

November 29, 2022

Alberta Transportation  
4<sup>th</sup> Floor, Provincial Building  
4920 – 51<sup>st</sup> Street  
Red Deer, Alberta  
T4N 6K8

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

Dear Mr. Penney:

**CON0022160 Central Region GRMP Instrumentation Monitoring  
Site C017-III; H575:04, km 26.631 Truckstop Slide  
Section C – 2022 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-III site in the Central Region on September 8 and 9, 2022 by Ms. Katrina Cereno 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-I through -III) along an approximate 600 m length of Hwy 575:04, where it transverse the south slope of the Red Deer River valley. The geohazard at each subsite consists of:

- C017-I: a shallow embankment slope failure on the north side (westbound lane) of Hwy 575:04,
- C017-II: an erosion gully that has formed downslope of a culvert outlet on the north side (westbound lane) of Hwy 575:04,
- C017-III: 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-I or C017-II 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-III site to install instruments and support design and construction work. 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 shown in Figure 1.

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

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

The SI was read using the same metric RST Digital MEMS Inclinometer 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 <sup>1</sup> (m)		Ground Surface Elevation <sup>1</sup> (m)	Stick Up (m)	Depth (mbgs <sup>2</sup> )	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:**

<sup>1</sup> Coordinates and ground surface elevations were estimated from February 2020 survey data.

<sup>2</sup> 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 each instruments tip elevation.

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 <sup>1</sup> )	Direction of Movement	Movement (mm)			Rate of Movement (mm/year)			
	Initialized (Re-initialized) <sup>2</sup>	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)	Jun. 24, 2022	Jun. 24, 2022	Sep. 09, 2022	747	3.0 – 6.5	A-Direction	2.2	4.5	6.7	1.3	5.6	6.3	4.2
						13.0 – 17.0		0.9	1.6	2.5	0.1	1.8	0.5	-1.4

**Notes:**

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

<sup>2</sup> 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 <sup>1</sup> )	Water Level		
	Installed	Previous Reading	Most Recent Reading			Previous Reading (mbgs <sup>1</sup> )	Most Recent Reading (mbgs <sup>1</sup> )	Change from Previous Reading (m)
VW69731	Oct. 06, 2020	Jun. 24, 2022	Sep. 09, 2022	747	11.0	11.0	11.0	0.0
VW69732	Oct. 06, 2020	Jun. 24, 2022	Sep. 09, 2022	747	3.4	3.3	3.3	0.0

**Notes:**

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

## 2.2 Zones of Movement

Distributed movement is being recorded in SI20-C017-01 in the upper 6.5 m and discrete movement at an approximate depth of 16 m below ground surface. The lower zone of movement was first observed during the June 2022 reading. This instrument was installed in October 2021 and more data is needed to confirm the depth and rate of movement.

## 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 overburden (sandy silt), respectively.

An overall relatively slow rate of movement (less than 7 mm/year) has been recorded in the SI since it was installed in October 2021. Increased movement may occur in response to periods of heavy or prolonged rainfall or freshet infiltration, resulting in a higher groundwater level. More data is needed to assess long-term trends for this instrument (and the VWPs).

Since installation in October 2020, porewater pressures recorded in the two VWPs (VW69731 and VW69732) have been within  $\pm 0.1$  m of each instruments tip elevation, 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-III 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.

### 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 VWPs 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.

KCB is in the process of completing a design repair for the C017 site (backfilling and armouring the C017-II site, installing a ditch block and culvert upslope of C017-III, and soil nailing at the C017-I and C017-III sites). The design will be completed in fall 2022 and construction is anticipated to start in 2023.

