

MINISTRY OF HIGHWAYS, ONTARIO
MEMORANDUM

To: Mr. E. R. Saint,
Regional Materials Engineer,
Regional Office,
North Bay, Ontario.

From: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention:

Date: November 4, 1968

Our File Ref:

In Reply To: NOV-5-1968

Subject:

FOUNDATION INVESTIGATION REPORT

Proposed Sec. E. #560 Realignment
Twp. of Dack - Dist. of Timiskaming
Lot #2 - Concession VI
District #14 (New Liskeard)
W.J. 68-F-61-2 -- W.P. 144-67-01

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your present requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/MdeF

Attach.

cc: Messrs. E. R. Saint (2)
E. A. Tregaskes
D. W. Farren
E. McArthur
D.A.O. White
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Sec. Hwy. #560 Realignment
Twp. of Duck - Dist. of Timiskaming
Lot #2 - Concession VI
District #14 (New Liskeard)
W.J. 68-P-61-2 -- W.P. 144-67-01

1. INTRODUCTION:

A request for a foundation investigation at the proposed Sec. Hwy. #560 Realignment from Hwy. #11 at Englehart westerly to Charlton, was received from Mr. E. R. Saint, Regional Materials Engineer, in a memorandum, dated July 2, 1968.

A field investigation was subsequently carried out by the Foundation Section to determine the subsoil conditions existing at the site. This report contains the results of this investigation and our recommendations pertaining to the stability of the proposed embankment.

2. DESCRIPTION OF THE SITE:

The site is located approx. 1/2 mile north of Englehart and extends westerly to Charlton from Hwy. #11. The surrounding area is flat and swampy at the immediate vicinity and is covered with scrub brush.

Physiographically, the site lies in a plain covered by glacial Lake Barlow. This lake resulted in the deposition of lacustrine materials to varying depths over the underlying bedrock. Four different deposits can be recognized:

Varved Calcareous Clay
Calcareous Clay
Calcareous Silt
Silty Clay

cont'd. /2 ...

12 -
2. DESCRIPTION OF THE SITE: (cont'd.) ...

The steeply rolling topography was caused by stream erosion. The run-off is very rapid and the internal drainage is very slow.

Large deposits of organic materials are also characteristic of this region.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of five boreholes and eleven dynamic cone penetration tests was carried out during the course of the field investigation (B.H.'s #1 - 11). Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. In addition to this, shallow holes were dug along the centre-line using a hand shovel to determine the depth of the surficial muck deposit (B.H.'s #12 - 16). During the field work, disturbed and 'undisturbed' samples were obtained. 'Undisturbed' samples were recovered using 2-inch I.D. Shelby tubes which were pushed into the soil by hand. Disturbed samples were recovered by means of a standard split-spoon sampler, and the energy used in driving it, conformed to the requirements of the Standard Penetration Test. Dynamic cone penetration tests were carried out adjacent to each borehole and at six other locations. Driving energy to advance the cone was 350 ft. lbs. per blow. In-situ vane tests were carried out, wherever possible, at elevations 12 inches below the various sample depths. The boreholes were surveyed in the field by personnel from District #14, New Liskeard.

The locations and elevations of all boreholes are shown on the attached Drawing #68-P-61-2A.

Samples were visually examined and classified at the site as well as in the laboratory. Tests were carried out in the laboratory to determine the following physical properties:

cont'd. /3 ...

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES: (cont'd.)

Atterberg Limits
Organic Content
Moisture Content
Undrained Shear Strength
Grain-Size Distribution
Bulk Density
Consolidation Characteristics

The test results are summarized on the Record of Borehole Sheets in the Appendix of this report.

4. SOIL TYPES AND SOIL CONDITIONS:

4.1) General:

The subsoil at the site consists of about three different deposits, namely: muck, silty clay to clay, and silt. The boundaries of the different deposits are shown on the accompanying Record of Borehole sheets. The estimated stratigraphical profile shown on Dwg. No. 68-F-61-2A, is based upon this information. It should be pointed out that the given soil boundary may vary between boreholes. From ground level downwards, the various soil types are as follows:

4.2) Muck:

This deposit was observed in all boreholes, and extends from ground level to a minimum depth of 2.5 ft. The thickness varies from 2.5 ft. to 7.2 ft. It is possible that the observed thickness may differ to a great extent at other locations. The material in the deposit consists mainly of black-coloured decayed and undecayed organic substances. The consistency may be described as very soft. The organic content was found to range from 42% to 82%. The moisture content was found to be as high as 483%.

cont'd. /4 ...

4. SOIL TYPE AND SOIL COMPOSITIONS: (cont'd.) ...4.3. Silty Clay to Clay:

This stratum underlies the surficial muck deposit in all borings. The lower boundary was not determined, since the borings were terminated in this zone, but extends to a minimum depth of 43 ft. Within this deposit an extensive silt stratum was encountered between El. 641 - El. 649 and El. 624 - El. 637. References should be made for proper boundary elevations listed on the Borehole Record sheets. For practical purposes, this report refers to the two zones of the silty clay to clay deposit as upper and lower zones.

The material in the deposit is predominantly a mixture of clay and silt with traces of sand and occasional pockets of thin layers of silt. A plot of Plasticity Index versus Liquid Limit (Fig. 1) shows the great majority of the points to fall within the CI and CH range.

