THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

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

Attention: Mr. Ed Szmata

PEACE REGION (PEACE RIVER) GEOHAZARD ASSESSMENT
HWY 744:02, JUDAH HILL (PH12)
2004 ANNUAL INSPECTION REPORT

Dear Sirs:

This letter report documents the 2004 annual site inspection of landslide sites along Highway 744:02 Judah Hill grouped under PH12, southeast of Peace River, Alberta. The work was undertaken by Thurber Engineering Ltd. (Thurber) in partial fulfilment of our Geotechnical Services for Geohazard, Assessment, Instrumentation Monitoring and Related Work contract (CE047/04) with Alberta Transportation (AT).

The inspections were undertaken on June 17 and 18, 2004 by Mr. Simon Cullum-Kenyon, P.Eng. and Mr. Don Proudfoot, P.Eng. of Thurber in the company of Mr. Ed Szmata, Mr. Girard Gravel and Ms. Amanda Russell of AT.

1. GENERAL

Site location maps are provided on attached Figure 1A. Figure 1, attached is an airphoto mosaic plan of the Judah Hill section of Hwy 744:04 that shows the locations of the various slide sites, instrumentation, and other pertinent features. A general description of the slope instability, site geological and geotechnical conditions and history of previous events, investigations and remedial measures is given in the Geotechnical File Review included in Section A of the Project Binder.

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2. HEART RIVER VALLEY SLIDES (STA. 57+000 TO 57+250)

2.1 Background and Observations

Hwy 744 runs along the crest of the western valley wall of the Heart River for several hundred metres before reaching the Lookout and descending Judah Hill into Peace River. As shown on Figure 2, there is a layby or pullout lane along a portion of this length, and four small slides have occurred. The slides vary in width from 12 m to 35 m, and in one instance (Slide No. 2 – see Photo 2), the slide has undercut the guardrail. Repair work was apparently conducted at Slide No.1 in 1998, including placement of a drain and re-construction of the slope with a geogrid reinforced compacted fill. It appears that the repair has been successful.

The slide backscarps are located between 4 m to 6 m of the edge of the asphalt, though the active lane is up to 11 m away. The overall angle of the upper slope segment is 38°. The lower portions of the slope appear unstable, judging by the chaotic topography and backscarp ponds.

The slides appear to be caused by water in the roadside ditch. There was some ponded water in the ditch adjacent to Slide No. 1. The slide bowl for Slide No. 2 now fully intercepts the ditch, and it is anticipated that it will develop rapidly now.

2.2 Assessment

There appears to have been some fresh activity at these slides. Past repair work conducted at the northernmost slide (Slide No.1) appears to have been successful. Development and enlargement of Slide No. 2 is expected to accelerate as it now captures drainage from the ditch. Surface water drainage appears to be the primary driving factor in these slides, though any remedial measures will have to consider the impacts on the lower portions of the slopes as well. The remaining slides at this location are expected to enlarge in a similar manner to Slide No.'s 1 and 2, and other slides may also develop.

2.3 Risk Level

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

PF(11) * CF(2) = 22

The slides will continue to enlarge and develop in this area. However, none of the slides are currently impacting the highway or layby.

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2.4 Recommendations

Consideration should be given to repair work at Slide No.2 similar to that for Slide No.1, though additional mapping and inspection is needed to ensure that any drainage would not adversely impact the slope below. The work could be deferred and the slide observed, but the extent of future repair work will be greater. The repair could be combined with more general improvements to drainage alongside the layby, in order to decrease or arrest slide development in this area. With no work, the slides will develop and expand to affect the layby, and ultimately the active lanes, though this may take a number of years, depending on spring runoff and rainfall. Slide No. 2 may start impacting the layby within 12 to 24 months.

The approximate cost for repairing Slide No. 2 is $100,000, with installation of a French drain along the ditch estimated to cost another $ 32,000.

3. LOOKOUT SLIDES (STA. 57+500)

3.1 Background and Observations

As shown on Figure 2, there are four slides at the lookout area on the western slope of the Peace River valley. The main slide impacts the car park area, and has a width of approximately 30 m (Photo 5). The guardrail has been moved back around the back of the slide bowl by about 1 m. To the south of the main slide are two smaller scarps (Photo 6), one near the south edge of the car parking area with evidence of fresh sliding, and one near the southern margin of the picnic area, which shows no fresh activity. The overall slope down from the crest is 38°. The slide near the southern edge of the parking area is roughly 5 m away from the guardrail, while the older slide at the southern end of the site is only 2 m from the rail. The car parking area appears to be sloped towards the crest of the slope and towards the north.

