new northbound left turn lane and southbound right turn taper at the Pickerel and Lower French River Road. Upon completion of the new structure, the existing structure and highway infrastructure will be removed and rehabilitated.

2.0 Foundations

2.1 Spread Footings

At both the north and south abutments and at the proposed pier location, bedrock is shallow as evidenced by the numerous bedrock outcroppings. As such, it should be feasible to excavate down to the rock, remove any surficial loose material and place the foundations directly on the bedrock surfaces. For the purpose of design, in accordance with the Ontario Highway Bridge Design Code, the following geotechnical resistance can be used for spread footings placed directly on the gneissic syenite/monzonite bedrock, subject to inspection by a qualified geotechnical engineer:

Table 2-1
Geotechnical Resistance for Spread Footings on Bedrock

Location	Spread Footing
Abutments: Factored Geotechnical Resistance at ULS	5,000 kPa
Pier: Factored Geotechnical Resistance at ULS	4,000 kPa

The above Factored Geotechnical Resistance at ULS for the abutments applies to spread footings placed directly on bedrock with a reasonably good Rock Mass Quality (RQD>80%). Although some of the RQD values obtained from the upper portion of the rock cores at the abutment locations have a lower RQD value, we believe this results from weathering. The lower portion of the rock cores exhibit higher RQD values, which is in our opinion, more representative of the

overall RQD value at the abutments. Since the rock cores obtained from the pier locations have lower RQD values as a result of the high density of fracturing, we have lowered the ULS factored geotechnical resistance available at the pier. The geotechnical resistance at SLS will not govern for a spread footing founded on bedrock, since the loads required to produce unacceptable settlements of the structure will be much larger than the recommended values for the factored capacity at ULS.

Based upon the examination of the bedrock cores, as described in Section 1.2.4.4 of this report, by integrating the observations on mineralogy and structural overprinting, the rock masses at the sites of the north and south abutments can be expected to behave isotropically and to form stable foundations for the two abutments. As indicated within the rock core tables, the bedrock is comprised of a gneissic syenite and monozonite plus deposited minerals such as hematite and calcite, and the behaviour of the bedrock is expected to be isotropic and thus, the specific bedrock composition at each foundation location should not have an impact on the foundation design. In addition, despite the more intense fracturing and alteration of the rocks at the pier foundation, the rocks, as seen in the cores, can be expected to behave similarly to those at the abutment sites. However the presence of an east-west, vertical or near vertical inactive fault, on or close to the site of the pier, can not be discounted.

Since the fault has not been active within recorded seismic history (i.e. the Ontario Geological Survey has indicated that the fault was active ~ 500 million years ago), it is improbable to assume reactivation of this fault during the service life of this bridge. The past movements of this fault, however, have created a zone where increased loose particles, fractures and discontinuities are found. As such, it is probable that the contractor will require increased efforts to remove all loose material, ensuring that the pier is founded on solid bedrock. Furthermore, an allowance should be made within the contract for an increased tremie concrete quantity that may be required to raise the foundation elevation if significant loose material removal is required.

The increased fractures and discontinuities associated with the past faulting may promote increased water flow within the bedrock and/or increased quantities of tremie concrete lost into the fractures.

For the proposed abutments and pier, the borehole data indicate that the construction of spread footings on bedrock would require excavation and removal of up to approximately 700 mm of overburden soil in some locations, however, for the majority of the boreholes, there should be less than 300 mm of overburden. The footing area must be cleared of all loose materials, exposing sound bedrock, prior to placement of concrete and inspected by a qualified geotechnical engineer to verify the Rock Mass Quality. Since it will probably be difficult to secure a geotechnical engineer with appropriate diving certification, it will more than likely be necessary to verify the rock mass quality of the pier through the use of video technology or on-site discussions between divers and the geotechnical engineer. The purpose of the inspection by a geotechnical engineer is to verify that the bedrock surface is sound, all the loose material has been removed, and that no unanticipated discontinuities exist in the bedrock surface.

Based on the borehole data, bedrock is anticipated at the following levels:

- BH-1, outcropping, ~ El. 179.9 m (proved by rock coring)
- BH-2, ~ 0.51 m depth,~ El. 179.3 m*
- BH-3, ~ 0.41 m depth, ~El. 179.6 m*
- BH-4, ~ 0.36 m depth, ~El. 180.7 m*
- BH-5, ~ 0.08 m depth, ~El. 180.6 m (proved by rock coring)
- BH-6, ~ 0.61 m depth, ~El. 179.2 m*
- BH-10, within ~4.57 m deep water, ~El. 172.8 m*
- BH-11, within ~5.79 m deep water, ~El. 171.6 m (proved by rock coring)
- BH-11B, within ~5.79 m deep water, ~El. 171.6 m (proved by rock coring)
- BH-12, within ~5.56 m deep water, ~0.05 m depth, ~El. 171.8 m*
- BH-13, within ~5.66 m deep water, ~0.01 m depth, ~El. 171.6 m*
- BH-14, within ~3.05 m deep water,~0.01 m depth, ~El. 174.3 m (proved by rock coring)
- BH-15, within ~5.83 m deep water, ~ El. 171.6 m*
- BH-20, outcropping, ~ El. 178.5 m (proved by rock coring)
- BH-24, outcropping, ~ El. 179.5 m (proved by rock coring)
- BH-26, ~0.30 m depth, ~ El. 180.2 m*
- BH-27, ~0.18 m depth, ~ El. 180.5 m*

*Bedrock levels were inferred from 'grinding' refusal to the machine augers. This refusal could, however, also represent a boulder obstruction in some instances.

Since the gneissic bedrock at this site, which forms most of the bedrock encountered in Northern Ontario, cannot be excavated or removed, except through blasting procedures, which generally lower the near surface structural integrity of the bedrock and produce a very irregular bedrock surface, the foundation elevation is conventionally assumed to be the bedrock surface, after all loose material has been removed. The thickness of the loose material at this site is variable, but should be minimal, i.e. less than 500 mm.

Discussions with LEA have indicated that the preferred founding elevations for the abutment footings are as follows: south abutment El. 181.0 m, north abutment El. 180.0 m, and the north retaining wall footings, El. 181.0 m. This should be sufficiently high enough such that the blasting is not required. If during construction, bedrock is encountered above this level, the founding elevation may need to be raised, such that the bedrock does not interfere. If need be, lean or tremie concrete may be placed on the cleaned bedrock surface to provide a uniform founding elevation. The tremie concrete pad should be designed such that the pad is both a minimum of 0.5 m wider in all directions than the footing, and that the bottom outside edge of the pad is no closer than 2 vertical to 1 horizontal to the bottom outside edge of the footing.

As per Section 6-8.4.2 of the Ontario Highway Bridge design code, a reduction factor would normally be applied to the Ultimate Bearing Resistance at ULS (5,000 kPa for the abutments and 4,000 kPa for the pier) to account for the effects of inclined loadings. Previous comments, however, received by Trow on an earlier assignment from the Pavement and Foundation Section of MTO, indicate that "Although, the OHBDC code talks about bearing resistance reduction due

such reduction will be required if the footing is constructed on bedrock". As such, for spread footings on bedrock, the structural engineer should consult with the Ministry to confirm that a reduction factor for inclined loadings need not be applied.

Discussions with the prime consultant and MTO indicate that the proposed design for the pier foundation involves tremie concrete to be placed to the desired founding elevation after the rock surface has been cleaned and all loose material removed, followed by dowelling into the concrete and rock, with footing construction in the dry within the confines of a coffer dam. The tremie concrete pad should be designed such that the pad is both a minimum of 0.5 m wider in all directions than the footing, and that the bottom outside edge of the pad is no closer than 2 vertical to 1 horizontal to the bottom outside edge of the footing. Since the river bottom contains little to no overburden material, it may be difficult to initially secure the coffer dam. As such, sand bags or other measures may be required. The contractor should provide his proposed coffer dam for review by the owner at least two weeks prior to implementation.

2.2 Frost Protection

Frost cover is not required for footings placed directly on sound bedrock.

2.3 Lateral Resistance

The computation of the lateral resistance of the spread footings shall be carried out in accordance with O.H.B.D.C. An unfactored friction angle, ∅, of 32 degrees can be used for sliding resistance along the bedrock.

If the factored resistance against sliding failure is inadequate based on friction, then the footings should be anchored into bedrock by means of keys, dowels or sockets. Given the hardness of the bedrock, sockets and keys will likely be impractical. Developing adequate resistance against sliding of spread footings founded on bedrock at the site will likely require dowels. It should be noted that the bedrock in the area of the proposed pier was noted to slope steeply. As such, the area may be levelled out through the placement of a tremie concrete mat placed directly on the exposed sound bedrock. Sound bedrock is generally considered as the surface of the bedrock once all loose material has been removed. The spread footing at the pier location could then be doweled through the tremie concrete and into the sound bedrock in an effort to develop adequate lateral resistance.

The length and diameter of the steel dowels for the footings are normally designed by the structural engineer. Based on our previous knowledge of the bedrock conditions in the area, we anticipate sound, unweathered bedrock at depth, with an estimated unit weight of approximately 25.1 kN/m^3, and an assumed Ultimate Bond Stress (UBS) of 1724 kPa (250 psi). The working bond stress, $A\tau_b@$ at 40% UBS is 690 kPa. (note: the working bond stress used to determine the bond length is normally 25% to 50% of the ultimate bond stress). The length required for bond length (L) for the anchor is a function of the dowel hole diameter (d), and can be calculated as follows:

$$L(mm) = P/(\pi \times d \times \tau_b)$$

Where: P = working capacity of anchor (kN)

τ_b = working bond stress (kPa)

d = dowel hole diameter.

Note: Typically, the bond length required for the anchor should be considered as the length of the anchor, minus the initial 300 mm, since this area is usually weathered/fractured, and thus does not have the ultimate bond stress used within the above calculations. However, at this site, for reasons noted within the report, the bond length of the anchor should be considered as the length of the anchor, minus the initial 1.0 m at the abutment locations and the initial 1.5 m at the pier location.

2.4 Backfill

Backfill to abutments or retaining walls should consist of free-draining granular materials such as Granular "A" and Granular "B", or rock fill. Computation of earth pressures shall be in accordance with Section 6.7.4 of the Ontario Highway Bridge Design Code. Unfactored properties for backfill materials are provided in the following table.

Table 2-6
Material Types and Unfactored Properties

Material	Friction Angle, ∅	γ(kN/m³)	K_a	K_p	K_o
Granular A	35 degrees	22.5	0.27	3.7	0.43
Granular B	30 degrees	21.1	0.33	3	0.50
Rock Fill	38 degrees	18	0.27	3.7	0.43

Note: *K_a is the earth pressure coefficient corresponding to the active state.*
K_p is the earth pressure coefficient corresponding to the passive state.
K_o is the earth pressure coefficient at rest.

If rock fill or Granular "B", Type II is used as backfill behind abutments, the particle size should be limited to no greater than 300 mm and the backfill must be placed carefully in a manner that does not cause damage to the abutments or other structural components of the bridge.

2.5 Excavation

2.5.1 Overburden

Excavations of about 300 mm of overburden soil will be required for the spread foundations on bedrock at the abutment locations and about 150 mm for the spread foundation on bedrock at the pier location. However, the contractor should anticipate encountering boulders and cobbles during the excavation for the north abutment. These minimal overburden soils may be classified as Type 3 soils. As such, excavations in accordance with the Occupational Health and Safety Regulations for Construction Projects for Type 3 soils should be adequate. The classification of the soil type should, however, be verified by the contractor prior to construction.

2.5.2 Bedrock

It is Trow's understanding that bedrock excavation is not anticipated at this site. However, any removal of bedrock required for the foundations will require drilling and blasting procedures. From previous experience, the type of bedrock expected on this site is known to be brittle and contains fractures and joints. It is difficult to blast and hence excavate to "neat" lines using conventional drilling and blasting procedures, since problems with "overbreak" are common. This potential problem may affect quantities claimed by the contractor for rock excavation, as well as the amount of imported fill required to compensate for "overbreak". The contractor should, therefore, make adequate allowances for these conditions. Some consideration may have to be given to pre-splitting techniques in critical areas in order to reduce potential problems. Due consideration must also be given to controlling blasting procedures, in order to prevent potential damage to the adjacent structures. Limiting the depth of subdrilling to control overbreak beneath the required foundation grade, while still achieving the desired break, is also an important factor that must be considered by the contractor. Overbreak conditions, i.e. rock shatter, under footing bases should be assessed by the geotechnical engineer prior to decisions either to continue over-excavation in the rock, or alternatively, to prepare footing bases on the specified grade.

A pre-blast survey of all the adjacent buildings (i.e. the nearby marina buildings located to the west of the proposed structure, etc.) is recommended, prior to blasting, to minimize potential liabilities.

Construction slopes in intact bedrock should stand at near vertical angles, provided the "loose" rock is properly scaled off the face. All excavations and blasting operations must be carried out in accordance with the most recent guidelines of the Occupational Health and Safety Act.

2.5.3 Approach Embankments

No stability or significant settlement problems are anticipated for the approach embankments established in the immediate vicinity of the proposed structure. Topsoil and compressible organics (if present) and all existing fills (i.e. within the existing southern approach) must be removed from the plan limit of the approach embankments. Boreholes were drilled within the approach embankment areas as part of the geotechnical investigation. Based on these borings, it

is unlikely that the surficial organics will exceed 1.0 m. A copy from the Pavement Design Report of the page containing the boreholes advanced within the approaches has been included within Appendix B.

Some form of roadway protection should be considered during construction of the proposed southern approach embankment, as the western side slope of the existing southern approach embankment is within/very near the proposed alignment.

If rock fill is used to construct the approach embankments, the side slopes and forward slopes should be constructed at a maximum gradient of 1.5H:1V. If Granular "A" or Granular "B" is used, the forward and side slopes should be constructed at 2H (minimum):1V, or flatter.

3.0 Conclusion

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the use of the Ministry of Transportation, DS-Lea Associates Ltd. and their design team for the design of the proposed Highway 69/Pickerel River crossing for the permanent replacement bridge. We request that we be retained to review the design and our recommendations as the design proceeds, to ensure that the final design is in general agreement with our recommendations, and that our recommendations have been interpreted as intended.

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations. It may then be necessary to carry out additional field work and analyses.

Contractors bidding on or undertaking the works should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the current geotechnical conditions at the site of the proposed Highway 69/Pickerel River crossing for the permanent replacement bridge. The conclusions presented in this report reflect site conditions existing at the time of the investigation. It is noted that the soil boundaries indicated on the logs are inferred from discontinuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

The field investigation was performed by Messieurs S. McAuliffe and R. Imbeau, senior field technicians, and supervised by Mr. L.J. Birn, B.Eng. This report has been prepared by Mr. L. J. Birn, B.Eng., Mr. E.A. Gonneau, P.Eng. and Mr. W. Meyer, M.Sc. Geology, P.Eng. (examination and description of bedrock cores) and reviewed by Mr. S.E. Gonsalves, M.Eng., P.Eng. (Trow's MTO designated foundation contact).

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly

Trow Consulting Engineers Ltd.

