4.6 S7 – MILLARVILLE

Background

The Millarville site is located on Secondary Highway 549:02, approximately 12 km west of Millarville and approximately 1.5 km west of the junction with Secondary Highway 762. This site has been inspected by AIT and consultant personnel since 2000 under the Southern Region GRMP.

Ongoing landslide movement at this site causing cracking and settlement of both lanes of the highway was first noted in 1987. Between 1987 and 2004 the road surface required numerous overlays and patching to mitigate the effects of the cracking and settlement through the slide area. AMEC performed a geotechnical site investigation and design of a shear key and slope flattening works for this site and these repairs were implemented in the fall of 2004. The site has been inspected annually since the repairs.

Please refer to Section A of the site binder for a more detailed discussion of the site background.

Site Assessment

The site assessment was performed on June 18, 2007. The weather at the time of the site assessment was partly cloudy with a fast approaching thunderstorm.

Please refer to Appendix S7 for a site plan illustrating the layout of the site. A current survey of the site topography is not available, and the topography shown on the site plan in Appendix S7 pre-dates the construction of the shear key and the slope flattening work that was done at this site in the fall of 2004.

The assessment covered the highway surface through the landslide area along with visual observations of the slope faces on either side of the highway.

Observations

The following points summarize the observations made during the site assessment. Please also refer to Appendix S7 for a site plan and annotated photographs illustrating key observations.

- A well-defined diagonal crack across the entire width of the highway was noted around Sta. 5+280 to 5+290 (approximately) and as shown on Photos S7-1 to S7-4. At the time of the inspection, the area to the east of the crack was downdropped approximately 30 to 50 mm relative to the west side. The orientation of the crack and the vertical displacement around it suggests that it forms the west/southwest flank of a landslide across the highway alignment. Cracking with a similar orientation but without such pronounced vertical displacement was noted in this area as well as further eastbound (around Sta. 5+320) in the 2005 and 2006 inspections. It appears that the specific cracking noted in 2005 and 2006 has been paved over and the currently visible cracking and settlement has formed since that time.

- A single crack was noted in the segment of the road through the area where the shear keys were constructed in the fall of 2004 (between approximately Sta. 5+400 and 5+460). No vertical displacement was noted across this crack. Photo S7-6 shows the crack. Otherwise, the road surface in this area was intact and in good condition with no visible signs of landslide damage from after the 2004 repairs. Photos S7-5 and S7-6 show this area.

- As noted during the previous inspections, the outlet of the weeping tile drain that was installed in the base of the lower shear key and daylighted near the toe of the slope immediately to the west of the 1200 mm culvert outlet could not be located during the site inspection. It appears that the drain outlet has been buried by soil washed down the slope face by surface runoff. The slope face around the expected drain outlet location was moist to wet at the time of the inspection but it was not possible to confirm if the drain outlet was discharging water at the time of the inspection.

Assessment and Risk Level

AMEC recommends the following Risk Level factors for this site:

- The Probability Factor should be set at 10 in order to reflect the cracking and settlement observed around Sta. 5+280 and 5+290, to the west of the area where the shear key was constructed in the fall of 2004. This is an increase from the value of 8 recommended after the 2006 inspection. The current damage to the road surface appears to have formed since the 2006 inspection with a greater magnitude of settlement than associated with similar cracking in this area in 2005 and 2006.

- The Consequence Factor should be set at 3 to reflect the degree of damage to the road surface due to this cracking and settlement, i.e. necessitating warning signage regarding the bump in the road grade and perhaps a reduced speed limit if further damage occurs.

Therefore, the current recommended Risk Level for this site is equal to 30, which is an increase from the value of 24 after the 2006 assessment. It should be noted that this Risk Level is applicable to the cracking and settlement around Sta. 5+280 and 5+290, west of the area where the shear key was constructed in the fall of 2004 (and which now has a lower Risk Level).

Recommendations

AMEC recommends the following work for this site:

SI's should be installed around the diagonal cracking and vertical downdrop area around Sta. 5+280 and 5+290 in order to check for active landslide movement creating a risk to the highway. Based on the previous borehole drilling in this area, it is expected that clay and clay till soils underlie the highway and any landslide movement may be driven by high groundwater pressures. Therefore, **piezometers should also be installed** to check the piezometric conditions in this area.

