January 2015

CG25399

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

Attention: Mr. Ross Dickson

Dear Ross:

Re: Southern Region Geohazard Assessment
2014 Annual Inspection Report
Site S10A: Highway 762:02, Archery Range

This letter documents the 2014 annual site inspection of Site S10(A) – Archery Range on Highway 762:02, approximately 12 km southbound of the junction between Highway 762 and Highway 22.

AMEC Environment and 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 Bryan Bale, P.Eng., and Tyler Clay, E.I.T., of AMEC; and Roger Skirrow, P.Eng., and Ross Dickson of AT during the 2014 Annual Tour.

1.0 SUMMARY

The site conditions are consistent with those observed in 2012; however, further cracking to the south portion of the site indicate potential expansion of the slide area. The risk level is unchanged since the 2012 assessment. AT's maintenance contractor personnel should continue to patch and re-grade the settlement in the southbound lane of the highway as necessary. A guardrail or jersey barrier is required along the west edge of the road where the shoulder drops off steeply. AMEC has submitted a preliminary design report outlining several repair options. AMEC recommends that AT chose a repair option for this site and AMEC can finalize the design for the repair work upon AT's selection. The annual inspections should continue and the site should be inspected next in 2015.

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2.0 BACKGROUND

There is limited background information available regarding this site prior to the start of annual assessments by AT and AMEC personnel in the spring of 2000. It is understood that there was a failure at this site (either a failure of the road subgrade and/or slope instability in the underlying native soil and the slope face downslope (west) of the road) in the mid-1990's. This instability required temporary closure of at least the southbound lane of the road prior to repair. There are no details currently available on the associated investigation and repair except that the road was reconstructed with granular fill.

There has been ongoing settlement and cracking of an approximately 30 m long segment of the southbound lane since approximately 2000. The semi-circular pattern of the cracking and instrument monitoring findings suggest a rotational earth slide failure towards the west. Asphalt overlays have typically been placed at this site on an annual basis since 2002.

AMEC and AT personnel have performed regular inspections of this site since 2000. The following site investigation, monitoring and assessment work has also been performed:

- Drilling a series of boreholes with the installation of two slope inclinometers (SI's) and two pneumatic piezometers in March 2007[1]. The data from these boreholes and instrumentation monitoring up to early 2008 was used to develop a list of potential repair options[2].

- A third SI was installed adjacent to the toe of the road embankment slope west of the highway in early 2009 in order to further define the landslide movement surface geometry and provide a basis to select the most appropriate repair measure for this site[3].

A large increment of movement occurred in 2011 causing significant down-drop and cracking within the southbound lane, and creating a safety hazard. The lane was temporarily closed and traffic controlled with signal lights while repairs were performed. Temporary traffic light posts were installed at the site in case closure of the southbound lane is required in the future.

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1 AMEC Earth & Environmental, 2007. *Highway 762, Borehole Drilling and Instrumentation for S8 – Fisher Creek, S-Curve Site, S10 – Site A*, Project Number CG25260, report submitted to AT July 30, 2007.

2 AMEC Earth & Environmental, 2008. *Highway 762, Site S10(A) Archery Range Site, Assessment of Landslide Conditions and Repair Options*, Project Number CG25260, report submitted to AT March 25, 2008.

3 AMEC Earth & Environmental, 2009. *Site S10 (A) – Hwy 762:02 – Archery Range, 2009 Geotechnical Investigation, Instrument Installations and Readings*, Project Number CG25305, report submitted to AT May 28, 2009.

3.0 SITE OBSERVATIONS

A summary of the key observations from the May 2014 inspection is as follows:

- Approximately 100 mm of settlement was noted within the previous slide extents that encompass the highway and along the previously observed cracking pattern. Refer to Photo S10A-1.

