

SITE NUMBER AND NAME: <b>S004 Willow Creek</b>		HIGHWAY & KM: 2:08, 6.284	PREVIOUS INSPECTION DATE: July 7, 2020	INSPECTION DATE: <b>July 8, 2021</b>
LEGAL DESCRIPTION: 13/14-20-009-26 W4M	NAD 83 COORDINATES: UTM Northing Easting 12 5514351 320169		RISK ASSESMENT: PF: 9 CF: 4 TOTAL: 36	
Average Annual Daily Traffic (AADT): 5460 (north), 6100 (south) (Ref. No. 92080)			CONTRACTOR MAINTENANCE AREA (CMA): 26	

SUMMARY OF SITE INSTRUMENTATION:  3 slope inclinometers, 5 standpipes, and 6 vibrating wire piezometers are located at the crest of the slide. Instruments located in the slide mass are assumed to be non-functional  LAST READING DATE: June 15, 2021		INSPECTED BY: Chris Morgan (KCB) Margot Lederman Roger Skirrow (AT) Alex Frotten (AT)
PRIMARY SITE ISSUE: Landslide at outside bend of Willow Creek (slope crest retrogressing), possibly due to seepage from irrigation on farmland on the opposite side of Hwy 2. Landsliding has retrogressed into eastbound lane ditch, causing ditch flows to discharge onto the slide surface.		
APPROXIMATE DIMENSIONS: Approximately 400 m long and 20 m high and the head scarp is located 11 m from the highway shoulder. Landslide slope approximately 4H:1V to 5H:1V.		
DATE OF ANY REMEDIAL ACTION: Repair in 2008 consisted of slope stabilization measures together with longitudinal peaked stone creek bank armoring to reduce toe erosion. The 2008 slope stabilization efforts consisted of soil nailing, regrading and bioengineering (live staking). Guard rail was installed in 2014.		

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress		X	Pavement not affected yet.		X
Slope Movement	X		Slope crest has been retrogressing into the ditch since 2016. Crest has retrogressed over 10 m in the last 9 years.		X
Erosion	X		Erosion observed on slopes from ditch discharge onto slide area, riprap armoring placed in 2008 is intact.		X
Seepage	X		Wet areas noted within slide area.		X
Culvert Distress		X			X

<b>COMMENTS</b>
There has been minimal change in slope retrogression observed between 2019 and 2021. The head scarp is approximately 11 m from the highway at the closest point.
There are four wooden stakes (3 reinstalled, 1 existing) present at the crest of slide that are used to estimate slide retrogression. It is estimated that there has been between 2.3 m and 3.5 m of retrogression into the ditch since 2016. Survey stakes are vulnerable to being knocked over or disturbed.
The head scarp has retrogressed 3 m to 5 m past the fence line. No significant changes were noted in the slide mass in 2021, and the site was well vegetated at the time of the visit. A buried black utility cable is exposed in the slide area.

The nature of landsliding (back tilting blocks) suggests a combination of rotational failure and failure along a weak layer at depth. The right flank of the slide (southeastern section) appears to be retrogressing faster. Slide mass below retrogressing head scarp is covered in grass with some bare patches of soil.

There is a wet area at the crest of the slope where the ditch is discharging onto the slide mass. Possible salt staining downslope of the backscarp. Standing water was present on the lower third of the slope (waypoint 20).

Longitudinal peaked stone creek bank armoring is in good condition, but continued slope movement has deflected armoring eastward across creek, straightening a former curved zone of creek bank. The riprap is exposed due to low water levels and needs maintenance to the vanes.

Recommendations:

Short-Term

- Continue to read instruments in spring and fall.
- Install two or more dataloggers in the existing standpipes to monitor groundwater levels throughout the year.
- Place additional survey stakes to monitor crest retrogression. Existing stakes are vulnerable to disturbance and survey data is limited by accuracy of hand-held GPS units.
- Complete desktop study for the site, including review of borehole logs, geological maps, and purchasing historic air photos. LiDAR data should be obtained for use in change detection monitoring (either airborne or terrestrial LiDAR, or photogrammetry).

Long-Term

- Carry out a ground investigation and hydrogeological evaluation for the site.
- Prepare preliminary design options for slide management.

Candidate repair options for this site include diverting surface water flow away from the slide zone so ditch discharge does not saturate the slide area; or installing horizontal drains connected to a seepage collection curtain. The seepage collection curtain could be constructed with either a Dewind trencher (with gravel backfill) or using a secant wall of gravel backfilled piles to lower the groundwater table. The seepage collection curtain would need to be assessed for potential impact to the farmland and reservoir on the west side of the highway.

