

October 7, 2020

Alberta Transportation  
4th Floor, Provincial Building  
4920 51 Street  
Red Deer, Alberta  
T4N 6K8

**Tony Penney, P.Eng.**  
**Construction Engineer**

Dear Mr. Penney:

**CON0017608 Central Region GRMP Instrumentation Monitoring  
Site C025; H569:02. km 18.469 Western Monarch Slide  
Section C – 2019 Fall Readings**

## **1 GENERAL**

One vibrating wire piezometer (VW42616) was read at the C025 site in the central region on September 18, 2019 by Mr. Tim Hillman, E.I.T. of Klohn Crippen Berger Ltd. (KCB). This instrument was read as part of the central region geohazard-risk-management program (GRMP). The site is located on Hwy 569:02, km 18.469, approximately 2 km southwest of Western Monarch, Alberta and 20 km southeast of Drumheller, Alberta. At the site location, Hwy 569:02 traverses the slope of a creek valley that drains to the Red Deer River. The site coordinates are 5686096 N, 395423 E (UTM Zone 12, NAD 83). A site plan is presented in Figure 1.

The geohazard at the C025 site consists of a natural slope failure in bedrock along the south side (eastbound lane) of Hwy 569:02. The backscarp is within 2 m of the guardrail. In 2006, the slope was excavated below the failure surface and reconstructed with geosynthetic reinforced granular fill. An erosion feature was also backfilled, and a culvert located at the crest of the erosion feature was removed and relocated approximately 40 m to the west.

In March 2017, KCB conducted a geotechnical site investigation at the C025 site. Drilling was completed by Mobile Augers and Research Ltd. The encountered stratigraphy was as follows: fill (granular, overlying similar material to the underlying silty clay), overlying medium to high plastic silty clay, overlying bedrock (siltstone, mudstone, and sandstone). The encountered stratigraphy was consistent with the stratigraphy encountered during a 2004 drilling investigation.

The C025 site is underlain by historic coal-mine workings. Conversations between KCB and staff at the nearby Atlas Coal Mine Historical Site (Atlas site) indicated that coal-mine fires between the Atlas site and the C025 site are a regular occurrence.

## 1.1 Instrumentation

Instrumentation installation details are tabulated in Table 1.1. Instrument locations are shown in Figure 1.

Slope inclinometer (SI) SI04-02 was lost in June 2011 due to re-grading and fill placement. Standpipe piezometer (SP) SP04-02 has been dry since installation.

In March 2017, KCB installed one SI (SI17-C25-01) and two vibrating wire piezometers (VWPs) (VW42616 and VW42617) to monitor future slide retrogression under Hwy 569:02 and groundwater conditions, respectively. The instruments were installed in a borehole that is recessed below ground surface (i.e., buried in the gravel highway) in the eastbound lane of Hwy 569:02 and capped with a flush-mounted head box (Photo 1). The approximate location of the head box is marked by a white line on the back of the guardrail. During drilling, refusal was encountered at a depth of 6.9 m below ground surface in bedrock (sandstone). The borehole partially collapsed during installation of the SI resulting in the bottom of the casing being installed 0.2 m below the mudstone-sandstone interface (5.8 m below ground surface) and not at the bottom of the borehole (6.9 m below ground surface).

By May 2019, SI17-C25-01 was sheared at an approximate depth of 0.6 m below ground surface (El. 770.4 m) (a shovel handle was used to confirm the depth of shearing in May 2019) and VW42617 was inoperable (no reading was obtained in May 2019 even after the read out cables were cut back twice).

VW42616 has been dry since installation.

The operational VWP was read using an RST VW2106 Vibrating Wire Readout.

