ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – SWAN HILLS
2022 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
SH023-11	Little Smoky River	Little Smoky River Valley, North Hill – Site #11	744:02	20.46-20.79
Legal Description		**UTM Co-ordinates**		
NE21-76-22-W5M		11U E 478,317	N 6,162,188	

	Date	PF	CF	Total
Previous Inspection:	2-Jun-2020	10	4	40
Current Inspection:	1-Jun-2022	10	4	40
Road AADT:	230		**Year:**	2021
Inspected By:	Rishi Adhikari, TRANS Max Shannon, TRANS		Ken Froese, Thurber Mark Gallego, Thurber	
Report Attachments:	☑ Photographs ☑ Plans		☐ Maintenance Items	

Primary Site Issue:	Highway traverses deep-seated (likely 35 m to 45 m deep at this Site), retrogressive landslides with ongoing creep movements due partly to erosion at toe by the Little Smoky River and Peavine Creek resulting in cracking and sagging of the pavement surface at numerous locations. Approx. 4 km of the highway crosses this unstable north valley slope. Site #11 is 60 m above and 260 m away from the Peavine Creek.
Dimensions:	330 m length of highway affected by cracking and distortion
Date of Remediation:	1988: 6 m deep subdrain installed in upslope ditch from Sta. 20+600 to 20+860. 2000: Toe berm, gravel drainage blanket, and subdrain pipe (drains to Site #10) installed (by AGRA/AMEC). Patching of the highway and ditch cleaning done at the same time. 2005: West ditch lined with ECP and GeoRidge (20 m spacing).
Maintenance:	Routine ACP crack sealing, milling, and patching, when required. 2017: ACP patch placed over south portion of Site #11. Guardrail removed and sideslopes regraded (1,200 m^3 of pitrun). Fall 2017: Milled and patched. 2019: Milling over most of the Site. 2020: Line painting 2021: Highway overlay (50 mm)

Observations:	Description	Worsened?
☑ Pavement Distress	Site was recently overlaid. Some of the previous longitudinal and traverse cracks have reflected through. Rutting was observed in a patch located in the outer wheel path of the SBL.	☑
☑ Slope Movement	Site is located on an active deep-seated landslide moving toward the Peavine Creek. There is significant vertical deformation of the pavement.	☑
☑ Erosion	Upslope ditch was regraded and erosion control measures installed.	☐
☐ Seepage		☐
☐ Bridge/Culvert Distress		☐

☐ Other		☐

Instrumentation:

Destroyed: (year lost)	*Installed in 1999 by AGRA:* SI99-1 (2000, sheared about 24m), PN99-1 (2008), SP99-3 (2006), SP99-4 (2006), SP99-5 (unknown), SP99-6 (2005), *Installed in 2000 by AGRA:* SI00-1 (2002), SP00-1 *Installed in 2001 by Thurber:* S01-1 (2002, sheared at 5.5m), SP-TH01-1A (2006), SP-TH01-1B (2006)

Assessment:

The overall valley slope is moving as several separate slide blocks in response to the toe erosion and downcutting of two different rivers resulting in numerous scarps, sag ponds, and differential movement zones going in slightly different directions. The highway intersects the scarps of these blocks at several locations resulting in an uneven highway surface and cracking. There is approximately 55 m to 60 m elevation difference between the highway and the Peavine Creek located about 250 m to the southeast with two significant scarps identified from LiDAR at 110 m and 205 m from the highway.

Site #11 is located on an active scarp with significant vertical deformation observed to be affecting the highway. Two significant scarp cracks were identified crossing the highway surface and could also be traced in the adjacent ditches (although obscured by regrading done in 2019 and 2021). The ditches were regraded and removed previously observed erosion gullies. Erosion control measures including matting and GeoRidges were installed in a portion of the upslope ditch. Since the highway overlay in 2021, the two main scarp cracks have become re-established. The south of the two sets of scarp cracks has greater deformation since the observed cracks were wider and deeper. There was less deformation at the north scarp crack; however, there is a significant 4 m high scarp located downslope in the trees (identified from LiDAR topography).

Historically, there has also been shallow movement of the embankment which was remediated in 2000 with the construction of a toe berm and blanket drain. Without instrumentation, it is difficult to determine the present effectiveness of the toe berm; however, there did not appear to be signs of toe berm instability (such as cracking or bulging); however, the crack pattern in the highway above the berm continues to expand which is likely indicative of deeper-seated movement below the berm.

Recommendations:

Short-Term:

- Road maintenance should continue as necessary to maintain as safe roadway surface and may consist of milling, patching, and crack sealing of the ACP.