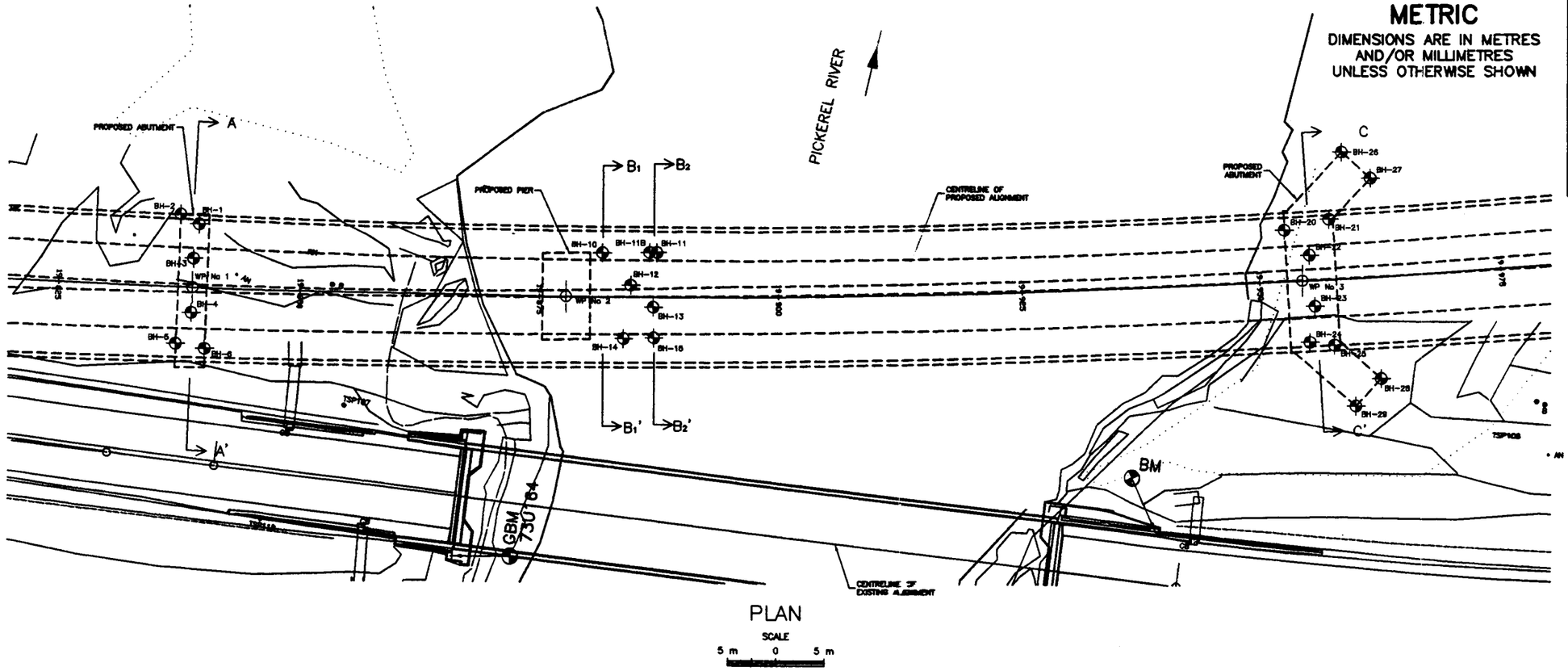
Lee J. Birn, B.Eng.

E.A. Gonneau, P.Eng.
Project Manager/Geotechnical Engineer

S.E. Gonsalves, M.Eng., P.Eng.
Principal
MTO Designated Foundation Contact

APPENDIX A

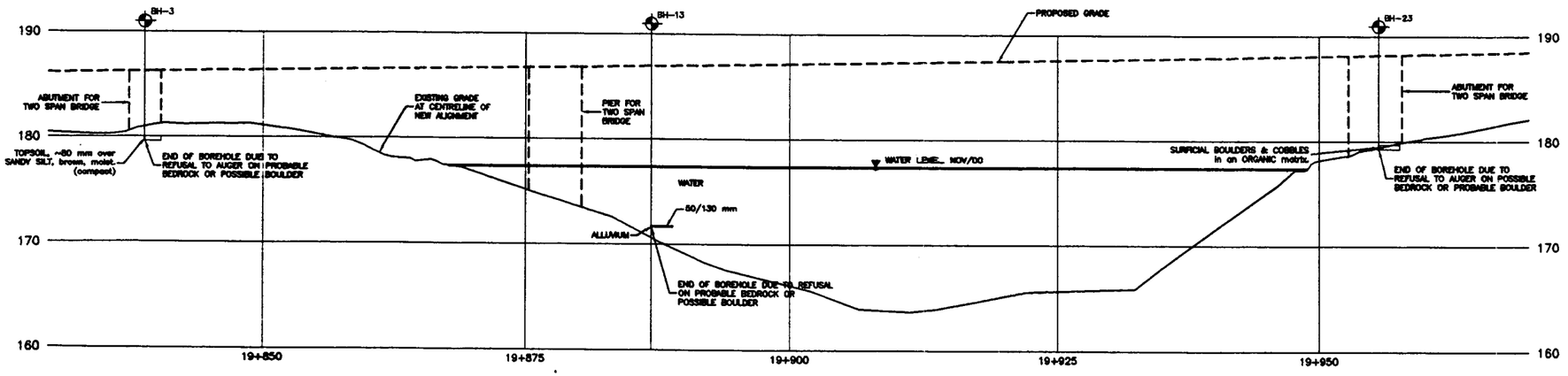
SITE PLAN, SECTIONS AND SITE PHOTOGRAPHS



PLAN

SCALE

5 m 0 5 m



CENTRELINE PROFILE

SCALE

5 m 0 5 m

NOTE:

All borehole locations and elevations were interpolated by referencing W.P.'s, spot elevations and ground surface contours presented on drawings by D.S. Lea Associates Ltd., dated October 2000 and January 2001.

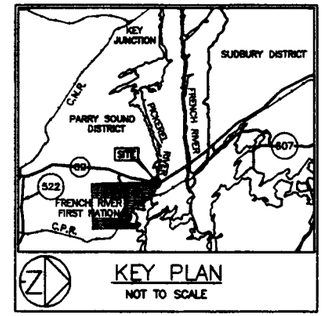
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DIST 54 HWY 69
CONT No
WP No 330-85-00

PICKEREL RIVER BRIDGE
TOWNSHIP OF MOWAT
BORE HOLE LOCATIONS & SOIL STRATA

SHEET 1 OF 2

TROW CONSULTING ENGINEERS LTD.
SUDBURY, ONTARIO
Trow PROJ. No. S08322G DWG. No. 1



KEY PLAN
NOT TO SCALE

LEGEND

Borehole (Oct. 2000)

No.	ELEVATION	STATION	OFFSET
BH-1	179.9	19+839.4	6.6 LT
BH-2	179.8	19+837.4	7.9 LT
BH-3	180.0	19+838.9	3.0 LT
BH-4	181.1	19+838.8	2.6 RT
BH-5	181.6	19+840.3	6.3 RT
BH-6	179.8	19+837.3	5.9 RT
BH-10	177.4	19+881.6	4.6 LT
BH-11	177.4	19+887.3	4.6 LT
BH-11B	177.4	19+886.6	4.6 LT
BH-12	177.4	19+884.8	1.2 LT
BH-13	177.4	19+886.9	1.1 RT
BH-14	177.4	19+883.8	4.3 RT
BH-15	177.4	19+886.9	4.3 RT
BH-20	178.5	19+952.9	5.4 LT
BH-21	179.7	19+957.5	6.3 LT
BH-22	179.2	19+955.3	2.6 LT
BH-23	179.7	19+955.6	2.7 RT
BH-24	179.5	19+954.8	6.5 RT
BH-25	180.3	19+957.3	6.5 RT
BH-26	180.5	19+959.2	13.2 LT
BH-27	180.7	19+962.1	10.3 LT
BH-28	181.4	19+961.9	10.6 RT
BH-29	181.2	19+959.1	13.4 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 GC 2-01 of OPS Gen. Cond.

REVISIONS			
DATE	BY	DESCRIPTION	

DESIGN	L.B.	CHK	E.C.	CODE	.	LOAD	.	DATE	MAR. 2001
DRAWN	M.D.	CHK		SITE		STRUCT		SCHEME	DWG 1

METRIC

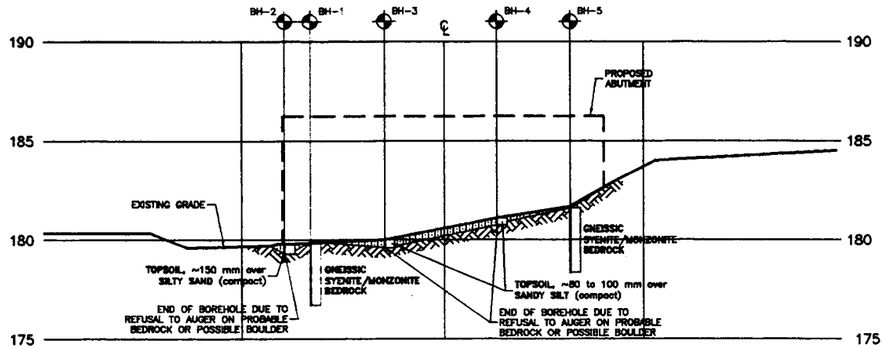
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST 54 HWY 69
CONT No
WP No 330-85-00

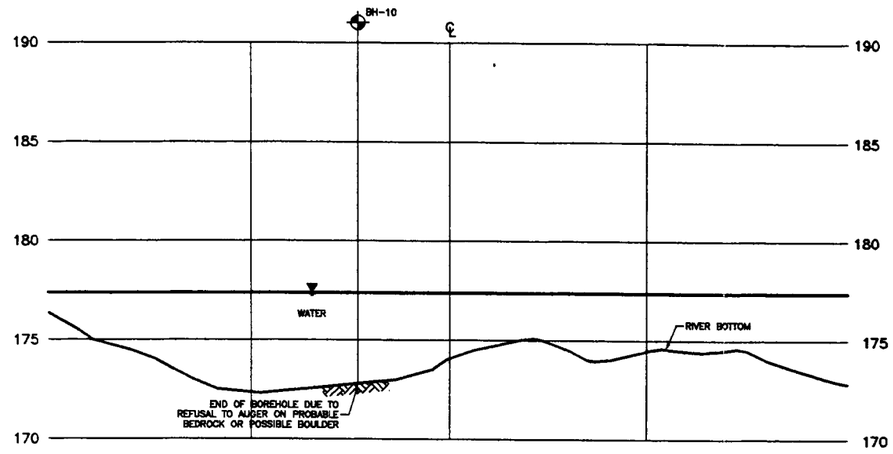
PICKEREL RIVER BRIDGE
TOWNSHIP OF MOWAT
CROSS SECTIONS

SHEET
2 OF 2

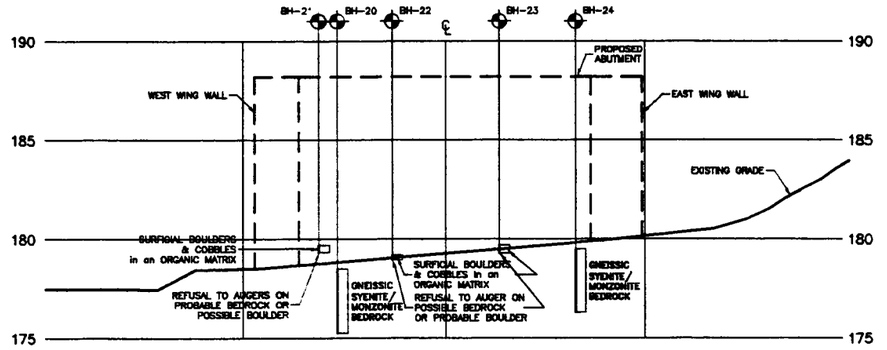
TROW CONSULTING ENGINEERS LTD.
SUDBURY, ONTARIO
Trow PROJ. No. S08322G DWG. No. 2



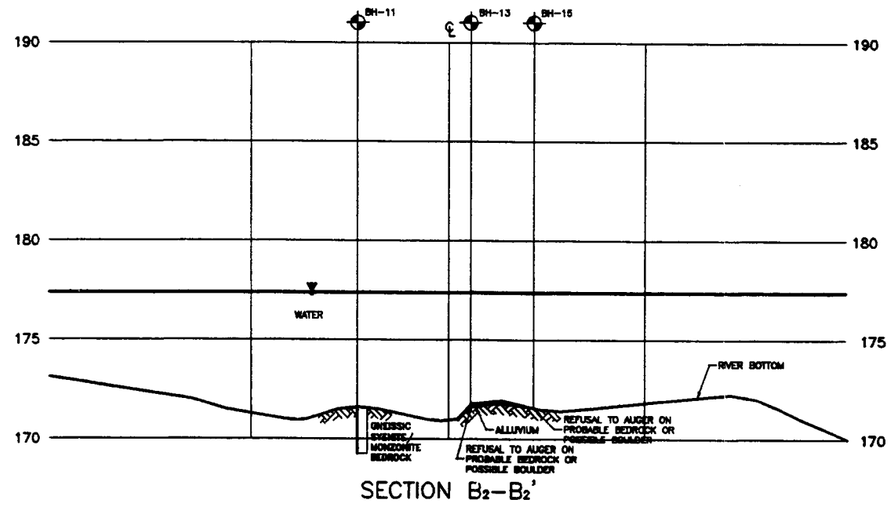
SECTION A–A'



SECTION B_1–B_1'



SECTION C–C'



SECTION B_2–B_2'

SCALE
5 m 0 5 m

LEGEND

- Borehole (Oct. 2000)
- Water Level (Nov. 2000)

No.	ELEVATION	STATION	OFFSET
BH–1	179.9	19+839.4	6.6 LT
BH–2	179.8	19+837.4	7.9 LT
BH–3	180.0	19+838.9	3.0 LT
BH–4	181.1	19+838.8	2.6 RT
BH–5	181.6	19+840.3	6.3 RT
BH–6	179.8	19+837.3	5.9 RT
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BH–22	179.2	19+955.3	2.6 LT
BH–23	179.7	19+955.6	2.7 RT
BH–24	179.5	19+954.8	6.5 RT
BH–25	180.3	19+957.3	6.5 RT
BH–26	180.5	19+959.2	13.2 LT
BH–27	180.7	19+962.1	10.3 LT
BH–28	181.4	19+961.9	10.6 RT
BH–29	181.2	19+959.1	13.4 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:

All borehole locations and elevations were interpolated by referencing W.P.'s, spot elevations and ground surface contours, presented on drawings by D.S. Lea Associates Ltd., dated October 2000 and January 2001.

