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

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
GP30	East of Fox Creek	Iosegun River (0.5 km W Bridge)	43:12	16.5
Legal Description		**UTM Co-ordinates (NAD 83)**		
SW35-61-18-W5		11U N 6,018,815 E 526,395		

	Date	PF	CF	Total
Previous Inspection:	May 13, 2019	11	2	22
Current Inspection:	June 18, 2020	12	2	24
Road AADT:	7,560		**Year:**	2019
Inspected By:	Barry Meays (Thurber) Roger Skirrow, Ed Szmata (AT)			
Report Attachments:	☑ Photographs ☑ Plans ☑ Maintenance Items			

Primary Site Issue:	Leakage from a buried 960 mm dia. “Big O” pipe running down the south backslope west of the river, that drains water from a catchwater ditch along the top of the backslope down to the south highway ditch. The pipe is separated (and possibly crushed), and a slump has formed alongside the pipe (which became much larger in 2020 when the berm downslope of the catchwater ditch breached above the slump). Also east of the river, a slump on the south backslope has formed.	
Dimensions:	W River: ~60 m length x <5m wide x <1.2m deep of settlement/erosion along the Big O pipe alignment. ~70 m wide x 70 m long slump in the backslope. E River ~40 m wide backslope slump x 50 m long.	
Date of any remediation:	In 2010 W of the River, ~110 m length of Big O pipe was installed down the south backslope, with some deepening/regrading of ~300 m of the catchwater ditch at the top of the backslope to drain into the pipe inlet from both directions, and construction of a 1.2 m high berm on the downslope side of the catchwater ditch, to funnel surface runoff into the pipe. The pipe was to be anchored, have 1 m of cover, have riprap protection at the inlet, and a gabion wall splash pad at the outlet. Some slope regrading of the previous slump, and some finger drains to tap existing seepage was also performed at this time.	
Maintenance:		
Observations:	**Description**	**Worse?**
☐ Pavement Distress		☐
☑ Slope Movement	W River: A slump ~70 m wide x 70 m long x <0.2m backscarp has formed (initially caused by backslope erosion and/or piping from the upper part of the pipe, and enlarged by the catchwater ditch berm breach), and extends west of the pipe. E River: ~40 m wide x 50 m long slump has its scarp about 1/3 of the way up the cut backslope, and appears to be toeing out in the south hwy ditch.	☑
☑ Erosion	Along the base and the surface of the Big O pipe in the highway backslope W of the River. Also at the point where the catchwater ditch berm breached into the slump.	☐
☑ Seepage	From joints of the 960 mm dia. Big O pipe. A bit from the sides of the catchwater ditch. Also, some intermittent	☐

	seepage in the paved westbound lanes further west of the Big O pipe.	
☑ Bridge/Culvert Distress	One or more joints of the pipe have become detached or separated, and the pipe is deformed (or possibly crushed) at some locations, causing undermining, piping, surface settlements, and now a slump.	☐
☐ Other		☐

Instrumentation (Records provided by AT in 2019 – Last reading June, 2011):
SI-1 (Horizontal Inclinometer along the west side of the new EB lanes bridge) – Averaged 20 mm/yr settlement between 2003 and 2011); **SI-2** (Beside SI-1 in Wick Drain area) – No significant movement since 2005; **SI-3** (In Fill area west of bridge) – No records provided; **SI-4** (In Fill area east of Bridge) – Note says sheared at 9m; **SI-5** (In cut slope area east of the river adjacent to a gas pipeline) – No significant movement since 2003.

Assessment:

W River

A catchwater ditch existed all along the top of the south backslope to capture and prevent surface water from running along the backslope (was supposed to drain towards the west). At a relatively low spot in the ditch, surface water began seeping through and/or spilling overtop the backslope (the channel capacity of this ditch may have been undersized and the gradient too flat). Erosion began to form along this surface runoff path. This caused a backslope slump failure to form, about 50 m long x 30 m wide on the lower half of this 30 m high, 3H:1V backslope, that transitions between the top catchwater ditch and the south highway ditch.

In 2010, the remedial measures described above were implemented. This flow from the Big O then runs along the south highway ditch over one of the pre-existing gabion check weirs, before entering a 900 mm CSP that crosses beneath the highway eastbound lanes and into settling ponds in the median.

The following spring (of 2011), failure of the Big O pipe was assessed via equipment entering the pipe internally, and joint separation was confirmed. This resulted in flow leakage, causing soil erosion along the slope face. It was also speculated equipment travelling overtop of the pipe with insufficient cover may have also crushed the top of the pipe, further worsening the situation.

The current observations suggest that below grade separation or disconnection of the pipe is well founded, or possibly the pipe is squashed almost shut further downslope from the inlet. The inlet area to the Big O pipe is quite well defined to intercept flow and funnel it into the pipe, and surface water should be entering the pipe with unabated resistance. Subsurface water leakage appears to be causing piping erosion below grade along the pipe alignment, which in turn caused settlement depressions to reflect at surface. A slump formed in the backslope west of the pipe (originally about the same size as the one noted prior to 2010), which originated near the upper part of the pipe alignment. In 2020 this slump has enlarged considerably (~70 m wide x 70 m long) due to surface runoff/infiltration coming from a breach in the catchwater ditch berm, which meanders over the disordered slump terrain and is saturating the slump and backslope surfaces. The west slide toe debris is starting to squeeze into the ditch, but so far ditch runoff is going around the toe bulge and not affecting the highway embankment yet.

