THURBER

ALBERTA TRANSPORTATION GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – PEACE-HIGH LEVEL
2020 INSPECTION

Site Number	Location	Name	Hwy	km
PH60	East Hill	35+680 to 36+180 Site 3	2:60	35.95
Legal Description		**UTM Co-ordinates**		
W28 & E29-083-21 W5M		11V E 483450	N 6231395	

	Date	PF	CF	Total
Previous Inspection:	3-Jun-2019	13	4	52
Current Inspection:	9-Jun-2020	13	4	52
Road WAADT:	4580		**Year:**	2019
Inspected By:	Ed Szmata, TRANS Rocky Wang, TRANS		Don Proudfoot, TEL Tyler Clay, TEL	
Report Attachments:	☑ Photographs ☑ Plans		☐ Maintenance Items	

Primary Site Issue:	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 and ongoing shallow and deep-seated movements are occurring on the downslope side. 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 roadway. A new shallow landslide developed on the northeast facing backslope within a through-cut area at 35+835 since the 2015 inspection. 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.
Dimensions:	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. The 2013 shallow slump at 35+900 is 35 m wide and developed 100 m from the roadway. The new shallow landslide at 35+835 was 30 m wide at the main scarp and 40 m long extending to the south roadway ditch. 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. The composite slide/flow at 35+900 is approximately 65 m wide and 165 m long with an exposed main

	scarp several meters high (estimated from 2016 satellite imagery).	
Maintenance:	No maintenance activity since 2011.	
Observations:	**Description**	**Worsened?**
☐ Pavement Distress		☐
☑ Slope Movement	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 minor ongoing movement but no significant retrogression/lateral expansion of the main 2016 slide area which is offset approximately 180 m from highway (Photo 60-04). Overgrown scarp near 35+750 shows no sign of recent movement. Shallow slide/flow on the backslope at 35+830 had no further expansion and was not blocking ditch (Photo 60-05).	☐
☑ Erosion	Ongoing erosion at the culvert outlet and gullying immediately below roadway at 35+700 where there is active slumping on the gully walls (Photos 60-01 and 60-02). The erosion and gullying significantly expands approximately 125 m downslope of the highway where trees and thicker vegetation becomes sparse. Ongoing minor retrogression but no significant expansion since 2019 and gully sidewalls are intermittently stable (Photo 60-03). Minor ditch erosion is ongoing on both sides of the roadway between 35+850 and 36+000. At 36+050, gully erosion is ongoing on the upper portion of the toe berm below the roadway (Photos 60-06).	☑
☐ Seepage		☐
☑ Bridge/Culvert Distress	Erosion ongoing at culvert outlet at 35+700 which is believed to be at least partially blocked (Photo 60-01).	☐

☐ Other		☐

Instrumentation:

SI12 - No discernible movement.

SI13 – Creep (0.5 mm/yr) over 2.2 m to 4.7 m depth.

SI88 - No discernible movement.

SI89 – 10 mm/yr over 11.8 m to 13.6 m depth (-3.4 mm/yr since the Fall 2019 readings), with total cumulative movement of 107 mm

