

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT
PEACE REGION (PEACE RIVER DISTRICT)
2021 INSPECTION**



Site Number	Location	Name	Hwy	km
PH075-1	North of Peace River	Whitemud River (km 44.4)	743:02	44.4
PH075-2		Whitemud River (km 44.8)		44.8
Legal Description		UTM Co-ordinates		
NE2-88-21-W5M		11U E 486,395 486,112	N	6,273,737 6273,982

	Date	PF	CF	Total
Previous Inspection:	4-June-2020	PH075-1: 11	4	44
	4-August-2020	PH075-2: 9	6	54
Current Inspection:	7-July-2021	PH075-1: 11	4	44
	7-July-2021	PH075-2: 9	6	54
Road AADT:	110		Year:	2020
Inspected By:	Kristen Tappenden, TRANS Don Proudfoot, Thurber Ed Szmata, TRANS Chase Milligen, TRANS			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	PH075-1: Creek bank erosion and slumping of over-steepened slope above culvert inlet. PH075-2: Retrogressive landslide scarp through both lanes	
Dimensions:	PH075-1: 40 m of creek bank erosion PH075-2: 55 m wide along the shoulder, approx. 275 m wide at the creek and 160 m long from the highway to the creek.	
Date of Remediation:	2009: Culvert replaced and sideslopes rebuilt.	
Maintenance:	Highway closed on Jul 13, 2020, until detours opened in Fall 2020.	
PH075-1 Observations:	Description	Worsened?
<input type="checkbox"/> Pavement Distress	Highway is gravel-surfaced.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Slump above culvert regressed significantly in 2018 and continues to move. There is major bank slumping upstream of the culvert and minor bank slumping downstream of the outlet.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Slump on the west side of the creek at the inlet has continued to retrogress since 2015; erosion at end of north ditch channel relatively stable.	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	No signs of distress in the culvert itself; however, slide movements are obstructing flow at the inlet and sediment is accumulating at the outlet.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
PH075-2 Observations:	Description	Worsened?
<input type="checkbox"/> Pavement Distress	Cracks and dip in gravel road surface.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	The dip encompasses the entire roadway surface and trees at the toe are leaning	<input checked="" type="checkbox"/>

<input checked="" type="checkbox"/> Erosion	Erosion occurring in east ditch sporadically over 200 m length between km 44.3 to 44.1 south of PH075-1 (not documented in 2021)	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
Instrumentation:		
None.		
Assessment:		
PH075-1 (Drawing 32121-PH075-1)		
<p>Significant landslide movements on both sides of the valley closed the highway in July 2020 until detours were in place in Fall 2020. This site is located on a relatively flatter section of the roadway and was unaffected by these other movements.</p> <p>The creek bank at the culvert inlet began to regress significantly due to heavy runoff in Spring 2018. The spring of 2020 also had significant runoff and there was an ice jam at this site (reported by MCI). The scarps above the culvert have formed into numerous slump blocks and continue to retrogress and were 2.6 m (slope distance) from the edge of the gravel surfacing (was 8.85 m in 2018 and 5 m in 2020). Slumping continues to worsen along the west bank of the creek moving further into the slope since first mapped in 2017. In 2018, the pin installed 2 m upslope of the tension crack was only 0.36 m from the resulting scarp and was shifted 3 m further upslope. The pin was 3.0 m from the scarp in 2019 and had to be reset again in 2020. The slumping of the riverbank is undermining the embankment and is causing instability which will impact the highway and has started to impact the culvert obstructing the inlet slightly.</p> <p>The embankment slope above the riprap was about 2H:1V which is steeper than usual for a slope constructed using clay in this area. This steeper slope will likely result in more rapid retrogression if the channel experiences similar water flows. The ongoing slumping on the west side at the culvert inlet has displaced much of the riprap apron which increases the vulnerability of the slope to future high water events. Furthermore, the point bar forming on the east side of the channel also concentrates flow into the west bank. This point bar had increased in size noticeably in 2020 and is starting to vegetate in 2021.</p> <p>Erosion was previously noted where the north ditch contacts the west bank north of the culvert inlet. The rate of downcutting has slowed with only an additional 0.1 m deeper and wider since 2017. It also appeared in 2021, due to lower water levels, that a significant amount of sediment has accumulated at the inlet which may be from the progressive downcutting and toe erosion that triggered the slide movements at PH039 and elsewhere in the valley.</p> <p>The shallow gully that formed at the west side of the top of the outlet riprap has vegetated and did not appear to have increased in size since 2017. This gully has likely formed due to surface runoff short-cutting out of the ditch channel. It was also observed that the displaced riprap from the culvert outlet apron is mounded in the centre of the channel forcing flow around causing the increasing undercut on the east bank. The length of affected bank was slightly longer in 2020.</p>		
PH075-2 (Drawing 32121-PH075-2)		
<p>The slide at PH075-2 was first noticed during a callout inspection of other sites on Hwy 743 on August 4, 2020, shortly after movements closed the highway. The site is located on a sidehill alignment ascending the valley slope of a tributary to the Whitemud River. LiDAR provided by Alberta Transportation shows that the valley slope has been affected by historic landslide movements. Similar to the other sites along this highway that moved during the summer of 2020, it was likely that higher groundwater levels re-activated a large slide block which affected about 55 m of the road surface. The highway is located about 25 m vertically above the creek. The valley slope surface, as</p>		

