

July 15, 2024

Alberta Transportation and Economic Corridors
4th Floor, Provincial Building
4920 – 51st Street
Red Deer, Alberta
T4N 6K8

Tony Penney, P.Eng.
Construction Engineer

Dear Mr. Penney:

CON0022160 Central Region GRMP Instrumentation Monitoring
Site C017-3; H575:04, km 26.631 Truckstop Slide
Section C – 2024 Spring Readings

1 GENERAL

One slope inclinometer (SI) (SI20-C017-01) and two vibrating wire piezometers (VWPs) (VW69731 and VW69732) were read at the C017-3 site in the Central Region on May 13, 2024 by Aden Shipton, E.I.T. of Klohn Crippen Berger Ltd. (KCB). These instruments were read as part of the Central Region Geohazard Risk Management Program (GRMP). The site is located on Hwy 575:04, km 26.631 to 26.050, approximately 10 km northwest of Drumheller, Alberta. The approximate site coordinates are 5707738 N, 370340 E (UTM Zone 12, NAD 83). A site plan is presented in Figure 1.

The C017 site consists of three geohazard subsites (C017-1 through -3) along an approximate 600 m length of Hwy 575:04, where the highway alignment is along the south slope of the Red Deer River valley. The geohazard at each subsite consists of:

- C017-1: a shallow embankment slope failure on the north side (westbound lane) of Hwy 575:04,
- C017-2: an erosion gully that has formed downslope of a culvert outlet on the north side (westbound lane) of Hwy 575:04, and
- C017-3: a moderately deep-seated slide on the north side (westbound lane) of Hwy 575:04 where the highway crosses a creek and enters a cut section in the valley wall.

No instrumentation is installed at the C017-1 or C017-2 sites, so these sites will not be discussed further herein.

In October 2020 and April 2022, KCB conducted two geotechnical site investigations at the C017-3 site to install geotechnical instruments and support design and construction work (no instruments were installed during the 2022 investigation). Drilling was completed by Mobile Augers and Research

Ltd. The encountered stratigraphy was as follows: silty clay/clayey silt, overlying bedrock (mudstone and clay shale). The encountered surficial stratigraphy was consistent with the stratigraphy encountered during a 2020 test pitting investigation.

1.1 Instrumentation

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

In October 2020, KCB installed one SI (SI20-C017-01) and two VWP (VW69731 and VW69732) to monitor depth of movement and groundwater conditions, respectively. The instruments were installed in borehole BH20-C017-1, located on the north (downslope) side of Hwy 575:04, within the C017-3 slide mass.

The instruments are protected by an above-ground casing protector.

The SI was read using the same metric RST Digital MEMS Inclinator System that has been used to read the SI since the instrument was re-initialized in June 2021, when the SI equipment was changed.

The VWPs were read using an RST VW2106 vibrating wire readout.

Table 1.1 Instrumentation Installation Details

Instrument ID	Instrument Type	Date Installed	UTM Coordinates ¹ (m)		Ground Surface Elevation ¹ (m)	Stick Up (m)	Depth (mbgs ²)	Condition
			Northing	Easting				
SI20-C017- 01	SI	Oct. 06, 2020	5707762	370348	747	0.8	17.3	Operable
VW69731	VWP	Oct. 06, 2020	5707762	370348	747	N/A	11.0	Operable
VW69732	VWP	Oct. 06, 2020	5707762	370348	747	N/A	3.4	Operable

Notes:

¹ Coordinates and ground surface elevations were estimated from February 2020 survey data.

² Meters below ground surface (mbgs).

2 INTERPRETATION

2.1 General

For the SI, the cumulative displacement, incremental displacement, and displacement-time data was plotted in the A-direction (i.e., the direction of the A0-grooves).

For the VWPs, the recorded porewater pressures were converted to an equivalent water/piezometric elevation and plotted relative to ground surface elevation and the tip elevation for each instrument.

The SI and piezometer data plots are included in Appendix I, and a summary of the SI and piezometer data is provided in Table 2.1 and Table 2.2, respectively.

