

GEOCREST No. _____

DIST. 9 REGION _____W.P. No. 502-93-00

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 17LOCATION Hwy 17 - Slope & Shoulder
 Failures ; Top of CumberlandNo of PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____REMARKS: _____



Ministry
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FILE No. _____ DATE _____

REMARKS _____

Dave - Marathon

Navan Patrol (613) 824-1291
#2

MEMORANDUM



To: B. Ruck
Head, Geotechnical Section
Eastern Region

Date: 1994 10 12

Attn: S. Morris.
PDEO

From: Foundation Design Section
Room 315, Central Bldg.
Downsview

Tel: 235-3731
Fax: 235-5240

Re: Slope Instability - Hwy 17 (approximately
0.5 km west of Regional Rd. 35)
Twp of Cumberland
W.P. 502-93-00
District 9, Ottawa

As requested in your memorandum dated September 12, 1994, our office has examined the slope stability concerns at the above mentioned site. An investigation procedure was carried out and consisted of (1) a review of historical data and foundation reports in the area (2) a site visit conducted on September 28, 1994 and (3) fieldwork that involved the advancement of one borehole at the site. The results of the investigation and recommended remedial measures to restore the slopes at the site are provided in this memorandum.

INVESTIGATION PROCEDURE

SITE INSPECTION

Station 19+470 to 19+485 (North Side)

The most current slope instability at the site exists immediately east of the existing rigid frame box culvert on the north side of Hwy 17. The slip surface spans a horizontal distance of approximately 15 m from the centre-line of the box culvert as revealed by tension cracks and sliding masses of earth. The sliding mass appears to extend for a distance of approximately 12 m measured along the slope. Slope movement appears to have been restricted to the upper portion of the slope, extending from the crest of the slope to a distance down the slope coplanar with the existing overhead hydro lines and a large coniferous tree-line.

The upper slope surface that has experienced the sliding movement is covered with grass and sparse tall shrubs. The lower slope surface beyond the sliding mass is covered with a denser population of trees. The slope is approximately 2H:1V. There was no evidence of toe erosion at the site.

The sliding masses appear to be surficial and shallow in depth. In addition, there appear to be multiple masses which seems to suggest that perhaps the slide may have occurred in separate sequential stages. The surficial slide appears to have taken place at the grass-topsoil and fill interface.

The culvert outlet contains two one-level gabion baskets extending approximately 3 metres in length on either side of the culvert. The culvert itself shows no signs of structure distress and appears to be found on bedrock which is exposed at the culvert outlet.

Station 19+475 - (South Side)

It appears that some rockfill has been placed at this location to remedy a possible previous surficial instability. The rock fill chosen does not appear to be of good quality and the rock has degraded and slaked as a result of weathering. In addition, the rockfill does not extend to the toe of the slope and hence earth is exposed at the toe. The slopes on the south side of Hwy 17 appear steeper than on the north side and are estimated as 1.5H:1V.

FIELD INVESTIGATION

One borehole was advanced at the roadway shoulder surface at Station 19+477, 5.1 m north of the centre-line of Hwy 17. The borehole was advanced using a truck-mounted drilling unit employing hollow stem augering techniques. Subsoil samples were generally retrieved at 0.76 m and 1.5 m intervals in accordance with the Standard Penetration Test (ASTM D1586). In-situ vane tests were also conducted using the standard MTO vane to determine undrained shear strengths of the soil. The groundwater level was measured in the open borehole.

SUBSURFACE CONDITIONS

At the site, approximately 9.6 m of embankment fill was encountered consisting of a surficial thickness of 1.7 m of brown, compact sand, some silt, underlain by approximately 7.9 m of a cohesive mottled, unstructured grey-red clayey silt to silty clay with minor random traces of organics and occasional zones of silty sand. The clayey silt to silty clay material has a stiff to very stiff consistency based on undrained shear strengths of 80 kPa and greater and "N" values ranging from 9 blows/0.3 m to 16 blows/0.3 m.

The embankment fill material is underlain by a thin native stratum of a grey very stiff silty clay of approximately 1.8 m thickness. The silty clay stratum is in turn underlain by a very dense heterogeneous mixture of silt, sand and gravel of glacial till origin. The thickness of the glacial till was not verified but it is inferred from observed auger refusal that the glacial till is of approximately 0.5 m and underlain by bedrock.

The groundwater table was determined at a depth 10.6 below the ground surface.