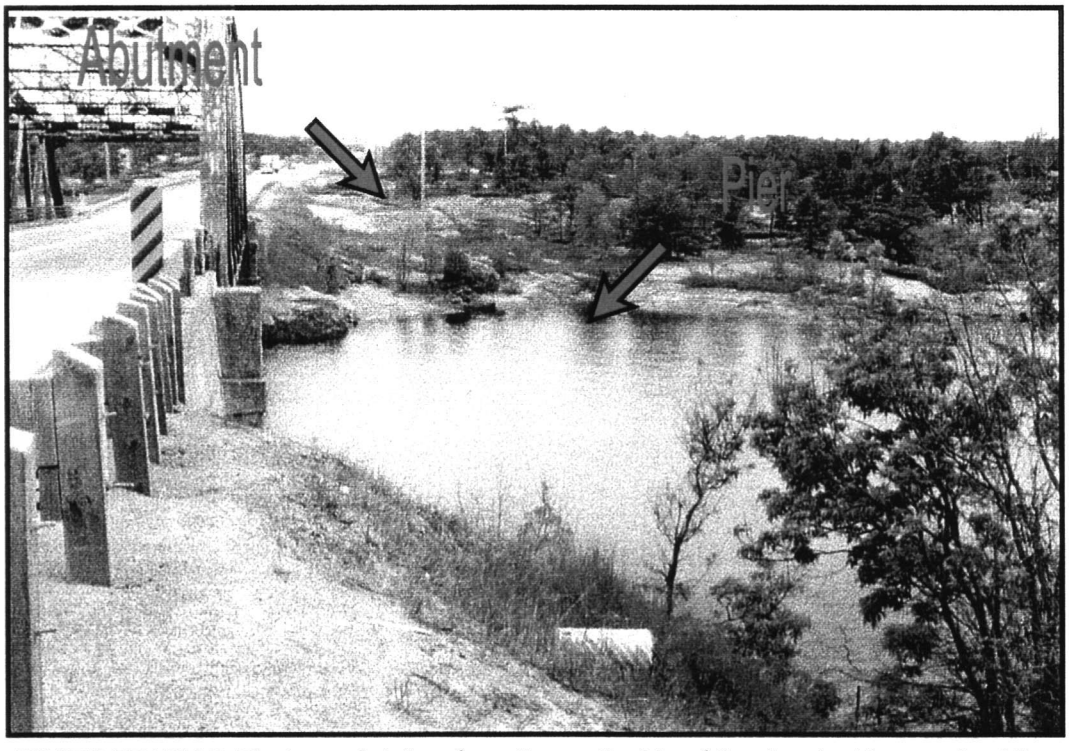
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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 GC 2-01 of OPS Gen. Cond.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	L.B.	CHK E.G.	CODE . LOAD . DATE MAR. 2001
DRAWN	M.D.	CHK .	SITE . STRUCT . SCHEME . DWG 2

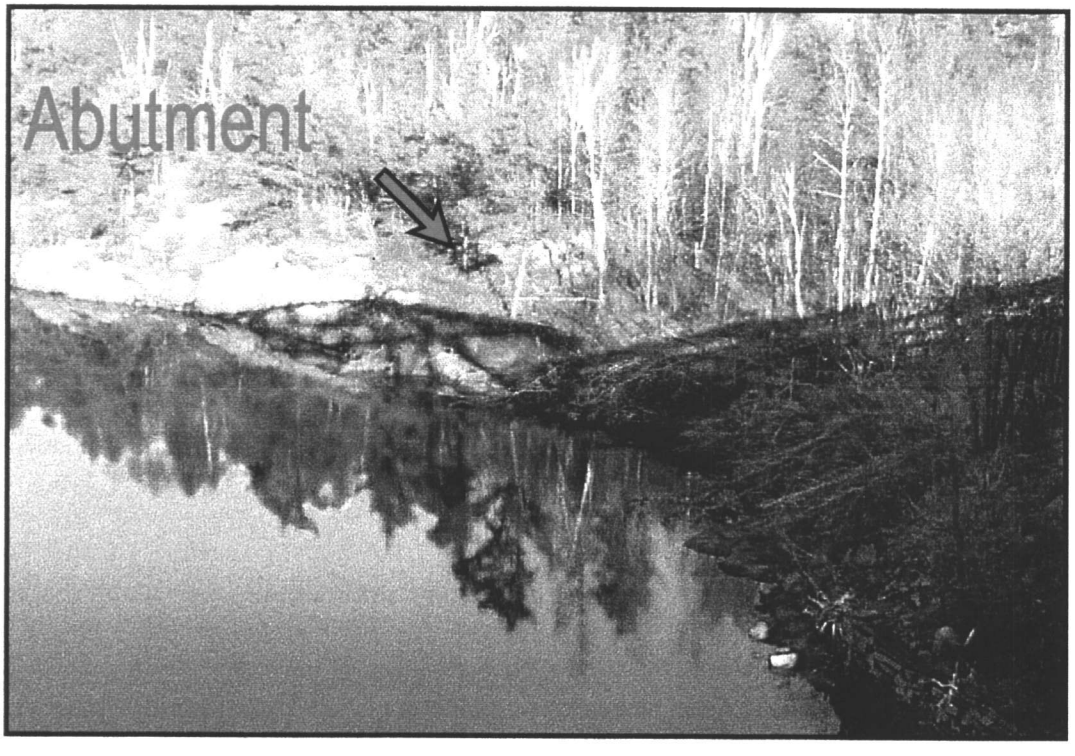
Drawing: F:\MY DOCUMENTS\PROJECT FILES\S083220-PICKEREL RIV BR\S083220-02-R1-SECTIONS.DWG Plot date: 2001/3/5 – 9:38

PHOTOGRAPH 1: Photograph taken at ~ Station 19+825, looking north along the proposed alignment's centerline.



PHOTOGRAPH 2: Photograph taken from the north side of the river looking south at the river's south shore in the area of the proposed alignment's centerline.

PHOTOGRAPH 3: Photograph taken from south shore of the river looking north towards the proposed northern abutment location.



PHOTOGRAPH 4: Photograph taken from the west side of the existing bridge looking northwest at the proposed northern abutment location.

APPENDIX B

BOREHOLE LOGS AND ROCK CORE TABLES

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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE BH-1

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 735.2 N, 222 158.7 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE NQ Core / Hilti Drill | COMPILED BY M.D.

DATUM Geodetic | DATE October 24, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) × / CONE PENETRATION TEST — 20 40 60 80	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. KPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ⊗ LAB SHEAR 20 40 60 80	WATER CONTENT (%) 10 20 30 40		
179.90	GROUND SURFACE									kN/m3	GR SA (SI & CL)
0.00	**GNEISSIC SYENITE/MONZONITE BEDROCK**		1	NQ			179				
			2	NQ							
			3	NQ			178				
			4	NQ			177				
176.70											
3.20	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+839.4, offset ~6.6 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-2

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 733.3 N, 222 157.7 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 24, 2000 | CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, kPa (○ UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	PLASTIC LIMIT wp; NATURAL MOISTURE CONTENT w; LIQUID LIMIT wl; WATER CONTENT (%)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.80	GROUND SURFACE							20 40 60 80	10 20 30 40		
0.00 / 179.29	**TOPSOIL**, ~150 mm over **SILTY SAND**, brown, wet. (compact)		1								
0.51	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+837.4, offset ~7.9 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.

MTO4 S08322G.GPJ 02/20/01

RECORD OF BOREHOLE BH-3

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 734.6 N, 222 162.3 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 23, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (O UNCONFINED QUICK TRIAXIAL, + & ⊠ FIELD VANE LAB SHEAR)	WATER CONTENT (%)	kN/m3	GR SA (SI & CL)
180.00	GROUND SURFACE						180	20 40 60 80	10 20 30 40		
0.00 179.59	**TOPSOIL**, ~80 mm over **SANDY SILT**, brown, moist, (compact)										
0.41	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+838.9, offset ~3.0 m left of centreline as referenced to the Proposed New Alignment.
3) Water level was at ~0.3 m depth hole was open to ~0.3 m depth on completion.

MTO4 S08322G.GPJ 02/20/01

RECORD OF BOREHOLE BH-4

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 734.4 N, 222 167.9 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 23, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80) / SHEAR STRENGTH: Cu, KPa (O UNCONFINED QUICK TRIAXIAL, ⊗ + FIELD VANE LAB SHEAR) (20 40 60 80)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl — WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
181.10	GROUND SURFACE						181				
0.00 / 180.74	**TOPSOIL**, ~100 mm over **SANDY SILT**, brown, moist. (compact)										
0.36	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+838.8, offset ~2.6 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.

MTO4 S08322G.GPJ 02/20/01

RECORD OF BOREHOLE BH-5

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 737.8 N, 222 171.2 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE NQ Core / Hilti Drill COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. kPa (UNCONFINED QUICK TRIAXIAL ○ ● / FIELD VANE + LAB SHEAR ⊗)	WATER CONTENT (%)		
181.60	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
0.00	**TOPSOIL, ~75 mm over GNEISSIC SYENITE/MONZONITE BEDROCK**		1	NQ			181				
			2	NQ			180				
			3	NQ							
			4	NQ			179				
178.35											
3.25	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+840.3, offset ~6.3 m right of centreline as referenced to the Proposed New Alignment.

MTO4 S08322G.GPJ 02/26/01

RECORD OF BOREHOLE BH-6

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 736.1 N, 222 172.0 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 23, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
179.80	GROUND SURFACE										
0.00	**TOPSOIL**, ~100 mm over										
179.19	**SILTY SAND**, occasional cobbles, brown, moist.										
0.61	(loose to compact)						179				
	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+837.3, offset ~5.9 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.3 m depth on completion.

RECORD OF BOREHOLE BH-10 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 777.2 N, 222 161.5 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ⊗ LAB SHEAR	WATER CONTENT (%)		
177.40	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m3	GR SA (SI & CL)
0.00	**WATER**						177				
							176				
							175				
							174				
172.83							173				
4.57	END OF BOREHOLE DUE TO AUGER REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+881.6, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-11

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 782.9 N, 222 161.4 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE BQ Core / BBS1 COMPILED BY M.D.

DATUM Geodetic DATE October 26, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80)	SHEAR STRENGTH: Cu, kPa (○ UNCONFINED QUICK TRIAXIAL, ⊗ FIELD VANE LAB SHEAR) (20 40 60 80)	PLASTIC LIMIT wp	NATURAL MOISTURE CONTENT w	LIQUID LIMIT wl	WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE														
0.00	**WATER**						177								
							176								
							175								
							174								
							173								
171.61							172								
5.79	**GNEISSIC SYENITE/MONZONITE BEDROCK**		1	BQ			171								
169.27							170								
8.13	END OF BOREHOLE														

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+887.3, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-11B

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 782.1 N, 222 161.4 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE BQ Core / BBS1 | COMPILED BY M.D.

DATUM Geodetic | DATE October 27, 2000 | CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, kPa (UNCONFINED QUICK TRIAXIAL ●, FIELD VANE LAB SHEAR +)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl; WATER CONTENT (%)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE							20 40 60 80	10 20 30 40		
0.00	**WATER**						177				
							176				
							175				
							174				
							173				
171.61							172				
5.79	**GNEISSIC SYENITE/MONZONITE BEDROCK**		1	BQ			171				
169.98							170				
7.42	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.6, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-12 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 780.2 N, 222 164.8 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST 20 40 60 80	SHEAR STRENGTH: Cu, kPa ● UNCONFINED QUICK TRIAXIAL ⊗ FIELD VANE + LAB SHEAR 20 40 60 80	PLASTIC LIMIT wp	NATURAL MOISTURE CONTENT w	LIQUID LIMIT wl	WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE														
0.00	WATER						177								
							176								
							175								
							174								
							173								
171.84							172								
5.56	COARSE ALLUVIAL SAND		1	SS	50/				X/50 mm						
171.79	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER														
5.61															

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+884.6, offset ~1.2 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-13 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 782.5 N, 222 167.1 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST 20 40 60 80	SHEAR STRENGTH: Cu, KPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ⊗ LAB SHEAR 20 40 60 80	PLASTIC LIMIT wp — NATURAL MOISTURE CONTENT w — LIQUID LIMIT wl WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE											
0.00	WATER						177					
							176					
							175					
							174					
							173					
171.74							172					
5.66	ALLUVIUM		1	SS	50				×/130 mm			
171.61	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER											
5.79												

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.9, offset ~1.1 m right of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-14

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 779.4 N, 222 170.4 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE BQ Core / BBS1 | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) × / CONE PENETRATION TEST —— 20 40 60 80	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT wp w wl	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ⊗ LAB SHEAR 20 40 60 80	WATER CONTENT (%) 10 20 30 40	kN/m³	GR SA (SI & CL)
177.40	GROUND SURFACE										
0.00	**WATER**						177				
							176				
							175				
174.35											
3.05	**ALLUVIAL SAND**, coarse, brown. (very loose)		1	SS	1		174	×			
174.25											
3.15	**GNEISSIC SYENITE/MONZONITE BEDROCK**		2	BQ							
							173				
			3	BQ			172				
171.15											
6.25	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+883.8, offset ~4.3 m right of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-15

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 782.6 N, 222 170.3 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Standard Sampling / BBS1 | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE ⊗ LAB SHEAR	WATER CONTENT (%)		
177.40	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
0.00	**WATER**						177				
							176				
							175				
							174				
							173				
							172				
171.56											
5.84	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.9, offset ~4.3 m right of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-20 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 848.1 N, 222 158.7 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE NQ Core / Hilti Drill COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST 20 40 60 80	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT wp w wl	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB SHEAR 20 40 60 80	WATER CONTENT (%) 10 20 30 40		
178.50	GROUND SURFACE									kN/m3	GR SA (SI & CL)
0.00	**GNEISSIC SYENITE/MONZONITE BEDROCK**		1	NQ			178				
			2	NQ			177				
			3	NQ			176				
175.27			4	NQ							
3.23	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+952.9, offset ~5.4 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-21

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 852.7 N, 222 157.5 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (O UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	WATER CONTENT (%)		
179.70	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
0.00 / 179.34	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix.										
0.36	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+957.5, offset ~6.3 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m south of BH-21 & met auger refusal at ~0.1 m depth.

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RECORD OF BOREHOLE BH-22 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 850.7 N, 222 161.3 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80) / SHEAR STRENGTH: Cu. KPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB SHEAR; 20 40 60 80)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl; WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.20	GROUND SURFACE										
179.07 / 0.23	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix. END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+955.3, offset ~2.6 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m south of BH-22 & met auger refusal at ~0.3 m depth.
5) Drill moved ~1.0 m east of BH-22 & met auger refusal at ~0.2 m depth.

RECORD OF BOREHOLE BH-23 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 851.3 N, 222 166.6 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (● UNCONFINED QUICK TRIAXIAL, ⊗ FIELD VANE LAB SHEAR)	WATER CONTENT (%)		
179.70	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
0.00 179.29	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix.										
0.41	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+955.6, offset ~2.7 m right of centreline as referenced to the Proposed New Alignment.
3) Drill moved ~1.0 m west or BH-23 & met auger refusal at ~0.1 m depth.
4) Drill moved ~1.0 m north of BH-23 & met auger refusal at ~0.3 m depth.

RECORD OF BOREHOLE BH-24

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 850.8 N, 222 170.4 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE NQ Core / Hilti Drill | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST / SHEAR STRENGTH: Cu, kPa (○ UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl / WATER CONTENT (%)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.50	GROUND SURFACE							20 40 60 80	10 20 30 40		
0.00	**GNEISSIC SYENITE/MONZONITE BEDROCK**		1	NQ			179				
			2	NQ			178				
			3	NQ			177				
176.30			4	NQ							
3.20	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+954.8 offset ~6.5 m right of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-25

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 853.6 N, 222 171.0 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (○ UNCONFINED QUICK TRIAXIAL, ⊗ FIELD VANE LAB SHEAR)	WATER CONTENT (%)		
180.30	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m3	GR SA (SI & CL)
0.00	**SURFICIAL BOULDERS & COBBLES,** in an organic matrix.						180				
179.64											
0.66	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+957.3, offset ~6.5 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m east of BH-25 & met auger refusal at ~0.1 m depth.
5) Drill moved ~1.0 m south of BH-25 & met auger refusal at ~0.4 m depth.

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RECORD OF BOREHOLE BH-26 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 854.0 N, 222 150.5 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa ○ UNCONFINED QUICK TRIAXIAL ● + FIELD VANE ⊗ LAB SHEAR	WATER CONTENT (%)	kN/m3	GR SA (SI & CL)
180.50	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40		
180.20 0.30	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix.						180				
180.09 0.41	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+959.2, offset ~13.2 m left of centreline as referenced to the Proposed New Alignment.
3) Drill moved ~1.0 m east of BH-26 & met auger refusal at ~0.1 m depth.
4) Drill moved ~1.0 m south of BH-26 & met auger refusal at ~0.2 m depth.
5) Bedrock outcropping ~2.0 m north of BH-26.

