

September 21, 2022

Alberta Transportation  
2<sup>nd</sup> Floor, 803 Manning Road N.E.  
Calgary, Alberta  
T2E 7M8

**Alex Frotten, P.Eng.**  
**Construction Engineer – Delivery Services Division (Southern Region)**

Dear Mr. Frotten:

**CON0022161 Southern Region GRMP Instrumentation Monitoring  
Site S037; H533:02 km 22.3 to km 21.9 Springhill Creek  
Section C – 2022 Spring Readings**

## **1 GENERAL**

Two slope inclinometers (SIs) (SI10-1 and SI10-2) and two vibrating wire piezometers (VWPs) (VWP10-1150 and VWP10-1151) were read at the S037 site in Southern Region on May 3, 2022 by Mr. Gabriel Bonot, E.I.T., of Klohn Crippen Berger Ltd. (KCB). These instruments were read as part of the Southern Region Geohazard Risk Management Program (GRMP). The S037 site is located on Hwy 533:02 km 22.3 and km 21.9, respectively, approximately 15 km southwest of Nanton, Alberta. The approximate site coordinates are 5576912 N, 290333 E (UTM Zone 12, NAD 83) and the legal land description for the site is NE 32-15-29-W4. A site plan is presented in Figure 1.

The geohazard at the S037 site consists of three adjacent landslides (Slide Area 1 through 3) located along an approximate 400 m length of Hwy 533:02. The landslides are occurring on the natural slope (approximately 30 m high sloped at 3H:1V) between the highway and Springhill Creek. In 2014, a pavement patch was completed above Slide Area 2, and subsequent crack sealing has been completed.

In February 2010, a geotechnical site investigation, which included installing instruments, was conducted at the S037 site by a previous consultant.

### **1.1 Instrumentation**

KCB has been reading the instruments at this site since 2016. Instrumentation installation details are tabulated in Table 1.1. Instrument locations are shown in Figure 1.

In February 2010, two SIs (SI10-1 and SI10-2) and two VWPs (VWP10-1150 and VWP10-1151) were installed at the site by a previous consultant to monitor movement and groundwater conditions, respectively. SI10-1 is between Slide Area 2 and 3, and the remaining instruments are in or near Slide Area 3. The instruments are installed along the south (eastbound) shoulder of Hwy 533:02 and are protected by flush-mounted casing protectors.

KCB changed the SI reading equipment in 2016 when KCB took over the readings from the previous consultant, and again in May 2022 after the previous equipment became inoperable. Currently, KCB is reading the SIs with a metric RST Digital MEMS Inclinometer System.

The VWPs were read using an RST VWP readout box.

**Table 1.1 Instrument Installation Details**

Instrument ID	Instrument Type	Date Installed <sup>1</sup>	UTM Coordinates <sup>2</sup> (m)		Ground Surface Elevation (m)	Stick Up (m)	Depth <sup>1</sup> (mbgs <sup>3</sup> )	Condition
			Northing	Easting				
SI10-1	SI	Mar. 30, 2010	5576815	290164	Unknown	0	24.0	Operable
SI10-2	SI	Mar. 30, 2010	5576874	290245	Unknown	0	24.0	Operable
VWP10-1150	VWP	Mar. 30, 2010	5576835	290185	Unknown	N/A	19.2	Operable
VWP10-1151	VWP	Mar. 30, 2010	5576849	290209	Unknown	N/A	12.0	Operable

**Notes:**

<sup>1</sup> Instrument installation details taken from reports and data files prepared or provided by the previous consultant(s) or Alberta Transportation.

<sup>2</sup> Coordinates were obtained by KCB with a handheld GPS. The handheld GPS had an accuracy of ±5 m.

<sup>3</sup> Meters below ground surface (mbgs). Bottom of casing for SIs and tip depth for piezometers.

## 2 INTERPRETATION

### 2.1 General

For the SIs, the cumulative displacement, incrementation displacement, and displacement-time data was plotted in the A-direction (i.e., in the direction of the A0-grooves) and in the X-direction (i.e., the direction of maximum movement obtained at a skew angle from the A0-grooves). SI10-1 and SI10-2 have skew angles of 130° and 220°, respectively, measured clockwise from the A0-grooves.

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

Monthly precipitation data is also plotted with the piezometer data. The data was obtained from the Alberta Climate Information Service (ACIS) database, referencing legal subdivision TWP015-29-W4.

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

**Table 2.1 Slope Inclinometer Reading Summary**

Instrument ID	Date				Ground Surface Elevation (m)	Depth of Movement (mbgs <sup>1</sup> )	Direction of Movement, Skew Angle <sup>2</sup>	Movement (mm)		Rate of Movement (mm/year)		
	Re-Initialized <sup>3</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
SI10-01	May 27, 2016	Jun. 15, 2021	Jun. 15, 2021	May 03, 2022	Unknown	16.2 – 23.2	X-Direction, 130°	5.3	1.4	2.6	1.5	0.5
SI10-02	May 27, 2016	Jun. 15, 2021	May 13, 2020	May 03, 2022	Unknown	0.0 – 22.0	X-Direction, 220°	13.7	7.5	2.9	10.5	12.1

**Notes:**

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

<sup>2</sup> Skew angle of X-direction measured clockwise from the A-direction.

<sup>3</sup> All SIs were re-initialized in May 2016 when KCB took over the readings from the previous consultant and changed the SI reading equipment. Movement recorded before 2016 was taken from reports prepared by the previous consultant.

**Table 2.2 Vibrating Wire Piezometer Reading Summary**

Instrument ID	Date			Ground Surface Elevation (mbgs <sup>1</sup> )	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)
VWP10-1150	Feb. 2010	Jun. 15, 2021	May 03, 2022	Unknown	19.2	11.9	11.9	0.0
VWP10-1151	Feb. 2010	Jun. 15, 2021	May 03, 2022	Unknown	12.0	4.1	4.4	-0.3

**Notes:**

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

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## 2.2 Zones of Movement

Distributed movement has been recorded in SI10-1 and SI10-2 from an approximate depth of 16 m to 23 m and 2 m to 22 m below ground surface, respectively.

## 2.3 Interpretation of Monitoring Results

Before KCB re-initialized the instruments in 2016, approximately 5 mm of movement was recorded in the upper 2 m of SI10-1 and SI10-2. The movement recorded near ground surface was attributed to shifting of the instrument casing protector and typical highway maintenance work (e.g., snow plowing, pavement patching, etc.).

