

**ALBERTA TRANSPORTATION  
GEOHAZARD ASSESSMENT PROGRAM  
PEACE REGION – GRANDE PRAIRIE DISTRICT  
2020 CALLOUT**



Site Number	Location	Name	Hwy	km
GP53 Call Out	NW of Grande Cache	Candle Road Slide	40:38	7.5
Legal Description		UTM Co-ordinates (NAD 83)		
NE20-61-4-W6		11U N 6,017,112	E 398,940	

	Date	PF	CF	Total
<b>Previous Inspection:</b>				
<b>Current Inspection:</b>	May 26, 2020	12	4	48
<b>Road AADT:</b>	860	<b>Year:</b>		2019
<b>Inspected By:</b>	Don Proudfoot, Nicole Wilder (Thurber) Ed Szmata, Rishi Adhikari, Dwayne Lowen (AT)			
<b>Report Attachments:</b>	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

<b>Primary Site Issue:</b>	Landslide with 1 m high backscarp in a steep sidehill embankment fill section on the east side of highway (2.8 m from guardrail).	
<b>Dimensions:</b>	The landslide is about 26 m wide (near the highway) and ~215 m long to the toe roll. The overall main width of the slide is about 90 m.	
<b>Date of any remediation:</b>	Four slope inclinometers were installed at the site in November 1994 to monitor slide movement. The highway was constructed in 1985 and, prior to it being paved in 1996, Torchinsky Engineering Ltd. completed a geotechnical assessment of how the slide could negatively affect construction and recommended various restrictions to the construction activities. They proposed further field investigation be undertaken to further investigation the slide mechanism and complete remedial design for the slide. During the 2020 investigation AT indicated that the failed slope had been rebuilt in 2004 or 2007 with pit run from the Westview Pit and gabion baskets.	
<b>Maintenance:</b>		
<b>Observations:</b>	<b>Description</b>	<b>Worse?</b>
<input type="checkbox"/> Pavement Distress		<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	The landslide occurred within the steep east sidehill embankment fill. The slump appears to be a rotational retrogressive slide with several intermediate tension cracks throughout slide mass.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	It appeared that there was some active erosion taking place by surface water and seepage flowing down slope.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Seepage was observed within intermediate tension cracks throughout the slide mass. From the 1996 assessment, it was mentioned that there was a centreline culvert that daylighted within the fill portion of the embankment which had eroded a small channel. In 2020 the culvert was not observed but may be contributing to the water within the slide mass if it was buried or leaking from slide movement.	<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>

**Instrumentation:** Four slope inclinometers were installed (SI's) installed in 1994 at the locations shown on the attached plan. AT records only showed initial and one additional set of readings on February 14, 1995 and May 5, 1995, respectively. No movement was noted at that time. It appears that these instruments are located outside of the landslide limits.

**Assessment:**

The slide is approximately 215 m long and varies from 25 to 90 m in width. The soils exposed in the slide scarp appeared to consist of gravel fill over clay till. Within the slide mass there were remnants of non-woven geotextile and pit run indicative of a previous slide repair. The toe bulge of the slide was approximately 0.5 m high, with many tilted/bent trees, which suggests prior, continuous movements.

Based on LiDAR (See Dwg. No.13353-Hwy-40:38 Callout-1) the slope affected by the landslide is about 60 m high and inclined at about 3.8H:1V.

The previous SI test holes show subsurface conditions consisting of till and clay over clay shale and sandstone bedrock (see attached borehole logs).

There was no pavement distress observed during the inspection, but there was relatively fresh sloughing now 2.8 m away from edge of pavement and seepage within the slide mass, which was marked with many secondary scarps and tears further downslope. Seepage was observed within the intermediate scarps and the soil was very wet and soft throughout the slide mass.

It is anticipated that the slide is based in clay shale and was triggered by water seepage. Poor embankment materials and a steep embankment slope may also have contributed to causing the slide. The main scarp appears to be retrogressing further back towards the highway (measured at 2.8 m from the highway) and could eventually begin to affect the highway. The depth of the slip surface and details of the previous slide repair are not fully known as it is not known whether the excavation of the failed mass was stepped or if they placed the pit run along a sloped plane. If details are available this would be valuable information to obtain.