Long-Term:

- It is understood that, at this time, the only long-term remediation option under consideration is realignment of the entire north hill section of Highway 744. However, given the high cost of this option and as it is a low volume highway, it is unlikely that a full realignment will be undertaken in the near-future. Consideration is also being given to a shorter realignment which would include both of the SH023 sites as they currently require frequent maintenance.
- However, given the significant vertical distortion, vertical realignment of the highway at this Site #11 should be considered. Lowering of the highway grade, or subcut and replacement with light-weight fill, would reduce the driving weight at the top of this slide block and might decrease the rate of maintenance. Alternatively, a horizontal shift of at least 20 m into the slope could be considered to move the highway off this active slide block. The Maintenance Contractor Inspector estimates a $2M cost to realign the highway around the current Sites #10 and #11.

Ongoing Investigation:

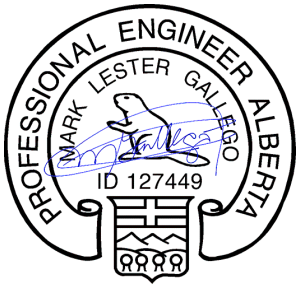
- It is recommended that the annual Geohazard inspection should continue as scheduled.

As this is one of the more-active Sites along this north valley slope, consideration should be given to installing two or three slope inclinometers to evaluate the ongoing performance of the toe berm and assessing current slope movement rates particularly if vertical or horizontal realignment is being considered.

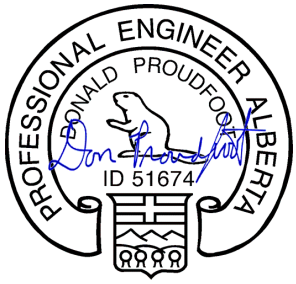
Closure

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.

Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer



October 17, 2022



October 17, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 17, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Mark Gallego, P.Eng.
Geotechnical Engineer

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

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.

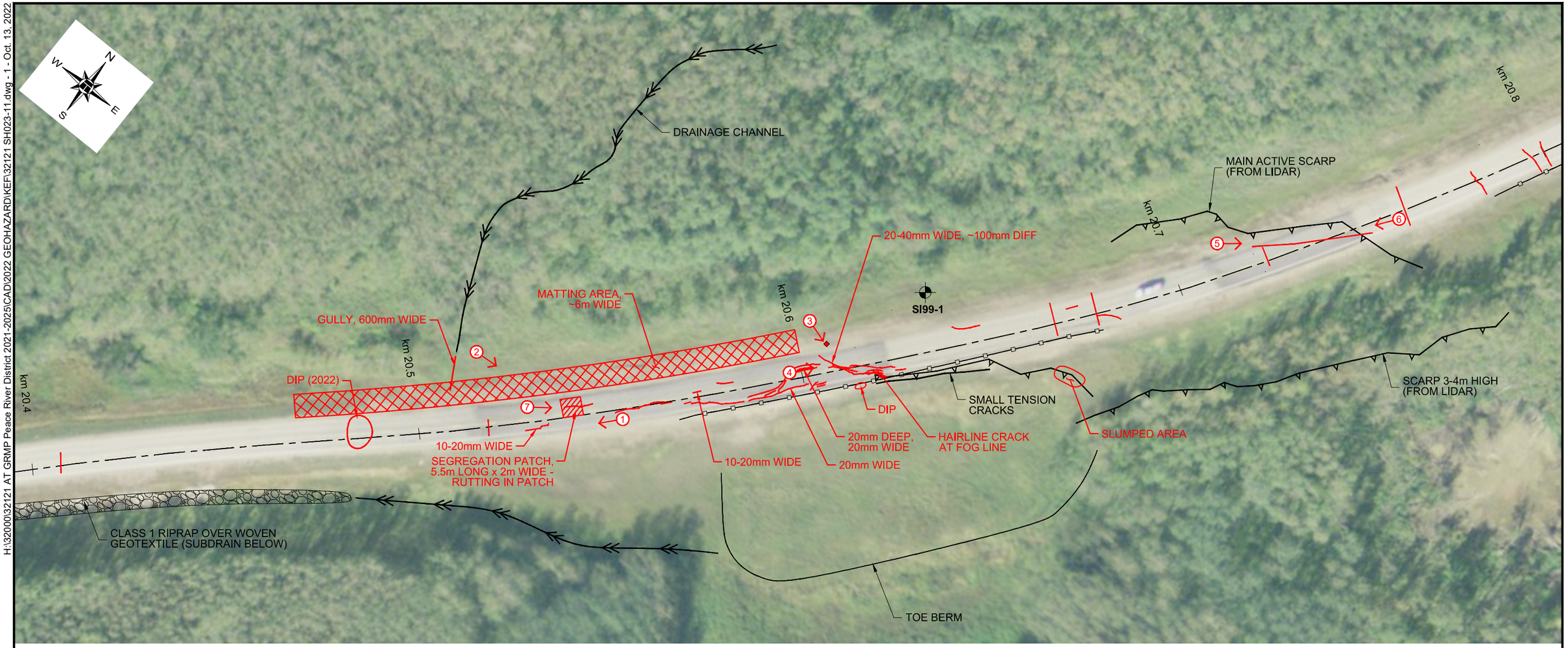
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2022 GEOHAZARD\KEF\32121 SH023-11.dwg - 1 - Oct. 13, 2022