shown by the cross-section on Dwg. No.13351-PH075-2, is hummocky, indicating the presence of several retrogressive slide blocks between the creek and the road. The dip encompasses the entire roadway surface at this location and trees at the toe of the embankment are being to lean.

Recommendations:

Short Term:

- The maintenance contractor and/or MCI should review these sites frequently, particularly after significant rainfall events, to ensure that the highway is not impacted by further slumping.
- At Site 2, the cracks and dip are limited in extent such that the road can still be used at slow speeds. Slide warning signs and a 30 km/hr speed limit are recommended.

Medium-Term:

- Site 2: A localized realignment to the west of the roadway around the slide could be carried out if the road condition worsens.
- Site 2: A local driven steel pile wall might also be considered to provide temporary support to the road but might become distorted over time if the larger slide blocks move again.

Long-Term:

- Site 1: Rebuild the west bank north of the existing riprap upstream of the culvert inlet at a flatter slope and protect with additional riprap.
- Site 1: The steep embankment slope above the culvert inlet needs to be stabilized. As the slope is now failing, it should be rebuilt with geogrid-reinforced granular material. A stability analyses should be undertaken to assess the potential effectiveness of these measures.
- Site 1: Line the shallow gully on the west bank at the culvert outlet with riprap to limit deterioration. The mound of riprap downstream of the outlet should be redistributed to create a flow path down the centre of the channel rather than the unprotected sides.

Ongoing Investigation:

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

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

Ken Froese, P.Eng.
Associate | Senior Geotechnical Engineer



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.

