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1.0 INTRODUCTION

AMEC Earth and Environmental (AMEC), a division of AMEC Americas Limited, performed a call-out site inspection at a site exhibiting cracks in the road surface along Highway 762:02 on March 5, 2010. The site is referred to as the "Hwy 762:02 Km 9.5 Surface Cracks Site". The call-out request was made by Mr. Ross Dickson of Alberta Transportation (AT). The site inspection was performed by Mr. Bryan Bale, P.Eng. of AMEC.

The purpose of the site inspection was to:

- Inspect some cracking and vertical deformation along the road surface that had been noted by AT personnel as potentially being a slide area that could affect the road.
- Provide a preliminary assessment of the hazard conditions and associated risk to the highway.
- Provide preliminary recommendations for mitigative measures, along with recommendations for further investigation and assessment of the hazard conditions.

The call-out site inspection was authorized under AT Consulting Services Agreement CE061/08.

2.0 SITE LOCATION AND GENERAL DESCRIPTION

The site is located at approximately Km 9.5 of Hwy 762:02, about 13 km southbound from the junction with Hwy 22X near Bragg Creek, AB. The site is between the existing S10A – "Archery Range" and S22 – "S-Curve" sites, at UTM coordinates 0677046 East, 5633073 North, Zone 11 U, NAD 27. Refer to the inset map in Figure 1 for the site location. The road at this location is oriented approximately north/south and traverses the side of an upland ridge to the east and a low-lying field to the west at a nearly level grade. The road has been constructed by excavation from the ridge to the east, and fill placement into the valley to the east (cut and fill).

The highway at the site has a single lane in each direction, with a 0.3 to 0.5 m shoulder and a 1.3 to 1.5 m high road fill embankment above the adjacent 3 to 4 m wide ditches. There are fences located along the ditch edge on both sides of the road. Upslope of the road there is a cut slope leading towards the natural treed slope above, and downslope is a natural slope leading to the farmed valley floor. The road is topped with asphalt pavement and an overlay was noted at the site area that appears to be several years old. It is understood that AT has noted cracks and settlement in the road surface that has reportedly worsened in recent months. Refer to Figure 1 for a site plan and cross-section through the area, and to Photograph 1 and Photograph 2 for the general site characteristics.

This site has not previously been reviewed under AT's Geohazard Risk Management Program.

3.0 MARCH 5, 2010 SITE INSPECTION

A site plan along with slope cross-sections through the landslide area is attached as Figure 1.

Key observations from the site inspection are outlined below and shown in the attached photographs:

1. Cracks were observed in the asphalt road surface and gravel shoulder perpendicular to the direction of travel, and also forming arc patterns. The locations of the cracks are shown on the site plan on Figure 1. The cracks were up to 40 mm deep with an aperture of 20 to 30 mm and no vertical downdrop. Some of the cracks extended onto the gravel road shoulder, which also had open cracks. Minor settlement was noted on the upslope edge of the road near the arc shaped cracks, which was only visible when standing downslope of the road with the road surface at eye level. When driving over the site the settlement is noted as a gentle bump. An asphalt overlay that appears to be at least several years old was noted at the site, the boundaries of which roughly correspond to the area presently exhibiting cracks in the asphalt surface. Refer to Photograph 3 to Photograph 6 for illustration of the cracks in the road surface.

2. The road is built in a cut and fill location where it traverses across the lower portion of the west slope of the north/south oriented ridge adjacent to the highway (see inset map on Figure 1). The cut slope above the road is at an angle of 28° and has sandstone cobbles/boulders protruding from the soil that may be indicative of bedrock near the ground surface. The slope is sparsely vegetated with small poplars, and shows no visible signs of shallow or deep instability. The natural slope above the cut slope is at an angle of 12°, is well vegetated with mature poplars, and also appears stable. The slope below the road is at 10°, is used for pasture, and appears stable. The road embankment is 1.3 to 1.5 m high above the adjacent ditches. Refer to the cross-section on Figure 1.

