

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION–GRANDE PRAIRIE
2017 INSPECTION REPORT**



Site Number	Location	Name	Hwy	km
GP001	Wapiti Hill South of Grande Prairie	Wapiti Hill (5 km's S. of Wapiti R. Bridge)	40:42	25.393
Legal Description		UTM Co-ordinates		
NE¼ 18-070-05 W6M		11U E 388597	N 6103792	

	Date	PF	CF	Total
Previous Inspection:	9-Jun-2016	7	4	28
Current Inspection:	14-Jun-2017	7	4	28
Road AADT:	3890		Year:	2016
Inspected by:	Ed Szmata, TRANS Ted Prue, TRANS Rocky Wang, TRANS		Renato Clementino, Thurber Shawn Russell, Thurber Nicole Wilder, Thurber	
Report Attachments:	<input type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	<p>This section of highway 40:42 was constructed as a side hill embankment fill crossing through the backscarp of a large landslide on the south valley slope of the Wapiti River. About a 300 m long section of the roadway is currently affected by the landslide and cracks on the pavement structure require regular milling and patching in order to maintain the highway.</p> <p>During the initial construction in 1981, soft and wet ground conditions were encountered on the exposed subgrade which required sub-excavation and placement of about 2 m of additional fill. Seepage was observed on the backslope cut above the highway and a lateral subdrain pipe was installed along the ditch at the toe of the backslope.</p> <p>As early as 1985 some settlement on the roadway surface and failures on the backslope were observed.</p> <p>In September of 1990, additional lateral and finger subdrains were installed to collect water seeping from the backslope and a berm was built at the toe of the embankment side slope in an effort to improve stability of the embankment.</p> <p>Several geotechnical investigations were conducted by TRANS from 1990 to 1998. Slope inclinometers and piezometers installed at the site indicated slow creep movement of the valley slope and groundwater levels at about 10 m in depth.</p> <p>A quarry has been operated near the bottom of the valley slope in the lower river terrace immediately below this section of the highway.</p>
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Dimensions:	<p>The overall width of the large ancient landslide backscarp is about 2 kilometers while the actual width of the backscarp in proximity to the impacted roadway alignment is about 500 m.</p> <p>The approximate height of the backslope above the highway is about 20 to 25 m.</p>	
Maintenance:	<p>The last ACP patching and milling of ACP along scarp drops on the pavement was carried out in 2014 and had been undertaken at a frequency of about two-year in the past.</p>	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Cracks and dips on the pavement along the backscarp of the postulated landslide. The drop in the pavement is up to 120 mm. Some alligator settlement cracks were observed in the southbound lane near km 25.8.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Slope Movement	No discernible slope movement was observed during this site visit.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Some erosion of the valley slope below centerline culvert outlets along the northern limit of the right-of-way was present previously; however, no erosion was observed during 2017 inspection.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Water was observed ponding at the culvert outlet	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	The outlet of the centerline culvert at km 25.7 was partially obstructed.	<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
Instrumentation:		
SI-6	Installed about 100 m downslope of the highway NBL shoulder at km 25.57. This SI is likely too shallow to intercept the slide surface of the landslide affecting the highway. No discernible slope movement was observed in this SI.	
SI-8	Installed 75 m downslope of the highway NBL shoulder at km 25.525. This SI showed previous creep movement at a rate of 2 mm/yr within depths from 1.8 m to 20.7 m below the existing ground surface. No discernible movement was noted in the Spring 2017 readings.	
SI-9	Installed 50 m downslope of the highway NBL shoulder at km 25.6. Historically, this SI has showed creep movement within depths from 2.7 m to 7 m and from 19.8 to 22.9 m below the existing ground surface. However, the recent SI readings and those in the fall 2016 SI readings did not detect any discernible movement.	
PN-4 PN-9A PN-9B PN-11	<p>Installed from 25 m to 50 m to downslope of the highway between km 25.55 and 25.6 with the tips at depths ranging from 15 m to 20 m below the existing ground surface.</p> <p>PN-4 and PN-11 could not be located on site during this inspection. PN9-A and PN9-B showed increases in water levels of 3.77 m and 0.23 m respectively.</p>	
PN-21 PN-23	Installed near the inlet and outlet of the centerline culvert at km 25.7. PN-21 showed an increase of 0.07 m and PN-23 showed no change in groundwater level since the fall 2016 readings.	