**Table 1.1 Instrumentation Installation Details**

Instrument ID	Instrument Type	Date Installed	Coordinates <sup>1</sup> (m)		Ground Surface Elevation (m)	Stick-up (m)	Depth Below Ground Surface (m)	Condition
			Northing	Easting				
SI04-02	SI	Oct. 21, 2004	5686037	395420	771	Recessed	10.7	Inoperable
SI17-C25-01	SI	Mar. 7, 2017	5686098	395419	771	Recessed	5.8	Inoperable
SP04-02	SP	Oct. 21, 2004	5686035	395423	Unknown	1.1	7.3	Operational, but dry
VW42616	VWP	Mar. 7, 2017	5686098	395419	771	N/A	2.1	Operational, but dry
VW42617	VWP	Mar. 7, 2017	5686098	395419	771	N/A	4.4	Inoperable

**Notes:**

<sup>1</sup> Coordinates for the instruments installed before 2017 have not been surveyed and were approximated based on record drawings and location plan.

<sup>2</sup> Coordinates for the instruments installed in 2017 were obtained with a handheld GPS during installation.

## 2 INTERPRETATION

### 2.1 General

No data plots are provided because the SIs are inoperable and the piezometers have been dry since installation (with one now being inoperable). A summary of the SI data is provided in Table 2.1.

## 2.2 Zones of Movement

Since SI17-C25-01 is no longer operable, a discussion on zones of movement was not included in this report as there is no new data to present. Discussions regarding zones of movement can be found in previous year's reports issued to AT.

## 2.3 Interpretation of Monitoring Results

Previous assessments of the slope failure suggest that movement is likely in response to the surcharge load applied by the fill at the crest of the slope, insufficient drainage (e.g., the nearby culvert is too short and surface water flows onto the slide area ), and creek erosion at the toe of the slope.

The piezometer data indicates that the slope above the bedrock is dry. Based on previous observations; e.g., SP04-02 being dry after a period of heavy rainfall in 2016, it is possible that the embankment and foundation are well-drained and slope movements are due to surface runoff infiltration. A level logger could be installed to record if a transient water table develops above the bedrock between the spring and fall readings.

The shallow movement indicated by the casing of SI17-C25-01 being sheared at an approximate depth of 0.6 m below ground surface indicates that slide retrogression beneath the highway is occurring. Further movement will result in partially or complete loss of the eastbound lane.

**Table 2.1 Slope Inclinometer Reading Summary**

Instrument ID	Date Initialized (Date Re-Initialized)	Date of Previous Reading	Date of Previous Maximum Cumulative Movement Recorded	Date of Most Recent Reading	Ground Surface Elevation (m)	Depth of Movement (mbgs <sup>1</sup> )	Maximum Cumulative Movement Recorded Before Being Re-initialized (mm)	Maximum Cumulative Movement Recorded After Being Re-initialized (mm)	Total Maximum Cumulative Movement Recorded (mm)	Incremental Movement Recorded Since Previous Maximum Cumulative Movement Recorded (mm) <sup>2</sup>	Rate of Movement (mm/year)		
											Previous Maximum	Current	Change from Previous Reading
SI04-02	Nov. 4, 2004	May 13, 2010	May 13, 2010	N/A – inoperable <sup>3</sup>	771	5.8	N/A – not re-initialized		11.9	N/A – inoperable <sup>3</sup>	9.3	N/A – inoperable <sup>3</sup>	
SI17-C25-01	Mar. 30, 2017 (Jul. 18, 2017) <sup>2</sup>	Sep. 6, 2018	Sep. 8, 2017	N/A – inoperable <sup>4</sup>	771	5.5	1.4 <sup>2</sup>	0.3 <sup>2</sup>	1.7	N/A – inoperable <sup>4</sup>	5.5	N/A – inoperable <sup>4</sup>	