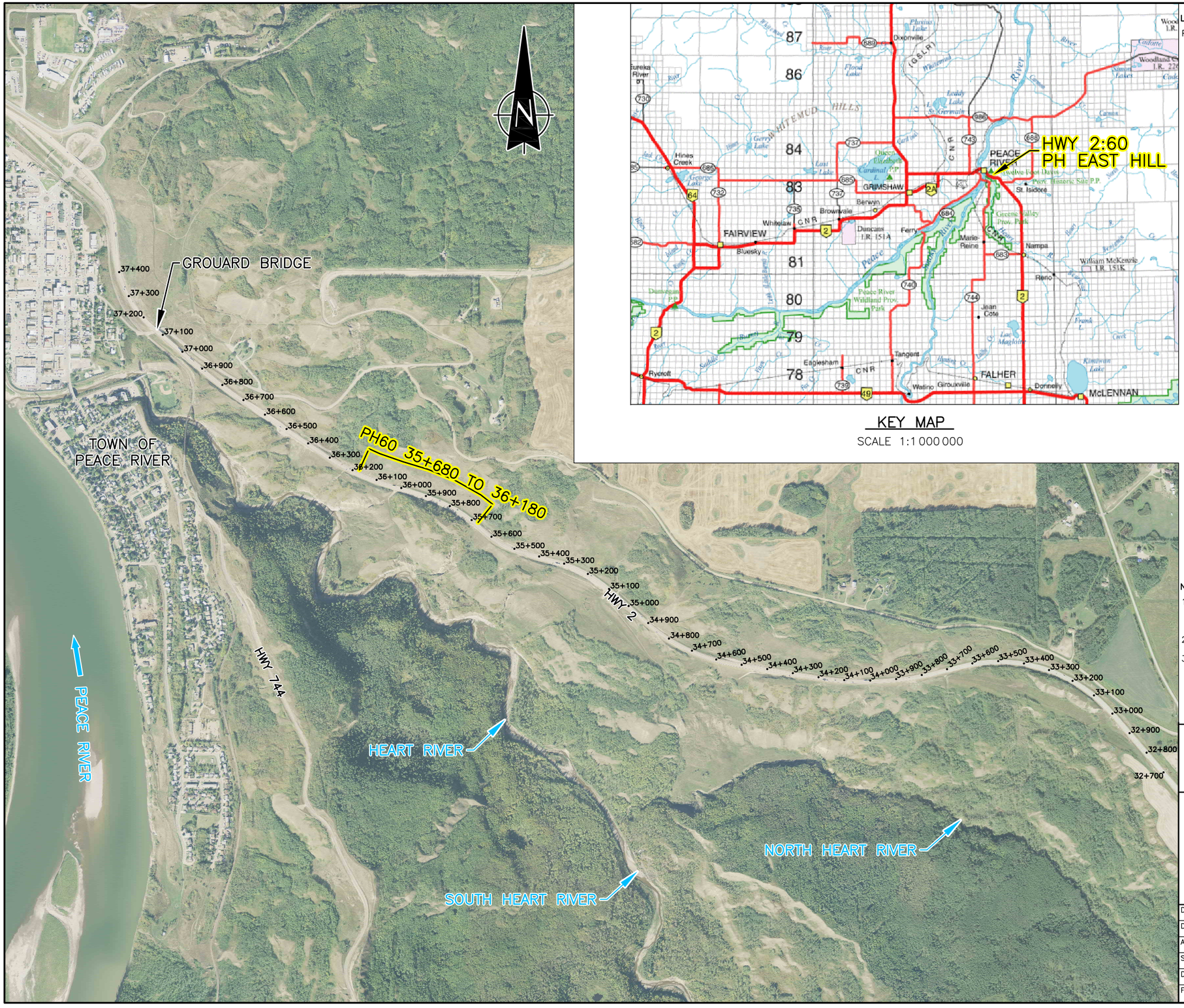
SI91 – Sheared at 13.1 m below top of casing as of Spring 2019

Assessment:

Small deep-seated movements are occurring within the fill embankment downslope of roadway indicating low Factors of Safety. The Spring 2019 instrument readings indicate 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). Additionally, SI 91, located in the base of the valley slope was sheared off at 13.1 m depth in the recent Spring 2019 readings. Surficial observations of active movement have not been observed in these areas, 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. A significant volume of material has been displaced from the valley toe in localized areas due to gullying and mass soil flow events and could be a factor in this trend. Increased movement rates at SI 89 may be driven by a loss of toe material at the erosion gully to the south.
In general, the shallow slumping upslope of roadway is active but currently has limited to no effect the highway.
The landslide within the backslope at 35+835 does not pose a risk to the roadway; however, as displaced material continues to move into the ditch; water flow could be blocked and require maintenance.
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 rate of retrogression.

Recommendations: **Cost**

Continue to monitor instruments twice yearly and undertake annual inspections.	
Consider redirecting surface runoff further downslope of headcutting/gullying that is occurring at 36+000 and 35+700. Consider repairing the shallow slope failures at 35+900 and 35+835. This may include removal of loose soil and backfill using granular fill; and protecting the exposed surface with liner and soil cover to allow vegetation to grow.	$300,000



KEY MAP
SCALE 1:1 000 000

LEGEND:
PH60 EXTENT

NOTES:
1 DRAWING MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 13351 DATED DECEMBER 2020 AND IS SUBJECT TO THE STATEMENT OF LIMITATIONS AND CONDITIONS INCLUDED IN THE REPORT.
2 AIR PHOTO BASE FROM TARIN RESOURCE SERVICES LTD. 0.4 m/PIXEL (2012).
3 CHAINAGE SHOWN ARE APPROXIMATE ONLY.

