

NO 2010-11018



**Foundation Investigation and
Design Report**
OR 174 Westbound Lane Widening
Overhead Sign Replacement
City of Ottawa

Delcan Corporation

Project No. 122410456

3168-237 X

3165-231



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1.0 Introduction

This report presents the results of a Foundation Investigation carried out for the replacement of an overhead sign located at approximately Station 10+222 on westbound OR 174. The replacement and relocation of the sign is occurring in conjunction with construction of an outer travel lane connecting the acceleration lane from the on-ramp leading from Blair Road to the off-ramp to Highway 417 Eastbound. This work was carried out in general accordance with our proposal submitted to Delcan on October 9, 2009.

This report has been prepared specifically and solely for the replacement of the aforementioned overhead sign. Pavement recommendations have been provided in a separate report.

2.0 Site Description and Geology

Site Location

The site location is shown on the Key Plan inset to Drawing No. 1, provided in Appendix A. It is noted that for project orientation purposes, Highway 174 will be assumed to run east-west at the overhead sign in question, with chainage increasing from west to east.

OR 174 becomes Ministry of Transportation of Ontario (MTO) Highway 417 west of approximately Station 10+226. The existing overhead sign and its proposed replacement are located within the MTO right-of-way.

General Site Description

At the location in question, OR 174 is a divided highway, with 3 lanes in the eastbound direction and 2 lanes in the westbound direction. The westbound lanes of OR 174 in the vicinity of the overhead sign consist of a rural cross section with paved shoulders and shallow ditches (see Photographs 1 and 2 in Appendix A).

Street lighting consists of high mast lighting in the median. Guide rail is located along the median side of the highway from approximately Station 10+220 to Blair Road (with a short break near Station 10+330) and along the north side near Station 10+220.

Existing Overhead Sign

The existing overhead sign is located at Station 10+222 and spans the full width of the roadway (see Photo 1 in Appendix A).

Replacement Overhead Sign

The replacement structure is to be constructed at Station 10+217 approximately 5 m to the west of the existing sign. The structure footings are to be designed as per the MTO Sign Support Manual.

Physiographic Description

Based on the Physiography of Southern Ontario by Chapman and Putnam (1984) this section of OR 174 is situated in the physiographic region known as the Ottawa Valley Clay Plains. The area consists of clay plains interrupted by ridges of rock or sand.

According to the Generalized Bedrock Geology of Ottawa-Hull, 1976, the project site is mapped within the Billings Shale Formation. The surficial geology is mapped as Till Plain. The drift thickness ranges from 3 to 5 meters.

The frost depth for this area is 1.8 m.

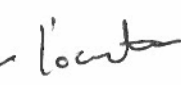
3.0 Method of Investigation

3.1 PREVIOUS INVESTIGATIONS

A Pavement Investigation for the proposed addition of a third westbound lane was carried out in January 2010. A cross-section of four (4) boreholes were drilled at Station 10+216, approximately 1 m from the proposed overhead sign location.

The boreholes carried out for the Pavement Investigation were identified by their chainage (10+216) and their offset from the construction baseline (dashed line between the existing driving and passing lanes). The boreholes were advanced with a track-mounted CME75 drill rig (off-road) and a boom-mounted power auger (on-road) employing continuous flight solid stem augers. The locations of the pavement investigation boreholes are shown on the Borehole Location Plan, Drawing No. 1 in Appendix A. A copy of the pavement borehole records is included in Appendix B for information purposes.

3.2 FOUNDATION DRILLING INVESTIGATION

The Foundation Investigation consisted of two (2) boreholes, designated BH10-1 and BH10-2, located as shown on the Borehole Location Plan, Drawing No.1 in Appendix A. 

Prior to carrying out the investigation, Stantec contacted the utility authorities to clear the borehole locations of both private and public utilities.

The field drilling program was carried out between January 18th and 20th, 2010. The boreholes were advanced using a track mount CME 75 drill rig equipped for soil and bedrock sampling. The drilling equipment was owned and operated by George Downing Estate Drilling of Hawkesbury, Ontario.