Since KCB re-initialized the instruments in 2016, the rate of movement recorded in SI10-1 and SI10-2 has been slow (less than 1 mm/year), except for an increased rate of movement (approximately 10 mm/year) recorded in SI10-2 in the spring of 2022. SI10-2 is located at the crest of Slide Area 3, and SI10-01 is located between Slide Area 2 and 3. Site conditions at the Slide Area 3 appear similar to 2021, so the increased rate of movement is likely due to a small data shift caused by KCB changing the SI reading equipment when the old equipment became inoperable. The small rate of movement being recorded in the SIs makes the data sensitive to changes in equipment. More data is needed to assess.

Since May 2011, the water level recorded in VWP10-1050 has slowly decreased. In total, a 1.9 m and 0.3 m decrease has been recorded since May 2011 and the spring 2021 reading, respectively.

The water level recorded in VWP10-1051 steadily increased between May 2010 and October 2013 (increased of approximately 3.3 m) before being relatively unchanged (fluctuations of approximately 0.1 m) between October 2013 and April 2019. A large increase of approximately 1.3 m was recorded between April 2019 and May 2020. Since May 2020, the water level has decreased relatively steadily (overall decrease of 0.4 m).

It appears that VWP10-1051 may respond to increased levels of precipitation, as higher-than-average precipitation was recorded between 2010 and 2013 (in particular 2013) and in 2019 (preceded by two years of less-than-average precipitation).

## 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 Southern Region GRMP Section B inspections.

### 3.2 Instrument Repairs and Maintenance

No instrument repairs or maintenance is required.

## 4 CLOSURE

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 Southern Region Geohazard Risk Management Program (Contract No. CON0022161), 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.**

Courtney Mulhall, M.Sc., P.Eng.  
Geotechnical Engineer

JL:bb

James Lyons, P.Eng.  
Civil Engineer

**ATTACHMENTS**

Figure

Appendix I

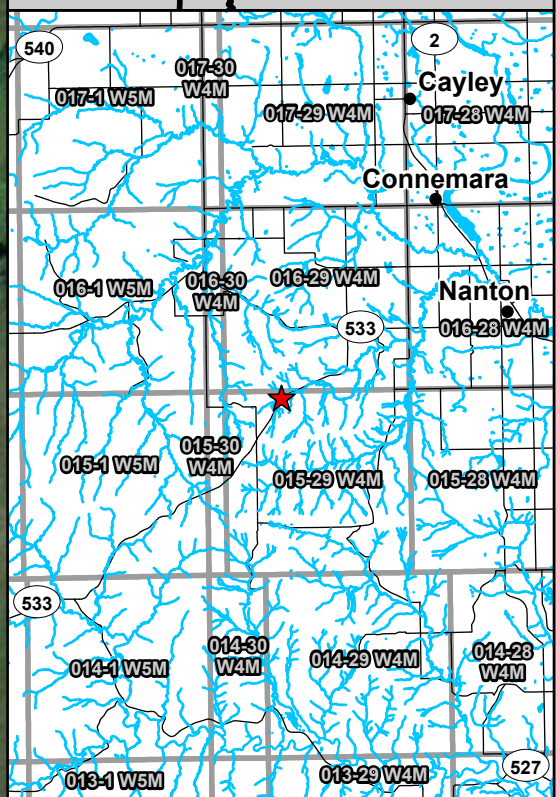
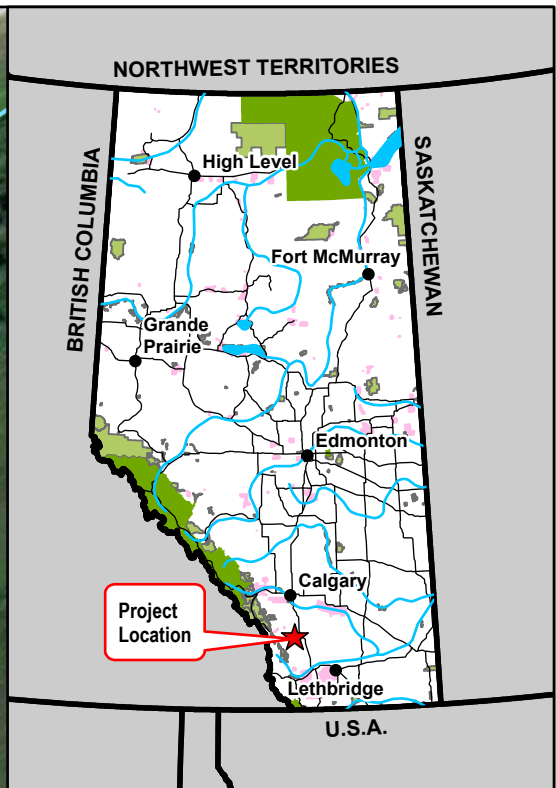
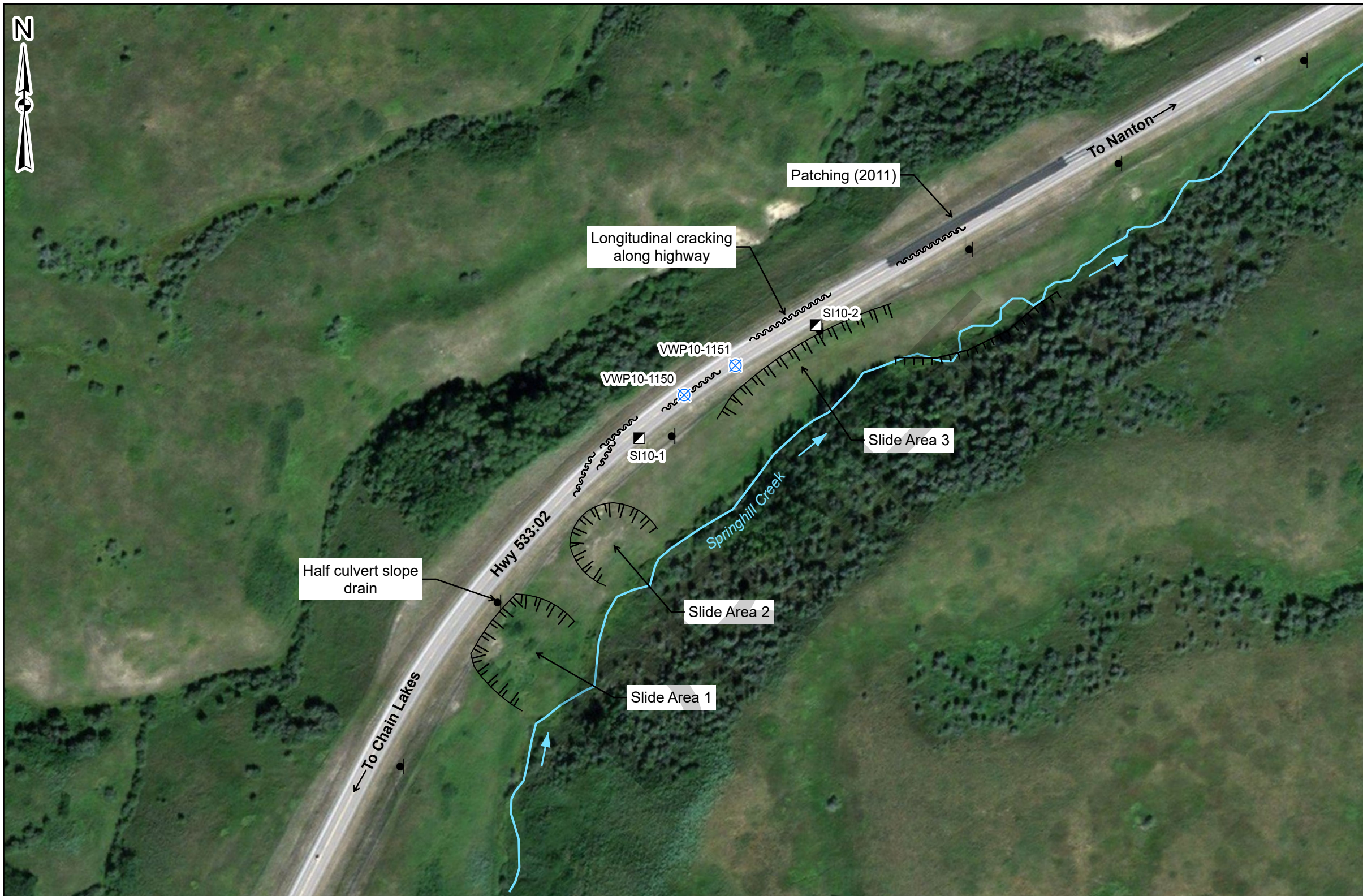
Instrumentation Plots