3. Barbed-wire fences exist both upslope and downslope of the road. The fences did not show any deflections indicative of ground movement.

4. The upslope ditch likely carries water during peak precipitation events and during periods of high groundwater flow (i.e. during spring thaw). At the time of the inspection the ditches contained hard-packed snow and ice. No culverts were noted in the immediate site area and it appears that water flows southbound from the site without ponding along the ditch.

5. Landsliding was not noted in the natural or cut slopes at the site. Damage to the road appears to be limited to the road fill embankment.

The extents of the cracks in the road surface at the time of the inspection were marked with paint for future reference.

4.0 DISCUSSION AND ASSESSMENT

Based on the observed arc-shaped pattern of cracking and settlement in the northbound lane, it appears that two shallow slumps (1 to 2 m deep) in the road fill towards the upslope ditch have caused the majority of the road damage. These shallow slumps are likely due to weak and poor quality fill material used for construction of the road embankment and possibly an underlying organic layer that was not fully removed during construction (based on site investigations at the nearby S10A – Archery Range and S22 – S-Curve sites). The other cracks perpendicular to the direction of travel are likely due to contraction and expansion of the road fill and surface due to seasonal temperature and water content variations in the road base.

AMEC understands that the cracking has worsened in recent months. Since the site has been generally frozen during that time, and damage to the road surface has reportedly worsened, it is expected that further road damage could occur during the spring melt or during the next large spring/summer precipitation event. Road damage would likely occur in the form of continued slumping in the northbound lane.

Three scenarios are presented below describing how the site may be affected into the spring/summer of 2010:

1. Continued Movement or Increment of Minor Magnitude – Settlement and cracking would continue requiring an asphalt overlay to restore the grade, and possibly a "bump ahead" sign in the interim.

2. Increased Rate of Movement or Increment of Major Magnitude – Slumps could form in the northbound lane requiring a reduction in the width of the lane or a temporary detour. A repair could be implemented in a day or two.

3. No Continued Movement – It is possible that the cracks and settlement have been present at the site for some time and are not actively forming. The report of increased settlement and cracking may be due to frost-heave which may become diminished after the ground thaws. Crack sealing would be required as part of the normal maintenance procedures.

Based on the single site inspection to date, it is not possible to determine which option will occur. AMEC judges that options 1 or 2 are the most likely, and bases the recommended risk level on these cases.

5.0 RISK LEVEL

Based on AT's general geohazard risk matrix, AMEC recommends the following risk level for the global landslide:

- Probability Factor of 5 based on the interpretation of the slumping/road surface settlement being active with slow or indeterminate rate of movement.

- Consequence Factor of 2 based on the potential loss of service of a portion of the northbound lane that would require signage and/or reduced lane width but no road closure.

Therefore, the recommended Risk Level for the Global Slide is 10 (i.e. 5 x 2).

6.0 RECOMMENDATIONS

AMEC recommends the following for this site:

1. Monitor the site during the spring thaw and peak spring/summer precipitation events for signs of increased cracking or settlement in the northbound lane. Regular visual monitoring to be performed by maintenance personnel, and the site should be inspected by AT and AMEC staff during the scheduled Southern Region Annual tour in June 2010. Due to the relatively low consequences associated with a large increment of movement, AMEC does not recommend installing instrumentation for monitoring but recommends relying on visual inspections only for the spring/summer of 2010.

2. Based on the visual monitoring up to June 2010, a maintenance or repair method can be selected from the following:

    a. Slow Movement Not Threatening Loss of Road – Repair the road surface with asphalt overlays and treat as an ongoing maintenance item. However, AT should consider the ongoing maintenance commitment and costs versus the upcoming asphalt overlay of this segment of Highway 762.

