

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2024 INSPECTION**



Site Number	Location	Name	Hwy	km
PH060	East Hill	35+680 to 36+180 Site 3	2:60	35.95
Legal Description		UTM Co-ordinates (NAD 83)		
W28 & E29-083-21 W5M		11V E 483450	N 6231395	

	Date	PF	CF	Total
Previous Inspection:	May 25, 2022	13	4	52 (Slide Risk Rating)
Current Inspection:	May 27, 2024	13	4	52 (Slide Risk Rating)
Road WAADT:	3760	Year:		2023
Inspected By:	Don Proudfoot, Tyler Clay, Cole Szakacs (Thurber). Rocky Wang, Robert Senior (TEC)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance			

Primary Site Issue:	<p>Large landslide referred to as Site 3 previously encompassed highway in the 1980s. The upslope area was mitigated by major crest unloading. Mitigated downslope of roadway by the construction of large toe berms. The area is still potentially unstable with ongoing shallow and deep-seated movements occurring on the downslope side.</p> <p>The shallow slump (first observed in 2013) upslope of highway at 35+900 continues to slowly retrogress. Deep active gully erosion and headcutting is also occurring within engineered berm below roadway which is progressing slowly towards the roadway.</p> <p>In 2016 a shallow landslide developed on the northeast facing backslope within a through-cut area at 35+835. The backslope was regraded and flattened as part of Fall 2022 repair work along the East Hill.</p> <p>Large slide movement and earth flow activity occurred in Spring 2016 between 35+700 to 35+900 approximately 150 m to 200 m below the roadway. The debris from these mass movements partially blocked the Heart River.</p>
Dimensions:	<p>Site 3 is 350 m wide; extends 200 m upslope of the roadway to just below the crest of the valley and between 200 m and 450 m downslope of the roadway to the Heart River.</p> <p>The 2013 shallow slump at 35+900 is 35 m wide and developed 100 m from the roadway.</p> <p>The earth flow within the gully at 35+700 affects an area approximately 70 m wide (note there are two gully head sources) and 180 m long.</p> <p>The composite slide/flow at 35+900 is approximately 65 m wide and 165 m long with an exposed main scarp several meters high.</p>
Date of any remediation:	Backslope was regraded and flattened as part of Fall 2022 repair work.
Maintenance:	2022 – Highway was repaved and there were numerous ditch and culvert repairs.

Observations:	Description:	Worsened?	
		Yes	No
<input type="checkbox"/> Pavement		<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	<p>Retrogressive slumping along Heart River is actively continuing, which encompasses the lower portions of the large toe berm constructed downslope of the roadway to stabilize the initial landslide in this area. Areas have ongoing movement and river erosion at the toe with some minor retrogression/lateral expansion of the main 2016 slide area which is offset approximately 180 m from highway.</p> <p>Overgrown scarp on north side of highway near 35+750 shows no sign of recent movement.</p> <p>Shallow slide/flow on the backslope at 35+830 was regraded and slope was flattened as part of Fall 2022 repair work. New backslope was vegetated and in good condition. (Photo 60-03).</p> <p>Active sliding is occurring at the valley bottom between km 35+650 and km 35+750 (partially into the PH059 site extents) (Photo 60-07).</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>Ongoing erosion at the culvert outlet and inlet near km 35+675. Outlet and inlet were regraded and rock armour added as part of the Fall 2022 repairs. Scour below the culvert outlet was 0.3 m in depth. Erosion at the inlet measured 0.5 m wide and 0.2 m deep creating a drop from ditch elevation into the inlet. (Photos 60-01 and 60-08)</p> <p>Gullying immediately downstream from culvert outlet at km 35+675 had active slumping on gully sidewalls that has expanded the gully width since 2022 (Photos 60-02). The erosion and gullying significantly expands approximately 125 m downslope of the highway where trees and thicker vegetation becomes sparse.</p> <p>Previous ditch erosion on both sides of the roadway between 35+850 and 36+300 was repaired in Fall 2022 with ECM and check dams. (Photos 60-04 and 60-09)</p> <p>At 36+050, active gully erosion is ongoing on the upper portion of the toe berm below the roadway. Top of the gullying was slightly deeper and closer to the highway relative to the 2022 condition. Further downstream the gully continues to expand with ongoing erosion and collapse of the vertical sidewalls. (Photos 60-05 and 60-06)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	Culvert was relined with SWSP and rock armoured at the inlet/outlet as part of Fall 2022 repair work. (Photos 60-01 and 60-08)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>	<input type="checkbox"/>

Instrumentation:

Instruments were read on May 19, 2024 and the results are summarized below:

- SI13 – Creep (<1 mm/yr) over 2.2 m to 4.7 m depth since the fall of 2023 readings. Over the long-term a movement rate of about 0.3 mm/yr with approximately 20 mm of cumulative movement has been observed since about 2007.
- SI88 – No discernible movement.
- SI12 – No discernible movement.
- SI89 – Sheared at 12.8 m below top of casing as of Spring 2021
- SI91 – Sheared at 13.1 m below top of casing as of Spring 2019