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RECORD OF BOREHOLE BH-27 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 857.0 N, 222 153.2 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (UNCONFINED QUICK TRIAXIAL ● / FIELD VANE LAB SHEAR ×)	WATER CONTENT (%)	kN/m³	GR SA (SI & CL)
180.70	GROUND SURFACE							20 40 60 80	10 20 30 40		
180.52 0.18	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix.										
	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER						180				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+962.1, offset ~10.3 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m east of BH-27 & met auger refusal at ~0.2 m depth.
5) Drill moved ~1.0 m west of BH-27 & met auger refusal at ~0.1 m depth.
6) Bedrock outcropping ~2.0 m north of BH-27.

MTO4 S08322G.GPJ 02/20/01

RECORD OF BOREHOLE BH-28 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 858.1 N, 222 174.2 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu. kPa (● UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT; WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
181.40	GROUND SURFACE										
0.00	**SURFICIAL BOULDERS & COBBLES**, in an organic matrix.						181				
180.92											
0.48	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69. Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+961.9. offset ~10.6 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.
4) Drill moved ~1.0 m east of BH-28 & met auger refusal at ~0.4 m depth.
5) Drill moved ~1.0 m west of BH-28 & met auger refusal at ~0.4 m depth.

MTO4 S08322G.GPJ 02/20/01

RECORD OF BOREHOLE BH-29 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 855.5 N, 222 177.0 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80)	SHEAR STRENGTH: Cu. KPa (○ UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR) (20 40 60 80)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl — WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
181.20 GROUND SURFACE												
181.92 0.28	**SURFICIAL BOULDER & COBBLES**, in an organic matrix. END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						181					

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+959.1, offset ~13.4 m right of centreline as referenced to the Proposed New Alignment.
2) Borehole was dry & open to ~0.2 m depth on completion.
3) Drill moved ~1.0 m north of BH-29 & met auger refusal at ~0.5 m depth.
4) Drill moved ~1.0 m west of BH-29 & met auger refusal at ~0.3 m depth.

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
1	1 2 3 4 1 to 4	0.0 to 0.76 0.76 to 1.52 1.52 to 2.28 2.28 to 3.19 0.0 - 3.19	97 96 99 101 98	50 33 96 97 70	0.0 to 3.19	**Gneissic Syenite / Monzonite** - Dark, reddish brown; fine to medium grained, much the same from top to bottom; - relict igneous texture; gneissosity weekly developed, dip 15 to 20 degrees, some steeper sections; no core breaks attributable to mineral foliation; - rock is massive, very solid; no open channel ways; a few hairline cracks (8 counted), which are hematite and hematite plus calcite cemented; irregular dips of mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: NQ drilling; 26 pieces of core, average length per piece 12.27 cm. Since the cores (RC #2, in particular) were so badly damaged during the drilling operation, it could not be ascertained whether or not the majority of the fractures were machine breaks or natural geological breaks. As a conservative measure, all fractures were regarded as geological breaks, resulting in a low RQD value at 33% for RC 2. The core of RC 2 has deep scratch marks and shows signs of churning and grinding on non-geological breaks. We believe that the actual RQD value for the hole would indeed be much greater if the extent of damage to the rock cores was less during the drilling operation.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
5	1 2 3 4 1 to 4	0.0 to 0.91 0.91 to 1.67 1.67 to 2.28 2.28 to 3.25 0.0 to 3.25	110 103 105 100 104	74 100 100 97 92	0.0 to 3.25	**Gneissic Syenite / Monzonite** - Dark, reddish brown; fine to medium grained, some coarser grained pink feldspathic and darker mafic segregations; - relict igneous textures; gneissosity weakly developed, dip 10 -15 degrees; good crystal interlocking; no core breaks on mineral foliation; - rock is massive, very solid; no open channel ways; a few hairline cracks and fractures (20 counted) with up to 3 mm aperture, cemented by hematite or hematite plus calcite; incipient brecciation in Run 4; cracks and fractures are planar to highly irregular, dips mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: NQ drilling; 22 pieces of core, average length 14.77 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
11	1	5.79 to 8.13	96	52	0.0 to 5.79 5.79 to 8.13	**Water** **Gneissic Syenite / Monzonite** - Dark reddish brown; fine to medium grained; mafic minerals partly chloritised, but less so than in 11B; - relict igneous textures; gneissosity weakly to moderately well developed; dips 10-20 degrees, but locally more steeply; good crystal interlocking; no visible signs of slippage or fault movement on any core breaks; - rock fractured (about 25 cracks counted); fractures from hairline to about 3 mm aperture; hematite or hematite plus calcite cemented; fractures irregular, some planar; dips variable but mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 30 pieces of core; average length per piece 7.8 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
11B	1	5.79 to 7.42	102	37	0.0 to 5.79 5.79 to 7.42	**Water** **Gneissic Syenite / Monzonite** - 5 cm rusty weathered top; dark, reddish brown with a green hue due to abundant chlorite; fine to medium grained, with several coarser grained feldspathic segregations; mafic minerals in part strongly chloritized; - relict igneous texture; gneissosity poorly developed, dip about 10 degrees; good crystal interlocking; no visible signs of slippage or fault movement on any core breaks; - rock highly fractured (about 40 fractures counted); fractures irregular to near planar, with up to 4 mm aperture; hematite or hematite plus calcite cemented; one small solution cavity on a calcite cemented fracture at 6.25 m; dips variable but mostly >45 degrees; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 24 pieces of core; average length per piece 7.16 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
14	1	3.15 to 4.15	100	22	0.0 to 3.05	**Water**
	2	4.15 to 6.24	100	53 ***	3.05 to 3.15	**Sand and Mud**
					3.15 to 6.24	**Gneissic Syenite / Monzonite**
	1 to 2	3.15 to 6.24	100	43		- Dark, reddish brown; fine to medium grained, some coarser feldspathic and mafic segregations; mafic minerals in part green, chloritised; - relict igneous texture; gneissosity weakly developed, dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock is solid, but strongly fractured (45 fractures counted); some local incipient brecciation; fractures are mostly irregular, some planar, hairline to cracks with 2 mm aperture; cracks cemented by hematite or hematite plus calcite, green chlorite; dips highly variable, mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 42 pieces of core; average length per piece 7.33 cm.

*** Despite the many pieces, much of the core reassembles surprisingly well. Many core breaks are not on rock fractures and appear machine related; reassembling core along non-geological breaks does not increase the RQD for the upper 1.0 m, but increases it from 53% to over 80% for the lower 2.09 m.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
20	1 2 - 4 1 to 4	0.0 to 0.76 0.76 to 3.23 0.0 to 3.23	100 94 95	42 79 70	0.0 to 3.23	**Gneissic Syenite / Monzonite** - Dark, greenish grey to deep reddish brown; fine to medium grained, some coarser feldspathic segregations; - relict igneous textures; gneissosity moderately well developed, mineral layers mostly less than 5 mm thick; dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock massive, very solid; no open channel ways; a few hairline cracks and fractures (11 counted); cracks are hematite or hematite plus calcite cemented; cracks are planar to irregular, with dips 20 - 60 degrees; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: NQ drilling; 20 pieces of core; average length per piece 16.15 cm. Core runs 2, 3, and 4 appear to be mixed up, and the correct sequence could only partially be restored.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
24	1 2 3 4 1 to 4	0.0 to 0.76 0.76 to 1.52 1.52 to 2.38 2.38 to 3.20 0.0 to 3.20	96 71 100 123 98	58 50 100 83 74	0.0 to 3.20	**Gneissic Syenite / Monzonite** - Dark, deep reddish brown; fine to medium grained, some coarser feldpathic and mafic segregations; - relict igneous texture; gneissosity moderately well developed; mineral layers mostly less than 5 mm thick; dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock massive, very solid; no open channel ways; a few hairline cracks and fractures (10 counted); cracks are hematite or hematite plus calcite cemented; cracks are near planar or irregular; dips variable; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: NQ drilling; 22 pieces of core; average length per piece 14.5 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

19+720	9.0 LT of proposed ℄	D+600
0	NFP BR	
19+740	3.0 LT of proposed ℄	D-1.0
0 - 280	Br Sa W Org Tr Gr	
280	NFP BR	
19+740	7.0 LT of proposed ℄	D-700
0	NFP BR	
19+740	11.0 LT of proposed ℄	D-600
0	NFP BR	
19+750	Proposed ℄	
0 - 1.0	Br Co Sa W Tr Gr, Moist, L **69SA#1** **No testing required.**	
1.0	NFP BR	
19+785	7.0 LT of proposed ℄	D-1.2
0 - 1.2	Org	
1.2	NFP BR	
19+785	12.0 LT of proposed ℄	D-1.2
0 - 1.3	Org	
1.3	NFP BR	
19+800	17.0 LT of proposed ℄	D-800
0	NFP BR	
19+800	Proposed ℄	D
0	NFP BR	
19+800	17.0 RT of proposed ℄	D+2.0
0	NFP Asph	
19+825	Proposed ℄	D
0 - 1.0	Br Sa W Gr Tr Org, Sat, L	
1.0	NFP BR	
19+850	Proposed ℄	D
0	NFP BR	
19+850	17.0 LT of proposed ℄	D-1.0
0 - 100	Org	
100	NFP BR	
19+850	17.0 RT of proposed ℄	D+3.0
0	NFP Asph	
19+950	Proposed ℄	D
0	NFP BR	
19+978	Proposed ℄	D
0 - 200	Org	
200	NFP BR/RF	

19+988	20.0 LT of proposed ℄	D-100
0 - 850	Br Sa W Tr Gr, Moist, L	**69SA#2**
	Not Accep Granular "B", Type I	
	69.9% Passing 300 μm	
	11.7% Passing 75 μm	
	Accep SSM	
850	NFP RF/BR	
19+996	Proposed ℄	D
0 - 250	Org W Sa, Moist, L	
250	NFP RF/BR	
20+000	20.0 LT of proposed ℄	D+2.3
0	NFP BR	
20+000	20.0 RT of proposed ℄	D-200
0 - 550	Br Sa W Org, Moist, L	
550 - 1.4	Br Org, Sat, L	
1.4	NFP RF/BR	
20+010	Proposed ℄	D
0 - 620	Br Org W Tr Sa W Blds, Moist, L	
620	NFP RF/Blds	
20+010	20.0 LT of proposed ℄	D+2.3
0	NFP BR	
20+020	Proposed ℄	D
0 - 020	Org	
020	NFP BR	
20+020	11.0 LT of proposed ℄	D+400
0 - 050	Org	
050	NFP BR	
20+020	11.0 RT of proposed ℄	D-1.2
0 - 030	Org	
030	NFP Blds/BR	
20+040	Proposed ℄	D
0 - 050	Org	
050	NFP BR	
20+040	11.0 LT of proposed ℄	D+500
0	NFP BR	
20+040	11.0 RT of proposed ℄	D-1.0
0 - 150	Org W Sa, Moist, L	
150	NFP Blds/BR	
20+060	Proposed ℄	D
0 - 150	Org	
150	NFP BR	
20+060	11.0 LT of proposed ℄	D+100
0 - 100	Org	
100	NFP BR	
20+060	11.0 RT of proposed ℄	D+200
0 - 020	Org	
020	NFP BR	

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 2001- 5102


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PAVEMENT AND
FOUNDATIONS
SECTION

Trow

Foundation Investigation Report
Highway 69
Pickerel River Bridge Replacement
and Re-alignment for 1.2 km
W.P. 330-85-00
MTO District 54, Sudbury

No Geo Cres

Prepared for:

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Geocres Number 41H-29
S08322G/G8
March 5, 2001

PREFACE

Group Work Project No. 330-85-00 encompasses the replacement of the Pickerel River Bridge on Highway 69. As a result of this replacement, an approximately 1.2 km section of new horizontal alignment with improvements to the vertical alignment will be constructed. This new alignment will involve the construction of new approaches to the structure, the construction of a northbound left turn lane and a southbound right turn taper to the Pickerel and Lower French River Road, and the reconstruction of all side roads and existing entrances to fit the new alignment. Upon construction completion of the new structure and alignment, the existing structure and highway infrastructure will be removed and rehabilitated.

This project commences approximately 470 m south of the Pickerel River and extends northerly to approximately 700 m north of the river, for a length of about 1.2 km (including the new structure over the Pickerel River). The project is located within the Geographic Township of Mowat, approximately 14.7 km south of Highway 64, in the District of Parry Sound, in the MTO Northern Region, District 54, Sudbury.

The following report addresses the foundation investigation and design implications of a proposed two span bridge at the Pickerel River crossing. A separate report prepared by Trow Consulting Engineers Ltd. addresses the pavement and geotechnical concerns of the assignment.

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PART 1: FOUNDATION INVESTIGATION

APPENDICES

PART 1 - FOUNDATION INVESTIGATION

1.0 INTRODUCTION

This submission presents the results of a foundation investigation completed by Trow Consulting Engineers Ltd. ("Trow") for the proposed two span replacement bridge at the Pickerel River and Highway 69 crossing. It is Trow's understanding that a two span replacement structure consisting of a 39.0 m south span and a 77.5 m north span is proposed at this site. This proposed layout will require a pier to be constructed within the river channel, approximately 10 m north of the south shore. This portion of the report contains factual information (obtained from the field investigation) pertaining to the design parameters required for the bridge foundations.

1.1 SITE DESCRIPTION AND GEOLOGICAL SETTING

1.1.1 Site Description

The proposed bridge site is located along Highway 69, approximately 25 m to the west of the existing bridge at the Pickerel River. The approximate stationing of the proposed bridge site is from Station 19+825 to Station 19+975, Mowat Township, District of Parry Sound. Appendix A contains a site plan, sections and four (4) photographs of the site.

Numerous bedrock outcrops are exposed within the vicinity of the proposed replacement structure location and large, surficial cobbles and boulders are visible along the northern shoreline At the crossing, the terrain on the south side of the river is undulating corresponding with the bedrock ridges and valleys, while a rise in elevation on the north side of the river is noted. The surrounding area to the south of the river has occasional small coniferous trees and shrubs, with marshy areas located within the bedrock valleys. The northern shoreline of the river contains mature coniferous and deciduous trees.

1.1.2 Geological Setting

Published geological information confirms that the site, located within the Central Gneiss Belt, comprises of bedrock consisting of Mesoproterozoic Gneisses of metasedimentary origin. As previously noted, the topography in the area is undulating, and appears to consist primarily of exposed bedrock.

1.2 Investigative Procedures

1.2.1 General

Part 1 of this report describes the investigative procedures adopted for the geotechnical assessment of the proposed replacement bridge for the Pickerel River crossing. Properties of the overburden soils and recovered bedrock samples were obtained by in-situ and laboratory testing. The procedures, used during the investigation, are described below.

1.2.2 Field Investigation

The field work for the investigation was carried out between October 24, 2000 and October 27, 2000, and consisted of twenty three (23) boreholes.

Six (6) boreholes were completed at the south abutment area (BH-1 to BH-6, inclusive), to depths varying from 400 mm to 3.2 m. Ten (10) boreholes were completed at the north abutment location (BH-20 to BH-29, inclusive), to depths varying from 200 mm to 3.2 m. All boreholes at both the south and north abutment locations were advanced by hand powered soils augering equipment until auger refusal was met. As a result of access limitations, it was not feasible to mobilize track mounted equipment (bulldozer, excavator or drill rig) to the abutment locations. Upon meeting auger refusal, two boreholes at each abutment location (BH-1 and BH- 5 at the southern location and BH-20 and BH-24 at the northern location) were cored ("NQ" size) a minimum of 3.2 m into the encountered bedrock. A senior Trow geotechnical drill rig technician supervised and logged the soil drilling and rock coring, which was performed by an approved soils drilling contractor, Colbar Resources.