To the north of the Lookout is another slide, roughly 26 m wide and only 4 m from the guardrail. The slide runout terminates in a debris lobe (Photo 7), and the overall slope angle along the slide to the toe of the debris is around 22° - the adjacent undisturbed slopes are 37°. The back of the slide scarp is not very steep and is vegetated, while the sides are close to vertical and have no vegetation. There is some minor cracking in the pavement back from the slide scarp (Photo 9). A 400 mm CMP carries drainage from the ditch to the south of the slide across the road.

3.2 Assessment

The Lookout slides have similar appearance to the Heart River Valley slides, and are also likely to be driven by surface water drainage. The fact that similar slides

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are occurring away from the car parking area suggests that nearby asphalt-covered surfaces are not necessary to trigger this kind of slide. However, the fact that the greatest retrogression and slide development has occurred at the car park area and near the road to the north suggests that concentrated surface flow from paved surfaces may accelerate slide retrogression.

3.3 Risk Level

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

PF(7) * CF(2) = 14

The slides do not appear to be very active, but may become active during periods of heavy rainfall. The slides are currently not impacting the highway directly, except to the north of the lookout where there is a possible public safety issue.

3.4 Recommendations

While slide movement is not currently occurring, heavy rainfall or prolonged wet weather may re-activate the slides, causing further movement and loss of the car park area. At the northern slide, further slide movement could impact the road. Precautionary drainage improvements might be considered, including use of curbs and catch basins to intercept water that would otherwise flow into the existing slide backscarps. However, unless drainage is directed downhill in a controlled manner that is easily maintained (i.e. along the road, rather than directly down slope), there is a significant risk that slide movement will be increased.

An inclinometer should be installed in the road shoulder at the northern Lookout slide to monitor movement. The inclinometer should be installed to a minimum of 20 m depth. Because of the lower importance of the car park area, it is not considered necessary to install any instrumentation at any of the remaining slides – continued visual observation should be adequate.

The approximate cost of installing curbs and catch basins at the Lookout car park to re-direct drainage is expected to be $ 50,000.

4. MICHELIN SLIDES (STA. 57+600 TO 58+100)

4.1 Background and Observations

As shown on Figure 3, there two broad zones with slide activity that occur within an old slide bowl in this area – these were referred to as Zones D1 and D2 in previous reports (see Figure 1). Slide repair works have been completed in both of these zones, consisting of an anchored pile retaining wall in the northern portion of the slide bowl (Zone D1 – see Photo 11) and a shear key, toe buttress and lightweight fill containing shredded tires in the southern portion (Zone D2 - see Photo 13).

The road has been patched recently at the southern portion of the slide bowl - there is only minor cracking evident in the road. At the northern portion of the slide, there is minor cracking in the road, and several smaller slides, presumably on the downslope side of the pile retaining wall (Photos 11 and 14). Instrumentation readings from remaining inclinometers installed beyond the toe of the two slides suggest only minimal movement.

4.2 Assessment

Although movement and distress at the road in the two slide zones appears to be minor (some minor cracking), areas downhill of the slide repair measures continue to show localised cracking and significant movement. There are no surviving inclinometers located within or above the repaired zones to quantify movement. Inclinometers installed beyond the toe of the current slide zones registered minor movements.

There is some concern about the ability of the pile wall to function adequately with loss of toe support – this requires a review of the design brief and assumptions for the wall. This should be reviewed prior to the next inspection, if possible.

4.3 Risk Level

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

PF(5) * CF(4) = 20

The slope movements downslope of the slide repair is of some concern.

4.4 Recommendations

The design assumptions for the pile retaining wall in Zone D1 should be checked to confirm that the wall will continue to function with some loss of downslope support.

Inclinometers could be installed in both slide repair areas to allow measurement and quantification of movement, though at this stage, because of limited movement observed at the road, this is not considered a high priority.

Consideration should be given to improving the uphill ditch drainage by extending the CPP drain pipe both uphill and downhill, and providing catch basins to capture drainage at intermediate points. Consideration will need to be given to the capacity of the pipe and installation details. An approximate cost for extending the storm drain pipe 250 m uphill and 50 m downhill (to the next site) is $ 55,000. If drainage is not improved, it is likely that water running in the ditch will continue to seep into the slope and allow continued slide movement. Controlling runoff is expected to reduce the amount of slide movement, though it will not eliminate it. This work should not be done unless drainage improvements are done at the Makeout Slide at the same time.