The shear key drain pipe outlet should be located, daylighted and marked with a delineator post for future visual inspection. It is very important that the drain outlet be visible for future inspection because the drain is a key component of the design of the shear key. Therefore, the drain outlet must be kept daylighted for visual inspection as required. The as-built survey data from the drain pipe installation could be used to locate the now-buried outlet. This action item remains incomplete from the recommendations after the 2005 and 2006 inspections. If the drain pipe outlet cannot be located and exposed, then another option would be to install standpipes into the shear key to provide a means for monitoring the groundwater level in the shear key backfill. However, this option is not recommended because the boreholes for the standpipe installations may penetrate through the geotextile lining the base of the shear key.

Semi-annual readings of the recommended new instruments and an annual assessment should be performed in 2008. The data from the new instruments and future inspections will help to confirm and update the Risk Level and determine if repair measures are required.

5.0 SUMMARY

A list of the sites, ranked by current recommended Risk Level, is presented in Table A4 in Appendix A for reference. This table also shows:

- Which sites have been recommended for further assessment (e.g. site investigation).
- Which sites have been recommended for repair work, and whether or not the recommended repair work is pending.

6.0 CLOSURE

This report has been prepared for the exclusive use of Alberta Infrastructure and 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,

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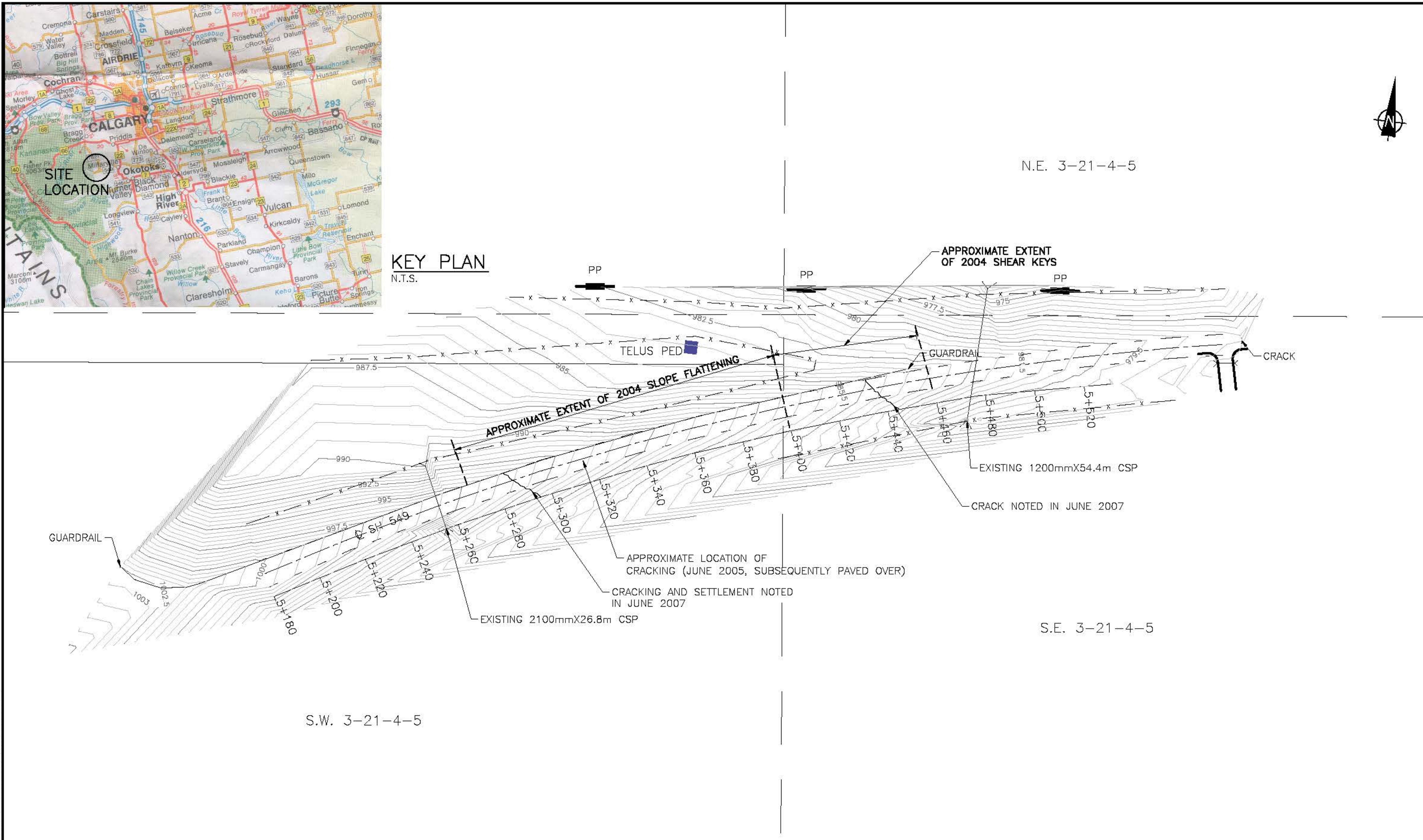
*PLOT 1:1=B (L)