The subsurface stratigraphy encountered in each borehole was recorded in the field by Mr. Jeff Forrester, CET., an experienced Stantec Field Technologist. Split spoon samples were collected at 760 mm depth intervals. Approximately 250 mm of snow cover was on the ground at the time of the drilling investigation. The bedrock at BH10-1 was cored with NQ equipment. All samples recovered were returned to our Ottawa laboratory for detailed classification and testing.

A standpipe was installed in Borehole BH10-1 to allow for the measurement of groundwater levels. The standpipe consisted of 25 mm diameter flexible pipe. The groundwater level was measured on April 21, 2010. The water level reading is provided on the Borehole Record in Appendix B.

3.3 SURVEY

Borehole locations were established in the field by Stantec personnel relative to the supports of the existing overhead sign. The ground surface elevation at each borehole location was surveyed by Stantec personnel with reference to the geodetic elevation of the existing road as shown on plan and profile drawings.

3.4 LABORATORY TESTING

All samples were taken to our Ottawa laboratory where they were subjected to a detailed visual examination by a Geotechnical Engineer. Selected soil samples underwent a gradation analysis and moisture content testing.

Unconfined compressive strength testing was completed on selected rock core samples.

Samples remaining after testing will be placed in storage for a period of one year after issuance of the final report. After the storage period, the samples will be discarded unless we are directed otherwise by Delcan Corporation.

4.0 Subsurface Conditions

4.1 SUBSURFACE PROFILE

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided.

Four (4) Borehole Records from the concurrent Pavement Investigation for this project are in the vicinity of the proposed new overhead sign and have been included in this report for completeness. An explanation of the symbols and terms used for these Borehole Records is also included in Appendix B.

In general, the subsurface stratigraphy consists of topsoil and fill materials over a silty sand (till) deposit, overlying shale bedrock.

A Borehole Location Plan and cross-section showing the soil stratigraphy encountered within the boreholes are provided on Drawing No. 1 in Appendix A.

4.1.1 Surficial Materials

A layer of topsoil and/or rootmat was encountered at the ground surface in both foundation boreholes. The thickness of the topsoil/rootmat ranged from 75 to 100 mm.

At BH10-2 a deposit of silty sand fill was encountered. This deposit, which was 690 mm thick (base elevation 69.8 m) contained trace shale.

4.1.2 Till: Silty Sand to Silty Sand with Gravel (SM)

A till layer was observed in both boreholes beneath the surficial materials. This layer ranged from 1.7 m to 2.5 m thick, with a base elevation of between 67.3 m and 67.6 m (geodetic). SPT 'N' values generally ranged from 23 to 50 blows per 0.3 m, indicating that the deposit varies from a compact to dense state.

The results of the gradation analyses indicate that the till deposit contained 6% to 20% gravel, 44% to 50% sand and 33% to 44% fines. The results of the gradation analysis are shown on Figure 1 in Appendix B. The moisture content of the three samples tested ranged from 7% to 13% with an average of 10%.

This material is a silty sand to silty sand with gravel (SM) using the MTO Soil Classification System. Shale fragments were also observed within the till.

4.1.3 Bedrock

Shale bedrock was encountered beneath the till layer. The top of this unit ranged from 67.3 m to 67.6 m (geodetic). The top portion of the bedrock was weathered and of very poor-quality. It appeared soil-like and was able to be penetrated by split spoons.

Less weathered shale bedrock was encountered in BH10-1 starting at geodetic elevation 66.5 m. The bedrock was of very poor to poor quality, with Rock Quality Designation (RQD) values of between 0% and 54%. The unconfined compressive strength of the rock is summarized below in Table 4.1. It is noted that tests were also attempted on three other samples of rock core, however, the samples fractured during preparation prior to the test.

Table 4.1: Unconfined Compressive Strength of Rock Cores

Borehole	Depth (m)	Elevation (m)	Unconfined Compressive Strength (MPa)
BH10-01	4.4	65.0	83.1
	5.6	63.8	81.9 *

* Note: Length to diameter ratio of sample was 1.90, slightly less than 2.00 as specified in ASTM D7012.

