

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – HIGH LEVEL
2019 INSPECTION**



Site Number	Location	Name	Hwy	km
PH006-1	North of Paddle Prairie	Tompkins Landing	697:02	16.97-17.62
Legal Description		UTM Co-ordinates		
NW30-103-19-W5M / E25-103-20-W5M		11U E 491,100	N	6,425,466

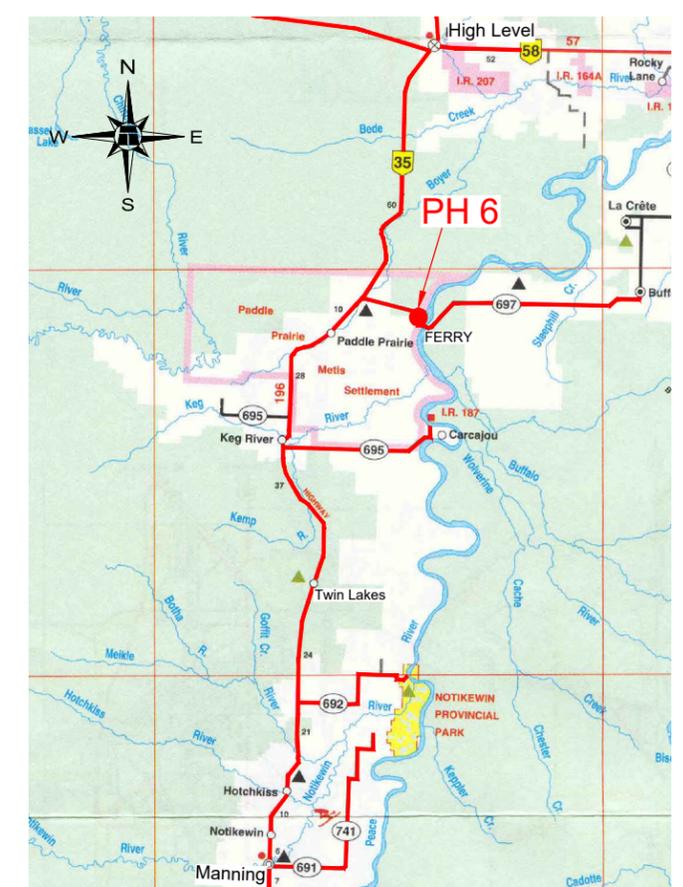
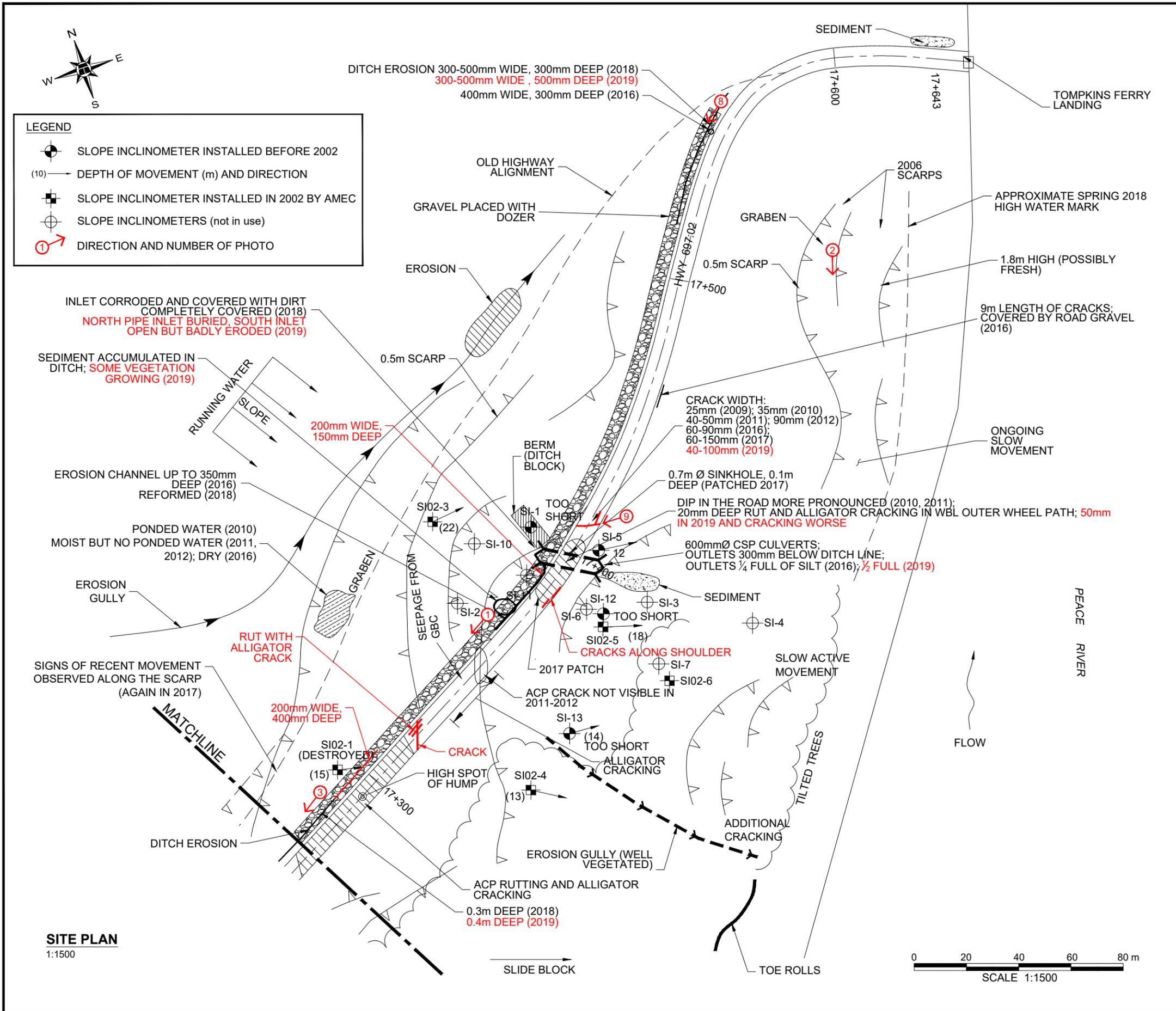
	Date	PF	CF	Total
Previous Inspection:	21-Jun-2018	10	4	40
Current Inspection:	16-May-2019	10	4	40
Road AADT:	290		Year:	2019
Inspected By:	Roger Skirrow, TRANS Ed Szmata, TRANS Austin Dillman, TRANS		Don Proudfoot, Thurber Ken Froese, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs	<input checked="" type="checkbox"/> Plans	<input type="checkbox"/> Maintenance Items	