Seven (7) boreholes (BH-10 through BH-15, inclusive and BH-11B) located near the pier location of the proposed structure were advanced through the overburden soils using a skid-mounted BBS1 drill, positioned into place through the use of a barge, and equipped with solid and hollow stem augers. The drill was operated by an approved soils drilling contractor, Marathon Drilling Co. Ltd. Soil samples were obtained by using a 51 mm O.D. split-spoon sampler in conjunction with standard penetration tests (ASTM D1586). The standard penetration (N) values were recorded and used to provide an assessment of the relative density of the overburden soils encountered within the river channel. Upon meeting auger refusal at the pier location, three (3) of the seven boreholes (BH-11, BH-11B and BH-14) were cored between 1.6 m to 3.1 m into the encountered bedrock. A "BQ" size core barrel and casing were used, and core samples of the bedrock were retrieved for rock quality determination and classification. The recovered soil samples and rock cores were used for identification and laboratory testing.

The borehole locations are shown on the attached site plan, Drawing 1, in Appendix A. These locations in the field were established by chaining off WP markers provided by DS-Lea Associates Ltd.'s ("LEA") survey crew. The surface elevations were established by interpolating the ground surface spot elevations and contours from a plan provided by LEA and are referenced to geodetic datum. As it was not possible to place stakes within the river channel at the location of the pier, LEA provided the station for WP2 as an offset on the existing bridge. In an attempt to place the boreholes within the pier location, our field staff lined the barge into position with the provided offset on the existing bridge and the staked out centreline of the proposed alignment on the slopes. Once the barge was positioned, it was both anchored to the river bottom and tied to three points along the southern shore. Upon review of the field sounding depths obtained during the drilling process, and the river bathymetry data provided by LEA, we now suspect that the actual locations of the boreholes advanced within the river channel vary between 1 to 7 m north of the proposed pier location.

Details of the soil and bedrock conditions encountered in the boreholes are included on the logs and the Rock Core Description Table in Appendix B. Further details on soil descriptions for classification purposes may be found on Figure 2, also included in Appendix B.

1.2.3 Laboratory Testing

The laboratory testing program for this assignment was limited to a detailed visual assessment of the recovered soil samples and rock cores.

The results of the visual assessment are summarized on the attached borehole logs and Rock Core Description Table in Appendix B.

1.2.4 Subsurface Conditions

The borehole locations are shown on the site plan and soil sections along the proposed centreline of the three foundation elements, and are plotted on Drawing 1, located in Appendix A. Soil sections at each of the three foundation elements are plotted on Drawing 2, also located in Appendix A. Based on this information, the following different soil layers were encountered:

- Topsoil/Surficial Boulders and Cobbles
- Silty Sand/Sandy Silt
- Alluvial Sand
- Bedrock/Boulders

A summary of the above soil strata encountered in the boreholes, and inferred from the boreholes is presented below.

1.2.4.1 Topsoil/Surficial Boulders and Cobbles

A surficial layer of topsoil, 80 mm to 150 mm thick, was encountered in boreholes BH-2, BH-3, BH-4 and BH-6 and a layer of surficial boulders and cobbles contained within an organic matrix, varying in thickness from 200 mm to 660 mm, was observed in boreholes BH-21, BH-22, BH-23, BH-25, BH-26, BH-27, BH-28 and BH-29.

1.2.4.2 Silty Sand/Sandy Silt

A thin deposit (i.e. less than 500 mm thick) of wet, brown silty sand/sandy silt was encountered beneath the topsoil layer in boreholes BH-2, BH-3, BH-4 and BH-6. This layer was described as loose to compact.

1.2.4.3 Alluvial Sand

A thin veneer (i.e. less than 130 mm thick) of overburden comprised of coarse, brown, alluvial sand was encountered surficially at the locations of boreholes BH-12, BH-13 and BH-14, within the river channel.

1.2.4.4 Bedrock/Boulders

Surficial bedrock was noted at the locations of boreholes BH-1, BH-5, BH-10, BH-11, BH-11B, BH-15, BH-20 and BH-24. The auger refusal was met on probable bedrock (possible boulders) beneath the silty sand/sandy silt layer in boreholes BH-2, BH-3, BH-4, BH-6, BH-26 and BH-27 and below the alluvial sand deposit in BH-12, BH-13 and BH-14. Auger refusal was met on probable boulders (possible bedrock) in boreholes BH-21, BH-22, BH-23, BH-25, BH-28 and BH-29 beneath the surficial boulder and cobble layer.

Bedrock was confirmed by retrieving "NQ" size cores in boreholes BH-1, BH-5, BH-20 and BH-24, i.e. at two locations beneath each of the two abutments and by retrieving "BQ" size cores in boreholes BH-11, BH-11B and BH-14, i.e. at three locations beneath the proposed pier.

The following table summarizes the location, depth to refusal, type of refusal, etc. of each borehole.

Borehole	Depth to Refusal (m)	Elevation of Refusal	Type of Refusal
South Abutment			
BH-1	0.00 (Bedrock outcropping)	179.9	Bedrock proven by coring
BH-2	0.51	179.3	Probable bedrock *
BH-3	0.41	179.6	Probable bedrock *
BH-4	0.36	180.7	Probable bedrock *
BH-5	0.00 (Bedrock outcropping)	180.6	Bedrock proven by coring
BH-6	0.61	179.2	Probable bedrock *
Pier			
BH-10	4.57 (water depth)	172.8	Probable bedrock *
BH-11	5.79 (water depth)	171.6	Bedrock proven by coring
BH-11B	5.79 (water depth)	171.6	Bedrock proven by coring
BH-12	5.61 (water depth plus 50 mm overburden)	171.8	Probable bedrock *
BH-13	5.79 (water depth plus 130 mm overburden)	171.6	Probable bedrock *
BH-14	3.05 (water depth plus 100 mm overburden)	174.3	Bedrock proven by coring
BH-15	5.84 (water depth)	171.6	Probable bedrock *

Borehole	Depth to Refusal (m)	Elevation of Refusal	Type of Refusal
North Abutment			
BH-20	0.00 (Bedrock outcropping)	178.5	Bedrock proven by coring
BH-21	0.36	179.3	Probable boulder
BH-22	0.23	179.0	Probable boulder
BH-23	0.41	179.3	Probable boulder
BH-24	0.00 (Bedrock outcropping)	179.5	Bedrock proven by coring
BH-25	0.66	179.6	Probable boulder
BH-26	0.30	180.2	Probable bedrock *
BH-27	0.18	180.5	Probable bedrock *
BH-28	0.48	180.9	Probable boulder
BH-29	0.28	180.9	Probable boulder

*Bedrock levels were inferred from 'grinding' refusal to the machine augers. This refusal could, however, also represent a boulder obstruction in some instances.

As noted above, bedrock either outcrops or is relatively shallow beneath the proposed pier and two abutment locations.

The above elevations were estimated, based on the boreholes drilled at the pier and abutment locations. Interpolation between boreholes is approximate, and, as such, actual footing elevations will depend on the conditions encountered at the time of construction. The bedrock surface in Northern Ontario is known to be erratic and hence may vary between explorations.

The reader is referred to Table 1 in Appendix B for detailed descriptions (i.e. RQD, discontinuities, etc.) of the recovered bedrock cores. Descriptions of the recovered bedrock cores are summarized within the following paragraphs.

The bedrock at the Highway 69 Pickerel River crossing belongs to the Rutter pluton, an igneous rock of syenitic to monzonitic composition. It is one of many granitic and anorthositic intrusions in the Central Gneiss Belt of the Grenville Province. The pluton is elongated and can be traced from west of Alban, parallel to Highway 69, and southeast to several kilometres south of Pickerel River.

At Pickerel River, the syenite / monzonite consists of about 60% reddish brown alkali and grey plagioclase feldspar. Mafic minerals constitute about 35% to 40%. The mafic minerals are soft and are most probably chloritized amphiboles. Biotite was not megascopically identified. Other minerals present in the low percent range are glassy quartz, disseminated grains and small aggregations of ruby red garnets, calcite as interstitial grains or on fracture planes, hematite, and specks of sulphides. There are no clay minerals present to cause rock swelling, and the widely disseminated specks of sulphides are not enough to cause concerns of acid rock drainage. The

rock is non-magnetic. Visually, the rock has a coarse grained appearance, but microscopically is seen to be fine to medium grained.

The pluton is deformed and was subjected to deep burial metamorphism. However, metamorphic reconstitution and segregation of minerals has been minimal. Gneissosity is weakly to moderately well developed. Mafic minerals cluster in disconnected aggregates which are mostly near planar, but may also be irregularly shaped. The mafic aggregates are aligned on planes inclined at a modest 10 to 15 degrees from the horizontal, rarely steeper. Individual mafic minerals mostly lie in the planes of these aggregates, but many grains deviate from this general alignment. The result is that the rock has maintained much of its original igneous texture, and with that good grain interlocking. Such an interlocking mineral fabric gives the rock structural integrity and strength. The drill cores do not preferentially break on compositional foliation. There is thus no inherent weakness in the rock mass due to the gneissic fabric.

The drill cores from the south abutment foundation (boreholes BH-1 and BH-5), and north abutment foundation (boreholes BH-20 and BH-24) are solid with little tectonic disturbance. Hairline cracks and narrow, well sealed, fractures are widely spaced. They are planar to irregular shaped, with rough surfaces, and with no signs of slippage or fault movement. Most core breaks have occurred on these fractures. However, they are not unidirectionally orientated, and in total do not impart a directional weakness on the rock mass. Except for minor and not significant differences, the four cores are much the same.

The drill cores from the mid-river pier site, boreholes BH-11, BH-11B and BH-14, are more highly fractured and mineralogically altered than those from the north and south abutment sites. Even the cores of boreholes BH-11 and BH-11B, which were drilled within 700 mm of each other, differ from one another in their intensity of rock fracturing and mineral alteration. This higher intensity of fracturing and alteration lends support to the idea that a now inactive east-west fault zone, parallel to the French River fault, may also lie along the water course of the Pickerel River.

1.2.4.5 Groundwater Conditions

Groundwater, perched on the bedrock surface, was encountered during the field work at a depth of 300 mm below the existing grade at borehole BH-3. Otherwise, groundwater was not encountered within the boreholes advanced for the abutments.

The river water elevation, based on survey data provided by LEA, was at El. 177.40 m, at the time of the field investigation.

2.0 Conclusion

The recommendations made in this report are in accordance with our present understanding of the project and are provided solely for the use of the Ministry of Transportation, DS-Lea Associates Ltd. and their design team for the design of the proposed Highway 69/Pickerel River crossing for the permanent replacement bridge. We request that we be retained to review the design and our recommendations as the design proceeds, to ensure that the final design is in general agreement with our recommendations, and that our recommendations have been interpreted as intended.

A subsurface investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those reported at the test locations, we require that we be notified immediately in order to allow reassessment of our recommendations. It may then be necessary to carry out additional field work and analyses.

Contractors bidding on or undertaking the works should, relative to the subsurface conditions, decide on their own investigations, if deemed necessary, as well as their own interpretations of the factual results provided herein, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

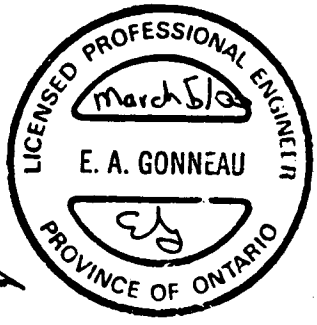
The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the current geotechnical conditions at the site of the proposed Highway 69/Pickerel River crossing for the permanent replacement bridge. The conclusions presented in this report reflect site conditions existing at the time of the investigation. It is noted that the soil boundaries indicated on the logs are inferred from discontinuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

The field investigation was performed by Messieurs S. McAuliffe and R. Imbeau, senior field technicians, and supervised by Mr. L.J. Birn, B.Eng. This report has been prepared by Mr. L. J. Birn, B.Eng., Mr. E.A. Gonneau, P.Eng. and Mr. W. Meyer, M.Sc. Geology, P.Eng. (examination and description of bedrock cores) and reviewed by Mr. S.E. Gonsalves, M.Eng., P.Eng. (Trow's MTO designated foundation contact).

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Yours truly

Trow Consulting Engineers Ltd.



Lee J. Birn, B.Eng.

E.A. Gonneau, P.Eng.
Project Manager/Geotechnical Engineer

S.E. Gonsalves, M.Eng., P.Eng.
Principal
MTO Designated Foundation Contact

APPENDIX A

SITE PLAN, SECTIONS AND SITE PHOTOGRAPHS

METRIC

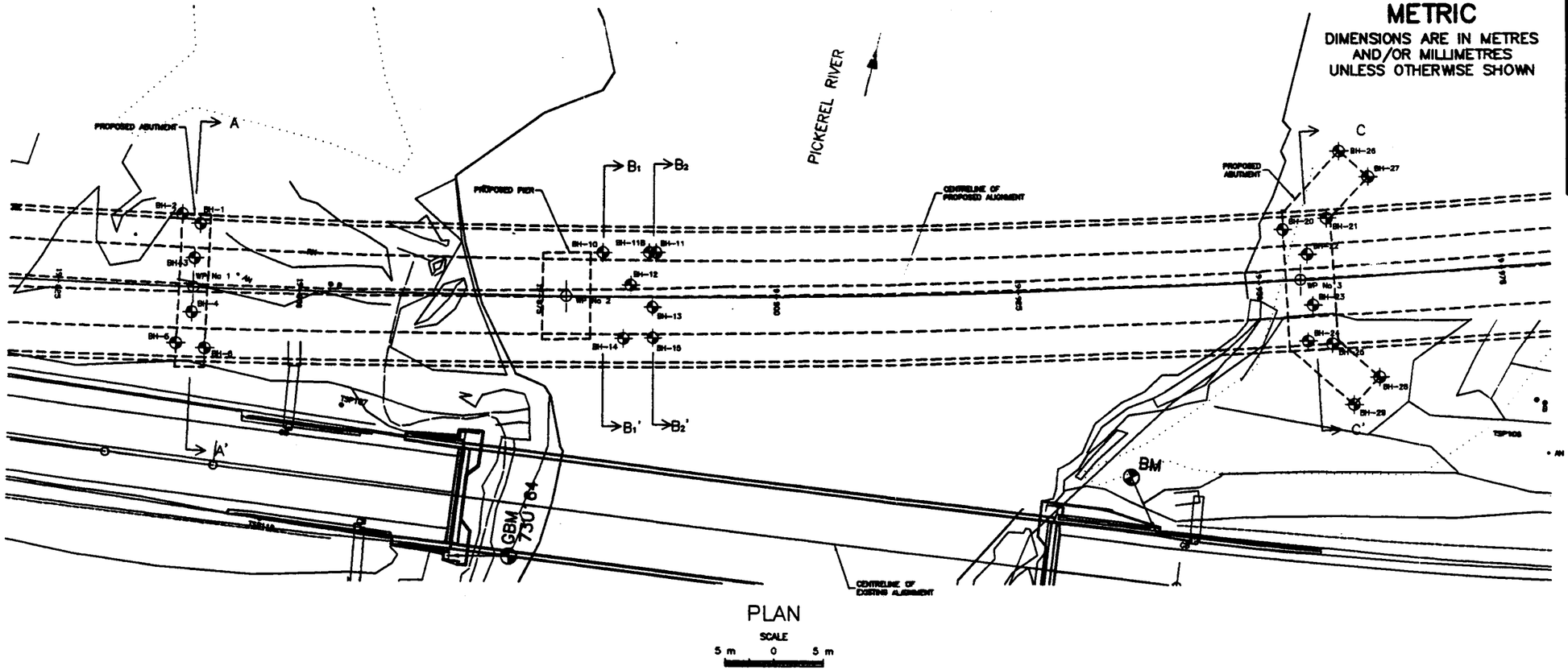
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