**Recommendations:**

**Investigation:**

Drill 2 or 3 test holes within the slide mass downslope of the highway to a depth of about 30 m (this would verify the depth of the hardpan layer). The test holes should be completed with piezometers and slope inclinometers. This would provide information on the soil and groundwater conditions and potential depth of slide movement, to help assess slope stabilization design measures.

**Short Term:**

In the short term, the slide should be regularly monitored for regression of the slide scarp, which could necessitate adequate signage and traffic control marking one lane driving lane closure if the slide retrogresses into the highway.

**Medium to Long Term:**

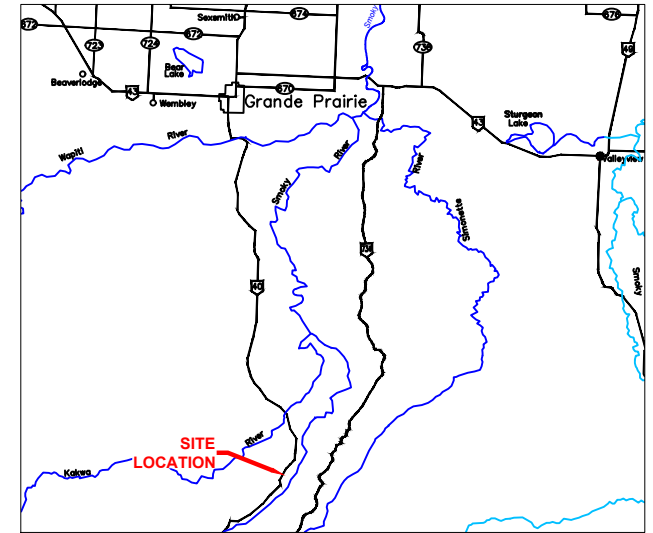
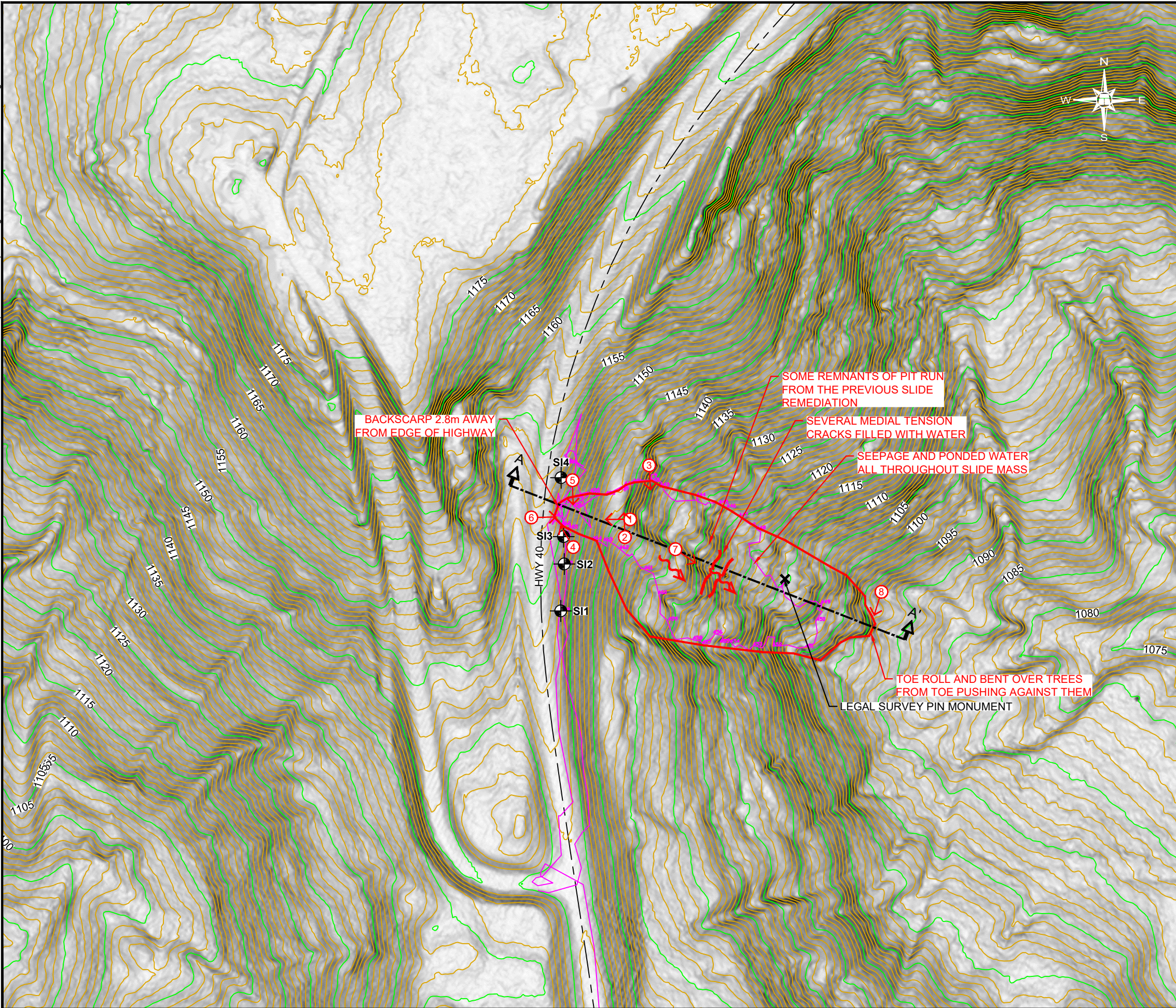
Construct a pile wall between the slide and the highway, consisting of steel H piles, or possibly concrete piles with a subdrain installed in the west ditch to help drain subsurface water before it enters the slide area. Also, a portion of the guardrail will have to be removed during construction and a temporary detour will likely have to be constructed on the west side of existing highway to allow two-way traffic.