Primary Site Issue:	Deep-seated, valley wall slope movements	
Dimensions:	490 m of highway affected by, or adjacent to, active movement.	
Date of Remediation:	None	
Maintenance:	2004: Overlay of highway 2006: Silt fence repair at the west end of the site 2010: Asphalt patch over southwest portion 2015: Asphalt patch (50m long) 2017: Gravel placed along north shoulder and asphalt patch on road	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Diagonal cracks and dips in the road over the slide blocks increasing in width and differential.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Ongoing slow slope movement.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Several active erosion gullies in the upslope ditch.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Seepage observed from the GBC between Sta. 17+300 and 17+400	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	800 mm CSP culvert in southwest site is being pulled apart by slope movement. Inlet of N 600 mm CSP culvert at 17+400 covered with dirt; inlet of S CSP badly corroded.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
Instrumentation (as of Fall 2019):		
Destroyed	SI02-2, -3, -4, and -5 sheared off between 2004 and 2009. PN02-4 was destroyed in 2005 and PN02-1 in 2008.	
Inclinometers	SI-1 has not shown a discernable movement pattern; SI-5 has cumulative movements of 73 mm in the upper 4 m and 302 mm below that depth. The corresponding average rates of movement since 2007 are 2.4 mm/year and 7.5 mm/year with similar current rates. SI-12 has shown a decreasing trend of movement in the 4 m depth zone since a peak displacement in Spring 2012. The 7 m zone is currently moving at 0.4 mm/year (cumulative displacement of 39 mm) compared to the average rate of 1.5 mm/year since 2007; the 12 m zone is currently moving at 1 mm/year (cumulative displacement of 12 mm) compared to the average rate of 0.4 mm/year since 2007.	