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**FIGURE**

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**Legend**

- Slope Inclinator (SI)
- ⊗ Vibrating Wire Piezometer (VW)
- Powerpole
- Flow Direction
- Watercourse
- ~ Crack
- ┌┐ Scarp
- └└ Toe Bulge

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

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PROJECT SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
TITLE Site Plan S037 - Springhill Creek Hwy 533:02, km 22.174		
SCALE 1:2,000	PROJECT No. A05116A03	FIG No. 1

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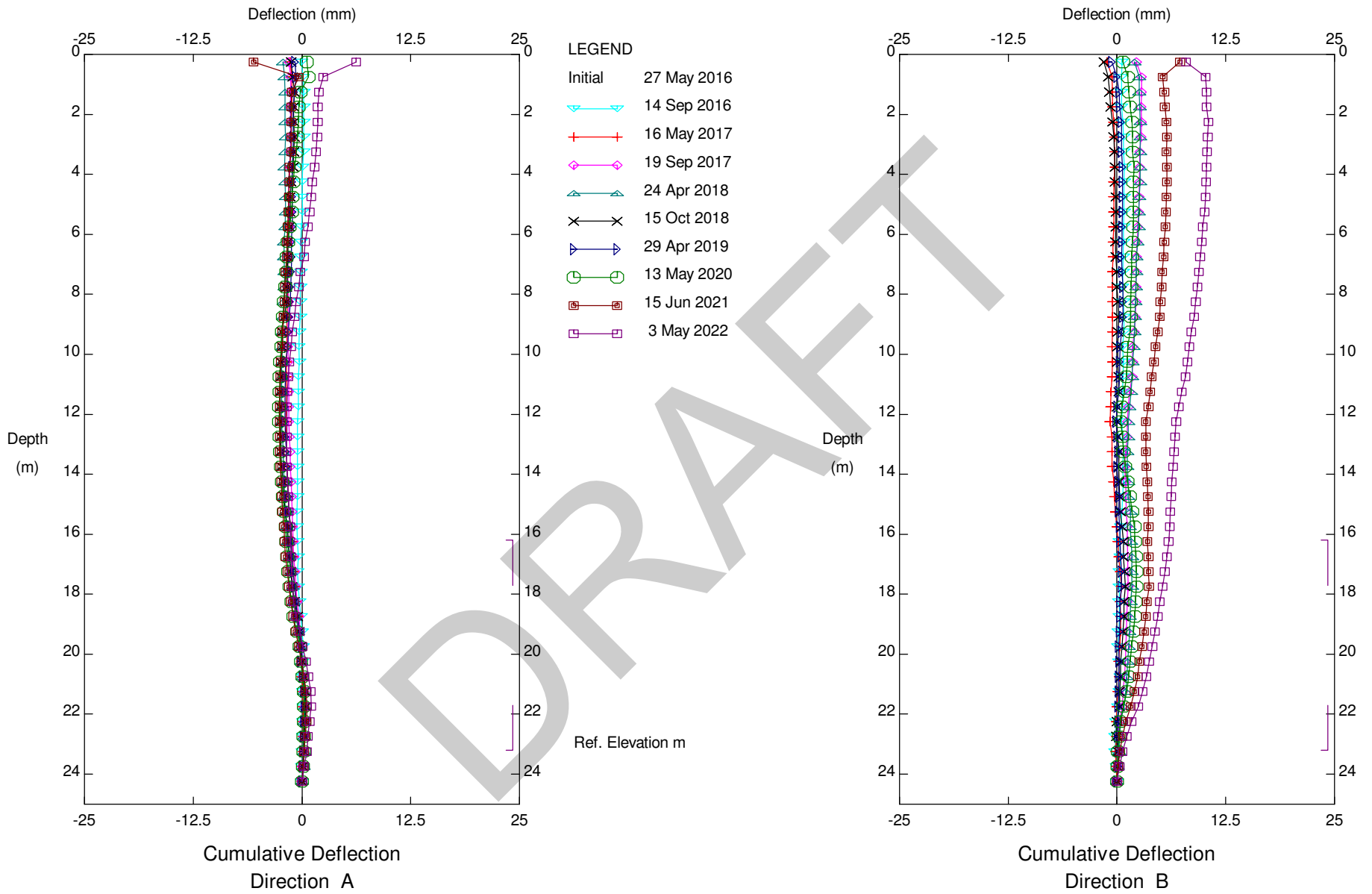
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## APPENDIX I