5. MAKEOUT SLIDE (STA. 58+300)

5.1 Observations

At the northern margin of the old slide bowl containing the Michelin Slides is a roughly 40 m wide slide feature that has developed within the last year (refer to Figure 3). The general slope angle at this location is around 34°. The slide scarp cuts across both lanes and extends into the upslope ditch (Photo 15) – the width of the scarp at the ditch is around 10 m. The scarp is most obvious on the southern margin of the slide, with up to 100 mm wide cracks with 50 mm vertical offset in the downslope gravel shoulder (Photo 16), and 100 mm to 150 mm vertical offset in the upslope ditch (Photo 17). Some patching has been done at the southern margin. At the north side of the slide, there is subtle cracking and a zone over which there is roughly 100 mm vertical offset. The cracking and vertical offset peters out in the downslope road shoulder beyond this (Photo 18). At the northern margin of the slide, there is a berm that directs road surface drainage north, away from the active sliding.

There are several small, localised slumps and an erosion gully downslope of the slide. The southern-most of these is directly downslope of the southern portion of the slide scarp, and has a 3 m high scarp.

The outlet of a 600 mm corrugated plastic pipe (CPP) that carries water through the area of the Michelin Slide along the east highway ditch occurs a short distance upstream of the Makeout Slide. Erosion in the ditch suggests that flow has been significant in the past.

There is no instrumentation to record deformations in this area.

5.2 Assessment

The slide has continued to develop since it was first observed in 2001. Drainage in the upslope ditch is expected to cause movement to continue or accelerate. Installation of the pipe in the ditch upstream of this site during repairs at the Michelen slide may have inadvertently increased the concentration of flow into the Makeout slide area. It is not clear how the older slump / debris flow downhill of this slide is related, if at all, though subsequent observations should include the areas uphill and downhill of the slide impacting the road.

5.3 Risk Level

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

PF(11) * CF(6) = 66

The slide is active with a moderate but increasing rate of movement. This is a site where a total road closure could be a result of a significant slide movement.

5.4 Recommendations

Inclinometers and piezometers should be installed at this slide as a matter of urgency, in order to provide information for repair strategies. The proposed locations of instruments and test holes are further discussed in our report prepared for a callout to this site on September 29, 2004 following additional slide movements.

In addition, the 600 mm CPP drain in the upslope ditch from the Michelin Slide should be extended through this area, complete with provision of catch basins to capture road surface drainage and direct it out of this area. The approximate cost of extending the CPP drain 150 m through the immediate slide area is expected to be $ 30,000.

To extend the drain 750 m to the Judah Trunk will cost approximately $150,000. This is not considered to be as urgent or as high a priority, though if water is discharged into the ditch immediately downstream of the slide, there is a strong possibility that further slide activity will be generated on the downslope side of the road. Rip rap erosion protection will be needed in the ditch for a minimum of 10 m downstream of the culvert outlet, if the culvert is not extended, in order to dissipate the energy of the water flowing out of the culvert.

In the interim, road maintenance crews should pay particular attention to this location after periods of heavy and/or prolonged rainfall or during periods of snowmelt to identify potentially dangerous conditions.

6. JUDAH TRUNK (STA. 58+700)

6.1 Observations

The Judah Trunk is a 450 mm diameter corrugated plastic pipe drain taking water downhill past an area of erosion (refer to Figure 4), presumably the result of drainage discharge on the slope in the past. The scarp at the head of the erosion feature is roughly 2 m to 3 m deep. Upslope of the scarp, erosion control mat has been placed to help vegetation to establish.

Water is carried across the road from the upslope ditch in a solid plastic pipe. There is a ditch block in the upslope ditch just downstream of the drain inlet. The junction between the solid and corrugated pipes was not visible. Some zip ties keeping the joint restraining bands secured have failed, and as a consequence, the elephant trunk drain pipe may be leaking. The pipe is partly restrained with galvanised steel cable secured at the top of the slope and tied to the pipe (Photo 19).

The downslope edge of the road in the area of the Trunk and immediately downhill is steep, and there is evidence of surface water erosion (Photo 20). At least portions of the inslope ditch below the ditch block at the inlet to the Trunk are geomembrane lined (Photo 21). In places, the geomembrane appears to have been ripped.

