Highway 940 – Km 15 Embankment Slide

This site is located approximately 15 km northbound along Highway 940 from the intersection between Highway 940 and Highway 3, in Coleman, AB. The site location is shown on Figures B1 and B3 in Appendix B. The site coordinates are listed in Table B1 in Appendix B. This site is approximately 100 m southbound from the Km 15 Cut Slope site.

The site inspection was performed on September 27, 2008 by Mr. Andrew Bidwell, P.Eng. of AMEC.

Background

AMEC is not aware of any previously reported problems or repair work at this site. The September 2008 site inspection was performed as part of the Highway 940 geohazard corridor review.

A general description of the geological and climatic conditions in this area is presented in Section 5.2 of this report.

Site Observations

- The segment of the highway at this site is a two lane, gravel surface road along a northwest/southeast orientation.

- The site is located in the downstream (east) face of a highway embankment crossing an unnamed tributary of Vicary Creek.

- The creek flow is conveyed from southwest to northeast across the highway alignment by a 900 mm diameter culvert at the base of an approximately 10 m high fill embankment. A cross-section of the embankment is attached.

- Please refer to the inset site plan sketch on the attached cross-section figure for a schematic site layout and the relative locations of the site features.

- There is an earth slide in the east embankment face, upstream of the culvert outlet. The slide is in the mid-slope area, roughly 3 to 4 m wide at the headscarp and with a depth of movement in the order of 1 to 1.5 m. The headscarp of the slide exposes embankment fill soil ranging from fines to gravel sized particles. Photos 940-6 and 940-7 show the slide.

- It appears that the slide has been triggered by erosion of the toe of the embankment slope along the east road ditch. The segment of the east ditch along the downstream toe of the embankment is being downcut and the

sidewalls locally undermined by erosion along the base of the ditch. This segment of the ditch connects the upland area south of the creek valley and the creek channel downstream of the embankment, and therefore has a significant gradient. The erosion appears to be due to ditch flow from the upland area south of the embankment picking up velocity along this segment of the ditch.

- As shown on the attached cross-section, there were tension cracks and signs of shallow sliding in the embankment slope face for a distance of approximately 5 m upslope from the slide headscarp. As shown in Photo 940-6, there were also tension cracks extending laterally to the north of the slide that could be traced across the mid and lower portions of the embankment slope, as shown on the attached site sketch.

- There was also a secondary slide in the toe of the embankment slope and immediately to the north of the culvert outlet, as shown in Photo 940-7. This slide appeared to also be due to ditch erosion, but had not retrogressed as far upslope as the main earth slide described above.

Assessment

The tension cracking and earth slide in the downstream embankment slope are not currently affecting the road surface. Based on the current appearance of the site, it is reasonable to expect that over time the instability will retrogress at least slightly further upslope. However, it does not appear that the northeast edge of the road surface will become undermined for at least several years if at all.

It is also possible that the area with tension cracking adjacent to the north side of the existing slide, as shown in Photo 940-6, will begin to slide. If the instability spreads like this, this would threaten to eventually undermine a longer segment of the northeast edge of the road.

As shown on the attached cross-section, there is ample room to shift the road to the southwest if required if the northeast edge of the road eventually becomes undermined. Therefore, if the northeast edge of the road were to eventually start to become undermined, the consequences should be easily manageable.

A proactive repair to the current sliding and tension cracking in the embankment slope face is advisable because it would require less effort than attempting to repair a larger slide on the embankment face in the future if the road starts to become undermined.

Repairing and stabilizing the embankment slope should be a matter of mitigating the ongoing erosion along the east road ditch, regrading the embankment slope to a stable angle and sealing the open tension cracks to minimize surface water infiltration.

Risk Level

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

- Probability Factor of 6 because the sliding and adjacent tension cracking on the downstream embankment face appears to be active with a relatively slow rate of movement but with some uncertainty regarding the rate of movement.

- Consequence Factor of 1 based on the negligible impact on the road surface to date or for the near future. The Consequence Factor will increase over time as the slumping and tension cracking retrogresses upslope towards the road.

Therefore, the recommended Risk Level for this site is 6.

Recommendations

Maintenance and Short Term Measures

There is no immediate impact to the road at this site and no short term repair measures are recommended.

