ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – SWAN HILLS DISTRICT
2019 CALL OUT INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
SH32	0.9 km W. Hwy 750	South Embankment Slide	679:06	26.2
Legal Description		**UTM Co-ordinates (NAD 83)**		
SE28-76-14-W5		11U N 6,163,235 E 556,162		

	Date	PF	CF	Total
Previous Inspection:				
Current Inspection:	June 25, 2019	11	3	33 (Landslide basis)
Road AADT:	280		**Year:**	2018
Inspected By:	Barry Meays (Thurber) Ed Szmata (AT)			
Report Attachments:	☑ Photographs ☑ Plans ☑ Maintenance Items			

Primary Site Issue:	A landslide occurred downslope of the pavement on the 6 m high south highway embankment, and extends to a stream located at the base of the embankment.	
Dimensions:	The landslide is about 25 m wide parallel to the highway near the base, and about 12 m long along the face of the hwy embankment.	
Date of any remediation:	None to date (this highway was paved in 2012).	
Maintenance:	None to date.	
Observations:	**Description**	**Worse?**
☑ Pavement Distress	Cracks exist randomly over both driving lanes/shoulders in the overall area, but are not thought to be related to the landslide.	☐
☑ Slope Movement	The landslide scarp (about 0.3 m vertical height) is located 3.6 m horizontally from the edge of the gravelled highway shoulder, and has a toe near a stream at the base of the hwy embankment inclined at ~20^0 overall.	☐
☑ Erosion	There are indications of subsidence of the north stream bank at the base of the landslide due to stream erosion and channel scour.	☐
☐ Seepage		☐
☐ Bridge/Culvert Distress		☐
☐ Other		☐

Instrumentation: NONE

Observations and Assessment:

The landslide outline in plan and section relative to the highway surface above, and the stream channel below the slide, are shown on the attached Figures 1 and 2 and the attached photos. The landslide is about 12 m in length perpendicular to the highway, and has widths parallel to the highway of about 12 m at the top and 25 m at the base (adjacent to the stream). The outermost slide scarp is located 3.6 m horizontally from the outside edge of the gravelled hwy shoulder and is about 0.3 m high. It is located on an approximate 6 m high embankment that was inclined at about 20^0 (= 2.7H:1V) overall, and was well grassed (except where disturbed by recent slide movements). There are intermediate scarps within the body of the slide, suggesting it may be a retrogressive failure.

The base of the slide is located at the toe of the highway embankment, immediately adjacent to a stream channel. The stream channel was <1 m in width and <1 m deep adjacent to most of the landslide area, except towards the east end where the stream widened/flattened out to about 8 m. The stream was carrying slight but steady flow westwards (and appears to be a tributary that empties into Salt Creek about 300 m to the southwest). Dense forest covered both banks of the stream channel adjacent to the slide area and extended southwards indefinitely.

Information provided by AT personnel indicated that the slide was first observed earlier this year.

It appears that the landslide may have occurred due to stream channel erosion along the toe of the embankment slope, as some subsidence was observed adjacent to the north bank of the stream channel outside the toe near the west end of the landslide. The slide may have been present in a smaller form in the past, and only recently retrogressed further up the embankment slope.

It is postulated that the embankment is composed of highly plastic clay. A secondary or contributing cause of the failure may be due to a gradual loss of cohesion due to weathering, which has dropped the resistive forces below what is needed to maintain stability. The overall embankment inclination of 20^0 is considered to be somewhat too steep for long term stability on slopes comprised of high plastic clay material.

The recent rainfall in the area may also have contributed to the recent landslide, infiltrating any open cracks/surface of the slide, and causing enlarged/further movement. Based on current observations there does not appear to be a high water table through the slide mass.

The open cracks observed in the pavement were not thought to be related to this landslide, as they are present on both sides of the highway surface, and also extend beyond the landslide area.