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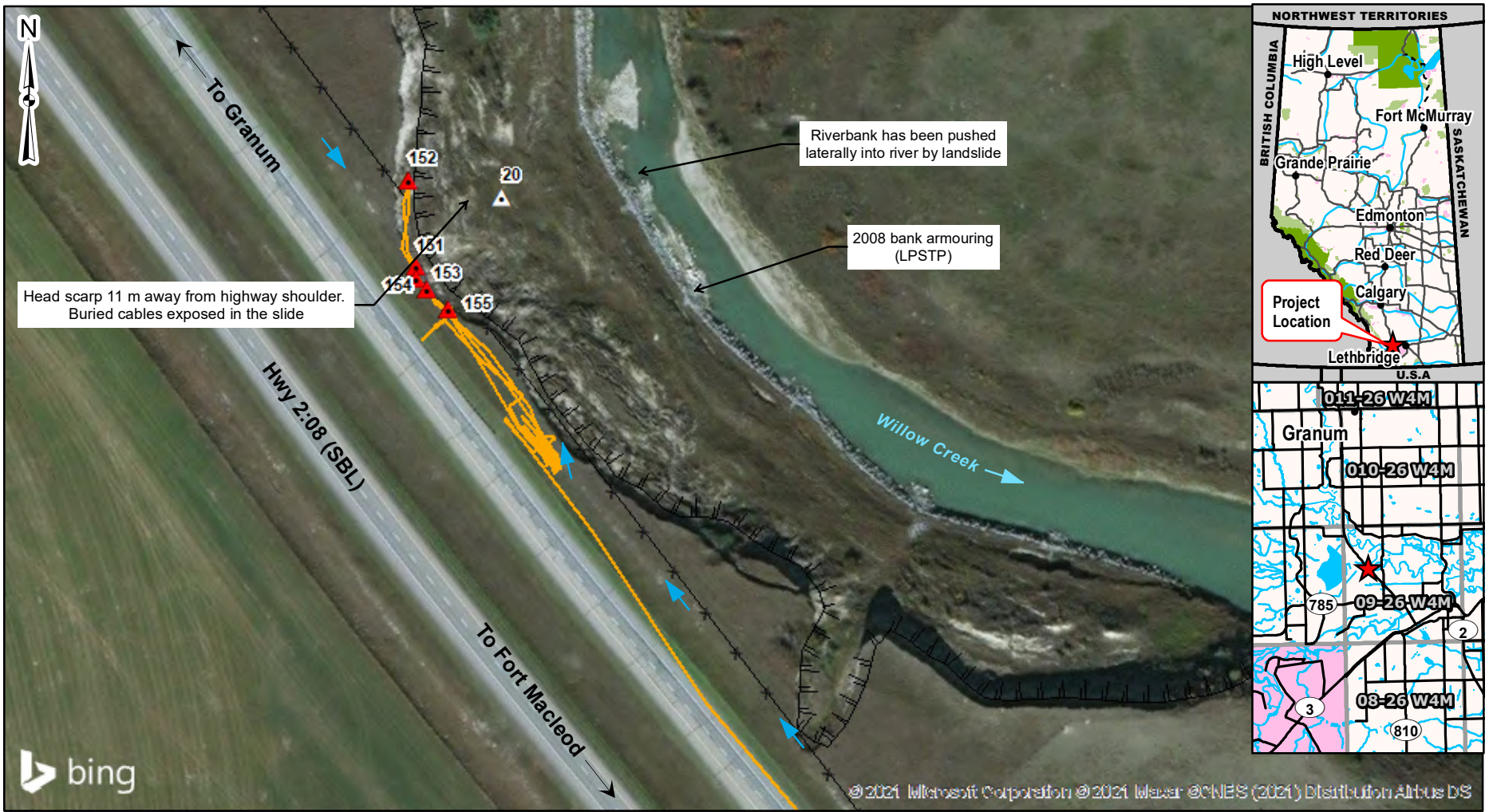
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- (iii) KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.



2021-11-24

Chris Morgan, M.Sc., P.Eng.  
Senior Geotechnical Engineer

Time: 15:58:36 PM  
 Date: October 14, 2021  
 File: Z:\ACG\Y\Alberta\A05116A03\ABT Southern Region GRMP\400 Drawings\2021\Section B figures\MXD\SD04\_211014.mxd Date: October 14, 2021 Time: 15:58:36 PM Creator: ahharrison



**Legend**

- ▲ GPS Waypoints (July 8, 2021)
- ▲ GPS Waypoint (July 7, 2020)
- GPS Track (July 8, 2021)
- Scarp
- ✕ Fence
- ➔ Surface Flow Direction
- NBL Northbound Lane
- SBL Southbound Lane

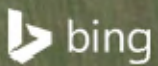
NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM Zone 12N  
 3. IMAGE SOURCE: Microsoft Bing Maps Source  
 date October 14, 2021. (MD of Willow Creek No. 26)

CLIENT

Alberta Government

Klohn Crippen Berger

PROJECT		
SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
TITLE		
Site Plan S004 - Willow Creek Hwy 2:08, km 6.284		
SCALE 1:2,000	PROJECT No. A05116A03	FIG No. 1



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**Photo 1** Slide area. Photo taken facing north on July 8, 2021.



**Photo 2** Back tilting blocks in the slide mass. Photo taken facing north on July 8, 2021.



**Photo 3** Ongoing slide movement retrogressing towards the highway. Photo taken facing southeast on July 8, 2021.

