



January 2015

CG25399

Alberta Transportation
2nd Floor, 803 Manning Road NE
Calgary, AB T2E 7M8

Attention: Mr. Ross Dickson

Dear Ross:

**Re: Southern Region Geohazard Assessment
2014 Annual Inspection Report
Site S44: Highway22:06, Cow Creek Erosion**

This report documents the 2014 annual site inspection of Site S44 – Cow Creek Erosion site, on Highway 22:06, approximately 11 km north of Highway 3. At the site location, Highway 22:06 is a paved two-lane undivided roadway oriented north to south. The area is mainly farmland with gentle topography. Cow Creek approaches the highway from the northwest, crosses near Township Road 85A then parallels the highway. The creek encroaches towards the east side of the road embankment at one location and several more locations on the west side within an 800 m long segment of the highway. The legal description for the site area is between E34-8-2-W5 (north) and W35-8-2-W5 (south). Refer to Figure S44-1 for a map of the site location.

AMEC Environment & Infrastructure (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfilment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CON0013506). The site inspection was performed by Bryan Bale, P.Eng., and Tyler Clay, E.I.T., of AMEC; Roger Skirrow, P.Eng., and Ross Dickson of AT during the 2014 Annual Tour.

1.0 SUMMARY

Ongoing bank erosion towards the highway is evident and significant retrogression has occurred at the two most critical encroachment sites reducing offset (northernmost and southernmost encroachment areas). The risk for the both of the areas has increased slightly due to an apparent increase in the rate of retrogression, with the highest Risk Level at 39 for the southernmost encroachment area. The site is included in AT's Southern Region High Water Related Mitigation project. AMEC performed an aerial drone survey in October 2014 as part of a hydrotechnical assessment for preparation of preliminary design options. The preliminary design options are currently being prepared, with AT to choose a design to be finalized in 2015. The anticipated mitigation work is expected to involve bank armoring and possible channel training. The site should be inspected during the 2015 Annual Tour.

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2.0 BACKGROUND

At the site location, Highway 22:06 is a paved two-lane undivided roadway oriented north to south. The area is mainly farmland with gentle topography. Cow Creek approaches the highway from the northwest, crosses near Township Road 85A then parallels the highway.

The site was first inspected in September 2013 by AMEC as part of a call-out request by AT to supplement observations made during the 2013 Annual Tour and help assess potential damage from the June 2013 floods. During the call-out inspection, AMEC identified one encroachment area on the west side of the highway (referred to as the “North Site”) and two encroachment areas and a bank slide with partial encroachment on the east side of the highway (all referred to as being in the “South Site”). The North Site is approximately 100 m north of the Cow Creek crossing and the South Site is approximately 500 m south of the crossing. The highway is a fill section in both areas.

Based on the 2013 observations, AMEC recommended temporary barriers for the northernmost and southernmost encroachment areas if mitigation work was not to be completed in the short term. Conventional rip-rap armouring was considered the most practical long-term mitigation option, however further study was recommended to confirm the assessment. Refer to the 2013 call-out report¹ for further details on the site observations and assessment.

In October 2014, as part of AT’s Southern Region High Water Related Mitigation project, AMEC performed an aerial drone survey of the site to as part of a hydrotechnical assessment for preparation of preliminary design options. The preliminary design options are currently being prepared, with AT to choose a design to be finalized in 2015. The anticipated mitigation work is expected to involve bank armoring and possible channel training.

3.0 SITE OBSERVATIONS

Key observations regarding changes in the site conditions since the 2013 inspection are summarized below and illustrated on Photos S44-1 to S44-8. Refer to Figure S44-1 for a site map referring to the hazard locations. Note that the areas previously referred to as the “North Site” and “South Site” in the 2013 callout are referred to as Area A and Area B, respectively.

