Klohn Crippen Berger

November 3, 2008

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

Mr. Dennis Grace, P.Eng.
Construction Engineer

Dear Mr. Grace:

Central Region GeoHazard Assessment
Site C24 H564:10 Slide Repair
October 2008 Inspection Report

The above site was inspected on October 20, 2008 by Ms. Danelle Stutt, EIT of Klohn Crippen Berger Ltd. (KCBL). Photographs from the inspection are attached. This report was prepared by Klohn Crippen Berger Ltd. for Alberta Transportation Central Region under Contract No. CE101/2008.

1. PROJECT BACKGROUND

1.1 Site Location

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 had developed and had resulted in an apparent dip in the highway grade. The slide area had an overall width of about 300 m with a steep scarp relatively close to edge of highway. Instrumentation was installed at the site in July 1985.

1.2 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.

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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. 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.

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 eastern 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.

August – October 2007 Observations

The movement area observed in August 2007 was about 70 m long and the road surface appeared to have dropped by about 1 m. Cracking was observed at the crest of the slope and in numerous locations below the highway. The movement zone appeared to coincide with where the slope was flatter below the highway surface. The slope below the road to the north is close to vertical and about 3 m high.

The slide was likely reactivated by ground saturation from the high regional precipitation in 2007 and the level of movement had effectively closed half the highway.

In October 2007, the road grade was reinstated using fill from the slope below. The south ditch was cleaned out and a Geo-Cell geosynthetic was installed and filled with gravel. It was proposed to use launched soil nails to stabilize the slope immediately after remediation. However, due to technical complications with the nail launcher, soil nailing could not be performed until the spring of 2008. About 300 m of guardrail was also installed at the crest of the slope.

Due to the road not being stabilized immediately after it was rebuilt, cracks began to form in the road. By the end of November, a crack approximately 50 mm wide had appeared extending about 4 m into the road structure over a 20 m long length. The area had also noticeably settled. Cracking and settlement continued into the spring of 2008.

To repair the zone of cracking and settlement, a portion of the road along the line of the crack was excavated and the back face of the excavation was soil nailed. A GRS (geosynthetic reinforced soil) wall was then be constructed to reinstate the highway and restore the grade. The slope on either side of the wall was nailed as per the original intent.

2. OCTOBER 2008 SITE OBSERVATIONS

The following observations were noted on October 20, 2008:

- The road surface still has a slight dip; however, the dip was not completely eliminated during construction.
- A hairline crack is beginning to form at the edge of the road at the east end of the GRS wall.
- A crack, about 10 cm wide, has developed on the bench at the base of the reinforced slope. The crack extends from about the centre of the GRS wall to the beyond the eastern excavation limit.
- Cracks have also developed at the west end of the stabilized area and extend from road level to well into the undisturbed area west of the repair zone.
- Vegetation is starting to grow.
- The GRS wall is performing well.

3. SITE ASSESSMENT

The cracks at road level do not compromise the integrity of the road structure at the present time. As many large cracks existed on the slope prior to the 2007/2008 remediation programs, it is expected that the cracks visible on the bench below the road grade are a reflection of existing cracks propagating through the newly landscaped surface. As vegetation is not yet as dense as it was originally, the cracks are more visible.

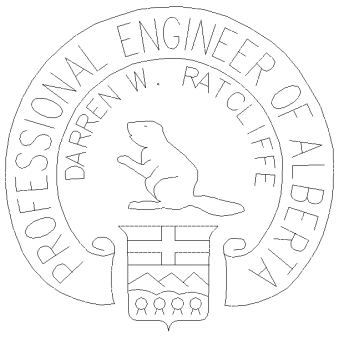
4. RECOMMENDATIONS

It is recommended that monitoring of the site continue in conjunction with Site C25, H569:02.

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

Yours truly,

KLOHN CRIPPEN BERGER LTD.



Darren W. Ratcliffe, P.Eng.
Project Manager

APEGGA Permit to Practice No. 9196