THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

December 12, 2006 File: 15-85-37

Alberta Infrastructure and Transportation
Room 301, Provincial Building
9621 - 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata

PEACE REGION (PEACE RIVER-HIGH LEVEL AREA)
GEOHAZARD ASSESSMENT
HWY 682:02 WEST OF FAIRVIEW - SITE 4 (PH 29)
GRIMM'S CREEK SITE
2006 ANNUAL INSPECTION REPORT

Dear Sir:

This letter documents the 2006 annual site inspection of erosion and slope instability along Hwy 682:02 at Site #4 – Grimm's Creek, west of Fairview, Alberta. The inspection was undertaken by Thurber Engineering Ltd. (Thurber) in partial fulfillment of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE049/2004) with Alberta Infrastructure and Transportation (AIT).

Mr. Barry Meays, P.Eng of Thurber undertook the inspection on June 15, 2006, in the presence of Mr. Roger Skirrow, P.Eng. of AIT.

1. BACKGROUND

The available background information for the site is described in the Geotechnical File Review in Section A of the site binder. More site specific and recent information are summarized in the 2005 inspection report and the November 29, 2005 Callout report included in Section B.

There are five slide/erosion sites located along Highway 682:02 extending along a 7 km length of this highway, as shown on Figure 1. Previously, all five of the sites were reported in the PH4 binder. However, the area has now been subdivided into 5 separate "PH" areas, and PH29 now includes only Site #4 located about 1.2 km east of the bridge crossing Hines Creek. The four most westerly sites are located

within the section of the highway that crosses the approximate 100 m deep valley of Hines Creek in a west-east direction.

No construction or maintenance work has been carried out at this site since our last visit in 2005.

2. SITE OBSERVATIONS

A site plan showing existing slide and erosion features is attached. The base plan for this figure was prepared by Mr. David Morrison of AIT using information from AIT's bridge files supplemented by picking up additional site features using a GPS unit. Thurber has added additional comments and notes, pertinent to our latest visit, in red. Selected photographs of the site, taken on June 15, 2006 are also attached.

Overall, conditions had changed significantly since the 2005 visit. The North slump and the West slump did not appear to have changed significantly, and the north/east sideslope did not appear to be noticeably worse. However a 15 m long crack was observed extending above and towards the east of the West slump. Additional cracks were observed outside the south edge of the sink hole overtop the culvert alignment.

Similar to last year, the stability and erosion conditions in the vicinity of the outlet of the culvert extension had deteriorated significantly since the 2005 visit. A new scarp was observed above the previous scarp located about 40 m above the culvert outlet. Slight seepage was emanating from the base of the former scarp about 35 m above the outlet where it formed a pond, and then was running downslope to the south side of the gabion baskets at the culvert outlet. A more well defined scarp and gully up to 1 m deep and 2 m wide (similar to a sunken channel) was observed along the erosion scar south of the culvert alignment between the 2 slide scarps observed last year along the lower portion of the site. Directly south of the culvert outlet along the south flank, new fresh, massive slumping had occurred exposing a bare backslope, including a large block of material (about 7 m x 20 m) which had separated from the sideslope and slid down. The gabion baskets that were located immediately beneath the culvert outlet were now eroded and detached from the culvert area, one piece transported about 20 m downslope.

Two slight dips were noted in the highway surface approximately over the culvert alignment. There were also some longitudinal cracks in the pavement; however these did not appear to be related to slope movements.

3. ASSESSMENT

The outlet area of the culvert extension is currently in a very unstable condition. The instability is considered to be triggered by aggressive down-cutting of the creek bed at and downstream of the culvert outfall. Most of the erosion likely occurs in the spring when melt water runoff flows are high. The erosion protection provided at the culvert extension outlet has not been sufficient to dissipate the flow energy from the creek water to prevent downward erosion at the outlet. Further downstream from the outlet, the creek gradient is too steep to prevent down-cutting of the native unarmored clay material.

The sliding has damaged the culvert. The November, 2005 inspection noted the presence of clay blockage inside the culvert extension pipe at 19 m from the outlet, and a sink hole at ground surface above the culvert alignment which suggest an opening or break in the pipe at one or more locations. The presence of the sink hole over the culvert extension alignment suggests that the culvert may have pulled apart and that water may be eroding outside the culvert. The sink hole is located about 75 m upstream of the pipe outlet, and the former 3 m high scarp marked “top of new slide” are two of the most probable locations of culvert separation.

The damaged culvert is likely charging the slope with water leading to the significant slide retrogression into the slope that has been noted since last year.

