THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

November 2, 2010 File: 15-16-229

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 2:60 EMBANKMENT SLIDE AREA (PH 13), NAMPA
2010 ANNUAL INSPECTION REPORT

Dear Sir;

This letter documents the 2010 annual site inspection of an area of slope instability located along Hwy 2:60, about 1.7 km north of the Town of Nampa, Alberta (Figure PH13-1). 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 (AT).

Mr. R. Saunders, P.Eng. of Thurber undertook the inspection on June 1, 2010 in the company of Mr. Roger Skirrow, P. Eng., Mr. Neil Kjelland, P.Eng. and Mr. Ed Szmata of AT and Mr. Don Proudfoot, P.Eng. of Thurber.

1. BACKGROUND

Thurber's last annual inspection of the site was in May 2009. Site conditions at that time are described in our Part B assessment letter in the site binder. Additional information regarding the site is provided in the Geotechnical File Review in Section A of the binder.

2. SITE OBSERVATIONS

Conditions at the site appeared to be relatively unchanged since the 2009 inspection and are noted on the attached site sketch plan. Select photographs taken during the visit are also included.

The following summarizes the observations made at each slide segment within the study area.

South Slide

The condition of the concrete retaining wall and piles appeared similar to that reported in previous assessments as shown in Photo 13-01. The graben area forming as the slide mass moves downslope below the wall appeared to be similar to that observed in previous years. However, there did appear to be a widening of cracking in the soil south of the concrete wall as shown in Photo 13-02 which was more evident this inspection.

The row of pipe piles along the edge of the road contained water at a depth of 0.1 m to 0.2 m, similar to the previous assessments. The guardrail was observed to be deflected outwardly at the top in this area, but this could have been due to vehicle impact.

Minor subsidence/creep of the slope below the guardrail in this area was also observed to be more pronounced this year compared to previous inspections (Photo 13-03).

Central Slide

The slide area below the lagging wall appeared to be in a similar condition as noted in previous inspections (Photo 13-04). The retaining wall itself also appeared to be in a similar condition to that reported in previous assessments. As in previous years, measurements were taken on the inclination of the piles using a hand held clinometer. The results are shown in Figure 13-2 and show no discernible increase in pile inclination since measurements began in 2004.

As noted in previous assessments, some of the lagging has become dislodged in the southern portion of the wall. Geotextile supporting the backfill behind the wall is also exposed locally (Photo 13-05) as the ground continues to subside within the graben feature below the wall.

The roadway adjacent to this area was patched in 2006 to address the local settlement around the piles/cracking that previously existed and has not changed significantly.

North Slide

The north slide area is the most active of the three areas within PH13 and is the only one of the three that has not been remediated to date. Photos 13-06 and 13-07 show the headscarp area of the slide encroaching into the edge of the roadway and guardrails. The slide is considered to be shallow, with an estimated maximum depth of 2 m.

As noted in previous inspections, an apparent spring is located in the west highway ditch about 50 m north of the slide site. Signs adjacent to the “spring” indicate that a water line crosses under the highway at this location. It is considered possible that a leak in the water line is responsible for this feature. It is also possible that water from this source is contributing to the slide activity.

Cracking in the roadway upslope of this slide is slightly open but has not changed significantly from 2009 (Photo 13-08).

3. ASSESSMENT

The Central Slide at this site is considered to be the least active of the three slides. Patching of the asphalt appears to have addressed the settlement of the shoulder adjacent to the wall, noted as of concern in previous assessments. Notwithstanding the above, there is still potential for ongoing loss of ground behind both of the retaining walls at this site. This could cause a sinkhole and potentially affect the highway surface.

Some ongoing downslope movement is likely occurring below the concrete retaining wall at the South Slide, evidenced by the formation of a graben between the piles and the slide mass. This movement is not believed to have affected the functionality of the retaining wall at this time, although the slope should be regularly monitored. The development of a crack on the south side of the wall suggests the slide may have recently become more active.

No remedial measures have been implemented at the North Slide, and the headscarp is presently located at the guardrail. As discussed earlier, the slide appears to be shallow and may be acerbated by a possible leak in the water line located north of the site.

At this time, the slide is not affecting the road surface, but if mitigation measures are not undertaken soon (e.g. within 1 to 2 years), it is likely that the slide will begin to affect the paved surface.