Assessment (Refer to Drawing PH060-2):

Small deep-seated movements are occurring within the fill embankment downslope of roadway indicating low Factors of Safety. The Spring 2019 instrument readings indicated an accelerating trend of annual movement rate since 2016 from an average of approximately 7 mm/yr between the years 2013 to 2016 to approximately 10 mm/yr since 2017 at SI 89. Prior to 2016, the average annual movement rate was approximately 3 to 4 mm/yr (not including initial movement picked up within the same year following the SI installation in 1996). SI 91, located in the base of the valley slope was sheared off at 13.1 m depth in the recent Spring 2019 readings. SI89 was found sheared in the Spring 2021 readings located in the upper valley slope above the erosion gully at KM 36+050. The three remaining operational instruments located in the upper to mid-slope below the highway near km 36+000 have only shown creep or negligible movement to date.

Surficial observations of active movement near the highway have not been observed, likely due to the relatively small magnitude, but the risk level for this site has been adjusted accordingly due to the concerning trend of increased movement rates over the last five years and active movement near the valley bottom. A significant volume of material has been displaced from the valley toe in localized areas due to gullying and mass soil flow events that could be contributing to this trend. The movement leading to shearing at SI 89 may have been driven by a loss of toe material at the erosion gully to the south.

In general, the shallow slumping upslope of roadway had not been visibly active over the last several years and has limited to no effect on the highway.

The mass movement near the valley base below 35+900 is expected to retrogress upslope and could cause instabilities that could potentially impact the highway in the future as toe support is lost. No slope instrumentation exists above this area to monitor potential impacts to the highway if movement were to occur.

The erosion gullies at 36+075 and 35+700 do not threaten the highway in their current state but a drainage structure (e.g. trunk drain) should be considered in the next 5 to 10 years to reduce the rate of retrogression.

Recommendations:**Monitoring:**

Biennial inspections should continue with the next inspection occurring in the Spring of 2026.
Continue to monitor instruments twice a year.

Maintenance:

- Add additional armoring rock, ECM and upstream synthetic check dams at the km 35+675 culvert inlet.

Short-term Measures:

- Consider redirecting surface runoff further downslope of headcutting/gullying that is occurring at 36+000 and 35+700. The upper erosion gully at 35+675 should be graded and armored with rock riprap or gabion mattress. Armoring the upper gully headwall should also be carried out at km 36+000. (\$250k to \$400k)

Long-term Measures:

- Installing trunk drains to convey water flow outside the gullies near km 36+075 and km 35+700. (\$1M to \$2M)

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

Tyler Clay, P.Eng.
Geological 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.

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5. INTERPRETATION OF THE REPORT

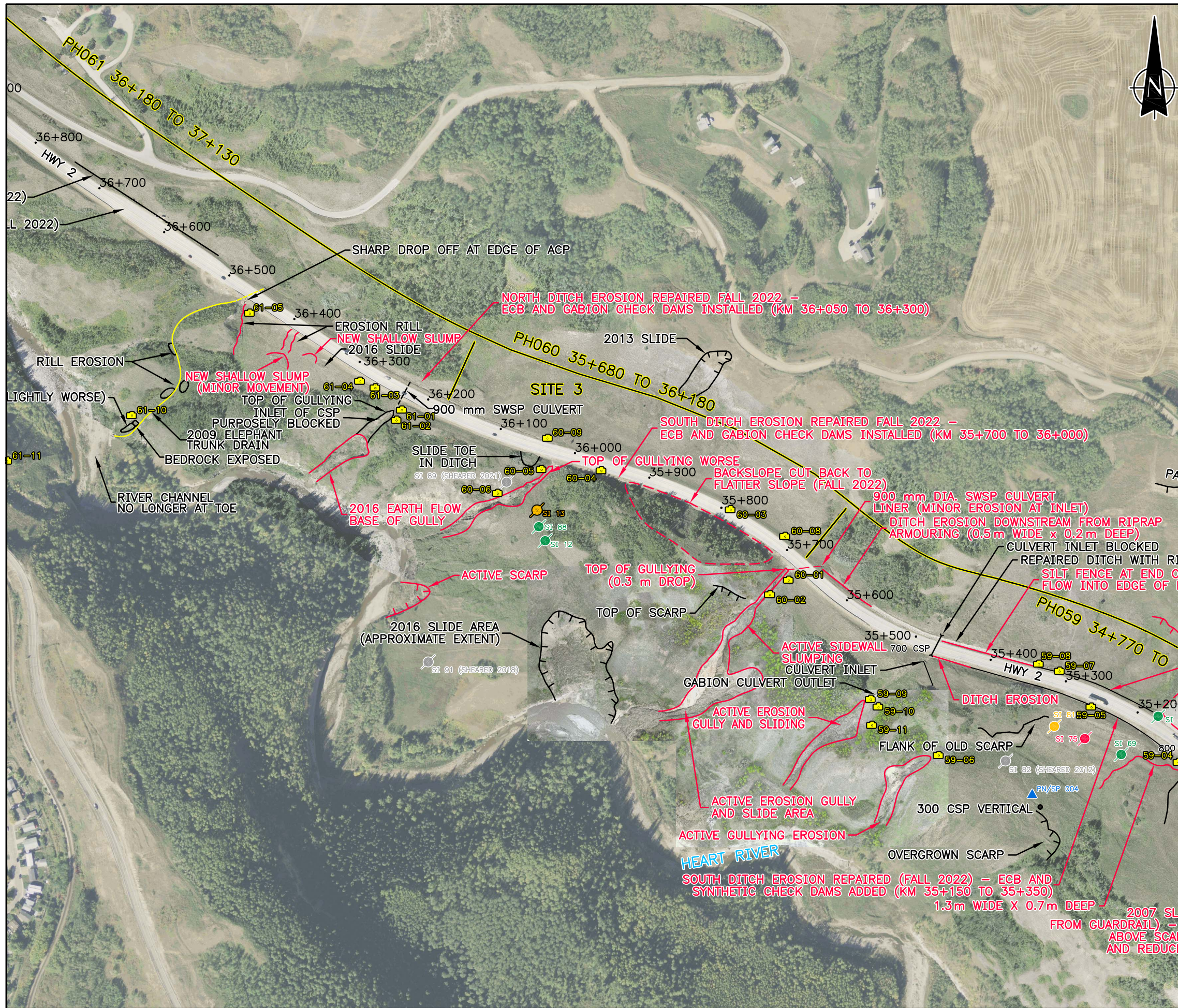
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification 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.