### Instrumentation Plots

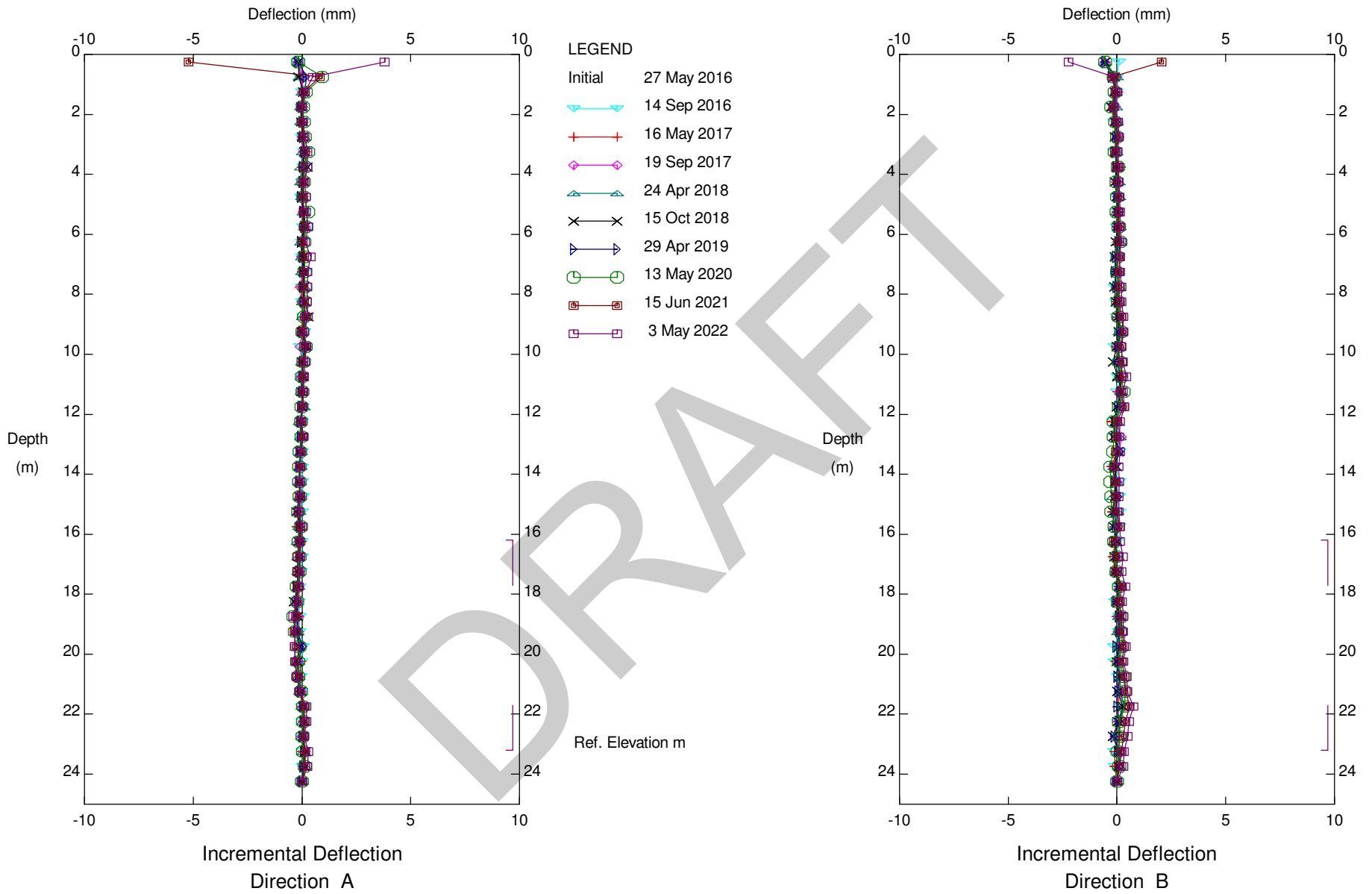
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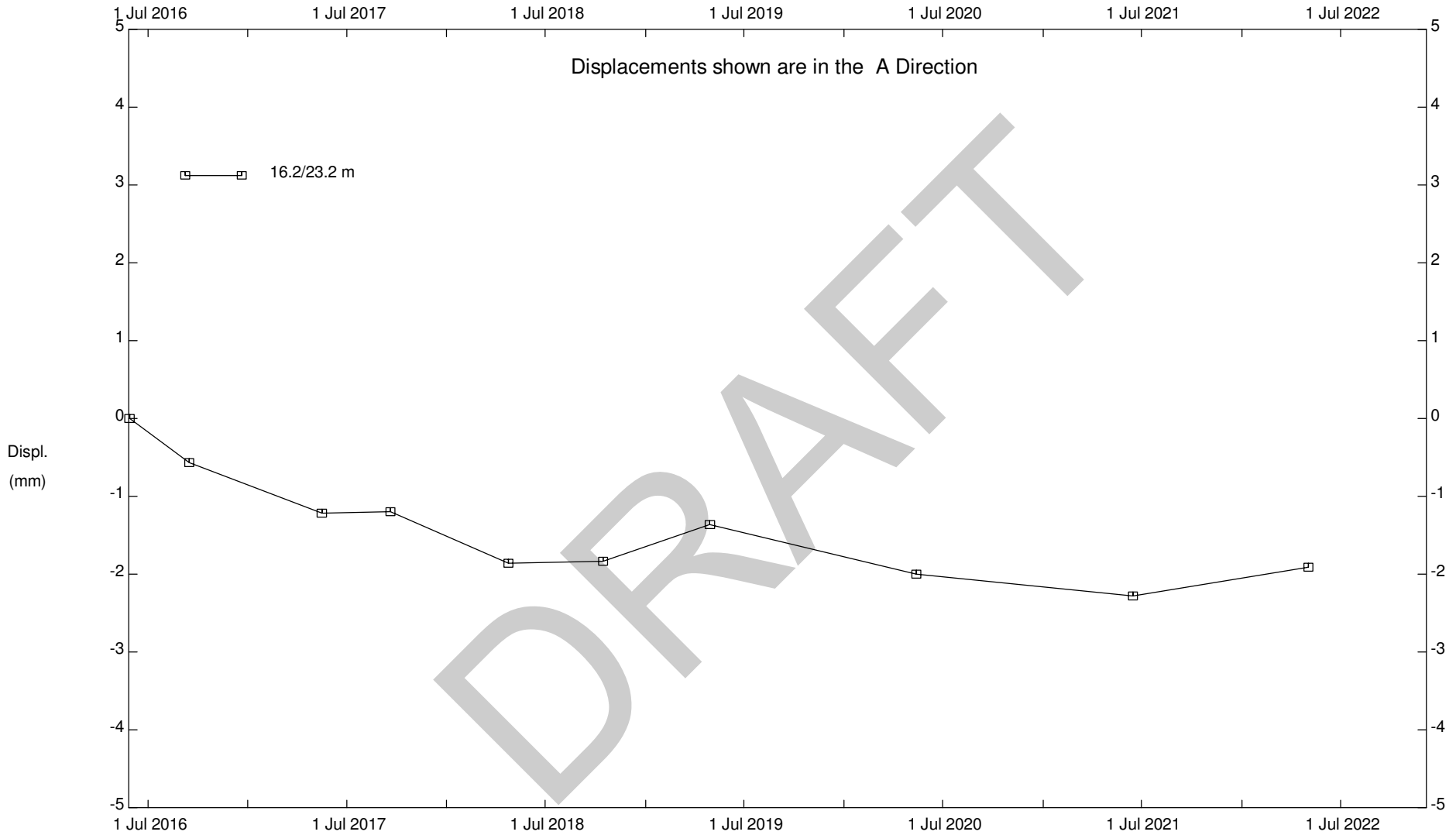


