

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



Site Number	Location	Name	Hwy	km
PH002	East Hill :32+800 to 34+780 (excludes PH070 wall site - 33+800 to 34+100)	Peace River East Hill	2:60	33.5 – 34.5
Legal Description		UTM Co-ordinates (NAD 83)		
SW27 & SE 28-083-21 W5M		11V E 485640	N 6230750	

	Date	PF	CF	Total
Previous Inspection:	May 25, 2022 Top of East Hill (32+800-33+800)	8	3	24 (Slide Risk Rating)
	Site 1 (34+100-34+780)	11	5	55 (Slide Risk Rating)
Current Inspection:	May 27, 2024 Top of East Hill (32+800-33+800)	6	3	18 (Slide Risk Rating)
	Site 1 (34+100-34+780)	11	5	55 (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>Top of East Hill (32+800 - 33+800): Widespread, mostly shallow slumping on the cut slope was occurring in this segment. Cut slope repairs were completed in Fall 2022 between 32+925 and 33+300 involving slope flattening and granular replacement with a shear key. A large upslope failure at 33+550, which was not included in the repairs, appears intermittently active.</p> <p>Site 1 (34+100 - 34+780): Site of large landslide that crossed Highway 2 in 1980s. Mitigated on upslope side of roadway by crest unloading. Mitigated on downslope side of highway by toe berm. North Heart River was channelled through large diameter steel culverts which were breached many years ago. Area below road embankment (34+550) is unstable with ongoing shallow and deep-seated instabilities as well as widespread gully erosion. Potential exists for retrogressive movement downslope of roadway to adversely affect road embankment.</p>
Dimensions:	<p>Landslide at 33+550 is about 100 m wide and extends 60 m upslope of the roadway.</p> <p>Site 1 landslide is 750 m wide extending 200 m to 500 m downslope of roadway to North Heart River and 300 m upslope of roadway to crest of valley slope.</p> <p>Embankment width in area of concern at 34+550 is 120 m.</p>
Date of any remediation:	None

Maintenance:	2022 – Highway was repaved, several cut slope slides repaired 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>Top of East Hill:</p> <p>Shallow slumps in cut slope between 32+925 and 33+300 were repaired in 2022 and slope was well vegetated and in good condition with no new slide damage. (Photos 2-02 and 2-03)</p> <p>No significant expansion or movement observed at the shallow slide near 33+450 (first observed in 2013). There was minor ravelling of disturbed slide materials. Previous slide toe material that entered the ditch was cleaned out as part of the 2022 repairs. (Photo 2-05)</p> <p>No new movement within the shallow slump north of the highway near 33+550. Previous slide toe material that was encroaching into ditch cleaned out as part of the 2022 repairs. (Photo 2-07)</p> <hr/> <p>Site 1:</p> <p>Shallow earth slide in backslope at 34+400 with slide toe partially blocking south ditch had no change from the 2022 condition. (Photo 2-10)</p> <p>Road fill embankment between 34+450 and 34+600 (old Site 1) had no visible signs of new slope movement. (Photos 2-12 and 2-13).</p> <p>Shallow slumping was ongoing on upslope side of the roadway within Site 1 landslide (34+350) but had no major visible changes from the 2022 condition.</p> <p>Visually, top of scarps just west of the embankment (34+600) appeared similar to the 2022 condition. (Photo 2-14)</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>Previous ditch erosion damage on the south side of the highway was repaired in 2022 between 33+300 and 33+715 with ECB and synthetic check dams installed. Overall, the ditch repairs were in good condition and grass growth was starting to develop. (Photo 2-06)</p> <p>Ditch repairs were completed on the north side of the highway between 32+700 and 33+715. ECB and synthetic check dams or gabion basket check dams (within steeper ditch grade sections) were installed. Minor erosion area (0.3 m x 0.2 m) was noted within the ditch bottom upstream of the culvert inlet near 33+715. (Photos 2-05 and 2-08)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