Physical properties of the material (lower and upper), as determined from field and laboratory tests, are as follows:

Natural Moisture Content (%)	32 to 65
Liquid Limit (%)	35 to 67
Plastic Limit (%)	17 to 27
Bulk Density (PCF)	99 to 117

<u>Shear Strength (PSF)</u>	<u>Upper Zone</u>		<u>Lower Zone</u>	
	<u>Range</u>	<u>Average</u>	<u>Range</u>	<u>Average</u>
Unconfined Comp.	36 to 250	150 (7)	203 to 630	430 (10)
Undrained Triaxial	68 to 394	200 (9)	285 to 610	438 (8)
Lab. Vane	129 to 206	169 (6)	112 to 630	387 (5)
Field Vane	80 to 320	156 (11)	400 to 680	520 (11)

The figure in bracket beside the average shear strength values indicates the number of tests carried out for that type of testing.

cont'd. /5 ...

4. SAND, SILT AND SOIL CONDITIONS: (cont'd.) ...

4.3. Silty Clay to Clay: (cont'd.)

Typical grain-size distribution curves are included in the Appendix of this report.

Based on the shear strength determinations, the consistency of the upper zone may be described as very soft to soft and of the lower zone, as soft to firm. Consolidation tests indicate that this material is slightly overconsolidated with an average preconsolidation pressure of 0.6 TSF.

4.4. Silt:

This deposit was found between the upper and lower zones of the silty clay to clay stratum. For boundary elevations reference should be made to the Borehole Record sheets contained in the Appendix. The thickness varies from 11.5 ft. to 19 ft.

The material in the deposit is mainly silt with traces of sand and clay, and also, layers of clayey silt at irregular intervals. In general, the thickness of the silt layers were found to range from 0.5" to 0.75", and the clayey silt layers were of the order of 0.25". The silt material exhibited slight plasticity. The relative density may be described as loose to compact. Physical properties are listed on the Record of Borehole sheets. In order to estimate the effective parameters with a fair accuracy, a consolidated undrained triaxial test was carried out on a selected sample. The following test results were obtained:

$$\sigma'_1 = 30.3^{\circ}$$

$$\sigma'_3 = 0$$

cont'd. /6 ...

5. ARTESIAN CONDITIONS:

The following water levels were observed in the boreholes.

B.H. #2	3.2 ft. below ground level	El: 651.5
B.H. #4	0.6 ft. " " "	El: 660.9
B.H. #7	At ground level	El: 665.3
B.H. #11	1.2 ft. below ground level	El: 665.2

No artesian water conditions were encountered during the course of investigation.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct Hwy. #560 on a new line, Line 'B', from Hwy. #11 to some 3000 ft. westerly. The new junction with Hwy. #11 is located some 1 mile north of the existing junction. The new line crosses a swampy area immediately west of Hwy. #11: it is this area which lies between Stations 0+00 and 12+00, which was investigated and which is discussed here.

The new highway will be built, according to available information, with a maximum profile grade about 5 feet above existing ground level. As can be seen from the previous paragraphs of this report, subsoil consists of very soft organic deposits overlying very soft to soft, clay to silty clay overlying loose to compact silt. The depth of the soft deposits ranges from 15 to 17 feet which includes the organic deposit of thickness 4 to 8 ft.

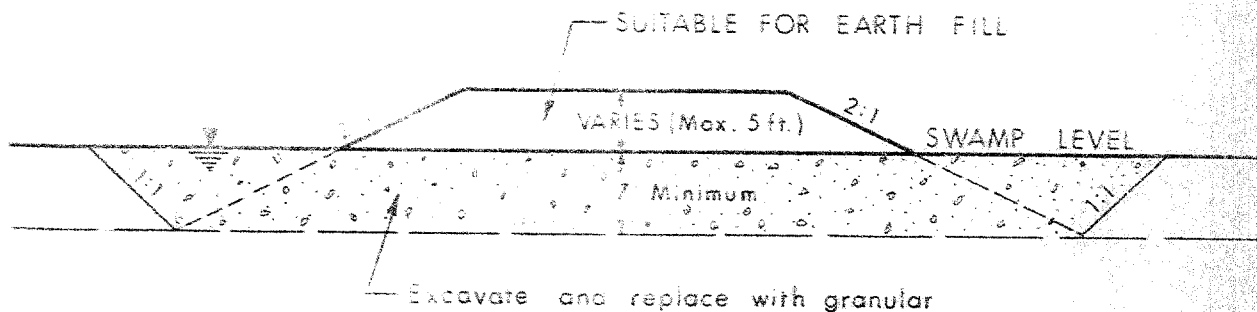
It should be stated from the outset that this proposed swamp crossing should be avoided if at all possible, since problems of stability, settlements and high construction costs are inevitable. If, however, no reasonable alternative exists, three methods of treatment are suggested. These are:

cont'd. /7 ...

6. CONCLUSIONS AND RECOMMENDATIONS: (cont'd.) ...

(1) Excavation of Soft Material:

This method requires that all soft material be removed down to a minimum depth of 7 ft. and replaced with suitable granular fill. If organic soil is found below this depth, it must also be removed. The width of excavation should be as shown in the diagram below. Stability analyses, in terms of total stresses, have been carried out which show the safety factor to be satisfactory in this case. Future settlements are likely to be in the order of 8 to 12 inches over a long-term period. If paving is delayed for one year, future settlements will probably be less than 6 inches. This method may prove to be the most costly, but from a performance point of view, it should be the most satisfactory.



