August 23, 2011 File: 15-16-262

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

Attention: Mr. Ed Szmata

PEACE REGION (PEACE RIVER/HIGH LEVEL) GEOHAZARD ASSESSMENT
HWY 986:01 (PH 42), DAISHOWA PUMPING WELL SITE – STATION 13+300
2011 ANNUAL INSPECTION REPORT

Dear Sir:

This letter documents the 2011 annual site inspection of an area of slope instability located along Hwy 986:01, on the east side of the Peace River, north of the Town of Peace River, Alberta (Figure PH42-1). Thurber Engineering Ltd. (Thurber) undertook this inspection in partial fulfillment of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE105/2008) with Alberta Transportation (TRANS).

Mr. R. Saunders, P.Eng. of Thurber undertook the inspection on May 25, 2011 in the company of Mr. Neil Kjelland, P.Eng. and Mr. Ed Szmata of TRANS and Mr. Don Proudfoot, P.Eng. of Thurber.

1. BACKGROUND

Thurber's last annual site inspection was in May 2010. Conditions of the site at that time are described in our Part B assessment located in the PH42 site binder. A callout inspection was also undertaken by Mr. Don Proudfoot (Thurber) on August 6, 2010 after conditions at the site had been observed to have worsened. A copy of this callout inspection report can be found in Part E in the site binder. Additional information for the site is provided in the Geotechnical File Review in Part A of the site binder.

Previously, the PH 7 site encompassed a 2 km length of this highway extending from the Peace River Bridge to the top of the east valley slope. However, the area has now been subdivided into four separate areas. The subject area of this report is located at an historic landslide site, which had been previously mitigated by the installation of several pumping wells upslope of the highway. This area has been re-named PH-42, and is located at about Station 13+300 (Figure PH42-1).

2. SITE OBSERVATIONS

Observations made during the field reconnaissance and the approximate locations of select photographs are shown on Figure PH42-1.

Site conditions observed in May 2011 were consistent with those observed in previous inspections; that is to say, ongoing movement is occurring resulting in additional vertical displacement and cracking on the roadway across both driving lanes. This movement is evidenced by cracking through recent asphalt patches on the roadway, which are required to be installed on an almost annual basis. Visually the surface of the roadway appeared to be lower than during the 2010 annual inspection, although this displacement is distributed through the slide area and does not all occur directly across the scarp feature (Photos 42-01 to 42-03).

The downslope main slide area appeared to be relatively unchanged from conditions observed during the August 2010 callout inspection. Indications of landsliding are evident well into the trees below the toe of the fill area. Observations included stepped terrain and tipped trees. It is, therefore, considered likely that the slide area extends to the creek level.

The area above the roadway was inspected in previous years and was determined to have been affected by past landsliding and was considered to be only marginally stable to unstable as well. Slumping of the upslope area at the very west end of PH42 was noted to be more active than in previous years. This upslope slumping was noted to extend well upslope of the roadway as shown in Figure 42-1 and Photo 42-06.

3. INSTRUMENTATION

In the fall of 2009, four slope inclinometers and vibrating piezometers were installed by Thurber at this site at locations shown approximately in Figure 42-01.

Since initialization, these instruments have been read between October 2009 and May 2011. During the Fall 2010 readings, SI09-3 was noted to be sheared at 11.0 m below grade. During the Spring 2011 readings, SI09-4 was noted to be sheared at 9.8 m below grade. The confirmed movement zones identified in the four slope inclinometers are summarized below.

Instrument	Location	Depth of Movement Zone (m)	Displacement Since October 2009 (mm)	Rate (mm/yr)
SI09-1	Upslope ditch	6 to 8	6	4
SI09-2	Below guardrail (west)	15.5	93	33
SI09-3	Below guardrail (east)	Sheared at 11.0	-	~100
SI09-4	Lower slope	Sheared at 9.8	-	~100

Groundwater conditions measured in the four vibrating wire piezometers were determined to be high, ranging from about 2 m and 5 m below ground surface and have not changed significantly since installation.

4. ASSESSMENT

Based on the results of the ongoing monitoring and the site observations, the slope and roadway at this location are actively unstable. While the most active portion of this slide coincides with the portion of the slope and roadway below (north of) the observed cracking in the roadway, ground movement has also been measured in the slope inclinometer installed in the upslope ditch. The rates of movement measured in the slope inclinometers are consistent with the observations made during the inspections.

The high pore pressure condition measured within the slope is likely one of the most important, if not the main, drivers of the current slope instability.

Given the high rates of movement, installation of a drainage system to dewater the slope and reduce the pore pressure will likely provide only short-term improvements before they too shear off like the existing pumping well system. Consequently, it is our opinion that long-term remediation measures should focus on structural support of the existing highway. Given the depth of the failure plane and the fact movement is occurring upslope of the roadway, a piled retaining wall will almost definitely require anchors installed behind the failure plane as well.

The possibility of installing some drainage mitigation in combination with the wall should also be considered; however, a drainage system alone is not considered practical in the long-term due to high maintenance requirements.

5. RISK LEVEL

The Risk Level at this slide has been assessed as follows:

PF(14) X CF(6) = 84

A Probability Factor (PF) of 14 has been assigned to this slide as it is active with a high rate of movement. A Consequence Factor (CF) of 6 has been assigned. This risk level is the same as assigned during the August 2010 callout and reflects the high measured rate of the movement and the fact that movement zones extend at depth under the roadway (i.e. complete road closure would be a likely result of failure).

6. RECOMMENDATIONS

6.1 Short Term

In the short term, it is recommended that the pumping well system be repaired and put into operation to lower the water table. This could help to slow down slope movements. An experienced well installer would need to be employed to flush out the wells and install and wire new submersible pumps. It is considered that the existing pumps are no longer serviceable. It is understood that the outlet of the well drainage manifold currently crosses under the highway and is likely damaged. It is recommended that a trench be excavated to trace the outlet to the point where it crosses the highway and then modifications be made to realign the outlet down the south ditch to drain into the ditch lining installed along PH7.

The new outlet should be installed by directional drilling, or in short sections by trenching, to avoid a long continuous cut that could result in slope stability issues along the south ditch.

Until the above measures can be implemented and proven to be effective, ongoing visual monitoring of the roadway in this area by TRANS personnel and the MCI should be performed when possible to look for signs of roadway distress.

6.2 Long Term

The most feasible long term solution for this site is likely a tied back pile wall. Consideration could be given to also carrying out a slight re-alignment of the highway towards the south to reduce the depth to the slide slip plane, and hence the required size and cost of the wall. It is considered that the long term measures would cost in the order of $3,000,000.

6.3 Maintenance

The removal of the ditch block and plugging of the centreline culvert will reduce the amount of surface water that drains into the slide area. However, there is a small dip near the inlet that should be filled in as a maintenance item to further reduce ponding of surface water in the south ditch beside the slide area.

7. CLOSURE

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

Yours truly,
Thurber Engineering Ltd.
Chris Workman, M.Eng., P.Eng.
Review Principal

PROFESSIONAL ENGINEER ALBERTA
ROBERT SAUNDERS
23-Aug-11

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature
Date Aug 23/2011
PERMIT NUMBER: P 5186
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Robert Saunders, M.Eng., P.Eng
Senior Geotechnical Engineer

Attachments