S037; H533:02, Spring Hill Creek, Inclinometer SI10-1  
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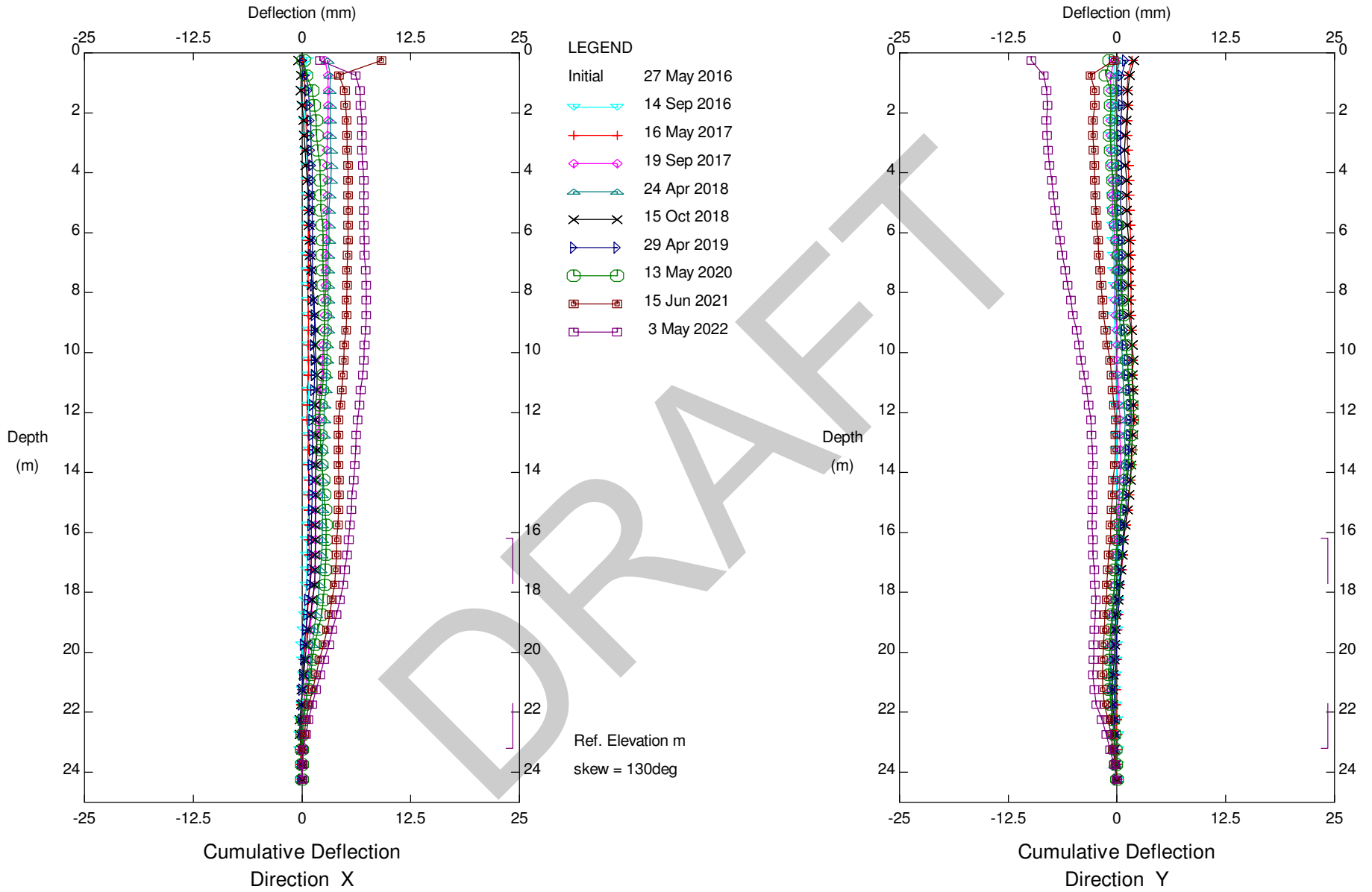
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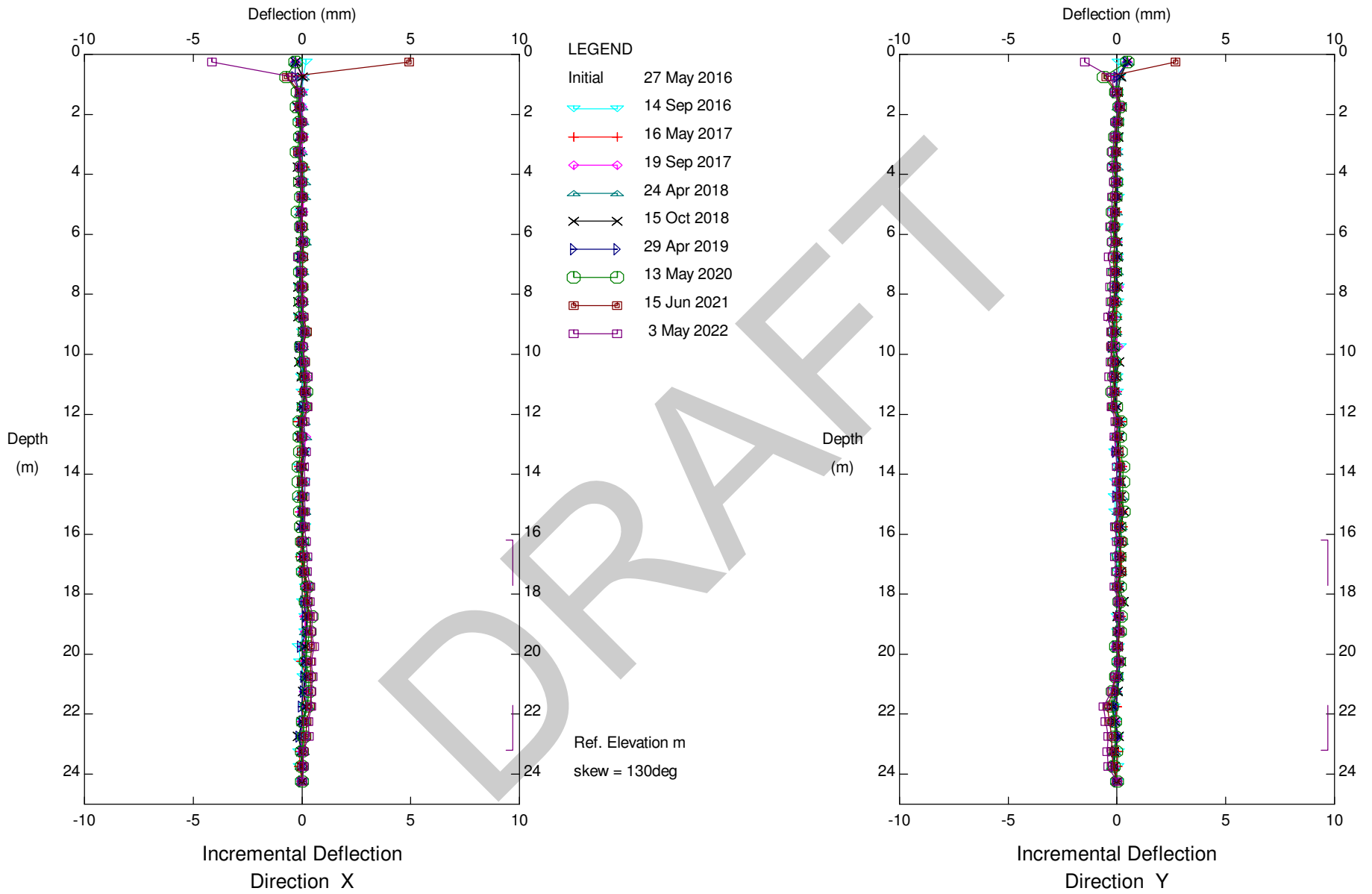
Alberta Transportation

