# ALBERTA TRANSPORTATION
# GEOHAZARD ASSESSMENT PROGRAM
# PEACE REGION – SWAN HILLS
# 2020 CALLOUT

THURBER ENGINEERING LTD.

| Site Number | Location | Name | Hwy | km |
|---|---|---|---|---|
| SH014-1 | Northeast of High Prairie | Salt Creek Slide | 750:02 | 30.57 |
| **Legal Description** | | **UTM Co-ordinates** | | |
| NE34-76-14-W5 | | 11U E 558,308 | N 6,165,584 | |

| | Date | PF | CF | Total |
|---|---|---|---|---|
| **Previous Inspection:** | 1-Jun-2020 | 11 | 5 | 55 |
| **Current Inspection:** | 30-Jul-2020 | 11 | 5 | 55 |
| **Road AADT:** | 440 | | **Year:** | 2020 |
| **Inspected By:** | Russell Romick, TRANS<br>Ed Szmata, TRANS | | Nicole Wilder, Thurber | |
| **Report Attachments:** | ☑ Photographs<br>☑ Plans | | ☐ Maintenance Items | |

| | | |
|---|---|---|
| **Primary Site Issue:** | A landslide is affecting both lanes of the highway of an original 7.5 m high sidehill embankment fill and extends downslope across the west highway embankment. | |
| **Dimensions:** | 40 m along highway on west side | |
| **Date of Remediation:** | 1988: 120 m long by 9 m wide by 3 m high toe berm with two 150 mm-diameter subdrains installed against west side of highway embankment and 5 m deep subdrain in east ditch. | |
| **Maintenance:** | Crack sealing and patching, as required<br>115 m long patch done in last few years. | |
| **Observations:** | **Description** | **Worsened?** |
| ☑ Pavement Distress | Crack is approximately 35 m long with 15 m dip primarily in SBL. The crack is now a prominent backscarp crack that crossed into the northbound lane and up to 100 mm wide with a 30 mm drop where it crosses into the northbound lane. | ☑ |
| ☑ Slope Movement | 27 m long settled area may be related to movement of toe berm. The area has settled more since the June 2020 inspection as seen from the drop in pavement.<br>Backslope of highway is also actively slumping over 45 m length and open tension cracks and the toe appears to be parallel to the east ditch. | ☑ |
| ☑ Erosion | 50 m long gully at the north side of existing berm and ditch on west side of highway.<br>Damage in the east ditch from phone line installation. | ☑ |
| ☑ Seepage | Seepage and wet area exist near the CSP outlets and along part of the fence on the west side of the highway where it appears animals have rutted it out.<br>Subdrains at north end of toe berm were dry; terrain beyond wet and soft. | ☑ |
| ☐ Bridge/Culvert Distress | BF09208 appears unaffected by slide movements. | ☐ |

| | | |
|---|---|---|
| ☑ Other | Possible intermediate scarps, or old equipment ruts, exist near crest of toe berm downslope edge | ☐ |

**Instrumentation (Fall 2020):**

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|---|---|
| Damaged/ Destroyed | SI02-2 sheared in 2005 at 4.7 m in clay below fill<br>SI02-4, paved over in 2005, was moving at 5.2 m in native clay just below fill |
| P02-3 | At fence line on top of berm; 2.15 m BGL |
| P02-4 | At west edge of pavement was dry. |

**Assessment:**

This landslide site has a history of instability going back to 1988, when an 80 m wide slide occurred on the west side of the highway on an approximate 7.5 m high embankment fill. Following a brief test pit investigation shortly after this, a ~120 m long by 9 m wide by 3 m high toe berm was constructed to remediate the slide, which included installation of two 150 mm diameter subdrains. Cracks and movements in the pavement and downslope were documented after this. In 2002, a geotechnical investigation which included instrumentation was undertaken. In 2008, a preliminary engineering report was prepared that outlined potential repair options. This site was annually inspected as part of the GRMP from 2001 up until 2013.

The site was reactivated in the GRMP after the slide crack/dip re-appeared in the roadway in the spring of 2019 after being dormant for the last several years. A call-out inspection was undertaken in June 2019, this annual Geohazard inspection in June 2020, and a second call-out in July 2020.

The 2002 geotechnical investigation briefly indicated that up to 4.5 m of fill (predominant clay fill containing organics and organic layers), was overlying a 2 m to 4 m thickness of highly plastic clay, which was overlying clay till containing extensive sand layers.

Based on previous information, the slide appears to be moving at two levels: an upper block in high plastic clay which is moving out onto the top of the toe berm and pushing out the fence; and a lower deep seated block also in high plastic clay that extends below the toe berm. The overall height and inclination of the highway embankment and toe berm fills is too great for the existing relatively weak and wet clay foundation soils. Ingress of water can also influence the rate of slide movement.