TYPE SECTION THROUGH EMBANKMENT

cont'd. /8 ...

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

(1) Extrusion of Soft Material: (cont'd.) ...

As an alternative to using granular fill in the swamp, it has been suggested by the Regional Materials Engineer, that the use of clay fill be considered. This method has been used on swamp crossings in the Cochrane area on Hwy. #11, apparently with success. In the present case, provided that an average undrained shear strength of about 750 p.s.f. can be achieved for the clay backfill, the embankment would be satisfactory from a stability point of view. The method of placing the clay fill should be to advance a dike of material forward with a bulldozer, constantly filling and compacting, in relatively dry conditions, the low area thus formed behind the dike. In this way only the front face of the advancing dike becomes saturated due to contact with water. Insofar as future performance is concerned, it is believed that this type of backfill will be inferior to the granular, though undoubtedly initially much cheaper. Paving should be delayed for at least one year.

(2) Partial Removal of Soft Material by Displacement:

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

cont'd. /9 ...

6. DISCUSSION OF RECOMMENDATIONS: (cont'd.) ...

Construction on a Floating Mat:

This method requires that a lightweight mat made up of bundles of brush or a layer of sawdust or perhaps both, be placed on the surface of the swamp followed by sufficient fill material to force the lightweight mat below the groundwater level. In this case, the effective weight of the fill will be small and little displacement of the underlying peat will occur. Settlement, however, will occur and may continue for a long period. It is estimated that about 3 ft. of sawdust would be sufficient to support about 2 ft. of fill initially, but additional support would be provided by the underlying peat layers as compression takes place. It would be necessary to observe the performance of the embankment for a period of at least one year before a decision as to final paving could be made. A temporary drainage, however, could be provided meantime. The method of construction on a floating mat has been tried at other locations in the Province with some success, although the long-term performances have not yet been evaluated. In this particular case, in view of the possible savings which might be effected, it would be worthwhile to construct a small test section at the same time.

7. MISCELLANEOUS:

The field work was carried out during the period July 31 to August 7, 1966. Equipment used was owned and operated by Canadian Logging Limited.

The supervision of the field work, together with the preparation of this report, was carried out by Mr. P. Payer, Project Foundation Engineer. The report was reviewed by Mr. A. G. Selby, Supervising Foundation Engineer.

November 7, 1966

APPENDIX I.

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

[illegible]

COMPANYWIDE OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO 3

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOA 68-F-61-2

LOCATION

Sta. 2 + 95 0

ORIGINATED BY

43

W P 144-67-01

BORING DATE

August 1, 1968

COMPILED BY

pp

DATUM Geodetic

BOREHOLE TYPE

Cone Test only

CHECKED BY

[illegible]

RECORD OF DEBATE NO. 2

1998, 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, 26

MATERIALS & TESTING DIVISION

108 62-7-61-2

Sta. 5 + 00 L.S. Rt.

Trial	Control	MCI	AD
1	95	85	75
2	95	85	75
3	95	80	70
4	95	78	68
5	95	75	65

NY 100-114-67-01

20840000 August 1 & 2, 1968

1. *Journal of the American Medical Association*, 2000; 284: 2551-2555.

Geodetic DATUM:

Washbore - HK Casing

11.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 68-F-61-2

LOCATION Sta. 5 + 00 51' Lt. of g

ORIGINATED BY _____ PP _____

W P 144-67-01

BORING DATE August 2, 1968

COMPILED BY _____ NB

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY _____

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _P WATER CONTENT _____ W _p		BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P S F	W _p ————— W _L WATER CONTENT %			
659.5	Ground Level										
0.0											
619.5											
40.0	End of Cone Test										
DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT											

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 68-F-61-2

LOCATION Sta. 7 + 02 13' Rt. of \emptyset

ORIGINATED BY PP

W P 144-67-01

BORING DATE August 2, 1968

COMPILED BY _____ VB

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— % Plastic Limit ——— % Water Content ——— %	BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SNEAR STRENGTH P S F + Field Vane	WATER CONTENT % 20 40 60		
664.4	Ground Level						25 50 75 100 125			
0.0	Muck Organic material. Black		1	TW	PM	660				
657.2			2	SS	L		+ 1.0			
7.2			3	SS	-		+ 2.0			0 1 64 35
						650				
						640				
						630				
624.4							End of cone test			
40.0	End of Borehole									

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE NO. 7

CONSTRUCTION SECTION

MATERIALS & TESTING DIVISION

JOB 65-7-51-2

LOCATION Sta. 6+50 Spt. 1st. 92.3

PREPARED BY

W.P. 111-47-01

BORING DATE August 6, 1961

SAMPLED BY

CATUM Geodetic

BOREHOLE TYPE Cast Iron - 1 1/2" Casing

CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		WATER CONTENT		REMARKS
ELEV. DEPTH	DESCRIPTION	SIRAT PLOT	NUMBER	TYPE	BL. SWS./FOOT	25	50	
665.3	Ground Level					25	50	
0.0	Muck					25	50	
660.1	Organic material Very soft.		1	SS	2			
5.2	Clay to silty clay with trace of sand & occ. pockets of silt. Very soft.		2	TW	PM			
			3	TW	PM			
			4	TW	PM			
			5	TW	PM			
648.1	Gray							
17.2	Silt with traces of clay & sand. Layers of clayey silt. Loose to compact.		6	TW	PM			
			7	TW	PM			
			8	TW	PM			
629.3			9	TW	PM			
36.0	Silty clay to clay with traces of sand.							
622.3	Soft.		10	TW	PM			
43.0	End of Borehole							