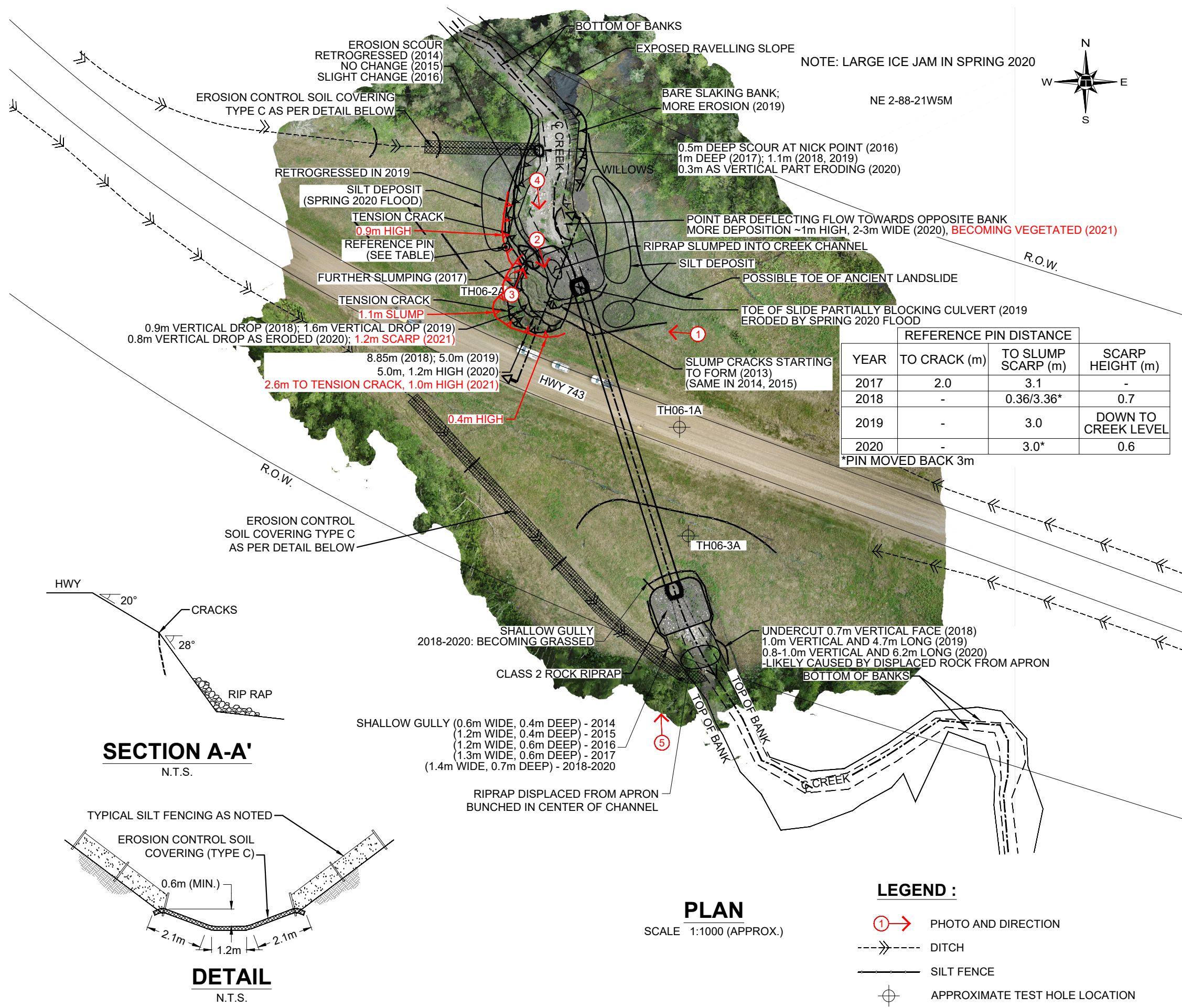
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

