KLOHN CRIPPEN

March 22, 2004

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

Mr. Melvin Mayfield, P.Eng.
Project Engineer

Dear Mr. Mayfield:

Site C24: H564:10 Slide
Geotechnical Summary

During the May 21, 2003 site inspection tour, a large slide was identified below Highway 564:10 at about km 32. One of the recommendations provided in the May report was to obtain historical information regarding the slide to determine a potential future course of action. The following report presents a summary of the information available for the site obtained from the Alberta Transportation files and from air photo interpretation. This report was prepared by Klohn Crippen Consultants Ltd. for Alberta Transportation Central Region under Contract No. CE053/2000.

Available subsurface information, lab testing results and instrumentation readings are included as Appendix I. Relevant historical notes and communications are included in Appendix II.

1. SITE DESCRIPTION

About 20 km southeast of Drumheller and south of the Red Deer River, Highway 564:10 (previously known as Duck Lake Road) descends into a coulee (known as East Coulee) to join with Highway 569. On the east side of the coulee, a large slide has developed and has resulted in an apparent dip in the highway grade. The slide area is about 300 m wide with a steep scarp relatively close to edge of highway. Instrumentation was installed at the site in July 1985.

For reference, the slide is located in SW21-27-18-W4 at NAD 83 coordinates of N5686020 and E396380. Based on the risk level criteria provided by Alberta

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Transportation, a risk rating of 18 was been assigned to this site. This is based on a probability factor of 9 for an active slide and a consequence factor of 2 as closure of the highway could be possible.

2. SITE HISTORY

June - November 1979

In 1979 it was proposed to widen the existing road in this location by cutting the slope above and filling below, adopting 3H:1V slopes. The installation of horizontal drains at observed spring sources was also recommended. Test holes drilled in the area identified highly variable soil strengths and bentonitic layers in the soil.

It is assumed that the work was done as planned in the summer of 1979. In November 1979, a crack was observed in the road surface that was 30 mm wide and had settled about 70 mm. Cracks on the downhill slope had opened up to 50 mm wide and were over 1 m deep.

July 1985

In July 1985, a site investigation was undertaken at the slide location. Four locations were drilled as shown on the plans in Appendix I and the hole details are presented in Table 1. The drilling indicated that the subsurface conditions comprised medium to high plasticity sandy clay over high plasticity clayshale and sandstone. Four slope inclinometers and three standpipe piezometers were installed. The instruments indicated that the water level and the shear movement generally corresponded with the clay-clayshale interface. The logs and laboratory test results are included in Appendix I.

Table 1 July 1985 Test Hole Summary

Hole ID	Location	Elevation (m) (Local Datum)	Total Depth (m)	Depth to Clayshale (m)	Water Depth (m)	Movement Depth (m)	Movement Elevation (m)
SI #1	5+263, 37 m LT	199.3	18.6	16.7	16.0	16.8	182.5
SI #2	5+331, 47 m LT	200.8	11.0	5.0	5.2	5.8	195.0
SI #3	5+220, 16 m LT	202.4	11.0	7.9	5.6	8.2	194.2
SI #4	5+298, 17 m LT	208.3	12.5	10.5 (more likely 7.0)		8.2	200.1

Liquid limits in the overburden soils ranged from 35% to 80% with an average moisture content of about 15%. SPT blow count values typically ranged from 12 to 23 blows per 300 mm, but were reduced to about 3 to 4 blows per 300 mm in soft wet zones. A direct shear test was performed on an overburden sample from test hole SI #1 at a depth of 9.1 m. The test indicated a friction angle of 33°, however, the material at this depth is about 7 m above the observed shear plane.

The clayshale liquid limits ranged from about 55% to 190%, indicating the presence of highly bentonitic, low strength layers. Natural moisture contents were typically about 25%.

1986 - 1991

Over the period 1986 to 1990, numerous complaints from various landowners were received and resulted in an Alberta Transportation memorandum dated January 1990 describing the section of highway as ”winding, traversing rugged terrain and there is evidence of road settlement and landslides on the hillside”. It was believed at the time that the road was constructed over some old underground mine shafts, however a review of an EUB plan indicates that the highway is to the east of the western limit of the mine activity. It was not recommended in 1990 that this section of road be paved.

A study of two alternative road alignments was carried out at this time and was summarized in a memorandum dated June 1991. The outcome was that in view of the very high cost of the alternatives, it was recommended that the alignment follow the existing road. It was recommended that any effects of the slide investigated in 1985 be repaired with periodical maintenance as the most economical procedure.

3. SITE ASSESSMENT

Based on the site visit in May 2003, the site history described above and a review of available air photos, it would appear that this is a relatively deep, but slow moving slide. The movements are likely of a creep nature responding to changes in the seasonal groundwater conditions. Climatic conditions, such as an extreme rainfall event, or the placement of fill on the road could trigger future movements of the slide.

4. RECOMMENDATIONS

Instrument readings for the slope inclinometers were last recorded in August 1985. It is recommended that the instruments at the site be checked for operational status. If the instruments can be read, they may provide information regarding the current rate of movement of the slide area. If the instruments have sheared off, this would provide

confirmation of the shear zone location and imply that movements have continued since 1985.

Based on the high cost of realignment options or stabilization methods for a deep slide, and the current low vehicle usage of the highway, it is considered that periodic maintenance and repair of cracks or pavement settlement is still the most cost effective solution. If it is considered that remedial work at the site will provide a benefit, then a topographic survey of the area should be undertaken as a next step.

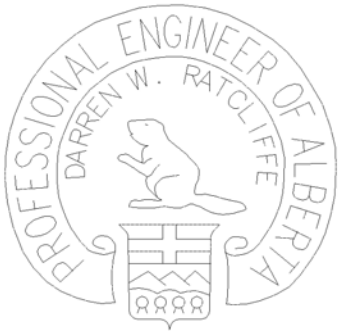
5. CLOSURE

This letter has been prepared for the exclusive use of Alberta Transportation for the specific application to the H564:10 slide area. The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen. In this letter, Klohn Crippen has endeavored to comply with generally accepted geotechnical practice common to the local area. Klohn Crippen makes no other warranty, express or implied.

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

Yours truly,

KLOHN CRIPPEN CONSULTANTS LTD.



Darren Ratcliffe, P.Eng.
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APPENDIX I
TEST HOLE LOGS
LAB TEST AND INSTRUMENTATION DATA

APPENDIX II
HISTORICAL NOTES AND CORRESPONDENCE