Proactive Repair Measures

It is recommended that the current ditch erosion and resulting sliding and tension cracking in the downstream embankment face be mitigated rather than deferring any repair work until if and when the instability retrogresses upslope and begins to directly undermine the northeast edge of the road. The effort required to repair the current erosion and instability would be much less than a future repair of a larger area.

The mitigation work should consist of the following:

1. The segment of the east road ditch along the toe of the embankment slope should be lined with a geosynthetic product in order to minimize erosion of the exposed soils and promote vegetation growth along the ditch sideslopes. This could be supplemented with a series of rock check dams (using locally available rock) along the ditch to limit the velocity of the ditch flow. The check dam concept is illustrated on the attached copy of AT's Best Management Practice #7 for Erosion and Sediment Control along highways.

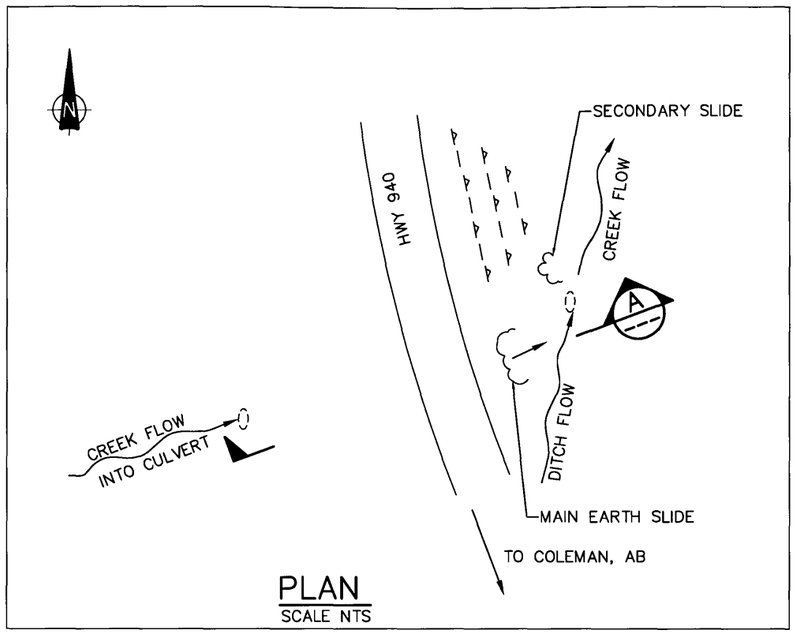
2. The headscarp of the existing slide should be graded down slightly from its near-vertical inclination (e.g. a laborer with a shovel should trim back the oversteepened scarp). The exposed soils in the headscarp and slide area

should then be covered with a seeded erosion control product secured to the slope face or hydroseeded.

3. The tension cracks in the embankment slope face should be backfilled with clay material (or even bentonite chips), shoveled into place by laborers and tamped/compacted in order to minimize the infiltration of surface runoff into the open cracks. The sealed cracks should then be covered with topsoil and hydroseeded.

Investigation

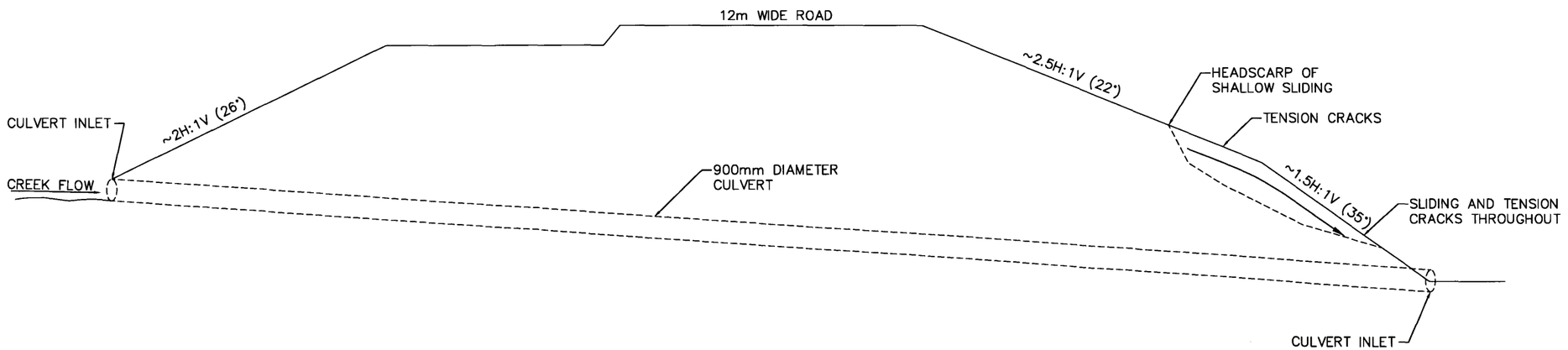
No site investigation work is recommended at this time.



