



October 14, 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 S5 – Chin Coulee, Highway 36:02
2010 Annual Inspection Report**

This letter documents the 2010 annual site inspection of Site S5 – Chin Coulee on Highway 36:02, approximately 20 km south of Taber, AB and on the north approach slope to the highway bridge across the Chin Coulee Reservoir. This site is located on the upper portion of the north slope above the Chin Coulee Reservoir, where the highway is oriented cross-slope as it descends to the bridge across the reservoir.

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 23, 2010 by Mr. Bryan Bale, P.Eng., of AMEC, in the company of Mr. Roger Skirrow, P.Eng., 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 Geotechnical File Review (Section A of binder) and summarized in previous annual inspection reports¹.

Landslide movement undermining the downslope shoulder of the highway was first noted by AT in the fall of 1978 and was reported to have occurred again in the spring of 1997. The landsliding consists of deep-seated instability (apparently inactive to intermittently active) in the north valley slope along with relatively shallower movements in the fill embankment immediately

¹ AMEC report "Southern Region Geohazard Assessment, Annual Assessment Report, 2008", project number CG25277, submitted to AT on September 8, 2008.

downslope of the affected segment of the highway. Geotechnical instrumentation was installed at this site in 1998 and the site has been monitored by AT and consultant personnel since that time.

Launched soil nails and a small retaining wall (“GCS wall” – supplier’s product name of Geosynthetically Confined Soils) were installed in May 2008 in order to reinforce the headscarp of the shallower, fill embankment landsliding where it had undermined a segment of the guardrail. Please refer to AMEC’s report to AT on observations from site visits during the soil nailing and wall construction² for further details.

SITE OBSERVATIONS

Key observations regarding changes in the site conditions since the 2009 inspection are summarized as follows:

- The condition of the retaining wall has worsened considerably since 2009. The previously noted cracking of the footing has progressed to the footing being broken completely (Photo S5-1). The wall has continued to settle in the centre (Photo S5-2), from the estimated 150 mm cm of differential settlement in 2009 to roughly 300 mm cm in 2010. As a result of the settlement, the bottom four 4 courses of cinder blocks have broken blocks. The settlement appears due to continued slumping of the colluvium soil beneath the wall foundation.
- The fill behind the wall has settled by up to 500 mm cm adjacent to the road surface (Photo S5-2), forming a scarp along the guardrail. This has resulted in two of the guardrail posts becoming undermined. The guardrail has noticeably settled and shifted towards the wall. The settlement has also left the road surface unsupported, and a circular scarp has formed in the road shoulder (Photo S5-3). Slumping and cracking of the road surface has occurred in this area in the past and may occur again in the future due to loss of the support formerly provided by the GCS wall.
- Fresh cracks were observed in the regraded slopes adjacent to the retaining wall that were regraded in May 2008, as is shown in Photo S5-4. The vegetation has become fairly well established in these areas, with no erosion problems.
- An erosion gully that had been forming below the culvert outlet to the west of the wall appears unchanged since 2009.

² AMEC report “Highway 36:02, Site S5 – Chin Coulee, Soil Nailing and GCS Wall Construction, Observations From Site Visits During Construction”, submitted to AT on May 27, 2008, AT Service Contract Number R1/037/08, AMEC project number CG25276.

- A scarp has formed on the slide mass below the wall, as is shown on Photo S5-5, and likely indicates continued movement of the slide mass. Photo S5-6 shows the general site area from below the retaining wall.

The May 2010 instrument readings at this site did not show any confirmed slope movement, which continues the trend of no significant slope movement since 2000 and 2002. Based on the locations of the functioning slope inclinometers GA98-2 and 2002-1 (illustrated on the site plan, Figure S5-1), this indicates that the previous landslide movement delineated by the visible scarp just below the south shoulder of the highway has not expanded laterally or retrogressed upslope and below the highway, nor has there been any recent reactivation of the deeper-seated landslide movement extending below the highway.