	<p>At the south side of the highway between the culvert outlet and trunk drain inlet near 33+715, there was minor gully erosion. No major change from the 2022 condition. (Photo 2-09)</p> <p>An erosion gully that has developed from ditch flow and runoff outside the armored swale near 34+450 was slightly worse from the 2022 condition. (Photo 2-11)</p> <p>Elephant Trunk Drain breached further upslope in ravine downslope of roadway. Significant gully erosion and slides have developed along the gully sidewalls at 34+650. (Photos 2-15 and 2-16).</p>		
<input type="checkbox"/> Seepage		<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	<p>Near 33+000 the previously damaged and partially buried culvert inlet was repaired and rock armoured culvert as part of the 2022 repair work. (Photo 2-01)</p> <p>Culvert near 33+715 was relined with SWSP and rock armoured as part of 2022 repair work. (Photo 2-08)</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	<p>A gabion mattress armoured drainage swale was installed near km 33+175 as part of the Fall 2022 cut slope repair work. The swale conveys ditch flow from the gravel road above the cut slope. Some minor erosion was noted at the edges of the mattress at the base to swale side slope transition. (Photo 2-04)</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Instrumentation:

No instruments are installed within the 'Top of East Hill' (32+800 - 33+800) section.

Instruments within the Site 1 section (34+100 - 34+780) were read on May 19, 2024 and the results are summarized below:

Downslope (Outside of Embankment Area – 34+325 to 34+425):

- SI 63 – No discernible movement.
- SI 64 – Showed a rate of movement below 1 mm/yr over within the upper 4 m since fall of 2023. Less than 25 mm of resultant cumulative movement measured since initialization in 1996.

Downslope (Below Road Embankment – 34+550):

- SI 10-3 – Near toe of road embankment - No discernible movement. The piezometer (PN10-3) installed at this location has shown a steady trend of groundwater depth between 14 m and 16 m since 2010.
- SI 10-4 – 50 m from toe of embankment - Sheared since June 2012 at 6.7 m depth.
- SI 10-5 – 100 m from toe of embankment - Sheared since Fall 2011 at 12.2 m depth.

Upslope:

- No operational instrumentation on the upslope side of roadway.

Assessment (Refer to Drawings PH002-1 to PH002-2):

Top of East Hill (32+800 - 33+800):

Backslope and ditch repairs (including ditch armouring) were completed at this site in 2022 as part of the pavement overlay project being administered by McIntosh Perry. The cut slope repairs between 32+925 and 33+300 appear effective and reduce the potential for slide materials affecting the ditch drainage. Ditch repairs on both sides of the highway appear effective in reducing erosion gully and sidewall instability that could affect the highway shoulders in previously identified damage sections.

Potential exists that the landslide at 33+550 could flow onto roadway. Movements of this landslide over the last decade have been intermittent and very slow but could accelerate after a heavy precipitation event. The shallow slide upslope of the highway near 33+450 has potential to block the ditch if a large increment of movement occurs but only minor movements have been observed since 2016.

Site 1 (34+100 - 34+780):

Deep-seated movements within the old berms on downslope side of roadway continue to be of concern to the stability of the road embankment at 34+550. Mitigation would be required if SI 10-3 began to register ground movements. The upslope portion of the Site 1 landslide is affected by numerous local shallow instabilities in the form of slumps. These slumps typically do not affect the roadway and toe out above the ditch. The possibility of deep-seated creep movement of the old rupture surface cannot be ruled out, although there is no surviving instrumentation to confirm or disprove.

Erosion at the breach in the elephant trunk drain (34+650) has become significantly worse and will continue to retrogress further upslope and destabilize upper portions of the slope closer to the road. The drain itself has become completely disconnected further upslope and has created a new outlet area. As gullying continues it is expected the trunk drain will undergo further stress and these new leak points will continue to move upslope along the joints if left unmitigated. Diversion of the current trunk drain to a new alignment to the east is required to slow the erosion.

Recommendations:

Monitoring:

Biennial inspections should continue with the next inspection occurring in the Spring of 2026.

Continue to monitor instruments twice a year.

Updated aerial imagery or drone photogrammetry survey completed every 2 to 4 years would be beneficial for tracking the rate of erosion, gully expansion and overall slide activity within the lower valley slope.

Maintenance:

- Add additional ditch armouring rock upstream of culvert inlet and downstream of outlet to the trunk drain inlet near 33+715.
- Fill erosion gully near armoured swale (34+450) with granular fill. Consider building a small berm (armoured with rock or non-permeable woven geotextile) to direct ditch flow upstream from the head of the gully into the armoured swale.

Short-term Measures:

- No short-term measures.