	SI-13 has a relative steady movement rate of about 10.2 mm/yr since 2007 over the 2 m to 15 m depth interval although it tends to accelerate in the summer and slow over the winter; the current movement rate is 4.5 mm/year and the cumulative movement is about 224 mm.
Piezometers	PN02-3 has shown a slightly decreasing trend since 2012 with the current water level at 7.3 m below ground (down 0.5 m from Fall 2018). PN02-5 has varied somewhat over the last few years but has decreased since Spring 2018 with a current water level 13.2 m below ground surface which is the lowest since Fall 2007.
<p>Assessment:</p> <p>It appears that the highway is situated on a deep-seated rotational slide extending the full height of the Peace River valley. This large-scale movement is likely based in clay shale bedrock near the bottom of the river valley with the slide initially triggered, and kept moving, by river erosion at the toe of the slope. Alberta Transportation personnel have indicated that the slide seems to accelerate when river levels are low. There may also be contribution from water-bearing sand and gravel layers providing water to the slip surface further reducing the shear strength of the soils. Through this site, the depth of the shear plane seems to be 20 m or deeper with intermediate scarps creating graben features. It is anticipated that this large-scale slide will continue to move with rates dependant on seasonal rainfall and the water level in the river. As the movement is deep-seated, remediating the slide will be difficult and may be limited to controlling localized issues. As shown on the drawing, there continues to be ongoing deterioration of the site. Erosion on the north sideslope and in the north ditch have begun to reform through the recently-placed gravel fill. A sinkhole is forming over one of the culverts at Sta. 17+400. There is general deterioration of the site and increasing undulation of the pavement surface.</p> <p>It should be noted that the SI's that can still be read likely do not extend deep enough to fully penetrate the base (main) slip surface of the landslide.</p>	
<p>Recommendations:</p> <p>Short-Term:</p> <ul style="list-style-type: none"> ▪ The gap in the 800 mm culvert should be repaired to reduce the amount of runoff into the slide mass. The culvert could be excavated and replaced; alternatively, a collar could be used to span the gap with one end not fastened to allow for future movement. The sinkhole should be backfilled with compacted low- to medium-plastic clay. ▪ The inlets of the pair 600 mm culverts should be uncovered and the ditch regraded to ensure proper flow. This pipe should be lined and grouted (or excavated and replaced) to stop the piping that has created the sinkhole. The outlets should also be exposed and the surrounding ditch regraded to limit the potential for future obstruction. ▪ Routine crack sealing, milling, and patching should be undertaken, as necessary, to maintain a safe riding surface and reduce water infiltration. <p>Long-Term remediation options:</p> <ol style="list-style-type: none"> a) Install horizontal drains into the water-bearing sand and gravel layers. Additional drilling investigation would be required to identify the depths and extents of such layers so the drain installation could be targeted. b) Place riprap armouring or re-directive rock vanes along the toe of the slope to reduce river erosion at the toe. It is estimated that this protection would need to be about 700 m in length to be effective. Also note that the efficacy of rock vanes in a river of this size has not been evaluated. c) Re-align the highway perpendicular to the slope to minimize the amount of the valley wall that is crossed and to take advantage of unloading in the upper cut section and buttressing in the lower fill section. <p>These options are relatively expensive, and the economical option may be to continue with routine maintenance with consideration given to vertical grade adjustments when distortions warrant. Light-weight fill could be considered to reduce some of the driving force; however, the impact may not be worth the cost nor the future difficulty with regrading as the light-weight would limit the depth to which grade adjustments could be made.</p>	

Ongoing Investigation:

- It is suggested that GeoHazard inspections be continued annually and that bi-annual instrumentation readings should continue as scheduled.
- If mitigative measures are being considered, it is recommended that additional drilling be undertaken including the installation of deep slope inclinometers (or shape accel arrays which could handle larger deformations) to confirm the depth of the main slip surface at various locations on the hillside.