As shown on Drawing 13355-SH014-1, the old inclinometer movement vectors show the slide is moving along an azimuth of about 242 degrees, nearly perpendicular to the general creek alignment.

The dominant crack is about 33 m in length with an approximately 15 m on the west side of the crack that has dropped about 30 mm. Crack widths were typically 30 mm wide but ranged up to 100 mm wide at the callout visit. These movements are likely attributed to the upper, shallower slide block. There is some concern that the extent of the overall slide may be larger than previously thought, and affecting a greater length of paved roadway. This is evidenced by the recent 115 m long full width pavement patch, and the intermittent crack that straddles the outside wheel path of the southbound lane through and beyond the patch. It is possible that movement on the lower slide block may be contributing to this greater extent.

There was a linear feature just below the crest of the toe berm that appeared somewhat indicative of a forming scarp. However, it could also be related to equipment rutting

Two distinct scarps and several tension cracks have formed along the top of the east backslope and are with a few metres of the fence line. Although the fence appears to be leaning slightly, the power pole is still vertical. It is not clear if the east backslope movements are linked to the movements at and below the roadway or if they have merely been triggered by the same cause.

Higher-than average rainfalls in the area over the last two or three years have likely contributed to the recent landslide movements by raising the local water table(s) reducing the effective stress in the foundation soils, highway embankment, and toe berm. However, the water level measured in P02-3 was within the stable, historical range indicating that it may not be within the critical zone.

The smaller, shallow-based landslide will continue to move, the rate predominantly dependent on rainfall and groundwater levels, and could become larger with time. The overall slide extent at this site may be in the order of 150 m long along the pavement, and requires further observation and monitoring to clarify this, and whether the backslope movements are linked to the slide movements or independent.

**Recommendations:**

Short-Term:

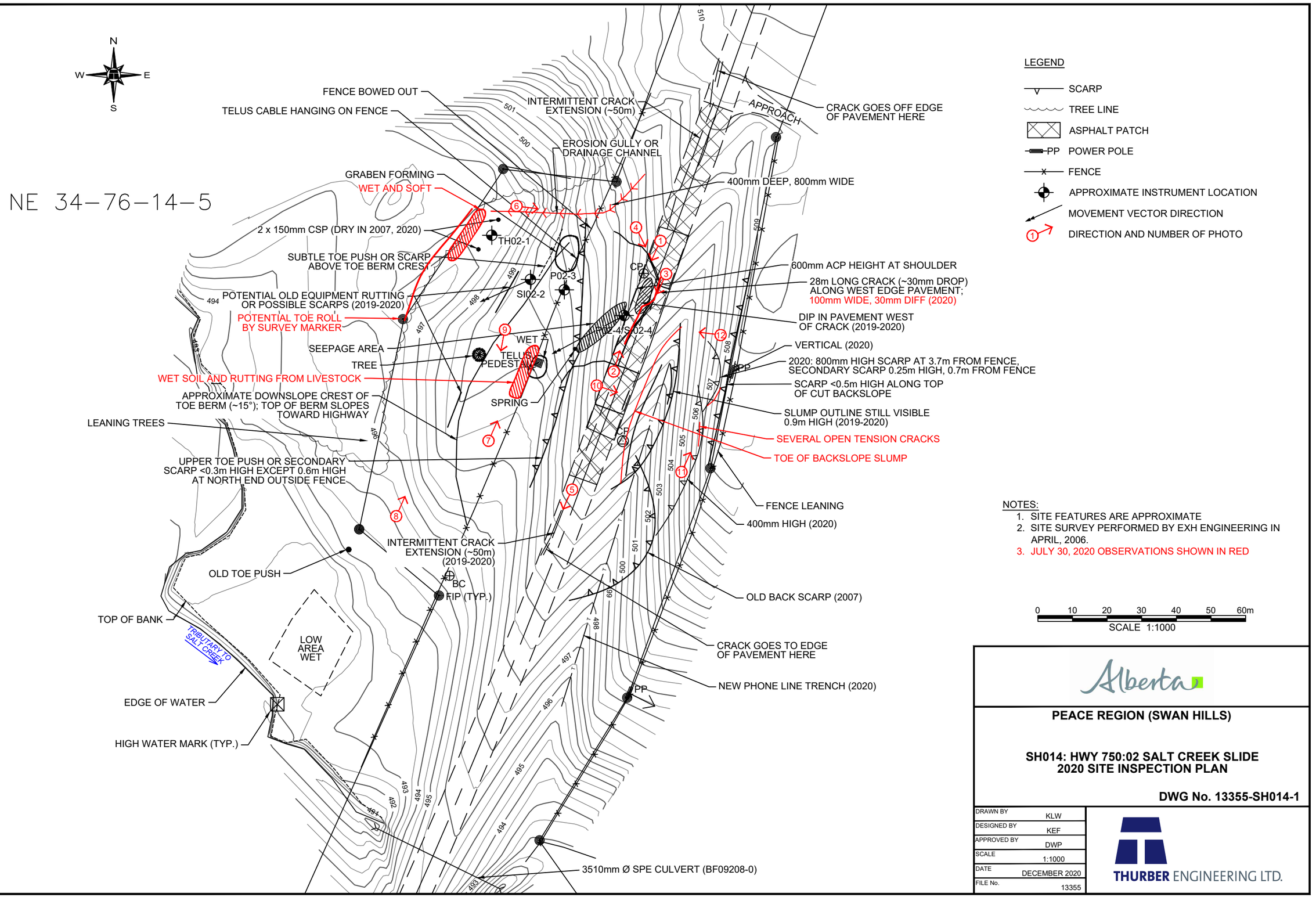
- The local MCI should regularly monitor this area for further movements or enlargement. Crack sealing and patching should be undertaken as required. If conditions worsen to the point where the slide affects traffic, barricades and/or warning/speed reduction signs may need to be erected around the distressed area in conjunction with constructing a temporary detour on the east side of the highway until repairs are undertaken.