DISCUSSION AND RECOMMENDATIONS

The embankment instabilities on both the north and south sides of the Hwy 17, immediately east of the existing culvert were investigated. Remedial measures to restore the slopes are given below. Although, either slope is not in immediate danger of failure, retrogressive surficial failures can result, if the slopes are not restored.

The instabilities are surficial failures characterized by plane translational type of sliding of estimated 0.3 to 0.6 m thickness. The slippage on the north side appears to have occurred at the topsoil-embankment fill interface.

The embankment fills are relatively high and in the order of magnitude of 6-9 metres within the site area. Embankment slopes range from 1.5H:1V on the south side to approximately 2H:1V on the north side. Hence, the combination of high embankment slopes and steep slopes can contribute to internal slope instabilities. It is generally recommended that to avoid internal surficial instabilities, earth embankments be constructed at 2H:1V, for fill lengths up to 8 metres. For fills exceeding 8 metres, the embankment fills be constructed with a midheight 2 metre berm. It is recommended therefore that the performance of these slopes be routinely monitored because of the height and steepness of the slopes.

The borehole advanced at the site confirms that global instabilities are not a concern at the site.

Station 19+470 to 19+485 (North Side)

It is recommended that the slope be restored as follows:

- (1) Remove surficial sliding mass. The thickness of the sliding mass is estimated as 0.3 to 0.5 m. The existing tree cover and roots present within the lower stable portion of the slope shall not be disturbed.
- (2) Replace the excavated material with 600 mm rockfill placed at 1.25H:1V or flatter. The rockfill shall be rip rap or gabion stone as specified in OPSS 1004.5.06.01.

Station 19+475

It is recommended that additional rockfill as specified above be positioned at the toe of the exposed slope as underpinning for the existing rockfill, and to prevent potential toe erosion.

If you have any questions regarding the above comments, please do not hesitate to contact this office.



T. Sangiuliano, P. Eng.
Foundation Engineer
for
P. Payer, P. Eng.
Sr. Foundation Engineer

memorandum



TO: Brian Ruck
Head, Geotechnical Section,
Eastern Region.

DATE: Sept 11, 94

FROM: Stan Morris
Pavement Design & Evaluation Officer
Geotechnical Section
Eastern Region

(613) 545-4814

4-1 7-0

RE: Shoulder & Slope Failures at Sta 19+475, Twp of Cumberland.
WP 502-93-00, Hwy. 17 From Reg Rd # 37 to Rockland, Dist 9, Ottawa

THE BACKGROUND

The Region is proposing to widen Highway 17 from two to four lanes in this area. The Geotechnical Section is currently examining the high fills for slope stability problems and investigations were carried out throughout the 20 km length of this project.

SHOULDER & SLOPE FAILURES

In mid August 94 a failure occurred in the shoulder at the top of a 8m fill over a box culvert on the Ottawa River side of Hwy 17 (Sta 19+475 It). Further investigation revealed a small slope failure on the other side of the fill in an area which appeared to have been previously stabilised with rock over-fill. (See attached photos). The District is monitoring the area and no treatment has taken place.

THE SOILS CONDITIONS AT FAILURES

Borings acquired during investigations for WP 502-93-00 (attached) revealed a 6.0m fill consisting of Hot Mix over 200mm of gravel on 1.2 m of Brown Silty Sand. The rest of the fill consisted of a mainly of moist clay materials. The material at the base of the fill (OG) consisted of soft to firm clay.

CONSIDERATIONS

Shoulder Slippage at sta 19+475 Lt. Twp Cumberland.

- i) The shoulder failure involves a surficial slippage of wet clays over the moist underlying clays in the 6m - 8m fill. (see photos taken August 17/94)
- ii) Photos taken Sept7/94 indicate that the shoulder slippage has progressed slightly since the initial investigation on August 17/94.
- iii) The lower portion of the slope below the shoulder slippage is treed, with a small water course at the 30m ROW limit. The private property here appears to be well maintained (Mown & Treed).
- iv) Stabilisation treatment will be complicated by the treed slope, the height and steepness of the slope, the watercourse at the base, and the slippage underway.

9

Rock Stabilisation Slippage at sta 19+475 Rt. Twp Cumberland.

- i) This slope failure involved a surficial slippage of a rock overlay and the underlying clays. (see photos). The presence of the rock overlay (slope stabilisation) indicates a possible history of failures in this area.
- ii) The poor performance of the existing slope stabilisation was probably caused by the shallow depth of rock placed (+300mm).