Area A (North Site)

- Encroachment Area A1 (previously referred to as “North Site Encroachment Area”)
 - The minimum offset measured from the bank crest to the western edge of the pavement was approximately 3.8 m. There was approximately 1 to 2 m of retrogression since the September 2013 inspection. Refer to Photos S44-1 and S44-2 for a comparison of the 2013 and 2014 conditions, respectively.

¹ AMEC Environment & Infrastructure, 2013. *Highway 22:06 – Cow Creek, Erosion Site, Call-out Report*, submitted to AT October 2013.

- A lath stake was placed at a 1 m offset from the bank crest to monitor future retrogression.

Area B (South Site)

- Encroachment Area B1 (not observed in 2013)
 - The encroachment at this creek meander was not noted during the 2013 inspection. It was contained within a fenced area.
 - The erosion area was approximately 25 m wide and had up to 2 m high grassy banks at 50 to 60 degree slopes.
 - The creek was not flowing in the old channel that ran against the toe of the bank meander. It appeared to only flow seasonally or during high water conditions and was not actively eroding the bank. Refer to Photo S44-3 for a general view of the bank edge at the creek meander.
 - The minimum offset between the bank edge and eastern road shoulder was approximately 6.7 m.
- Encroachment Area B2 (previously referred to as “Northernmost Encroachment Area of the South Site”)
 - The conditions in this area were mostly unchanged since the 2013 inspection. There was further lateral erosion at the south end of the encroachment area where the channel was diverted but overall the creek flow was not against the eroded bank. Refer to Photos S44-4 and S44-5 for a comparison of the 2013 and 2014 conditions, respectively.
 - The minimum offset between the bank edge and eastern road shoulder was approximately 6.7 m, which is unchanged from the 2013 conditions.
- Slide Area B1 (previously referred to as “Slide Area”)
 - The slide area along the creek meander did not have significant changes since the 2013 inspection. The minimum offset between the slide scarp and road edge was 11.5 m. Refer to Photo S44-6.
- Encroachment Area B3 (previously referred to as “Southernmost Encroachment Area”)
 - A guardrail has been installed on the east edge of the highway within the segment of encroachment.
 - The minimum offset between the bank edge and eastern edge of the pavement was approximately 8.2 m. There was approximately 1.6 m of retrogression since September 2013. Refer to Photos S44-7 and S44-8 for a comparison of the 2013 and 2014 conditions.
 - The orange fibre optic communication line had been disconnected or removed.
 - The bank edge was approximately 1 m from the ditch invert.
 - Three lath stakes were installed around the bank crest at 1 m offsets for future retrogression measurements.

4.0 ASSESSMENT

The retrogression of the identified encroachment areas towards the highway embankment is expected to continue. The rate of erosion is dependent on creek volume and will likely be higher at Encroachment Area A1 and Encroachment Area B3 where active erosion was observed. These encroachment areas had significant retrogression since the September 2013 inspection. The rate of retrogression should be expected to continue at both areas. The other encroachment areas were not observed to have active flow at the meanders and therefore are expected to retrogress at a much lower rate and are likely to only be affected significantly during high water conditions.

A sudden embankment failure affecting the pavement at Encroachment Area A1 or B3 is not expected based on the current bank height, offset from the road and observed creek conditions. The encroachment areas should be visually monitored annually and a guardrail should be installed at Encroachment Area A1 to protect motorists (similar to Encroachment Area B3).

Movement is expected at Slide Area B1 as the bank is eroded at the toe; however, it currently poses no risk to highway due to the sufficient offset. The landslide movement may affect buried utilities in this area. This is supported by signs of daylight work in the ditch near the slide area, observed during the 2013 inspection.

Encroachment Area B3 has eroded into the eastern ditch invert which could affect drainage conditions and cause flow into the exposed bank scarp, increasing erosion rates. Consideration should be given to creating a ditch block between the ditch area affected by the encroachment and installing a pipe to carry ditch flow.

