

Dist. 28-9.

Mr. L. E. Walker,
District Engineer,
Ottawa, Ontario.

September 15, 1961.

SUBSOIL INVESTIGATION - D.H.O

W.J. 61-F-88.

Materials & Research Section,

(Foundations Office)

Re: -- ROAD FILL MOVEMENTS --
Sta. 386+40 to Sta. 392+00,
Hwy. #17, Near Cobden, Dist. #9.

At the request of Mr. L. E. Walker, District Engineer, Ottawa, and Mr. J. E. Gruspier, Regional Soils Engineer, Kingston, this Section has carried out a subsoil investigation in order to determine the causes for the movements that have occurred on Highway 17 between Sta. 386+40 and Sta. 392+00.

The field investigation was carried out in two stages - i.e. - in August 1960 and a year later, in August 1961. During the first field investigation, boreholes 1, 2 and 3 were completed, and during the second investigation, two additional boreholes No's 4 & 5 were carried out. The borehole locations are shown on Drawing No. 61-F-88A.

In all boreholes, conventional wash boring procedures were followed using a small core drill adapted for soil sampling. Disturbed samples were recovered at 2 to 3-ft. intervals in carrying out the Standard Penetration Test. In the cohesive strata, undisturbed samples were recovered with the Osterberg sampler, using

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2" I.D. thin-walled tubes. Wherever possible, in-situ vane tests were carried out in order to determine the shear strength. Representative samples were tested to determine the properties of the subsoil. The results of some of these tests, as well as two cross sections showing the estimated subsoil stratigraphy are shown on Drawing No. 61-F-88A.

As mentioned earlier, the movements occurred between Sta. 386+40 and Sta. 392+00, and they were still visible during the second stage of the field investigation in August 1961. Within this section, a distinct crack near the centre line of the pavement, was clearly distinguishable. Beyond Sta. 388+80, this crack continued along the shoulder to the west end of the swamp to approximately Sta. 392+00. At the time of the field investigation in August 1961, differential settlements of the pavement in the order of 12 inches, could be observed in some places. Some lateral movements could also be evidenced by sighting along the guard rail line and the fence line 60 ft. to the right of centre line. At a point near Sta. 387+25, the fence line has been shifted laterally for a distance of approximately 18 inches.

At Sta. 388+65, a 48" C.I.P. is located. The culvert is not functioning at present, because its north end has settled so much that it is now below the existing ground level.

The cross sections at which the four out of five boreholes were drilled, are presented on Drawing No. 61-F-88A. The presented stratigraphy shows the variable depth to which the original subsoil was either excavated or displaced and replaced by fill material. Underlying the fill material is a layer of very soft silt with a high content of calcium carbonate in the form of small shells (marl).

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In places, this layer was found to be disturbed, as evidenced by the presence of mucky material which was originally overlying the marl. Being very soft, the material has a low shear strength and is highly compressible.

Bulk density and undrained shear strength measurements in the marl material under the 26-ft. high fill, carried out during the 1960 field investigation, produced values of 92 lb./cu.ft. and 565 lb./sq.ft., respectively. During the 1961 field investigation those values, under the 36-ft. high fill, were 95 lb./cu.ft. and 785 lb./sq.ft., respectively, while at the location of B.H.'s. 3 & 5 where the fill was not as high, lower values were determined in 1960 and 1961, respectively. All this indicates that the material has consolidated under the superimposed fill load and, consequently, its bulk density and undrained shear strength have increased.

On the basis of the above given information, data and the established subsoil stratification, as presented on Drawing No. 61-F-88A, the conclusion has been reached that the described movements were mostly due to rather rapid consolidation of the soft underlying marl layer, resulting in differential settlements of the fill. Due partly to the ground topography, and partly to the uneven displacement of the soft layer, the movements have occurred on the northern half of the road. It is believed that the lateral movements are the result of some lateral consolidation of the soft layer due to the above reasons, rather than the result of a circular or shear block failure.

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On the basis of the afore-mentioned conclusion, no radical remedial measure can be recommended, but to pad the settled portion with granular material, thus bringing the road to the required design grade and maintain the road surface. Any surcharging that would increase the rate of consolidation of the soft layer and thus shorten the time to equilibrium, could easily result in a shear failure and therefore, has to be discarded.

Since the existing 48" C.I.P. is not functioning, it should be replaced. It is recommended that the new culvert be placed on a compacted granular pad extending for the full width and length of the culvert, and should be 2 ft. thick. It is suggested that the existing C.I.P. be excavated, salvaged and if not damaged, rebuilt.

September 1961.

REPORT PREPARED BY:

