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# REPORT ON

## SUPPLEMENTAL FOUNDATIONS

## INVESTIGATION SERVICES

## HIGHWAY DISTORTIONS

**STATION 37+495 TO 37+553**
**TOWNSHIP OF PITTSBURGH, LENGTH ± 60 M**
**STATION 37+050 TO 37+175 RT**
**TOWNSHIP OF PITTSBURGH, ± 125M**

**W.P. 793-93-01**
**HIGHWAY 15 FROM 1.5 Km NORTH OF HIGHWAY 401**
**NORTHERLY 25.0 KM TO 0.3 KM SOUTH OF**
**BIG HILL ROAD AT SEELEY'S BAY**

Submitted to:

Ministry of Transportation
Eastern Region
355 Counter Street
Kingston, Ontario
K7L 5A3

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June 4, 2004

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Ministry of Transportation
Eastern Region, Geotechnical Section
355 Counter Street
Kingston, Ontario
K7L 5A3

Attention: Mr. Todd Filson

**RE: SUPPLEMENTAL FOUNDATIONS INVESTIGATION SERVICES**
**HIGHWAY 15 DISTORTIONS, W.P. 793-93-01**
**STATION 37+050 TO 37+175, TOWNSHIP OF PITTSBURGH, LENGTH ± 125 M**
**STATION 37+495 TO 37+553, TOWNSHIP OF PITTSBURGH, LENGTH ± 60 M**

Dear Sirs:

This report presents the results of a supplemental foundations subsurface investigation carried out at the above site along Highway 15 in the Township of Pittsburgh, Ontario (for location, see Key Plan on Figure 1). The purpose of the supplemental investigation was to determine the general soil and groundwater conditions at two distortions identified in the Pavement Design Report (Golder Associates Ltd report number 991-8063B) as requiring additional foundations investigation by means of a limited number of boreholes and, based on an assessment of the possible cause(s) of the distortions, to provide guidelines on the remediation treatment options for the distortions.

## BACKGROUND

The geotechnical investigation for this project identified two sections of Highway 15 that require additional foundation investigation as follows:

- Soft Ground Area No. 2 – Station ±37+050Rt. to 37+175Rt.; Township of Pittsburgh, Length ±125 m, and;
- Distortion No. 4 – Station ±37+495 to 37+553; Township of Pittsburgh, Length ± 60 m.

Soft Ground Area No.2 was pointed out by MTO maintenance. This section of highway has been an ongoing maintenance problem with settlement of the highway along the right lane. It is located on relatively flat lying terrain with swampy ground on the right side of the Highway adjacent to farmland. The highway embankment is about 2 to 2.5 metres high along the right side. There is a noticeable depressed area in the highway with pavement cracking along the right lane. Borings, put down as art of the pavement design investigation, indicate that the embankment is constructed of earth materials (sand and silty clay) with cobbles and boulders. Under the embankment about 2.1 m of muckamor was encountered in one of the borings. Probes in the swampy area, where a proposed passing lane will be added indicate about 4.4 metres of organic deposit underlain by firm silty clay to 6.5 metres depth. No bedrock was encountered at that depth. Although recent ditching has been provided along the right side of the highway to improve drainage, the ditch slopes are eroding and the culvert at Station 36+940 requires cleanout.

This section of highway is within the limits of a proposed 2.5 km long southbound passing lane between Stations 35+725 and 38+225. The proposed SB passing lane will require a major widening along the right side for a full lane and a shoulder width over the existing swampy ground. The existing highway performance is poor with noticeable settlement. The foundations investigation is required to establish the extent of organic deposit and underlying silty clay, determine if the underlying organic deposit and/or silty clay are prone to further settlement, to provide recommendations for subexcavation of the organic material and design of the new embankment. In addition, an evaluation is required to determine if the additional settlements through this section, resulting from the planned grade raise of 200 mm associated with the rehabilitation strategy, will be within acceptable limits.

Distortion No. 4 was also pointed out by MTO maintenance. The highway is built on a 2 to 3 metre high embankment with swampy ground conditions on both sides. The concrete box culvert, at Station 37+000, near this section of highway, is not functioning; On the right side the culvert is fully buried and on the left side the CSP extension is partially under water. The embankment is constructed of sandy earth material with cobbles and boulders. On the left side, the embankment it is underlain by clayey silt. On the right side of the embankment, boulders were encountered in the geotechnical investigation. The existence of organic material was not confirmed under this side of the embankment as part of the geotechnical investigation. Up to 4 metres of organics (muckamor) was encountered at the toe of the embankment in the proposed widening area for the SB passing lane.