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

108 68-F-61-2

LOCATION

Sta. 8 + 50 50' Rt. of ϕ

ORIGINATED BY

pp

144-57-01

BORING DATE

August 6, 1968

COMPILED BY

14

DATUM Geodetic

BORE HOLE TYPE

Diamond Drill

CHECKED BY

[illegible]

CHECKED BY _____

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT _____ WL PLASTIC LIMIT _____ WP WATER CONTENT _____ W		BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH PSF	WP ———— W ———— WL ———— ———— WATER CONTENT %			
665.9	Ground Level.										
0.0											
625.9											
40.0	End of Cone Test										

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

208 68-F-61-2

LOCATION Sta. 11 + 3/4 20' Lt. of Ø

ORIGINATED BY WB

144-57-01

BORING DATE August 7, 1968

COMPILED BY _____ NB

DAYUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY _____

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 68-P-61-2

LOCATION Sta. 11 + 45 50' Rt. of 0

ORIGINATED BY WB

W P 111-67-01

BORING DATE August 7, 1968

COMPILED BY WB

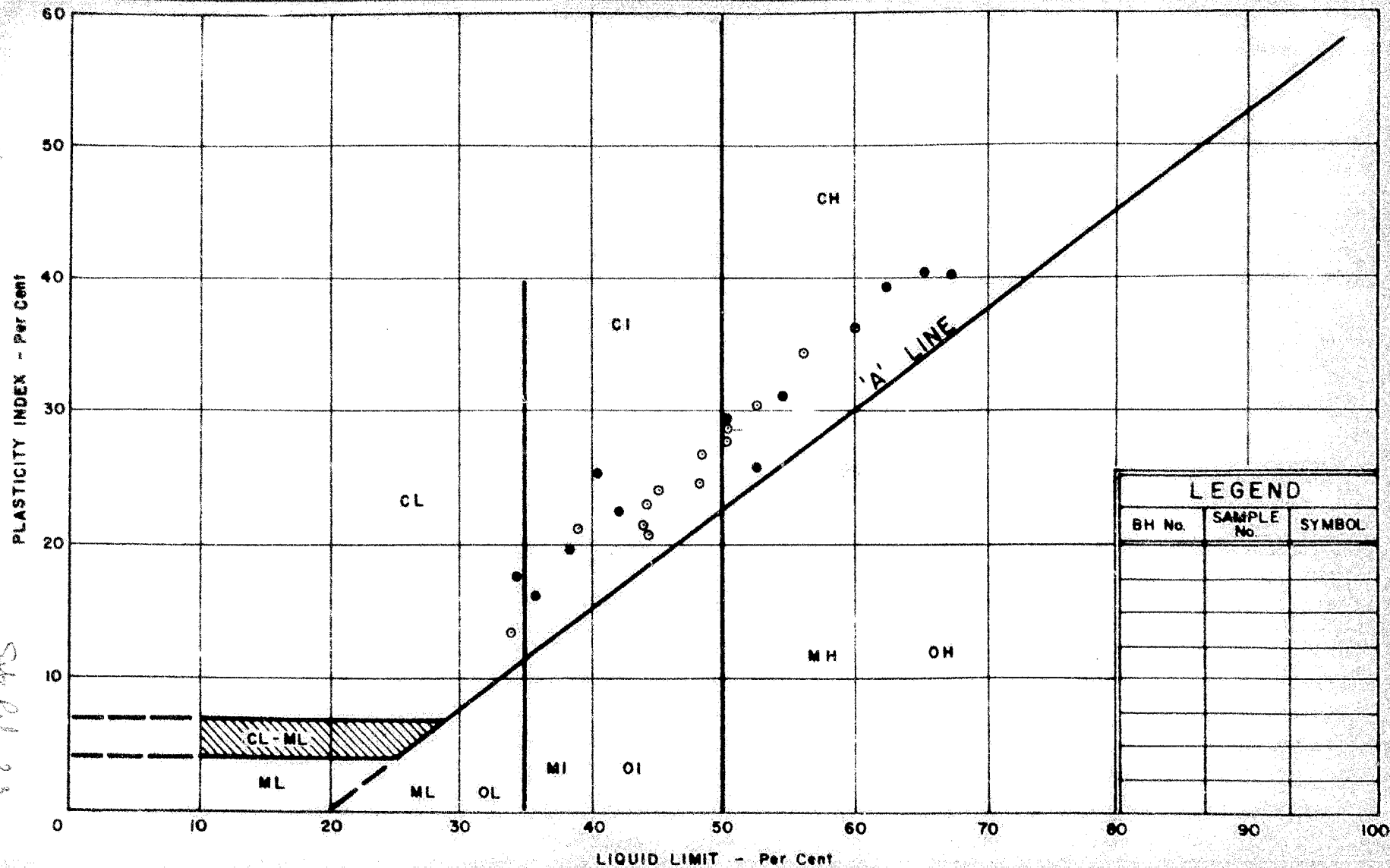
DATUM Geodetic

BOREHOLE TYPE Washbore NX Casing

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		25	50	75	100	125	WP	WL	W		
666.4	Ground Level														
0.0	Muck														
	Organic material		1	SS	2										
659.9	Dark Brown to Black		2	SS	2										
6.5	Clay to silty clay with occ. pockets of silt and organic material.		3	TW	PM										
	Very soft to soft.		4	TW	PM										
648.9	Grey.		5	TW	PM										
17.5	Silt with trace of clay and layers of clayey silt.		6	TW	PM										