There is not an immediate threat to the highway, as the scarp of the landslide was about 5.9 m from the edge of the pavement (3.6 m from the edge of the gravelled shoulder). However, the landslide will continue to grow in size if not dealt with, eventually retrogressing into the eastbound shoulder and possibly the driving lane.

Recommendations:

This site should be added to the GRMP and visited again in the spring of 2020.

Maintenance/Short Term Measures:

The local MCI should regularly monitor this area for further movements or enlargement. If conditions worsen to the point where the slide encroaches into the shoulder of the highway, barricades and/or warning/speed reduction signs may need to be erected around the distressed area until highway repairs are undertaken.

Geotechnical Investigation:

Prior to the implementation of the remedial measures described below, it is recommended a geotechnical investigation be conducted to assess soil conditions in the study area, to perform a topographic site survey, and to carry out a slope stability analyses. One test hole should be drilled in the edge of the road above the slide extending to a depth of 15 m, and a second shallow test hole drilled near the toe of the slope by the stream. Standpipe piezometers should be installed in the test holes to determine the ground water conditions.

Medium to Long-Term Measures:

Three remedial options are provided below for consideration.

Option 1 – Excavate Slide Mass & Replace with Gravel

Since there is no available space to flatten the slope with the existing right of way, the most feasible option is considered to be sub-excavating the failed slide mass down to intact clay and rebuilding the slope with imported gravel. The new gravel fill material should be placed and compacted in thin horizontal lifts, benched into the intact slope surface. A gravel shear key may also be needed to stabilize the slide area. The excavated clay would have to be hauled/disposed offsite. A subdrain should be installed along the base of the slide excavation backslope, to drain any surface/subsurface water that may enter the rehabilitated slide mass. Class 2 riprap should also be placed over non-woven geotextile along the toe of the repaired slope and creek bed to guard against future toe erosion. Another requirement will be to strip the topsoil from the slide area and replace and seed the topsoil upon completion of the repairs.

This option would depend on the exact location of the existing right of way boundary, and who owns the property. If it exists along the existing tree line, there may be enough room to construct the works with temporary access, and then return the property back to the landowner at completion.

Ball Park Cost $300,000.

Option 2 – Flatten Slope/Channel Stream Through a Culvert

An alternative option involves sub-exavating the failed slide mass and rebuilding it with clay. This would require flattening the slope from its existing inclination (to at least 4H:1V), and channeling the flow through a culvert beneath the toe of the flattened slope. Where the stream channel widens out near the east end, the slope would need to extend further into the heavily forested area. Slope flattening is considered to be somewhat more complex, and would require an imported, separate clay source to complete the repairs, Compacting the clay in horizontal lifts, installing a subdrain, and stripping/replacing/reseeding the new topsoil will also be required. The existing stream flow will need to be passed through a culvert that will need to be installed below the toe of the slope, and will need to be sized appropriately for a 1 in 100 year flow event and properly protected with riprap.

The slope flattening option will extend into private/crown land and hence right-of-way negotiations or an agreement with the land owner(s) and potential first nations consultations may be required before the work can commence. Clearing of some dense forest (including across the stream channel) would be required for this option. Alberta Environment and DFO should also be contacted prior to performing any work adjacent to the stream course for this option.