4.2 GROUNDWATER

A standpipe was installed in BH10-01 at the completion of drilling. The groundwater level was measured to be at 67.4 m on April 21, 2010. Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.0 Discussion

5.1 PROPOSED DEVELOPMENT

It is understood that the City of Ottawa plans to replace the existing overhead sign located at Station 10+222 on OR 174 westbound to allow for the planned westbound roadway widening from 2 to 3 lanes. The new overhead sign will be located approximately 5 m west of the current sign (or at approximately Station 10+217).

5.2 SOIL SUMMARY

In general, the subsurface stratigraphy consists of topsoil/fill over silty sand till overlying weathered shale bedrock. Although bedrock was encountered at shallow depths, it is generally of very poor quality and is not considered "sound rock".

Groundwater was noted to be at approximate elevation 67.4 m at the time of the investigation. For design purposes, the groundwater level will be governed by the water level in the ditches.

6.0 Recommendations

6.1 FOUNDATIONS

It is understood that the proposed overhead sign structure will be designed in accordance with the procedures and standard details presented in the MTO Sign Support Manual.

The soil/bedrock conditions at this site are suitable for the application of a standard foundation design.

The foundations may be designed and constructed in accordance with the footing details shown on Drawing SS118-3 (copy in Appendix D). This detail is based on a single caisson supporting each end of the overhead sign. The caissons have a diameter of 1200 mm and are to extend to a depth of 5 m below the design frost depth. Note 8 in the General Notes, allows for the footing depth to be reduced where sound rock is encountered at a depth of less than 5 m below the frost depth. The shale bedrock identified at this site is not considered sound rock for the purposes of General Notes 8, therefore, the footing depth should be the standard 5.0 m plus the frost depth (1.8 m) for a total depth below finished grade of 6.8 m.

For design purposes, the following geotechnical model may be applied if required.

Elevation	Soil/Rock Condition	Total Unit Weight (kN/m ³)	Angle of Initial Friction	Unconfined Compressive Strength (kPa)
70.0 – 67.3	Glacial Till	21.0	34°	0
67.3 – 63.0	Weathered Bedrock	24.0	42°	0

Note: The geotechnical design treats the weathered and very poor quality shale as a dense soil, due to the ease of penetration observed at Borehole BH10-2.

The geotechnical design also requires that the water table be assumed to be at ground surface.

6.2 CONSTRUCTION RECOMMENDATIONS

Caissons for high mast pole foundations should be carried out in accordance with OPSS 915 Construction Specification for Sign Support structures and OPSS 903 Construction Specifications for Deep Foundations.

Open holes drilled within the existing fill and till are likely to undergo some cave in, particularly if left open for extended time or during periods of precipitation. The need for a steel casing within the overburden should be assumed. Open drill holes within the shale bedrock are expected to remain open.

Rock sockets can be constructed using a number of different drilling techniques including coring techniques, churn drilling or percussion drilling. All three methods are feasible in the rock conditions encountered at the pole locations. In addition, due to the weathered nature and poor quality of the upper shale bedrock, some penetration into the bedrock by augering is expected to be possible.

Caisson drill holes that extend below the water level within till soils, fill materials and very severely fractured to severely fractured bedrock may be difficult to completely dewater. Where the drill hole cannot be completely dewatered using a sump pump inserted to the base of the hole, water should be left in the holes and the concrete should be placed using tremie techniques.

7.0 Closure

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete.

A soil investigation is a limited sampling of a site. The conclusions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information and its effects on the above recommendations.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

This report has been prepared by Laura Bostwick and Paul Carnaffan and reviewed by Fred Griffiths. A technical review has been carried out by Raymond Haché, M.Sc., P.Eng.

Respectfully submitted,

STANTEC CONSULTING LTD.

Laura Bostwick, M.Sc.Eng., E.I.T.

