

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2022 INSPECTION**



Site Number	Location	Name	Hwy	km
PH031	Judah Hill	Michelin Slides	744:04	57.664
Legal Description		UTM Co-ordinates		
NE¼ 20-083-21 W5M		11V E 483226	N 6229678	

	Date	PF	CF	Total
Previous Inspection:	6-July-2021	15	6	90
Current Inspection:	24-May-2022	13	7	91
Road WAADT:	620		Year:	2021
Inspected By:	Tyler Clay, TEL Ed Szmata, TRANS Max Shannon, TRANS		Don Proudfoot, TEL Roger Skirrow, TRANS	
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input checked="" type="checkbox"/> Maintenance Items			

Primary Site Issue:	Slope instability affecting road and downslope area, including a 50 m wide slide at km 57.8 during the summer of 1997. In 1997, the highway was shifted into the hill on a lightweight (shredded tire) embankment and the west side was buttressed with a tied-back pile wall. Shear key, toe buttress and lightweight shredded tire fill slide repairs were carried out in 1998. Cracking and continued movement was noted at the south end of the site. Additional slope movement was noted at north end of site, between the km 57.8 slide and the repairs conducted for the 'Makeout Slide'. New slide movement was noted on the east side of Hwy 744 towards the Heart River since 2014. Landslide activity is now occurring in opposing directions, leaving the road on a narrow ridge.		
Dimensions:	KM 57.8 slide – 50 m to 70 m wide. Slide movement now extending between Michelin and Makeout slides, suggesting a much larger slide zone possibly 500 m wide and extending downslope towards the Peace River. The backscarp of the slide in the Heart River Valley is about 120 m wide along the ATCO Gas pipeline right-of-way.		
Maintenance:	Highway was closed from May 2013 to December 2013 due to the Sunshine Landslide failure at km 58.2 and no maintenance has been performed since then other than ancillary work performed in the surrounding areas as part of Contract CON0015153, such as the regrading of the NBL ditch, the profiling of the inlet to the 2005 NBL ditch subdrain pipe and the grading of the landslide scarp feature below the 1997 pile wall below the SBL.		
Observations:	Description	Worsened?	
<input checked="" type="checkbox"/> Pavement Distress	Cracks in the road at km 57.8 are more apparent with increased localized settlement since the 2021 pavement condition. Some increased settlement and more visible dip across the road in the road at km 57.83, just north of cracking near SI 10-07. (Photos 1 and 7).	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/> Slope Movement	No significant slope changes were observed on the west side of the road and downslope below the old pile wall (Photos 2 and 5). At the old pile	<input checked="" type="checkbox"/>	

	<p>wall maximum soil drop was as high as 1.8 m and additional piles were noted to be protruding at the ground surface (Photo 5). No major change to slump located on the lower valley slope on the west side, offset approximately 70 m from the road.</p> <p>Active erosion within the backscarp and ongoing minor movement within disturbed slide mass at the landslide through the ATCO R/W towards the Heart River. No major retrogression noted within the main scarp. Increased buildup of soil beneath the vertical, southernmost segment of the scarp (Photos 3 and 4).</p>	
<input checked="" type="checkbox"/> Erosion	No significant change noted in previous erosion areas: east ditch between km 57.8 and 57.85. Erosion gully from drainage off the road near km 57.84 was worse and is up to 1.0 m wide and 0.5 m deep (Photo 8).	<input checked="" 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:		
	Installed at the toe of Michelin Slide repair:	
SI98-10i	The maximum incremental movement (i.e., 2.7 mm), between the fall of 2021 and the spring of 2022, was noticed in the deepest zone of the six distinct shear planes. The sum of the movement of all these zones was 366 mm since its initialization in October 2000. Movement rates are up to 4.2 mm/yr and have decreased since Fall 2021.	
SI94-43i	Installed approximately 450 m downslope of the road (slope distance), approximately 100 m below the level of the road. Not read during the Spring 2022 readings. The Spring 2021 readings showed no discernible movement.	
SI10-4 SI10-5 (Sheared at 2.1 m) SI10-6 (Sheared at 3 m)	Installed on the east side of highway (Heart River Side): SI10-4 showed rates of movement of below 1.0 mm/yr since Fall 2021. The movement is in the direction of the active landslide in the Heart River valley slope.	
SI10-7 SI10-8 (SAA) SI10-9	Installed at crest of slope, on the west side of the road (Peace River Valley): Since their initialization (26 March 2010), all three have exhibited downslope movement towards the Peace River. SI10-7 showed rates of movement of approximately 2 mm/yr within three movement zones since the fall of 2021 readings. SI10-9 showed rates of movement below 1 mm/yr over 6.5 m to 7.7 m depth and over 11.9 m to 14.4 m depth since the fall of 2021 readings. The manual readings for SAA10-8 showed an incremental movement of 1.8 mm over 15.0 m to 16.5 m depth since the fall of 2021 readings, corresponding to an average rate of movement of 2.7 mm/yr over this zone. The overall trend of movement in the SAA seems to indicate that the average movement rate in the instrument has decelerated since the beginning of 2018, compared to the first three years of measurements.	