ACTIONS ON SLOPE FAILURE PROBLEM.

- 1) The District will continue to monitor the situation at this site and measure slope movement.
- 2) Geotechnical will acquire more background data on this site.
 - i) Survey Request is being ordered for x-sections at 20m intervals and 30m width.
 - ii) A historic survey of slope failures here is being prepared by Remote Sensing.
 - iii) Foundation information may be available for the 54m long box culvert at this site.
 - iv) Contract books, soils profiles and reports are being reviewed for background info.
 - v) More borings will be taken in the fills, on the slopes and in the O.G. at the base of the slopes to further define the soils in this area.
- 3) If slope slippage further undermines the guide-rail or driving portion of the shoulder, emergency work should be carried out. This could consist of using a hi-hoe excavator to remove as much of the slumping clay as possible and replacing it with rock keyed into the slope. This would stabilize the shoulder and guide-rail until further work could be done.

GENERAL CONSIDERATIONS

The instability of the clay fill here has important implications for the widening of Hwy 17 to be done under WP 502-93-00. Due to the shortage of more suitable borrow materials, the new widenings will likely be built of the same materials as the existing fills. Therefore the resolution of the stability problems in this fill could have wider implications for WP 502-93-00.

To address these concerns the following measures should be considered.

- 1) The Regional Aggregates unit should be consulted for their input on the type of borrow materials available for use in the fill areas widened under WP 502-93-00.
- 2) The Foundations Section should be consulted because their experience and equipment could provide valuable insight into treatment of this type of problem.
- 3) The Regional Remote Sensing unit should be consulted for historic information on slope failures throughout WP 502-93-00.

A handwritten signature in black ink, reading "Stan Morris". The signature is written in a cursive, flowing style with a large, prominent "M".

Stan Morris

17+970 6 m Rt of C.L. PA
0.0 - 80.0mm RAP
80.0- 310.0mm Gry Cr Gr
310.- 1.2 m Br Si Sa
1.2 - 2.0 m Br Si Cl (d+s)
2.0 - 2.3 m Gry Si Sa
2.3 - 3.8 m Gry Si Cl (m+f)
3.8 - 4.0 m Gry Si Cl (s+w)
4.0 - 4.8 m Gry Sa Cl w Gr (s+w)
4.8 - 5.4 m Gry Si Cl (m+f)
5.4 - 5.8 m Gry Si Cl (s+w)

18+875 6 m Rt of C.L. PA (1.5fll)
0.0 - 60.0mm RAP
60.0- 200.0mm Gry Cr Gr
200.- 1.8 m Br Si Sa
1.8 - 2.8 m Br Si Cl (d+s)
2.8 - 3.5 m Br Si Cl (m+f)
3.5 - 4.5 m Gry Si Cl (m+f)
4.5 - 5.5 m Gry Si Cl (s+w)
5.5 - 5.8 m Gry Si Cl (s+s) (leda)

19+460 25 m Rt of C.L. HA -8.0
0.0 - 200.0mm Water
200.- 700.0mm Gry Si Cl (s+w) (push)
700.- 1.2 m Gry Si Cl (m+f)

20+300 6 m Rt of C.L. PA
0.0 - 60.0mm RAP
60.0- 200.0mm Gry Cr Gr
200.- 1.6 m Br Si Sa
1.6 - 1.9 m Blk Si Sa Stny tr Org
1.9 - 2.8 m Gry Si Cl (d+s)
2.8 - 3.5 m Br Si Cl (m+f)
3.5 - 4.3 m Gry Si Cl (s+w)
4.3 - 5.8 m Gry Si Cl (s+s) (leda)

21+000 6 m Rt of C.L. PA (0.5cut)
0.0 - 60.0mm RAP
60.0- 250.0mm Gry Cr Gr
250.- 2.8 m Br Si Sa (94-LX-97)
2.8 - 5.5 m Gry Si Cl (m+f) (94-LX-98)
5.5 - 5.8 m Gry Si Cl (s+w)

18+045 15 m Lt of C.L. PA -0.6
0.0 - 200.0mm Br Sa Tps w Gr
200.- 350.0mm Br Si Sa
350.- 2.0 m Gry Si Cl (m+s)
2.0 - 2.5 m Gry Si Cl (m+f)
2.5 - 3.0 m Gry Si Cl (w+f) (94-LX-118)
3.0 - 3.8 m Gry Si Cl (s+w) (wat @ 3.0m)
3.8 - 9.2 m Gry Si Cl (s+s) (leda)