Assessment:

Over last several years, this site has been relatively dormant with little signs of active slope movement aside from slow development of the cracks on the roadway pavement surface, which have been regularly addressed by TRANS by milling and patching maintenance efforts. The subdrains installed along the backslope ditch appear to have performed as per the designs intent at this site in improving the stability of the embankment and backslope.

The large landslide in the area appears to govern the global stability of the roadway embankment. Due to the size of the landslide, realigning the highway further into the backslope would be prohibitive and would take several years to implement.

There is a possibility that the currently dormant landslide could be activated from the adjacent quarry operation or the erosion of the Wapiti River at the bottom of the valley slope. The global stability of the valley slope in this area should be monitored periodically.

Recommendations:**Ballpark Cost**

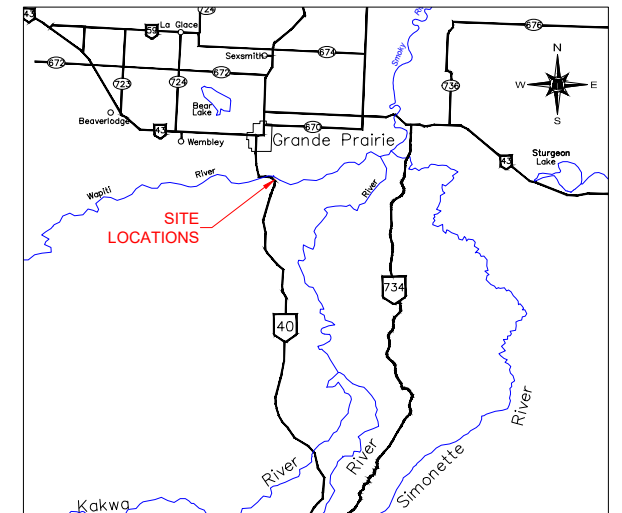
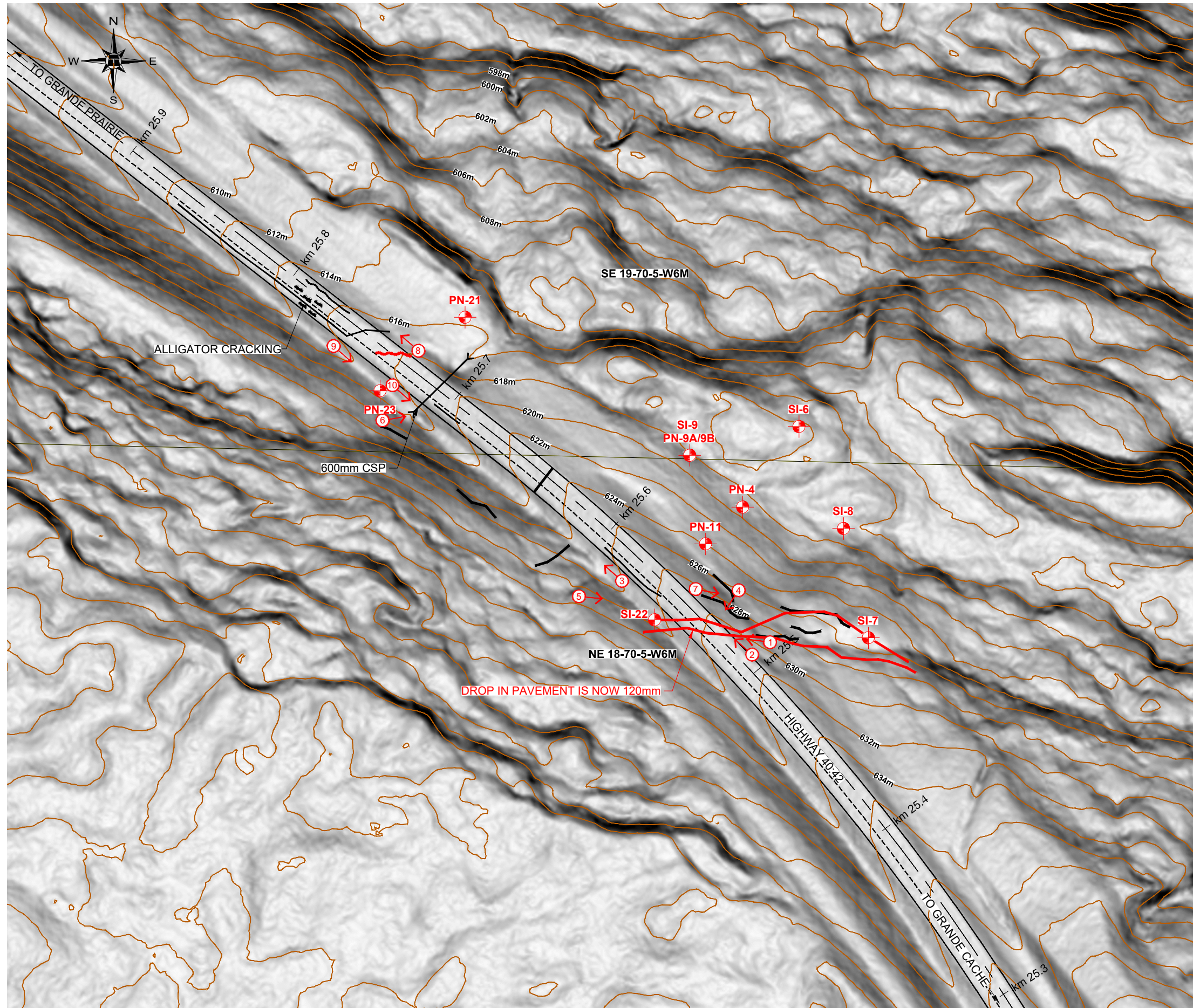
In the short term, it is recommended that the cracks in the pavement be sealed or overlain with asphalt patches and the drops along the backscarp be milled. The area be closely monitored for early signs of slope movement.