Table 2.1 Slope Inclinometer Reading Summary

Instrument ID	Date				Ground Surface Elevation (m)	Depth of Movement (mbgs ¹)	Direction of Movement	Movement (mm)				Rate of Movement (mm/year)		
	Initialized (Re-initialized) ²	Previous Maximum Cumulative Movement Recorded	Previous Reading	Most Recent Reading				Maximum Cumulative			Incremental Since Previous Maximum Cumulative	Previous Maximum	Most Recent Reading	Change from Previous Reading
								Before Re-Initialization	After Re-Initialization	Total				
SI20-C017-01	Oct. 16, 2020 (Jun. 12, 2021)	Sep. 19, 2023	Sep. 19, 2023	May 13, 2024	747	3.5 – 6.9	A-Direction	2.2	8.6	10.8	1.1	5.6	1.7	-1.3
						12.9 – 17.0		0.9	4.5	5.4	0.5	1.8	0.7	-1.6

Notes:
¹ Meters below ground surface (mbgs).
² The SI was re-initialized to the June 12, 2021 reading since the data did not match well with the readings taken with the previous SI equipment.

Table 2.2 Vibrating Wire Piezometer Reading Summary

Instrument ID / Serial No.	Date			Ground Surface Elevation (m)	Tip Depth (mbgs ¹)	Water Level		
	Installed	Previous Reading	Most Recent Reading			Previous Reading (mbgs ¹)	Most Recent Reading (mbgs ¹)	Change from Previous Reading (m)
VW69731	Oct. 06, 2020	Sep. 19, 2023	May 13, 2024	747	11.0	11.1	11.1	0.0
VW69732	Oct. 06, 2020	Sep. 19, 2023	May 13, 2024	747	3.4	3.3	3.3	0.0

Notes:
¹ Meters below ground surface (mbgs).

2.2 Zones of Movement

Distributed movement is being recorded in SI20-C017-01 in the upper 6 m and from approximately 14 m to 16 m below ground surface.

2.3 Interpretation of Monitoring Results

Based on the stratigraphy encountered during the 2020 drilling investigation, the upper and lower zones of movement recorded in SI20-C017-01 appear to be occurring in a soft zone in the embankment fill (silty clay and sand) and in the underlying foundation material (sandy silt), respectively.

An overall relatively slow rate of movement (approximately 3 mm/year) has been recorded in the SI since June 2021, excluding an increased rate of movement (approximately 6 mm/year) recorded in fall 2022 after wet weather in June and July 2022. Increased movement may occur in response to periods of heavy or prolonged rainfall or freshet infiltration, resulting in a higher groundwater level.

Since installation in October 2020, porewater pressures recorded in the two VVPs (VW69731 and VW69732) have been within ± 0.2 m of the tip elevation for each instrument, indicating these instruments are dry. Since an elevated groundwater level is believed to be one of the factors driving instability of the slide at the C017-3 site, KCB believes the piezometers may have been installed at depths that do not record transient changes in groundwater or that the current bi-annual reading frequency of the instruments does not capture short-term fluctuations (i.e., increases and decreases) in water level that could be occurring in response to heavy rainfall events or freshet infiltration between readings.

3 RECOMMENDATIONS

3.1 Future Work

All operable instruments should continue to be read twice per year (spring and fall).

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

Construction for the repair of the C017-1 and -3 sites is scheduled for summer or fall 2024 (Tender No. TND0022533). The instrumentation should be read throughout construction to monitor the porewater pressure and movement in response to construction activities.

3.2 Instrument Repairs and Maintenance

No instrument repairs or maintenance is required. However, installation of a data logger on one or more of the VVPs may be beneficial, as more frequent readings may capture short-term fluctuations (i.e., increases and decreases) in groundwater level that could be occurring in response to periods of heavy or prolonged rainfall or freshet infiltration between readings.

4 CLOSING

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Alberta Transportation and Economic Corridors (Client) for the specific application to the Central Region Geohazard Risk Management Program (Contract No. CON0022160), and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
3. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
4. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.
5. This report is electronically signed and sealed and its electronic form is considered the original. A printed version of the original can be relied upon as a true copy when supplied by the author or when printed from its original electronic file.

