THURBER ENGINEERING LTD.

ALBERTA TRANSPORTATION GEOHAZARD ASSESSMENT PROGRAM
PART A: FILE REVIEW

PEACE REGION – PEACE-HIGH LEVEL

PH31 JUDAH HILL – MICHELIN SLIDE

Legal Location:	NE¼20-083-21 W5M
Nearest Landmark:	1.8 km south of the CN Rail crossing on Hwy 744
Highway Control Section:	Hwy 744:04
Date of Initial Observation:	1984
Date of Last Inspection:	2008
Last Inspected By:	Thurber Engineering Ltd.
Instrumentation Installed:	10 inclinometers At least 2 pneumatic piezometers
Instrumentation Operational:	2 inclinometers 2 pneumatic piezometers
Risk Assessment: (as of last inspection)	PF = 9 CF = 4 Risk = 36

1. INTRODUCTION

The site is located 1.8 km south of the CN rail level crossing (km 59.6) on Hwy 744 near the town of Peace River. The site covers the road between km 57.7 and km 57.9 and the downslope stabilisation works.

Highway 744 runs south from Peace River through Marie-Reine to Highway 683 and on to Highway 49 near Girouxville. For the first 2 km south of the town of Peace River, it climbs roughly 200 m up the valley wall of the Peace River to prairie level at elevation 545 m.

This site encompasses the south flank of a 300 m wide old slide bowl, with the north flank of the slide bowl encompassing the Makeout Slide (PH32). The site includes a series of recent 1 m to 4 m high scarps and small slides down slope of a concrete pile wall, at the edge of repairs to the Makeout slide, and a roughly 50 m wide slide repair just down slope of the road at the southern edge of the site.

The location of the site is shown on Figure 1, while site details are shown on Figure 2, based on the last inspection.

This section is a review of files made available by Alberta Transportation regarding this site, and has been conducted to update the previous Part A review, which covered all the Judah Hill sites.

2. BACKGROUND

2.1 Bedrock Geology

Based on the AGS 1:1,000,000 bedrock geology map of Alberta, the following bedrock units occur in the valley slope down to the Peace River:

- Dunvegan Formation – fine sandstone with hard calcareous beds, laminated siltstone, silty shale.
- Shaftsbury Formation – silty shale and shale, ironstone beds, bentonite partings, thin silty and sandy intervals.
- Peace River Formation – silty shale, fine sandstone, silty interbeds.

No rock is exposed at the immediate site – cross-sections presented on the published hydrogeological maps suggest a considerable thickness of surficial materials overlie the rock.

2.2 Surficial Geology

AGS Map 291 (Surficial geology of the Grimshaw area) indicates a local veneer of eolian sand and silt overlying glaciolacustrine fine sand, silt and clay on the upland, with mixed colluvial materials on the slopes. Coarser sand and gravel deposits have been noted in road cuts locally along Hwy 744.

2.3 Hydrogeology

The ARC 1:250,000 Hydrogeological map of Peace River does not show springs or flowing wells (mainly completed within glacial deposits) in this area. Perched aquifers are expected locally, associated with local pockets of sand and gravel. Such pockets can become confined where covered by colluvium or fill on slopes.

2.4 Geomorphology

The site is below the crest of the east valley slope of the Peace River, on a ridge formed between the Peace River and Heart River. Highway 744 runs down the west side of the ridge as it decreases in height and narrows northwards, towards the town of Peace River. The sides of the Peace River and Heart River valleys are characterised by extensive landslide activity. Common landslide mechanisms in this region include:

- Earthflows caused by sudden saturation of surficial material.
- Landslides with a base in the weak Shaftsbury Formation shales.
- Landslides within weak glaciolacustrine silts and clays.