19+000 6 m Rt of C.L. PA
0.0 - 60.0mm RAP
60.0- 200.0mm Gry Cr Gr
200.- 1.5 m Br Si Sa
1.5 - 1.8 m Gry Si Sa w Cl
1.8 - 2.3 m Gry Si Cl (d+s)
2.3 - 3.3 m Gry Si Cl (m+f)
3.3 - 4.3 m Gry Si Cl (s+w)
4.3 - 5.8 m Gry Si Cl (s+s) (leda)

19+475 6 m Rt of C.L. PA (6.0fll)
0.0 - 60.0mm RAP
60.0- 180.0mm Gry Cr Gr
180.- 1.4 m Br Si Sa
1.4 - 2.0 m Br Si Cl (m+f)
2.0 - 2.5 m Gry Si Sa w Cl
2.5 - 3.3 m Gry Si Cl (m+f)
3.3 - 4.0 m Gry Cl Sa
4.0 - 5.8 m Gry Si Cl (m+f)

20+600 7 m Rt of C.L. PA
0.0 - 60.0mm RAP
60.0- 180.0mm Gry Cr Gr
180.- 500.0mm Gry Cr Gr (B)
500.- 1.0 m Br Si Sa
1.0 - 2.5 m Br Si Cl (d+s)
2.5 - 3.0 m Gry Si Cl (m+f)
3.0 - 3.5 m Gry Si Cl (s+w)
3.5 - 5.8 m Gry Si Cl (s+s) (leda) (94-LX-96)

21+300 6 m Rt of C.L. PA (2.0cut)
0.0 - 60.0mm RAP
60.0- 300.0mm Gry Cr Gr
300.- 1.0 m Br Si Sa
1.0 - 1.4 m Br Si Cl (m+f)
1.4 - 2.5 m Gry Si Cl (s+w)
2.5 - 5.8 m Gry Si Cl (s+s) (leda) (94-LX-99)

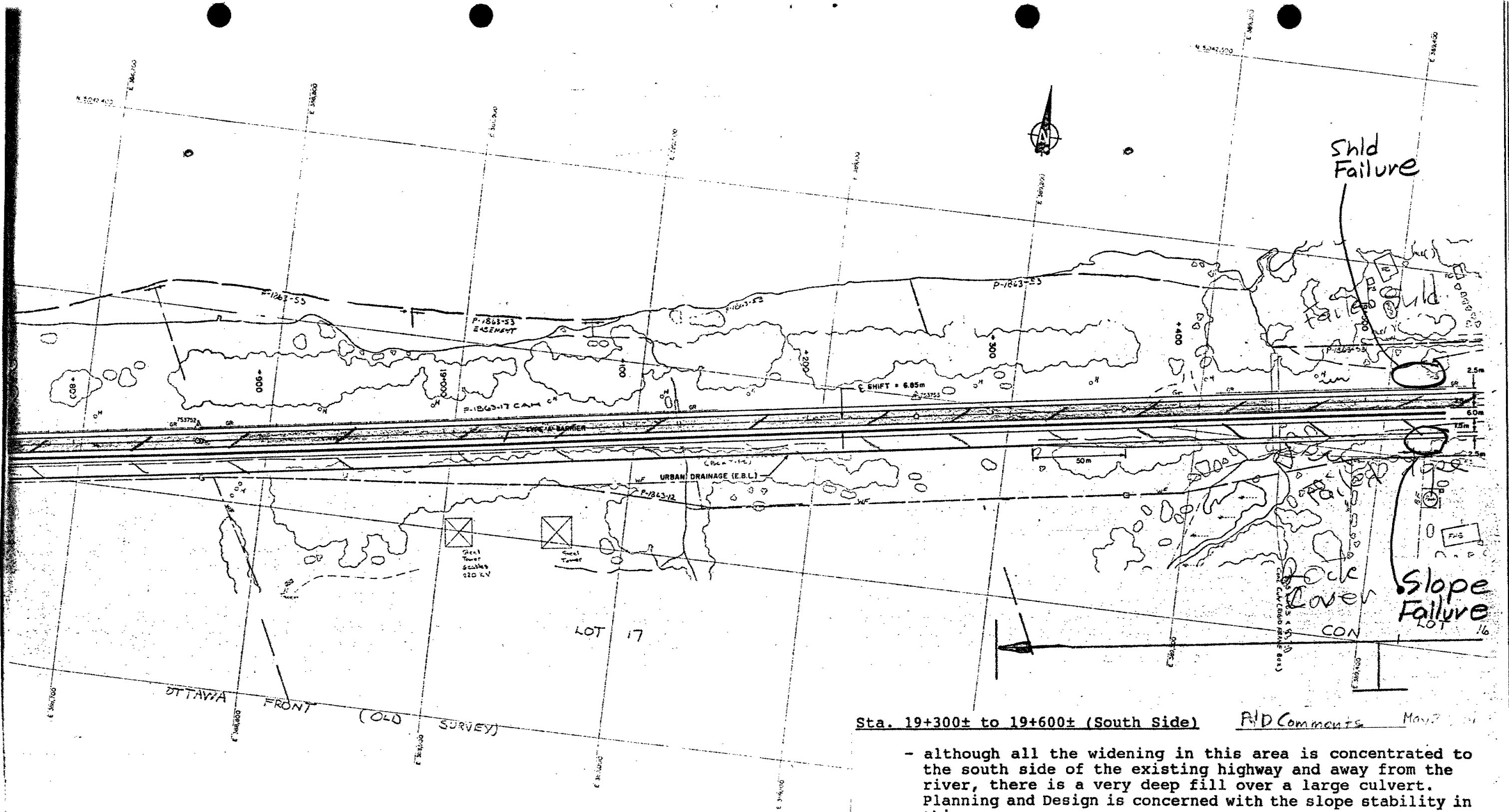
18+200 6 m Rt of C.L. PA
0.0 - 80.0mm RAP
80.0- 350.0mm Gry Cr Gr
350.- 1.0 m Br Si Sa
1.0 - 2.0 m Gry Si Cl (m+f)
2.0 - 3.5 m Br Si Cl (m+f)
3.5 - 4.0 m Br Si Cl (s+w) (wat @ 3.5)
4.0 - 4.8 m Gry Si Cl (s+w)
4.8 - 5.8 m Gry Si Cl (s+s) (leda)