Maintenance
(currently about
every 2 years)

In the long term, the section of the roadway affected by the landslide could be realigned into the backslope, which would require a substantial backslope cut generating a large amount of surplus material for disposal. The estimated length of highway to be realigned would be in the order of about 3 km to 5 km. Alternatively, the backslope cut volumes could be marginally reduced by a combination of partial roadway realignment and construction of tie-back reinforced cast-in-place concrete piles to stabilize the backslope. It should be noted that the latter option only partially solves the landslide issues by diverting roadway alignment away from it. It is possible that the landslide could develop retrogressively and encroach into the realigned highway in the future after the partial realignment.

\$30 Million to
\$60 Million

(A proper
planning study
would be
required to
determine the
actual cost of
various
realignment
options)



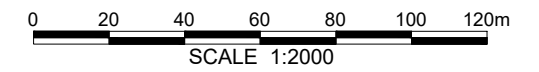
KEY PLAN
SCALE: 1:2 000 000

LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- SLOPE INCLINOMETER
- PNEUMATIC PIEZOMETER
- GROUND SURFACE CONTOUR (2m INTERVAL)
- CRACK (APPROXIMATE)
- DIRECTION AND NUMBER OF PHOTO

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. JUNE 14, 2017 FEATURES SHOWN IN RED



BASE PLAN PROVIDED BY ALBERTA TRANSPORTATION



**PEACE REGION (GRANDE PRAIRIE) 2017
GP01-1: HWY 40:42 WAPITI HILL
(5km SOUTH OF WAPITI RIVER BRIDGE)**

2017 INSPECTION FIGURES

DWG No. 13353-GP01-1-1

DRAWN BY	ML
DESIGNED BY	SGR
APPROVED BY	RVC
SCALE	1:2000
DATE	JUNE 2017
FILE No.	13353





Photo 1.
Looking west from
the NBL shoulder
at km 25.51 across
the dip the
roadway. No
significant change
since 2016.



Photo 2.
Looking northwest
across the dip in
the roadway from
the NBL shoulder.



Photo 3.
Looking northwest
along the NBL
ditch.



Photo 4.
Looking west
towards dip in the
roadway at km
25.51.



Photo 5.
Looking east from
west cut slope at
where dip crosses
the road.



Photo 6.
Looking northeast
in the SBL ditch
towards the inlet of
the centerline
culvert at km 25.71.
A 450 mm subdrain
pipe and a 150 mm
subdrain pipe both
discharge water
into the culvert
inlet.



Photo 7.
Looking northeast from the NBL shoulder towards where scarp crack in road extends into the downslope.



Photo 8.
Looking northwest at km 25.75 along the NBL shoulder at cracks in the roadway shoulder.



Photo 9.
Looking southeast
at km 25.8 along
the SBL shoulder at
longitudinal cracks
in the SBL ACP.



Photo 10.
Looking southeast
at km 25.71 at west
ditch and culvert
inlet.