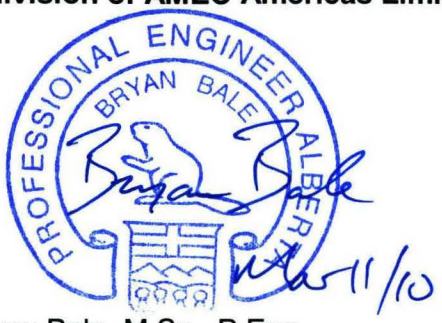
    b. Rapid or Episodic Movement – Rebuild the northbound lane at the damaged area with competent fill. Approximately 250 m^3 (500 tons) of competent fill would be required, with closure of the northbound lane during the repair. This option would also be suitable to mitigate slow and ongoing movement.

7.0 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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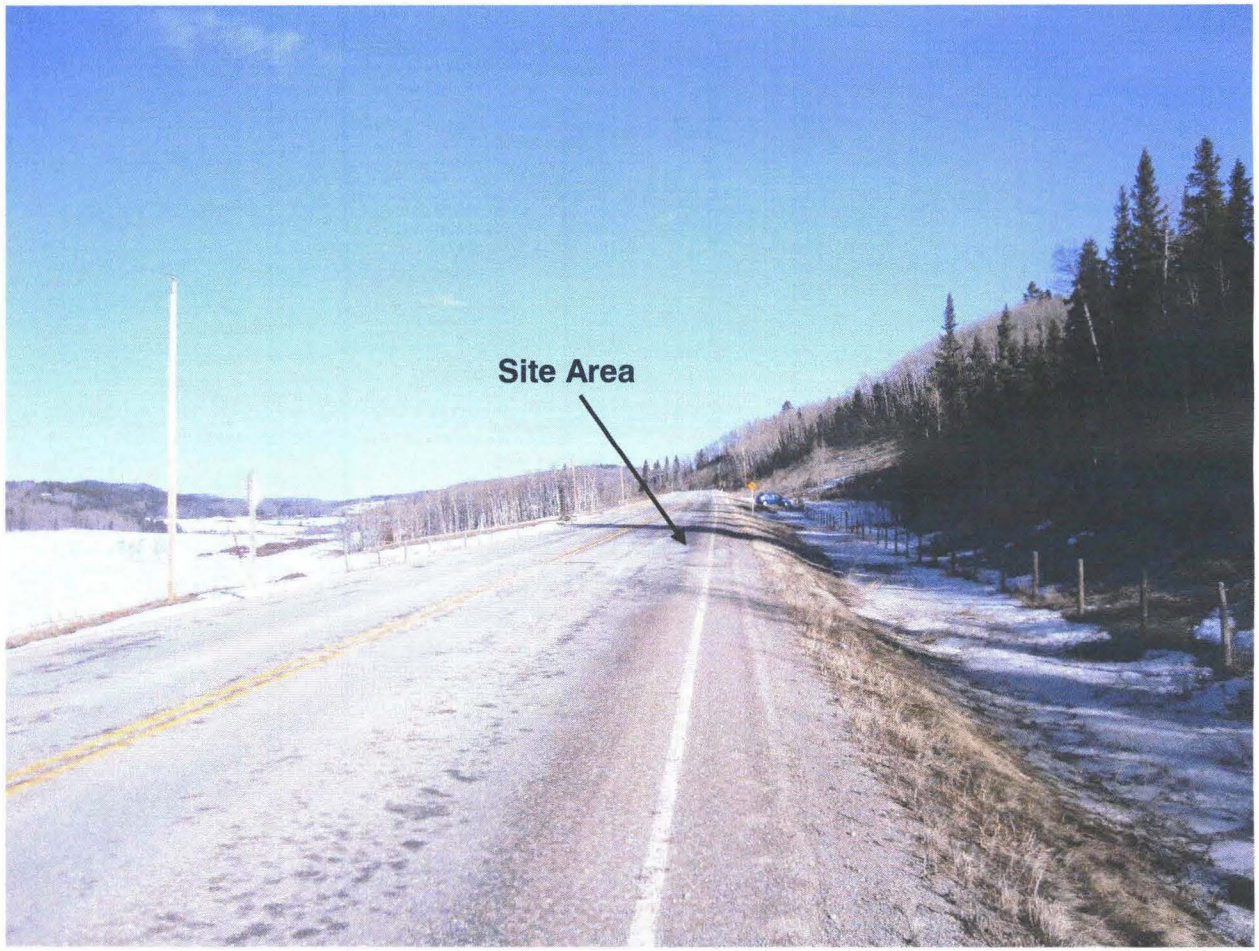
Reviewed by:

APEGGA Permit to Practice No. P-04546

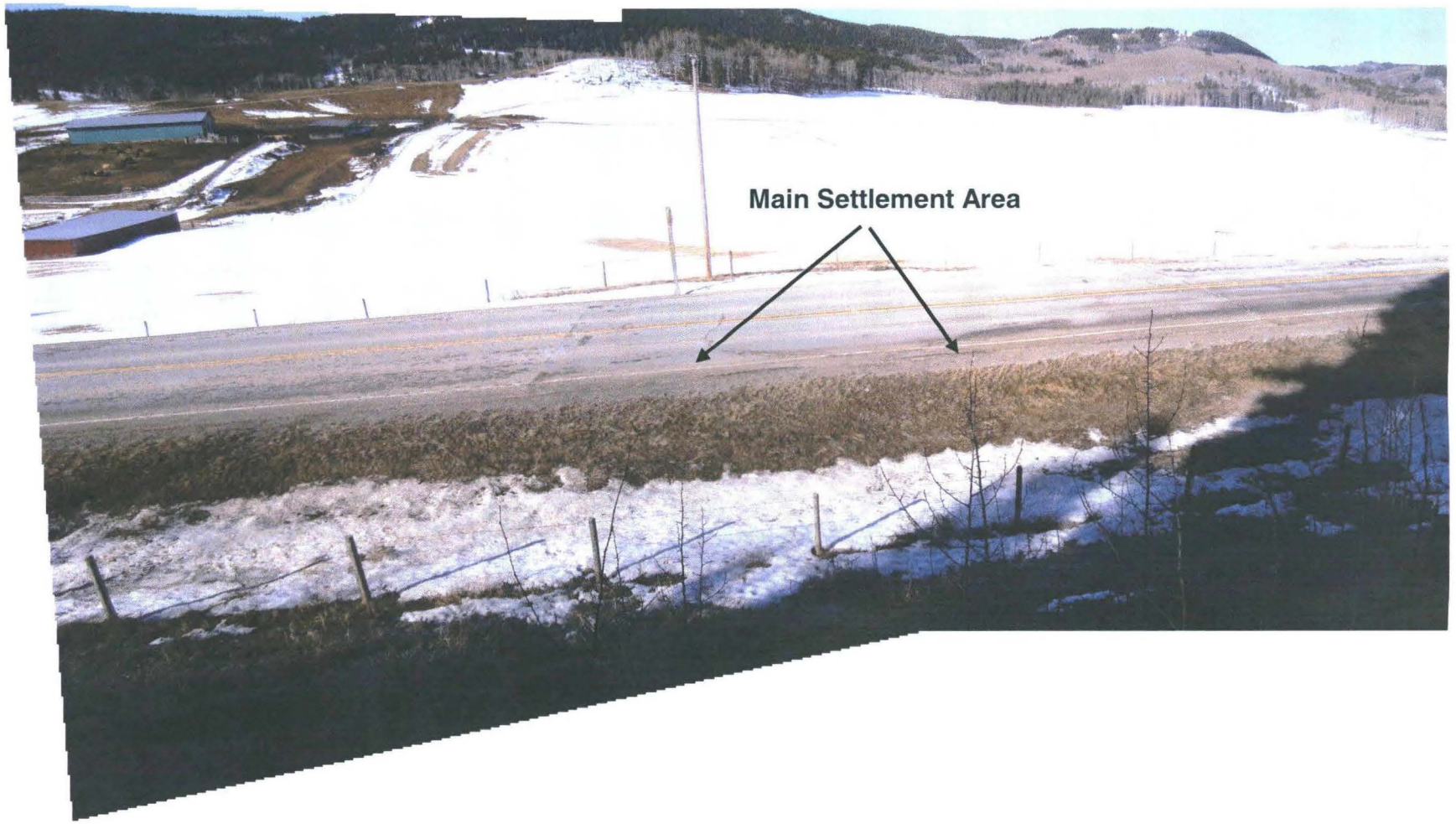
Andrew Bidwell, M.Eng., P.Eng.
Associate Geological Engineer