19+170 6 m Rt of C.L. PA (cut)
0.0 - 60.0mm RAP
60.0- 300.0mm Gry Cr Gr
300.- 1.8 m Br Si Sa
1.8 - 200.0mm Gry Si Cl (s+w)
200.- 5.8 m Gry Si Cl (s+s) (leda)

19+480 25 m Rt of C.L. HA -8.0
0.0 - 500.0mm Br Si Cl (m+f)
500.- nfp BR

20+735 14 m Rt of C.L. PA +0.5
0.0 - 200.0mm Br Cl Tps
200.- 1.5 m Gry Si Cl (m+f)
1.5 - 2.0 m Gry Si Cl (s+w)
2.0 - 8.3 m Gry Si Cl (s+w) (leda) (94-LX-120)
8.3 - 9.0 m Gry Si Sa w Gr (till)

21+600 25 m Lt of C.L. HA -4.0
0.0 - RF on surface



Sta. 19+300± to 19+600± (South Side) *AND Comments May 7*

- although all the widening in this area is concentrated to the south side of the existing highway and away from the river, there is a very deep fill over a large culvert. Planning and Design is concerned with the slope stability in this area.



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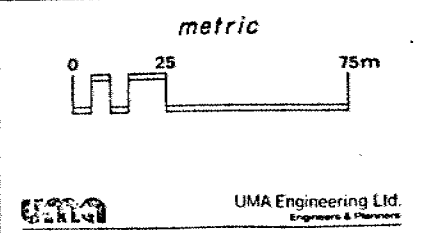
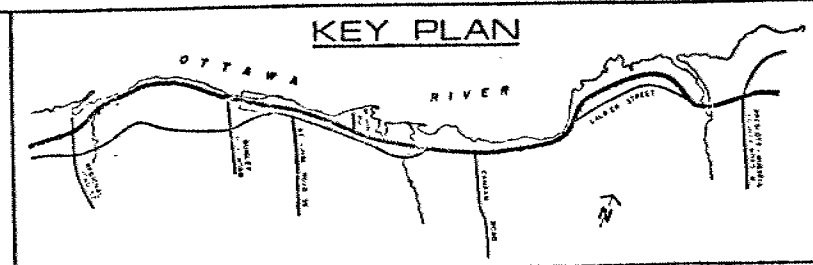
HIGHWAY 17 WIDENING STUDY