## 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 (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.**



Chris Gräpel, M.Eng., P.Eng.  
Senior Civil Engineer, Associate

James Lyons, P.Eng.  
Civil Engineer

JL:bb

**ATTACHMENTS**

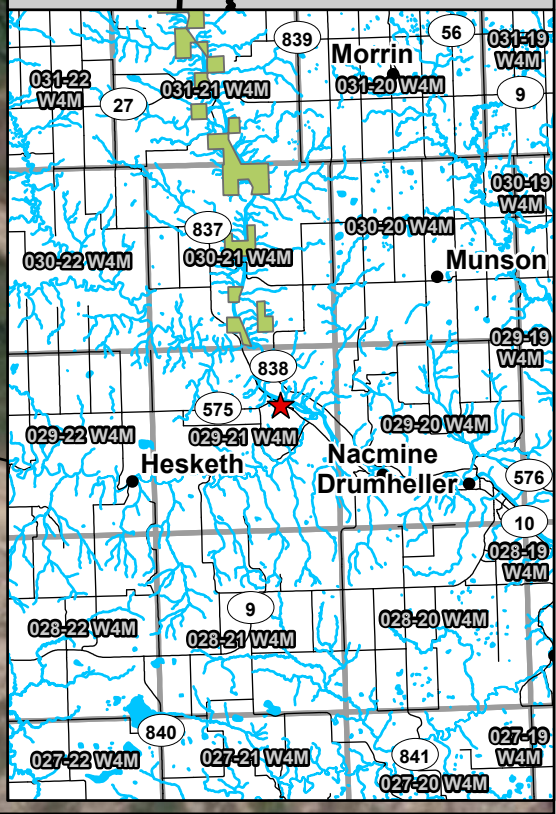
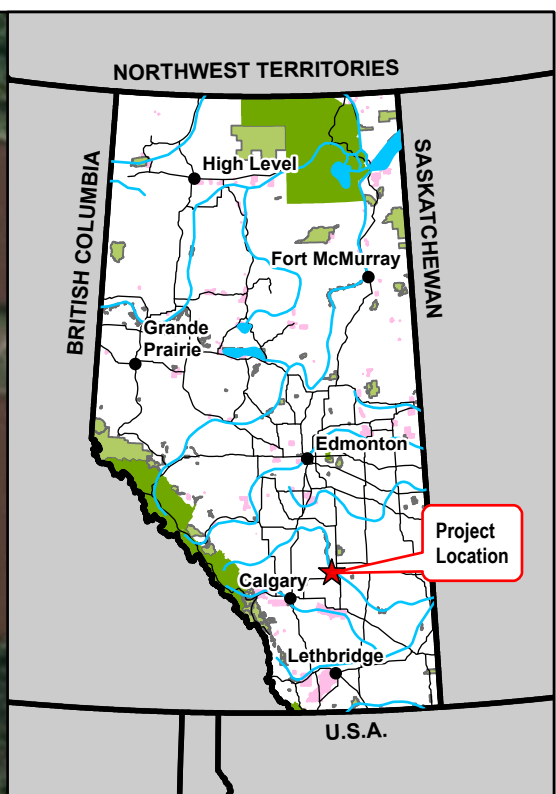
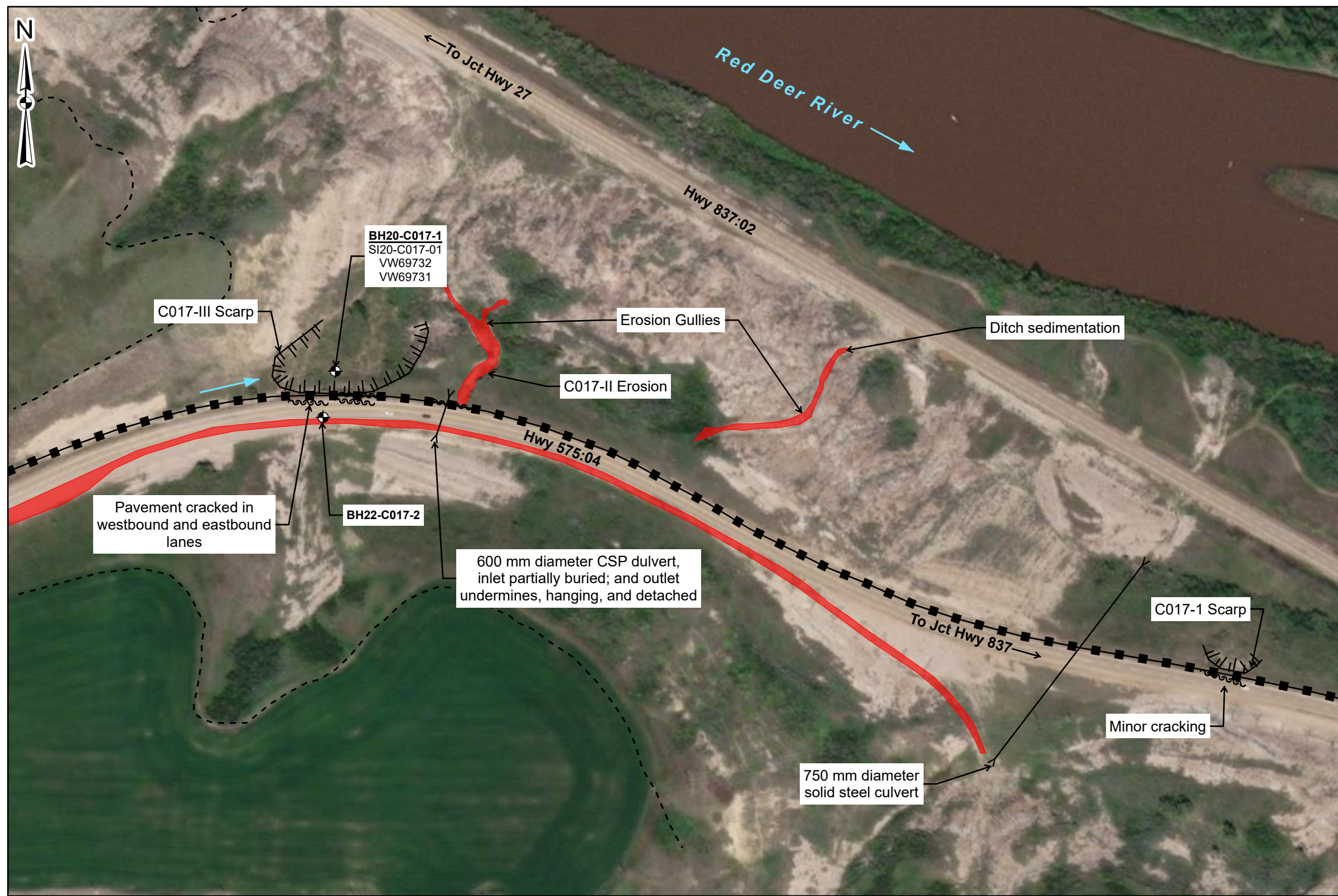
Figure