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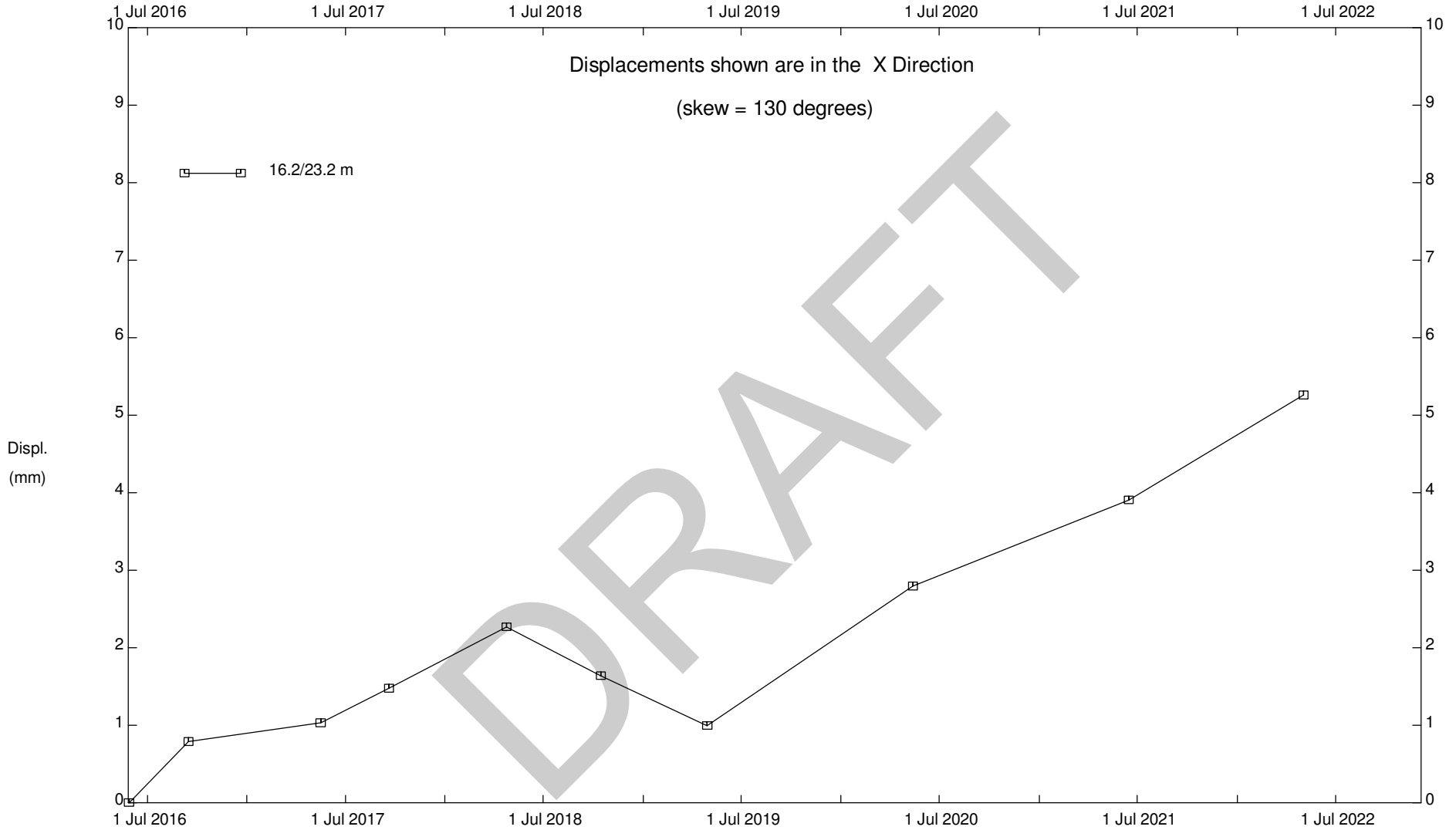
S037; H533:02, Spring Hill Creek, Inclinometer SI10-1  
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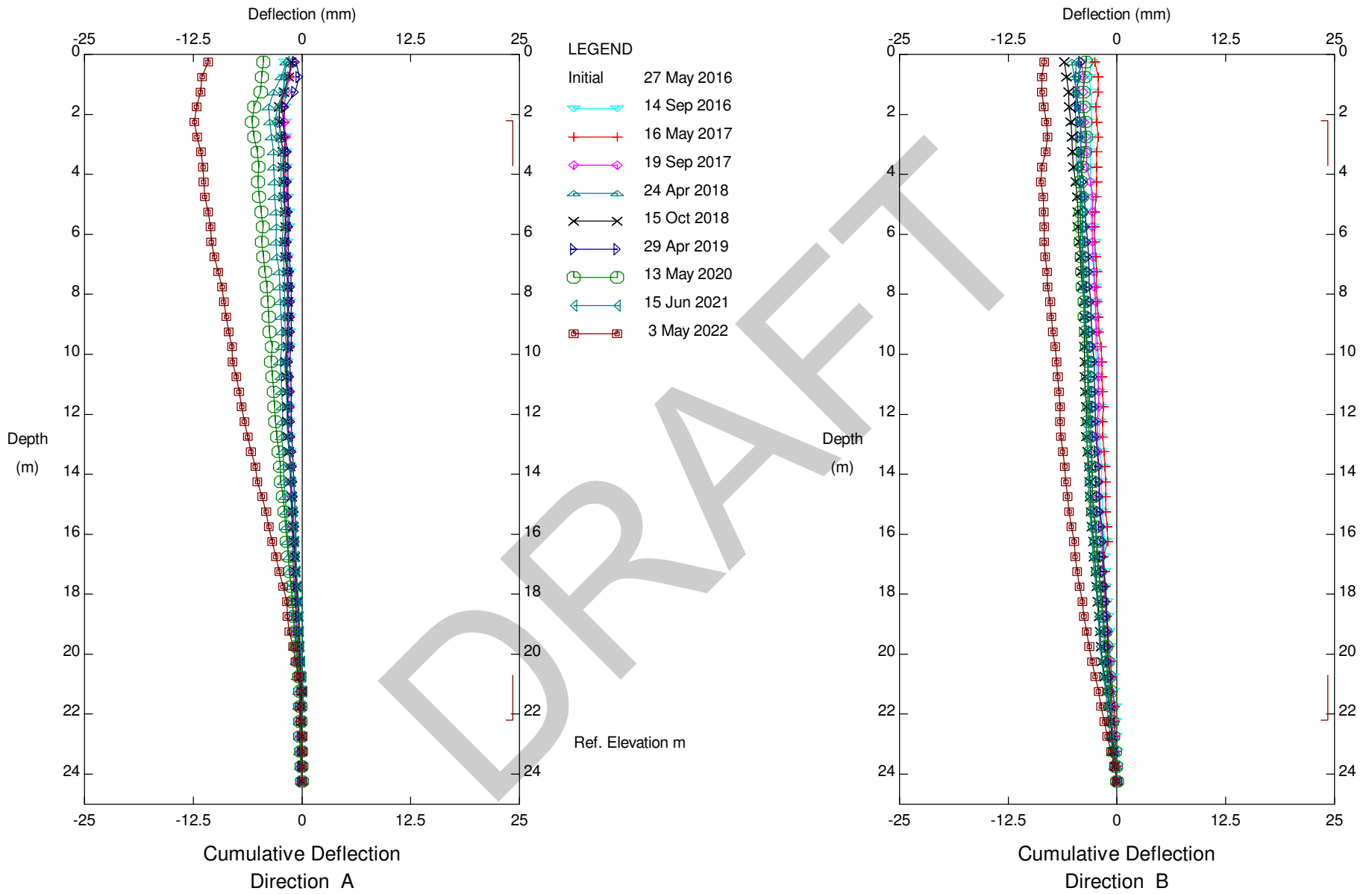