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

Yours truly,

KLOHN CRIPPEN BERGER LTD.



James Lyons, P.Eng.
Civil Engineer

Aden Shipton, E.I.T.
Civil Engineer-in-Training

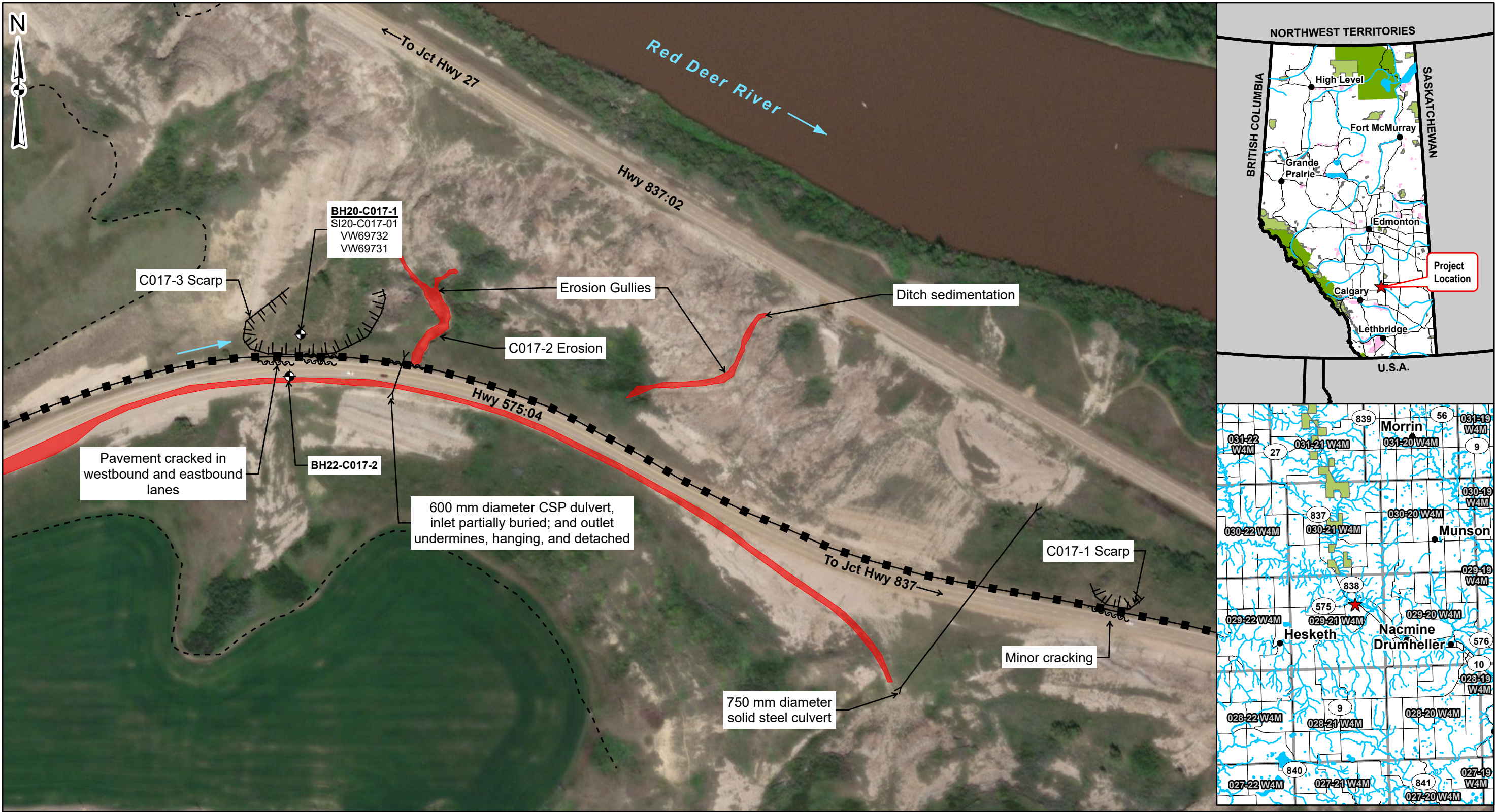
JL:bb

ATTACHMENTS

Figure
Appendix I Instrumentation Plots

FIGURE

File: Z:\A\EDMA05116\A02 ABT Central Region GRMP\400 Drawings\GISMXD\2022\C017_22\617.aprx Creator: almarison



