

November 2012

CG25399

Alberta Transportation
2nd Floor, 803 Manning Road NE
Calgary, AB T2E 7M8

Attention: Mr. Ross Dickson

Dear Ross:

**Re: Southern Region Geohazard Assessment
2012 Annual Inspection Report
Site S28: Highway 3A:06, Slide East of Lundbreck Falls**

This report documents the 2012 annual site inspection of Site S28 – Slide East of Lundbreck Falls, along Highway 3A:06 and approximately 3 km westbound along Highway 3A from the town of Lundbreck, AB.

AMEC Environment & Infrastructure (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfilment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CON0013506).

The site inspection was performed by Georgina Griffin, P.Eng., Bryan Bale, P.Eng., and Tyler Clay, E.I.T., of AMEC; and Roger Skirrow, P.Eng., Ross Dickson, and Nathan Madigan, E.I.T., of AT during the 2012 Annual Tour.

1.0 BACKGROUND

The highway at the site is located across the upper portion of a north-facing slope above the south bank of the Crowsnest River. A site plan and cross-section are attached as Figures 1 and 2. This site was first inspected by AT and AMEC personnel in June 2007 after AT regional personnel had noted landslide damage to the road surface. The information from the previous inspections is documented in the 2010 annual inspection report¹.

It is understood that no previous geotechnical investigation or repair work has been performed at this site, including any work related to an old timber pile wall visible along the downslope side of the highway a short distance eastbound from the current damage to the highway surface.

¹ AMEC report "Southern Region Geohazard Assessment Program, Site S28 – Slide East of Lundbreck Falls, Highway 3A:06, 2011 Annual Inspection Report", project number CG25352.200, submitted to AT on October 31, 2011.

AMEC conducted a field investigation and instrument installation program in early 2009. The boreholes for the instrument installations encountered weak fill underlain by high plastic native clay, medium to high plastic till, and slickensided shale and sandstone bedrock².

2.0 SITE OBSERVATIONS

Key observations from the June 2012 inspection were as follows:

- An asphalt overlay had been placed at the site in Spring 2010. As of the 2012 inspection, the cracks had formed again through the overlay following the same pattern and extent as observed during previous inspections (refer to Figure S28-1). The cracks had approximately 10 mm aperture and up to 20 mm of settlement across the cracks in the central part of the site (Photo S28-1). More settlement was observed at the east end of the site, with approximately 30 mm aperture and 60 mm drop (Photo S28-2).
- Fresh landslide scarps were found downslope of the site area (to the north) in the forested slope during the June 2011 inspection. The first scarp was located near the old access road on the slope, with several other scarps noted down to approximately 1145 m elevation, at an existing culvert outlet near the river (refer to Figure S28-1). The scarps had up to 400 mm vertical separation, with fresh soil exposed. No significant changes to the landslide scarps were observed in 2012, and no fresh soil exposures or new scarps were found downslope of the site area.
- An area of back-tilted trees was noted to the north of the highway during the June 2010 inspection that was not noted in the past. These tilted trees may indicate recent slope movement in that area. The condition of the back-tilted trees was unchanged as of the June 2012 inspection.
- The culvert near the toe of the valley slope and near the south bank of the river was noted to be flowing at approximately 20 litres per minute. The inlet of the culvert is buried, but based on the orientation of the pipe at the outlet the inlet may be around the intersection of the highway and Range Road 2-2A (see Figure S28-1).

3.0 ASSESSMENT

Movement zones were confirmed between 6 and 12 m depth at the slope inclinometers (SI's) installed at the downslope road shoulder in 2011. Refer to the attached Figure S28-2 for a cross-section showing the movement zones. Based on the location of the cracks on the road surface, the depth of the movement zones at the SI's, and the recent scarps noted on the lower slope, it appears that the landslide consists of a series of retrogressive slides extending from the

² AMEC report "Highway 3A:06, Site S28 – Slide East of Lundbreck Falls, Report on 2009 Geotechnical Investigation, Instrument Installations, and Initial Readings", submitted to AT on May 28, 2009.

culvert outlet near the river level to a short distance upslope of the highway. The slides are seated approximately 6 to 10 m deep. Near the road, the slide is seated in medium plastic lacustrine silt and clay, resting atop bedrock. The bedrock surface is likely irregular, and the slide may be moving within weak soils draped atop the varied bedrock surface.