Appendix I      Instrumentation Plots

## FIGURE

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**Legend**

	Borehole		Scarp		Crack
	Flow Direction		Guardrail		Erosion
	Top of Bank		Culvert		



NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM ZONE 12N  
 3. IMAGE SOURCE: 2022 MICROSOFT CORPORATION, 2022 MAXAR CNES, DISTRIBUTION AIRBUS DS

CLIENT

PROJECT  
 CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE  
 Site Plan  
 C017-I, -II, and -III Truckstop Slide  
 Hwy 575:04, km 26.631

SCALE 1:2,500 PROJECT No. A05116A02 FIG No. 1

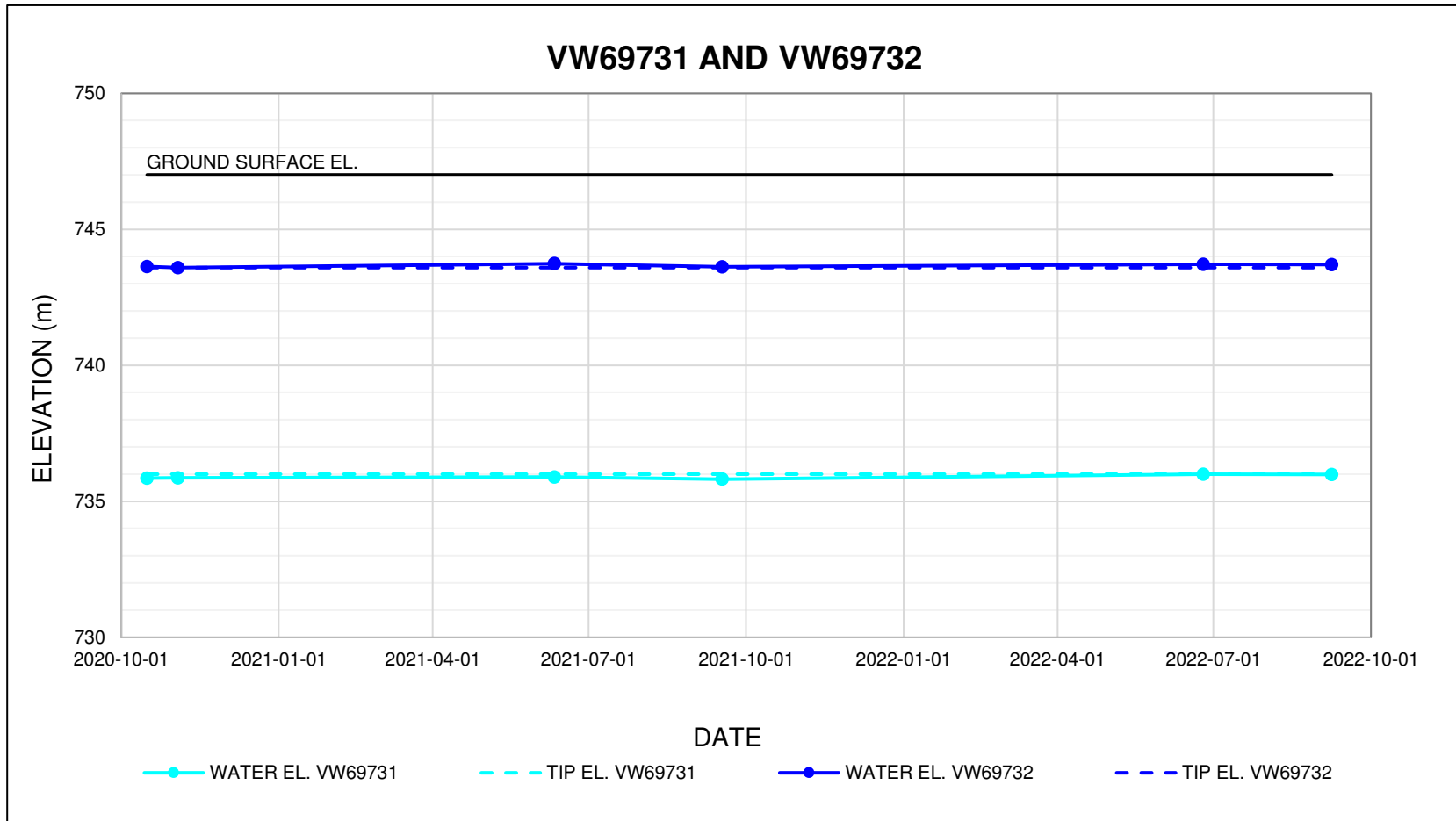
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# APPENDIX I