- NOTES:**
1. BASE PLAN COPIED FROM AMEC DRAWING (FIGURE 1 - PROJECT EG08628.33 DATED JUN. 2003)
 2. SLOPE INCLINOMETERS SI's 3, 7, 10, 11 AND SI02-6 WERE DESTROYED
 3. FEATURE LOCATIONS ARE APPROXIMATE.
 4. PREVIOUS OBSERVATIONS SHOWN IN BLACK
 5. MAY 2019 OBSERVATIONS SHOWN IN RED
 6. SI's THAT REMAIN OPERATIONAL ARE SI-1, -5, -12, AND -13

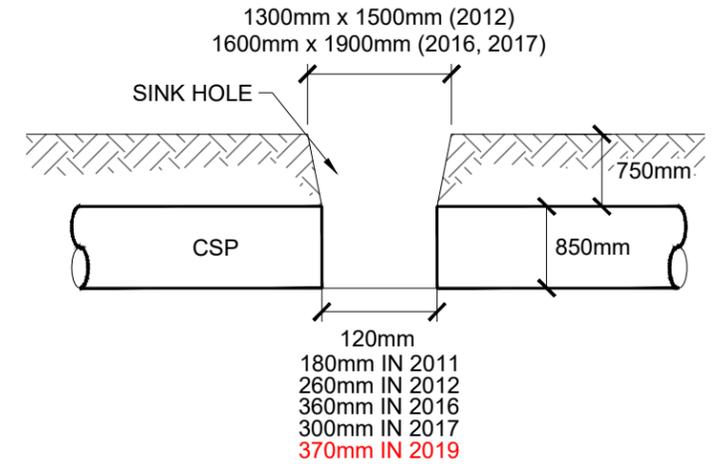
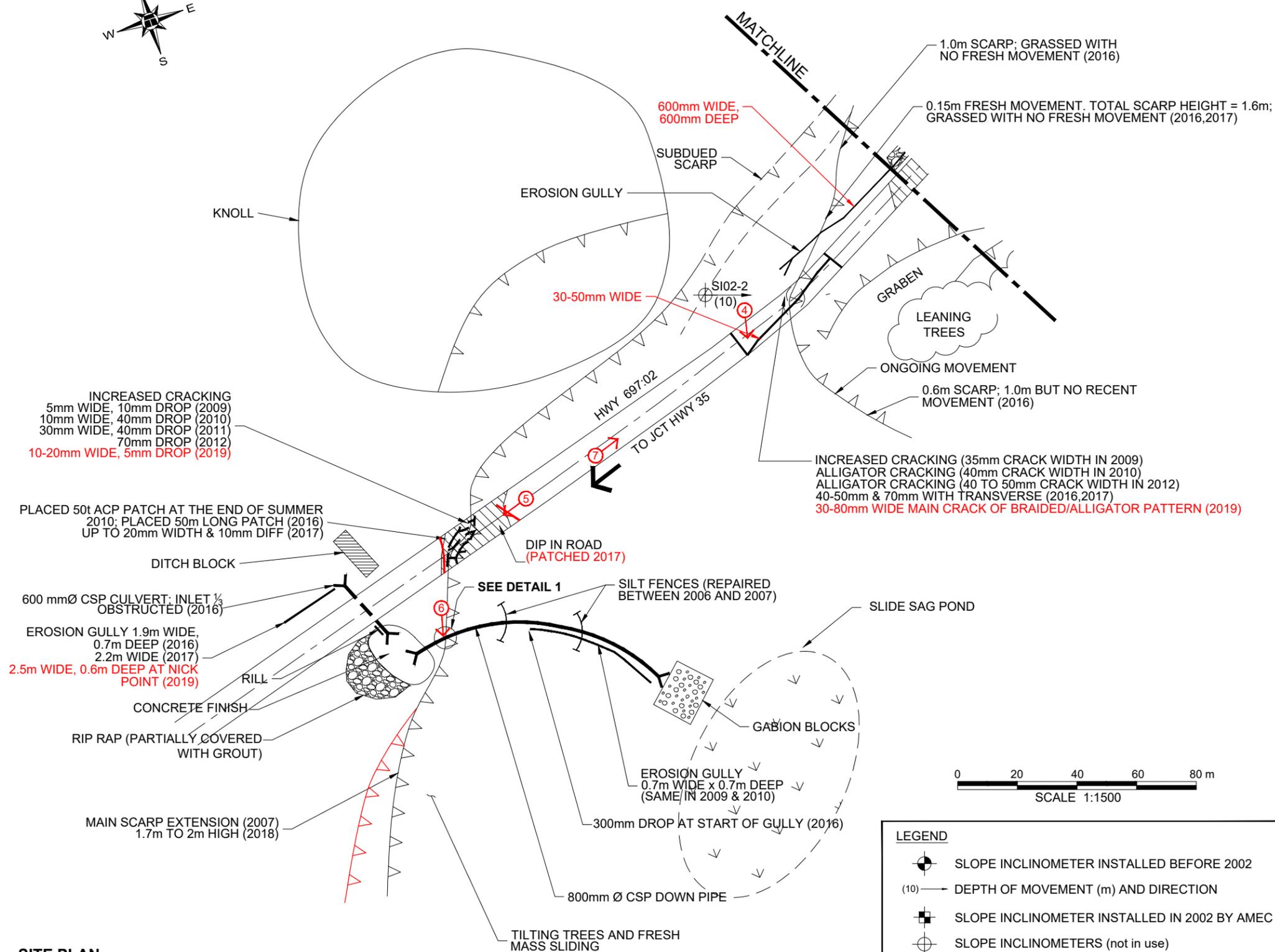
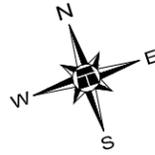
PEACE REGION (PEACE RIVER / HIGH LEVEL)

