

November 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 Fall 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 September 17, 2024 by Evan Hergott, 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.

KCB completed design work for the C017-1 and C017-3 subsites in 2023 and the tender was advertised in May 2024. The contract was awarded in September 2024 (TEC Contact No. CON0022533) and construction is scheduled to begin in November 2024.

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 a Slope Indicator VW Data Recorder 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)	May 13, 2024	May 13, 2024	Sep. 17, 2024	747	3.5 – 6.9	A-Direction	2.2	8.6	10.8	-0.7	5.6	-2.1	-3.8
						12.9 – 17.0		0.9	5.1	6.0	0.6	2.4	1.9	1.1

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. 6, 2020	May 13, 2024	Sep. 17, 2024	747	11.0	11.1	11.1	0.0
VW69732	Oct. 6, 2020	May 13, 2024	Sep. 17, 2024	747	3.4	3.3	3.4	-0.1

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 (between approximately 2 mm/year and 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. Negative movement recorded in September 2024 in the upper 6 m of SI20-C017-01 may indicate the movement rate has slowed and is within the reading accuracy of the SI equipment.

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.

Due to construction for the repair of the C017-1 and -3 subsites scheduled to begin in November 2024, the instrumentation at C017-3 should be read throughout construction to monitor porewater pressures 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 with one or more of the VWP's 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.

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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