## Instrumentation Plots

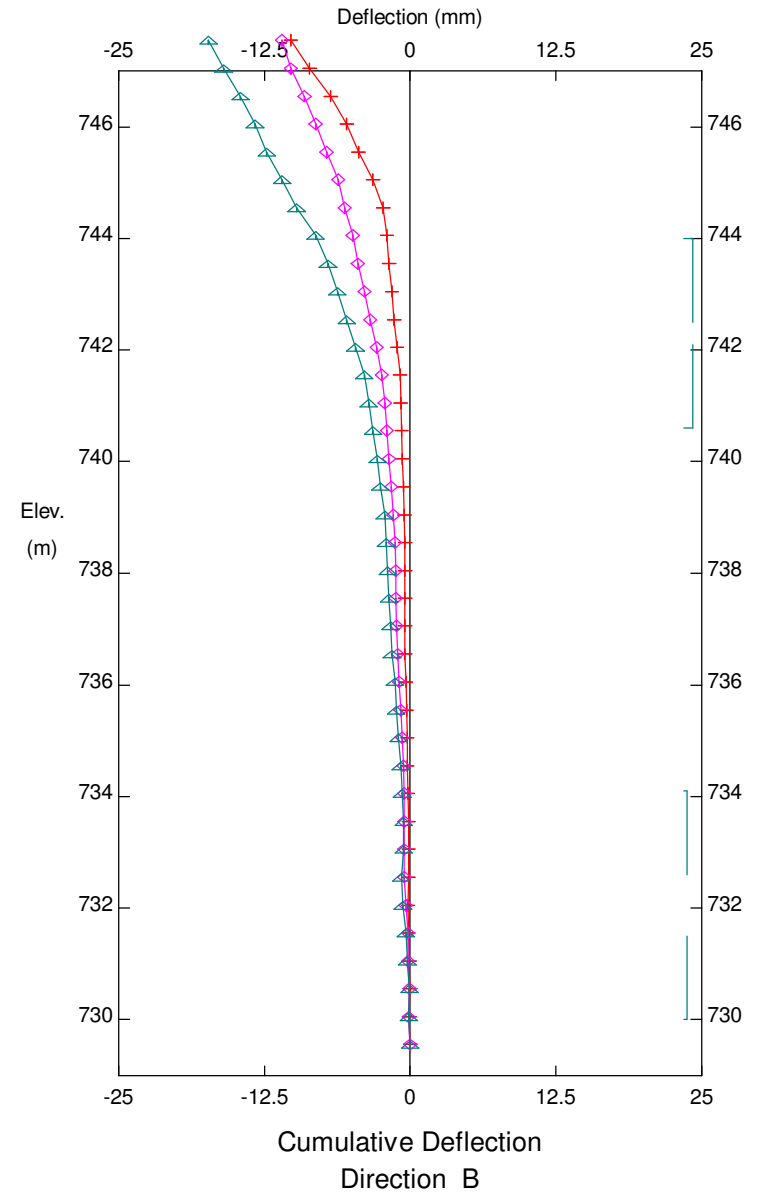
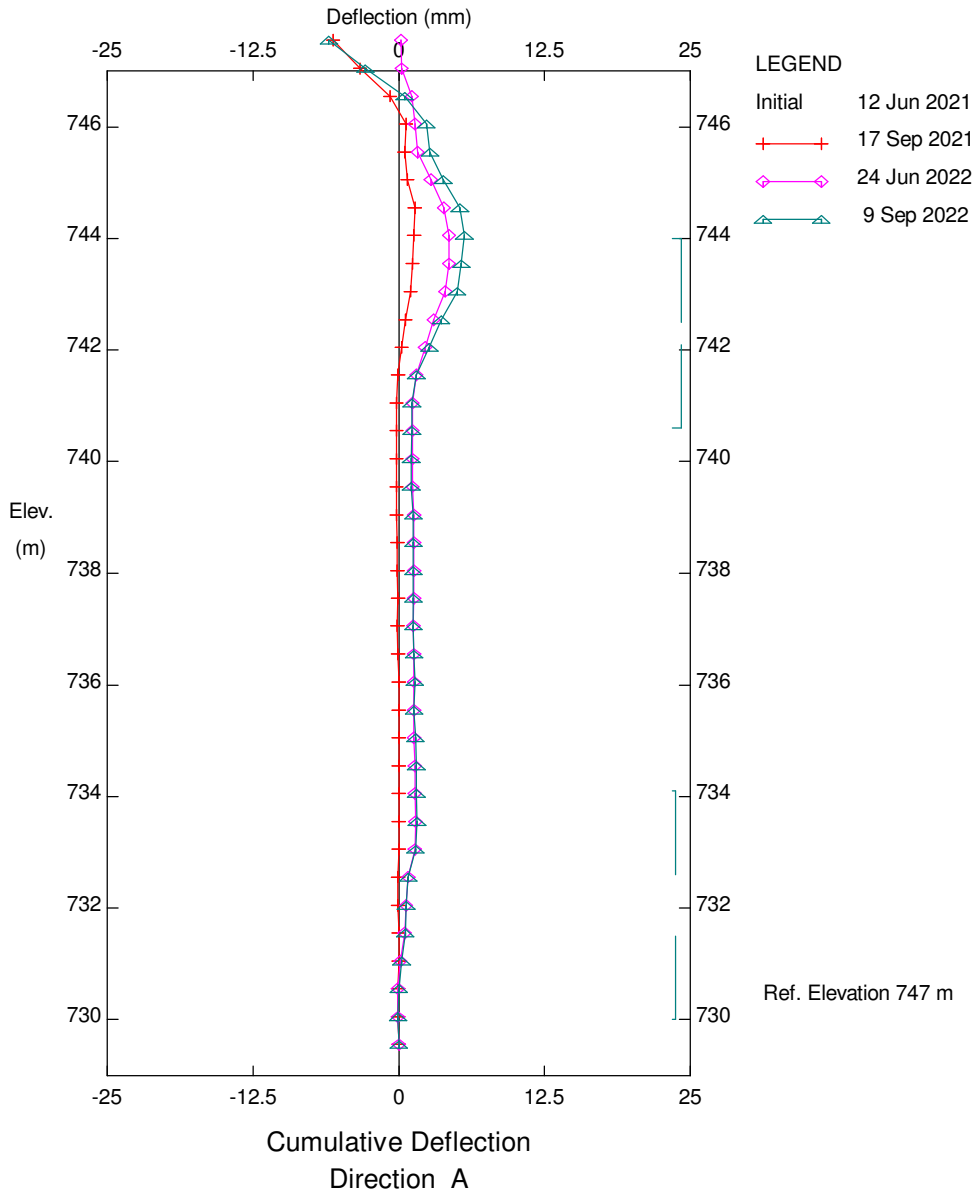