The 900 mm CSP cross-culvert outlet in the median was noted to be about half full of grass and water. This could be due to a flatter than desired gradient in order to match the median ditch elevation, and/or vegetation growth in/around the outlet.

EB Lane Bridge Abutment

As part of the new hwy EB lane twinning in ~2002, a horizontal and vertical inclinometer were installed along the west side of the new EB lanes bridge to monitor movements of the west embankment fill over wick drains. Apparently the horizontal inclinometer SI-1 can be accessed through a manhole which must be first pumped out, and provided good previous data.

E River

Also as part of the hwy EB lane twinning in ~2002, a vertical inclinometer was installed between the top of the south cut backslope and a pipeline running east-west, for early warning of potential movements in the event the slump on the lower third of the south backslope enlarges which could endanger the pipeline.

Recommendations:

Maintenance:

Although OK now, the east bound (south) highway ditch at either slide location may need periodic cleaning of toe debris that accumulates if the slide(s) continue to move.

The cross-culvert in the median should be cleaned of accumulated debris, as the outlet was about half-full of grass and water.

Short Term:

The erosion and slumps should be regularly monitored for deterioration and enlargement. Install subdrains to control the intermittent seepage that is occurring adjacent to the pavement westbound lanes. Repair the breached catchwater ditch berm by constructing an ~10m long x 2 m high berm in place to redirect catchwater ditch drainage into the Big O pipe inlet further downslope (east).

The inclinometer between the backslope slump and the pipeline east of the river should be added into the biannual instrumentation monitoring program to warn of any potential retrogressive movements related to the backslope slump.

Medium Term

Excavate out, remove and dispose of the existing 960 mm Big O pipe west of the river. Then reconstruct the eroded/settled slope area by either:

1a) Installing a new welded steel pipe buried in the backfilled erosion channel. Retain or re-construct the shallow berm with compacted soil at the front of the pipe to funnel flow from the catchwater ditch into the new pipe, and line this entry point with riprap over non-woven geotextile.
OR

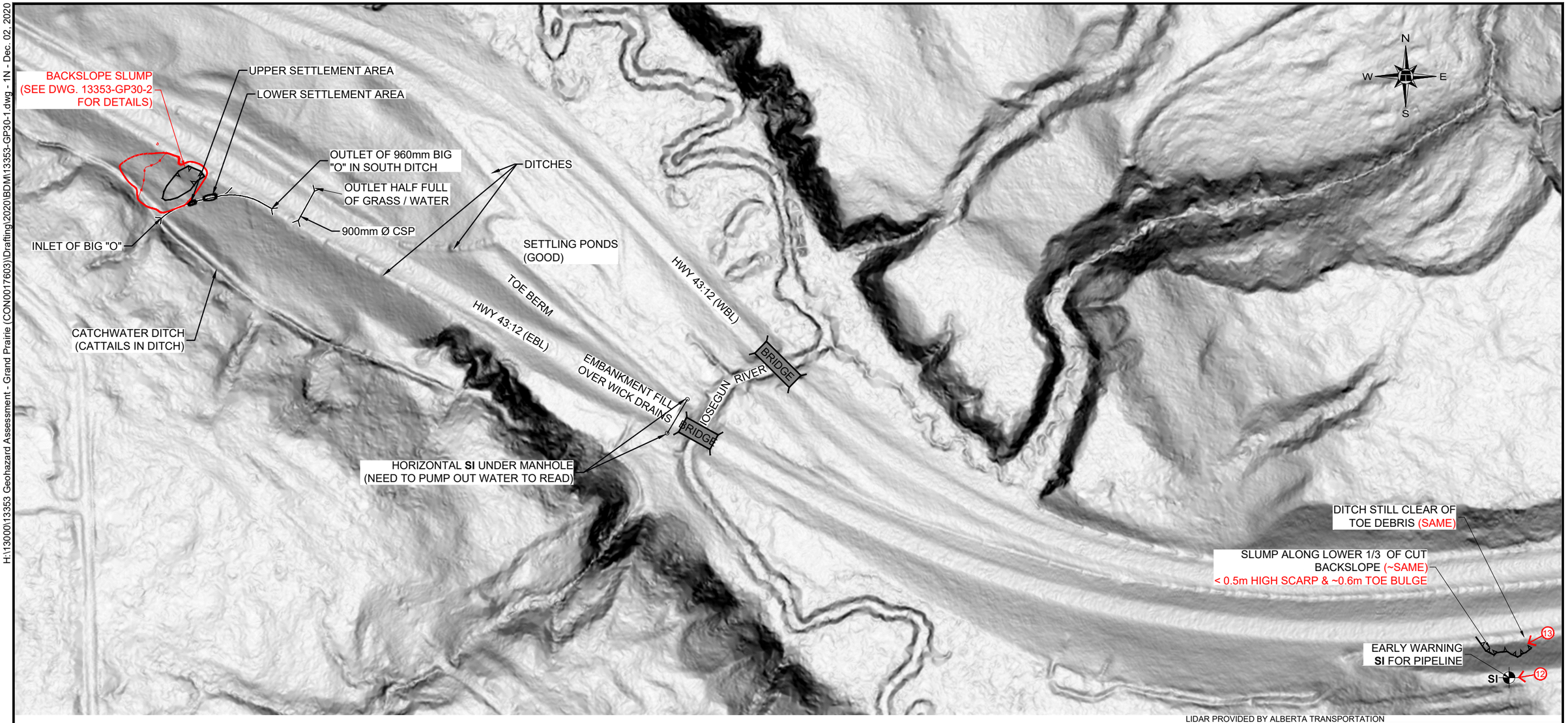
1b) Alternatively (instead of the steel pipe reconstruction): Constructing an open channel along the slope. Re-grade the surface, forming a neatly contoured, flat-bottomed (min. 2 m wide) well defined channel with 3H:1V sideslopes by compacting the excavated clay in thin lifts using a sheepsfoot compactor. The open channel would need to be lined with either gabion mattress, or riprap, overtop of non-woven geotextile. This construction alternate is considered to have less chance of re-activation or re-occurrence.