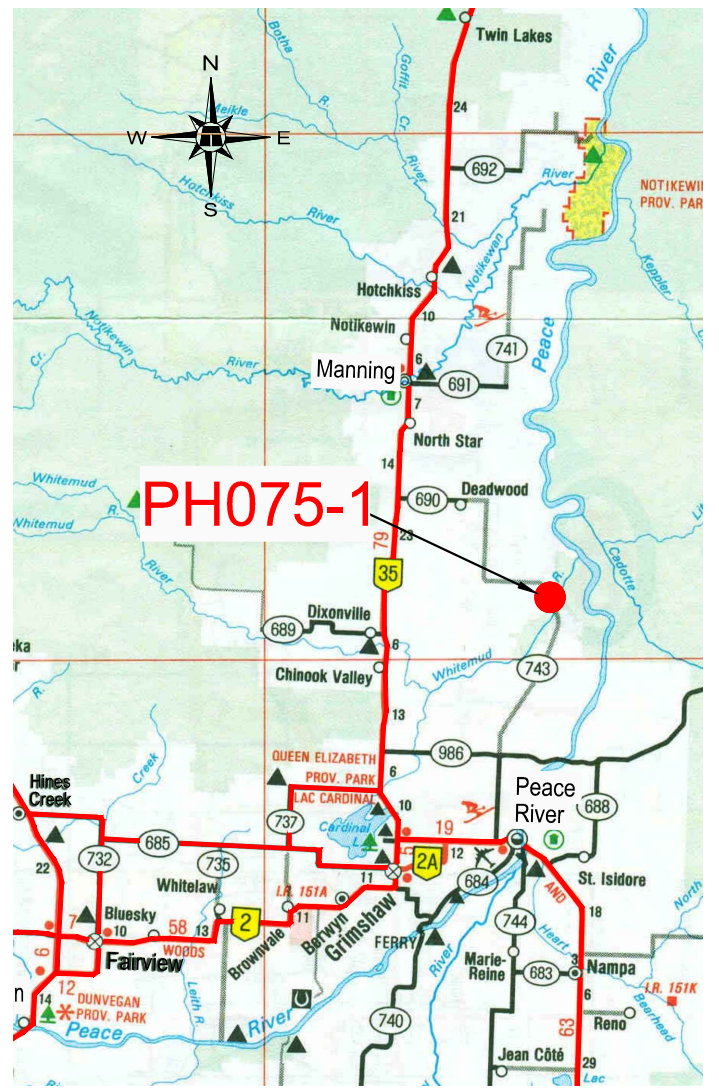
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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\2021\KEF\32121 PH075-1-1.dwg-Oct. 05, 2021 1:56pm



YEAR	REFERENCE PIN DISTANCE		
	TO CRACK (m)	TO SLUMP SCARP (m)	SCARP HEIGHT (m)
2017	2.0	3.1	-
2018	-	0.36/3.36*	0.7
2019	-	3.0	DOWN TO CREEK LEVEL
2020	-	3.0*	0.6

*PIN MOVED BACK 3m



- NOTES :**
1. FEATURE LOCATIONS ARE APPROXIMATE
 2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
 3. JULY 2021 OBSERVATIONS SHOWN IN RED

UAV ORTHOIMAGE FLOWN BY THURBER 2020

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

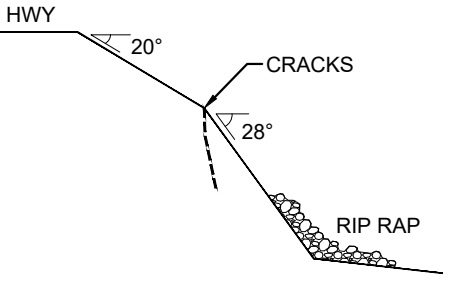
**PH075-1: HWY 743:02 AT km 44.4
2021 GEOHAZARD ASSESSMENT**

DWG No. 32121-PH075-1-1

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	APPROX. 1:1000
DATE	OCTOBER 2021
FILE No.	32121

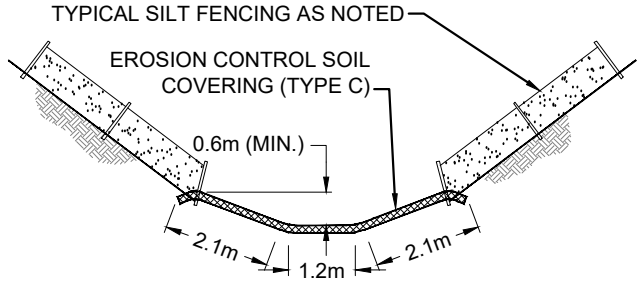
THURBER ENGINEERING LTD.

SECTION A-A'
N.T.S.