Attachments: Figure 1
Photos 1 to 6



Photograph 1 – Looking northbound towards the site area. The power pole and sign post are indicated on Figure 1 for reference.

Photograph 2 – Stitched photographs of the site area, facing northbound and taken from the west edge of the road, showing the natural slope downslope of the road, and the cut slope in the ridge upslope of the road.

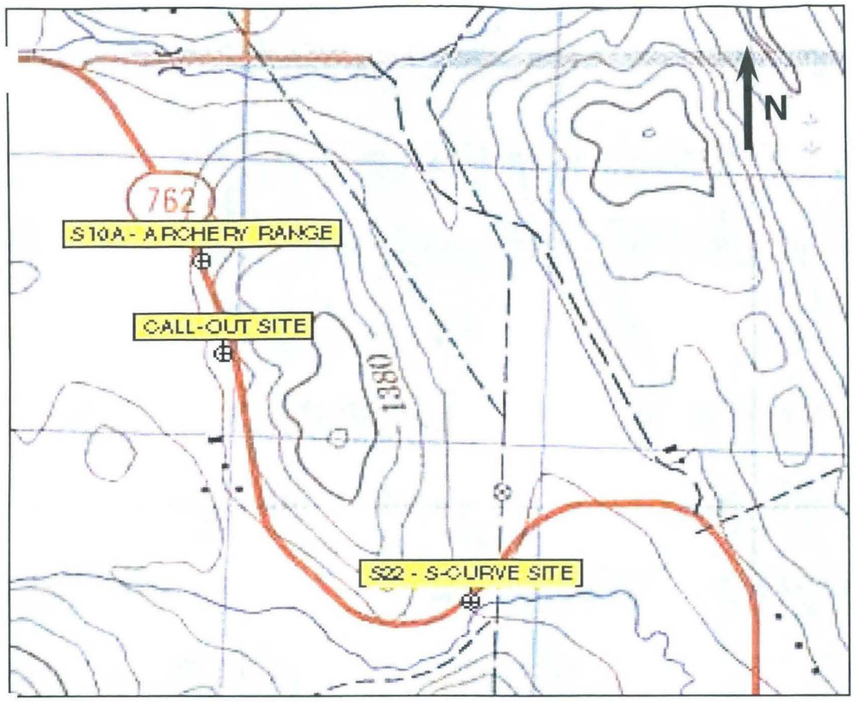


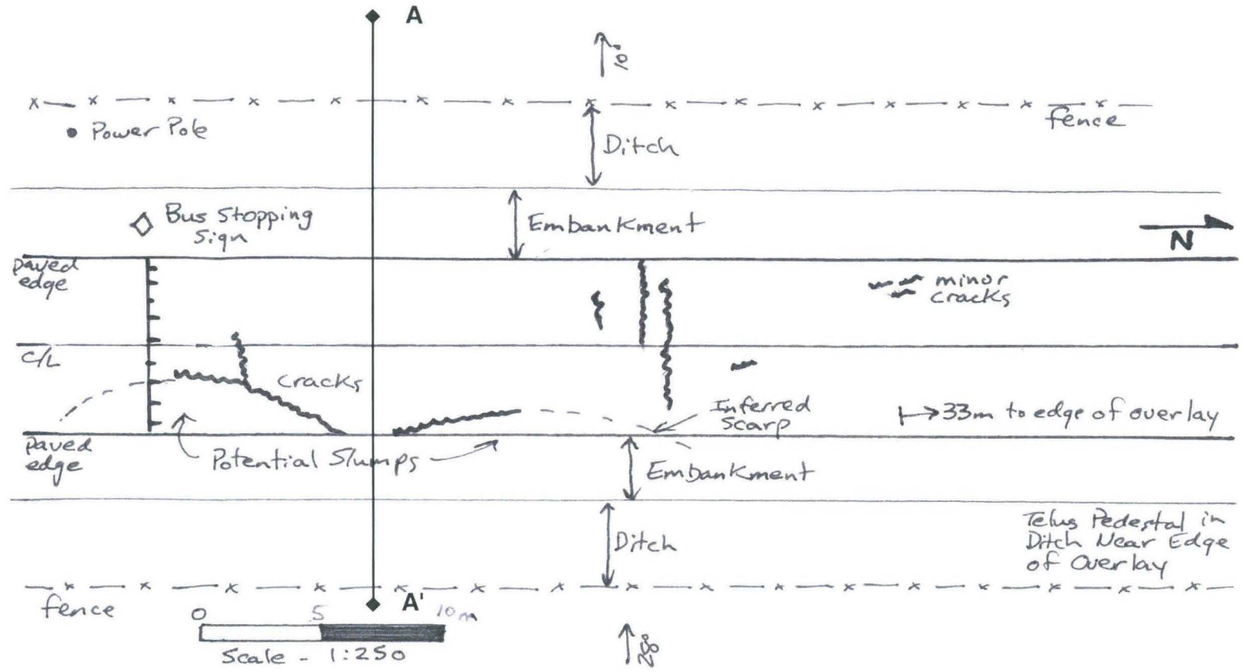
Photograph 3 – Stitched photographs of the site area from upslope showing the extent of cracking on the road surface, and the settlement areas.

