



August 28, 2009

CG25309.B

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

Attn: Mr. Ross Dickson

**Re: Southern Region Geohazard Assessment Program
Site S15 – Crowsnest Lake Rockfall Barrier, Highway 3:02
2009 Annual Inspection Report**

This letter documents the 2009 annual site inspection of Site S15 – Crowsnest Lake Rockfall Barrier, along Highway 3:02 on the southeast shore of Crowsnest Lake, west of Coleman, AB and a short distance east of the border between Alberta and British Columbia. There is a rockfall hazard to the highway at this site that is being mitigated by the rockfall barrier net.

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 10, 2009 by Mr. Andrew Bidwell, P.Eng. and Mr. Bryan Bale of AMEC in the company of Mr. Neil Kjelland, 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 2007 annual inspection report¹.

The rockfall hazard at this site was first identified by AT in the late 1990's. Subsequent work by AT and their geotechnical consultants culminated in the installation of the current rockfall barrier net in November 2005. The annual inspections of the site have been continued since the barrier net was installed in order to monitor the effectiveness of the barrier net and troubleshoot its

¹ AMEC report "Southern Region Geohazard Assessment, Annual Assessment Report, 2007", project number CG25263, submitted to AT on November 6, 2007.

required maintenance. A call-out site inspection to assess the rockfall hazard along the segment of the highway immediately west of the barrier net was also performed in June 2008².

SITE OBSERVATIONS

A summary of the observations from the 2009 inspection is presented below:

- As shown in Photos S15-1 and S15-2, the barrier net is in fair condition after the late 2008 maintenance and repairs and the debris cone has been recently cleaned out. One of the support posts is bent and leaning towards the highway, and the braking element on the anchor cable has been activated. This was also noted during the May 6, 2009 inspection at the site. Of concern were the anchor cables at the east end, which were disconnected at the time of the inspection. This greatly reduces the net's ability to withstand an impact. AMEC understands that the cables are disconnected by the maintenance contractor for cleaning out the debris cone, however they must be reconnected after the debris cleaning is completed in order to restore the net's capacity.
- The gully that has formed in the talus slope above the rock cut slope appears to have expanded laterally to the east since the 2008 inspection. There are now two channels, as is shown in Photos S15-3 and S15-4. A photo from the June 2008 inspection is also included for comparison (Photo S15-5).
- There was at least one location where one or two of the wire rope rings on the main net had been severed with a resulting gap in the net. This damage has been observed since 2006.
- There were several gaps in the chain link mesh installed across the wire rope net, which could allow small rockfall debris to fly through the net.
- Rockfall along the segment of the highway to the west of the barrier net remains a concern with predominantly gravel to cobble sized rockfall. Most of the rockfall is contained in the ditch however some rocks are deposited on the road edge. The rockfall conditions along this segment of the highway are largely unchanged from the June 2008 call-out site inspection of this area.
- Rockfall debris was also noted in the ditch to the east of the barrier net site. The debris was contained within the ditch, and ranged in size from gravel to a boulder (0.9x0.8x0.6m) that was noted approximately 50 m eastbound from the barrier net.

² AMEC report "Report On June 3, 2008 Site Inspection, Highway 3:02 Crowsnest Lake, Alberta", project number CG25277.D, submitted to AT on June 16, 2008.

AMEC understands that AT has given permission for a graduate student at the University of Alberta to perform LiDAR mapping of the rock cut slope and adjacent slope faces at this site. The data from this mapping may be suitable for replacing the approximate slope profile used in the previous work for this site.

ASSESSMENT

The rockfall hazard at this site has not changed significantly since the barrier net was installed in late 2005, however the frequency of rockfalls may be increasing as the gully erosion in the talus slope above the highway cut slope expands upslope and laterally. This erosion is expected to continue in the future. However, the design capacity of the rockfall barrier is judged to remain sufficient because the maximum size of rocks exposed in the upper portions of the gully are not significantly different than previously noted and the design rockfall case for the barrier net was for a large rock releasing from the gully headwall. The lateral extent of the rockfall barrier is also judged to be sufficient because any rolling rocks/rockfalls are channelled into the existing gully by the shape of the slope face.

The barrier net is judged to still be the most practical and cost-effective way to reduce the risk to the highway from rockfall at this site. As noted in the initial inspection report for this site, it is judged cost-ineffective to impractical to attempt to stabilize the large potential rockfall source area on the slope above the highway.

The rockfall barrier net has not been properly maintained since installation. In its current condition the barrier net's capacity to prevent the design rockfall event from impacting the highway has been significantly decreased. The anchor cables at the east end must be reconnected to restore the design capacity and the tilted post should also be reset to restore the design barrier height.

The maintenance contractor has been more diligent with cleaning out the rockfall debris from behind the net. This practice should be continued.

RISK LEVEL

The recommended Risk Level to the highway at the barrier net location is as follows:

- The Probability Factor for this site should be set at 16 to reflect the active rockfall.
- The Consequence Factor for this site should be set at 5 to reflect the reduced capacity of the net largely due to the east side anchor cables being disconnected. The actual reduction in net capacity is difficult to estimate, however a Consequence Factor of 5 is considered reasonable for the June 2009 condition of the net relative to:

- The significantly degraded net condition noted in June 2008 (i.e. before the late 2008 repairs), for which a Consequence Factor of 7 was recommended, and
- A Consequence Factor of 1 previously recommended for a properly maintained net at design capacity.

Therefore, the current recommended Risk Level at the barrier net site is 80. This is equal to the value recommended following the May 6, 2009 inspection, and a reduction from the value of 112 recommended prior to the late 2008 repairs to the net. The Consequence Factor could be further reduced if the east anchor cables are reconnected and kept sufficiently tensioned (aside from temporary disconnection while cleaning the debris from behind the net, followed by re-connecting and re-tensioning).

RECOMMENDATIONS

Maintenance and Short Term Measures

- The maintenance contractor should continue to clean out the rockfall debris.
- The anchor cables for the net should be re-attached and properly tensioned as soon as possible. The manufacturer's guidelines for installing, inspecting and maintaining the net detail these procedures.
- The support post for the barrier net that is tilted too far forward toward the highway should be adjusted to restore the design barrier height. The braking element on the anchor cable needs to be reset or replaced.
- The gaps in the wire rope net should be repaired, along with the gaps in the chain link mesh.

Long Term Measures

- The barrier net should be regularly inspected and maintained as recommended in the manufacturer's guidelines.
- Rockfall debris behind the barrier net should be cleaned out as required to keep the volume of accumulated debris at a practical minimum.
- The annual site inspections by AT and geotechnical consultant personnel should be continued.

Investigation

- The data from the planned Summer 2009 ground-based LiDAR survey of the slope at this site by a University of Alberta graduate student should be reviewed and compared to the approximate slope profile used in the previous work for this site. Depending on the quality and extent of the data, it may provide a sufficient basis to assess if additional rockfall mitigation measures (e.g. additional nets at selected locations on the slope above the highway) may be worthwhile in an effort towards reducing the dependence on timely cleaning of the debris from behind the existing barrier net at the highway.

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**

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APEGGA Permit to Practice No. P-04546

Reviewed by:

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Attachments: Site Plan
Photos