Encroachment Area B3 is located on the apex of a large amplitude and tight radius meander bend. The channel is relatively well entrenched, resulting in severe attack on the outside of the meander bend, which is now encroaching into the highway right-of-way. The mechanism for bank loss is primarily hydrotechnical and is due to the attack that is occurring on the outside of the meander bend. The inside of the meander bend is a depositional zone and the gravel point bar which is located there appears to have increased in size as the outside of the meander bend has progressed towards the highway. A secondary mechanism for bank loss may also be due to groundwater seepage or ditch flow, which further destabilizes the eroding bank. Since the meander bend is quite entrenched, the bank erosion is expected to continue unless remedial measures are undertaken.

As noted previously, the site is part of AT's high water mitigation project and a hydrotechnical assessment and preliminary design is planned for 2015. The design concept is expected to involve bank armouring and possible channel training.

5.0 RISK LEVEL

AMEC recommends the following Risk Levels for these site areas, based on AT's general geohazard risk matrix:

Site Area A (North Site)

- Probability Factor of 12, based on an assessment that the scarp of the bank is expected to continually retrogress and cause settlement or damage to a portion of the road embankment. The rate of retrogression appeared to be increasing relative to the previous inspections. Erosion and retrogression rates will likely increase during years of high precipitation.
- Consequence Factor of 1, reflecting the fact that a large sudden failure is unlikely and the hazard does not currently impact the pavement. The encroachment has reduced the embankment width and created a drop-off that could affect the safety of a motorist under potential circumstances but poses no immediate risk.

Therefore, the recommended Risk Level is 12 (i.e. 12×1), which is increased slightly from the 2013 assessment due to the apparent increase in rate of active retrogression since the previous inspections (provided the limited monitoring period to date).

Site Area B (South Site)

Encroachment Area B3 presents the largest risk to the highway and motorists relative to the other hazards within the South Site area. The risk assessment below relates to this area directly.

- Probability Factor of 13, based on the current offset between the road and bank edge, previous flow volumes in this area with high angle of attack, and the increased erosion rate observed between the 2013 May and September and 2014 May inspections. Erosion and retrogression rates will likely increase during years of high precipitation.
- Consequence Factor of 3, reflecting the fact that the ditch has been affected and will continue to reduce in width as retrogression continues, decreasing ditch clearance, affecting buried facilities and creating a severe drop-off. A guardrail was installed in 2014 which has alleviated some of the risk for motorists relative to the drop-off and reduced ditch clearance. A large sudden failure is considered unlikely and to date the pavement appears unaffected by the erosion and encroachment. A lane closure would be unlikely.

Therefore, the recommended Risk Level is 39 (i.e. 13×3), which is increased slightly from the 2013 assessment of 36 due to the apparent increase in rate of active retrogression since the previous inspections (provided the limited monitoring period to date).

6.0 RECOMMENDATIONS

AMEC recommends the following:

6.1 Short Term / Monitoring

- A temporary barrier should be considered for Encroachment Area A1 if mitigation work is not completed in the short term.
- Consideration should be given to constructing a temporary ditch block and pipe to carry ditch flow within the Encroachment Area B3 until a more permanent repair is constructed.
- The site should be inspected during the 2015 annual tour.

6.2 Long Term / Mitigation

- The site is part of AT's high water mitigation project and a hydrotechnical assessment and preliminary design is planned for 2015. The design concept is expected to involve bank armouring and possible channel training.

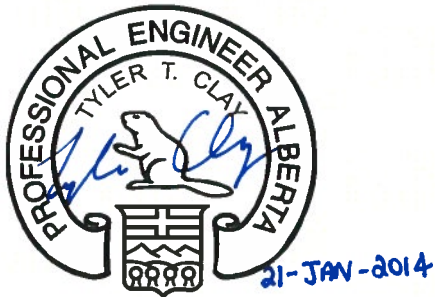
7.0 CLOSURE

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 Environment & Infrastructure, 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 Environment & Infrastructure,
a division of AMEC Americas Limited**



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