AND 2) The west slump will need to be repaired for either option above, by excavating out the material to below the slide plane, installing a subdrain(s) along the base that outlets into the ditch, and re-compacting the salvaged clay material in place (assume 3m deep average).

Ballpark Cost = $300,000 to $500,000

The backslope slump east of the river will also need to be repaired. Due to the higher consequence of failure resulting from a pipeline behind the backslope, it is recommended that the slide be excavated and backfilled in stages with granular fill, topped with topsoil, soil covering and seed. The SI should be read to guide construction and ensure that excessive ground movements are not occurring near the pipeline.

Ballpark Costs = $300,000



LIDAR PROVIDED BY ALBERTA TRANSPORTATION

LEGEND

- APPROXIMATE SLOPE INCLINOMETER (SI) LOCATION
- 8 DIRECTION AND NUMBER OF PHOTO

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. JUNE18, 2020 FEATURES SHOWN IN RED

0 50 100 150 200 250m

SCALE 1:4000

Alberta

PEACE REGION (GRANDE PRAIRIE) 2019
GP30-1: HWY 43:12, IOSEGUN

2020 INSPECTION PLAN

DWG No. 13353-GP30-1

DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:4000
DATE	JUNE 18, 2020
FILE No.	13353

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H:\13000\13353 Geohazard Assessment - Grand Prairie (CON0017603)\Drafting\2020\BDM\13353-GP30-2.dwg - 2 - Dec. 02, 2020

PUDDLE OF WATER ON ROCKS
(POSSIBLE SUBDRAIN OUTLET)

POSSIBLE NORTH EDGE OF SLIDE
(NOT VISIBLE IN 2020)

2020 SLIDE OUTLINE

SLIDE TOE STARTING TO
SQUEEZE INTO DITCH

HWY 43

MAIN SURFACE DRAINAGE
PATH FROM DITCH BREACH

0.6m HIGH SCARP

POWER POLE ANCHOR
ON JUT OF SOIL

POWER POLE

TOP OF SLIDE SCARP MERGE WITH
CATCHWATER DITCH BREACH

2m HIGH SCARP

SOME SETTLEMENT & EROSION

LOWER SETTLEMENT &
EROSION OVER PIPE
ALIGNMENT <1.2m DEEP x
8.0m WIDE x 20m LONG
(SAME IN 2020)

UPPER SETTLEMENT AREA
<0.5m DEEP x 2m WIDE WITH
2 SINK HOLES OVER PIPE
(SAME IN 2020)

OUTLET OF 960mm DIA
BIG "O" IN SOUTH DITCH

BIG "O" 960mm DIA PIPE INLET AT CATCH WATER DITCH
(PIPE DEFORMED TO OVAL SHAPE UNDER ENTRANCE BERM)
(SAME IN 2020)

N
W E
S

AIR PHOTO FROM ESRI WORLD IMAGERY EXPORTED ON DECEMBER 1, 2020

LEGEND

SLIDE OUTLINE

DIRECTION AND NUMBER OF PHOTO

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. JUNE18, 2020 FEATURES SHOWN IN RED

0 5 10 15 20 25 30m
SCALE 1:500

Alberta

PEACE REGION (GRANDE PRAIRIE) 2019
GP30-1: HWY 43:12, IOSEGUN

2020 INSPECTION PLAN

DWG No. 13353-GP30-2

DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:500
DATE	JUNE 18, 2020
FILE No.	13353