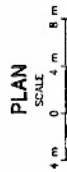
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Associate

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Principal

APPENDIX A

Drawing No. 1 – Borehole Location Plan
Site Photographs

METRIC



OR 174 WESTBOUND
STA TO STA
BOREHOLE LOCATIONS & SOIL STRATA

 Bore Hole

	Flow / min	(Std Dev)	Test	475 J/min
+				

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

No	ELEVATION	NIM ZONE 9		COORDINATES EAST
		NORTH	EAST	
10-1	68.42	5 032 223.2	373 955.1	
10-2	70.55	5 032 200.0	373 971.9	

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

[illegible]



Photo No. 1: View of existing overhead sign looking west.



Photo No. 2: Drilling BH10-1.

APPENDIX B

Symbols and Terms Used on Borehole and Test Pit Records	
Borehole Records	
Explanation of Terms Pavement Investigation Borehole Records	
Pavement Investigation Borehole Records	
Laboratory Test Results	

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200



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ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

Terminology describing rock strength:

Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.



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STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel



Sand



Silt



Clay



Organics



Asphalt



Concrete



Fill



Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT



measured in standpipe,
piezometer, or well



inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)



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	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

DATUM _____ Geodetic

STAN-GE0 122410455 - OR HWY 174 WESTBOUND WIDENING GPJ SMART GDT 4/23/10

CLIENT Delcan Corporation BOREHOLE No. BH10-2
 LOCATION OR 174 Westbound, Blair Rd to Hwy 417, Ottawa, ON PROJECT No. 122410456
 DATES: BORING January 20, 2010 WATER LEVEL _____ DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES				UNDRAINED SHEAR STRENGTH - kPa									
					TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD	<div style="display: flex; justify-content: space-between; width: 100%;"> 50 100 150 200 W_p W W_L </div> <div style="display: flex; justify-content: space-between; width: 100%;"> 10 20 30 40 50 60 70 80 90 </div>									
0	70.55								WATER CONTENT & ATTERBERG LIMITS DYNAMIC PENETRATION TEST, BLOWS/0.3m STANDARD PENETRATION TEST, BLOWS/0.3m									
0	70.5	75 mm TOPSOIL			SS	1	420	6	<div style="display: flex; justify-content: space-between;"> ● </div>									
	69.8	Silty sand, occasional shale fragments, dark brown (FILL)																
1		Silty sand (SM), compact to dense, brown (TILL)			SS	2	610	23	<div style="display: flex; justify-content: space-between;"> ○ </div>									
	68.7				SS	3	610	39	<div style="display: flex; justify-content: space-between;"> ● </div>									
2		Silty sand with gravel (SM), shale fragments, dense, grey to dark grey (TILL)			SS	4	610	50	<div style="display: flex; justify-content: space-between;"> ○ </div>									
	67.3				SS	5	610	110	<div style="display: flex; justify-content: space-between;"> ● </div>									
4		Black SHALE BEDROCK -Very poor quality, weathered			SS	6	610	36	<div style="display: flex; justify-content: space-between;"> ○ </div>									
5					SS	7	610	44	<div style="display: flex; justify-content: space-between;"> ● </div>									
	64.4				SS	8	610	78	<div style="display: flex; justify-content: space-between;"> ● </div>									
6		End of Borehole			SS	9	75	50/75mm										
7																		
8																		
9																		
10																		