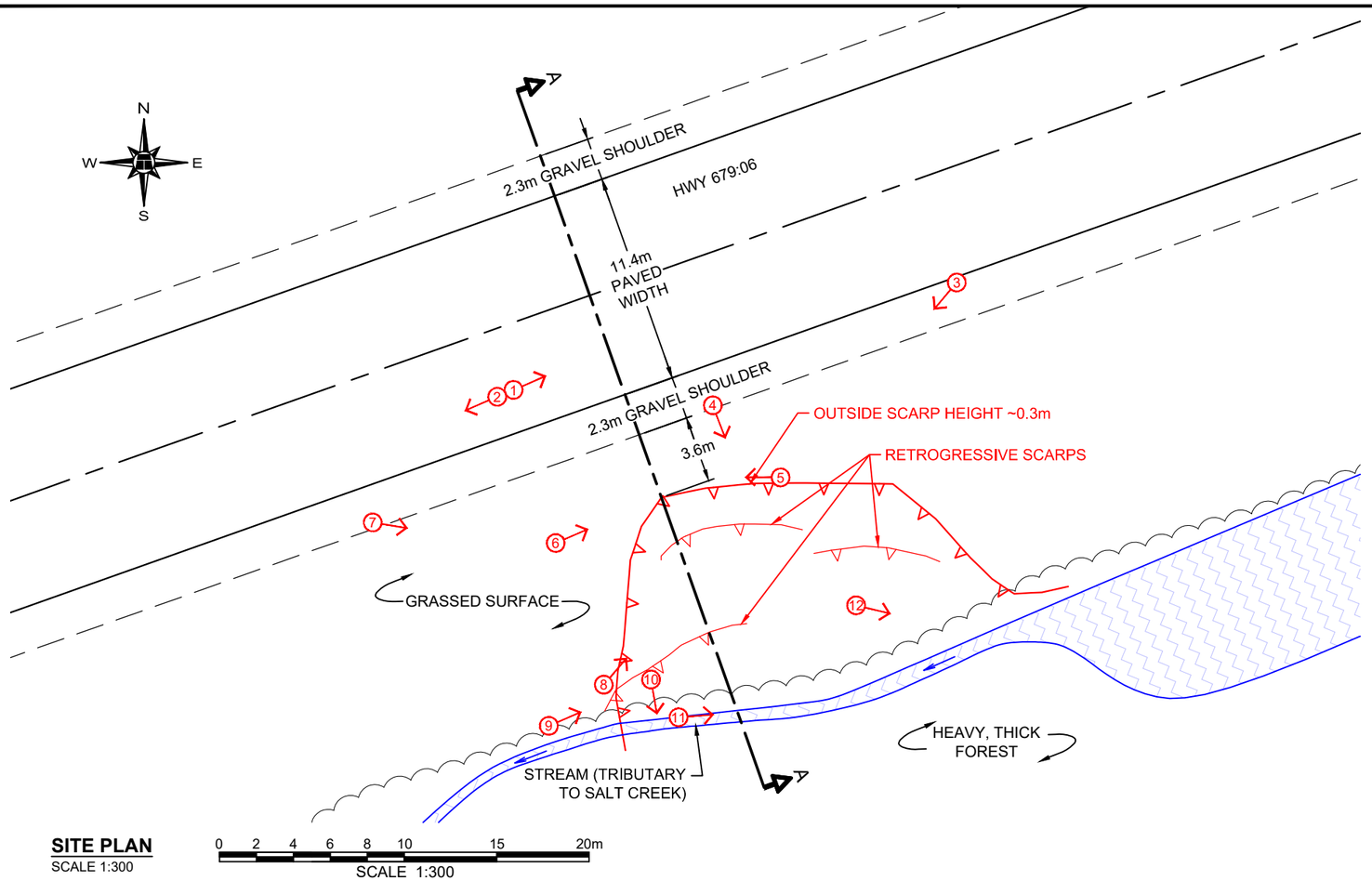
Ball Park Cost $300,000.

Option 3 – Install Driven Steel Pile Wall

This option consists of installing a sheet pile wall at least halfway down the embankment slope to retain the upper part of the landslide mass. The length of this pile wall is currently anticipated to be about 35 m. In the absence of geotechnical information, the piles are anticipated to be in the order of about 10 to 15 m long. Riprap would be placed near the toe of the slope.

This option would not require additional right of way.

Ball Park Cost $450,000.