4. RISK LEVEL

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

$$PF(13) * CF(3) = 39$$

A Probability Factor of 13 is considered appropriate since the north slide is active with a perceived high rate of movement (4 m of retrogression since 2004). A Consequence Factor of 3 is considered appropriate since the embankment fill is moderately high and a partial closure of the road would be a direct result of an aggressive slide movement.

This is unchanged from previous assessments undertaken between 2005 to 2009.

5. RECOMMENDATIONS

5.1 Short Term

In the short term, the site should be regularly inspected by the MCI to assess if the highway becomes affected, and implement any traffic safety requirements.

The owner of the water line should be contacted and advised that a leak is suspected, and that repairs should be implemented as soon as possible.

5.2 Long Term

It is understood that a new bridge is being proposed over the Heart River just south of the PH13 that would involve a realignment of the highway away from the current areas of instability. Providing this work is undertaken in the next few years, there is likely no requirement for additional long-term remediation measures at this site. However, if plans for a new bridge were to go on hold, then consideration for long-term mitigation may be required as outlined below.

Potential long term stabilization measures at this site include construction of a third pile wall at the north site, replacement of the slide mass with a free-draining granular material (gravel) and slope flattening. These options could be combined depending on costs and final configurations. A variation on the slope flattening option would include a toe berm. Based on similar previous projects it is expected that the costs of remedial measures to fix the north slide will be in the order of $280,000.

5.3 Investigation

Should long-term mitigation measures be required due to delays in the new bridge and highway realignment, the next phase of work for this site would be to carry out a detailed topographic survey, geotechnical investigation and stability analyses to assess the most effective remedial solution. The geotechnical investigation could consist of a test hole at the shoulder of the road, complete with a standpipe piezometer, and 3 test pits at the base of slope to assess a potential toe berm option. The investigation work as described above, including a preliminary engineering report, is expected to cost about $30,000.

5.4 Maintenance

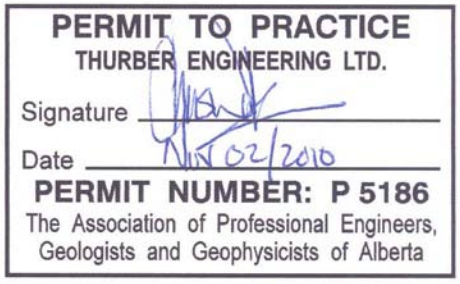
Cracks in the pavement through the slide area(s) should be sealed.

In previous years it was suggested a wedge of clean (<5% fines) granular material be placed at the base of the southern 5 panels of the timber lagging wall (Central Slide) to reduce loss of ground due to the dislodged lagging. However, based on the performance of the North and South Slides, we believe this form of remediation/maintenance could potentially load the slope and result in further movement. Hence no immediate action in this area is recommended unless additional material loss occurs through the retaining wall.

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 condition worsens.

Yours very truly,
Thurber Engineering Ltd.
Simon Cullum-Kenyon, P.Eng.
Review Engineer



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

Attachments

Photo 13-01

June 2010

Looking south at concrete retaining wall in South Slide area. Note graben developing in front of wall and poor condition of concrete showing exposed H-piles.

Photo 13-02

June 2010

Crack developing on south side of concrete wall at South Slide.

Photo 13-03

June 2010

Guardrail leaning outward in vicinity of South Slide, possibly from vehicle impact. Note ground subsidence/creep behind asphalt layer.

Photo 13-04

June 2010

Looking north at wooden lagging wall in Central Slide area in similar condition to previous years.