Long-term Measures:

- A new trunk drain alignment should be constructed at 34+650. (\$350k - \$700k)

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

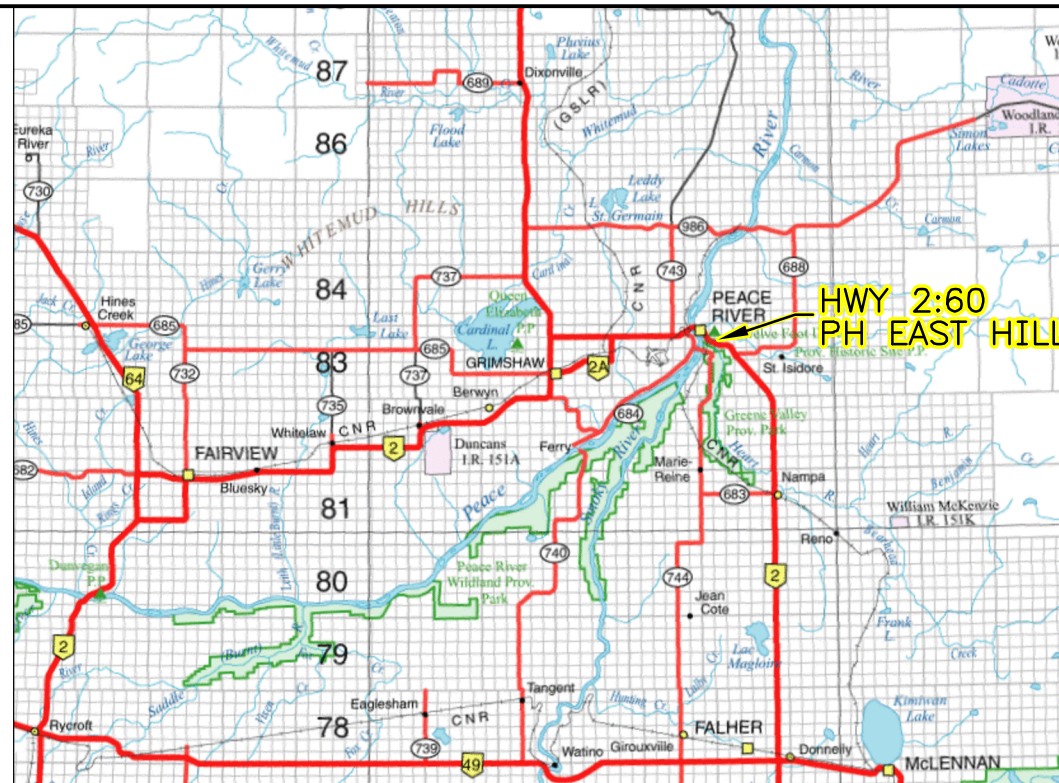
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification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



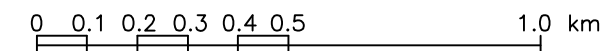
KEY MAP
SCALE 1:1 000 000

LEGEND:
PH002 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 CHAINAGE SHOWN ARE APPROXIMATE ONLY.