LEGEND:

HORIZONTAL CHAINAGE (37+130 GROUARD BRIDGE)	● 35+900
PHOTOGRAPH LOCATION	📷 41-01
SLOPE INCLINOMETER	
- NO MOVEMENT	● SI 64
- CREEP	📐 SI 82
- MEASURABLE MOVEMENT (OR RECENTLY SHEARED)	📐 SI 82
PIEZOMETER	▲ PN 004
PH060 EXTENT	—

- NOTES:
- 1 FIGURE MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 32121 DATED MAY 2024 AND IS SUBJECT TO ANY LIMITATIONS DESCRIBED THEREIN.
 - 2 PHOTO BASE IMAGE COMBINED FROM 2012 AIR PHOTO (TARIN RESOURCES SERVICES LTD.), THURBER DRONE IMAGERY (2022), MACINTOSH PERRY DRONE SURVEY (2022).
 - 3 SLIDE FEATURES, PHOTOGRAPHS AND CHAINANGE ARE SHOWN APPROXIMATE ONLY.
 - 4 MAY 28, 2024 OBSERVATIONS SHOWN IN RED.


PEACE REGION (PEACE RIVER DISTRICT)
PEACE RIVER EAST HILL
HWY 2:60 (PH060) STA. 35+680 TO 36+180
LOCATION PLAN

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:5000
DATE	OCTOBER 10, 2024
FILE No.	32121-A7E


THURBER ENGINEERING LTD.

FIGURE PH060-2



Photo 60-01.
View north towards the culvert outlet near km 35+675. As part of Fall 2022 repair work, a 900 mm diameter SWSP liner was installed and rock armoring was added at the inlet and outlet. Ongoing erosion downstream of culvert and rilling above. Scour depth below culvert inlet was 0.3 m.



Photo 60-02.
Looking downslope at erosional gullying below culvert shown in Photo 60-01 (35+675). Active slumping on gully sidewalls has expanded gully width since 2022.



Photo 60-03.
View south towards the backslope near km 35+830 where a landslide had previously developed. As part of the Fall 2022 repair work the backslope was cut back flatter and regraded. New slope configuration was well vegetated and in good condition.



Photo 60-04.
Looking east near km 35+950 at the regraded south ditch. ECM and gabion check dams installed as part of Fall 2022 repairs.



Photo 60-05.
View south towards erosional gullying occurring below the roadway where ditch runoff enters near km 36+050. Top of the gullying was slightly deeper and closer to the highway relative to the 2022 condition.



Photo 60-06.
Looking north towards expanded gully erosion downstream from km 36+050. Ongoing erosion and collapse of the near vertical gully sidewalls.



Photo 60-07.
Looking southeast at active sliding at the bottom of the Heart River valley near KM 35+600 (downslope from PH059 site). Increased downdrop and expansion of the sliding area as the slide material and valley toe soils are eroded by the river.



Photo 60-08.
Minor erosion at the culvert inlet near km 35+675. Culvert was lined and had rock armoring added as part of the Fall 2022 repairs. Erosion damage was approximately 0.5 m wide and there was a 0.2 m drop.



Photo 60-09.
Looking west towards the north ditch where Fall 2022 erosion repairs were completed with gabion check dams installed between approximately km 36+050 and km 36+300.