September 29, 2008

CG25277.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
2008 Annual Inspection Report

This letter documents the 2008 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 installation of 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 25, 2008 by Mr. Andrew Bidwell, P.Eng. and Mr. Bryan Bale of AMEC in the company of Mr. Roger Skirrow 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 previous annual inspection report[1].

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 required maintenance.

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

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SITE OBSERVATIONS

There were no fundamental changes in the site appearance or rockfall conditions since the 2007 inspection.

As a general note, the maintenance issues noted in the 2007 annual inspection report and more recently in an email from AMEC to AT on June 6, 2008 had not been addressed and overall the barrier net was in fair to poor condition and its likely capacity to prevent the design rockfall event from impacting the highway has been significantly decreased if not entirely compromised.

In summary:

- As shown in Photo S15-1, the erosion in the gully on the slope above the barrier net is continuing and it appears that the rockfall source area in the upper portion of the gully may have expanded laterally since the previous annual inspections.

- The lower seam cable of the barrier net was disconnected at the time of the inspection. AMEC understands that this was done by the maintenance contractor during the week of May 26, 2008 in anticipation of later disconnecting the anchor cables from the east end of the net and using a loader to clean out the accumulated debris from behind the net (as per the standing recommendations to keep the amount of debris to a reasonable minimum). It is also understood that the maintenance contractor subsequently determined that the rockfall hazard in the area behind the net was too high for the loader to work behind the net as planned, therefore the debris clean-out was not completed but the lower seam rope was not re-connected.

- Several of the other anchor cables and seam cables for the net were not sufficiently tensioned at the time of the inspection, as shown in Photo S15-3.

- One of the barrier net support posts was tilted too far towards the highway. This has reduced the effective height of the barrier net below the design value.

- There was an extremely large accumulation rockfall debris in a cone extending downslope from the gully outlet and encroaching onto the barrier net itself. The amount of debris seen behind the net during the June 2008 inspection is likely the largest accumulation between clean-outs since the net was installed in late 2005.

    - This size of a debris cone could allow a rockfall coming out of the gully to bounce and roll directly into the barrier net rather than first bouncing on the ground behind the net and losing significant kinetic energy prior to striking the net. As stated in the design report for the barrier net, the rockfall debris that accumulates behind the net must be cleaned out as required to prevent such a large debris

cone from developing in order form the net to provide the design factor of safety for the highway with respect to rockfall.

- 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 (Photo S15-4). This appeared to be the result of the large April 2006 rockfall that impacted the net and severed one or two of the wire rope rings when they were pinched between the rockfall and the ground surface.

- 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. See Photo S15-4.

ASSESSMENT

The rockfall hazard at this site has not changed significantly since the barrier net was installed in late 2005. The barrier net is still 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 continued erosion in the upper portion of the gully above the rockfall barrier has likely caused an increase in the volume of rockfalls at this site. This erosion is expected to continue in the future with the gully headwall area continuing to expand upslope and laterally. 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 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 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 if not entirely compromised.

The maintenance contractor's concerns about the rockfall risk to their personnel and equipment while cleaning out the accumulated rockfall debris behind the net are acknowledged. However, the design basis for the barrier net relies on the accumulated rockfall debris behind the net being kept to a practical minimum. Therefore, a safe and practical way to clean out the debris must be found. If the rockfall debris is routinely allowed to accumulate to the volume observed during the June 2008 site inspection the design capacity of the barrier net may prove to be insufficient in a worst-case rockfall that is able to bounce and roll on top of the debris cone and directly into the barrier net.

RISK LEVEL

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

- The Probability Factor for this site should be set at 15 to reflect the active rockfall conditions at this site, with ongoing and persistent rockfalls during specific times of the year and where the area producing rockfalls is expanding. This is unchanged from the 2006 and 2007 assessments.

- The Consequence Factor for this site should be set at 7. This is an increase from the value of 6 recommended after the 2007 inspection in order to reflect the further degraded condition of the barrier net due to lack of maintenance. It also reflects the potential for an individual rock large enough to damage or destroy a vehicle and severely injure the vehicle's occupants to exceed the barrier net's current capacity and impact the highway. For example, it is possible that the approximately 2.2 m x 1.3 m x 0.9 m rock that was retained by the barrier net in April 2006 could exceed the net's current capacity and impact the road.

Therefore, the current recommended Risk Level for this site is 105, which is an increase from the value of 90 that was recommended after the 2007 inspection. For reference, when the barrier net is maintained at its design capacity and the accumulated rockfall debris behind the net is kept reasonably low, then the Risk Level is reduced to 15.

RECOMMENDATIONS

Maintenance and Short Term Measures

- As discussed on site, AMEC recommends that the debris behind the barrier net be cleaned out as soon as possible to restore the capacity of the barrier net. If the maintenance contractor personnel consider working in the net area to be unsafe due to rockfall from above, then a specialized subcontractor from BC should be brought in to scale and remove pending rockfall material from the crest of the slope immediately above the net as well as any material that is thereby loosened and ravelling down.

- The seam ropes and 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 ensure the design net height.

- 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

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

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APEGGA Permit to Practice No. P-04546

Reviewed by:

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Attachments: Site Plan
Photos