Photograph 4 - Looking north towards the arc shaped cracks in the road surface. Field notebook shown for scale.

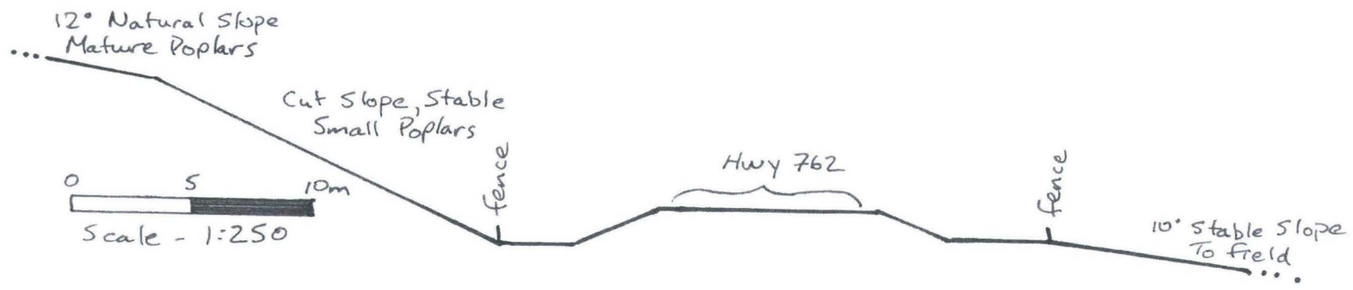
Photograph 5 – Looking west at the arc shaped cracks in the road surface.

Photograph 6 – Looking west at the cracks perpendicular to the direction of travel.





Approximate Site Plan



Approximate Cross-Section A-A'

Client: Alberta Transportation		**Figure 1**	
Project: **Hwy 762:02 - KM 9.5 Surface Cracks Site**		Date: **Mar-10**	Revision:
Site Plan and Cross-Sections		Job No.: **CG25309.D**	
		File No.:	

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