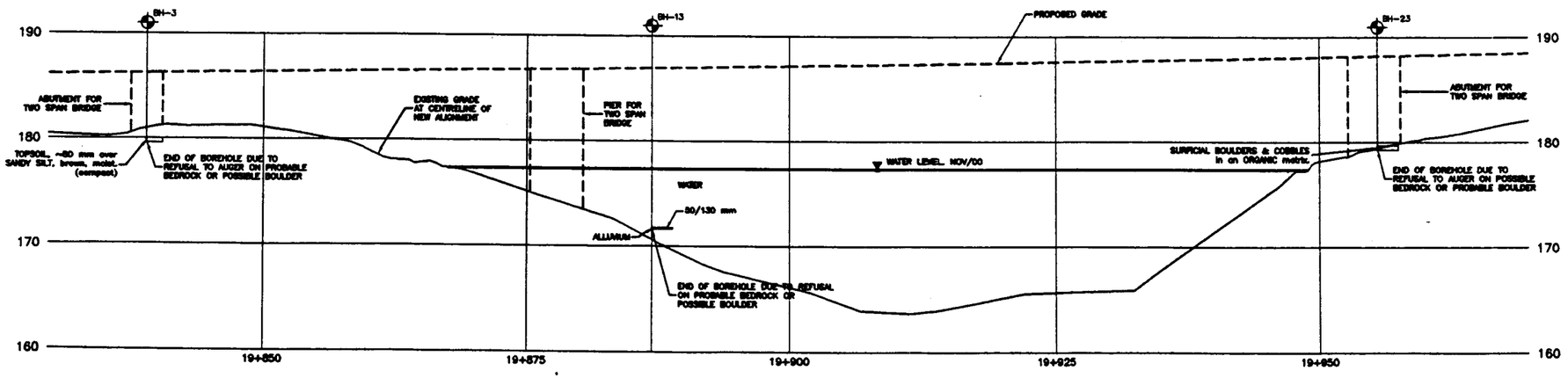
DIST 54 HWY 69
CONT No
WP No 330-85-00

PICKEREL RIVER BRIDGE
TOWNSHIP OF MOWAT
BORE HOLE LOCATIONS & SOIL STRATA

SHEET 1 OF 2

TROW CONSULTING ENGINEERS LTD.
SUDBURY, ONTARIO
Trow PROJ. No. S08322G DWG. No. 1





CENTRELINE PROFILE

SCALE
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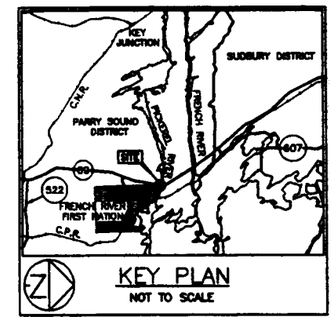


KEY PLAN
NOT TO SCALE

LEGEND

Borehole (Oct. 2000)

No.	ELEVATION	STATION	OFFSET
BH-1	179.9	19+839.4	6.6 LT
BH-2	179.8	19+837.4	7.9 LT
BH-3	180.0	19+838.9	3.0 LT
BH-4	181.1	19+838.8	2.6 RT
BH-5	181.6	19+840.3	6.3 RT
BH-6	179.8	19+837.3	5.9 RT
BH-10	177.4	19+881.6	4.6 LT
BH-11	177.4	19+887.3	4.6 LT
BH-11B	177.4	19+886.6	4.6 LT
BH-12	177.4	19+884.6	1.2 LT
BH-13	177.4	19+886.9	1.1 RT
BH-14	177.4	19+883.8	4.3 RT
BH-15	177.4	19+886.9	4.3 RT
BH-20	178.5	19+952.9	5.4 LT
BH-21	179.7	19+957.5	6.3 LT
BH-22	179.2	19+955.3	2.6 LT
BH-23	179.7	19+955.6	2.7 RT
BH-24	179.5	19+954.8	6.5 RT
BH-25	180.3	19+957.3	6.5 RT
BH-26	180.5	19+959.2	13.2 LT
BH-27	180.7	19+962.1	10.3 LT
BH-28	181.4	19+961.9	10.6 RT
BH-29	181.2	19+959.1	13.4 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 GC 2-01 of OPS Gen. Cond.

NOTE:

All borehole locations and elevations were interpolated by referencing W.P.'s, spot elevations and ground surface contours presented on drawings by D.S. Lea Associates Ltd., dated October 2000 and January 2001.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN L.B. CHK E.C. CODE . LOAD . DATE MAR. 2001
DRAWN M.D. CHK SITE STRUCT SCHEME TRAF.

METRIC

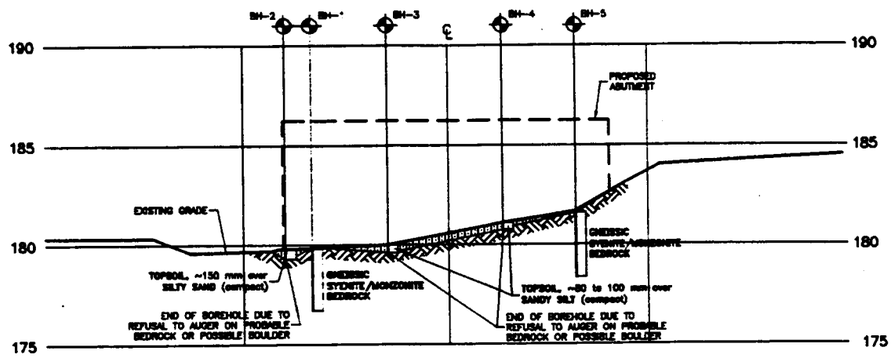
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST 54 HWY 69
CONT No
WP No 330-85-00

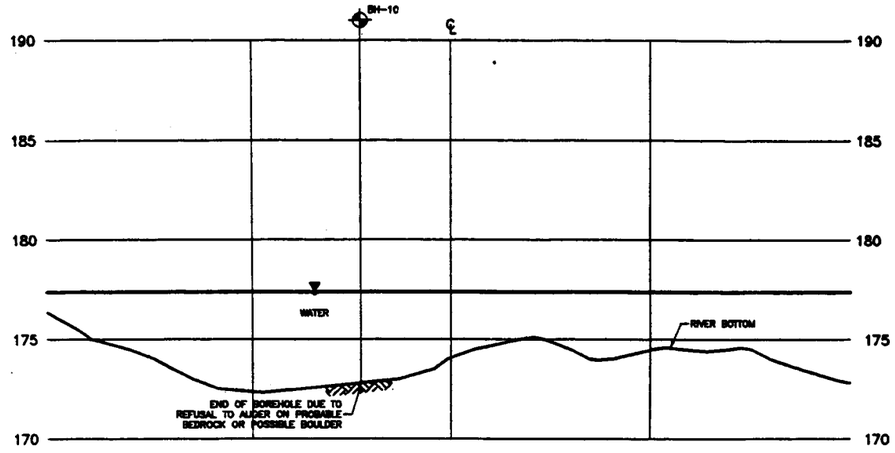
PICKEREL RIVER BRIDGE
TOWNSHIP OF MOWAT
CROSS SECTIONS

SHEET
2 OF 2

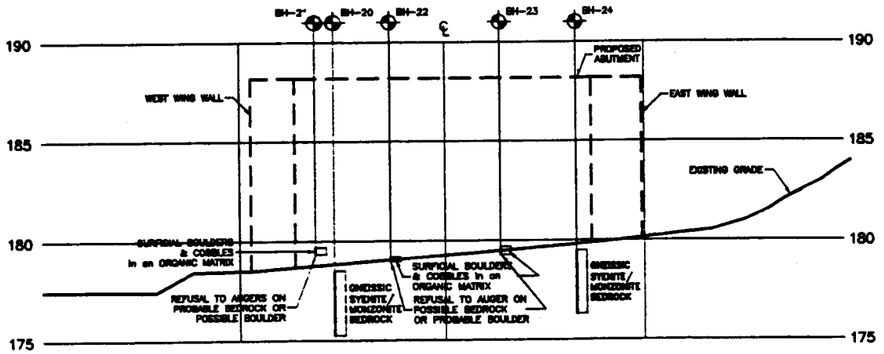
TROW CONSULTING ENGINEERS LTD.
SUDBURY, ONTARIO
Trow PROJ. No. S08322G DWG. No. 2



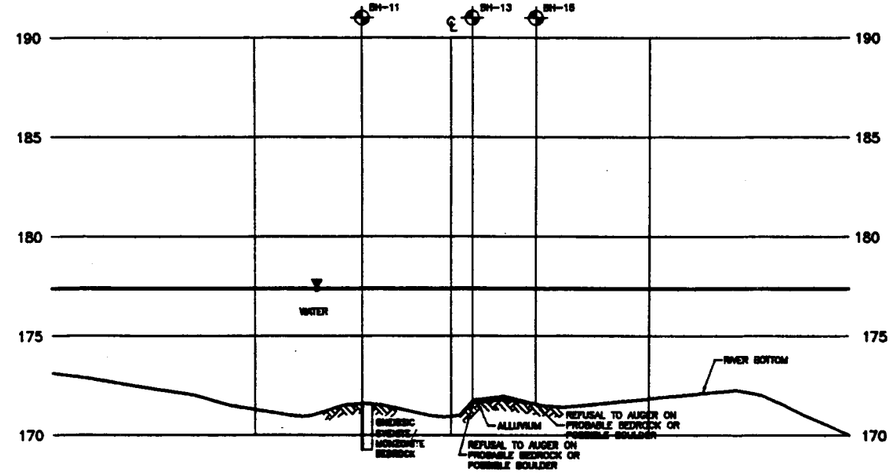
SECTION A–A'



SECTION B_1–B_1'



SECTION C–C'



SECTION B_2–B_2'

SCALE
5 m 0 5 m

LEGEND

- Borehole (Oct. 2000)
- Water Level (Nov. 2000)

No.	ELEVATION	STATION	OFFSET
BH-1	179.9	19+839.4	6.6 LT
BH-2	179.8	19+837.4	7.9 LT
BH-3	180.0	19+838.9	3.0 LT
BH-4	181.1	19+838.8	2.6 RT
BH-5	181.6	19+840.3	6.3 RT
BH-6	179.8	19+837.3	5.9 RT
BH-10	177.4	19+881.6	4.6 LT
BH-11	177.4	19+887.3	4.6 LT
BH-11B	177.4	19+886.6	4.6 LT
BH-12	177.4	19+884.8	1.2 LT
BH-13	177.4	19+886.9	1.1 RT
BH-14	177.4	19+883.8	4.3 RT
BH-15	177.4	19+886.9	4.3 RT
BH-20	178.5	19+852.8	5.4 LT
BH-21	179.7	19+857.5	6.3 LT
BH-22	179.2	19+855.3	2.6 LT
BH-23	179.7	19+855.6	2.7 RT
BH-24	179.5	19+854.8	6.5 RT
BH-25	180.3	19+857.3	6.5 RT
BH-26	180.5	19+958.2	13.2 LT
BH-27	180.7	19+962.1	10.3 LT
BH-28	181.4	19+961.9	10.6 RT
BH-29	181.2	19+959.1	13.4 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:

All borehole locations and elevations were interpolated by referencing W.P.'s, spot elevations and ground surface contours, presented on drawings by D.S. Lea Associates Ltd., dated October 2000 and January 2001.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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 GC 2-01 of OPS Gen. Cond.

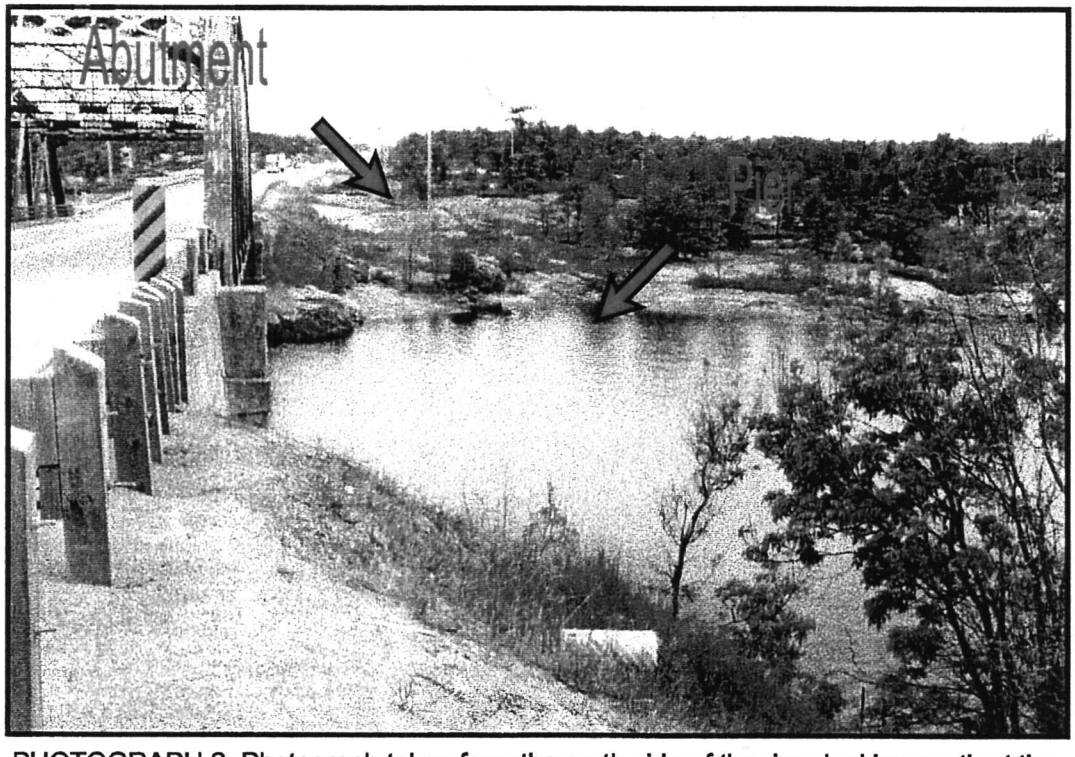
REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	L.B.	CHK	E.C.	CODE	.	LOAD	.	DATE	MAR. 2001
DRAWN	M.D.	CHK		SITE	.	STRUCT	.	SCHEME	.	DWG	2