	Loose to compact.		7	TW	PM										
637.4	Grey		8	TW	PM										
29.0	Clay to silty clay with occ. layers of silt & clayey silt.		9	TW	PM										
	Soft to firm.		10	TW	PM										
623.4	Grey														
13.0	End of Borehole														

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT



5/27/23



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

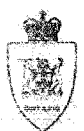
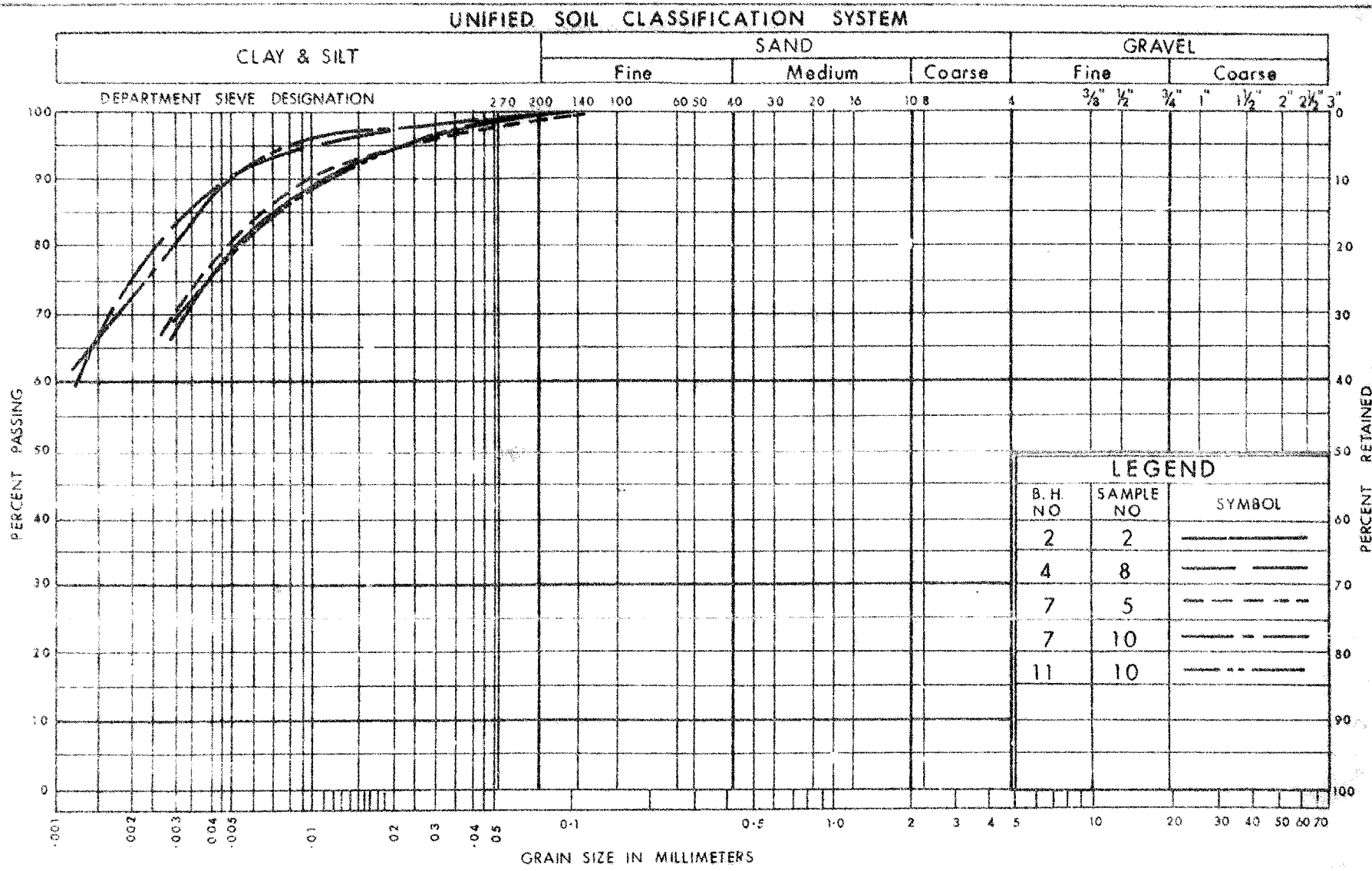
SILTY CLAY TO CLAY ○ UPPER ZONE
● LOWER ZONE

W.P. No. 144-67-01

JOB No. 68-F-61-2

FIG. No. 1

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT



DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

GRAIN SIZE DISTRIBUTION

SILTY CLAY TO CLAY

W.P. No. 144 - 67 - 01

JOB No. 68 - F - 61 - 2

FIG. 2

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF B'OWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

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

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

SS	SPLIT SPOON	T W	THINWALL OPEN
WS	WASHED SAMPLE	T P	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	OS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PH	SAMPLE ADVANCED HYDRAULICALLY	
	PM	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Qu	UNCONFINED COMPRESSION	LV	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	FV	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
Q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
C_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

NOTE

MARCH 19th. 1968.