At this site, other factors that might influence landslide occurrence include saturation of downslope road fill, and drainage off the impermeable road surface. There are concerns about slide activity extending to the base of the slope, based on the irregular slope topography and observation of slides at the toe of the slope, including the 101 Street slide (see Barlow, McRoberts and Tenove 1990 “Stabilization of Urban Landslides in Peace River”). The Michelin Slide

corresponds to Slide 1 in Zone D2 in reporting prior to 2005, and is on the southern flank of an old slide bowl that encompasses the Makeout Slide to the north (Zone D1). Previous investigations suggest that there is up to 4 m of fill below the road, overlying clay, sand, lacustrine clay and clay till. Within the slide, fill was found to overlie organics, in turn underlain by clay. It is possible that road fill might have blocked seepage from more permeable layer, though movement at depth in slope indicators (e.g. 24 m to 28 m depth in SI-43) suggests deep-seated movement is also important.

3. HISTORIC INFORMATION

3.1 Summary

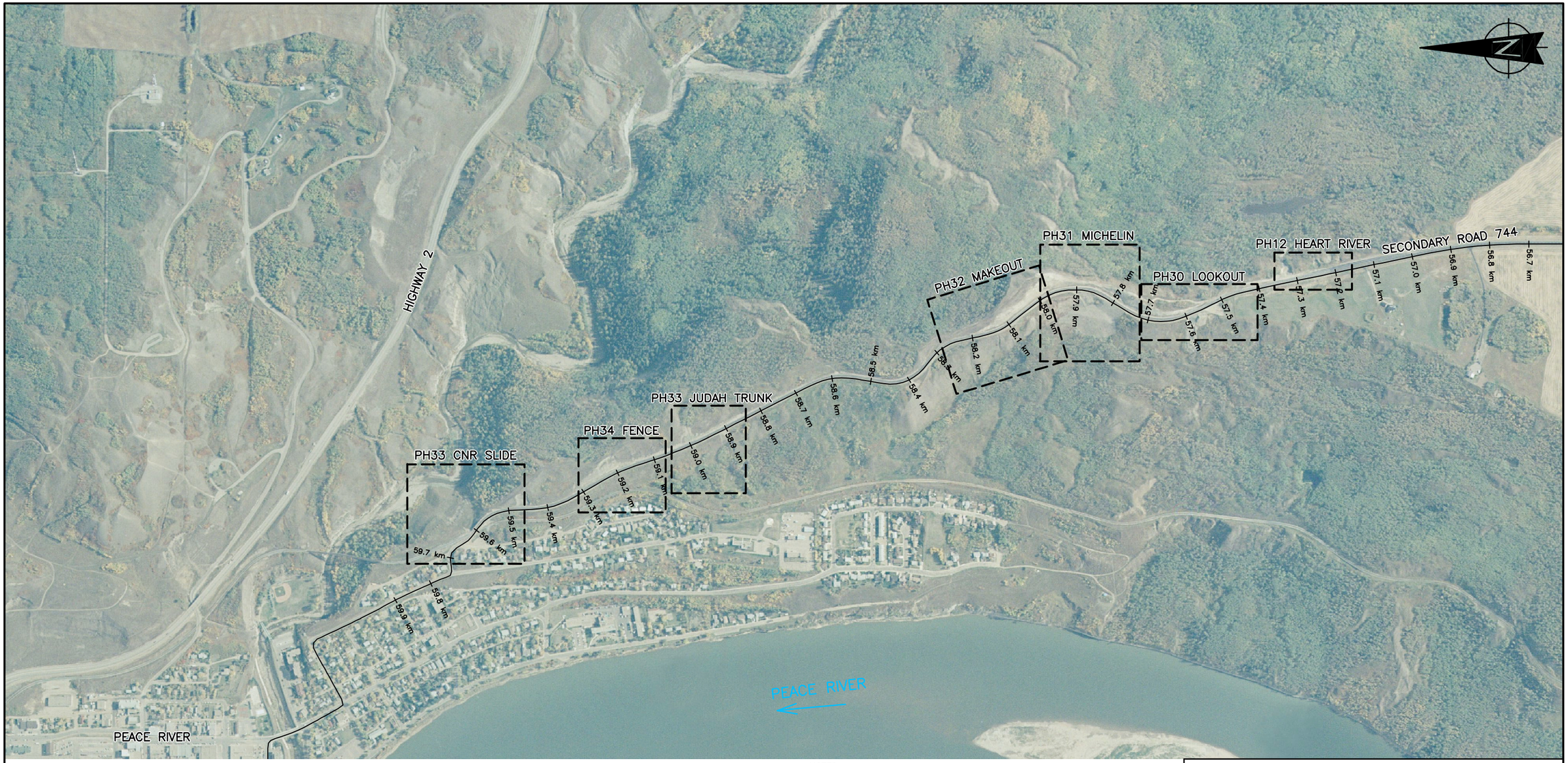
Initial problems were noted within this area in 1988. At some point between 1988 and early 1992, cement stabilised stone columns were installed through the area. In 1992, slide activity caused settlement of material between the columns at the outer 1/3 of the roadway. Various phases of investigation and installation of inclinometers occurred in 1992. Further slide movement occurred in 1994 downslope of the road. During the spring or summer of 1997, a new 50 m wide slide occurred at km 57.8. In September 1997, an anchored concrete caisson wall was installed from 1.3 km to 1.5 km south of the CN Rail crossing (within the Makeout Slide), and the road was re-aligned from km 57.5 to km 58.2. The 1997 slide at km 57.8 was repaired by May of 1999, involving construction of a shear key and toe buttress, with light-weight fill (shredded tires) placed on the upper portion of the slope. Since that time, some cracking and settlement has been noted in the road at the repair, and continued movement has been noted in the inclinometers at depth.