W.P. no. 911-73-00

RECOMMENDED WIDENING ALTERNATIVE

Figure 8

Sta. 18+775 to 19+525

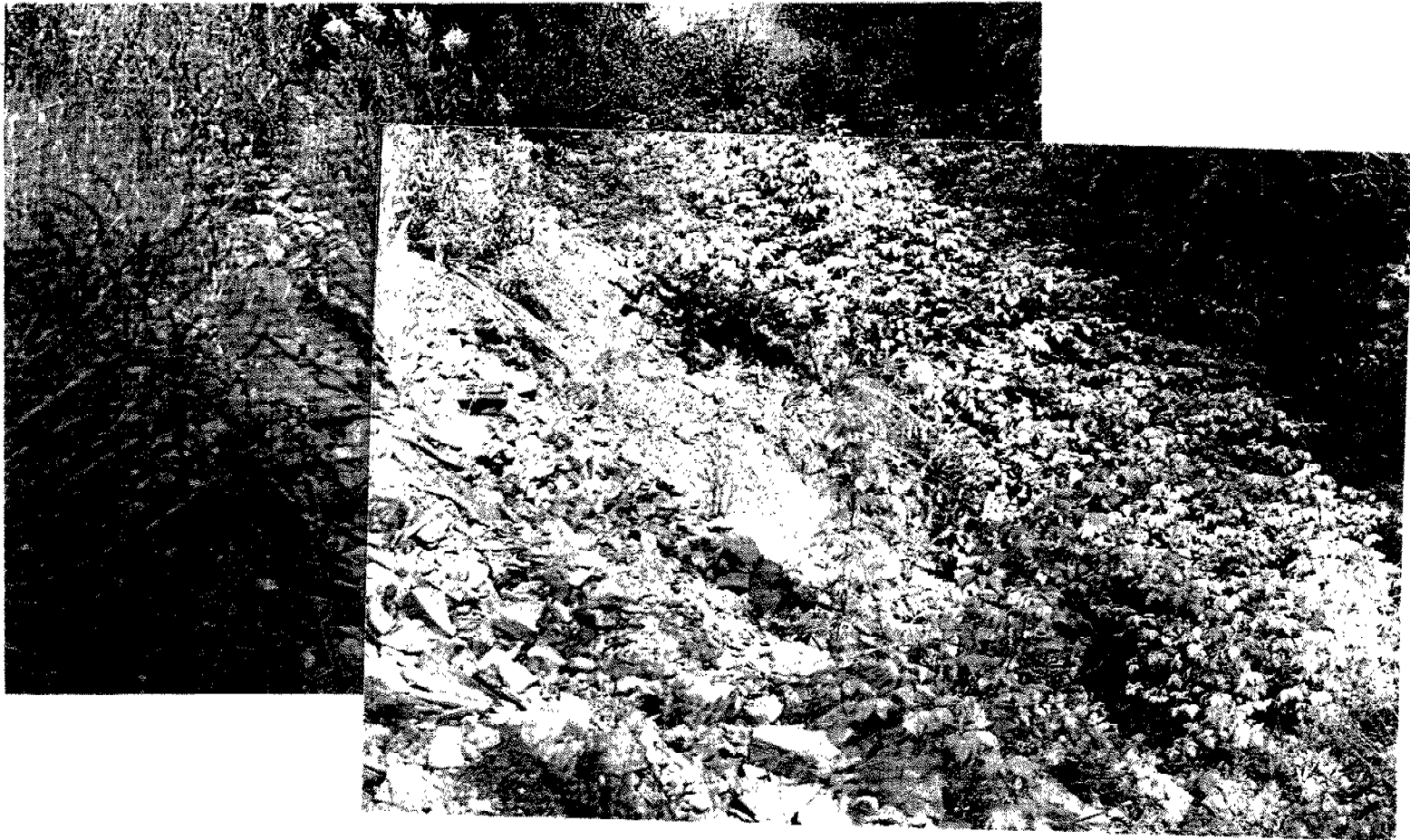


Aug 20/94



Failure at North Shoulder Hwy 17
Sta 19+475
Twp Gloucester

Aug 20/94



Failure on South Slope Hwy 17

Sta 19+475

Twp of Gloucester