DISCUSSION WITH JOHN CURTIS

SINCE IT APPEARS THAT NO BRIDGE SITE INVESTIGATION IS PLANNED FOR THIS AREA IN THE NEAR FUTURE IT WOULD BE GOOD IF SOMEONE FROM THE REGIONAL MATERIALS ENG. OFFICE WOULD GO TO THE SITE AND TRY TO DEFINE THE SUBSOIL CONDITIONS. EVEN THE USE OF THE PEAT SAMPLES COULD BE SUFFICIENT. THIS WAS AGREED UPON.

JOHN CURTIS WILL THEN ADVISE US OF THE RESULTS AND WE WILL EITHER FILE THE LETTER & PLANS AND CONSIDER IT A CLOSED CASE OR WE WILL ORGANISE A PROPER INVESTIGATION.

AKS

RE: ENGLEHART RIVER BRIDGE ON HWY 560
APPROX. 1.5 MILES EAST OF CHARLTON
W.P. 114-64 (GRADING); B.S. 47-31

1958 MAR 26 AM 9:46

00077

DOWN MRAR 2 MAR 26/58 9.36A

MR A G STERNAC PRINC FOUNDATIONS ENGR LAR BLDG

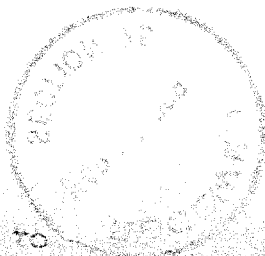
RE: ENGLEHART RIVER ON HWY. 560 EAST OF CHARLTON

DISTRICT 14. BRIDGE SITE 47-31

FURTHER TO OUR RECENT TELEPHONE DISCUSSION REGARDING THE EMBANKMENT INVESTIGATION IN THE VICINITY OF THE ABOVE BRIDGE I WISH TO INFORM YOU THAT I HAVE MADE ARRANGEMENTS WITH THE REGIONAL SURVEYS PEOPLE TO MAKE SOUNDINGS IN THE VICINITY OF THE ABUTMENTS. SHOULD THESE SOUNDINGS INDICATE THAT A FURTHER INVESTIGATION IS REQUIRED I WILL POSSIBLY CONTACT THE REGIONAL SOILS PEOPLE AND REQUEST A HAND AUGER SURVEY. IT IS MY UNDERSTANDING THAT YOU WILL NOT HAVE A FOUNDATION CREW IN THE AREA IN THE FORESEEABLE FUTURE.

J B CURTIS BRIDGE PLANNING

BA



DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

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MEMORANDUM

To: Mr. A. G. Stermac
Principal Foundations Engineer
Lab Building, Downsview

FROM: Bridge Planning Section
Northern Region

DATE: February 8, 1968

OUR FILE REF.


IN REPLY TO

SUBJECT:

Englehart River Bridge on Highway 560
approximately 1.5 miles east of Charlton
W. P. 144-67-1 (Grading); B. S. 47-31

Attached find a copy of a memorandum to file regarding the condition of the above structure as determined in a bridge inspection on February 6, 1968. As mentioned in the memorandum the bridge drawing, No. D2787, for this structure indicates that the river bank consists of rock or shallow clay over rock in the vicinity of the approach spans. Considering the apparent nature of the structure failure, as described in the memorandum, I am rather suspect of this assessment of the river banks. I wonder if you would be good enough to make arrangements to have your crew, or possibly the Regional Soils crew, make some borings to further establish exactly what type of soil is to be found at this location. There is no scheduled date as far as the Foundations Section is concerned for this crossing so it will likely be most convenient and economical for you to do this at a time when there is another investigation in the area.

I will make arrangements with our head office to forward to you a print of the first drawing, as mentioned, in order that you might locate your borings appropriately.



J. B. Curtis
Regional Bridge Location Engineer

MEMORANDUM

To: FILE

FROM: Bridge Planning Section
Northern Region

DATE: February 7, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

Englehart River Bridge on Highway 560
approximately $1\frac{1}{2}$ miles east of Charlton
Bridge Site 47-31

As a result of a request from Mr. B. A. Schoales of the Regional Functional Planning Section, I inspected the above noted bridge on February 6, 1968. The following are my comments regarding the condition and structural aspects of the bridge:

1. Both abutments (especially the westerly one) have pushed forward and are bearing directly on the end trusses.
2. As a result of the above the western most pier has cracked at the top of the heavy section at the bearing of the centre heavy truss; i. e. the end truss has pushed forward toward the centre of the bridge with the result that the column supporting the bearing of the small truss has cracked.
3. The bottom chord of the north west small truss has kinked slightly as a result of the abutment bearing against it.
4. The top chord of the small truss being a rather heavy section has resisted any bending tendencies and, as a result, the abutments have cracked to some degree in that there is less resistance on the bottom chord of the small truss.
5. The existing deck and structural steel would be considered to be in good shape.
6. Immediate remedial action, possibly by the addition of end spans, would alleviate the situation with a resultant guarantee of structure life in the order of 20 to 25 years.
7. As there is no recorded history of the movement of the abutments of the existing bridge it is impossible to determine how long it will be before the structure fails to a significant degree.