3.2 Chronology

May 1984	Hwy 744 first paved
September 1988	Geotechnical investigation along Hwy 744. Worst conditions noted at 57+760 to 58+000 (Michelin and Makeout Slides). Cement stabilised stone columns proposed.
1991 or 1992	Perforated pipe drain constructed through the centre of the slide.

April 1992	Slide at 57+780 affecting outer 1/3 of roadway (material has dropped away between columns). Test pit and test hole investigation. Fill overlies organics locally. Proposal to rebuild slope with granular material and include toe berm.
September 1992	SI-13 installed at 57+967
November 1992	SI-25 to SI-28 installed at km 57.8
August 1994	Slide 20 m downhill from road – but appears to be within the Makeout Slide area (location is not clear – movement is noted in SI-13). Cracking in the backslope of the slide at km 57.8.
September 1994	SI-42 and SI-43 installed downslope of Michelin slide.
1996	Ditch on uphill side of the road established.
September 1996	SI-60 to SI-64 installed (between Makeout Slide and Michelin Slide).
Spring-Summer 1997	New 50 m wide slide at km 57.8, to south of anchored caisson wall. Small shear movements registered in downhill inclinometers.
September 1997	Anchored concrete caisson wall installed from 1.3 km to 1.5 km south of CN Rail crossing (within Makeout Slide). Re-alignment of road from km 57.5 to km 58.2.
March 1998	Inclinometers and pneumatic piezometers installed at km 57.8
August 1998	Reporting on site investigation for 1997 slide at km 57.8. Concern that repair work might re-activate adjacent old slide areas. Proposed repair work consists of shear key and toe berm with light-weight fill (shredded tires) in the upper part of the slide.
May 1999	Repair work at 1997 slide at km 57.8 completed.
October 1999	Hwy 744 re-paved
May 2000	Crack (approx. 25 mm wide) observed in road in backscarp of km 57.8 slide repair.
May 2001	Possible widening of crack in road in backscarp of km 57.8 slide.
May 2002	Possible minor additional movement in crack in slide repair backscarp.
May 2003	Possible minor additional movement in crack in slide repair backscarp.