<p>PN10-4 PN10-6 PN10-5 (Blocked) PN10-7 PN10-8 PN10-9</p>	<p>Pneumatic piezometers PN10-4, PN10-6, PN10-7, and PN10-9 showed increases in groundwater level of 0.06 m, 0.36 m, 0.12 m, and 0.05 m, respectively, since the fall of 2021 readings. PN10 8 showed a decrease in groundwater level of 0.28 m since the fall of 2021 readings/</p>
<p>VW17-1 VW17-2</p>	<p>Vibrating wire piezometer VW17-1 showed a decrease in groundwater level of 0.19 m compared to when the instrument was previously read during the spring of 2021 (an attempt was made to read these instruments in the fall of 2021, but no data could be obtained). VW17-2 has been dry since initialization.</p>
<p>Shear Wave Guide Trial</p>	<p>Working in collaboration with Queen's University (Kingston, Ontario, Canada) and Loughborough University (Leicestershire, United Kingdom), a shear wave guide was installed in 2013, consisting of a 38 mm diameter steel pipe connected to a shear wave monitor and datalogging system at km 57.86 near S110-8. Data from the Shear Wave Guide system was uploaded at regular intervals and the patented ALARMS system had the capability of emitting SMS text messages, via a cell phone modem uplink. The purpose of this trial installation was to determine if an empirical relationship could be established between acoustic emission waves, pore water pressure responses and slope movement. The results of the trial were published in the paper <i>Nancy Berg et al "Correlation of Acoustic Emission with Patterns of Movement in an Extremely Slow Moving Landslide at Peace River, Alberta, Canada", dated Feb.6, 2018.</i></p>
<p>Shape Accelerator Array</p>	<p>Working in collaboration with Queen's University, a shape accelerator array (SAA) was installed with the conventional PVC slope inclinometer casing at S110-8 in 2014, which was nearing the limit of its service life due to the casing deformation resulting from the slope movement. To date, the results of the SAA have indicated that the slope at S110-8 continues to move at the same depth as previously measured using the conventional cable and probe. Queen's University have also been able to append the SAA readings to the previous manual probe readings, extending the duration of the readings taken at this location. Following Fall 2019 readings the battery powering the SAA's datalogger was found to be stolen.</p>
<p>Assessment:</p> <p>Continued landslide creep near the km 57.8 repair is expected to be ongoing however damage to the highway has not significantly worsened. Minor erosion damage is occurring in localized areas.</p> <p>Slope movement in the area west of the highway between the Michelin and Makeout landslides is ongoing at similar or slightly reduced rates measured and observed in the past. Water being shed off the road on the inside of the bend may be contributing to the problem. Cracking and slope movement downslope of the pile wall is ongoing at similar or slightly reduced rates. The existing pile wall is still providing some support to the highway. The instruments on the west side of the highway show ongoing movement at rates previously observed.</p> <p>Intermittent movement and active erosion within the backscarp of the slide that is moving toward the Heart River indicates that the road is at risk from both eastward and westward movement. No accelerating movement trends were measured at S10-4 indicating a slide plane has not retrogressed further towards the highway beyond the visible scarp. As first mentioned in 2012, there is no room to move the road at this location and because of the severity and rapidity of movement, design for a pair of tied-together retaining walls should be conducted quickly to limit the extent of work required.</p>	

Recommendations:	Cost
<p>Long-term repair using ~ 230 m of tied back retaining walls. Approximately 80 m would be required on the Heart River side and 150 m on the Peace River side, extending south from the km 58 wall.</p>	<p>~ \$ 13 million</p>
<p>The battery powering the SAA in SI10-8, VW17-1 VW17-2 and the datalogger for these instruments should be replaced so that continual readings can resume. The battery for this datalogger has been stolen twice, so a more secure enclosure and battery system should be considered to prevent future thefts.</p>	<p>Maintenance</p>
Closure:	
<p>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.</p>	
<p>Don Proudfoot, P.Eng. Principal Senior Geotechnical Engineer</p>	
<p>Tyler Clay, P.Eng. Geological Engineer</p>	



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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.

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- 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.