**Ballpark Cost ~\$1.5 Million**

Depending on the results of further investigation it might also be possible to stabilize the slide through further excavation, drainage, and reconstruction of the side slope (extending down to the base of the slope) at a flatter inclination. However, this was already tried once (and didn't last) and the slope is high so would involve a significant undertaking.



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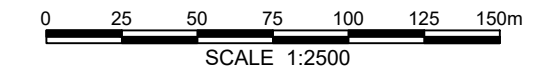
**KEY PLAN**  
SCALE: 1:200 000

**LEGEND**

- APPROXIMATE SLOPE INCLINOMETER LOCATION
- GROUND SURFACE CONTOUR (CONTOUR INTERVAL = 1m)
- DIRECTION AND NUMBER OF PHOTO

**NOTES :**

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK.
3. MAY 26, 2020 FEATURES SHOWN IN RED.



**PEACE REGION (GRANDE PRAIRIE)  
HWY 40:38 CANDLE ROAD (GP53)**

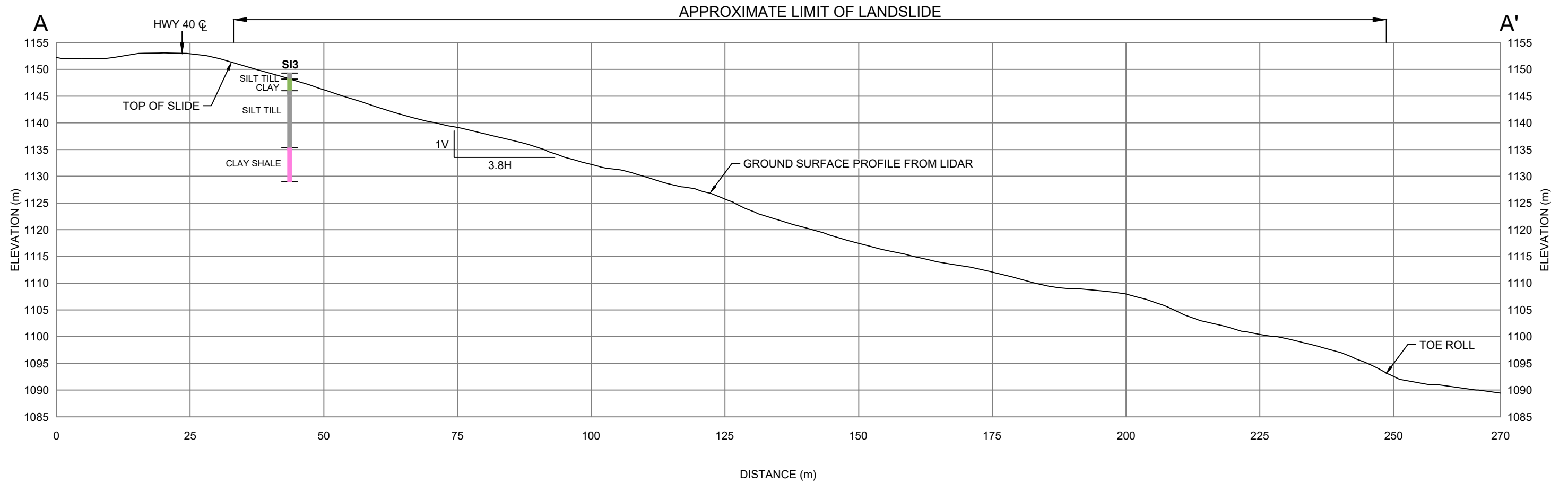
**2020 INSPECTION PLAN**

**DWG No. 13353-GP53-1**

DRAWN BY	ML
DESIGNED BY	NPW
APPROVED BY	DWP
SCALE	1:2500
DATE	DECEMBER 2020
FILE No.	13353







PEACE REGION (GRANDE PRAIRIE)  
HWY 40:38 CANDLE ROAD

CROSS - SECTION A - A'

DWG No. 13353-GP53-2

DRAWN BY	ML
DESIGNED BY	NPW
APPROVED BY	DWP
SCALE	1:750
DATE	DECEMBER 2020
FILE No.	13353





**Photo 1.**  
Looking west up at  
main back scarp.



**Photo 2.**  
Looking north  
towards the north  
flank of the  
landslide.





**Photo 3.**  
Looking south  
towards south flank  
of the landslide and  
medial tears.



**Photo 4.**  
Looking northwest  
at backscarp  
nearing the  
highway.





**Photo 5.**  
Looking south at backscarp which is now 2.8 m away from the highway edge.



**Photo 6.**  
Looking east down at slide mass and medial tears.





**Photo 7.**  
Looking southeast  
at open tension  
cracks that were  
filled with water.