The organic material is underlain by silty clay (CL-CI, w = 30-35 percent). The proposed SB passing lane requires a centreline shift to the Rt E/P and a major widening consisting of a full lane shift and shoulder width over the existing swampy ground. The distortion is believed to be the result of settlement of the earth embankment due to either compression of the underlying organic material and silty clay and/or lateral distortion of the embankment toe material into the adjacent organic material that forms the swamp. The foundation investigation is required to establish the

presence/extent of organic material and silty clay below the existing embankment, to determine if the underlying organic material and/or silty clay are prone to further settlement, to provide recommendations for subexcavation of the organic material and design of the new embankment. In addition, an evaluation is required to determine if the additional settlements through this section, resulting from the planned grade raise of 200 mm associated with the rehabilitation strategy, will be within acceptable limits.

## PROCEDURE

As a result of inclement weather conditions interrupting the field investigation stage, the field work for this investigation was carried out on January 7 and 8, 2004 and January 20 to 22, 2004. During the period, a total of 12 boreholes were put down at the two sites as shown on Figure 2. Six of the boreholes, number 03-1 to 03-6 inclusive, were put down to investigate Distortion No. 4 and six of the boreholes, numbered 03-7 to 03-12 inclusive, were put down to investigation Soft Ground Area No. 2. Ten of the borings were advanced using a track mounted hollow stem auger drill rig supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. Two of the boreholes, 03-11 and 03-12, were advanced using portable hand operated drilling equipment. The boreholes were advanced to depths which vary from 1.5 to 10 metres below present ground surface.

Within the boreholes, standard penetration tests were carried out at regular intervals of depth, and samples of the soils encountered were recovered using drive open sampling equipment. In situ vane testing was carried out where possible in the silty clay to determine the undrained shear strength of this soil unit. The in situ vane shear testing was carried out using a standard MTO size N vane and in accordance with MTO's Pavement Design and Practices Manual. In addition, 3 relatively undisturbed, 75 millimetre diameter thin walled Shelby tube samples of the silty clay were obtained using a fixed piston sampler. A laboratory vane was used to determine the undrained shear strength of the silty clay recovered in one of the Shelby tubes (sample 8 of borehole 03-8).

The field work was supervised by an experienced technician from our staff who located the boreholes, directed the drilling operations, logged the boreholes, took custody of the samples, and carried out the in situ testing.

The borehole locations were selected by Golder Associates personnel in relation to existing site features and pedological sketches provided in the Pavement Design Report that detail the distortion and soft ground areas.

The borehole elevations were referenced to the existing centreline elevation at Station 37+145 and Station 37+555 as provided on the contract working profiles for this contract. The elevations of these points are indicated as being 106.35 metres and 108.70 metres respectively and are understood to be referenced to Geodetic datum.

On completion of the drilling operations, samples of the soils encountered in the boreholes were transported to our laboratory for examination by the project engineer and for laboratory testing.

The groundwater levels at the site were observed in the open boreholes for the short period of time that the boreholes remained open during the field work.

## SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes are shown on the Record of Borehole sheets following the text of this report. The results of the laboratory classification testing on the soil samples are given on the Record of Borehole sheets and on Figures 5 to 7.

The results of auger borings put down at the site as part of the site investigation for the Pavement Design Report are provided in Attachment A and B for Soft Ground Area No. 2 and Distortion No. 4 respectively. In addition, the pedological sketches drawn during the geotechnical investigation for each location are provided in the respective attachments.

The locations of the boreholes and the auger borings from the geotechnical investigation report are provided on Figure 2.

The Record of Borehole sheets indicate the subsurface conditions at the test hole locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which the subsurface conditions are indicated depends on the method of boring, the frequency of sampling, the method of sampling, and the uniformity of the subsurface conditions. Subsurface conditions may vary across the site. The soil descriptions in this report are based on commonly accepted methods of classification employed in geotechnical practice. Classification and identification of soil involves judgement and Golder Associates does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties.

In general, the subsurface conditions at both of the distortion sites investigated is similar consisting of roadway pavement structure and highway embankment fill over native subsoils consisting of amorphous peat increasing in thickness towards the middle of the distortion and