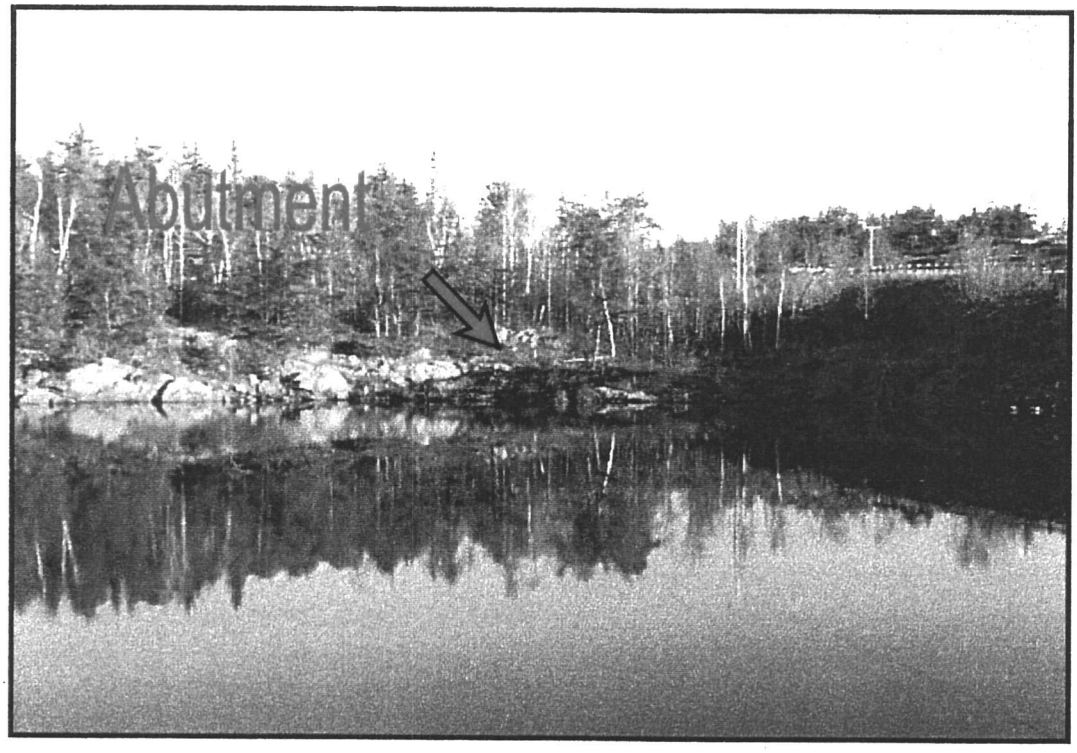
(14)

Drawing: F:\MY DOCUMENTS\PROJECT FILES\S08322G-PICKEREL RIV BR\S08322G-02-R1-SECTIONS.DWG Plot date: 2001/3/5 - 9:38

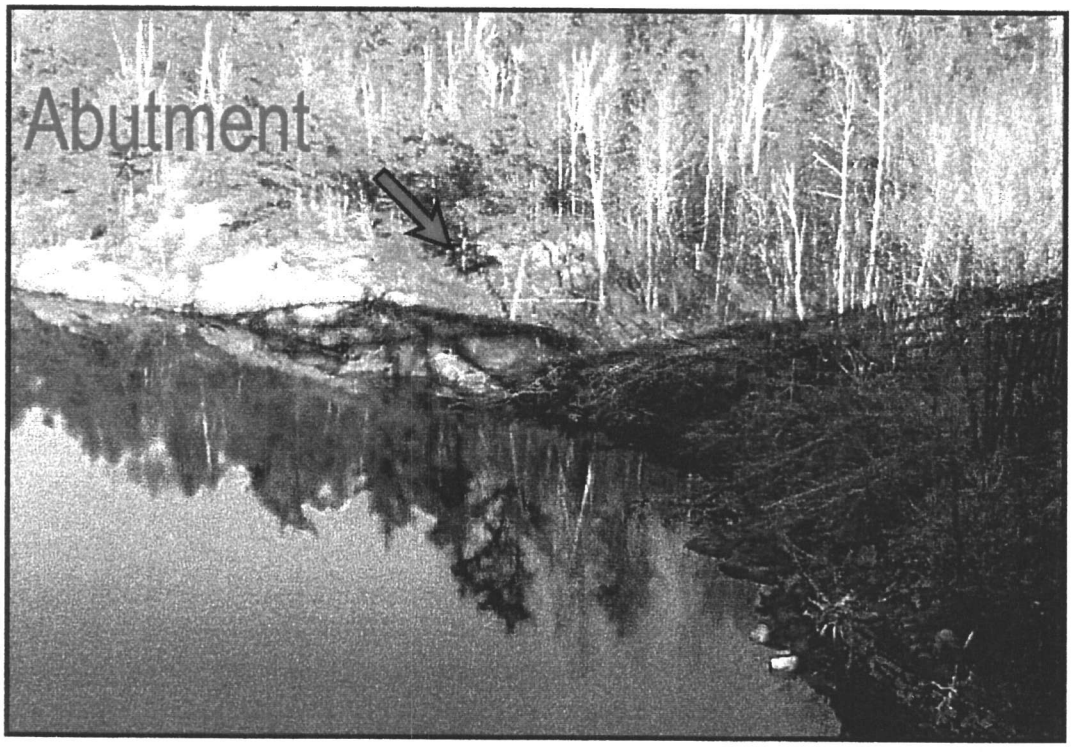
PHOTOGRAPH 1: Photograph taken at ~ Station 19+825, looking north along the proposed alignment's centerline.



PHOTOGRAPH 2: Photograph taken from the north side of the river looking south at the river's south shore in the area of the proposed alignment's centerline.



PHOTOGRAPH 3: Photograph taken from south shore of the river looking north towards the proposed northern abutment location.



PHOTOGRAPH 4: Photograph taken from the west side of the existing bridge looking northwest at the proposed northern abutment location.

APPENDIX B

BOREHOLE LOGS AND ROCK CORE TABLES

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 (R Q D), 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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE BH-1 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 735.2 N, 222 158.7 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE NQ Core / Hilti Drill COMPILED BY M.D.
DATUM Geodetic DATE October 24, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80)	SHEAR STRENGTH: Cu. KPa ● UNCONFINED ○ QUICK TRIAXIAL + FIELD VANE ✲ LAB SHEAR (20 40 60 80)	PLASTIC LIMIT wp — NATURAL MOISTURE CONTENT w — LIQUID LIMIT wl; WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.90	GROUND SURFACE											
0.00	GNEISSIC SYENITE/MONZONITE BEDROCK		1	NQ			179					
			2	NQ								
			3	NQ			178					
			4	NQ			177					
176.70												
3.20	END OF BOREHOLE											

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+839.4, offset ~6.6 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-2

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 733.3 N, 222 157.7 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE Hand Sampling / Hand Power Auger | COMPILED BY M.D.

DATUM Geodetic | DATE October 24, 2000 | CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST — 20 40 60 80	SHEAR STRENGTH: Cu. KPa ● UNCONFINED QUICK TRIAXIAL + × FIELD VANE LAB SHEAR — 20 40 60 80	PLASTIC LIMIT wp	NATURAL MOISTURE CONTENT w	LIQUID LIMIT wl	WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.80	GROUND SURFACE														
0.00 / 179.29	TOPSOIL, ~150 mm over SILTY SAND, brown, wet. (compact)		1												
0.51	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER						179								

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+837.4, offset ~7.9 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.

RECORD OF BOREHOLE BH-3

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 734.6 N, 222 162.3 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 23, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, kPa (UNCONFINED QUICK TRIAXIAL; FIELD VANE; LAB VANE)	PLASTIC LIMIT wp; NATURAL MOISTURE CONTENT w; LIQUID LIMIT wl; WATER CONTENT (%)	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
180.00	GROUND SURFACE						180	20 40 60 80	10 20 30 40		
0.00 / 179.59	TOPSOIL, ~80 mm over SANDY SILT, brown, moist. (compact)										
0.41	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+838.9, offset ~3.0 m left of centreline as referenced to the Proposed New Alignment.
3) Water level was at ~0.3 m depth hole was open to ~0.3 m depth on completion.

(21)

RECORD OF BOREHOLE BH-4

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 734.4 N, 222 167.9 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 23, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. kPa (● UNCONFINED QUICK TRIAXIAL, + FIELD VANE, ⊗ LAB SHEAR)	WATER CONTENT (%)	kN/m³	GR SA (SI & CL)
181.10	GROUND SURFACE						181	20 40 60 80	wp — w — wl; 10 20 30 40		
0.00 / 180.74	TOPSOIL, ~100 mm over SANDY SILT, brown, moist, (compact)										
0.36	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+838.8, offset ~2.6 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.

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(22)

RECORD OF BOREHOLE BH-5

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 737.8 N, 222 171.2 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE NQ Core / Hilti Drill | COMPILED BY M.D.

DATUM Geodetic | DATE October 25, 2000 | CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80) / SHEAR STRENGTH: Cu, KPa (UNCONFINED QUICK TRIAXIAL, FIELD VANE LAB SHEAR) (20 40 60 80)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (wp — w — wl) / WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
181.60	GROUND SURFACE										
0.00	**TOPSOIL**, ~75 mm over **GNEISSIC SYENITE/MONZONITE BEDROCK**		1	NQ			181				
			2	NQ			180				
			3	NQ							
			4	NQ			179				
178.35											
3.25	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+840.3, offset ~6.3 m right of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-6

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 736.1 N, 222 172.0 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 23, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. KPa (UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB SHEAR)	WATER CONTENT (%)		
179.80	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
0.00	TOPSOIL, ~100 mm over										
179.19	SILTY SAND, occasional cobbles, brown, moist.	1									
0.61	(loose to compact)						179				
	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+837.3, offset ~5.9 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.3 m depth on completion.

RECORD OF BOREHOLE BH-10 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 777.2 N, 222 161.5 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, kPa (UNCONFINED / QUICK TRIAXIAL, FIELD VANE / LAB SHEAR)	PLASTIC LIMIT wp; NATURAL MOISTURE CONTENT w; LIQUID LIMIT wl; WATER CONTENT (%)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40 GROUND SURFACE								20 40 60 80	10 20 30 40		
0.00	WATER						177				
							176				
							175				
							174				
172.83							173				
4.57	END OF BOREHOLE DUE TO AUGER REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+881.6, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-11

1 OF 1

METRIC

G.W.P. 330-85-00 | LOCATION 5 095 782.9 N, 222 161.4 E | ORIGINATED BY L.B.

DIST 54 HWY 69 | BOREHOLE TYPE BQ Core / BBS1 | COMPILED BY M.D.

DATUM Geodetic | DATE October 26, 2000 | CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu. kPa (UNCONFINED QUICK TRIAXIAL; FIELD VANE LAB SHEAR)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m					kN/m³	GR SA (SI & CL)
177.40 GROUND SURFACE								20 40 60 80	10 20 30 40		
0.00	WATER						177				
							176				
							175				
							174				
							173				
							172				
171.61 5.79	GNEISSIC SYENITE/MONZONITE BEDROCK		1	BQ			171				
							170				
169.27 8.13	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation investigation.
2) Borehole located at station ~19+887.3, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-11B 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 782.1 N, 222 161.4 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE BQ Core / BBS1 COMPILED BY M.D.
DATUM Geodetic DATE October 27, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) × / CONE PENETRATION TEST — 20 40 60 80	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT wp — w — wl	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa ● UNCONFINED QUICK TRIAXIAL ○ + FIELD VANE LAB SHEAR 20 40 60 80	WATER CONTENT (%) 10 20 30 40	kN/m³	GR SA (SI & CL)
177.40	GROUND SURFACE										
0.00	WATER						177				
							176				
							175				
							174				
							173				
							172				
171.61											
5.79	GNEISSIC SYENITE/MONZONITE BEDROCK		1	BQ			171				
169.98							170				
7.42	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.6, offset ~4.6 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-12 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 780.2 N, 222 164.8 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80)	SHEAR STRENGTH: Cu. kPa (UNCONFINED QUICK TRIAXIAL ● ○ / FIELD VANE LAB SHEAR × + ; 20 40 60 80)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl — WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE											
0.00	WATER						177					
							176					
							175					
							174					
							173					
171.84							172					
5.56	COARSE ALLUVIAL SAND		1	SS	50/0.0m				×/50 mm			
171.79	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER											
5.61												

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+884.6, offset ~1.2 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-13

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 782.5 N, 222 167.1 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu. kPa (UNCONFINED QUICK TRIAXIAL; FIELD VANE LAB SHEAR)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m						
177.40	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
0.00	WATER						177				
							176				
							175				
							174				
							173				
							172				
171.74											
5.66	ALLUVIUM		1	SS	50			×/130 mm			
171.61	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER										
5.79											

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.9, offset ~1.1 m right of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-14 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 779.4 N, 222 170.4 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE BQ Core / BBS1 COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST / SHEAR STRENGTH: Cu. KPa (UNCONFINED QUICK TRIAXIAL, FIELD VANE, LAB SHEAR) 20 40 60 80	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl — WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
177.40	GROUND SURFACE										
0.00	WATER						177				
							176				
							175				
174.35 3.05	ALLUVIAL SAND, coarse, brown. (very loose)		1	SS	1		174				
174.25 3.15	GNEISSIC SYENITE/MONZONITE BEDROCK		2	BQ							
							173				
			3	BQ			172				
171.15 6.25	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+883.8, offset ~4.3 m right of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-15 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 782.6 N, 222 170.3 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Standard Sampling / BBS1 COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu, KPa (UNCONFINED QUICK TRIAXIAL ⊕, FIELD VANE LAB SHEAR +)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
177.40	GROUND SURFACE										
0.00	WATER						177				
							176				
							175				
							174				
							173				
							172				
171.56 5.84	END OF BOREHOLE DUE TO REFUSAL ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+886.9, offset ~4.3 m right of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-20 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 848.1 N. 222 158.7 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE NQ Core / Hilti Drill COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST 20 40 60 80	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%) 10 20 30 40	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa ● UNCONFINED QUICK TRIAXIAL ✻ FIELD VANE LAB SHEAR 20 40 60 80	wp — w — wl	kN/m³	GR SA (SI & CL)
178.50	GROUND SURFACE										
0.00	GNEISSIC SYENITE/MONZONITE BEDROCK		1	NQ			178				
			2	NQ			177				
			3	NQ			176				
			4	NQ							
175.27											
3.23	END OF BOREHOLE										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+952.9, offset ~5.4 m left of centreline as referenced to the Proposed New Alignment.

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RECORD OF BOREHOLE BH-21

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 852.7 N, 222 157.5 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, kPa (● UNCONFINED QUICK TRIAXIAL, ⊕ + FIELD VANE, ⊗ LAB VANE)	WATER CONTENT (%)		
179.70	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
0.00 179.34	SURFICIAL BOULDERS & COBBLES, in an organic matrix.										
0.36	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+957.5, offset ~6.3 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m south of BH-21 & met auger refusal at ~0.1 m depth.

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RECORD OF BOREHOLE BH-22 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 850.7 N, 222 161.3 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. KPa (UNCONFINED QUICK TRIAXIAL / FIELD VANE LAB SHEAR)	WATER CONTENT (%)		
179.20	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
178.97 0.23	SURFICIAL BOULDERS & COBBLES, in an organic matrix. END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+955.3, offset ~2.6 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m south of BH-22 & met auger refusal at ~0.3 m depth.
5) Drill moved ~1.0 m east of BH-22 & met auger refusal at ~0.2 m depth.

RECORD OF BOREHOLE BH-23 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 851.3 N, 222 166.6 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (UNCONFINED QUICK TRIAXIAL ⊕, FIELD VANE LAB SHEAR +)	WATER CONTENT (%)	kN/m³	GR SA (SI & CL)
179.70	GROUND SURFACE							20 40 60 80	10 20 30 40		
0.00 179.29	SURFICIAL BOULDERS & COBBLES, in an organic matrix.										
0.41	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						179				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+955.6, offset ~2.7 m right of centreline as referenced to the Proposed New Alignment.
3) Drill moved ~1.0 m west or BH-23 & met auger refusal at ~0.1 m depth.
4) Drill moved ~1.0 m north of BH-23 & met auger refusal at ~0.3 m depth.