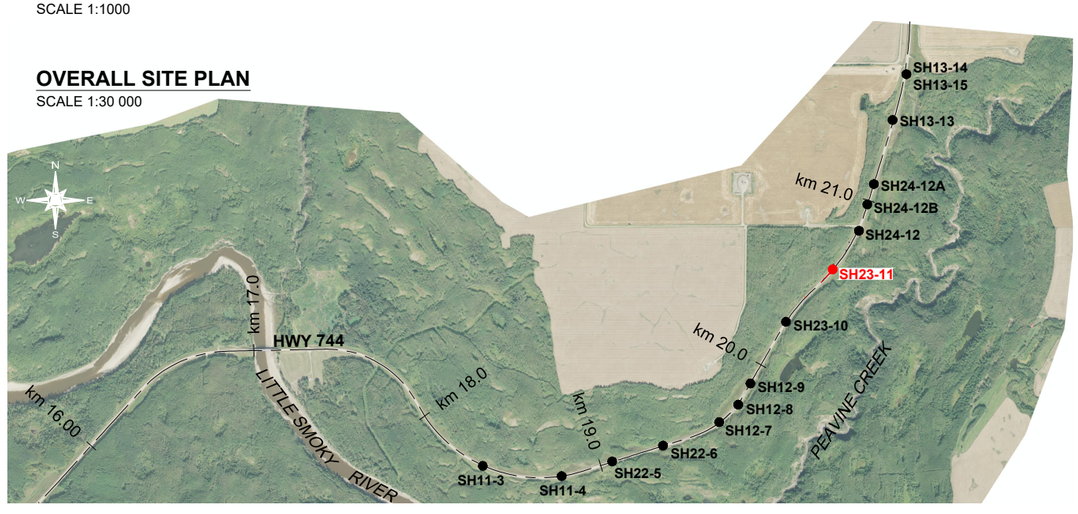


DETAILED SITE PLAN

SCALE 1:1000

OVERALL SITE PLAN

SCALE 1:30 000



LEGEND

- LANDSLIDE SCARP (GREY FOR PORTIONS OBSCURED BY PATCHING OR GRADING)
- SLOPE INCLINOMETER (APPROXIMATE)
- GUARDRAIL
- DIRECTION AND NUMBER OF PHOTO

NOTES

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. JUNE 2022 OBSERVATIONS SHOWN IN RED.
3. CRACK AND PATCH PATTERNS RESET AS HWY 744 WAS OVERLAID IN SUMMER 2021.
4. GUARDRAIL AND CULVERT LOCATIONS TAKEN FROM MCINTOSH PERRY AS-BUILT DRONE SURVEY (JULY 2021).

0 10 20 30 40 50 60m

SCALE 1:1000

SATELLITE IMAGE FROM VALTUS IMAGERY (DATED 2014)

Alberta

PEACE REGION (SWAN HILLS)

SH023-11: HWY 744:02 LITTLE SMOKY RIVER VALLEY 2022 SITE INSPECTION PLAN

DWG No. 32121-SH023-11

DRAWN BY	ML
DESIGNED BY	MG
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	OCTOBER 2022
FILE No.	32121

THURBER ENGINEERING LTD.

Photo 1 – Looking southwest at the southwest end of Site 11.

Photo 2 – Looking east highway at south end of site where previous significant gully was regraded and erosion control measures (matting and GeoRidges) were installed.

Photo 3 – Looking east at main scarp crack crossing highway (see Photo #4).

Photo 4: Looking northeast where main scarp crack crosses the highway at the central portion of Site 11.

Photo 5 – Looking northeast at north scarp crack.

Photo 6 – Looking southwest at north scarp crack.

Photo 7: Scarp crack and rutting in a patch located in the SBL.