**Photo 8.**  
Looking south at  
toe roll where the  
toe has pushed  
over some trees.



PROJECT ENGINEER: KL	Wet Rotary	BOREHOLE No: PHD40:38--941104
SHELBY ENGINEERING LTD.	Nodwell mounted Mayhew 1000	Project No: Hwy40:38
PROJECT ENGINEER: KL	Garritty and Baker	ELEVATION: 0.000 (m)

SAMPLE TYPE  SHELBY TUBE  CORE SAMPLE  SPT SAMPLE  GRAB SAMPLE  NO RECOVERY

DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC	M.C.	LIQUID	BLOW COUNT		UNCONF. SHEAR STR. (kPa)	0.5 x POCKETPEN. (kPa)	OTHER DATA	WATER LEVEL
									100	200				
0.0		SILT TILL; light brown to brown; trace oxides, fine sand, ironstone, clay shale, siltstone, sandstone pieces, sandstone boulders. MH												
1.0														
2.0														
3.0														
4.0		-sandstone boulder 1.83-2.90												
5.0		-sandstone boulder to 4.42m.												
6.0														
7.0														
8.0		-sandstone ledge												
9.0		CLAY TILL; brown; very silty sandy; trace pebbles, coal. CI-CH.												
10.0		SILT; brown; tr. fine sand, sandstone pieces. ML.												
11.0														
12.0		CLAY SHALE; grey; weathered; soft to hard layers.												
13.0		-sandstone ledge @ 12.19m.												
14.0														
15.0														
16.0		SANDSTONE; brown; very hard; & CLAY SHALE; grey; soft to hard.												
17.0		-layers of 50mm to 150mm.												
18.0														
19.0														
20.0														
21.0														
22.0		End hole at 21.34m. S.I. installed.												
23.0														
24.0														
25.0														
26.0														
27.0														
28.0														
29.0														



PROJECT ENGINEER: KL	Wet Rotary	BOREHOLE No: PH040:38—941103
SHELBY ENGINEERING LTD.	Nodwell mounted Mayhew 1000	Project No: Hwy40:38
PROJECT ENGINEER: KL	Garritty and Baker	ELEVATION: 0.000 (m)