Evan Hergott, E.I.T.
Civil Engineer-in-Training

JL:bb

ATTACHMENTS

Figure
Appendix I Instrumentation Plots

FIGURE

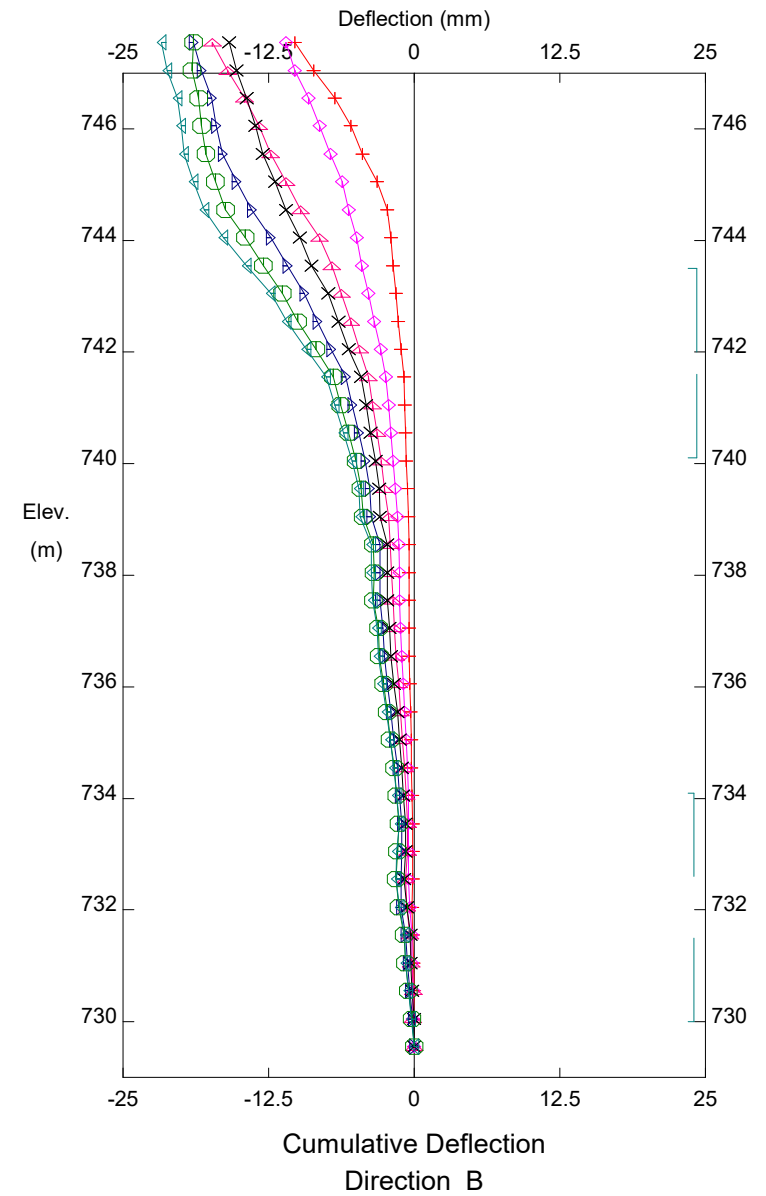
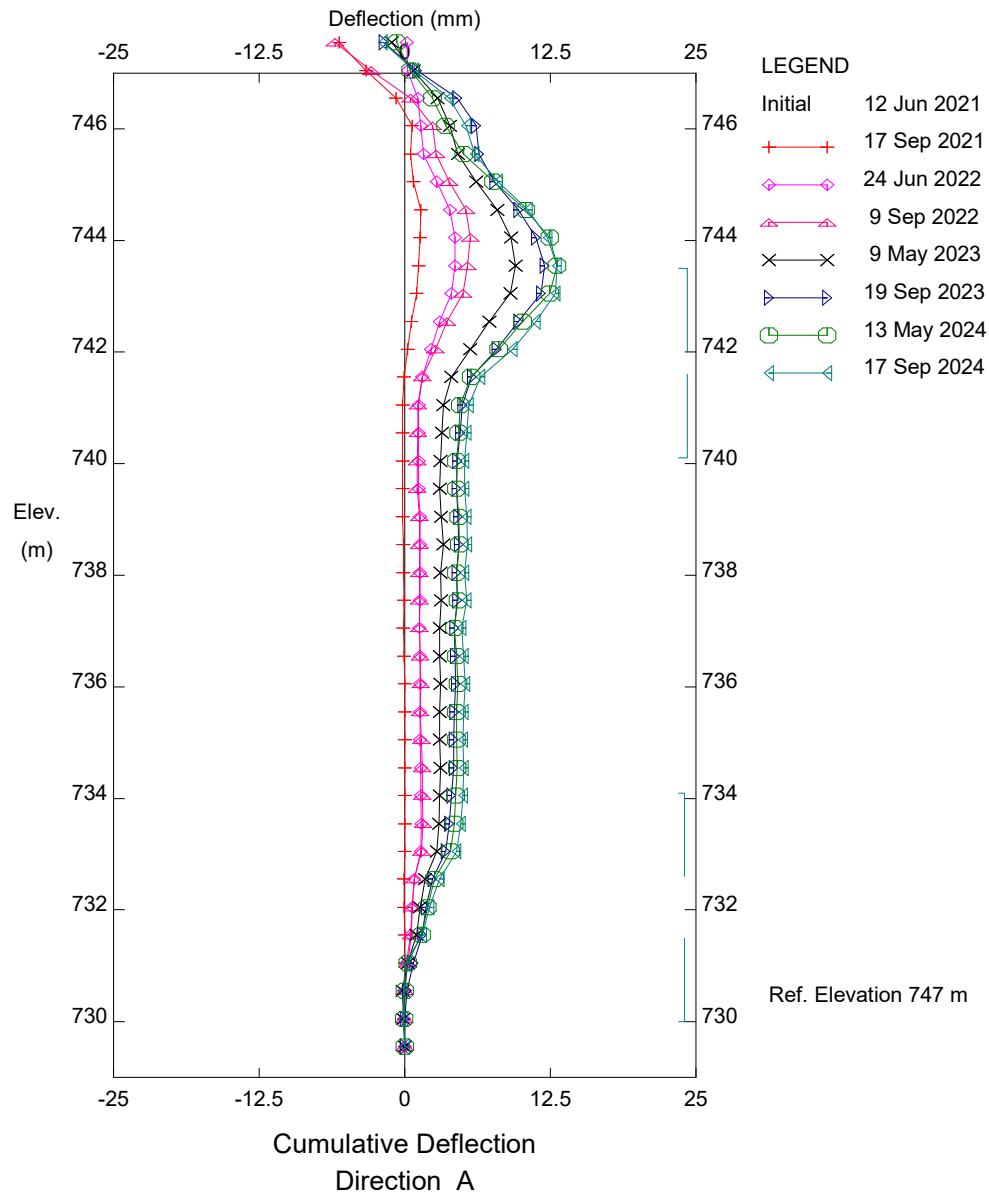
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APPENDIX I