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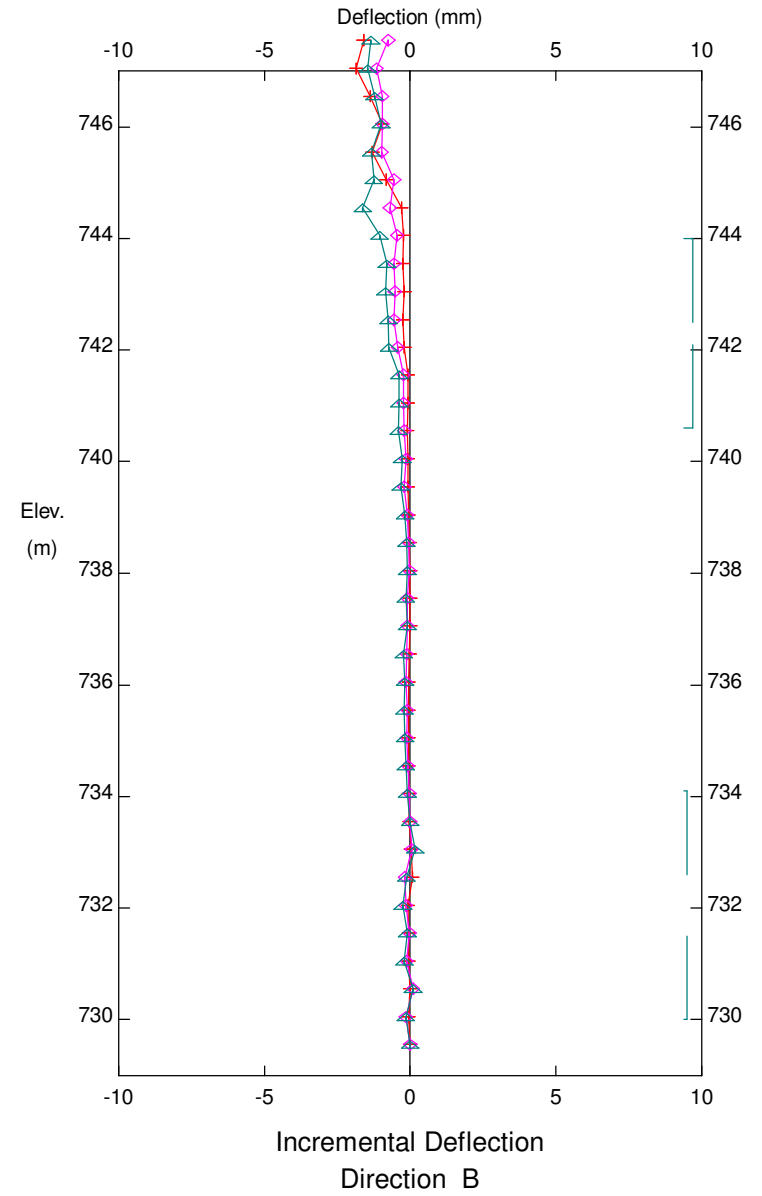