It appears that the landslide headscarp extends to the upslope side of the highway or perhaps a short distance upslope of the highway into the area between the highway and the railway alignment approximately 20 m further upslope. However, the exact upslope extent of the landsliding cannot be absolutely confirmed because cracking and settlement of the area upslope of the highway would be obscured by the thick vegetation growth and/or not discernable through the coarse rock backfill placed over the railway alignment further upslope.

The landslide movement has likely been ongoing for many years and the rate of cracking and settlement of the road surface appears to have been relatively consistent from 2007 onwards. The damage to the road surface has been treated as a maintenance issue to date. This practice could be continued, likely for many years, however over the long term a more permanent repair would be more technically sound and possibly more cost-effective than the ongoing maintenance work.

4.0 RISK LEVEL

The recommended Risk Level for this site, based on AT's general geohazard risk matrix, is as follows:

- Probability Factor of 9 to reflect the active movement measured by current monitoring data at a slow to moderate ongoing rate with potentially increasing occurrence.
- Consequence Factor of 4 to reflect the magnitude of damage to the road surface to date that appears to be manageable as a maintenance issue, but with the possibility that a significant increment of landslide movement could possibly require temporary closure of the westbound (downslope) lane of the highway.
- Therefore, the recommended Risk Level for this site is 36, which is increased from 24 since the previous inspections back to 2008.

The Consequence Factor does not consider that the highway is a local access road at this location. Local traffic using the road could still access areas along Highway 3A on either side of the site from Highway 3 if a significant failure were to occur.

5.0 RECOMMENDATIONS

5.1 Maintenance and Short Term Measures

- As part of the normal highway maintenance operations, AT's maintenance contractor should continue to seal and patch the cracks in the road surface at this site as well as place overlays as required to maintain a suitable running surface.
- The instruments should continue to be read on a semi-annual basis to check for deeper-seated movement than has been noted to date.

5.2 Long Term Measures

Potential repair options for this site include a pile wall, drainage improvements, slope re-grading, or a shear key. Refer to the 2011 Annual Report for a discussion of each option.

The annual site inspections by AT and AMEC personnel should be discontinued unless repair work is planned or if a change in site conditions is noted by AT or maintenance contractor personnel or by AMEC personnel during the semi-annual instrument readings.

5.3 Investigation

AMEC has submitted a proposal to install another SI on the lower portion of the slope to better define the landslide mechanism, and also to determine the depth to bedrock in the upslope ditch for a potential anchored pile wall repair³. If AT wishes to proceed with a repair with this site, rather than treating the damage to the road surface as an ongoing maintenance issue, then it is recommended that this work be performed to determine which repair option is the most suitable and practical and to obtain parameters required for a repair design.

³ AMEC report, "Proposal and Cost Estimate for Geotechnical Investigation, Site S28 – Slide East Of Lundbreck Falls, Highway 3A:06", submitted to AT on March 15, 2011, AMEC File no. CG25332.

6.0 CLOSURE

This report has been prepared for the exclusive use of Alberta Transportation for the specific project described herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. AMEC Environment & Infrastructure, a division of AMEC Americas Limited, cannot accept responsibility for such damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report has been prepared in accordance with accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

We trust that this meets your needs at this time. Please contact the undersigned if you have any questions or require any further information.

Respectfully Submitted,

**AMEC Environment & Infrastructure,
a division of AMEC Americas Limited**

ORIGINAL SIGNED AND STAMPED NOVEMBER 20, 2012

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Reviewed by:

APEGA Permit to Practice No. P-04546

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