ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – GRANDE PRAIRIE DISTRICT
2018 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
GP44 Call Out	South of Grande Prairie	Cutbank River North	40:40	1
Legal Description		**UTM Co-ordinates (NAD 83)**		
NE21-65-5-W6		11U N 6,056,500	E 391,430	

	Date	PF	CF	Total
Previous Inspection:	May 30, 2017	12	4	48
Current Inspection:	May 23, 2018	12	4	48
Road AADT:	4,060		**Year:**	2017
Inspected By:	Don Proudfoot, Nicole Wilder (Thurber) Ed Szmata, Rocky Wang, Dwayne Lowen (AT)			
Report Attachments:	☑ Photographs ☑ Plans ☐ Maintenance Items			

Primary Site Issue:	Landslide in a 30 m high back slope which is toeing out into the west highway ditch in several locations. This area appears to be old landslide terrain.	
Dimensions:	About 425 m wide along the Hwy, and ~150 m long (from upper-most head scarp based on LiDAR drawing) to the toe in the west Hwy ditch. The most active slumping extended over a distance of about 225 m over the north half of the site.	
Date of any remediation:		
Maintenance:		
Observations:	**Description**	**Worse?**
☐ Pavement Distress		☐
☑ Slope Movement	The area west of the highway appears to be old landslide terrain with several retrogressive landslide scarps and toe bulges. The landslide area closer to the highway (lower ~50 m) had intermediate tension cracks and secondary scarps. Many of these areas contained freshly disturbed soil from recent movement, while other areas appeared to be older with less active movement zones, and some were partially overgrown with vegetation and small trees. A zone of fresher slumps toed out into the highway ditch in two locations.	☑
☑ Erosion	Ditch erosion existed intermittently along the west highway ditch and was incising into the highway embankment (well within the clear zone) at some locations where runoff was forced to go around toe slumping. An erosion gully has formed along the east highway ditch. At the time of the visit it was up to 1.3 m wide and 0.7 m deep. Two erosion gullies were observed in the backslope which were being actively eroded (sidewall sloughing evident): 1) at the northern 1/3 of the site marked by broken/failed gabions, and 2) at the southern 1/3 of the site marked by failed concrete matting at the top and a broken, separated 600 CSP further downslope.	☑
☑ Seepage	Seepage appears to be a contributing factor to the landslide movement. Seepage was observed emanating from the highway backslope at a number of locations over the northern 1/3 of the site, and water was flowing	☐

	from the erosion gully containing the broken gabions. There were also several ponded areas (sag ponds) above/behind the crest of the backslope as well.	
☑ Bridge/Culvert Distress	The 600-mm diameter CSP observed in the southern gully was separated, disjointed and non-functional.	☐
☑ Other	There is a rockfall hazard from a sandstone outcrop cliff near the southern end of the site. A 1m^3 boulder was observed laying in the highway ditch directly downslope of it, with some fractured rock fragments existing in the cliff.	☐

Instrumentation June 21, 2018: Inclinometers SI17-3 sheared off at 7.3 m depth. **Piezometers (All BGS): SP17-2** = 12.3 m; **SP17-4** = 18.2 m; **VW17-3** = Not functioning. Two old SIs (CBN01 and CBN02) installed 1997 were found at the location of the old landslide at the east side slope of the highway. The SIs depth reading was marked on the SI casings as 3' to 61' and 3' to 55', for SIs CBN01 and CBN02, respectively.

Assessment:

The immediate backslope above the highway is overly steep, with slope inclinations in the order of 1.2H:1V to 2H:1V. Seepage was also evident intermittently throughout the slide area. The exposed material in some of the scarps appeared to consist of silty sand or weathered sandstone, with some clay till, and highly plastic clay or clay shale evident in the highly slumped areas. The recent movements were probably triggered by slopes near their existing angles of repose for the insitu soils, which were destabilized by seepage. The areas of ponded water above the crest of the immediate backslope are a further source of seepage feeding the lower slope.

It was noted by AT that the east side slope of the highway embankment had failed in the mid 80's, during road construction. After the construction of a toe berm at the base of the side slope, there was some continued creep movement observed after the berm construction. Two SI's were installed in 1997 which have mainly experienced trace movements. A faint outline of the slide was observed during the site visit, as shown in the attached drawing; however, no cracking in the pavement was noted.

The west highway ditch and embankment erosion is being caused by surface runoff being forced to go around the toe of the landslide areas that have bulged into the ditch, incising into the unprotected embankment and is now only 0.4 m away from the white pavement line on the west side of the highway. If this is left unchecked, it could eventually threaten the stability and integrity of the highway. New erosion was noted on the east side of the highway as well and may eventually undercut the guardrail.

The structures conveying flow down the backslopes along the two swales have eroded and become non-functional, creating unprotected gullies, which were causing the side walls to slough in and enlarge them.

Recommendations:

Short Term:
The slope areas with ponded water should be graded and have drainage channels constructed to allow for this water to flow into the swales and remove the source of seepage on the top of the slope.

Where the slide toes protrude into the ditch causing highway embankment erosion, perhaps temporary drainage pipe could be installed in the ditch below the slide mass to let ditch water pass. The pipe would need to be installed in short sections, with each section backfilled before digging the next, as existing excavation could mobilize more slide material.

To control the rockfall hazard, a row of lock blocks could be strategically placed adjacent to the edge of the highway. However, the guardrail would need to be extended to the north to protect traffic from the lock blocks.

Ballpark Cost ~ $100,000

Long Term:
LiDAR, and geotechnical drilling studies were carried out in 2017 as part of the AT's proposed roadway improvements to the Highway 40 corridor between Grande Cache and Grande Prairie to determine the soil/groundwater conditions to design a remediation work for the impacted area.

