KLOHN CRIPPEN

May 9, 2003

Alberta Transportation
Central Region
#401, 4902 – 51 Street
Red Deer, Alberta
T4N 6K8

Mr. Melvin Mayfield, P.Eng.
Project Engineer

Dear Mr. Mayfield:

Central Region Landslide Assessment Site C18
SH837:02 River Scour @ km 1.9
May 2003 Emergency Inspection Report

Klohn Crippen was notified of instability at the above site on May 8, 2003. The emergency site inspection was undertaken on May 9, 2003 by Mr. Darren Ratcliffe, P.Eng. of Klohn Crippen Consultants Ltd. accompanied by Mr. Melvin Mayfield, P.Eng., of Alberta Transportation.

This report was prepared by Klohn Crippen Consultants Ltd. for Alberta Transportation Central Region under Contract No. CE053/2000.

1. PROJECT BACKGROUND

About 10 km northwest of Drumheller, SH837 was constructed at the base of the Red Deer River valley. The highway is primarily used by tourists in the summer as part of the "Dinosaur Trail" to access the Royal Tyrrell Museum of Paleontology, the Midlands Provincial Park and the surrounding Badlands area.

The highway is located at the toe of a steep valley slope (about 1.5H:1V) and for a length of about 860 m is directly adjacent to the Red Deer River. It is believed that the road was constructed on an original trail along a narrow terrace in the area and the surfacing was placed on native material. Drilling was performed in 1981 and indicated about 0.5 m to 5.5 m of medium to high plasticity clay (weathered bedrock) over sandstones and shales.

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The existing riverbank slopes are typically very steep (about 1H:1V or steeper) and erosion of the toe of the riverbank by the river is ongoing.

During the summer of 2000, Alberta Transportation noted an instability in the riverbank at about km 1.9 in the 860 m section adjacent to the river. The slide material at the edge of the river appeared to consist of fine-grained, clay-rich soil-like material, most likely consisting of weathered bedrock material. The material was observed to be highly erodable and becomes very soft when wet. At this location, the highway pavement was 6.7 m wide and the scarp of the slip was about 0.8 m from the edge of the paved surface.

Sloughing of the steep backslopes above the road was highly apparent at this time. The road ditch on the west side of the road, at the toe of the backslope, had completely silted up at this location. In the fall of 2000, the ditch on the west side of the road was excavated to a depth of about 0.5 m. Pit run gravel was placed in the scour zone by dumping over the edge of the scarp, however, no riprap was placed at the toe.

During the period 2000 to 2002, the riverbank slide area appeared to be extending both upstream and downstream. Beyond the slide itself, cracks appeared at the crest of the riverbank. The location of the cracks would tend to suggest that the near vertical banks located immediately to the north and south are becoming unstable. The overall extent of the unstable riverbank measured approximately 40 m.

In October 2002, the riverbank slide area was remediated with a pit run gravel berm with riprap placed at the toe. The slope configuration included a flattened toe area at about 3H:1V to 4H:1V, with a steepened upper portion at about 1H:1V to 1.5H:1V and a 2 m wide road shoulder.

Significant precipitation occurred during the Spring of 2003. During the thaw in May, a series of shallow slides occurred in the steep backslope that blocked the ditch and the highway. In addition, a further riverbank slide occurred about 100 m upstream from the original location. The highway and ditch area was cleared by moving slump material to the crest of the riverbank slope.

The current features of the site are illustrated in Figure 1 and in the attached photographs.

2. SITE OBSERVATIONS

A series of surficial slides has occurred on the steep high backslopes above the highway. The slides are typically about 10 m wide and extend about 10 m to 15 m up the slope. The slides are very shallow, less than about 200 mm thick, and comprise a “peeling off” of the softened upper layer of the slope surface. The slide mechanism is consistent with the observation that the Horseshoe Canyon Formation bedrock material is highly

erodable and becomes very soft when wet. Erosion channels with flowing water were observed in the slope and are likely sourced from snowmelt from the upper part of the slope. At the time of the inspection, further slumping had occurred since the ditch had been cleaned out and the ditch was again blocked. A review of the current slope configuration indicated that there was the potential for more slide material to slump down unless the surface dries out in the near future.

About 100 m upstream from the previous riverbank slide, another slide has occurred. This slide extends for about a length of 50 m and is similar to the previous slide, except that in this location the riverbank (distance from the road edge to the river) is wider. At present, the scarp of the slide is at least 2 m from the highway edge.