KEY PLAN
N.T.S.

SCALE
1:1500
0 10 20 30 m

NOTES:

1. TOPOGRAPHY AND SITE FEATURES SHOWN ARE FROM 2001 AND DO NOT REFLECT THE EARTHWORKS PERFORMED AT THIS SITE IN LATE 2004.
2. ALL INSTRUMENTATION BOREHOLES FROM 2001 HAVE BEEN PAVED OVER OR REMOVED DURING 2004 EARTHWORKS.

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CLIENT:
Alberta
INFRASTRUCTURE AND TRANSPORTATION

PROJECT:
SOUTHERN REGION GEOHAZARD ASSESSMENT

TITLE:
INSTRUMENTATION SITE PLAN
SH 549 - WEST OF MILLARVILLE

DATE:	JOB No.:	CAD FILE:	FIGURE No.:	REV.
AUGUST 2007	CG25263	25263N11.dwg	FIGURE S7-1	A

I:\CG\25263\25263N11.dwg - FIGURE S7-1 - Aug. 23, 2007 1:37pm - scott.peters

Photo S7-1 – June 2007 (upper left)
Facing east across the area where a pronounced diagonal crack and downdrop of the road surface was observed around Sta. 5+280/5+290 in the 2007 inspection. This area is approximately 120 m west of where the shear keys were installed in 2004 to mitigate landslide damage to the road surface. The crack position is marked with the orange “Sharp Shoulders” sign on the south side of the road and the vertical displacement across the crack is visible in the guardrail profile.

Photo S7-2 – June 2007 (upper right)
Closer view, facing east, of the diagonal crack and downdrop area around Sta. 5+280 and 5+290. This location was marked with a “Sharp Shoulders” sign at the time of the inspection.

Photo S7-3 – June 2007 (lower left)
Facing northwest across the diagonal crack and downdrop area around Sta. 5+280/5+290. At the time of the inspection, the road surface to the east of the crack (right hand side of photo) was downdropped approximately 30 to 50 mm relative to the west side.

Photo S7-4 – June 2007 (lower right)
Facing west across the diagonal crack and downdrop area around Sta. 5+280/5+290. The vertical displacement across the crack is clearly visible.

Photo S7-5 – June 2007 (upper left)
Facing east across the segment of the highway where the shear keys were installed in 2004 (approximately Sta. 5+400/5+460) in order to prevent further landslide damage to the highway. Aside from one crack in the road surface (shown in Photo S7-6), there has been no further damage to the road surface since the repair.

Photo S7-6 – June 2007 (upper right)
Facing west across the segment of the highway where the shear keys were installed in 2004. The diagonal crack visible in the middle background (highlighted in the photo) has developed since the repair, but otherwise no further damage to the road surface. There was negligible vertical displacement across the crack at the time of the inspection.