Cont'd. ...

8. Due to snow and ice on the bridge deck no assessment has been made of the pavement and curbs, however, some deterioration of the curbs can be seen on the exterior of the bridge.

The Englehart River in the vicinity of the bridge has not frozen thus the centre span has been inspected by standing in the vicinity of the piers. No deterioration was visible in the centre span however.

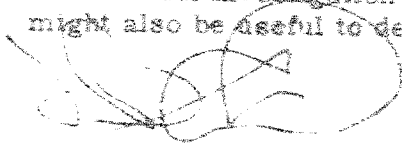
Because of the depth of snow in the vicinity of the bridge no assessment can be made of the ground from a point of view of soil failure. The wing wall on the south west side, however, has no dirt under it. This may be as a result of soil failure or possibly merely a result of erosion.

Drawing No. D2787 which appears to be the structural drawings for this bridge, indicates the presence of rock or shallow clay over rock on the banks of the river in the vicinity of the approach spans. If this is the case presumably some remedial action by the removal of the clay behind the abutments might alleviate further settlement problems in the abutments. It would appear, however, from these drawings that the abutment footings are on bedrock. These soundings or probes however could be very suspect.

On reviewing the bridge inspection reports made by the Bridge Maintenance Section there has been mention from time to time of the lack of room for expansion in the forward settlement of the abutments. At no time, however, has any mention been made of the buckling lower north west chord. The buckling here is very slight and may merely have been overlooked, however, on the other hand, there is a possibility that the settlement is now becoming more significant and the buckling has resulted from the settlement.

A detailed inspection of this structure might be warranted by the Bridge Maintenance staff once the snow has disappeared in the spring of 1965. At that time an assessment can better be made of the settlement problems.

An investigation by the Materials and Research Foundation Section might also be useful to determine the underlying stratum of the river banks.