As part of the highway and ditch cleaning, the slump material was moved to the crest of riverbank. It is understood that this was a temporary measure only and that the material will be moved to a lower level beside the river.

The repaired riverbank has performed well over the first winter post-construction. A small amount of settlement has occurred at the crest of the gravel berm (about 75 mm) and is likely related to the lower degree of compaction of the top portion of the slope. Riprap is visible at the upstream toe and the upstream and downstream riverbanks in the near vicinity appear to be stable.

3. SITE ASSESSMENT

Minor slumping of the backslope and siltation of the ditch has been ongoing for a significant period of time due to shallow penetration rainfall runoff etc. The primary trigger for the observed major instability is the softening of the material to a deeper level due to considerable snow melt in a short period of time. The combination of the very steep slope, the close proximity to the Red Deer River, and the softening of the slope material is creating the slide conditions. As the material dries out, the cohesive strength will be regained and the slope will stabilize.

The practice of placing slide material from backslope at the top of the riverbank should be stopped as it could create more instability. Slump material should be placed at a lower level on the riverbank to provide a resisting weight in the toe area of the slope.

The 2002 gravel berm appears to be performing satisfactorily with minor settlement of the crest.

Based on the risk level criteria provided by Alberta Transportation, a risk rating of 54 has been assigned to this site. This is based on a probability factor of 9 for an active slide but

with a high probability of remobilization and a consequence factor of 6 as another closure of the highway is possible following a heavy storm.

4. RECOMMENDATIONS

It is recommended that the highway section be inspected daily while the slope material is wet and runoff is following down the slope. The number of inspections can be reduced as the slope dries out and stabilizes. The site should be inspected following any significant rainfall event.

It is recommended that the crest of the high backslope be inspected for cracks or other signs of more significant instability of the slope.

The ditch should be cleaned out regularly to permit the flow of water. At the present time, only the minimal amount of material should be removed to prevent more material slumping into the ditch. The existing slump material and newly excavated material should be placed at the lower level of the riverbank for stability purposes. Slump material may be placed in the riverbank slide area, provided it is placed at the bottom and does not load the crest of the slide. The crest of the riverbank slide should be monitored for regression towards the highway edge.

A thin layer of gravel should be placed at the top of the 2002 gravel berm to remove the drop in the shoulder caused by the settlement.

As previously noted, it is recommended that only specific instances of instability along this length of highway would be repaired. The long-term remediation for this length of highway is likely very expensive. Possible options include:

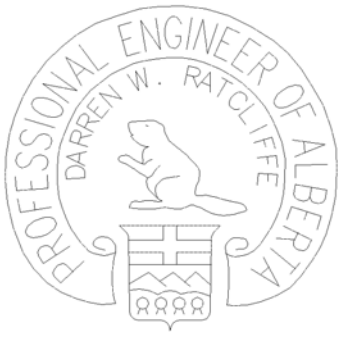
- Flattening the backslope by benching and vegetating; or
- Moving the highway alignment away from the toe of the steep backslope, however, this would move the highway into the river and so the road would need to be supported on an elevated bridge structure in the river.

For the lower riverbank below the highway, the stability of the area could be improved by re-vegetating the area with small trees and shrubs. However, this would require any slump material removed from the ditch to be trucked away and disposed elsewhere.

Please contact the undersigned if you have any questions regarding this report.

Yours truly,

KLOHN CRIPPEN CONSULTANTS LTD.