0 0.1 0.2 0.3 0.4 0.5 1.0 km

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PEACE REGION (PEACE RIVER/HIGH LEVEL)

PEACE RIVER EAST HILL
HWY 2:60 (PH60)
KEY MAP

FIGURE PH60-1

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	WCW
SCALE	1:15 000
DATE	DECEMBER 10, 2020
FILE No.	13351–C4A

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PH61 36+180 TO 37+130

00

36+800

HWY 2

36+700

36+600

36+500

61–02

36+400

EROSION RILL

DITCH EROSION

2013 SLIDE

2016 SLIDE

61–01

36+300

ATV DAMAGE TO EROSION CONTROL

RILL EROSION

PH60 35+680 TO 36+180

EROSION IN FILL

61–03

36+200

SITE 3

TOP OF GULLYING

36+100

2009 ELEPHANT TRUNK DRAIN

36+000

DITCH EROSION

BEDROCK EXPOSED

SI 89

35+900

2016 SLIDE

RIVER CHANNEL NO LONGER AT TOE

2016 EARTH FLOW BASE OF GULLY

TOP OF GULLYING

35+800

60–05

SI 13

SI 88

SI 12

35+700

CULVERT INLET BLOCKED

PN

TOP OF GULLYING

ACTIVE DITCH (UP TO 1.5

ACTIVE SCARP

60–01

SLIDE AREA

PH59 34+770 TO 3

60–02

35+600

TOP OF SCARP

60–04

2016 SLIDE AREA (APPROXIMATE EXTENT)

35+500

59–06

700 CSP

59–09

35+400

60–03

CULVERT INLET

HWY 2

35+300

SI 91 (SHEARED 2018)

GABION CULVERT OUTLET

59–07

DITCH EROSION

OVERGROWN EROSION GULLY

59–08

35+200

SI 67

SI 81

SI 75

SI 69

FLANK OF OLD SCARP

800 CS

59–05

SI 82 (SHEARED 2012)

59–03

PN/SP 004

2016 AIR PHOTO FROM BING (DIGITAL GLOBE)

NEW SLIDE AREA 2016 (APPROXIMATE EXTENT)

300 CSP VERTICAL

ACTIVE GULLYING EROSION

LARGE SCARP FEATURE

HEART RIVER

GULLYING/EROSION (5m WIDE X 1.2m DEEP)

SCA

N

LEGEND:

- HORIZONTAL CHAINAGE (37+130 GROUARD BRIDGE) — 35+900
- PHOTOGRAPH LOCATION — 61–01
- SLOPE INCLINOMETER
  - NO MOVEMENT — SI 64
  - CREEP — SI 82
  - MEASURABLE MOVEMENT (OR RECENTLY SHEARED) — SI 82
- PIEZOMETER — PN 004
- PH60 EXTENT

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2 AIR BASE FROM TARIN RESOURCE SERVICES LTD. 0.4 m/PIXEL (2012).

3 SLIDE FEATURES, PHOTOGRAPHS AND CHANIANGE ARE SHOWN APPROXIMATE ONLY.

0 50 100 150 200 250 m

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PEACE REGION (PEACE RIVER/HIGH LEVEL)

PEACE RIVER EAST HILL
HWY 2:60 (PH60) STA. 35+680 TO 36+180
LOCATION PLAN

FIGURE PH60-2

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	WCW
SCALE	1:5000
DATE	DECEMBER 10, 2020
FILE No.	13351–C5A

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Photo 60-01.
Close-up of hanging culvert outlet (35+700). Ongoing erosion below culvert and rilling above. No major change from the 2019 condition.

THURBER

	**Photo 60-02.** Looking downslope at erosional gullying below culvert shown in Photo 60-01 (35+700). Active slumping on gully walls.
	**Photo 60-03.** Gully and slide area below the culvert outlet at 35+700, offset approximately 125 m from the highway. Mass movement occurred in 2016, ongoing minor retrogression but no new major retrogressions or movements were noted in 2020. Gully sidewalls are intermittently stable.

	**Photo 60-04.** View overlooking the main scarp of a major slide/earth flow event that occurred in 2016. Minor retrogression since that time. Slide area is offset approximately 180 m from the highway (35+950).
	**Photo 60-05.** Shallow slide/flow within through-cut area on the south cut slope (35+830). First observed in 2016, no further expansion or blocking of ditch.

Photo 60-06. Headcutting and erosional gullying occurring below roadway (36+050).