Photo 13-05

June 2010

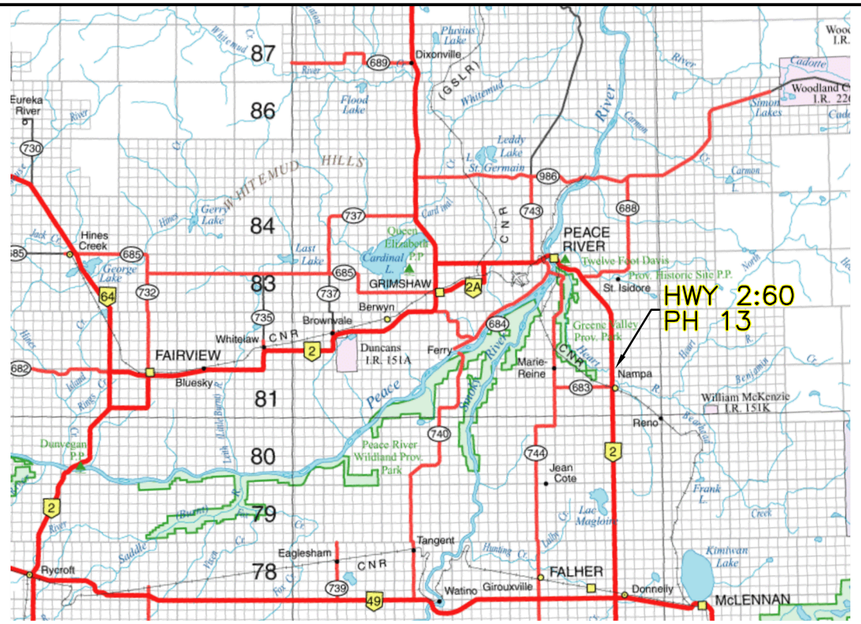
Close-up of subsidence in front of lagging wall and exposed geotextile similar to that observed in previous years.

Photo 13-06

June 2010

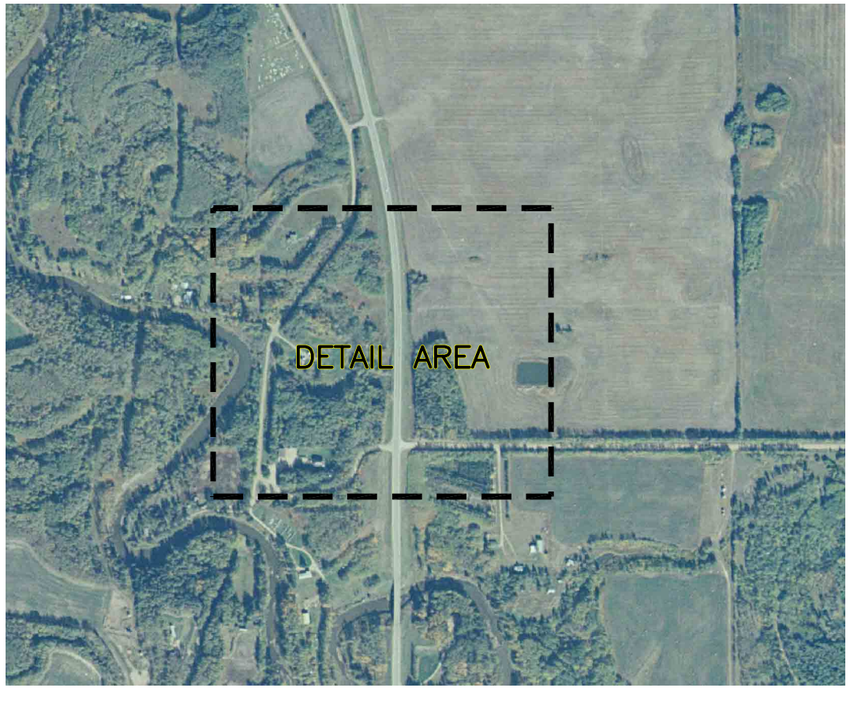
Looking upslope at shallow slide in upper portion of North Slide area. Condition is similar to previous years although guardrail has moved out slightly at bottom from 2009.

	**Photo 13-07** **June 2010** Looking southeast at upper portion of North Slide .
	**Photo 13-08** **June 2010** Looking south at cracking parallel to the roadway in the vicinity of the North Slide. Cracks are open and slightly wider than in 2008/9. Patched asphalt adjacent to lagging wall in Central Slide area shown in the distance.