Alberta Transportation

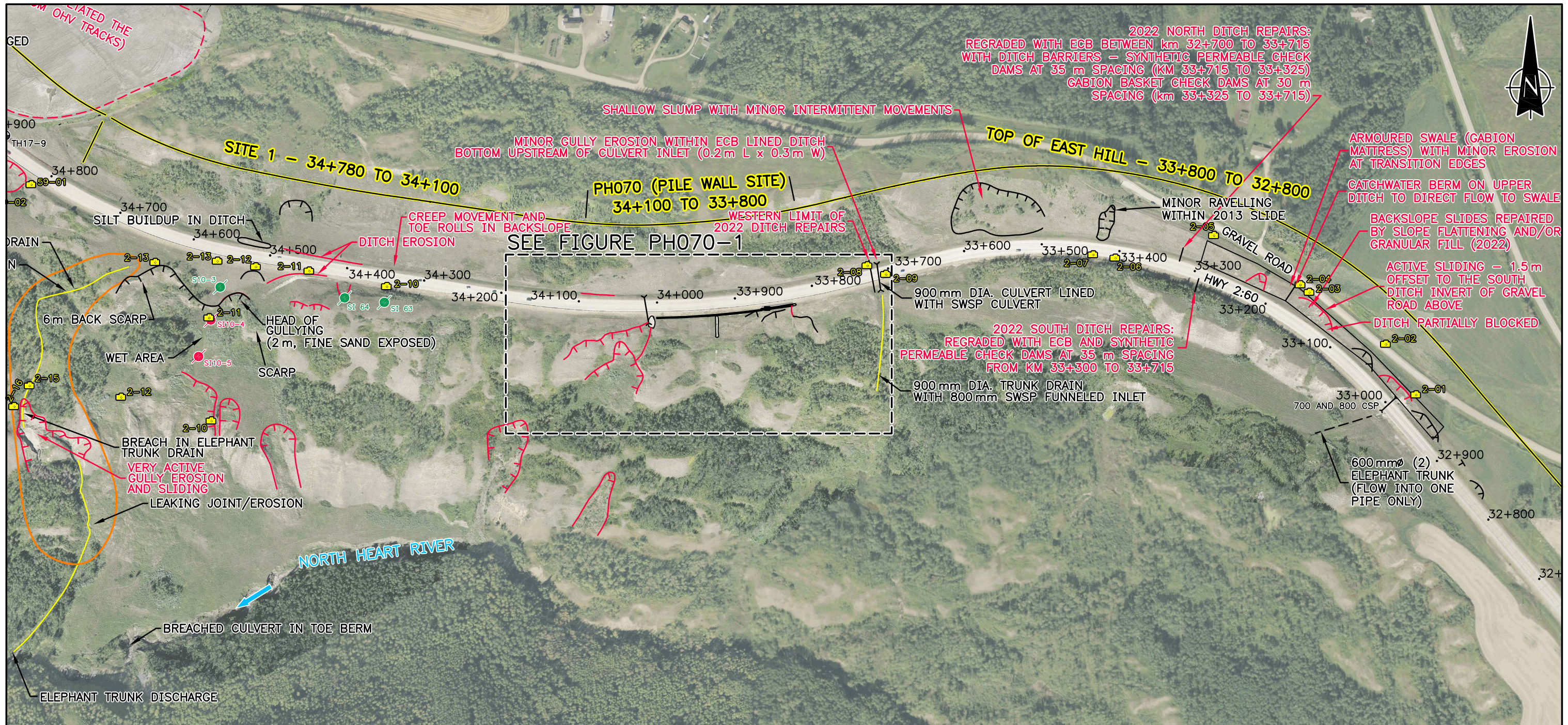
PEACE REGION (PEACE RIVER DISTRICT)

PEACE RIVER EAST HILL
HWY 2:60 (PH002)
KEY MAP

FIGURE PH002-1

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:15 000
DATE	OCTOBER 10, 2024
FILE No.	32121-A6D





LEGEND:

HORIZONTAL CHAINAGE (37+130 GROUARD BRIDGE)	● 33+900
PHOTOGRAPH LOCATION	📷 41-01
SLOPE INCLINOMETER	<ul style="list-style-type: none"> 🟢 SI 64 🟡 SI 82 🔴 SI 82 ▲ PN 004
- NO MOVEMENT	—
- CREEP	—
- MEASURABLE MOVEMENT (OR RECENTLY SHEARED)	—
PIEZOMETER	—
PH002 EXTENT	—
DRAIN BOUNDARY	—

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



PEACE REGION (PEACE RIVER DISTRICT)

PEACE RIVER EAST HILL
HWY 2:60 (PH002) STA. 32+800 TO 34+780
LOCATION PLAN

FIGURE PH002-2

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





Photo 2-01.
Previously damaged and partially buried culvert inlet was repaired and rock armoured at 33+000 as part of the Fall 2022 overlay and repair work.



Photo 2-02.
Looking northwest at cut slope area with previous shallow slumps on the northeast side of the road (33+100). Backslope regrading and granular replacement was completed as part of the Fall 2022 repair work. Repaired slopes were good condition, well vegetated and no new slide damage was observed.



Photo 2-03.
Looking southeast at the cut slope repair section (33+150). No new slide damage was noted.



Photo 2-04.
Looking south from the top of a gabion mattress armoured drainage swale installed near km 33+175 as part of the Fall 2022 repair work. The swale conveys ditch flow from the gravel road above the cut slope. Some minor erosion was noted at the edges of the mattress at the base to swale side slope transition.