**Notes:**

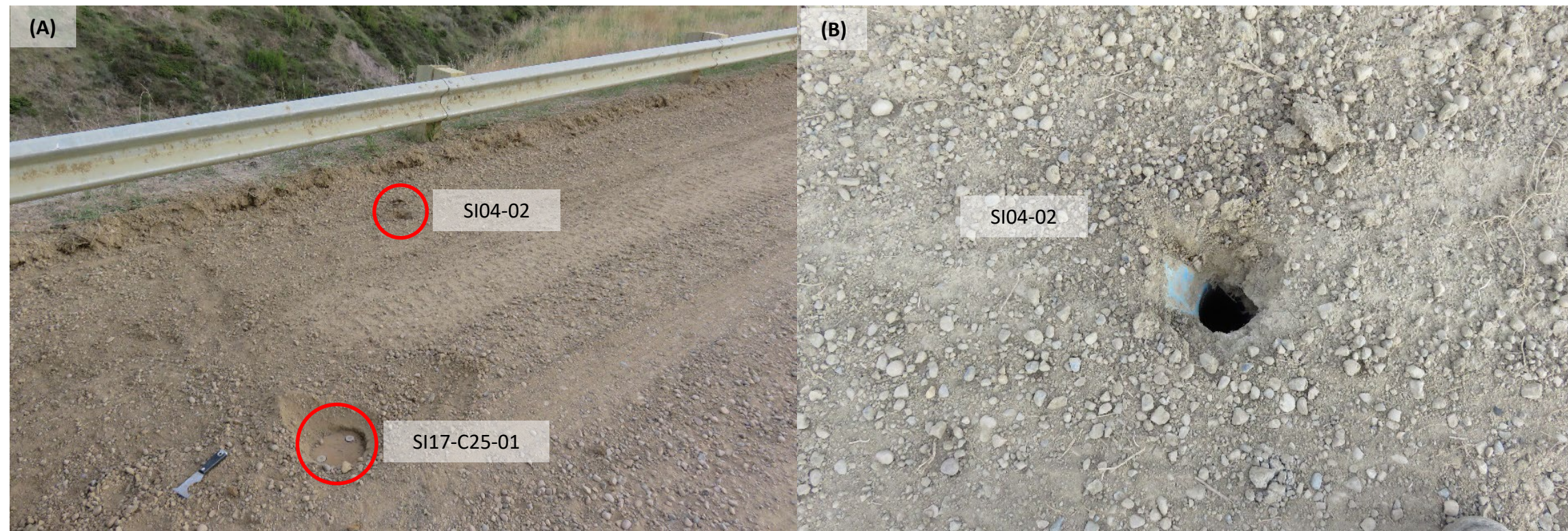
<sup>1</sup> Meters below ground surface (mbgs).

<sup>2</sup> SI17-C25-01 was re-initialized in July 2017 when the SI equipment was changed.

<sup>3</sup> SI04-02 was lost in June 2011.

<sup>4</sup> SI17-C25-01 has sheared at an approximate depth of 0.6 m below ground surface.

**Photo 1 SI04-02 has been shattered at ground surface.**



### 3 RECOMMENDATIONS

#### 3.1 Future Work

VW42616 is the only operational instrument remaining at C025 and has been dry since installation. KCB recommends that the C025 site be removed from the spring 2020 Section C instrument readings. If need be, KCB could facilitate backfilling the inoperable SIs with grout during a future drilling investigation near the site. Alternatively, the MCI could attempt to backfill the SIs with a “home-made” grout mix.

Remedial options are currently being assessed by KCB and AT which includes realignment of the highway further north (upslope) and improving drainage (e.g., constructing ditches and slope drains to reduce slope erosion).

The site should continue to be inspected by the Maintenance Contract Inspector (MCI) and as part of the central region GRMP Section B inspections.

#### 3.2 Instrument Repairs

SI04-02 was exposed during the 2017 spring reading, but the top of the casing was shattered (Photo 1), and SI17-C25-01 is sheared at an approximate depth of 0.6 m below ground surface. Additional readings of SI04-02 might be possible if the casing is carefully exposed, repaired, and backfilled. KCB will attempt to expose SI04-02 and read the instrument with a dummy probe during the spring 2020 readings.

## 4 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. The report has been prepared for the exclusive use of Alberta Transportation for the specific application to the central region GRMP (Contract No. CON0017608). The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen Berger. In this report, Klohn Crippen Berger has endeavoured to comply with generally-accepted professional practice common to the local area. Klohn Crippen Berger makes no warranty, express or implied.

Please contact the undersigned if you have any questions or comments regarding this report.