6.2 Assessment

The trunk appears to have dealt with drainage from the upslope ditch, though some repairs to the joints are required to ensure continued good performance. There are some concerns over surface water erosion on the downslope edge of the road – the requirement for repair or preventative measures should be re-assessed during the next inspection.

6.3 Risk Level

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

PF(3) * CF(1) = 3

The elephant trunk appears to be working adequately but requires some repair.

6.4 Recommendations

Broken or leaking drain joints should be repaired. The capacity of this pipe may need to be re-assessed if the CPP from the Michelin slide is extended downhill. If this occurs, additional inspection of the area downslope of the outfall will be required.

7. FENCE SLIDE (STA. 59+200)

7. Background and Observations

The area immediately surrounding the inslope debris fence (refer to Figure 4) has been subject to past landslide activity and repair work. The downslope edge of the road just south of the debris fence has a number of cracks running parallel to the slope (Photo 22).

Further downhill along the road, at a previous stone column stabilisation repair, there has been settlement and/or loss of ground from around the stone columns, so that the heads of the columns are protruding through the pavement surface by up to 25 mm (Photo 23). There is significant cracking and voids extending around the repair – the cracks are up to 50 mm wide and 200 mm deep.

In the upslope ditch through a portion of this section, a wire mesh debris fence has been installed to prevent blocks of soil which spall off the slope from falling onto the road. The fence appears in good condition, and the material is cleaned-out on a regular basis. In the slide bowl upslope of the fence, a high pressure gas line is exposed it is understood that the gas line was relocated further upslope and the exposed section has been abandoned.

Further downhill of the stone columns, there is some minor cracking in the road, mostly impacting the road shoulder over a length of around 40 m.

7.2 Assessment

Settlement and cracking appears to have continued at the stone columns, even with the additional drainage measures that were installed after initial stabilisation work. The magnitude of the movements is unclear – it is not possible to determine if movement is steady or increasing, though based on comparison with observations in the previous AMEC reports, it appears that movement at the road is significant. There are no operational slope inclinometers located within the slide mass.

Erosion control matting that had been placed in the upslope ditch prior to AMEC last inspection in 2003 was not evident – it has either been covered entirely or ripped out. Significant water flow probably occurs in the ditch, based on lack of vegetation and presence of erosion features.

7.3 Risk Level

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

PF(11) * CF(8) = 88

The stone column slide is active with a high rate of movement. A partial road closure would be a direct consequence of a significant slide movement. There is the added consequence that a significant slide movement could affect the CNR track located at the base of the slope.

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7.4 Recommendations

Given the apparently significant flows that occur in the ditch, it would make sense to improve drainage by installing a CPP culvert and catch basins to capture and direct water safely through this area. Consideration needs to be given to pipe sizing when designing the drainage improvements. The approximate cost of installing a CPP drain 200 m through this area is $ 40,000.

The reason for continued settlement of soils around the stone columns is not clear, and some additional monitoring is required in order to determine what repair work might be necessary, and at what point this repair work becomes urgent. Our recommended test holes and instrumentation was outlined in our Callout Report prepared following a September 29, 2004 visit to assess additional slope movement at this site.

8. CNR SLIDE (STA. 59+600)

8.1 Background and Observations

The CNR Slide was examined only briefly (Photo 26). We understand that no new movement has been noted since the last inspection. AMEC noted that erosion had occurred at the toe prior to their inspection in 2003 – it is not clear whether this has worsened since then (Photo 27).

8.2 Assessment

The wall and associated works appear to be performing based on our cursory inspection. Normal inspection and maintenance of the wall, drainage measures and slope toe protection should be continued. There is no currently active instrumentation at the wall to detect movement – it would be useful to be able to confirm continued good performance.

8.3 Risk Level

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

PF(4) * CF(4) = 16

Some movement has been observed at the toe of the slide, however, the previous repairs appear to be functioning. Partial closure of the road would result if the pile wall failed.

There does not appear to be any current means to monitor the performance of the wall. Recommendations in the 2003 AMEC inspection report to reinstate or replace existing slope could be supplemented by survey monitoring of the wall. In addition, some means of checking or verifying the effectiveness of the pumps should be considered.

9. CLOSURE

It appears that better control of surface water will benefit most of the problem areas along the Judah Hill section. Consideration could be given to developing an overall drainage strategy, perhaps consisting of a water tight buried storm sewer with periodic catch basin access and strategic discharge points to elephant trunks and/or drop pipes.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,
Thurber Engineering Ltd.
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Review Principal

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