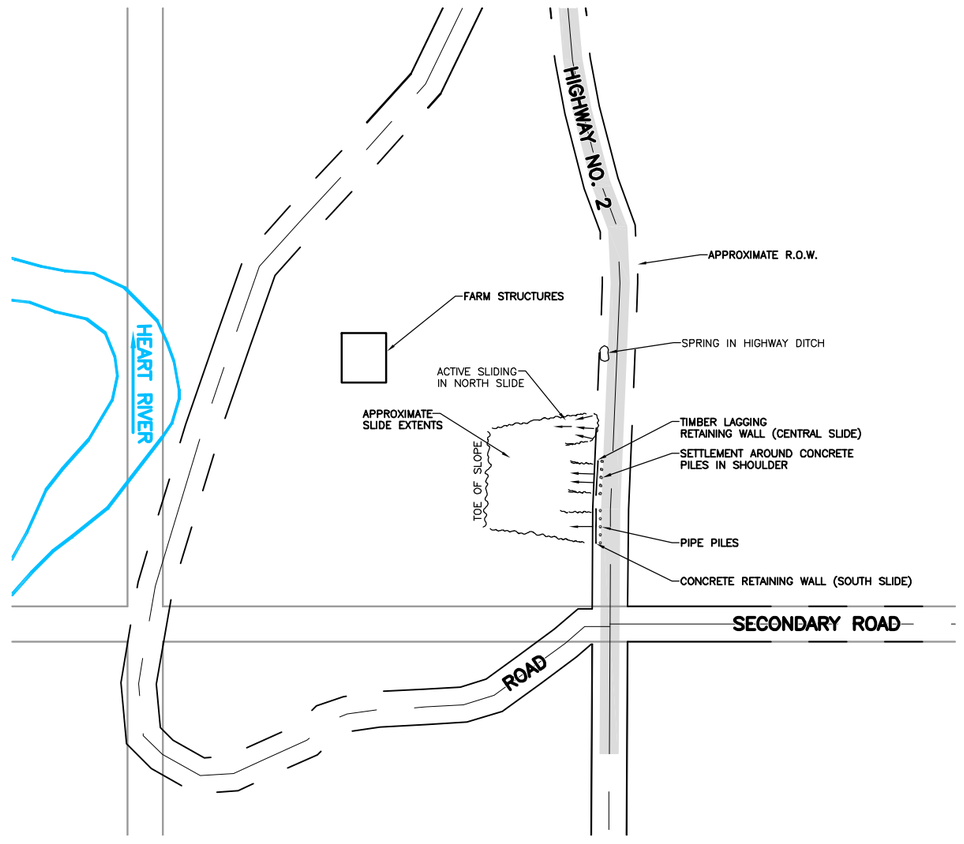
KEY MAP

SCALE 1:1 000 000



LOCATION PLAN

SCALE 1:10000



DETAIL PLAN

NOT TO SCALE

NOTES:

1 AIRPHOTO BASE FROM TARIN RESOURCE SERVICES LIMITED (1 m/PIXEL) 1999.

2 SLIDE FEATURES ARE SHOWN APPROXIMATELY ONLY.

3 DRAWINGS MUST BE USED IN CONJUNCTION WITH ATTACHED REPORT AND ARE SUBJECT TO THE STATEMENT OF GENERAL CONDITIONS.

DRAWN BY	ICB	DESIGNED BY	RJS	APPROVED BY	WCW
SCALE	AS SHOWN	DATE	OCTOBER 22, 2010	FILE No.	15-16-229-B3D

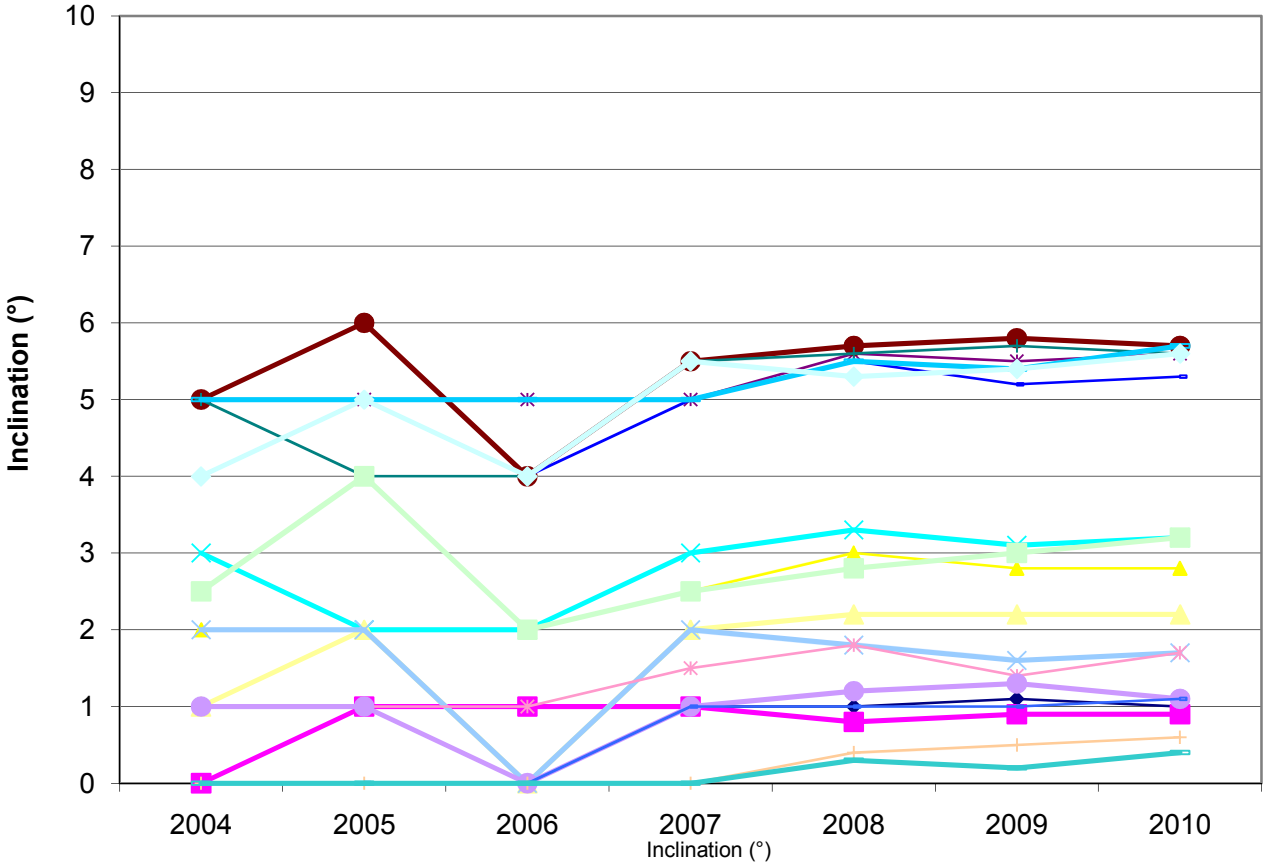
Government of Alberta
Transportation

PEACE REGION (PEACE RIVER/HIGH LEVEL)

NAMPA
HWY 2:60 (PH13)
LOCATION PLAN

FIGURE PH13-1

THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS



	Jun-04	Jun-05	Jun-06	May-07	May-08	May-09	Jun-10
Pile 1	1.0	1.0	1.0	1.0	1.0	1.1	1.0
Pile 2	0.0	1.0	1.0	1.0	0.8	0.9	0.9
Pile 3	2.0	2.0	2.0	2.5	3.0	2.8	2.8
Pile 4	3.0	2.0	2.0	3.0	3.3	3.1	3.2
Pile 5	5.0	5.0	5.0	5.0	5.6	5.5	5.6
Pile 6	5.0	6.0	4.0	5.5	5.7	5.8	5.7
Pile 7	5.0	4.0	4.0	5.5	5.6	5.7	5.6
Pile 8	4.0	5.0	4.0	5.0	5.5	5.2	5.3
Pile 9	5.0	5.0	5.0	5.0	5.5	5.4	5.7
Pile 10	4.0	5.0	4.0	5.5	5.3	5.4	5.6
Pile 11	2.5	4.0	2.0	2.5	2.8	3.0	3.2
Pile 12	1.0	2.0	0.0	2.0	2.2	2.2	2.2
Pile 13	2.0	2.0	0.0	2.0	1.8	1.6	1.7
Pile 14	1.0	1.0	1.0	1.5	1.8	1.4	1.7
Pile 15	1.0	1.0	0.0	1.0	1.2	1.3	1.1
Pile 16	0.0	0.0	0.0	0.0	0.4	0.5	0.6
Pile 17	0.0	0.0	0.0	1.0	1.0	1.0	1.1
Pile 18	0.0	0.0	0.0	0.0	0.3	0.2	0.4

HWY 2:60 (PH13) NAMPA CENTRAL SLIDE AREA
LAGGING WALL INCLINATION READINGS

FIGURE 13-2