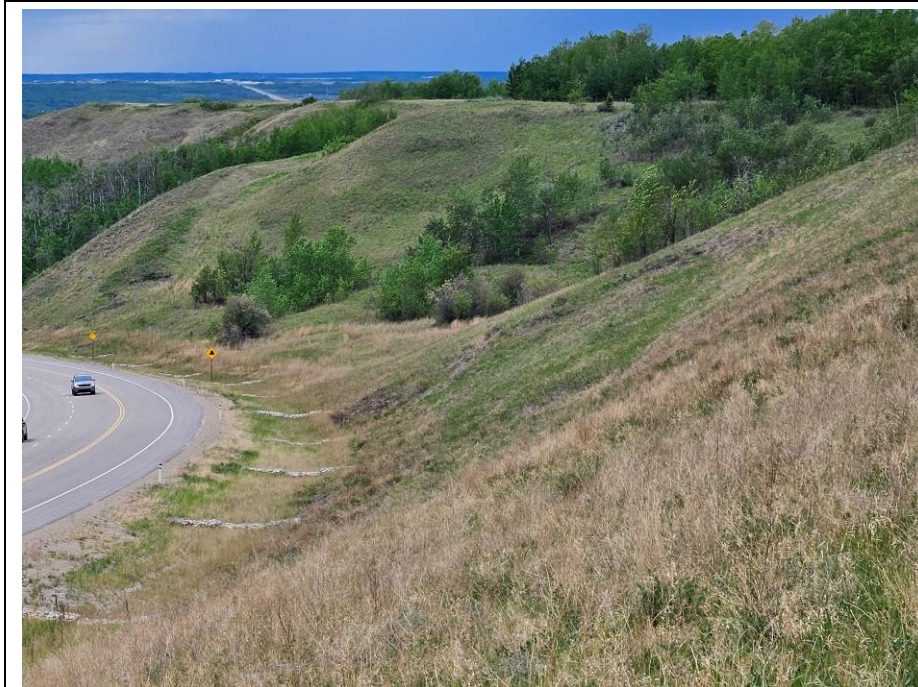


Photo 2-05.
Looking west towards the toe roll of a larger surficial slump (130 m wide) within the cut slope near 33+450. There was minor ravelling of disturbed slide materials but no major changes relative to the 2022 condition. Previous slide toe material that entered the ditch was cleaned out as part of the Fall 2022 repairs. New gabion check dams in the north ditch are visible.



Photo 2-06.
Looking east towards the south road ditch where there was previous erosion damage between 33+300 to 33+715 that was repaired in Fall 2022. Ditch was regraded and ECB and synthetic check dams were installed.



Photo 2-07.
Looking northwest towards the shallow slump north of the highway near 33+550. Previous slide toe material that was encroaching into ditch cleaned out as part of the ditch regrading work in 2022.



Photo 2-08.
Looking east within the north ditch at the culvert inlet near 33+715 that was relined with SWSP and inlet/outlet rock armoured during the 2022 repairs. Minor erosion area (0.3 m x 0.2 m) was noted within the ditch bottom upstream of the inlet.



Photo 2-09.
Looking south at trunk drain inlet at km 33+715. Minor gully erosion upstream of inlet between the ditch repairs but no major change from the 2022 condition.



Photo 2-10.
Backslope slump near 34+000 south of highway had no visible changes from the 2022 condition.



Photo 2-11.
Looking east at slightly worse erosion gully from ditch flow outside the armored swale near 34+450.



Photo 2-12.
Downslope (south) view of the mid-slope below the road embankment near 34+550 (Old Site 1). No visible changes from the 2022 condition.



Photo 2-13.
Looking east towards the road fill embankment between 34+450 to 34+600 (old Site 1). No visible changes from the 2022 condition.



Photo 2-14.
View southwest of the 6 m backscarp near the top of trunk drain, near 34+625. No major changes visible since 2022.



Photo 2-15.
Looking east at the trunk drain breach (34+650). Significant gully erosion and landsliding has developed upslope from the initial breach. Terrain is actively eroding and sliding that is expected to continue to retrogress upslope. Diversion of the current trunk drain to a new alignment is required to slow the erosion.



Photo 2-16.
View east of the expanded erosion gully below the hanging trunk pipe breach.