Long-Term:

- As per 2008 preliminary engineering report, dewatering with slope flattening or increased toe berm options are less-effective options. The two other options for consideration (described in more detailed in the 2019 callout report) are installation of a cast-in-place concrete cantilever retaining wall (estimated cost of $1.6M) or a shear key with slope regrading (estimated cost of $1M) but which has significant regulatory hurdles (see Spencer Environmental assessment included in 2009 Preliminary Engineering Report) as Salt Creek is classified as fish-bearing stream in addition to potential impacts to migratory birds, wildlife, and navigable waters.

Ongoing Investigation:

- It is recommended that the annual GeoHazard inspection should continue as scheduled.
- Supplementary geotechnical investigation needed for detailed design of selected option and to determine if the east backslope movements are linked to the downslope side and to confirm if the extent of the deeper seated slide block has expanded since 2007. Slope inclinometers and piezometers should be installed in the test holes to determine the depths of movement(s) and ground water conditions. LiDAR should also be obtained, the topographic site survey updated, and detailed slope stability analyses carried out to further investigate potential remedial measures.




LEGEND

- SCARP
- TREE LINE
- ASPHALT PATCH
- PP POWER POLE
- FENCE
- APPROXIMATE INSTRUMENT LOCATION
- MOVEMENT VECTOR DIRECTION
- ① DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. SITE SURVEY PERFORMED BY EXH ENGINEERING IN APRIL, 2006.
3. JULY 30, 2020 OBSERVATIONS SHOWN IN RED

0 10 20 30 40 50 60m

SCALE 1:1000

Alberta

**PEACE REGION (SWAN HILLS)**

# SH014: HWY 750:02 SALT CREEK SLIDE 2020 SITE INSPECTION PLAN

**DWG No. 13355-SH014-1**

| | |
|---|---|
| DRAWN BY | KLW |
| DESIGNED BY | KEF |
| APPROVED BY | DWP |
| SCALE | 1:1000 |
| DATE | DECEMBER 2020 |
| FILE No. | 13355 |

THURBER ENGINEERING LTD.

THURBER

Photo 1 – Looking south at main crack and dip in highway surface. Significant thickness of asphalt visible at the edge of the pavement.

Photo 2 – Looking north at main crack and dip in highway surface.

Photo 3 – Looking south at differential across crack.

Photo 4 – Looking southeast at north end of crack pattern and several layers of ACP patches.

Photo 5 – Looking south at potential extension of slide-related cracks.

Photo 6 – Looking east at erosion gully forming on north side of toe berm (west of the highway).

Photo 7 – Looking north at where soil was wet and had rutting from livestock.

Photo 8 – Looking northeast along the top of the back-tilted toe berm  and leaning fence

Photo 9 – Looking south at where linear disturbance along toe berm which might be a scarp or previous equipment rutting/disturbance; however, was grown over in July.

Photo 10 – Looking northeast at backslope slumps just south of the power pole.

Photo 11 – Looking north at slumping backslope below power pole with open tension cracks.

Photo 12 – Looking west from the backslope at the subsiding area in the pavement.

Photo 13 – Looking south at scarp crack taken on July 29, 2020 by MCI