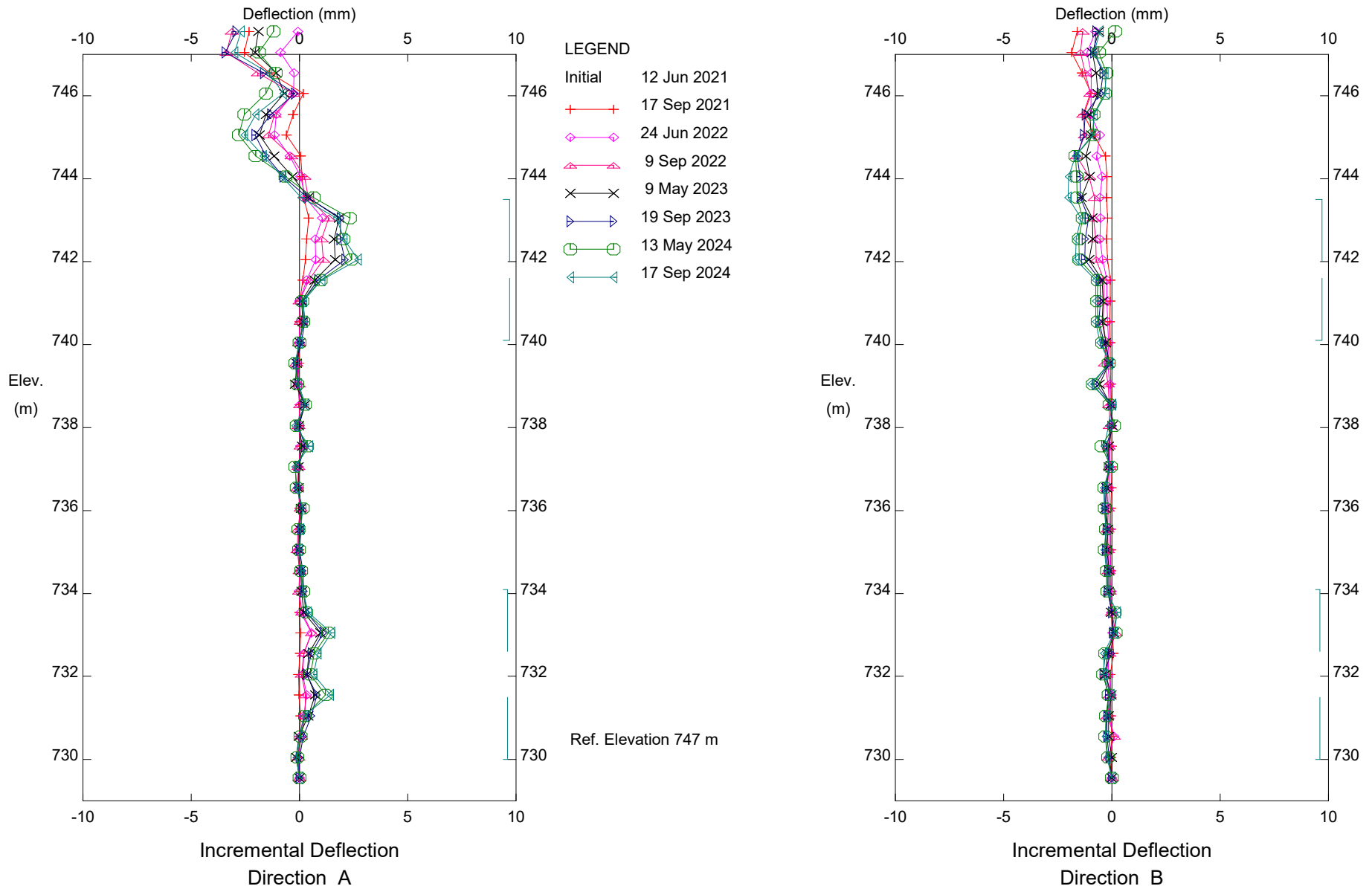
Instrumentation Plots

Klohn Crippen Berger - Edmonton



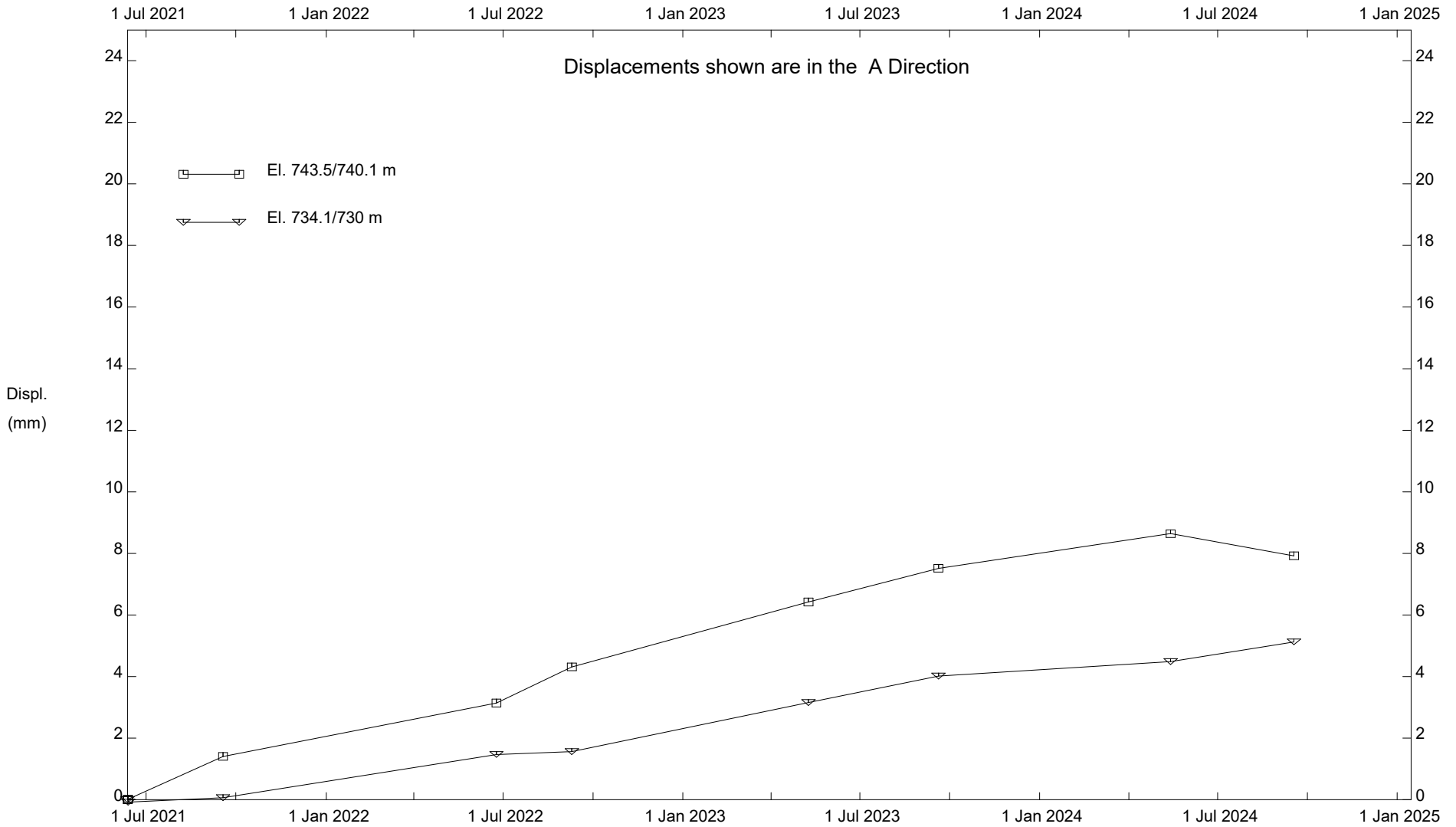
C017-III; H575:04; Truckstop Slide, Inclinator SI20-01