ASSESSMENT

Shallow Landsliding (Fill Embankment Along Downslope Side Of Road, Undermining The Guardrail)

The risk to the road surface from the shallower, fill embankment movements that were undermining the guardrail had been reduced by the construction of the retaining wall and soil nails. The soil nails continue to function properly, however the retaining wall is becoming less effective in supporting the guard rail posts and the risk to the road surface is increasing. Fill placement on top of the wall may be effective to support the guardrail posts; however this would in turn cause further settlement and eventual collapse of the wall. Alternatively, longer guardrail posts could be installed however this would not necessarily prevent loss of ground from between the guardrail posts. The paved shoulder has been damaged and requires repair for safe operation.

Potential Deep-Seated Landsliding

The tension cracks and scarps noted on the slide mass below the wall indicate that the colluvium within the old slide area continues to creep/slide down the slope. This may indicate a retrogressive type failure in the long-term.

The spring 2008 repair work was targeted to address the shallower, fill embankment movements and does not have any effect on the risk to the road from a potential reactivation of the overall deep-seated landsliding at this site. The risk to the highway from deep-seated landsliding has been managed by the planning and preliminary design for an upslope shift of the highway alignment as part of the 2004 Functional Planning Study. This repair design could be finalized promptly if required in the future due to a reactivation of the deep-seated landsliding with significant damage to the existing highway.

RISK LEVEL

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

Shallow Landsliding (Fill Embankment Along Downslope Side Of Road, Undermining The Guardrail)

- Probability Factor of 10 based on the estimated moderate rate of ongoing shallow movement in the slope below and adjacent to the highway (i.e. the ground movement that sheared-off SI 98-3 on the slope below the highway). The two functioning SI's at this site are outside of the shallow landsliding, therefore the movement has been conservatively assumed to be ongoing. This is consistent with the observations of cracking and scarps in the slide mass.
- Consequence Factor of 2 based on the potential loss of a portion of the roadway but not requiring closure of the entire roadway. This is an increase from the value of 1 recommended after the 2009 inspection, and is a return to the value recommended prior to the construction of the retaining wall and soil nails. The damage to the paved shoulder noted in 2010 is similar to the cracking and settlement that had occurred prior to the soil nailing and retaining wall construction.

Therefore, the current recommended Risk Level with respect to the shallow landsliding is 20, which is an increase from the value of 10 recommended after the 2008 and 2009 inspections.

Potential Deep-Seated Landsliding

The risk associated with potential deep-seated landsliding at this site is unchanged from the 2008 inspection. In summary:

- Probability Factor of 3 since instrument data shows that the deep-seated movement below the road alignment has been inactive for several years and the probability of remobilization is judged to be low.
- Consequence Factor of 5 on the basis that a large portion of the highway could be significantly damaged by a reactivation of the deep-seated failure mode.

Therefore, the current recommended Risk Level with respect to the potential deep-seated landsliding is 15, which is unchanged from the 2008 and 2009 inspections.

RECOMMENDATIONS

Maintenance and Short Term Measures

- The retaining wall is not properly supporting the guardrail posts and road surface. Fill placement and/or longer guardrail posts are required to restore support, however it should be noted that placing additional fill atop the GCS wall would temporarily support the guardrail however it would also further destabilize the wall. The road surface should also be patched to maintain a smooth surface. The maintenance contractor should be aware that the wall is expected to degrade in the future, and inspection of the site should be performed regularly to determine when repairs are required.

Long Term Measures

- Continue the semi-annual instrument readings, including a visual inspection of the condition of the wall and adjacent slope face during each site trip for instrument readings.
- Discontinue the annual site inspections by AT and the regional geotechnical consultant unless the visual inspections during the semi-annual instrument readings or inspection by the maintenance contractor identifies something of concern.

Investigation

No further investigation work for this site is recommended at this time. There are no functioning SI's on the presumed active landslide below the retaining wall. Although access to this area would be difficult, it may be worthwhile to consider the installation of additional instrumentation in this area, especially if other work is planned in the area of the retaining wall. Installing instrumentation is not considered critical if there is a plan ready to shift the road to the upslope if landsliding damages the road significantly.



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 14, 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: Site Plan
Photos