Yours truly,

**KLOHN CRIPPEN BERGER LTD.**



Ryan Gazley, E.I.T  
Geotechnical Engineer

TH:kc

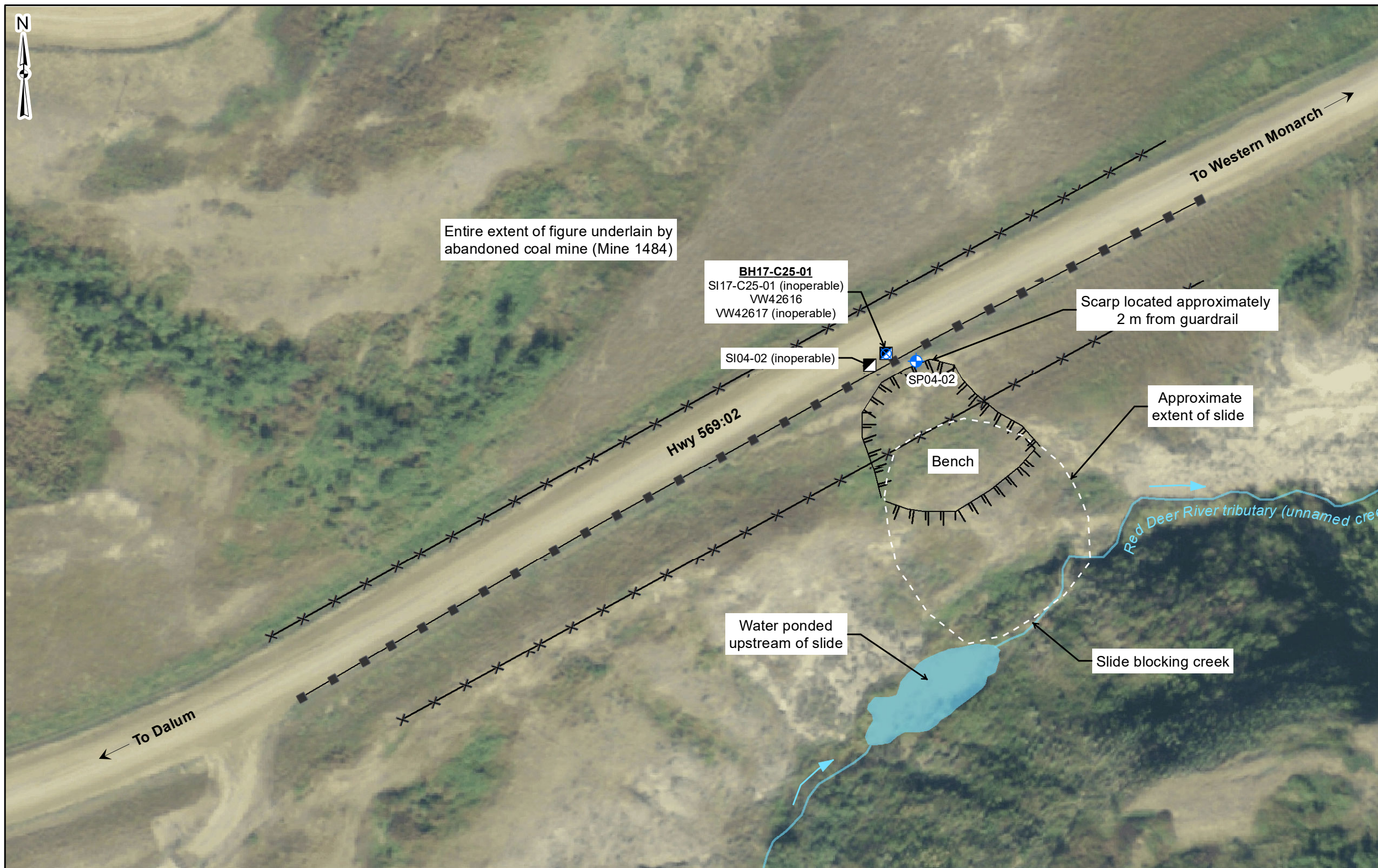


2020-10-23  
Chris Gräpel, M.Eng., P.Eng.  
Senior Civil Engineer, Associate

**Attachment**  
Figure

## FIGURE

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Entire extent of figure underlain by abandoned coal mine (Mine 1484)

