THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

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Alberta Infrastructure and Transportation
Room 223, Provincial Building
4709 – 44 Avenue
Stony Plain, Alberta
T7Z 1N4

Attention: Mr. Michael Baik

NORTH CENTRAL REGION GEOHAZARD ASSESSMENT
HWY 43:16 WHITECOURT EAST HILL (NC1)
2005 ANNUAL INSPECTION REPORT

Dear Sir:

This letter documents the 2005 annual site inspection of the Hwy 43:16 (km 1.9) Whitecourt East Hill site. The legal land description is 26-59-12-W5M. The work was undertaken by Thurber Engineering Ltd. (Thurber) in partial fulfillment of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE046/2004, Section B) with Alberta Infrastructure and Transportation (AIT).

The site reconnaissance was undertaken on May 31, 2005 by Mr. Don Law, P.Eng of Thurber. The reconnaissance was carried out in the presence of Mr. Roger Skirrow, P.Eng., Mr. Michael Baik and Mr. Darryl Yagos of AIT.

1. BACKGROUND

Thurber last visited the site in June 2004 and the site conditions observed at that time are described in our Part B assessment letter provided in the site binder. Additional background information for the site is provided in the Geotechnical File Review in Section A of the binder.

2. RESULTS OF THE 2005 INSPECTION

2.1 Roadway

The roadway surface was inspected during the reconnaissance along the full length of the hill. As in previous years, no distress to the pavement surface was noted except for two cracks noted in the vicinity of Stations 1+850 and 1+900. This pavement distress was first observed in 1998.

The approximate locations of the cracks are shown on the site plan, Figure NC-1-1A, and the crack pattern is shown on Figure NC-1-2 (Section F). A cross-section through the roadway, back slope and side slope in this area is provided on Figure NC-1-1B. The crack patterns are also shown in photographs taken of the area, attached.

No noticeable additional crack extension has been observed over the past year. A differential height up to about 5 mm to 8 mm was observed across both the west and east cracks in the westbound lanes, which is similar or slightly more than that observed last year. There appeared to be a somewhat deeper depression near the centreline between the two downhill lanes at the west crack location than observed during the 2004 site visit. In addition, the differential height across the east crack within the north lane appeared to be marginally larger in comparison to last year.

No other significant cracking was noted in the asphalt surface along the length of the hill. The guardrails appeared straight at the time of the site visit, indicating that no gross slope movement is occurring at the guardrail locations.

A patch was noted in the north lane approximately 20 m east of the east crack location as shown on the site plan. It is understood from Mr. Yagos that a subgrade failure occurred in this area, and the asphalt and base material were subexcavated to a depth of about 0.3 m and patched. It is expected that this feature is not related to slope instability.

2.2 Toe Berm, Side Slopes and Back Slopes

The toe berm area below (i.e. north of) the highway at Stations 1+600 to 1+800 was inspected. No visual evidence of slope movement (i.e. cracking, slumping, and seepage) was noted in this area.

The back slope and side slope areas above and below the highway (Station 1+600 to Station 2+100) were also inspected. No visual evidence of slope movement (i.e. cracking, slumping, and seepage) was noted at these locations.

As noted in previous years, some leaning trees were observed within a treed area located down slope of the roadway and southeast of the toe berm, located approximately as shown on Figure NC-1-1A. No tension crack development was noted, and no signs of seepage were observed in the ground in this area. This area appears visually unchanged from previous site visits.

The ground movements measured by the slope inclinometers installed at the site are summarized as follows:

- Movement has been recorded at a depth of about 13 m in SI #5 located on the southwestern corner of the toe berm as shown on the site plan. The rate of movement since the previous reading is about 1.5 mm per year, which is a reduction from the 6 mm per year rate measured over the previous interval (Spring to Fall 2004) and is significantly less than the maximum movement rate previously recorded (12.7 mm per year between May to September, 2001).

- Minor movements were also noted in SI01-1A and SI01-2A, located as shown on the site plan, at depths of about 13 m and 8 m, respectively. The current rate of movement is about 1 mm to 2 mm per year respectively, whereas the maximum movement rate in these instruments was determined at 6.6 and 13.6 mm/year in 2001. Water levels in pneumatic piezometers installed at these locations were 6.2 m and 10.0 m below ground surface, respectively.

- SI12 was blocked at a depth of 1 m below ground surface, potentially as a result of cumulative shear.

- Minor ongoing movement was recorded in the two operational instruments located in the back slope in the vicinity of the bin wall near the bottom of the hill (SI#30 and SI#31, located approximately as shown on Drawing No. NC1-1 included in Section D of the binder). Movement rates of about 1 mm to 2 mm per year were recorded, which is similar to past movement rates.

2.3 Culverts at Station 1+650

Inspection was undertaken of the two culverts at this location; an upper culvert directing surface water from above the walking path to the ditch on the south side of the highway, and a lower centerline culvert which transmits the water across the highway right of way to the base of the toe berm fill located north of the highway. A half-round culvert connects the outlet of the upper culvert to the inlet of the lower culvert. The outlets of two subdrain pipes discharge into the half-round culvert, and the ditch flow from upslope areas flows onto a concrete spillway and over the lip of the half-round culvert.