Legend

- | | | |
|----------------|-----------|---------|
| Borehole | Scarp | Crack |
| Flow Direction | Guardrail | Erosion |
| Top of Bank | Culvert | |

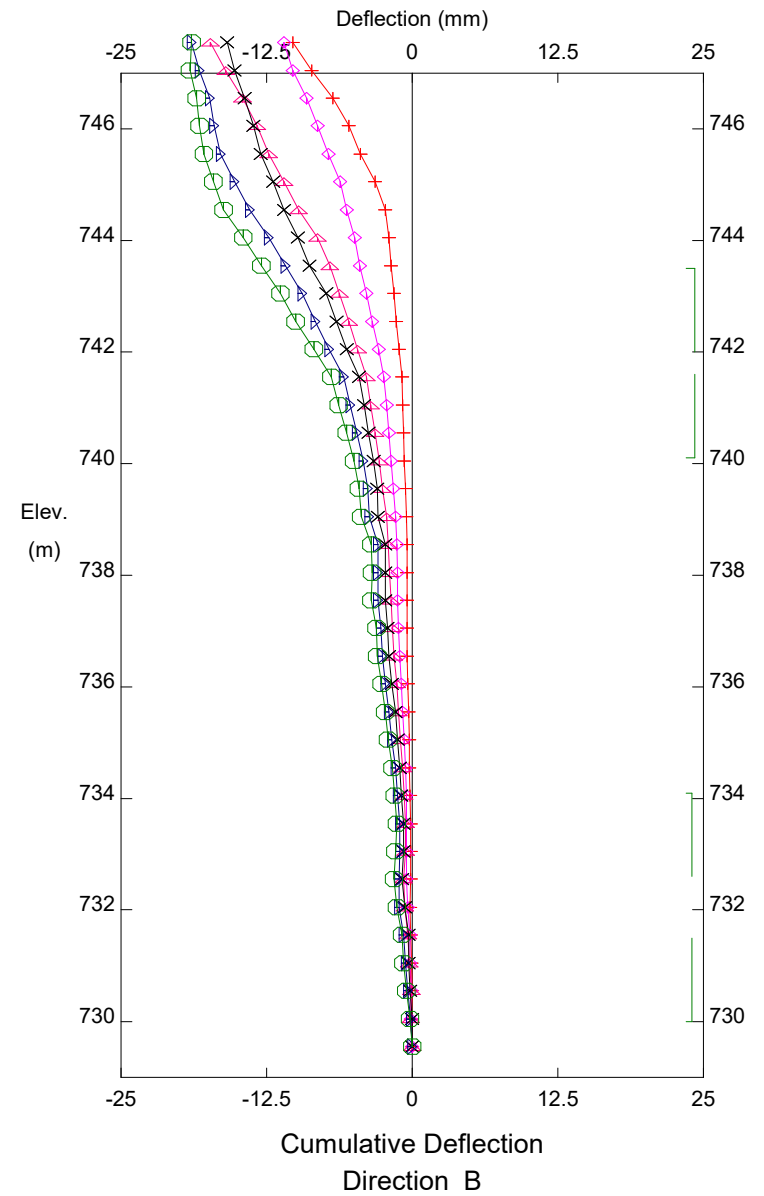
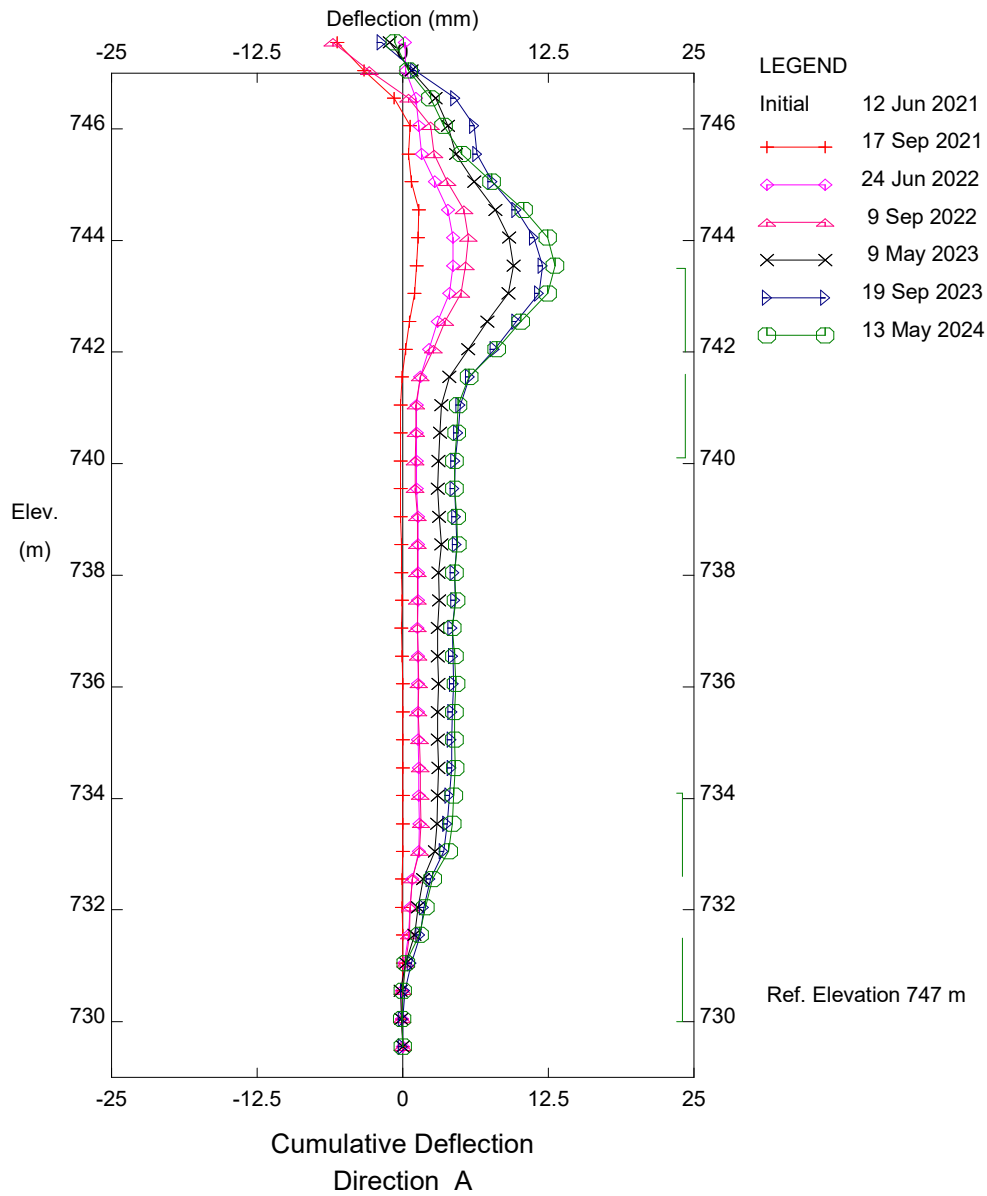
0 125 Metres