**BH17-C25-01**  
SI17-C25-01 (inoperable)  
VW42616  
VW42617 (inoperable)

Scarp located approximately 2 m from guardrail

SI04-02 (inoperable)

SP04-02

Approximate extent of slide

Bench

Water ponded upstream of slide

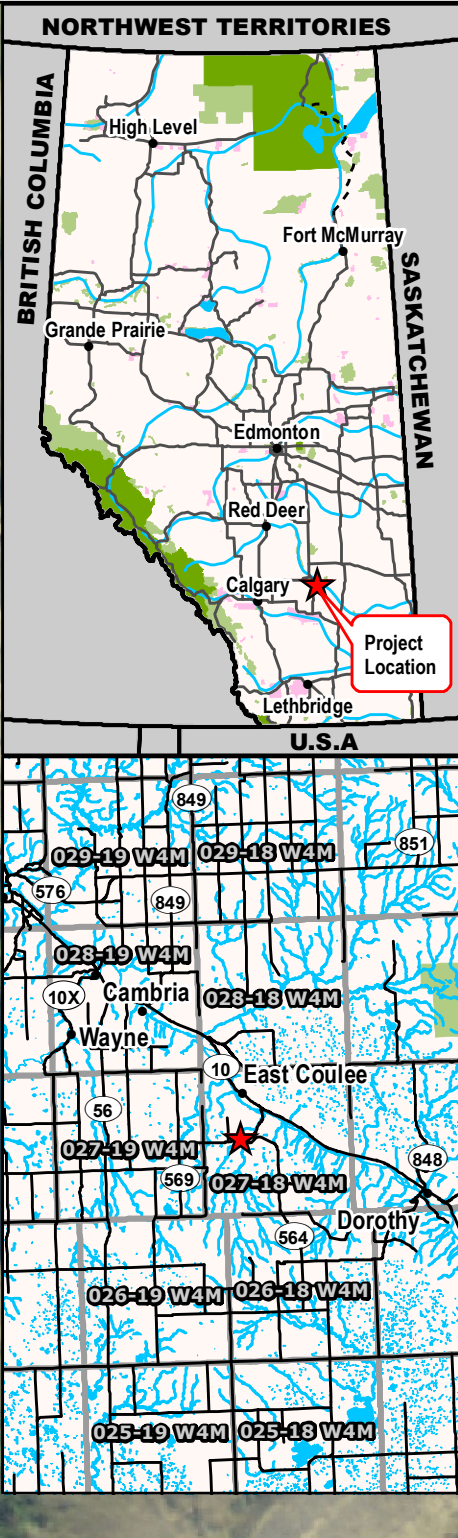
Slide blocking creek

Hwy 569:02

Red Deer River tributary (unnamed creek)

To Dalum

To Western Monarch



**Legend**

- ⊗ Vibrating Wire Piezometer (VW)
- ▣ Slope Inclinator (SI)
- ⊕ Standpipe Piezometer (SP)
- ✕ Fence
- Guardrail
- ||| Scarp
- Creek
- ➔ Flow Direction
- ☑ Ponded water



NOTES:  
1. HORIZONTAL DATUM: NAD83  
2. GRID ZONE: UTM Zone 12N  
3. IMAGE SOURCE: Abacus Datagraphics Ltd.  
Image dated July 5, 2011 to October 7, 2011  
4. Location of instruments is approximate (not surveyed)

CLIENT

*Alberta*

**Klohn Crippen Berger**

PROJECT	CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM	
TITLE	Site Plan C025 - Western Monarch Slide Hwy 569:02, km 18.469	
SCALE	PROJECT No.	FIG No.
1:1,000	A05115A02	1

Time: 10:50:46 AM  
 Date: September 26, 2019  
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