ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION–GRANDE PRAIRIE
2022 INSPECTION REPORT

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
GP029	Saddle (Burnt) River Crossing North Valley Slope	RR771 Slide (Church Camp)	2:70	11.881
Legal Description		**UTM Co-ordinates**		
NW¼4-077-05-W6M		11U E 393076	N 6168469	

	Date	PF	CF	Total
Previous Inspection:	28-May-2020	11	6	66
Current Inspection:	17-May-2022	11	6	66
Road AADT:	3260		**Year:**	2021
Inspected by:	Ed Szmata, AT Max Shannon, AT Kristen Tappenden, AT Austin Dillman, AT Ken Szmata, AT		Don Proudfoot, Thurber Nicole Wilder, Thurber Barry Meays, Thurber	
Report Attachments:	☑ Photographs ☑ Plans		☐ Maintenance Items	

Primary Site Issue:	This section of Highway 2:70 is located adjacent to the crest of the valley slope on the west side of the Saddle (Burnt) River. The highway was widened further east in 2013 to accommodate the construction of a new northbound passing lane. A portion of the passing lane was likely constructed over the backscarp of an existing landslide on the west valley slope. River erosion at the toe of valley slope undermines the global stability of the overall valley slope in combination with artesian conditions observed to occur at this site.	
Dimensions:	The cracks observed on the ACP surface of the Hwy 2:70 indicated that the landslide backscarp extended beyond the SBL shoulder and into the west highway ditch. The lateral extent of the cracks observed in the ACP indicated that the affected area is about 240 m in width.	
Maintenance:	Previously several ACP patches were observed in a small section of the SBL as well as a section of both NBLs over the previously distressed areas near the intersection between Highway 2:70 and Township Road 771 in 2019. The site on all lanes was chip sealed in 2021 immediately prior to when we would have inspected the site in 2021. Hence why the 2021 inspection was postponed to 2022.	
Observations:	**Description**	**Worsened?**
☑ Pavement Distress	Cracks are showing through the chip seal that was placed in 2021 with opening width up to 80 mm were observed on the shoulder of SBL. The scarp crack observed in the pavement extended 200 m further south through all lanes and into the east shoulder. The cracks in the east shoulder are about 20 mm in width. A crack extended about 50 m further south running parallel to a crack directly east of the crack	☑

	extension. There is also a dip in the road that is evident when cars drive over the surface.	
☑ Slope Movement	The readings of the SIs installed in 2017 indicated the presence of a deep slip surface at a depth about 45 m below the existing ground surface. There were also movement zones observed between 17 m and 33 m depth below ground surface. Only SI17-5 did not show movement; however, this may be installed too shallow.	☑
☐ Erosion		☐
☑ Seepage	Ponded water observed mid-slope northeast of SI-2 appeared to have more water.	☑
☐ Bridge/Culvert Distress		☐
☐ Other		☐

Instrumentation:

SI-1 (Destroyed)	Installed at about 20 m downslope (east) of Hwy 2:70 as a part of the 2007 geotechnical investigation program. This SI was likely destroyed during the construction of the northbound climbing lane in 2013. Readings of this SI indicated a slip surface at an approximate elevation of 622.6 m (about 22 m below ground surface).
SI-2	Installed about 60 m downslope of the Hwy 2:70 NBL at approximately the middle of the Saddle (Burnt) River west valley slope. This SI showed a rate of slope movement of: 1.8 mm/yr within depths from 6.4 m to 9.5 m below the existing ground surface during the spring 2022 readings. A movement zone within depths of 34.4 m to 35.1 m showed a rate of slope movement of 1.5 mm/yr during the spring 2022 readings.
SI-3	Installed about 120 m downslope of the Hwy 2:70 NBL, approximately 20 m west of the crest of the top of bank of the lower terrace of the Saddle (Burnt) River. This SI showed a rate of movement of: 5.6 mm/yr within depths from 4.5 m to 7 m in spring 2022. The SI showed 0.5 mm/yr within depths of 9.4 m to 10.6 m in spring 2022.
PN-2	Installed at the same location as SI-2 with the tip at an elevation of 629.66 m. The measured piezometric surface was 0.02 m above ground surface (B.G.S) indicating an increase in water level of approximately 1.3 m since the fall 2021 readings.
PN-3	Installed at the same location as SI-3. Piezometer leads were damaged. The last water level measured in 2014 was at an elevation of about 626 m (approximately 5 m below ground surface).
SI17-1	Installed about 12 m downslope of the Hwy 2:70 NBL, opposite of Township Rd 771. This SI previously showed a rate of movement of 4.1 mm/yr within depths from 25 m to 26.3 m and 16.7 mm/yr within depths of 31.8 m to 33 m. However, this SI has since sheared off at 33.2 m below the ground surface.
SI17-2	Installed about 55 m downslope of the Hwy 2:70 NBL and 43 m downslope of SI17-1. This SI showed a rate of movement of: 3.1 mm/yr within depths from 17.2 m to 19.7 m. The SI showed a zone of movement with rate of movement of 1.0 mm/yr within depths of 21.5 m and 23.3 m and showed a rate of movement of: 8.0 mm/yr within depths of 48.3 m to 50.8 m in spring 2020. However, this SI has since sheared off at 50.6 m below the ground surface.
SI17-3	Installed about 137 m downslope of the Hwy 2:70 NBL and 75 m downslope of SI17-2. This SI showed a rate of movement of:

	58.2 mm/yr within depths from 42.2 m to 44.6 m in Fall 2019; however, this SI has since sheared off at 43.6 m below the ground surface.
SI17-4	Installed about 112 m downslope of the Hwy 2:70 NBL and 25 m north of SI-3. This SI showed a rate of movement of: 17.1 mm/yr within depths from 37.4 m to 39.2 m and a rate of movement of: 59.9 mm/yr within depths of 43.5 m to 45.3 m in Fall 2018; however, this SI has since sheared off at 45.1 m below the ground surface.
SI17-5	Installed about 12 m west of Hwy 2:70 SBL and about 80 m upslope from SI-2. This SI has shown no discernable movement since installation.
PN17-1A PN17-1B	Installed at same location as SI17-1 with PN17-1A and PN17-1B tips at elevations of 633.9 m and 610.5 m (11.7 m and 35.0 m B.G.S.), respectively. Both PN17-1A and PN17-1B are not functioning now.
PN17-2A PN17-2B PN17-2C	Installed at same location as SI17-2 with PN17-2A, PN17-2B and PN17-2C tips at elevations of 628.4 m, 598.5 and 587.9 m (10.2 m, 40.1 m, and 50.8 m B.G.S.), respectively. PN17-2A showed an increase in water level of 0.77 m, PN17-2B showed an increase in water level of 0.64 m and PN17-2C showed an increase in water level of 0.28 m since the fall 2021 readings.
PN17-3A PN17-3B PN17-3C	Installed at same location as SI17-3 with PN17-3A, PN17-3B and PN17-3C tips at elevations of 603.8 m, 591.3 and 581.4 m (25.7 m, 38.2 m, and 48.1 m B.G.S.), respectively. PN17-3A has not been functioning since installation. PN17-3B and PN17-3C both showed an increase of 0.50 m and 0.56 m, respectively in water levels since the fall 2021 readings, respectively.
PN17-4A PN17-4B PN17-4C	Installed at same location as SI17-4 with PN17-4A, PN17-4B and PN17-4C tips at elevations of 606.3 m, 590.9 and 582.7 m (24.9 m, 40.3 m, and 48.5 m B.G.S.), respectively. PN17-4A and PN17-4B showed decreases in water levels of 0.07 m and 0.21 m, respectively and PN17-4C showed an increase in water level of 0.49 m since the fall 2021 readings. PN17-4C shows the ground water level to be 7.53 m above ground surface.
PN17-5A PN17-5B	Installed at same location as SI17-5 with PN17-5A and PN17-5B tips at elevations of 633.2 m and 612.0 m (14.2 m and 35.4 m B.G.S.) respectively. PN17-5A showed an increase in water levels of 0.28 m and PN17-5B showed a decrease in water level of 0.14 m since the fall 2021 readings.
SP17-6	Installed in the farmers field about 125 m south of SI17-5 and showed a decrease of 0.72 m in water level since the fall 2021 readings.

Assessment:

Cracks on the ACP surface have been regularly observed and patched/chip sealed yearly since 2004. The distress and cracking of the pavement observed at the site since 2014 are likely the result of the widening of the roadway and the construction of pavement over the backscarp of the existing landslide.

The depth of the slip surface previously observed in the slope inclinometer SI-1 was about 22 m below the existing ground surface, indicating that the landslide affecting the highway is a deep-seated slope failure. The new SIs installed on September 2017 indicated that the landslide failure plane is even deeper, at approximately 45 m depth. The cracks observed in the ACP indicated that the backscarp of the landslide extended into the west higway ditch beyond the SBL.

The instruments installed in 2017 confirmed that the landslide affecting the highway is in fact a deep-seated landslide driven by artesian groundwater conditions; therefore, the most feasible mitigation measure is to realign the highway further west out of the landslide area. The conventional slope stabilization measures such as toe berms and pile walls are not considered to be feasible alternatives.

A preliminary design for a highway re-alignment was carried out by Thurber and WSP to by-pass the affected area. The preliminary design was submitted to AT in July 2018.