<div>NOTES: 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM ZONE 12N 3. IMAGE SOURCE: 2022 MICROSOFT CORPORATION, 2022 MAXAR CNES, DISTRIBUTION AIRBUS DS</div>	CLIENT 	PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
		TITLE Site Plan C017-1, -2, and -3 Truckstop Slide Hwy 575:04, km 26.631		
SCALE 1:2,500		PROJECT No. A05116A02	FIG No. 1	

APPENDIX I

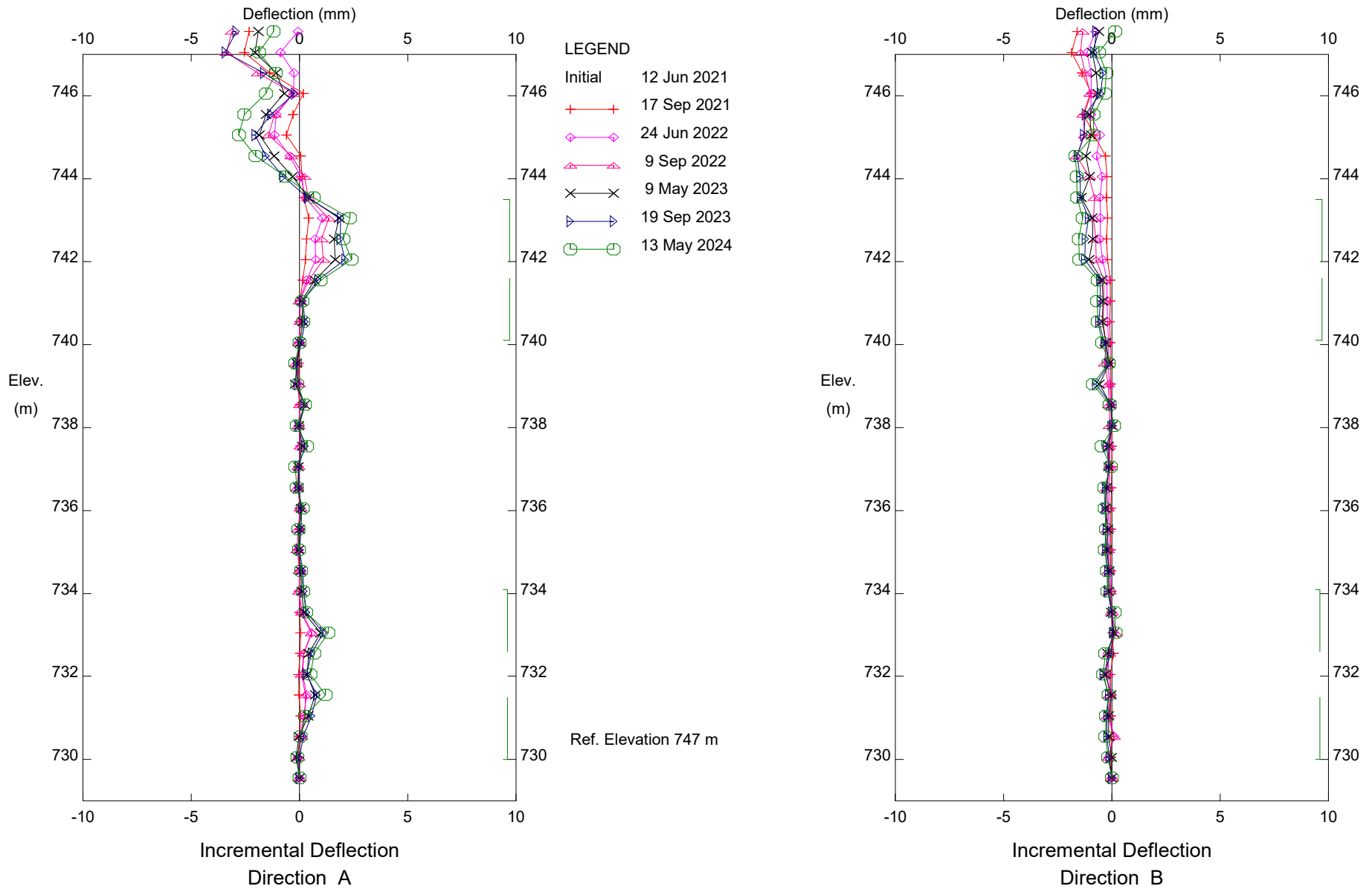
Instrumentation Plots

Klohn Crippen Berger - Calgary



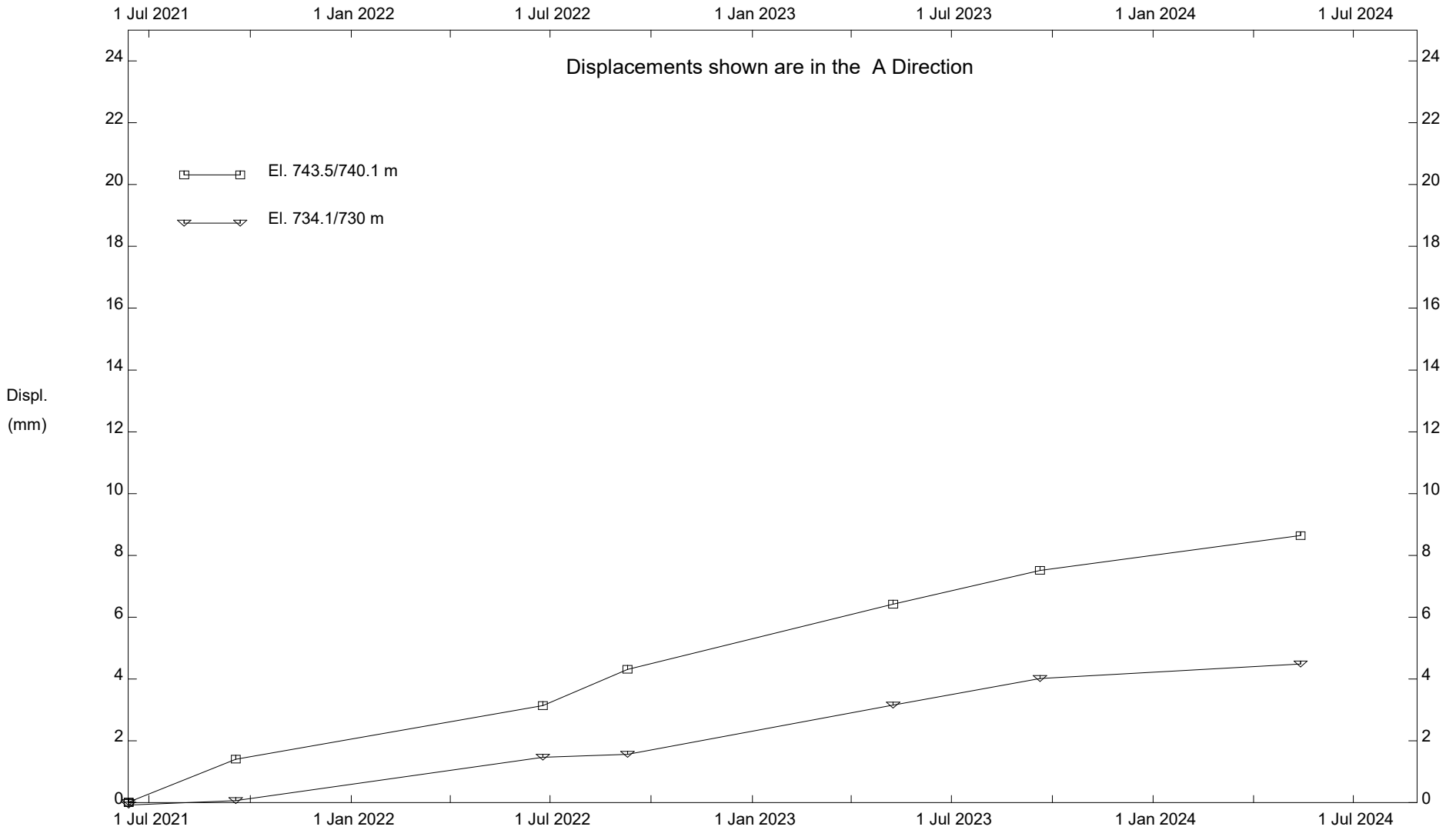
C017-III; H575:04; Truckstop Slide, Inclinometer SI20-01
Alberta Transportation