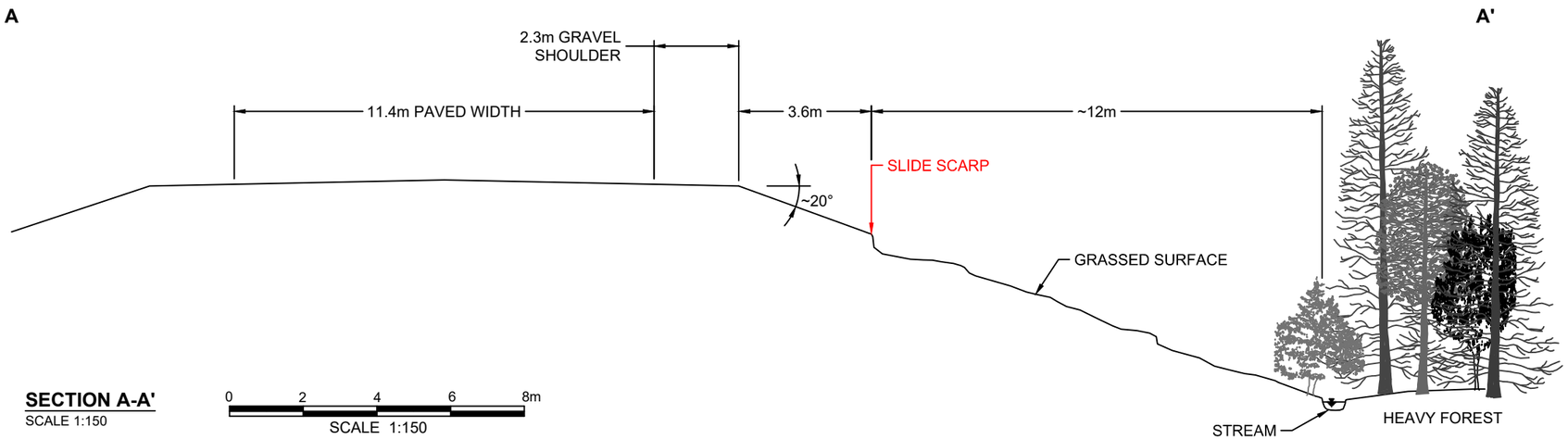
SITE PLAN
SCALE 1:300

0 2 4 6 8 10 15 20m
SCALE 1:300

LEGEND

- SCARP
- TREE LINE
- (1) DIRECTION AND NUMBER OF PHOTO

NOTES:
1. SITE FEATURES ARE APPROXIMATE
2. JUNE 25, 2019 OBSERVATIONS SHOWN IN RED



SECTION A-A'
SCALE 1:150

0 2 4 6 8m
SCALE 1:150

Alberta

PEACE REGION (SWAN HILLS)

EMBANKMENT SLIDE HWY 679:06, KM 26.2
JUNE 25, 2019 CALLOUT PLAN AND SECTION

FIGURE 1

DRAWN BY	KLW
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	JUNE 2019
FILE No.	13355

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Photo 1 – Looking east along Hwy 679 above the slide site towards Hwy 750 in the background.

Photo 2 – Looking west along Hwy 679 above the slide site.

Photo 3 – Looking west across the south hwy embankment (the slide is below the trucks).

Photo 4 – Looking south down along the slide from the edge of the highway.

Photo 5 – A close-up view of the slide scarp (looking west) in the south hwy embankment.

Photo 6 – Looking east across the slide site.

Photo 7 – Looking southeast across the slide. Note the very dense forest extending over the stream and right up to the toe of the south hwy embankment.

Photo 8 – Looking north up at the slide from the toe of the hwy embankment.

Photo 9 – Looking east along the toe of the hwy embankment and edge of the stream at subsidence at the west edge of the slide.

Photo 10 – Looking south at the stream below the west end of the slide. The streambed is in the order of 0.5 m wide here.

Photo 11 – Looking east along the stream from the west end of the slide.

Photo 12 – Looking south across the stream near the east end of the slide site. Note the stream is about 8 m wide here.