Maintenance of the concrete spillway was undertaken in 2001. Based on the results of the 2005 inspection, the subdrain and ditch water appear to be entering the centreline culvert in a controlled manner. However, two small sinkholes were observed above the subdrain outlet pipe. Photographs of the area from the May 2005 site visit are attached.

Other sinkholes were observed beside the asphalt path at some of the small diameter culvert crossings below the path. It is understood that maintenance of the path and associated culvert crossings is the responsibility of the Town of Whitecourt.

2.4 Bin Wall Area (Station 1+200)

The bin wall and backslope area above the bin wall near the bottom of the east hill were inspected. The bin wall is located between the access road to the McConnell property and the highway, near Station 1+200 at the bottom of the hill. The trail above the bin wall was paved with asphaltic concrete in 2003.

Three tension cracks noted during the 2004 site visit in the trail above the east end of the bin wall had not widened or extended as of the May 2005 visit, and there was no differential height across the cracks. The cracks were filled with sealant recently (likely Spring 2005).

The slight bulging noted in the east wing of the bin wall has not changed since first observed by Thurber.

Photographs of the tension cracks in the asphalt pavement and of the bin wall are attached.

3. ASSESSMENT

The observations made during the site reconnaissance and the recent slope inclinometer readings indicate that slope movements at this site remain relatively minor.

The increased depression across the east and west cracks of the roadway surface is consistent with a slow rate of slope instability movement in the vicinity of the roadway distress, as confirmed by the slope inclinometer movements. The reason instability is occurring at this location may be a result of not extending the toe berm far enough to the east during twinning operations to stabilize the area east of Station 1+780. The remainder of the roadway side slope, where the toe berm exists, appears to be stable at the present time. Unfavourable groundwater conditions may also be a significant contributing factor to the instability at the location of the highway distress.

The crack development is not significantly affecting the trafficability of the roadway surface at present. Ongoing movements in this area may however be expected, and an increased rate of movement may follow shortly after heavy or prolonged precipitation events. The ongoing movement may result in a reduction in the ride

quality in this section of the roadway in the future, possibly to the extent where trafficability and safety are compromised.

The lack of further development of the cracks encountered in the trail located on the back slope above the bin wall is consistent with shallow movements that do not affect the overall integrity of the back slope in this area.

It is anticipated that the observed sinkholes are a result of piping of soil around the subdrain or culvert outlets. The source of water may be from infiltration of water from above or leakage from the pipes.

4. RISK LEVEL

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

PF(6) * CF(3) = 18

This risk level is considered applicable to the area of distress on the roadway in the upper portion of the hill (Stations 1+800 to 1+900). A Probability Factor of 6 is considered appropriate since the slide is active but with a slow, indeterminate movement pattern. A Consequence Factor of 3 is applicable since the embankment is relatively high and a partial closure of the road may be required as a result of slide movement. This risk level is the same as that applied for the previous four site visits. Other areas of the site are considered to have a lower risk rating.

5. RECOMMENDATIONS

5.1 Geotechnical Investigation

Further geotechnical investigation has been previously recommended for this site in the vicinity of Stations 1+800 and 1+900 and east of the existing toe berm, including test hole drilling and installation of instrumentation as discussed in our preliminary conceptual design recommendations (letter dated March 10, 2003).

A total of four slope inclinometers (SI's) and nine piezometers have been recommended, located as shown and to the depths provided on the site plan, Figure NC1-1A in Appendix F. The monitoring should be undertaken in conjunction with the existing geotechnical instrumentation monitoring program (semi-annually). An initial proposal for the work was provided previously. A revised proposal and cost estimate can be provided upon request.

5.2 Potential Remedial Measures

The following remedial measures are postulated, based on the current information available. The applicability of these measures will depend on the results of the geotechnical investigation:

- A potential short term remedial measure is the installation of horizontal subdrains below the roadway to drain subsurface water away from the area and lower piezometric levels, should this prove to be an appropriate remedial measure.

- A possible long term measure is the extension of the toe berm to the east to buttress the slope at the location of the slope movement, potentially in conjunction with subsurface drainage. However, further information regarding the extent of the slide is required to allow design of a toe berm option.

Based on previous similar projects the cost for the construction of the remedial measures is expected to be in the order of $300,000 to $500,000.

5.3 Maintenance and Further Monitoring

Ongoing maintenance will be required to maintain water flow into the lower culvert in a controlled manner at this location. The sinkholes observed above the subdrain outlet at this location should be filled with well graded pit run or crushed gravel in an attempt to stabilize and seal the area from further soil piping.

As noted in previous annual reports, it is expected that frost action will continue to have a negative effect on the concrete and half round culvert in the vicinity of Station 1+650. Although not required at present, maintenance of this facility will likely be required in future years.

It is recommended to continue monitoring the existing instrumentation on a semi-annual basis, and to undertake annual geotechnical inspections as currently programmed. In addition, the quality of the ride over the west and east cracks in the west bound lanes should be monitored at least monthly by the MCI, and if significant changes occur an interim engineering site reconnaissance and assessment should be undertaken.

6. CLOSURE

We trust this assessment meets with your needs at this time. Please contact the undersigned should questions or concerns arise.

Yours very truly,
Thurber Engineering Ltd.
D. Papanicolas, P.Eng.
Review Principal

D.J. Law, P.Eng.
Principal

/slp

Attachments

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