June 2004	Southbound lane was patched. Minor cracking evident in the road at the km 57.8 repair
June 2005	Slight worsening of cracking at km 57.8 repair. Cracks in soil slope downhill of road at km 57.9. SI-10 and SI-43 have higher movement rates within some movement zones.
June 2006	Slight worsening of cracking at km 57.8 repair. Cracks in soil slope downhill of road at km 57.9 with increased vertical movement. Some changes in inclinometer rates of movement.
May 2007	Worsening of cracking and settlement at back of km 57.8 slide repair. Gullying up to 0.5 m deep off downslope road shoulder at km 57.85. Additional cracking and vertical offsets downslope of road at km 57.9. Dip running across the road surface up to 20 cm deep at km 57.9. Repair of Makeout Slide.
June 2008	Longitudinal crack developed in the north-bound lane at km 57.74. Worsening of cracking at the back of the km 57.8 slide repair – cracks open to 70 mm and maximum settlement of 18 cm. Cracking and vertical offsets downslope of the road at km 57.9 have worsened. Acceleration of movement rates in SI-10 since 2005. Movement rates steady in SI-43.



NOTES:

1 LOCATION DATA RECORDED USING HAND HELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.

0 100 200 300 400 500 m

DRAWN BY ICB	DESIGNED BY	APPROVED BY
SCALE 1:10 000	DATE OCTOBER 29, 2008	FILE No. 15-16-213A-C1A

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PEACE REGION (PEACE RIVER/HIGH LEVEL)
JUDAH HILL

KEY PLAN

FIGURE 1

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GENERALLY MODERATE TO POOR GREEN-UP IN MAY 07.
BETTER GREEN-UP IN SEPT 07.
GOOD GREEN-UP IN JUNE 08.

SEEPAGE

SCARPS FROM 1 m TO 4 m HIGH

CRACKING IN RE-GRADED AREA

SLIDE RE-GRADED AS PART OF MAKEOUT REPAIRS

TOPSOIL PILE (APPROX.)

WOODPILE

TOE OF SLIDE DEBRIS

SCARP IS 8 m FROM EDGE OF PAVEMENT

600 CORRUGATED PLASTIC PIPE

NEW TIE-IN TO EXISTING BIG "O" PIPE

SI13

SI60

SI61

SI

SI63

SCARP 10 cm

0.6 m DIA CONCRETE PILES 2 m CENTRE-TO-CENTRE AT 5 m TO EDGE OF ROAD

DIP ACROSS ROAD (=0.2 m)

PREVIOUS ATV RIGHT OF WAY

GUARDRAIL IS BENT

UP TO 0.5 m OFFSET

58.0 km

57.9 km

MICHELIN SLIDE

BERM

FRESH SCARP

> 0.1 m VERTICAL OFFSET

NE 20-83-21-5

SI64

DRAINAGE FROM ROAD ERODED 0.5 m DEEP, 0.75 m WIDE

NEW TRANSVERSE CRACK

INLET

CSP 900mm
OUTLET EL=512.967

MINOR DEBRIS AT CULVERT INLET

SI1C

56+800

TO GROUMILE

SI98-10
PN98-10
PN98-10a

SI27

BC 56+713.40

SI26

CRACK TYP. 10 mm WIPE

57+750.00

REGRADED SCARP WITHIN 3 m OF GUARDRAIL

ASPHALT PATCH

CRACK OPEN UP TO 70 mm
VERTICAL OFFSET INCREASED TO 18 cm

SI25

10 m LONG CRACK IN N-BOUND LANE < 25 mm WIDE

OLD GUARDRAIL POSTS

N

LEGEND:

SLOPE INDICATOR

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2 2008 OBSERVATIONS SHOWN IN RED

0 10 20 30 40 50 m

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ICB		
SCALE 1:1 000	DATE OCTOBER 31, 2008	FILE No. 15-16-213A-COA

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PEACE REGION (PEACE RIVER/HIGH LEVEL)
PH31 JUDAH HILL - MICHELIN SLIDE

SITE PLAN

FIGURE 2

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