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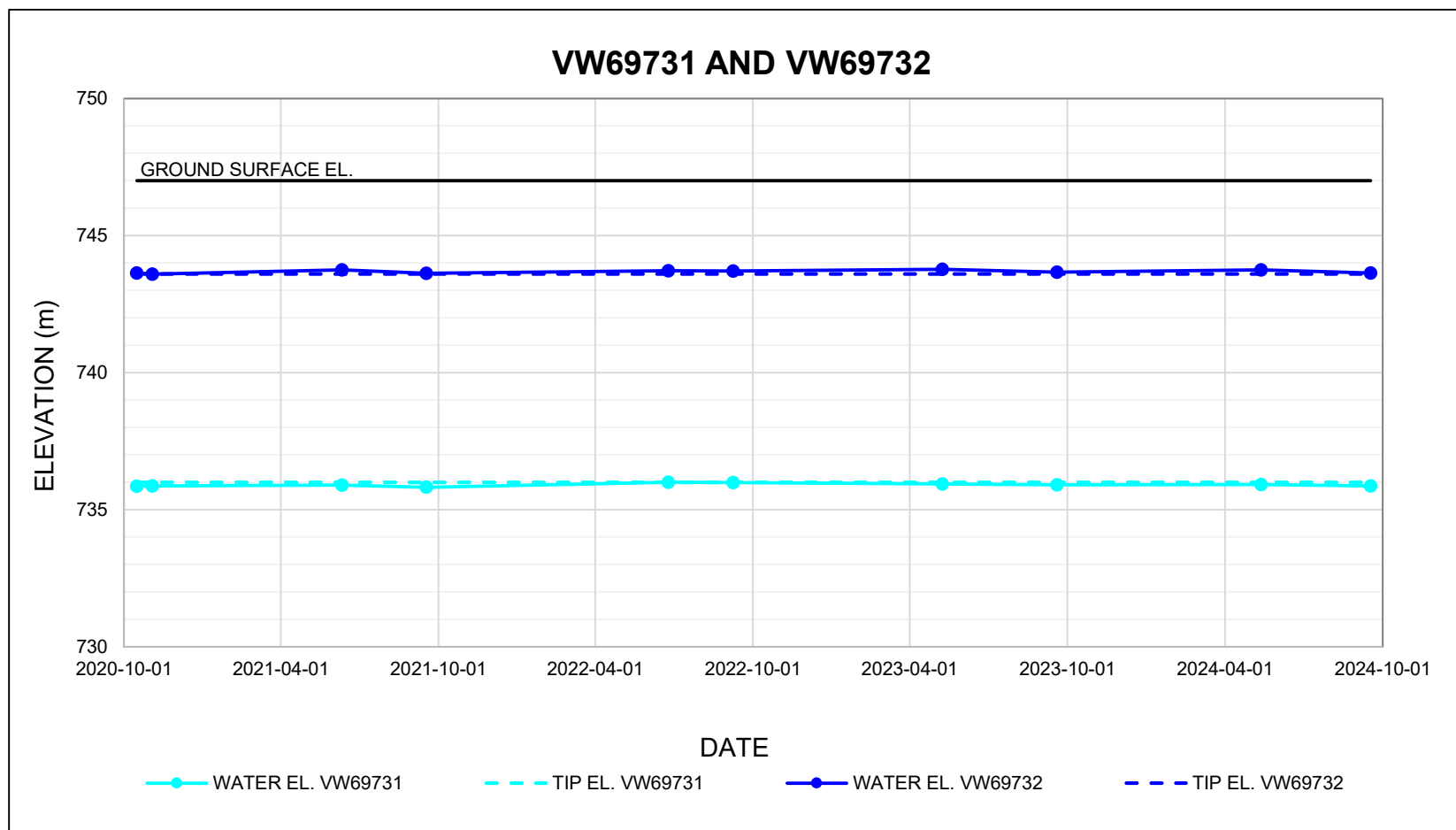
C017-III; H575:04; Truckstop Slide, Inclinometer SI20-01
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C017-III; H575:04; Truckstop Slide, Inclinometer SI20-01

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

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