..... *R. J. Salvas*
R. J. Salvas,
PROJECT FOUNDATION ENGINEER

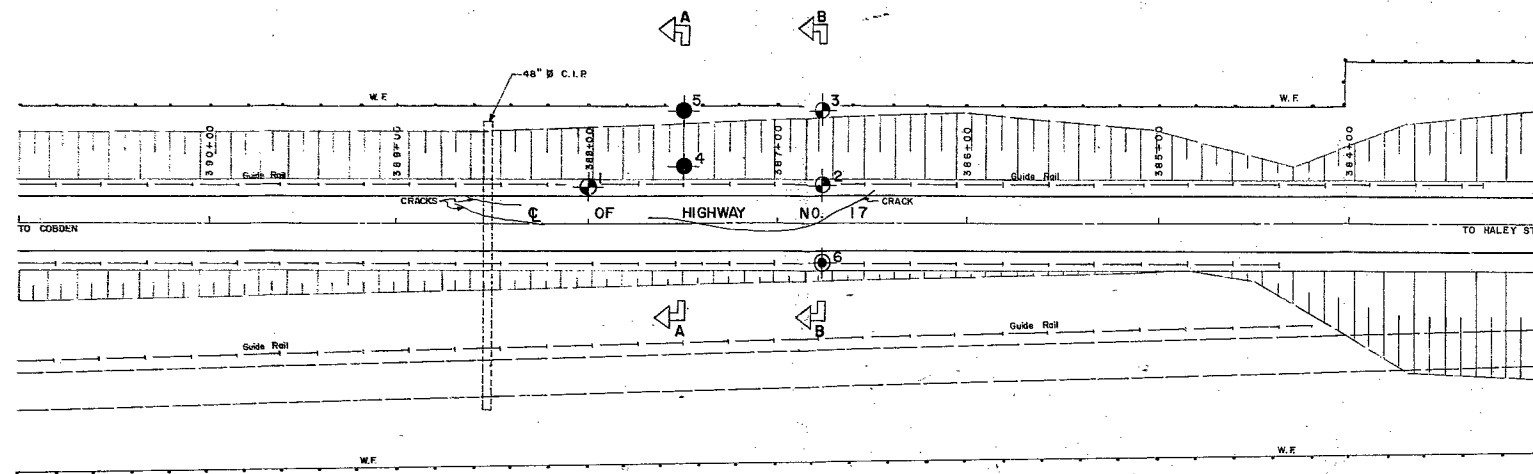
REPORT APPROVED BY:

..... *M. Devata*
M. Devata,
SR. PROJECT FOUNDATION ENGR.

cc: Messrs. -

C. A. Wrong
J. E. Gruspier
Foundations Office
Gen. Files.

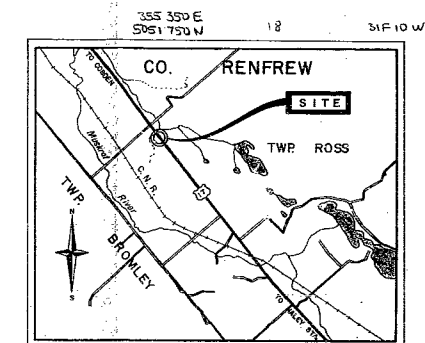
61-F-88
Hwy # 17
ROAD FILL
MOVEMENTS
NEAR COBDEN



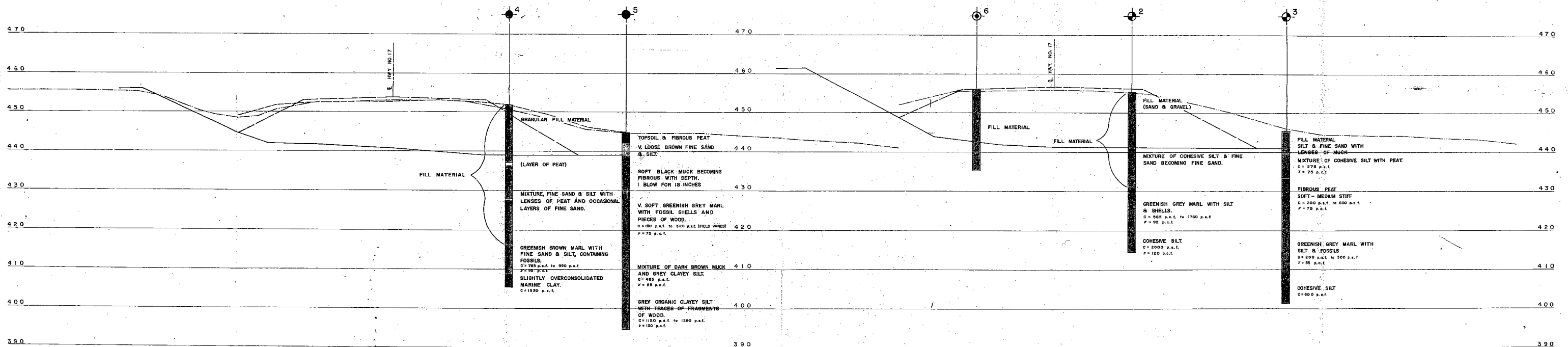
PLAN
SCALE: 1 in. = 40 ft.

LEGEND			
	BORE HOLE		
	BORE & PENETRATION HOLE		
	AUGER HOLE		
	AS CONSTRUCTED		
	ORIGINAL GROUND		
	AT TIME OF INVESTIGATION 1960		
	AT TIME OF INVESTIGATION 1961		

HOLE	ELEVATION	STATION	OFFSET
1	456.0	388+00	20' RT.
2	456.0	386+75	20' RT.
3	445.0	386+75	60' RT.
4	451.4	387+50	30' RT.
5	444.7	387+50	60' RT.
6	456.0	386+75	20' LT.



KEY PLAN
SCALE: 1 inch = 0.8 miles



SECTION A - A
STATION 387+50
SCALE: 1 in. = 10 ft.

SECTION B - B
STATION 386+75
SCALE: 1 in. = 10 ft.

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & RESEARCH SECTION			
ROAD FILL MOVEMENTS			
STA. 386+40 TO STA. 392+00			
HIGHWAY NO. 17, NEAR COBDEN.			
ORIGINATED R. J. SALVAS	DISTRICT NO. 9	DATE 19 SEPT. 1961	
DRAWN D. MUMFORD	W.P. NO. CONTRACT 58-28	JOB NO. 61-F-88	
CHECKED <i>[Signature]</i>	SCALE	DRAWING NO.	
APPROVED <i>[Signature]</i>	AS SHOWN		61-F-88A