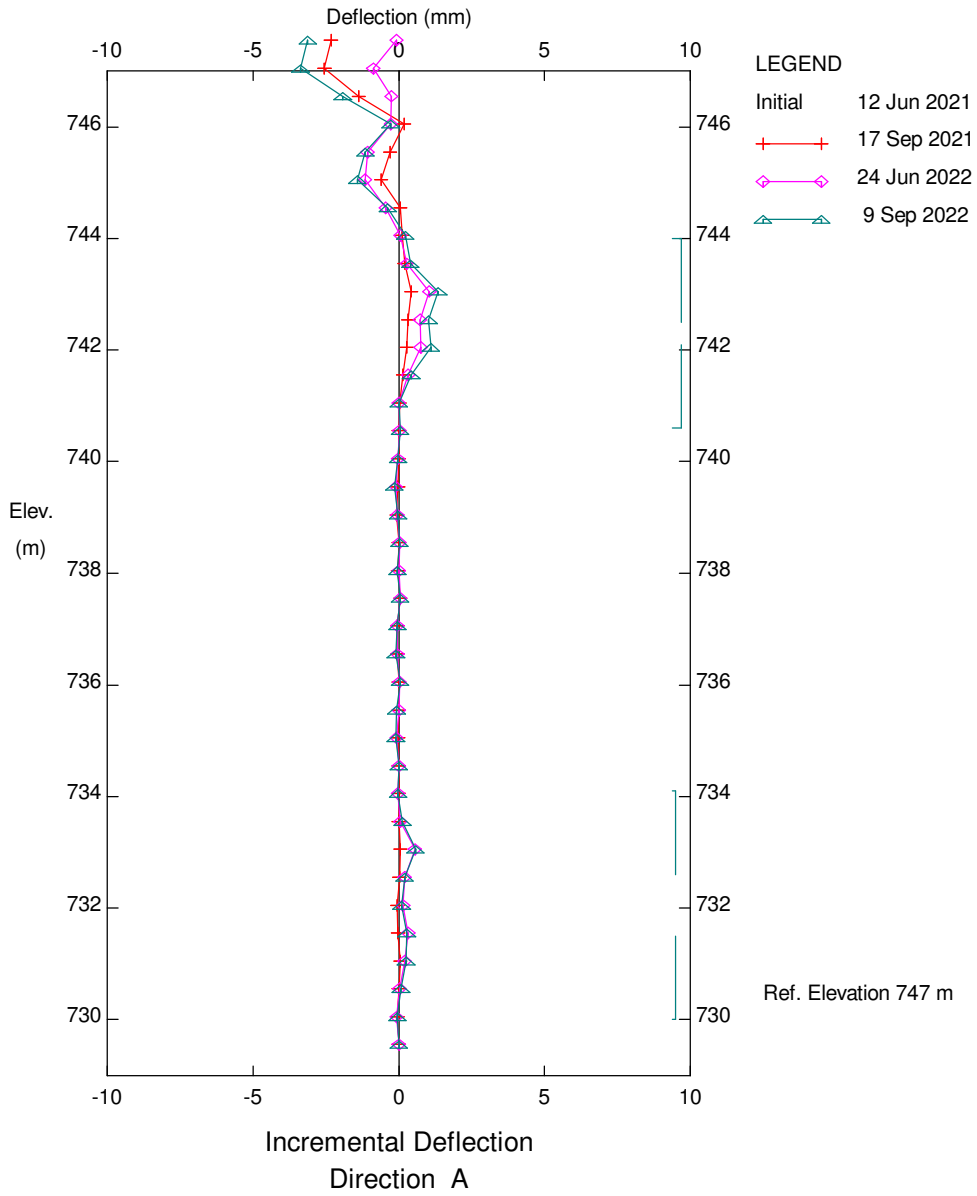
NOTES:  
 1. GROUND SURFACE ELEVATION ESTIMATED FROM SURVEY DATA FROM FEBRUARY 2020.

