



October 1, 2010

CG25332.200

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

Attn: Mr. Ross Dickson

**Re: Southern Region Geohazard Assessment Program
Site S18 – Galatea Creek Rock Cut, Highway 40:12
2010 Annual Inspection Report**

This letter documents the 2010 annual site inspection of Site S18 – Galatea Creek Rock Cut, along Highway 40:12, approximately 32 km south of the junction between Highway 40 and Highway 1 and just north of the Galatea Creek Provincial Recreation Area.

AMEC Earth & Environmental (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfillment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CE061/08).

The site inspection was performed on June 21, 2010 by Mr. Bryan Bale, P.Eng., and Mr. Andrew Bidwell, P.Eng., of AMEC in the company of Mr. Neil Kjelland, P.Eng., Mr. Roger Skirrow, P.Eng., and Mr. Ross Dickson of AT.

BACKGROUND

A general description of the geohazard conditions at this site along with the site geological setting and chronology of previous events, investigations, monitoring and repair work were provided in the 2008 annual inspection report¹ and are summarized as follows:

- The site consists of a through-cut in bedrock along this segment of the highway. The East Cut Slope is near vertical with a maximum height of approximately 16 m. The West Cut Slope is near-vertical to vertical with a maximum height of approximately 10 m.

¹ AMEC report "Southern Region Geohazard Assessment Program, Site S18 – Galatea Creek Rock Cut, Highway 40:12, 2008 Annual Inspection Report" AMEC project number CG25277, submitted to AT on September 8, 2008.

- There is a rock fall hazard at this site that was first documented during a June 2004 call-out site inspection by AMEC.
- The east ditch does not meet the sizing guidelines from the Ritchie Ditch Chart and during past inspections up to cobble sized rock fall debris has been noted on the road surface across the northbound lane and onto the centerline. Figure S18-1 shows a typical slope and ditch cross-section around the maximum East Cut slope height.
- There is also a hazard of rock block sliding, wedge or toppling failures from the East Cut Slope because the East Cut Slope is oriented unfavourably relative to the bedrock structure at this site. Numerous rockbolts were installed in the East Cut Slope during construction in order to mitigate the risk to the highway from these hazards.
- The west ditch meets the sizing guidelines from the Ritchie Ditch Chart and during past inspections it has not appeared that any rock fall debris from the West Cut Slope has been impacting the road. Figure S18-2 shows a typical slope and ditch cross-section around the maximum west cut slope height.

SITE OBSERVATIONS

The site conditions have not changed significantly in recent years. Observations from the 2010 inspection are summarized as follows:

- There continued to be an accumulation of rock fall debris in both the east and west ditches. The rock fall debris included material up to cobble and small boulder size, which is consistent with observations from past inspections.
- As shown in the photos, virtually all of the rock fall debris was contained within the ditches at the time of the inspection. Some large gravel sized rocks were noted scattered along the road surface throughout the site area. There were no rocks larger than gravel sized on the road at the time of the inspection, although up to cobble sized rock fall debris has been noted on the pavement in past years.
- There was a large accumulation of rock fall debris in the east ditch near the centre of the site (Photo S18-1). This area may have also had a large wedge failure in the past, as is shown in Photo S18-6 and evidenced by the rock bolt protruding from the face. Some large rocks in this area may be unstable. The large rock pile at this location may be due to continued unravelling of the rock face or it may be due to a larger wedge failure breaking apart into boulders in the ditch.

ASSESSMENT

The assessment of the hazard conditions at this site has not changed in recent years. In summary:

- The rock fall conditions have not changed at this site since the previous inspections, therefore there remains a risk that rock fall debris from the East Cut Slope at this site will bounce or roll onto the road surface. This has been evident from past inspections where rock fall debris was noted in the northbound lane. The risk is somewhat mitigated by the “Watch For Fallen Rock” signs in place on either side of the through-cut to warn users of the highway along with the available catchment capacity of the east ditch, but the hazard of large rocks being deposited on the pavement remains.
- As noted in the previous inspection reports, the risk from potential rock block sliding, wedge, or toppling failures in the East Cut Slope is judged to be lower than the rock fall risk because of the rockbolts installed in the East Cut Slope.
- The risk to the highway from rock fall from the West Cut Slope is low because the west highway ditch is larger and able to contain virtually all of the rock fall debris from the West Cut Slope.