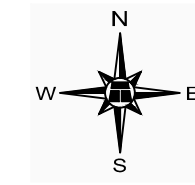
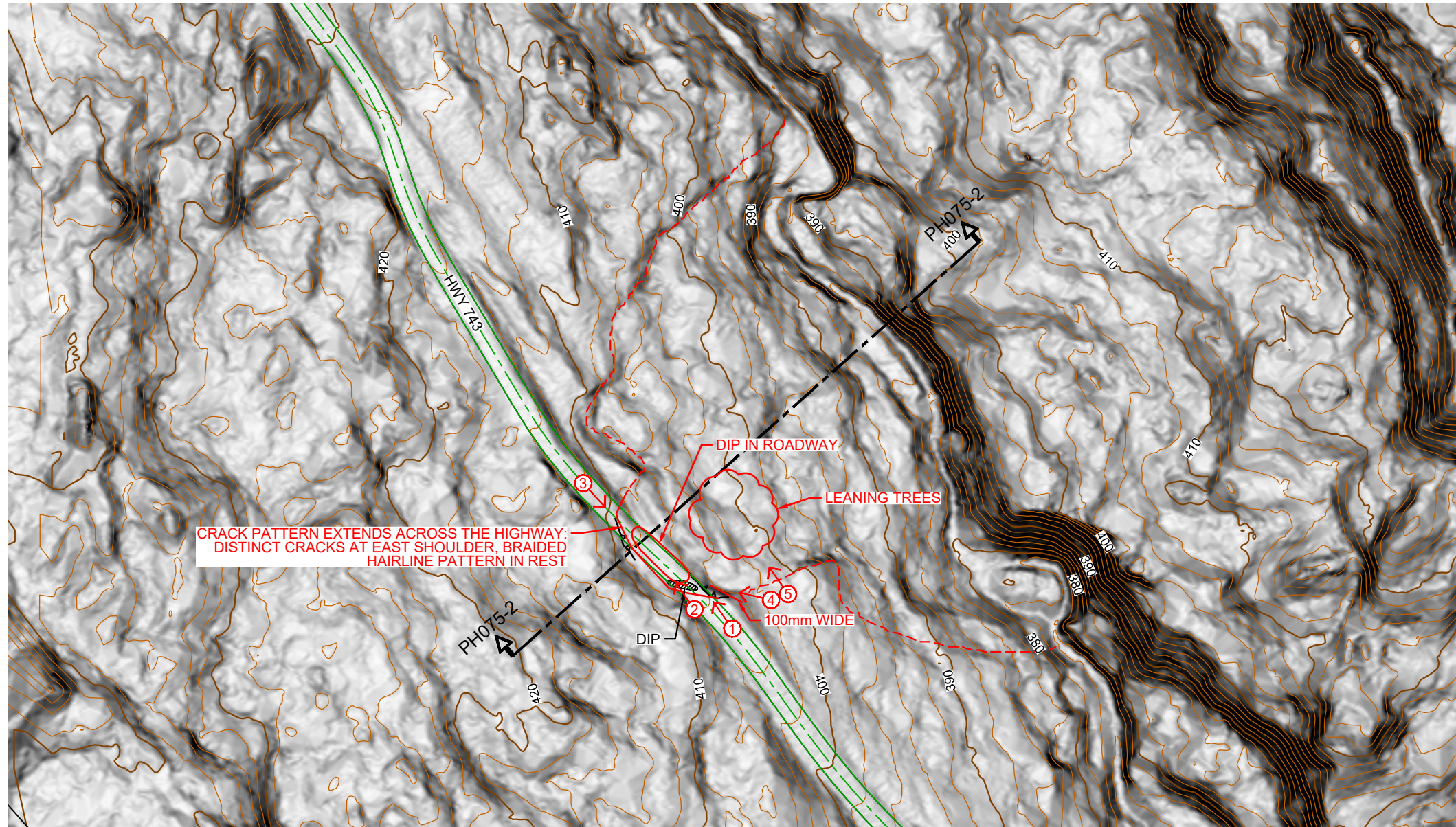
SHALLOW GULLY (0.6m WIDE, 0.4m DEEP) - 2014
 (1.2m WIDE, 0.4m DEEP) - 2015
 (1.2m WIDE, 0.6m DEEP) - 2016
 (1.3m WIDE, 0.6m DEEP) - 2017
 (1.4m WIDE, 0.7m DEEP) - 2018-2020

DETAIL
N.T.S.