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

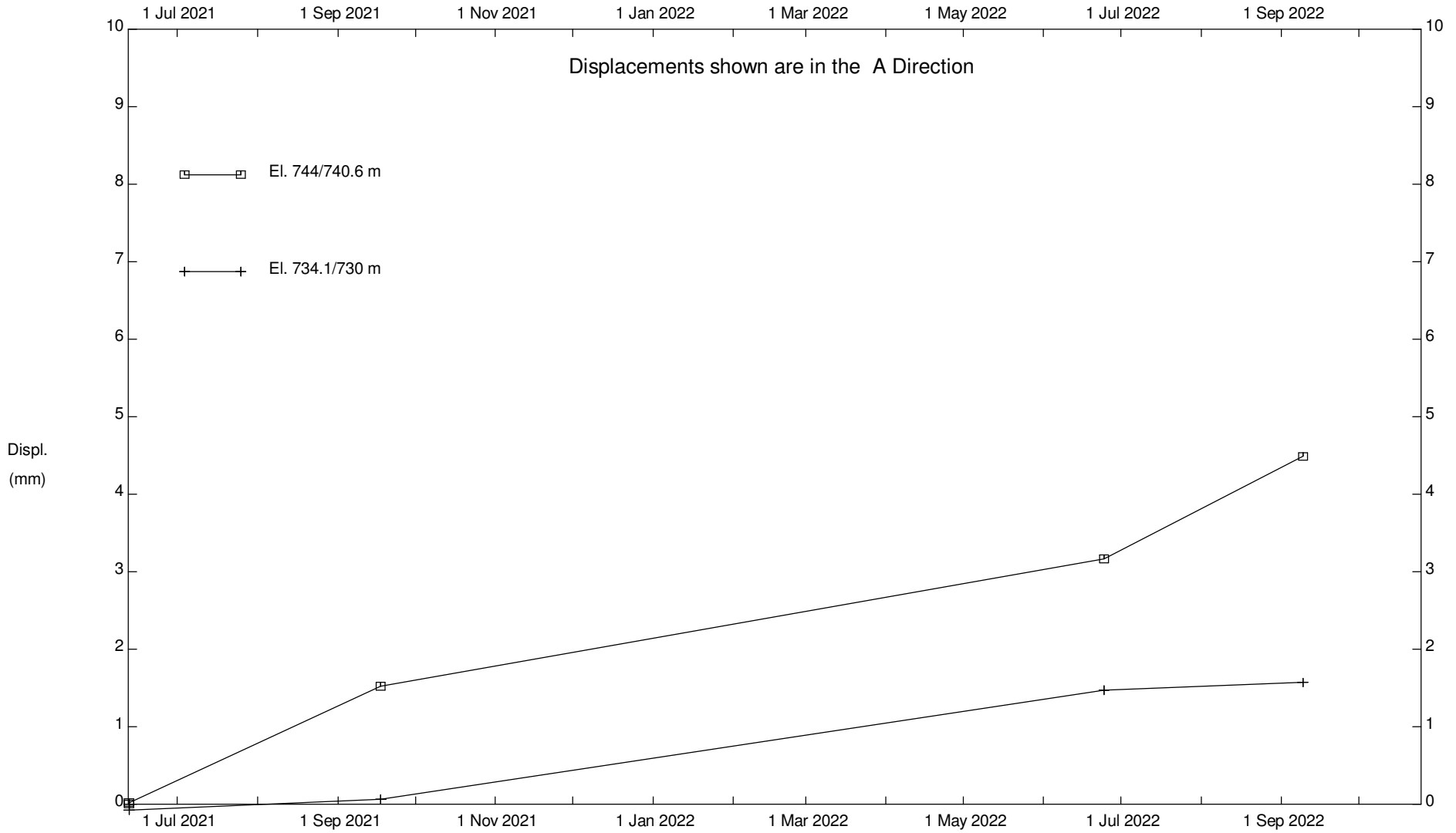
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C017-III; H575:04; Truckstop Slide, Inclinator SI20-01

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