Klohn Crippen Berger - Calgary



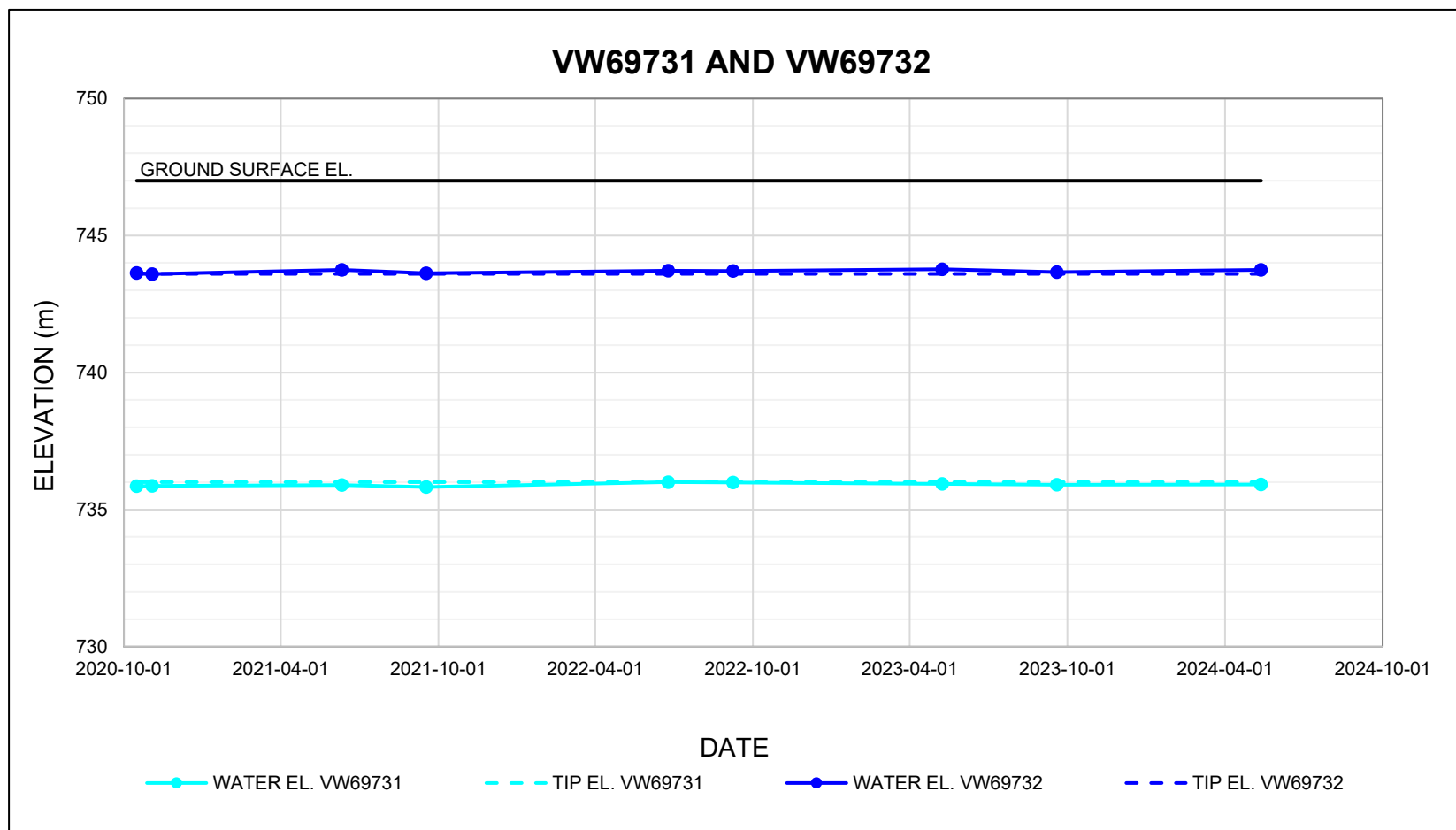
C017-III; H575:04; Truckstop Slide, Inclinometer SI20-01
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C017-III; H575:04; Truckstop Slide, Inclinometer SI20-01

Alberta Transportation



NOTES:
 1. GROUND SURFACE ELEVATION ESTIMATED FROM SURVEY DATA FROM FEBRUARY 2020.

CLIENT  	PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
	TITLE Piezometer Data C017-3 - Truck Stop Slide Hwy 575:04, km 26.341		
SCALE	N/A	PROJECT No.	A05116A02
FIG No.			I-4