On July 24, 2018 a call-out was performed at this site as Mr. Ken Misik, AT's MCI for this area observed a pronounced dip at the inner wheel path of the road. A copy of the call-out letter dated August 16, 2018 is included in the site binder.

Currently, a detailed design for highway re-alignment is being carried out by Thurber and WSP. A key issue for the finalization of the detailed design is related to obtaining agreements for pipeline crossing and existing oil wells along the proposed re-alignment, in addition to the acquisition of additional ROW.

Recommendations:	**Ballpark Cost**
In the short term, the development of the cracks on in the ACP surface of the roadway should be regularly monitored. Cracks should be timely patched/sealed to prevent surface water infiltration into the landslide backscarp.	Monitoring

Closure

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Yours very truly,
Thurber Engineering Ltd.
Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer

PROFESSIONAL ENGINEER ALBERTA
NICOLE WILDER
ID 174073
October 18, 2022

PROFESSIONAL ENGINEER ALBERTA
DONALD PROUDFOOT
ID 51674
October 18, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 18, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Nicole Wilder, M.Eng., P.Eng.
Geotechnical Engineer

THURBER

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b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2022\NPW\32123-GP029-1.dwg - 1 - Oct. 13, 2022

TH17-9

TH17-8

SE 9-77-5-W6M

SW 10-77-5-W6M

R/W PLAN 8421187 GOVERNMENT ROAD ALLOWANCE

A

A'

CHIP SEALED IN 2021

CRACK UP TO 80mm WIDE WITH A 40mm DIFFERENTIAL

DIP IN ROAD - VISIBLE WHEN CARS DRIVE OVER (2020, 2022)

TWP RD 771

TH17-7

SI/PN17-1

SI/PN17-2

SI/PN17-3

BURNT RIVER

WETLAND NOTICED IN 2014 WAS DRY IN 2022

CRACKS OPEN TO 10mm (2020, 2022)

B

B'

PONDED WATER

NE 4-77-5-W6M

SI1 (DESTROYED)

SI/PN17-5

PN-02
SI-2

SI/PN17-4

NW 3-77-5-W6M

PN-03
SI-3

BH-4

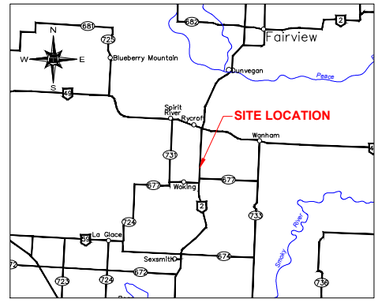
SLOUGHING PREVIOUSLY OBSERVED HERE

~14m FROM CROWN TO RIVER

TH17-6

HIGHWAY 2: 70

POSSIBLE OLD BORROW PIT AREA



KEY PLAN
SCALE: 1:2 000 000

LEGEND

- TEST HOLE FOR HIGHWAY REALIGNMENT
- APPROXIMATE LOCATION OF INSTRUMENT
- APPROXIMATE LOCATION OF FORMER INSTRUMENT
- APPROXIMATE LOCATION OF FORMER TEST HOLE
- SI SLOPE INCLINOMETER
- PN PNEUMATIC PIEZOMETER
- SCARP CRACK
- CRACK
- OP OVERHEAD POWER LINE (APPROXIMATE)
- GUARDRAIL (APPROXIMATE)
- APPROXIMATE LOCATION OF ABANDONED WELL
- BURIED TELUS CABLE (APPROXIMATE)
- DIRECTION AND NUMBER OF PHOTO

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. MAY 18, 2022 FEATURES SHOWN IN RED

0 25 50 75 100 150 200 m
SCALE 1:3000

Alberta

PEACE REGION (GRANDE PRAIRIE)
GP29-1: HWY 2:70 RR771 SLIDE

2022 INSPECTION FIGURE

DWG No. 32123-GP29-1-1

DRAWN BY	ML
DESIGNED BY	NPW
APPROVED BY	RVC
SCALE	1:3000
DATE	OCTOBER 2022
FILE No.	32123

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	**Photo 1.** Looking southwest from middle of highway about 50 m north of the intersection between Hwy 2:70 and Township Road 771.
	**Photo 2.** Looking at cracks in ACP patch in the northeast outer NB passing lane.

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	**Photo 3.** Looking south standing near Township Road 771 looking at crack in the SBL.
	**Photo 4.** Looking south at the cracks in the SBL shoulder just south of Township Road 771.

	**Photo 5.** Looking south at cracks observed crossing both NBL and extending into the shoulder.
	**Photo 6.** Looking north from highway embankment to the east where scarp crack was observed and was slightly more grown over in 2022.

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	**Photo 7.** Looking east at low lying wet land area where water was ponded.
	**Photo 8.** Looking south at cracks observed crossing both NBL.