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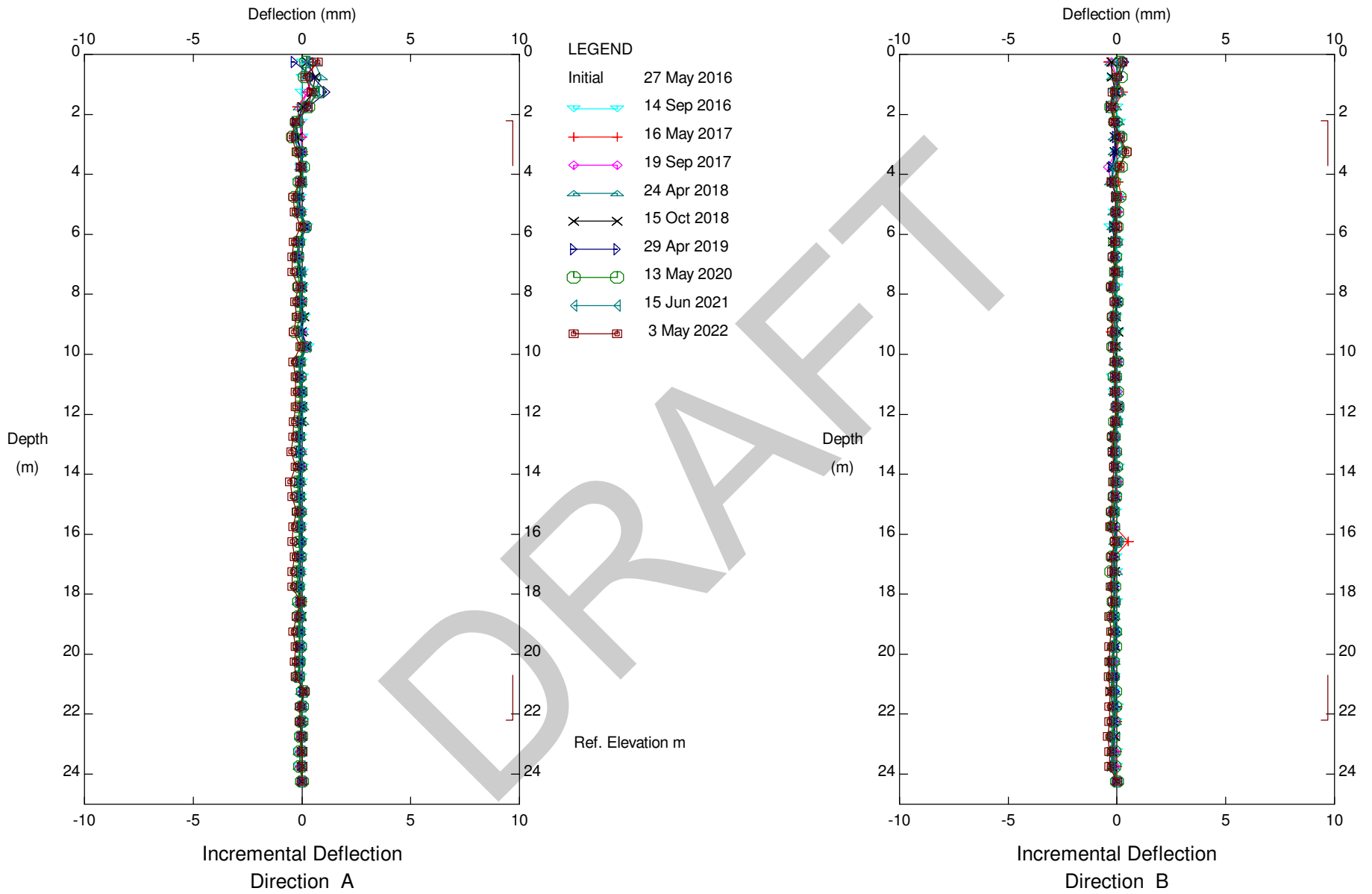
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S037; H533:02, Spring Hill Creek, Inclinator SI10-2  
 Alberta Transportation