PLAN
SCALE NTS

SOUTHWEST

NORTHEAST



A TYPICAL CROSS SECTION
SCALE APPROX. 1:200

SCALE
1:1000 0 10 20m

SCALE
1:200 0 1 2 3 4m

amec Earth & Environmental

CLIENT: Alberta Transportation

PROJECT: HWY 940 GEOHAZARDS REVIEW				
TITLE: Km 15 EMBANKMENT SLIDE NE EMBANKMENT SLOPE CROSS SECTION				
DATE: JANUARY 2009	JOB No.: CG25262	CAD FILE: 25262Z10.dwg	FIGURE No.: .	REV. A

Hwy 940 – Km 15 Embankment Slide

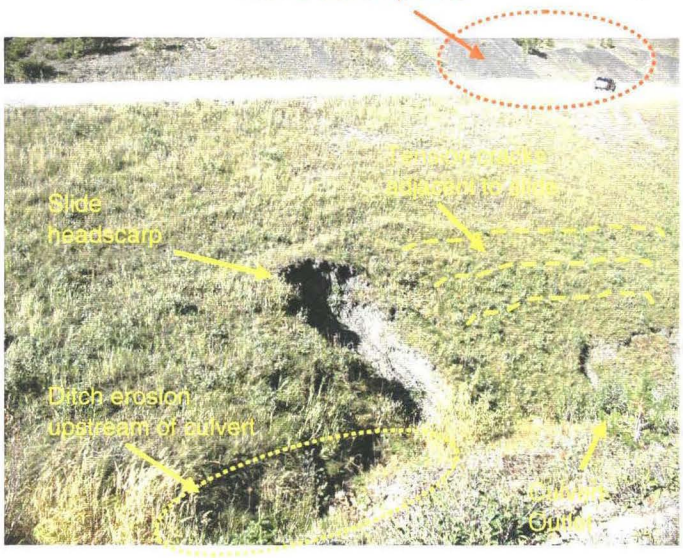


Photo 940-6 (top) – Facing northwest toward the slide area on the embankment slope. The slide appears to have been triggered by ditch erosion along the toe of the embankment slope. Tension cracks were visible in the embankment slope adjacent to the active slide, and that area may further destabilize in the future.

Photo 940-7 (middle) – Facing upstream along the ditch, showing the position of the existing slide relative to the culvert outlet. Also note the secondary earth slide at the toe of the embankment slope and immediately north/downstream of the culvert outlet (lower right corner of this photo).

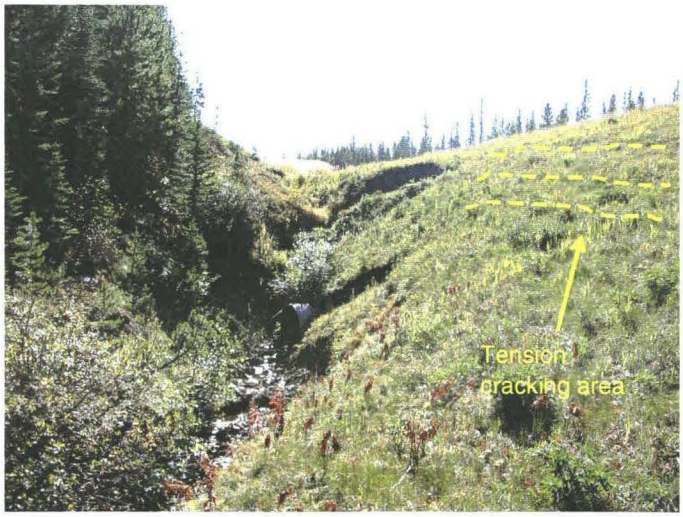


Photo 940-8 (bottom) – Wider view facing upstream along the ditch. Note the erosion along the ditch relative to the location of the slide in the embankment slope face and the tension cracking area.