RISK LEVEL

The current recommended Risk Levels for this site, based on AT’s rock fall geohazard risk matrix, are as follows:

East Cut Slope

- A Probability Factor of 15 is recommended based on the apparent frequency of rock fall due to weathering and freeze/thaw effects on the exposed rock.
- A Consequence Factor of 3 is recommended based on the history of cobble-sized rocks rolling onto the pavement at this site.

Therefore, the recommended Risk Level for the East Cut Slope is 45. This value is unchanged from the previous site inspection.

West Cut Slope

- A Probability Factor of 12 is recommended based on the apparent frequency of rock fall from the West Cut Slope.

- A Consequence Factor of 1 is recommended because there has been no evidence of rock fall debris from the West Cut Slope reaching the road.

Therefore, the recommended Risk Level for the West Cut Slope is 12. This value is unchanged from the previous site inspection.

RECOMMENDATIONS

Maintenance and Short Term Measures

- AT's maintenance contractor should clean the accumulated rock fall debris from the east and west ditches as often as practical in order to maintain the ditches reasonably close to their maximum capacity. This should be treated as an ongoing maintenance issue and cleaning done as required. The east ditch was noted to have a larger amount of rock fall debris rock fall than was observed during the 2009 inspection, however it is not cleared based on the two most recent annual inspections if the rock fall conditions are worsening in recent years.
- Any rocks that are deposited on the road should be cleared as soon as they are noted. The most practical and efficient method of ensuring that the road is clear of rock fall debris on an ongoing basis would be to have maintenance contractor personnel visually inspect the site each time they travel by during their other work and kick any rocks on the road into the ditch.
- If the debris is not cleaned out and kept off the road as described above, the Consequence Factor for the rock fall risk from the East Cut Slope will increase.

Long Term Measures

- The Consequence Factor for the East Cut could be reduced by increasing the capacity of the east ditch to contain rock fall debris.
 - The ditch width and depth could be increased. The ditch sizing criteria on the Ritchie Ditch chart and/or more recent guidelines based on work by the British Columbia Ministry of Transportation should be used as a guide.
 - Alternatively, a line of jersey barriers could be placed along the east shoulder of the road in order to increase the effective depth of the ditch. This should only be done if AT's requirements for a minimum clear width and/or sideslope angles can be met (and also practicality with respect to snow plowing). The barriers would also be effective in preventing vehicles that may run into the east ditch for other reasons from striking boulder-sized rock fall debris that has been contained in the

ditch. It should be noted that it will be necessary to keep cleaning the rock fall debris from the east ditch after the ditch is further excavated or jersey barriers are in place.

- This site could be included in the planned work package for scaling at several rock cut slope sites in the Southern Region that AT intends to put out to bid. Scaling at this site should reduce the Probability Factor at least for the short term.
- The annual inspections at this site should be continued. The purpose of the site inspections will be to check the slope conditions, the rate of rock fall debris accumulation in the ditches, and note specific locations where large blocks of rock in the cut slope may require further stabilization. Additional stabilization measures could consist of mesh or draped rock fall nets to guide falling rocks to land close to the toe of the cut slope, additional scaling, or perhaps additional rockbolts to supplement or replace the existing ones.

Investigation

No further investigation work for this site is recommended at this time.



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 Earth & Environmental, 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 Earth & Environmental,
a division of AMEC Americas Limited**

ORIGINAL SIGNED
OCTOBER 1, 2010

Bryan Bale, M.Sc., P.Eng.
Geotechnical Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

Andrew Bidwell, M.Eng., P.Eng.
Associate Geological Engineer

Attachments: Cross-Section Figures S18-1 and S18-2
Photos S18-1 to S18-6