The proposed remediation work for the backslope will mainly consist of flattening the backslopes to a gentler angle varying from 2H:1V to 4H:1V. The steeper section will start at the north end and becomes flatter going to the south end. The ditch erosion remediation design will address as part of the highway improvement design. A copy of the geotechnical report prepared for WSP for the backslope remediations work is attached herein for your reference. WSP was awarded the highway improvement design contract, which have retained Thurber to provide the backslope remediation recommendations. It is our understanding that construction will start in 2019.

Instrumentation:
The recently found SIs CBN01 and CBN02 should be included to be read during the instrumentation reading program for this site in the spring of 2019.

H:\13000\13353 Geohazard Assessment - Grand Prairie (CON0017603)\Drafting\2018\NPW13353-GP44-1.dwg - 1N - Dec. 18, 2018

EROSION

EROSION UP TO 0.7m DEEP AND 1.3m WIDE

SICBN02

OLD SLIDE

HIGH PLASTIC SHALE IN SLIDE MASS

SLIDE BLOCKING DITCH CAUSING EROSION IN SIDESLOPE 1.2m FROM WHITE LINE, 0.8m DEEP

1m³ BOULDER IN DITCH

SICBN01

EROSION GULLIES 0.4m FROM WHITE LINE

HWY 40:40

BROKEN CULVERT 600 Ø CSP

0.6m DEEP, 0.7m WIDE EROSION & 3.3m FROM WHITE LINE

EROSION 1.6m FROM WHITE LINE; 1m DEEP

CLAY TILL EXPOSED IN SCARP

BROWN SILTY SAND OR SANDSTONE (WEATHERED) EXPOSED IN SCARP

1.1m WIDE x 0.4m DEEP

SEEPAGES

EROSION GULLIES AROUND SLUMP TOED INTO DITCH

740

750

LARGE BOULDER

SEEPAGE AREA FROM TOP OF SCARP

720

PONDED WATER

FRESH SLUMPING

25° SLOPE FROM SCARP TO DITCH TOE

FRESH MUD FLOWS

DRAINAGE SWALE WITH FAILED CUPCAKE CONCRETE MATTING

PONDED WATER 8m x 3m x 0.3m DEEP

730

740

750

RUNOFF SWALE WITH BROKEN GABION ARMOURING

760

MORE MOVEMENT

PONDED WATER

VERY FRESH SLOUGH

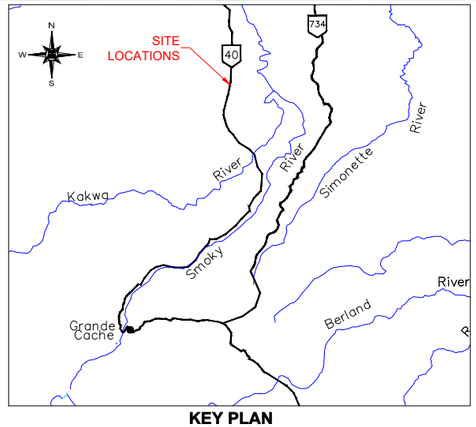
DRY CLAY OR SHALE EXPOSED IN SCARP

760

WATER ERODING GULLY IN SANDSTONE CLIFF

MORE SANDSTONE BLOCKS COULD FALL

OLD GRASSED OVER SCARP



KEY PLAN
SCALE: 1:2 000 000

LEGEND

- CONTOUR LINE (CONTOUR INTERVAL = 2.5m)
- SLUMP SCARP (APPROXIMATE)
- DIRECTION AND NUMBER OF PHOTO
- APPROXIMATE LOCATION OF SLOPE INCLINOMETER
- GUARDRAIL (APPROXIMATE)

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. MAY 23, 2018 FEATURES SHOWN IN RED

0 10 20 30 40 50 60 70 m
SCALE 1:1250

BASE PLAN FROM 2005 LIDAR

Alberta

PEACE REGION (GRANDE PRAIRIE)
GP44: HWY 40:40, km 1.0, CUTBANK RIVER NORTH
NE 21-65-5-W6M

2018 INSPECTION PLAN

DWG No. 13353-GP44-1

DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	RVC
SCALE	1:1250
DATE	DECEMBER 2018
FILE No.	13353

THURBER ENGINEERING LTD.

THURBER

	**Photo 1.** Looking south along at seepage into the west ditch at the north end of the site.
	**Photo 2.** Looking west at the northern section of the slide mass.

THURBER

	**Photo 3.** Looking south at the deteriorated gabion armour.
	**Photo 4.** Looking north at the toe slumping into the west ditch.

THURBER

	**Photo 5.** Looking north at the north end of the scarp crack.
	**Photo 6.** Looking west at erosion caused by a broken 600 mm CSP exposed in the slumping backslope.

THURBER

	**Photo 7.** Looking south at new erosion observed on the east side of the highway.
	**Photo 8.** Looking north at large fallen boulder in erosion gully.

THURBER

	**Photo 9.** Looking west up at hanging boulders that will eventually fall into ditch or highway.
	**Photo 10.** Looking north at the west ditch erosion gully which has formed around the toe of slide encroaching against the highway embankment near middle of site.

THURBER

	**Photo 11.** Looking down towards road from the slope crest at the eroded gully caused by the broken 600 CSP.
	**Photo 12.** Looking southeast down at erosion gully that runs along the west ditch/shoulder.

THURBER

	**Photo 13.** Looking north at recent area of movement
	**Photo 14.** Looking north at sloughed material just north of photo 13.