▽ Inferred Groundwater Level

▽ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa App'd _____

▲ Pocket Penetrometer Test, kPa Date _____

Accep	acceptable	Gry	grey	Quant	quantity
Agg	aggregate	H	heavy	Reinf	reinforced
Amor	amorphous	Hi	highly	RF	rock fill
Asph	asphalt	HM	hot mix	RSS	remoulded shear strength
BH	borehole	HP	high plasticity	Sa (y)	sand (y)
Bl	blue	Ip	plasticity index	Sat	saturated
Bld (y)	boulder (y)	L	loose	SH	shale
Blds	boulders	Liq	liquid	Sh Rk	shot rock
Blk	black	Lo	loam	Si (y)	silt (y)
Br	brown	Lt	light	Sl (y)	slight (ly)
BR	bedrock	Matl	material	SP	slight plasticity
BU	break up	Max	maximum	SSM	select subgrade material
CF	channel face	MDD	maximum dry density	St	sensitivity
Cl (y)	clay (ey)	Med	medium	Stn (y)	stone (y)
Co	coarse	Mod	moderate	Stks	streaks
Cob	cobbles	Mott	mottled	Surf	surface
Comp	compact	MP	medium plasticity	Temp	temperature
Conc	concrete	Mrl	marl	TH	test hole
Contam	contaminated	Mul	mulch	TP	test pit
Cord	corduroy	MWD	maximum wet density	Tps	topsoil
Cr	crushed	NFP	no further progress (boulders)	Tr	trace
D	dense	NFP (bids)	no further progress (boulders)	Unreinf	unreinforced
Decomp	decomposed	Num	numerous	USS	undisturbed shear strength
Dk	dark	Ob	overburden	Varv	varved
Dr	relative density	Occ	occasional	VF	very fine
E	earth	Ora	orange	w	field moisture content
F	fine	Org	organic	W	with
FB	frost boil	Org M	organic matter	WL	liquid limit
FH	frost heave	Pavt	pavement	Wd (y)	wood (y)
Fib	fibrous	Pedo	pedological	Weath	weathered
Fr Wat	free water	Pen Mac	penetration macadam	Wopt	optimum moisture content
Gr (y)	gravel (ly)	Poss	possible	Wp	plastic limit
Gran	granular	PST	prime and surface treated	WT	water table
Grn	green	Psty	polystyrene	Yel	yellow

SUSCEPTIBILITY TO FROST HEAVING		ONTARIO PROVINCIAL STANDARD DRAWING		Nov 2006	Rev 1	
HSFH - High		ABBREVIATIONS GEOTECHNICAL		---	---	
MSFH - Medium				---	---	
LSFH - Low						OPSD 100.060

**OR 174 Westbound Lane Widening
Pavement Borehole Records**

**Project No. 122410456
Page 1 of 1**

Note : B/L = Construction Baseline (dashed line
between driving and passing lanes)

All elevations measured relative to existing
OR 174 WBL crown

10+216		12.8 LT B/L	D - 1.3 m
0	-	100	Tps
100	-	1.8	Dk Gry Sa some Si Tr Gr some SH Till
10+216		9.2 LT B/L	D - 0.3 m
0	-	90	Dk Br Tps
90	-	460	Gry Cr Gr(y) Sa some Si (BS-11)
460	-	1.5	Br Gr(y) Sa some Si (BS-12)
10+216		7.5 LT B/L	D - 0.0 m
0	-	130	Asph
130	-	450	Gry Cr Gr(y) Sa some Si
450	-	1.5	Br Gr(y) Sa some Si
10+216		5.4 LT B/L	D - 0.0 m
0	-	110	Asph
110	-	440	Gry Cr Gr(y) Sa some Si (BS-13)
440	-	590	Br Sa Tr Si Tr Gr (BS-14)
590	-	710	Dk Br to Blk Cl(y) Si (BS-15)
710	-	1.5	Br Si(y) Sa Tr Gr (BS-16)
10+216		3.3 LT B/L	D - 0.0 m
0	-	90	Asph
90	-	260	Conc
260	-	510	Gry Cr Gr(y) Sa some Si (BS-59)
510	-	670	Br Sa Tr Si Tr Gr (BS-60)
670	-	1.35	Br Cl(y) Sa W Si Tr Gr (BS-61)
			w = 18%
			% Gr = 6
			% Sa = 37
			% Si = 23
			% Cl = 34
1.35	-	NFP	Blds