- Minor arc-shaped cracking and settlement was noted further south in an area where damage has not previously been observed within the southbound lane. The damage extended up to 2 m from the west road shoulder towards the centerline and for approximately 10 to 15 m south of the established slide extents within the road surface. Refer to Photo S10A-1 and Figure S10A-1.

- The repeated overlays across the damaged segment of the road have created a steep drop below the west downslope edge of the road and there is currently no effective shoulder width in that area.

4.0 ASSESSMENT

The assessment of the geohazard conditions at this site from previous annual inspections is still considered valid and is summarized as follows: provided below:

- The ongoing landslide movement below the southbound lane of the highway presents a significant, ongoing maintenance issue that has required one to two asphalt overlays per year for the last several years.

- Major increments of slide movement are expected to continue, especially during years with greater precipitation amounts or rapid snow-melt. These increments of rapid slide movement (as observed in 2011) present a significant hazard to road users.

- The instrumentation has confirmed the depth of active ground movement below the southbound lane and around the toe of the road embankment slope. These movement zones, along with the position of the cracking in the road surface and the toe bulge a short distance downslope of SI 2009-1, align along a rotational or possibly rotational/translational failure surface. The movement rates measured since 2007 have supported the assessment of ongoing episodic movement, likely corresponding to periods of peak precipitation or wetter than normal years. The instruments are no longer operational.

The 2014 observations support the previous assessments of the ongoing landslide hazard at the site; however, based on the new damage observed to the south of the identified slide extents the slide area may potentially be expanding or causing new instabilities to form within the fill embankment. The slide failure is expected to progress and potentially expand or cause other changes to site conditions in the future. The unlimited progression of the failure may require

further investigation and decrease the relevancy of the current analysis and repair concepts as time proceeds.

AMEC has submitted a preliminary design report outlining several repair options and their associated costs, as well as a right-of-way plan showing the land required to undertake a repair. AMEC can finalize the repair design and prepare a draft tender package for the repair work upon AT's selection of a repair method.

5.0 RISK LEVEL

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

- Probability Factor of 11 based on the rate of movement that was measured in the SI's and apparent active slide conditions based on the ongoing damage observed in the road surface.

- Consequence Factor of 8 based on the rapid increments of movement to date and the potential for similar movements in the future that could cause sudden and significant changes to the pavement elevation and/or crack development in this segment of the highway that pose consequence of extended road closure and/or severe injury or risk to life to motorists.

Therefore, the current recommended Risk Level for this site is 88, which is the same as the previous recommended Risk Level from 2012.

6.0 RECOMMENDATIONS

6.1 Maintenance and Short Term Measures

- AT's maintenance contractor personnel should continue to patch and re-grade the settlement in the southbound lane of the highway as necessary.

- Signs should be setup to reduce traffic speed for both north and south bound traffic when the road surface is damaged due to landslide movement. "Slide Area" signs should also be posted year-round.

- A guardrail or jersey barrier is required along the west edge of the road where the shoulder drops off steeply, according to AT's highway design requirements.

- Replacement of monitoring instruments are not recommended, as the slide mechanism is understood.

6.2 Long Term Measures

- A longer-term repair should be constructed at this site. AT should select one of the repair options presented in AMEC's January 2010 report[4] and authorize the final design and draft tender package preparation for the repair.
- The site should be inspected during the Annual Tour if damage or site changes are noted by the MCI.

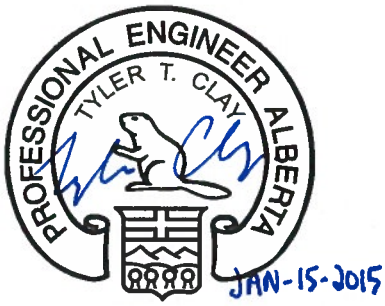
7.0 CLOSURE

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



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APEGA Permit to Practice No. P-04546

[4] AMEC Earth & Environmental, 2010. *S10(A) – Hwy 762:02 – Archery Range, Recommended Repair Option*, Project Number CG25305, report submitted to AT January 28, 2010.