J. B. Curtis
Regional Bridge Location Engineer

c.c. Mr. E. Schoales
Mr. W. Birch
Mr. A. G. Stermac
Mr. D. A. O. White

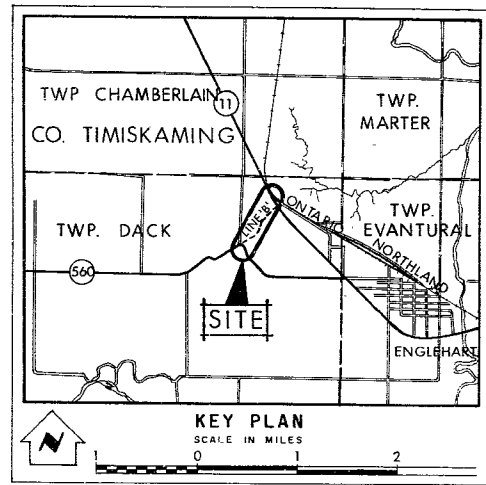
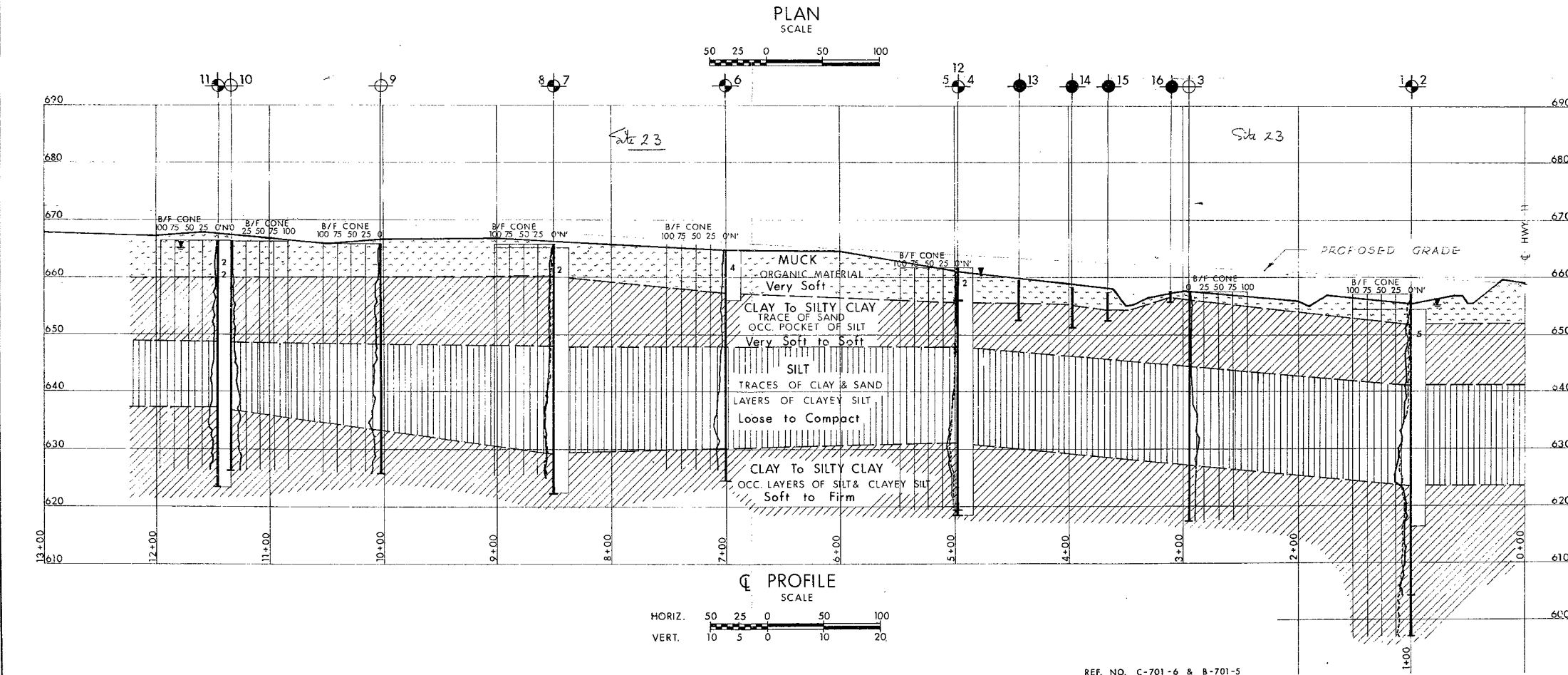
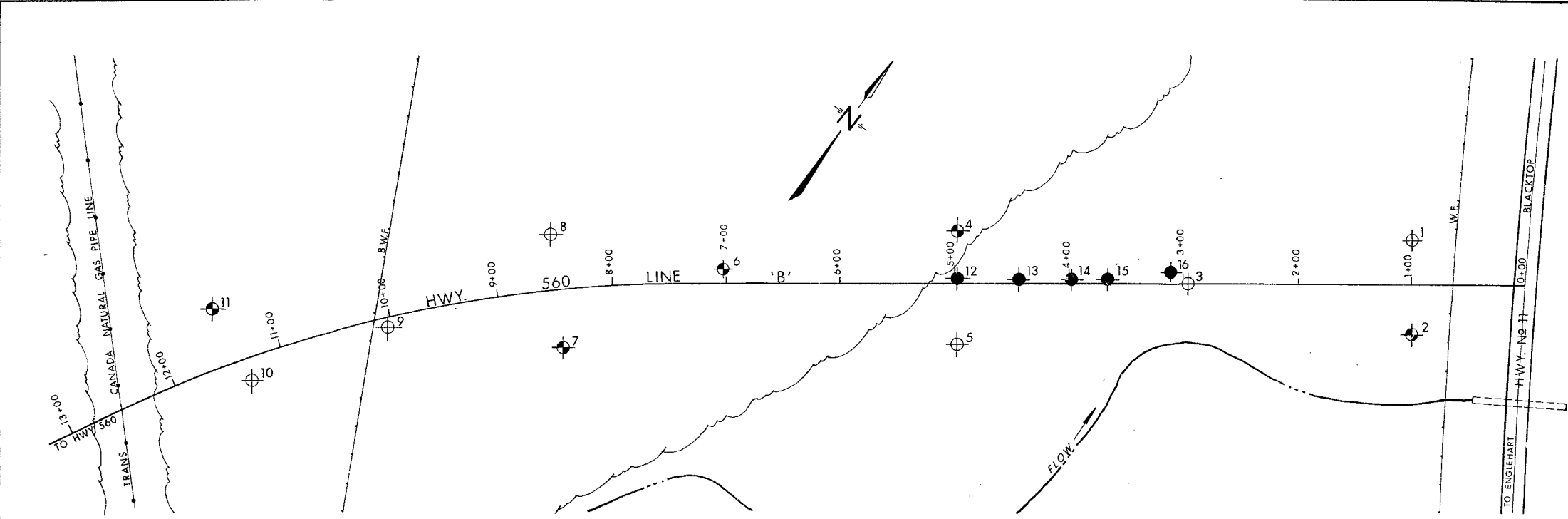
68-F-61-2

W.P. # 144-67-01

HWY. # 560

LOT # 2 LINE 'B'
, CON. VI

DACK TWP.



- LEGEND**
- Bore Hole
 - ⊕ Cone Penetration Hole
 - ⊕ Bore & Cone Penetration Hole
 - Water Levels established at time of field investigation, AUG. 1968.

NO.	ELEVATION	STATION	OFFSET
1	657.1	1+00	40' RT.
2	654.7	1+00	42' LT.
3	657.2	2+95	6
4	661.5	5+00	48' RT.
5	659.5	5+00	51' LT.
6	664.4	7+02	13' RT.
7	665.3	8+50	50' LT.
8	665.9	8+50	50' RT.
9	665.9	10+02	8' LT.
10	666.2	11+34	20' LT.
11	666.4	11+45	50' RT.
12	660.8	5+00	5' RT.
13	659.6	4+45	4' RT.
14	658.3	4+00	4' RT.
15	657.3	3+69	4' RT.
16	657.5	3+12	10' 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 and may be subject to considerable error.

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

LINE 'B' INVESTIGATION

KING'S HIGHWAY NO. 560 LINE 'B' DIST. NO. 14
CO. TIMISKAMING
TWP. DACK COR. VI

BORE HOLE LOCATIONS SOIL STRATA

SUBMD. P.P.	CHECKED	W.P. NO. 144	M.B.T. DRAWING NO.
DRAWN D.M.	CHECKED	JOB NO. 68-F-61-2	68-F-61-2A
DATE SEPT. 12 / 68	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. J. Thomas</i>	CONT. NO.		

PRINT RECORD		
NO	FOR	DATE