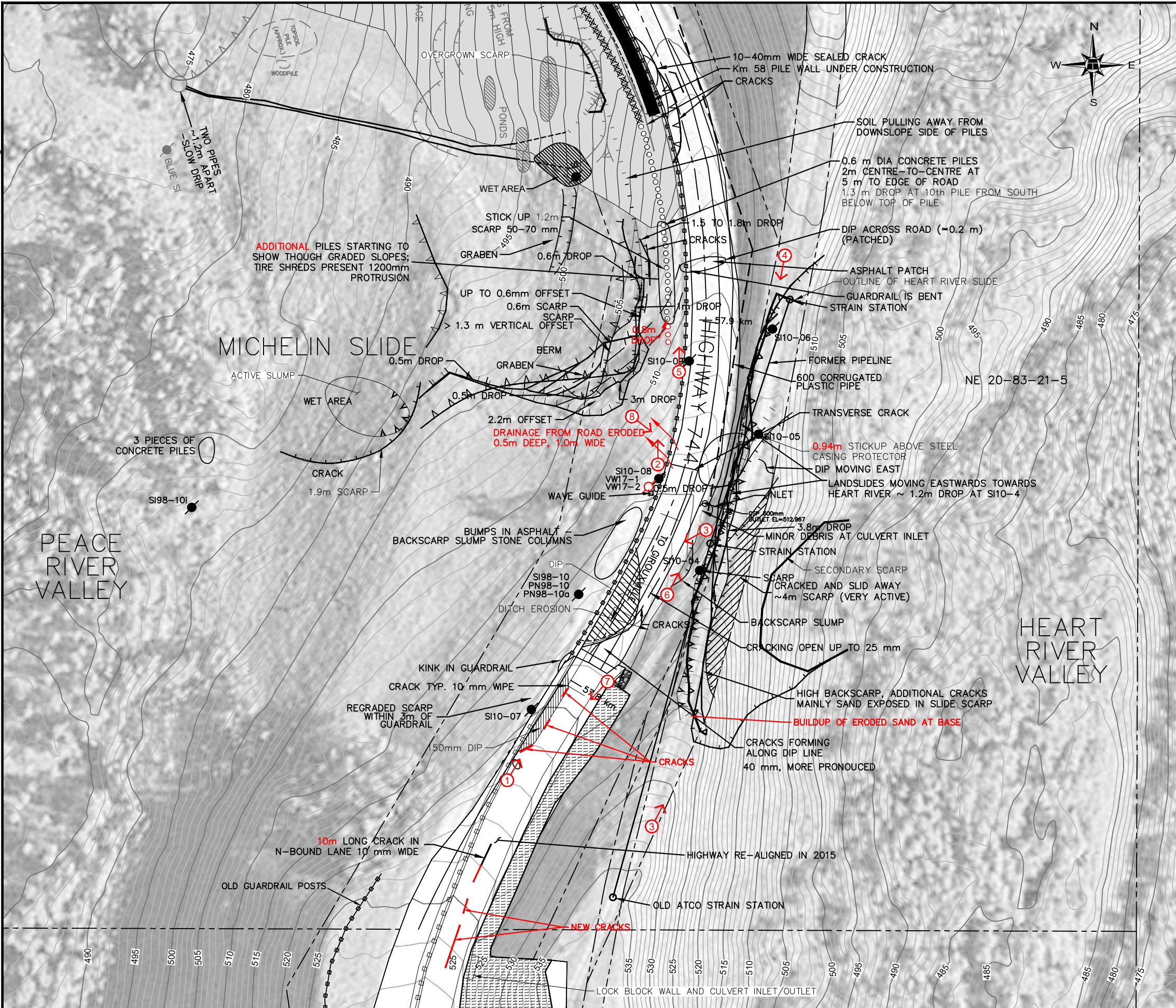
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2022 GEOHAZARD\TTC\32121-PH030-1, PH031-1, PH033-1, PH033-2.dwg - PH31 MICHELIN - Oct. 15, 2022

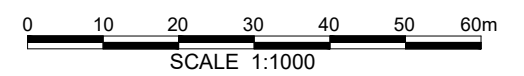



- LEGEND:
- SLOPE INDICATOR
 - DIRECTION AND NUMBER OF PHOTO
 - OLD PILE TOP CUT OFF DURING 2014 CONSTRUCTION
 - VW PIEZOMETER
 - SHEAR WAVE GUIDES
 - FORMER ATCO STRAIN STATION

NOTES:

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

2 MAY 24, 2022 OBSERVATIONS SHOWN IN RED.






PEACE REGION (PEACE RIVER DISTRICT)

**PH031-1 MICHELIN SLIDES
2022 SITE INSPECTION PLAN**

DWG No. 32121-PH031-1

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:1000
DATE	OCTOBER 2022
FILE No.	32121



THURBER ENGINEERING LTD.



Photo 1.
Looking northeast along the centerline of Hwy 744:04 at km 57.75 at the north end of the 2014-2015 realignment. Cracks have become more apparent and there was increased localized settlement at the shoulder relative to the 2021 condition.



Photo 2.
Looking north along the west sideslope of Hwy 744:04 at km 57.94 below the old pile wall.



Photo 3.
Looking northeast along the backscarp of the landslide at the top of the Heart River valley on Hwy 744:04 at km 57.8. No change to the location of the main scarp. More erosion and downslope movement within the upper scarp face.



Photo 4.
Looking south along the backscarp of the landslide at the top of the Heart River valley on Hwy 744:04 at km 57.85. Larger buildup of soil at base of vertical scarp, indicative of ongoing erosion but no major retrogression since 2021.



Photo 5.
Looking north along the west side of Hwy 744:04 at protruding piles near km 57.9. Max drop of 1.8 m below top of pile.



Photo 6.
Looking north along the abandoned ATCO gas pipeline right-of-way on the east side (Heart River) of Hwy 744:04 at km 57.8.



Photo 7.
Looking southwest along Hwy 744:04 from km 57.85 at the crack and dip across the road.



Photo 8.
Drainage erosion from the west side of the road near KM 58.86 that has become worse relative to the 2021 condition.