**PH006-1: HWY 697:02 - TOMPKINS LANDING SLIDE
2019 GEOHAZARD ASSESSMENT**

DWG No. 13351-PH006-1-1

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	DECEMBER 2019
FILE No.	13351

THURBER ENGINEERING LTD.



DETAIL 1
1:75

NOTES:

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SITE PLAN
1:1500



LEGEND

- ⊙ SLOPE INCLINOMETER INSTALLED BEFORE 2002
- (10) → DEPTH OF MOVEMENT (m) AND DIRECTION
- ⊕ SLOPE INCLINOMETER INSTALLED IN 2002 BY AMEC
- ⊙ SLOPE INCLINOMETERS (not in use)
- ① → DIRECTION AND NUMBER OF PHOTO



PEACE REGION (PEACE RIVER / HIGH LEVEL)

**PH006-1: HWY 697:02 - TOMPKINS LANDING SLIDE
2019 GEOHAZARD ASSESSMENT**

DWG No. 13351-PH006-1-2

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	DECEMBER 2019
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Photo 1 – Looking southwest at one of the dips in the road and recently-patched pothole (was at the centreline of the road).



Photo 2 – Looking south at slope with ongoing movement in the northeast portion of the site. Note that much of the vegetation along the river bank was destroyed by flooding in Spring 2018.



Photo 3 – Looking southwest at erosion in north ditch.



Photo 4 – Alligator cracking near the southwest end of the site.



Photo 5 – Looking southwest at recent patch near southwest portion of the site.



Photo 6 – Sinkhole at separated 800 mm CSP downpipe south of the highway.



Photo 7 – Looking east at dips in the road (minor with yellow arrow, major with red arrow).



Photo 8 – Looking west at ditch erosion near bottom of valley.



Photo 9 – Cracks on highway near bottom of valley.