Unified Soil Classification System

CLAY & SILT		SAND			Gravel	
		Fine	Medium	Coarse	Fine	Coarse

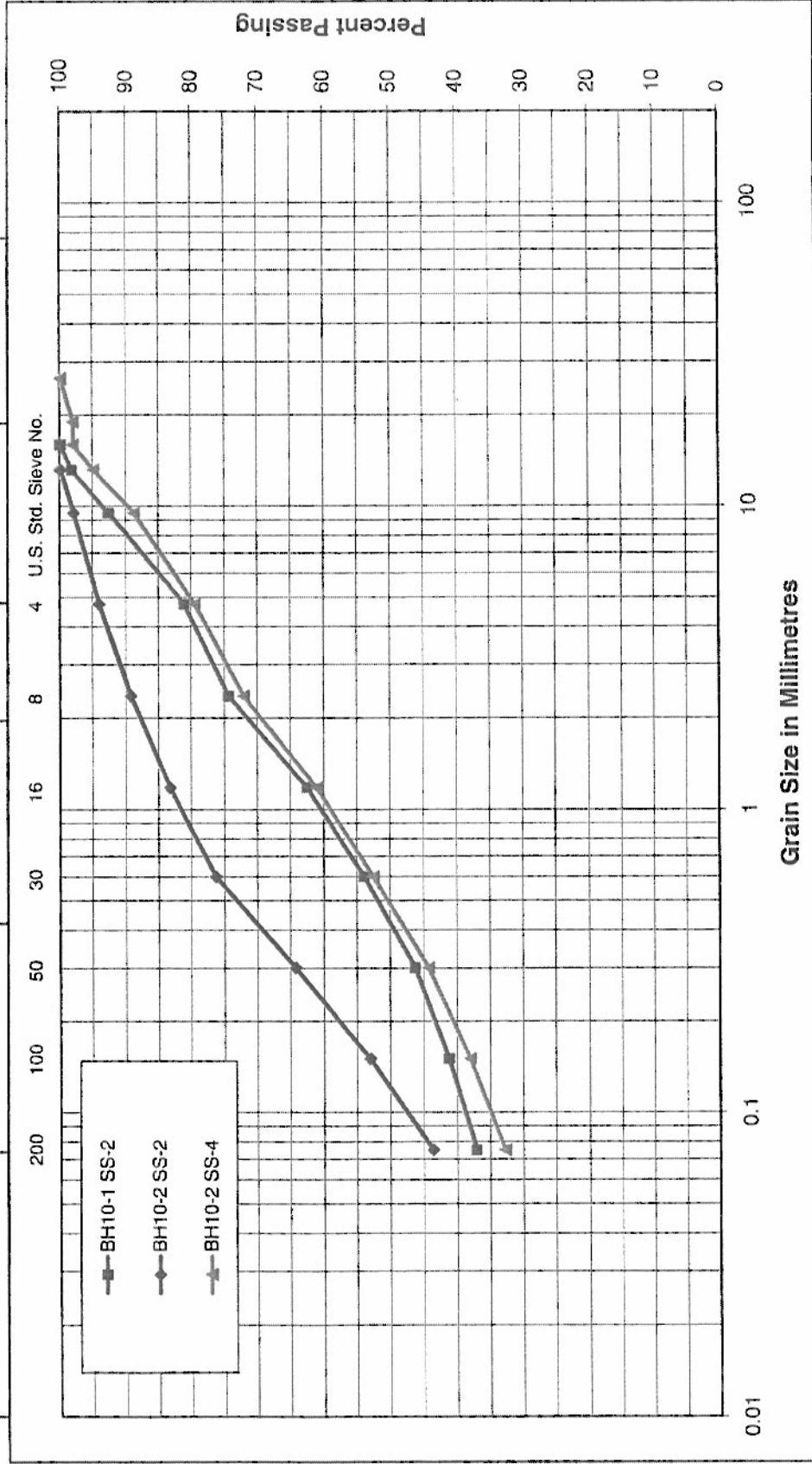


Figure No. 1

Project No. 122410456

GRAIN SIZE DISTRIBUTION

TILL - Silty Sand to Silty Sand with Gravel



Stantec

APPENDIX C

Rock Core Logs
Rock Core Photographs



2781 Lancaster Road, Suite 200
Ottawa, ON K1B 1A7
Tel: (613) 738-0708 Fax: (613) 738-0721

Field Core Log

Stantec

Client:

Delcan Corporation

Project:

OR 174 Overhead Sign Replacement

Contractor:

George Downing Estate Drilling

Project No.:

122410456

Date:

March 9, 2010

Borehole No.:

BH10-1

Logger:

Laura Bostwick

DEPTH FROM	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	
2.9	5	78%	0%	3.7	Black SHALE Bedrock	-	S	1	B	F	VC	SP	-	-	
3.7	6	92%	54%	5.1	Black SHALE Bedrock	S	S	1	B	F	VC	SP	-	-	
5.1	7	97%	30%	6.7	Black SHALE Bedrock	S	U	1	B	F	VC	SP	-	-	

STRENGTH (MPa)
EH = Extremely Strong = > 250
VS = Very Strong = 100-250
S = Strong = 50-100
MS = Medium Strong = 25-50
W = Weak = 5 - 25

WEATHERING
U = Unweathered = No Signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-like

DISCONTINUITY TYPE
B = Bedding Joint
J = Cross Joint
F = Fault
S = Shear Plane

SPACING
VW = Very Wide = >3m
W = Wide = 1-3 m
M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ORIENTATION
F = Flat = 0-20°
D = Dipping = 20-50°
V = n-Vertical = >50°

ROUGHNESS
RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
LU = Slickensided Undulating
LP = Slickensided Planar

FILLING
T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay



Photo No. 1: Bedrock core from borehole BH10-01 (2.9 m to 5.1 m)

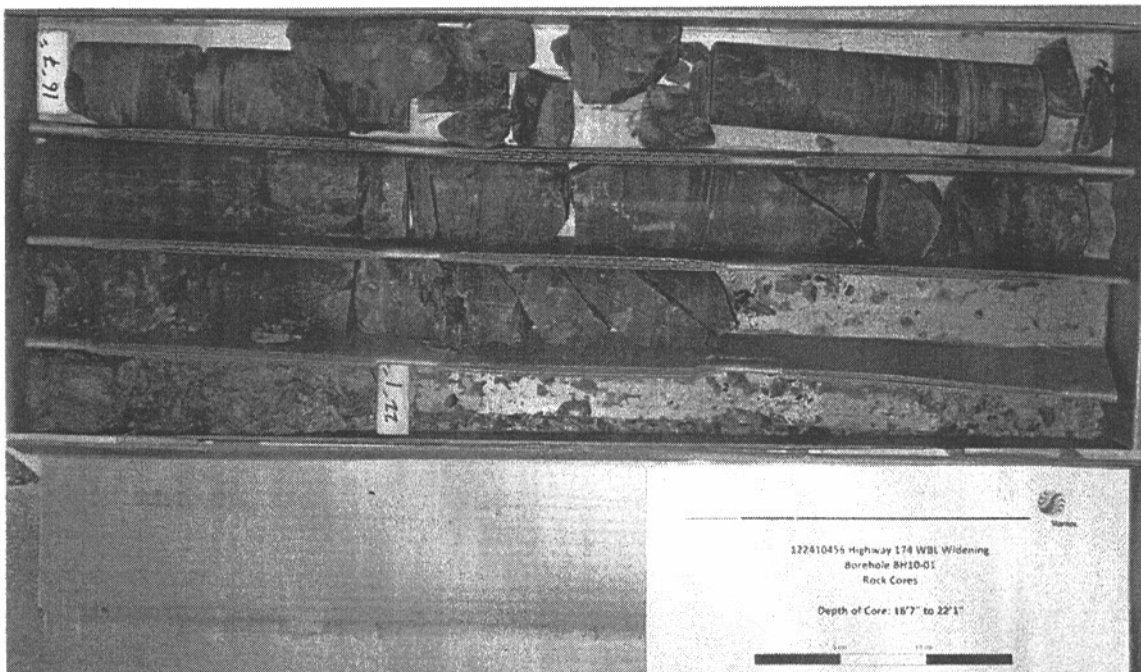


Photo No. 2: Bedrock core from borehole BH10-01 (5.1 m to 6.7 m)

APPENDIX D

Standard Footing Detail – SS118-3