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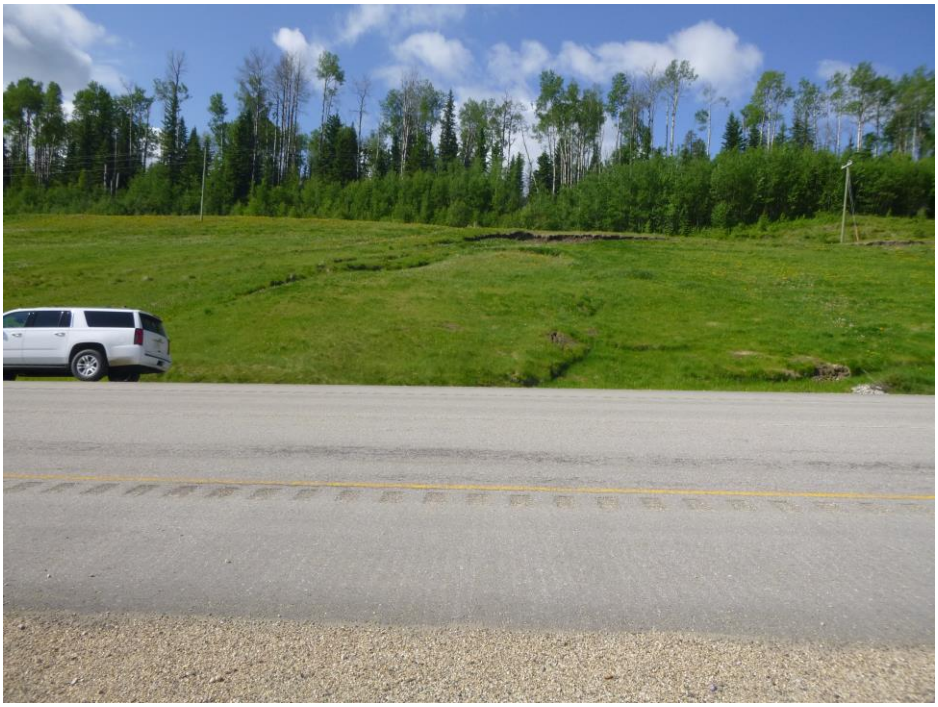

Photo 1 – Looking south (upslope) at the east side of the embankment slide that has fresh movement adjacent to the buried 960 mm diameter “Big O” pipe alignment just east of the slide.

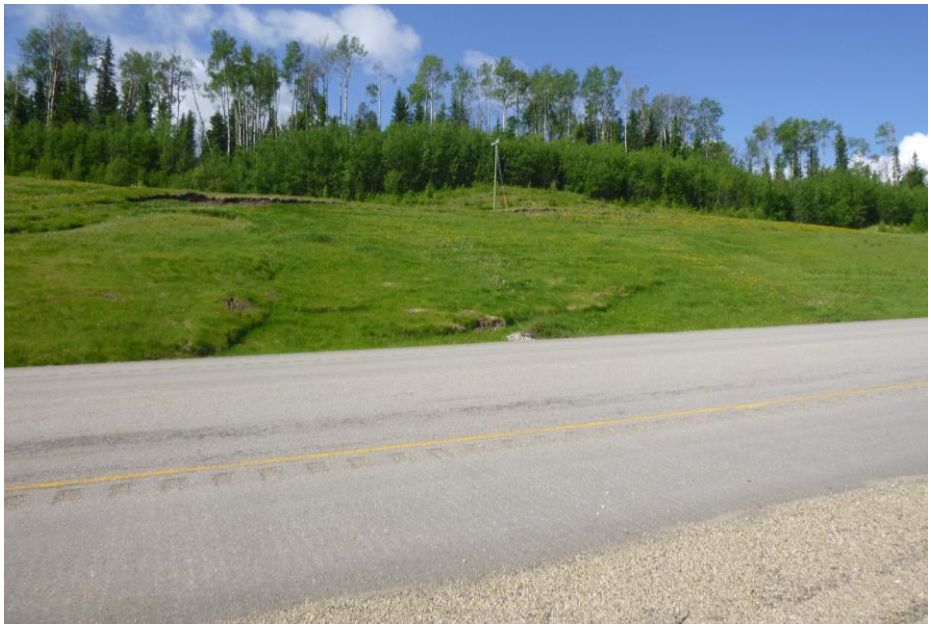

Photo 2 – Looking southeast (upslope) from the highway at the enlarged west side of the embankment slide.