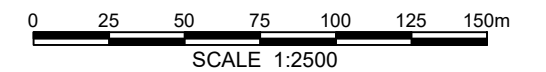
PLAN
SCALE 1:1000 (APPROX.)

- LEGEND :**
- ① → PHOTO AND DIRECTION
 - > DITCH
 - SILT FENCE
 - ⊕ APPROXIMATE TEST HOLE LOCATION



LEGEND

- ▼▼▼▼ ACTIVE LANDSLIDE SCARP
- ANCIENT LANDSLIDE SCARP
- ①➔ PHOTOGRAPH NUMBER AND DIRECTION



LIDAR PROVIDED BY ALBERTA TRANSPORTATION

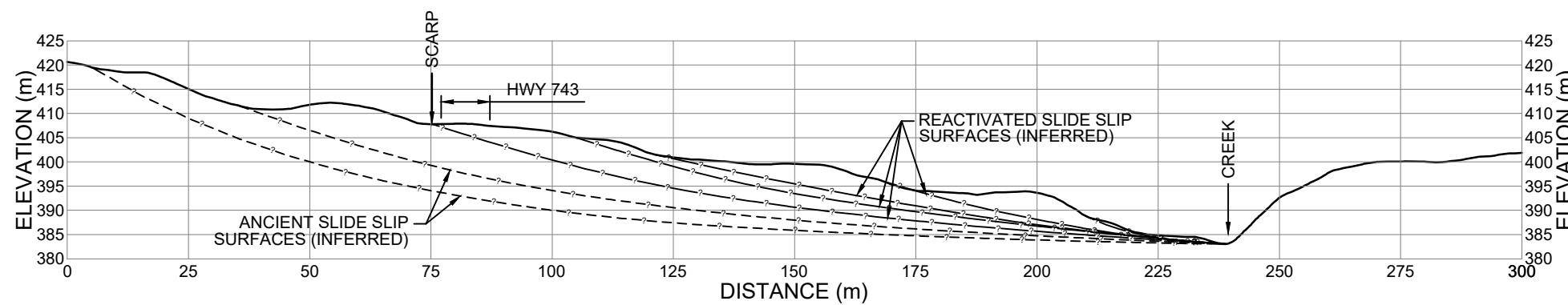


PEACE REGION (PEACE RIVER DISTRICT)

**PH075-2: HWY 743:02
2021 SITE INSPECTION PLAN**

DWG No. 32121-PH075-2

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:2500
DATE	OCTOBER 2021
FILE No.	32121



SECTION
SCALE 1:1250



Site 1, Photo 1 – Looking west at north sideslope.



Site 1, Photo 2 – Looking southeast at creek bank slumping upstream of the culvert inlet.



Site 1, Photo 3 – Looking north at creek bank slumping upstream of the culvert inlet. Note fresh material deposits on the right-hand side of the channel.