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RECORD OF BOREHOLE BH-24

1 OF 1

METRIC

G.W.P. 330-85-00 LOCATION 5 095 850.8 N, 222 170.4 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE NQ Core / Hilti Drill COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST (20 40 60 80)	SHEAR STRENGTH: Cu. KPa (UNCONFINED ● QUICK TRIAXIAL ○ FIELD VANE + LAB SHEAR) (20 40 60 80)	PLASTIC LIMIT wp / NATURAL MOISTURE CONTENT w / LIQUID LIMIT wl — WATER CONTENT (%) (10 20 30 40)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
179.50	GROUND SURFACE											
0.00	GNEISSIC SYENITE/MONZONITE BEDROCK		1	NQ			179					
			2	NQ			178					
			3	NQ			177					
			4	NQ								
176.30												
3.20	END OF BOREHOLE											

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+954.8 offset ~6.5 m right of centreline as referenced to the Proposed New Alignment.

RECORD OF BOREHOLE BH-25 : OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 853.6 N, 222 171.0 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

ELEV. / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST; SHEAR STRENGTH: Cu. kPa (UNCONFINED QUICK TRIAXIAL ●, FIELD VANE ×, LAB SHEAR +)	PLASTIC LIMIT wp; NATURAL MOISTURE CONTENT w; LIQUID LIMIT wl; WATER CONTENT (%)	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA (SI & CL)
180.30	GROUND SURFACE							20 40 60 80	10 20 30 40		
0.00	SURFICIAL BOULDERS & COBBLES, in an organic matrix.						180				
179.64											
0.66	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+957.3, offset ~6.5 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m east of BH-25 & met auger refusal at ~0.1 m depth.
5) Drill moved ~1.0 m south of BH-25 & met auger refusal at ~0.4 m depth.

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RECORD OF BOREHOLE BH-26 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 854.0 N, 222 150.5 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu. kPa (● UNCONFINED QUICK TRIAXIAL, + FIELD VANE LAB SHEAR)	WATER CONTENT (%)		
180.50	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40	kN/m³	GR SA (SI & CL)
180.20 0.30	SURFICIAL BOULDERS & COBBLES in an organic matrix.						180				
	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+959.2, offset ~13.2 m left of centreline as referenced to the Proposed New Alignment.
3) Drill moved ~1.0 m east of BH-26 & met auger refusal at ~0.1 m depth.
4) Drill moved ~1.0 m south of BH-26 & met auger refusal at ~0.2 m depth.
5) Bedrock outcropping ~2.0 m north of BH-26.

RECORD OF BOREHOLE BH-27 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 857.0 N, 222 153.2 E ORIGINATED BY L.B.

DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.

DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, kPa (UNCONFINED QUICK TRIAXIAL ● / FIELD VANE LAB SHEAR ×)	WATER CONTENT (%)	kN/m³	GR SA (SI & CL)
180.70	GROUND SURFACE							20 40 60 80	10 20 30 40		
180.52 0.18	SURFICIAL BOULDERS & COBBLES, in an organic matrix. END OF BOREHOLE DUE TO REFUSAL TO AUGER ON PROBABLE BEDROCK OR POSSIBLE BOULDER						180				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+962.1, offset ~10.3 m left of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.1 m depth on completion.
4) Drill moved ~1.0 m east of BH-27 & met auger refusal at ~0.2 m depth.
5) Drill moved ~1.0 m west of BH-27 & met auger refusal at ~0.1 m depth.
6) Bedrock outcropping ~2.0 m north of BH-27.

RECORD OF BOREHOLE BH-28 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 858.1 N, 222 174.2 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, KPa (● UNCONFINED QUICK TRIAXIAL, + & ⊕ FIELD VANE LAB SHEAR)	WATER CONTENT (%)		
181.40	GROUND SURFACE							20 40 60 80	10 20 30 40	kN/m³	GR SA (SI & CL)
0.00 180.92	SURFICIAL BOULDERS & COBBLES, in an organic matrix.						181				
0.48	END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER										

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+961.9, offset ~10.6 m right of centreline as referenced to the Proposed New Alignment.
3) Borehole was dry & open to ~0.2 m depth on completion.
4) Drill moved ~1.0 m east of BH-28 & met auger refusal at ~0.4 m depth.
5) Drill moved ~1.0 m west of BH-28 & met auger refusal at ~0.4 m depth.

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RECORD OF BOREHOLE BH-29 1 OF 1 METRIC

G.W.P. 330-85-00 LOCATION 5 095 855.5 N, 222 177.0 E ORIGINATED BY L.B.
DIST 54 HWY 69 BOREHOLE TYPE Hand Sampling / Hand Power Auger COMPILED BY M.D.
DATUM Geodetic DATE October 25, 2000 CHECKED BY E.G.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE (metres)	SPT TEST (N-Value) / CONE PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.3m			SHEAR STRENGTH: Cu, kPa (● UNCONFINED QUICK TRIAXIAL, + FIELD VANE, × LAB SHEAR)	WATER CONTENT (%)	kN/m³	GR SA (SI & CL)
181.20	GROUND SURFACE							20 40 60 80	wp — w — wl; 10 20 30 40		
180.92 0.28	SURFICIAL BOULDER & COBBLES, in an organic matrix. END OF BOREHOLE DUE TO REFUSAL TO AUGER ON POSSIBLE BEDROCK OR PROBABLE BOULDER						181				

Notes:

1) This borehole forms part of the Highway 69, Pickerel River Bridge Foundation Investigation.
2) Borehole located at station ~19+959.1, offset ~13.4 m right of centreline as referenced to the Proposed New Alignment.
2) Borehole was dry & open to ~0.2 m depth on completion.
3) Drill moved ~1.0 m north of BH-29 & met auger refusal at ~0.5 m depth.
4) Drill moved ~1.0 m west of BH-29 & met auger refusal at ~0.3 m depth.

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
1	1	0.0 to 0.76	97	50	0.0 to 3.19	**Gneissic Syenite / Monzonite** - Dark, reddish brown; fine to medium grained, much the same from top to bottom; - relict igneous texture; gneissosity weekly developed, dip 15 to 20 degrees, some steeper sections; no core breaks attributable to mineral foliation; - rock is massive, very solid; no open channel ways; a few hairline cracks (8 counted), which are hematite and hematite plus calcite cemented; irregular dips of mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.
	2	0.76 to 1.52	96	33		
	3	1.52 to 2.28	99	96		
	4	2.28 to 3.19	101	97		
	1 to 4	0.0 - 3.19	98	70		

Comment: NQ drilling; 26 pieces of core, average length per piece 12.27 cm. Since the cores (RC #2, in particular) were so badly damaged during the drilling operation, it could not be ascertained whether or not the majority of the fractures were machine breaks or natural geological breaks. As a conservative measure, all fractures were regarded as geological breaks, resulting in a low RQD value at 33% for RC 2. The core of RC 2 has deep scratch marks and shows signs of churning and grinding on non-geological breaks. We believe that the actual RQD value for the hole would indeed be much greater if the extent of damage to the rock cores was less during the drilling operation.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
5	1	0.0 to 0.91	110	74	0.0 to 3.25	**Gneissic Syenite / Monzonite** - Dark, reddish brown; fine to medium grained, some coarser grained pink feldspathic and darker mafic segregations; - relict igneous textures; gneissosity weakly developed, dip 10 -15 degrees; good crystal interlocking; no core breaks on mineral foliation; - rock is massive, very solid; no open channel ways; a few hairline cracks and fractures (20 counted) with up to 3 mm aperture, cemented by hematite or hematite plus calcite; incipient brecciation in Run 4; cracks and fractures are planar to highly irregular, dips mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.
	2	0.91 to 1.67	103	100		
	3	1.67 to 2.28	105	100		
	4	2.28 to 3.25	100	97		
	1 to 4	0.0 to 3.25	104	92		

Comment: NQ drilling; 22 pieces of core, average length 14.77 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
11	1	5.79 to 8.13	96	52	0.0 to 5.79 5.79 to 8.13	**Water** **Gneissic Syenite / Monzonite** - Dark reddish brown; fine to medium grained; mafic minerals partly chloritised, but less so than in 11B; - relict igneous textures; gneissosity weakly to moderately well developed; dips 10-20 degrees, but locally more steeply; good crystal interlocking; no visible signs of slippage or fault movement on any core breaks; - rock fractured (about 25 cracks counted); fractures from hairline to about 3 mm aperture; hematite or hematite plus calcite cemented; fractures irregular, some planar; dips variable but mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 30 pieces of core; average length per piece 7.8 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
11B	1	5.79 to 7.42	102	37	0.0 to 5.79 5.79 to 7.42	**Water** **Gneissic Syenite / Monzonite** - 5 cm rusty weathered top; dark, reddish brown with a green hue due to abundant chlorite; fine to medium grained, with several coarser grained feldspathic segregations; mafic minerals in part strongly chloritized; - relict igneous texture; gneissosity poorly developed, dip about 10 degrees; good crystal interlocking; no visible signs of slippage or fault movement on any core breaks; - rock highly fractured (about 40 fractures counted); fractures irregular to near planar, with up to 4 mm aperture; hematite or hematite plus calcite cemented; one small solution cavity on a calcite cemented fracture at 6.25 m; dips variable but mostly >45 degrees; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 24 pieces of core; average length per piece 7.16 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
14	1	3.15 to 4.15	100	22	0.0 to 3.05	**Water**
	2	4.15 to 6.24	100	53 ***	3.05 to 3.15	**Sand and Mud**
					3.15 to 6.24	**Gneissic Syenite / Monzonite**
	1 to 2	3.15 to 6.24	100	43		- Dark, reddish brown; fine to medium grained, some coarser feldspathic and mafic segregations; mafic minerals in part green, chloritised; - relict igneous texture; gneissosity weakly developed, dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock is solid, but strongly fractured (45 fractures counted); some local incipient brecciation; fractures are mostly irregular, some planar, hairline to cracks with 2 mm aperture; cracks cemented by hematite or hematite plus calcite, green chlorite; dips highly variable, mostly 45 degrees or steeper; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: BQ drilling; 42 pieces of core; average length per piece 7.33 cm.

*** Despite the many pieces, much of the core reassembles surprisingly well. Many core breaks are not on rock fractures and appear machine related; reassembling core along non-geological breaks does not increase the RQD for the upper 1.0 m, but increases it from 53% to over 80% for the lower 2.09 m.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
20	1 2 - 4 1 to 4	0.0 to 0.76 0.76 to 3.23 0.0 to 3.23	100 94 95	42 79 70	0.0 to 3.23	**Gneissic Syenite / Monzonite** - Dark, greenish grey to deep reddish brown; fine to medium grained, some coarser feldspathic segregations; - relict igneous textures; gneissosity moderately well developed, mineral layers mostly less than 5 mm thick; dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock massive, very solid; no open channel ways; a few hairline cracks and fractures (11 counted); cracks are hematite or hematite plus calcite cemented; cracks are planar to irregular, with dips 20 - 60 degrees; rough surfaces; no visible signs of slippage or fault movement on any core breaks.

Comment: NQ drilling; 20 pieces of core; average length per piece 16.15 cm. Core runs 2, 3, and 4 appear to be mixed up, and the correct sequence could only partially be restored.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

TABLE 1
ROCK CORE DESCRIPTION

BH#	Core Recovery				Core Description	
	RC #	Depth (m)	% CR*	% RQD**	Depth (m)	Description
24	1	0.0 to 0.76	96	58	0.0 to 3.20	**Gneissic Syenite / Monzonite** - Dark, deep reddish brown; fine to medium grained, some coarser feldpathic and mafic segregations; - relict igneous texture; gneissosity moderately well developed; mineral layers mostly less than 5 mm thick; dips 10 - 15 degrees; good crystal interlocking; no core breaks attributable to mineral foliation; - rock massive, very solid; no open channel ways; a few hairline cracks and fractures (10 counted); cracks are hematite or hematite plus calcite cemented; cracks are near planar or irregular; dips variable; rough surfaces; no visible signs of slippage or fault movement on any core breaks.
	2	0.76 to 1.52	71	50		
	3	1.52 to 2.38	100	100		
	4	2.38 to 3.20	123	83		
	1 to 4	0.0 to 3.20	98	74		

Comment: NQ drilling; 22 pieces of core; average length per piece 14.5 cm.

**CR* = *Total Core Recovery*
***RQD* = *Rock Quality Designation*

19+720	9.0 LT of proposed ℄	D+600
0	NFP BR	
19+740	3.0 LT of proposed ℄	D-1.0
0 - 280	Br Sa W Org Tr Gr	
280	NFP BR	
19+740	7.0 LT of proposed ℄	D-700
0	NFP BR	
19+740	11.0 LT of proposed ℄	D-600
0	NFP BR	
19+750	Proposed ℄	
0 - 1.0	Br Co Sa W Tr Gr, Moist, L **69SA#1 No testing required.**	
1.0	NFP BR	
19+785	7.0 LT of proposed ℄	D-1.2
0 - 1.2	Org	
1.2	NFP BR	
19+785	12.0 LT of proposed ℄	D-1.2
0 - 1.3	Org	
1.3	NFP BR	
19+800	17.0 LT of proposed ℄	D-800
0	NFP BR	
19+800	Proposed ℄	D
0	NFP BR	
19+800	17.0 RT of proposed ℄	D+2.0
0	NFP Asph	
19+825	Proposed ℄	D
0 - 1.0	Br Sa W Gr Tr Org, Sat, L	
1.0	NFP BR	
19+850	Proposed ℄	D
0	NFP BR	
19+850	17.0 LT of proposed ℄	D-1.0
0 - 100	Org	
100	NFP BR	
19+850	17.0 RT of proposed ℄	D+3.0
0	NFP Asph	
19+950	Proposed ℄	D
0	NFP BR	
19+978	Proposed ℄	D
0 - 200	Org	
200	NFP BR/RF	

19+988 20.0 LT of proposed ℄ D-100

0 - 850 Br Sa W Tr Gr, Moist, L 69SA#2
Not Accep Granular "B", Type I
69.9% Passing 300 µm
11.7% Passing 75 µm
Accep SSM
850 NFP RF/BR

19+996 Proposed ℄ D

0 - 250 Org W Sa, Moist, L
250 NFP RF/BR

20+000 20.0 LT of proposed ℄ D+2.3

0 NFP BR

20+000 20.0 RT of proposed ℄ D-200

0 - 550 Br Sa W Org, Moist, L
550 - 1.4 Br Org, Sat, L
1.4 NFP RF/BR

20+010 Proposed ℄ D

0 - 620 Br Org W Tr Sa W Blds, Moist, L
620 NFP RF/Blds

20+010 20.0 LT of proposed ℄ D+2.3

0 NFP BR

20+020 Proposed ℄ D

0 - 020 Org
020 NFP BR

20+020 11.0 LT of proposed ℄ D+400

0 - 050 Org
050 NFP BR

20+020 11.0 RT of proposed ℄ D-1.2

0 - 030 Org
030 NFP Blds/BR

20+040 Proposed ℄ D

0 - 050 Org
050 NFP BR

20+040 11.0 LT of proposed ℄ D+500

0 NFP BR

20+040 11.0 RT of proposed ℄ D-1.0

0 - 150 Org W Sa, Moist, L
150 NFP Blds/BR

20+060 Proposed ℄ D

0 - 150 Org
150 NFP BR

20+060 11.0 LT of proposed ℄ D+100

0 - 100 Org
100 NFP BR

20+060 11.0 RT of proposed ℄ D+200

0 - 020 Org
020 NFP BR