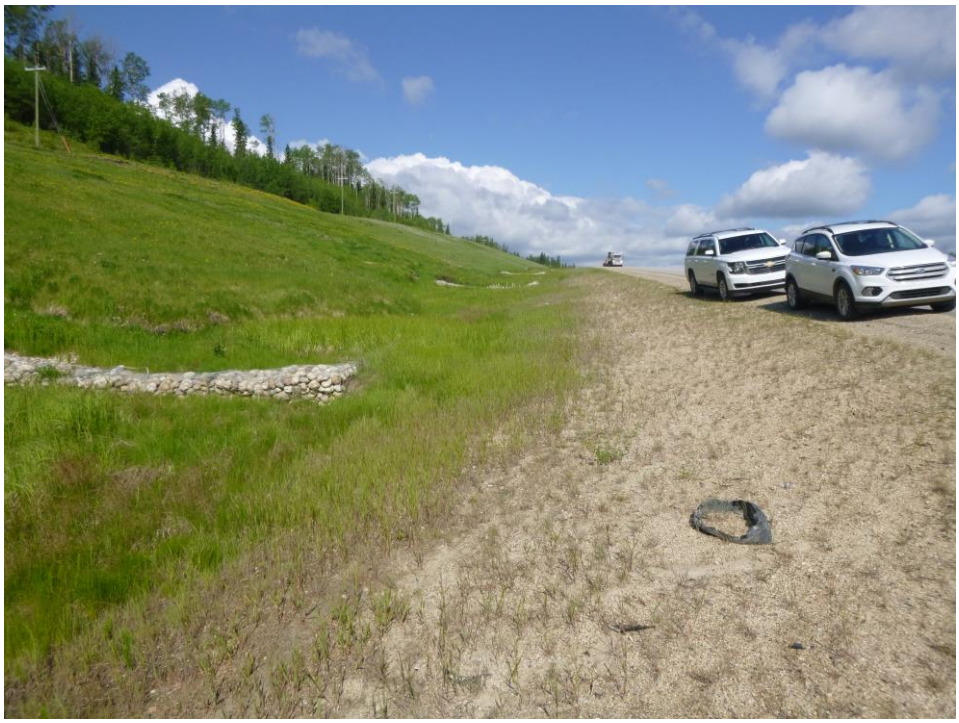

Photo 3 – Looking west at the fresh slide toe encroaching into the south hwy ditch.

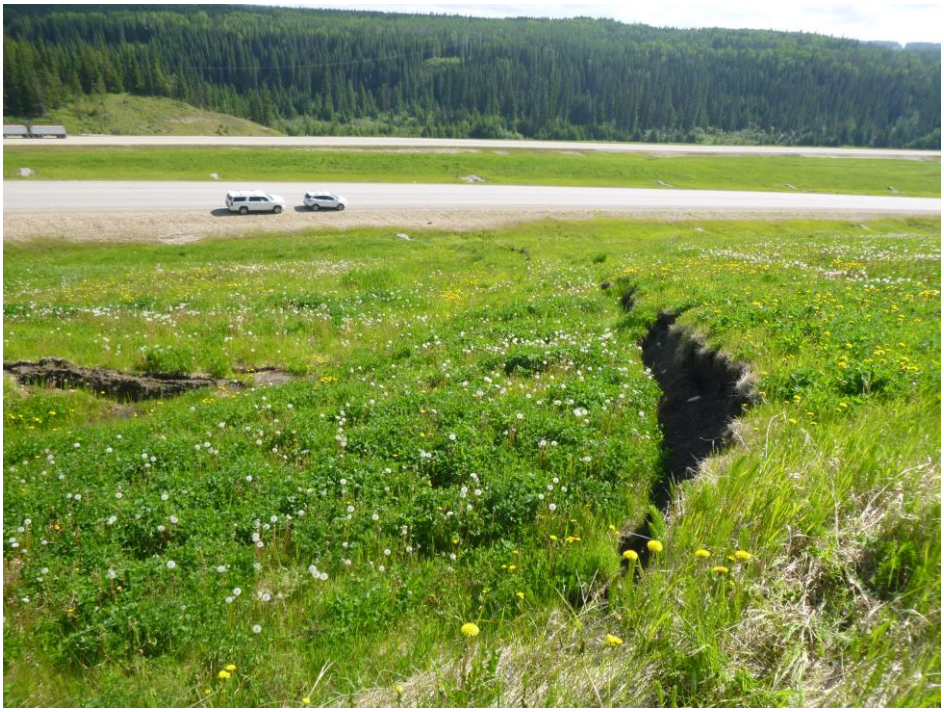

Photo 4 – Looking north downslope along the east edge of the fresh slide.

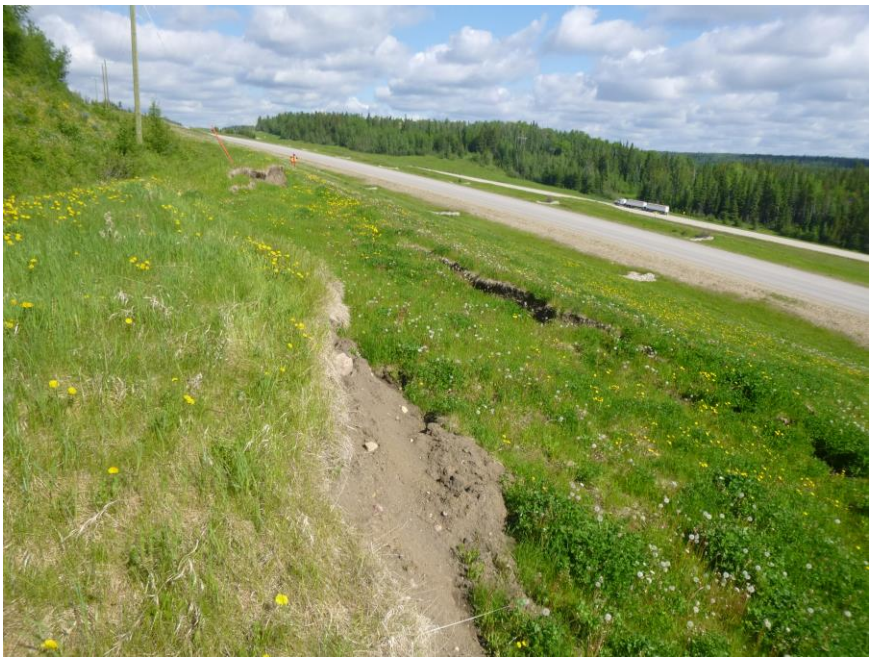

Photo 5 – Looking west along the top of the fresh slide scarp just below the catch water ditch. Note the power pole anchor in the background still intact in a mound of soil but which could soon lose support.