SAMPLE TYPE  SHELBY TUBE  CORE SAMPLE  SPT SAMPLE  GRAB SAMPLE  NO RECOVERY

DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC      M.C.      LIQUID ────┬───┬───┬─── 20  40  60  80	▲ -- ▲ 100 200 300 400 ■ BLOW COUNT ■ 20 40 60 80				OTHER DATA	WATER LEVEL
							◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400 ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400					
0.0		SILT TILL; brown; some clay; trace oxides, clay shale, sandstone pieces MH										
1.0		CLAY; grey; silty; some clay shale, sanstone pieces CH.										
2.0												
3.0		SILT TILL; brown; some clay; trace oxides, ironstone clay shale, sanstone pieces, sandstone cobbles & boulders. MH										
4.0												
5.0												
6.0												
7.0												
8.0												
9.0												
10.0												
11.0												
12.0												
13.0												
14.0		CLAY SHALE; grey; tr. coal; soft to hard layers -dark grey; very hard										
15.0												
16.0												
17.0												
18.0												
19.0												
20.0		-dark grey; very hard										
21.0		-sandstone ledge										
22.0		End hole at 20.34m.										
23.0												
24.0												
25.0												
26.0												
27.0												
28.0												
29.0												



PROJECT ENGINEER: KL		Wet Rotary		BOREHOLE No: PH040:38--941102					
SHELBY ENGINEERING LTD.		Nodwell mounted Mayhew 1000		Project No: Hwy40:38					
PROJECT ENGINEER: KL		Garritty and Baker		ELEVATION: 0.000 (m)					
SAMPLE TYPE <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> CORE SAMPLE <input checked="" type="checkbox"/> SPT SAMPLE <input type="checkbox"/> GRAB SAMPLE <input type="checkbox"/> NO RECOVERY <input type="checkbox"/>									
DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC                      M.C.                      LIQUID  ----- ----- -----  20      40      60      80	▲    ▲ 100 200 300 400 ■ BLOW COUNT ■ 20    40    60    80 ◆ UNCONF. SHEAR STR. (kPa) ◆ 100 200 300 400 ● 0.5 x POCKETPEN. (kPa) ● 100 200 300 400	OTHER DATA	WATER LEVEL
0.0		SILT TILL; brown; some clay; trace clay shale, sandstone, siltstone pieces sandstone boulders, ironstone nodules. MH							
1.0									
2.0									
3.0									
4.0									
5.0									
6.0									
7.0		CLAY; grey; silty; some clay shale, sandstone, siltstone inclusions. CH.							
8.0		-brown; trace coal, roots.							
9.0									
10.0									
11.0									
12.0		CLAY SHALE; grey; soft to hard; layered with sandstone & siltstone every 100mm to 150mm. (mostly clay shale)							
13.0									
14.0									
15.0									
16.0									
17.0									
18.0		CLAY SHALE; grey; soft to hard layers; tr. coal							
19.0									
20.0		-sandstone ledge							
21.0									
22.0		End hole at 21.34m. S.I. installed.							
23.0									
24.0									
25.0									
26.0									
27.0									
28.0									
29.0									
ALBERTA TRANSPORTATION & UTILITIES						LOGGED BY: SJ REVIEWED BY: SJ Fig. No: 40:38-02	COMPLETION DEPTH: 21.3 m COMPLETE: 94/11/29		
						Page 1 of 1			



PROJECT ENGINEER: KL	Wet Rotary	BOREHOLE No: PH040:38--941101
SHELBY ENGINEERING LTD.	Nodwell mounted Mayhew 1000	Project No: Hwy40:38
PROJECT ENGINEER: KL	Garrity and Baker	ELEVATION: 0.000 (m)

SAMPLE TYPE  SHELBY TUBE  CORE SAMPLE  SPT SAMPLE  GRAB SAMPLE  NO RECOVERY

DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID	UNCONF. SHEAR STR. (kPa)				OTHER DATA	WATER LEVEL		
							100	200	300	400				
0.0		SILT TILL; brown; some clay; trace clay shale, silt-stone and sandstone pieces, sandstone boulders, oxides, iron-stone. MH  -grey clay till to 9.75m. -sandstone boulder to 10.67m -sandstone to 12.19m.												
1.0														
2.0														
3.0														
4.0														
5.0														
6.0														
7.0														
8.0														
9.0														
10.0														
11.0														
12.0														
13.0		CLAY SHALE; grey; soft to hard layers.  -sandstone ledge sandstone ledge -sandstone ledge												
14.0														
15.0														
16.0														
17.0														
18.0														
19.0														
20.0														
21.0														
22.0		End hole at 21.34m. S.I. installed.												
23.0														
24.0														
25.0														
26.0														
27.0														
28.0														
29.0														