The North and West slumps could be the result of progressive softening and loss of cohesion to the clay fill in the embankment slope. The backscarps of those slumps approximately line up in a direction parallel to the river suggesting that the sliding could be related to poor quality backfill or fill placed over previously sheared river bank material.

4. RISK LEVEL

The risk level for this site has been assessed as follows:

PF(13) * CF(4) = 52 (same as last year)

A Probability Factor of 13 is considered appropriate since the slide near the culvert outlet is active with a high rate of movement. A Consequence Factor of 4 is considered appropriate since the slide is in a high fill and is affecting the function of a centerline culvert. If no remedial measures are carried out soon, this site could continue to deteriorate very rapidly.

5. RECOMMENDATIONS

5.1 Short Term

In the short term the culvert should be repaired prior to spring 2007 to prevent further erosion and extension of the slide areas. If water continues to leak from the culvert into the slide mass it could cause a faster/larger movement.

All of the short term repair measures outlined in the November, 2005 Callout report issued December 15, 2005 by Thurber still apply and should be adhered to, except that the last sentence in the first point should be changed so that the Class 2 riprap placement over the non-woven geotextile should be extended over a length of at least 10 m and to a height of 4 m [previously listed as 2 m] up each side of the natural channel.

5.2 Potential Long Term Measures

Possible long term solutions might consist of one of the following options assuming that the culvert has already been repaired:

a) Remove the slumped material back to the sinkhole, extend the smooth wall pipe further downstream to a location where the creek gradient flattens (to be determined by survey) and reconstruct the lower part of the slope with common clay fill. The clay could be obtained from the excavated material provided it is moisture conditioned (disced and dried) before use, or from the steep valley walls adjacent to the creek. This option will only be feasible if a longer pipe can safely pass the design flows. Suitable erosion protection and a flow dissipation bowl will be required at the outlet of the new pipe extension.

b) Construct a rigid concrete pile wall, concrete drop structure and concrete flow dissipation bowl across the creek valley near the existing culvert extension outlet. Remove the slide material upslope of the structure and replace it with suitable new common clay fill as discussed in Option a) above.

For each of the above options, consideration could be given to installing further natural drop structures at additional locations downstream of the outfall possibly consisting of staked natural logs (wattles) and/or biologs to slow and pool the water. Also, the areas of the sideslope that have been affected by shallow slumping at the North and West slumps could be subexcavated and rebuilt with reconditioned, lime or cement stabilized clay.

There is currently insufficient information available to provide an accurate estimate of the construction costs for the long term measures. However, based on previous projects they will likely be in the order of $1,000,000 to $1,500,000. The estimated cost has increased from last year because this site is deteriorating rapidly.

5.3 Investigation

The following investigation program is recommended to determine suitable long term measures to mitigate the instability and erosion problems at this site:

- Detailed survey of the sideslopes and culvert outfall area.
- Streambed profile from 100 m upstream of culvert inlet downstream to the confluence with Hines Creek.
- Review of drainage watershed, assessment of design flows and suitability of the existing culvert to pass the design flows (especially spring meltwater runoff events).
- Drill three test holes along the culvert alignment and 1 test hole above the North and West slumps. Install slope inclinometers (SI's) in 3 of the test holes and pneumatic piezometers in all of the test holes. The proposed locations of the test holes and Sis are shown on Figure 1.
- Drill two hand auger holes in the creek bed downstream of the culvert outlet.
- Carry out stability analyses and prepare remedial options.

Based on previous projects the above investigation and preliminary design work is expected to cost in the order of $55,000 to complete.

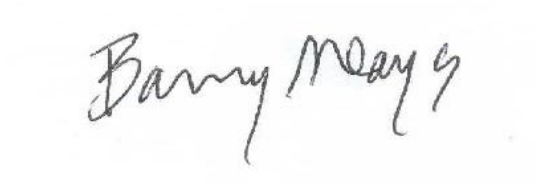
5.4 Maintenance

Culvert repairs and temporary riprap at the culvert outlet are the primary maintenance items for this site. These are discussed in more detail in our November 2005 Call out report.

6. CLOSURE

We trust this assessment and recommendations meet with your needs at this time. Please contact the undersigned should questions arise or if the slide conditions worsen.

Yours very truly,
Thurber Engineering Ltd.
Don Proudfoot, P.Eng.
Review Principal



Barry Meays, P.Eng.
Project Engineer
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Attachment

cc: Mr. Roger Skirrow, P. Eng.
Director of Geotechnical Services, AIT