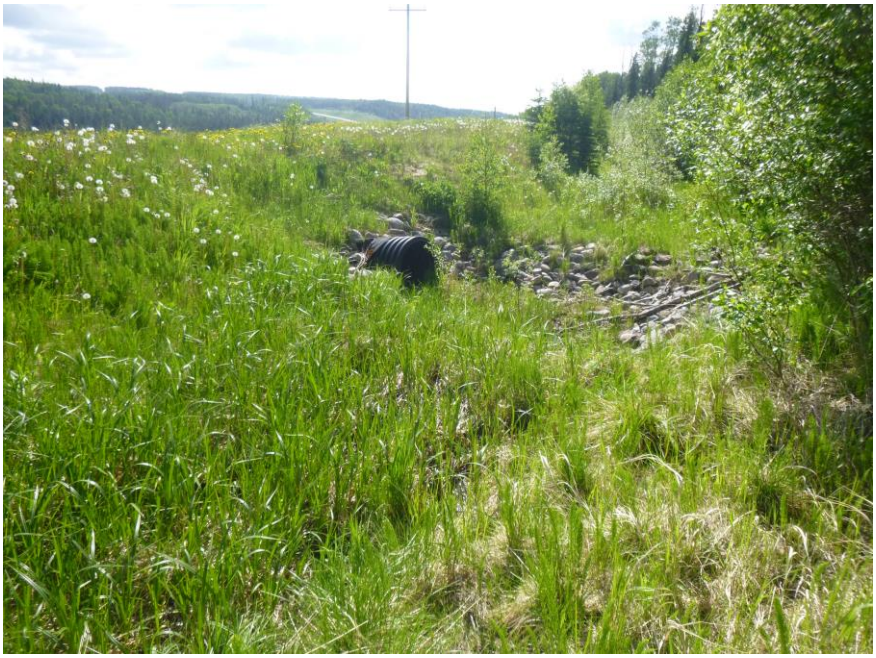

Photo 6 – Looking east along the catch water ditch towards the inlet of the Big O pipe (the inside is squashed on top).

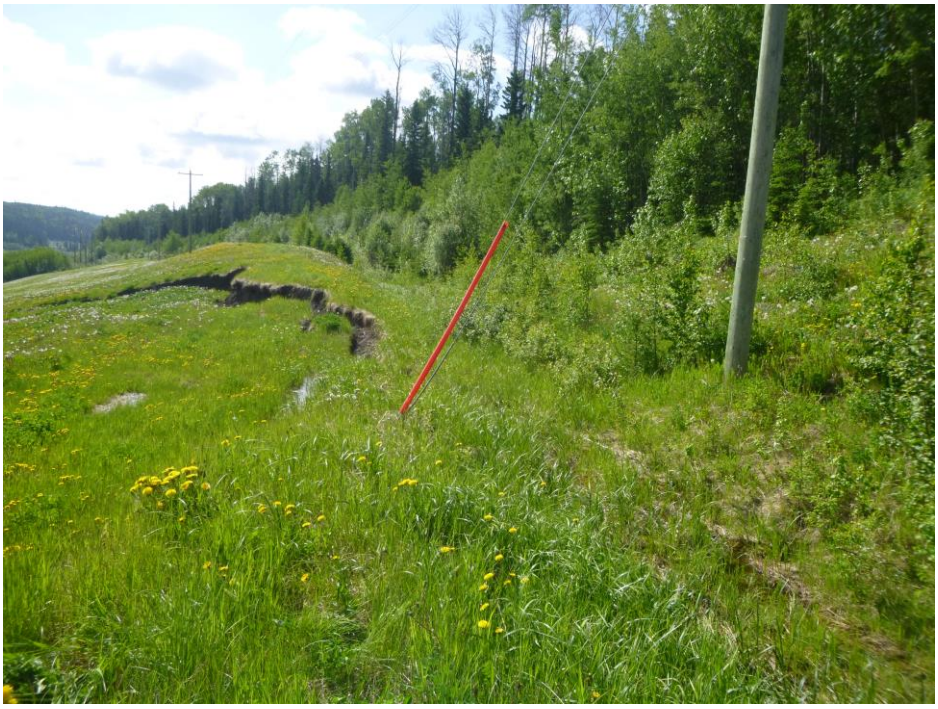

Photo 7 – Looking east along the new slide scarp at the power pole, anchor, and the point where the catchwater ditch breached a short distance east of the power pole anchor.