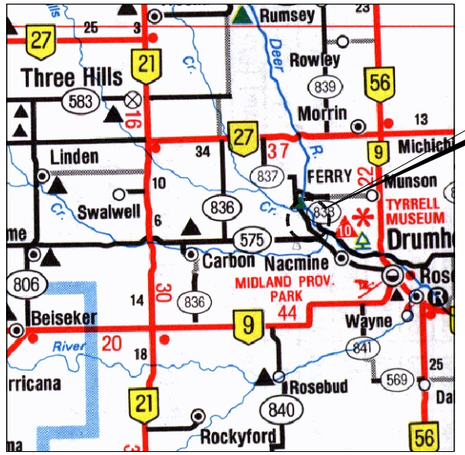


Darren Ratcliffe, P.Eng.
Senior Geotechnical Engineer

Reviewed by Tom Murray, P.Eng.
Manager, Geotechnical

APEGGA Permit to Practice No. 433

FIGURE

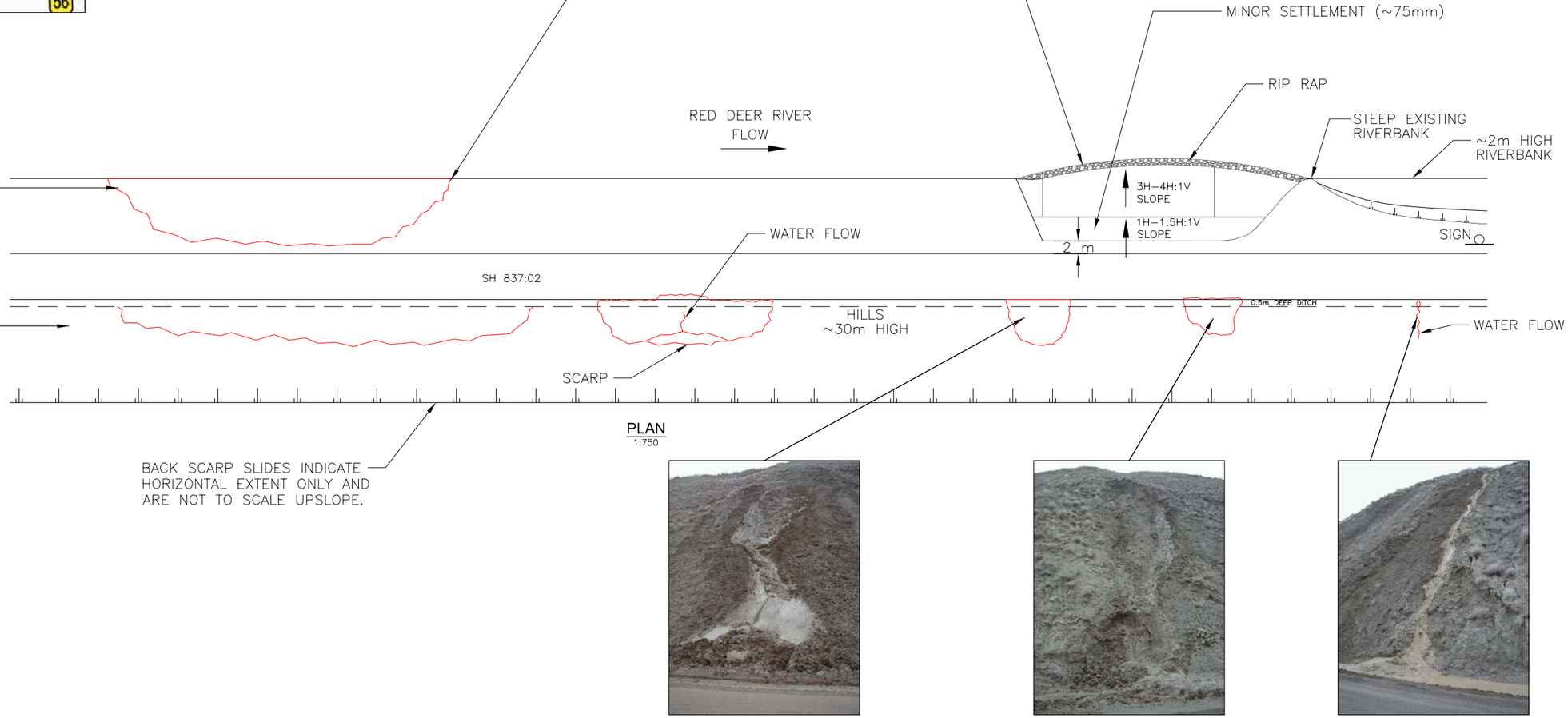


KEY MAP
N.T.S.

2002 GRAVEL BERM

NOTES

1. PHOTOS TAKEN MAY 9, 2003



PLAN
1:750

PROJECT FILE No. 2908.06.C18.F2.C.dwg
DRAWING No. _____
CENTER CODE No. _____
PWSS PLAN No. _____
MICROFILM DATE _____

MARK	DESCRIPTION OF REVISIONS	DATE	DWN.	ENG.
F				
E				
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PERMIT

SEAL

DESIGNED BY: D.W.R. | APPROVED BY:

DRAWN BY: J.J.D. | CHECKED BY:

SCALE: 1:750 0 7.5 15 m

CONSULTANT: KLOHN CRIPPEN

Alberta TRANSPORTATION

PROJECT: CENTRAL REGION

LANDSLIDE RISK ASSESSMENT

TITLE: SITE C18 : SH837 RIVER BANK SLIDE
SITE PLAN

DATE	SHEET	DRAWING No.	REV.
MAY 2003	1 OF 1	FIGURE 1	