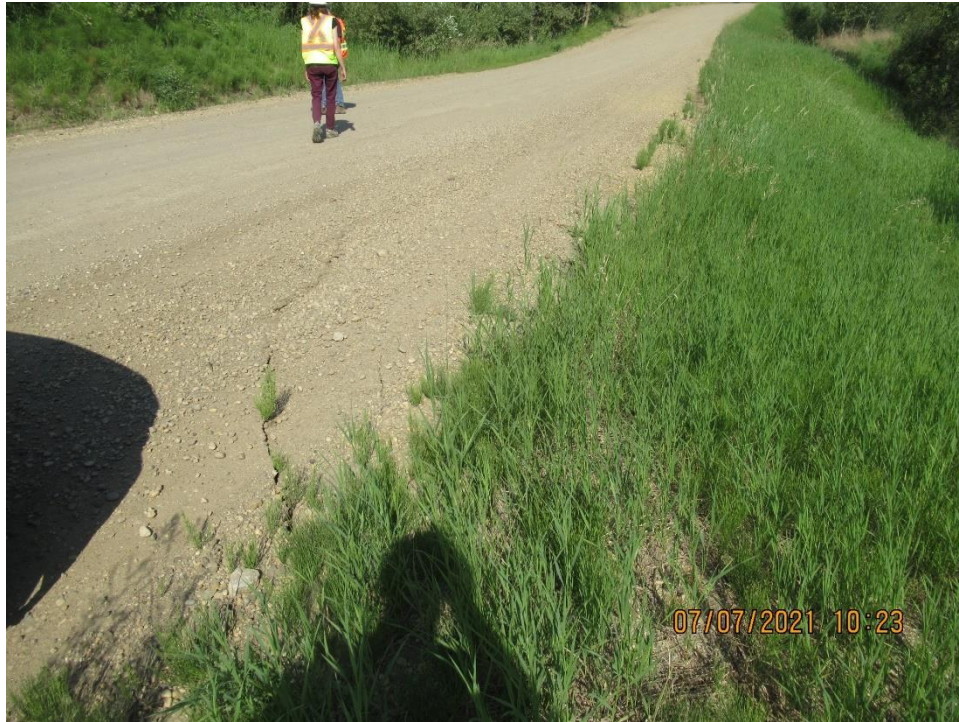
Site 1, Photo 4 – Looking south at culvert inlet.



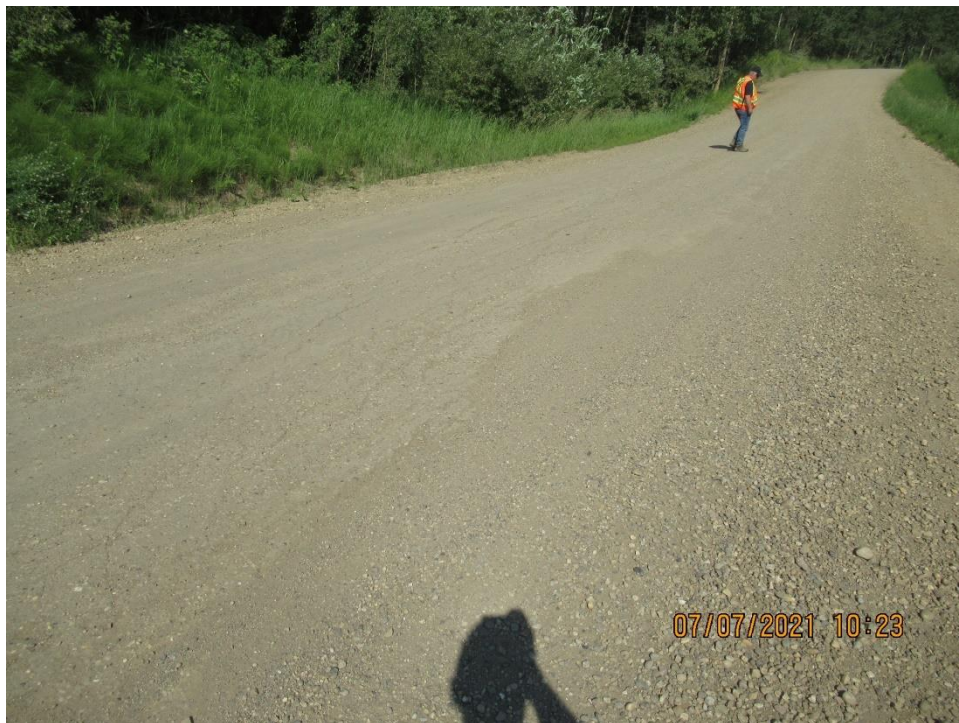
Site 1, Photo 5 – Looking north at culvert outlet



2020 UAV Image of slumping around Site 1 culvert inlet.



Site 2, Photo 1 – Looking north along scarp in highway shoulder at south end of PH075-2 Site.



Site 2, Photo 2 – Looking north at scarp cracks in middle of site.



Site 2, Photo 3 – Looking at north end of cracks.



Site 2, Photo 4 – Looking at dip in highway surface over the slide.



Site 2, Photo 5 – Rotating trees at the toe of the highway embankment.