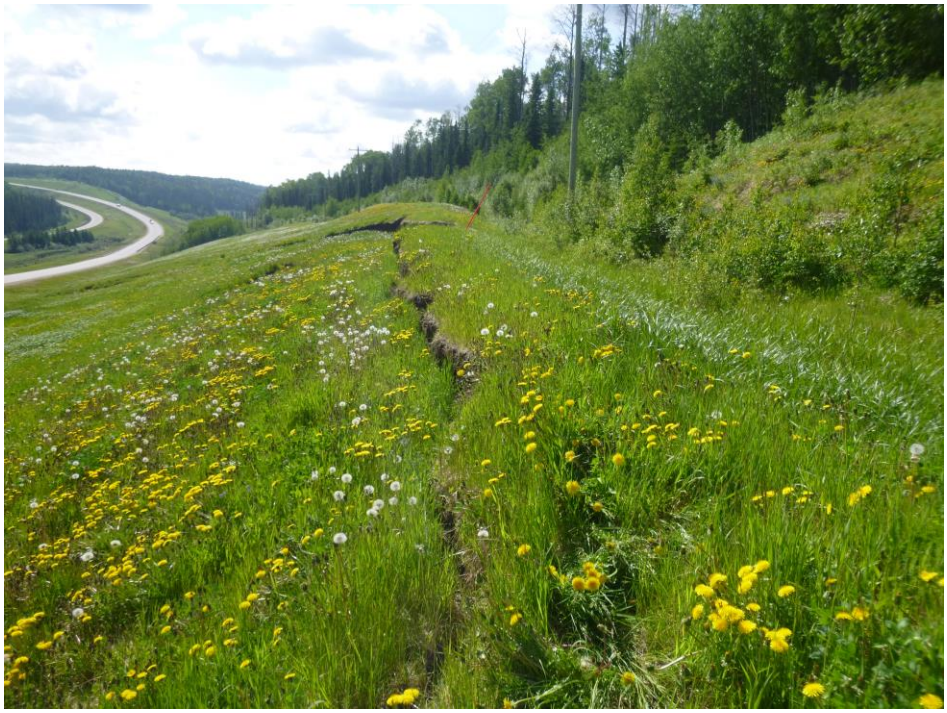

Photo 8 – Looking east along the catchwater ditch and the top of the new slide scarp from the west end.

Photo 9 – Looking at a puddle of water on some riprap west of the new slide toe. This may be a possible subdrain outlet.

Photo 10 – Looking northeast downslope from ~mid-slope along the settled area and erosion overtop the culvert alignment. Note the settling ponds in the median in the photo background.

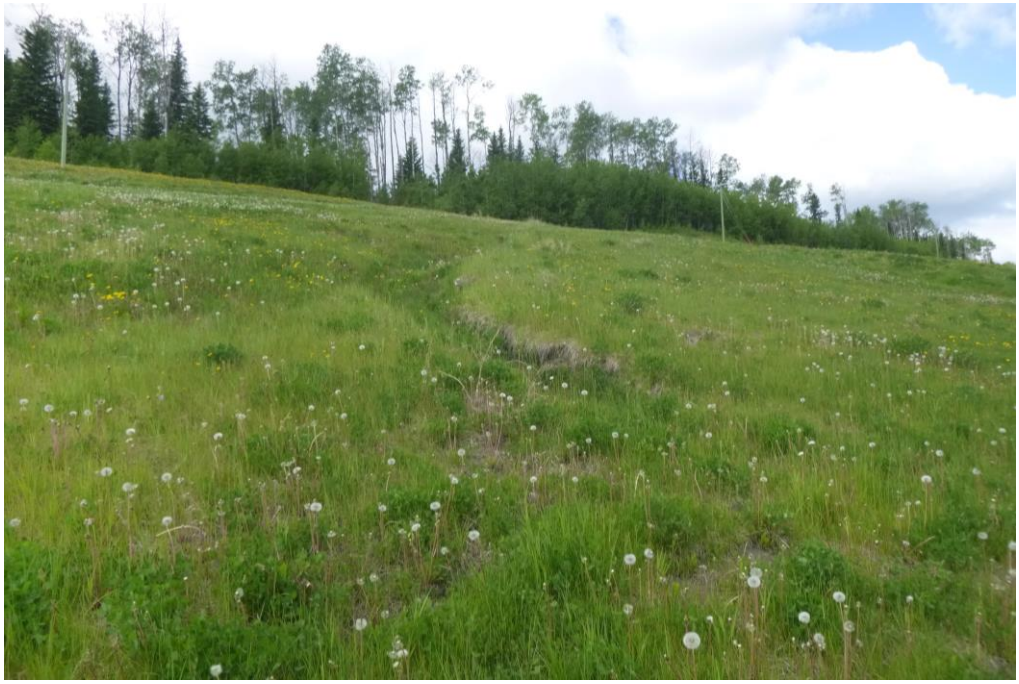

Photo 11 – Looking southwest (upslope) at the sunken depression and erosion overtop the culvert alignment.

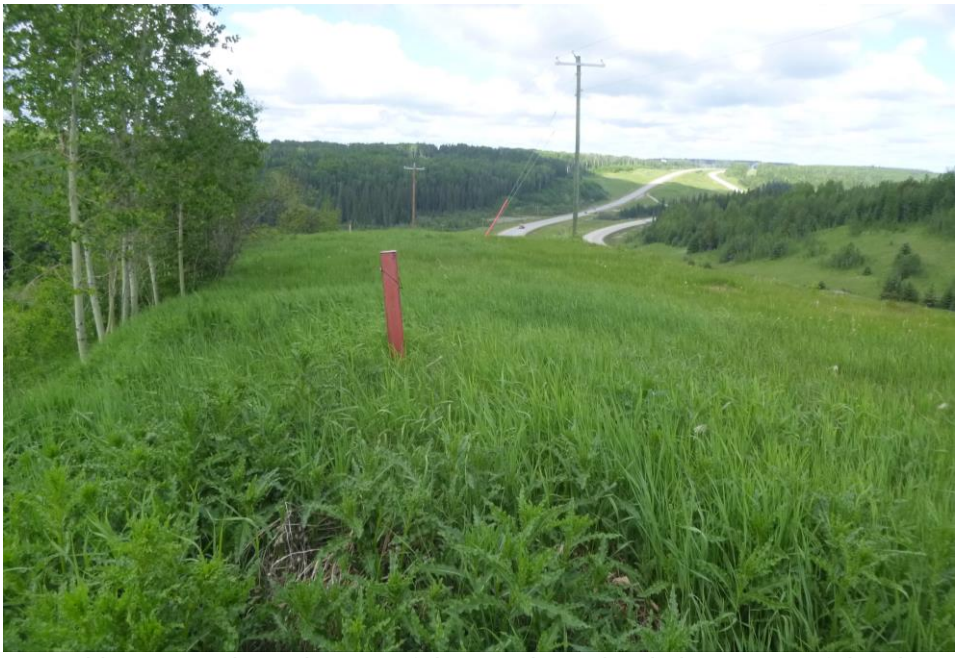

Photo 12 – Looking west along the top of the south cut backslope east of the river. Note the inclinometer casing, which was put in as an early warning indicator of potential movement adjacent to a pipeline if the slump below enlarges.

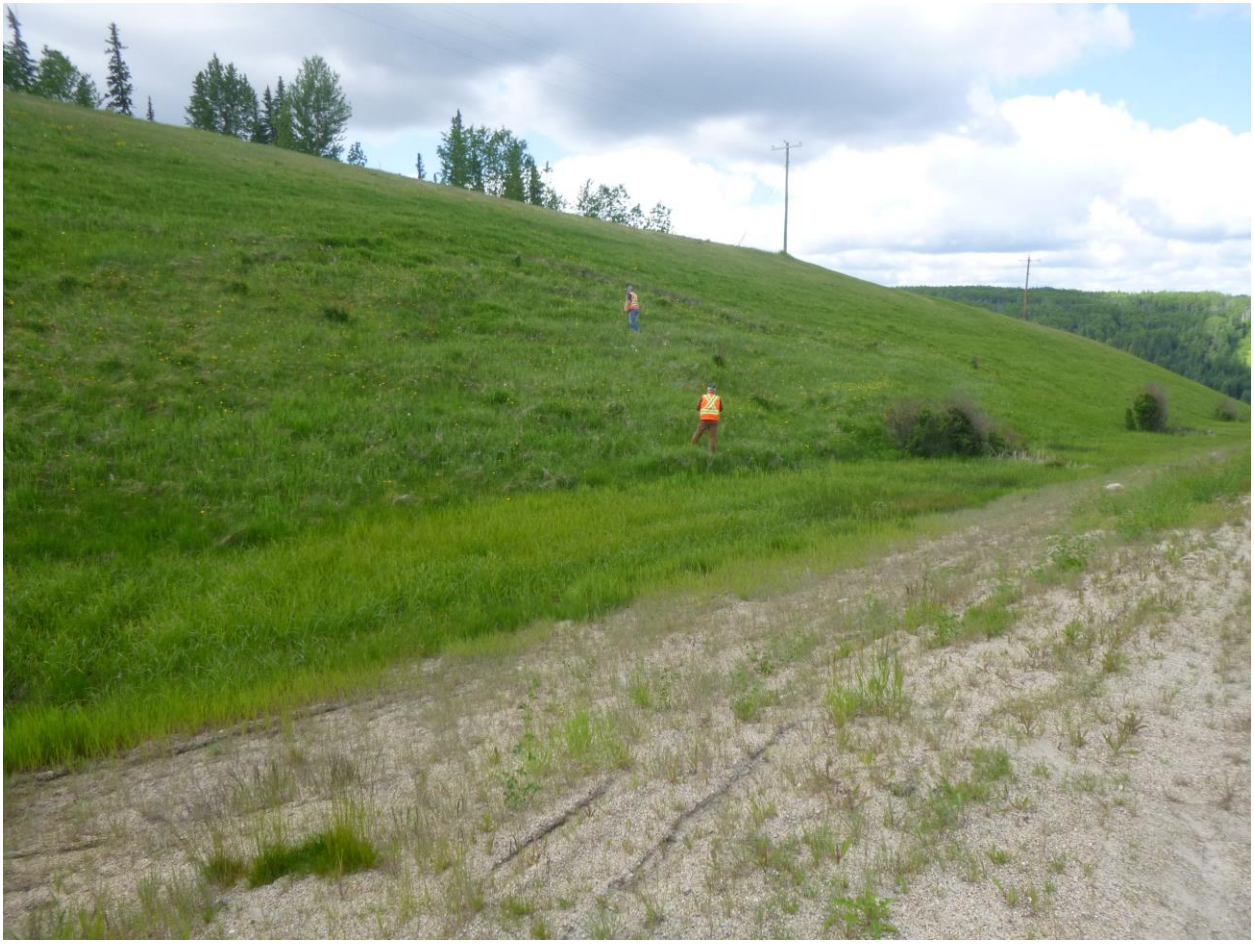

Photo 13 – Looking southwest towards the south cut backslope slide east of the river from the eastbound lanes.