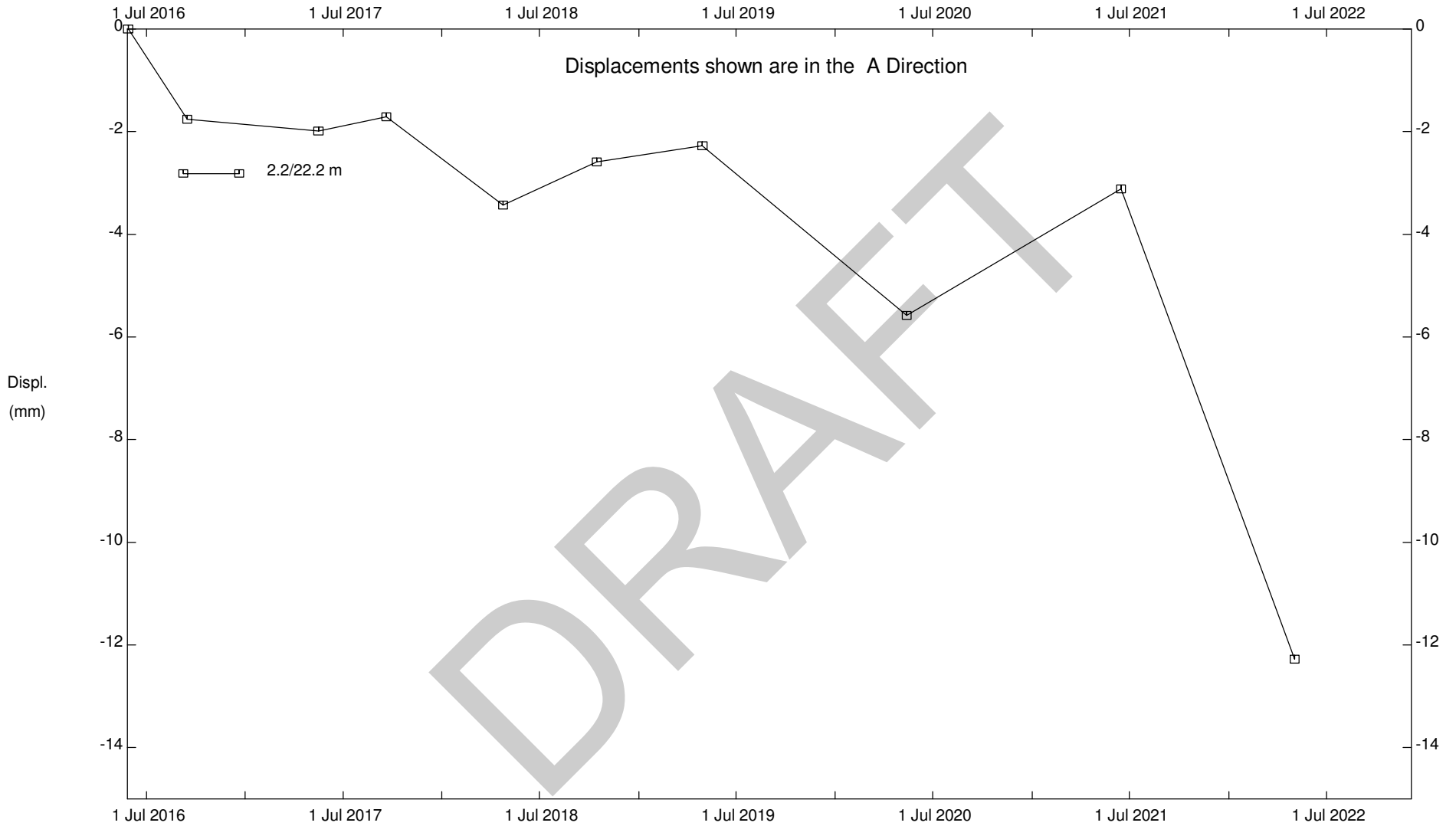


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S037; H533:02, Spring Hill Creek, Inclinometer SI10-2  
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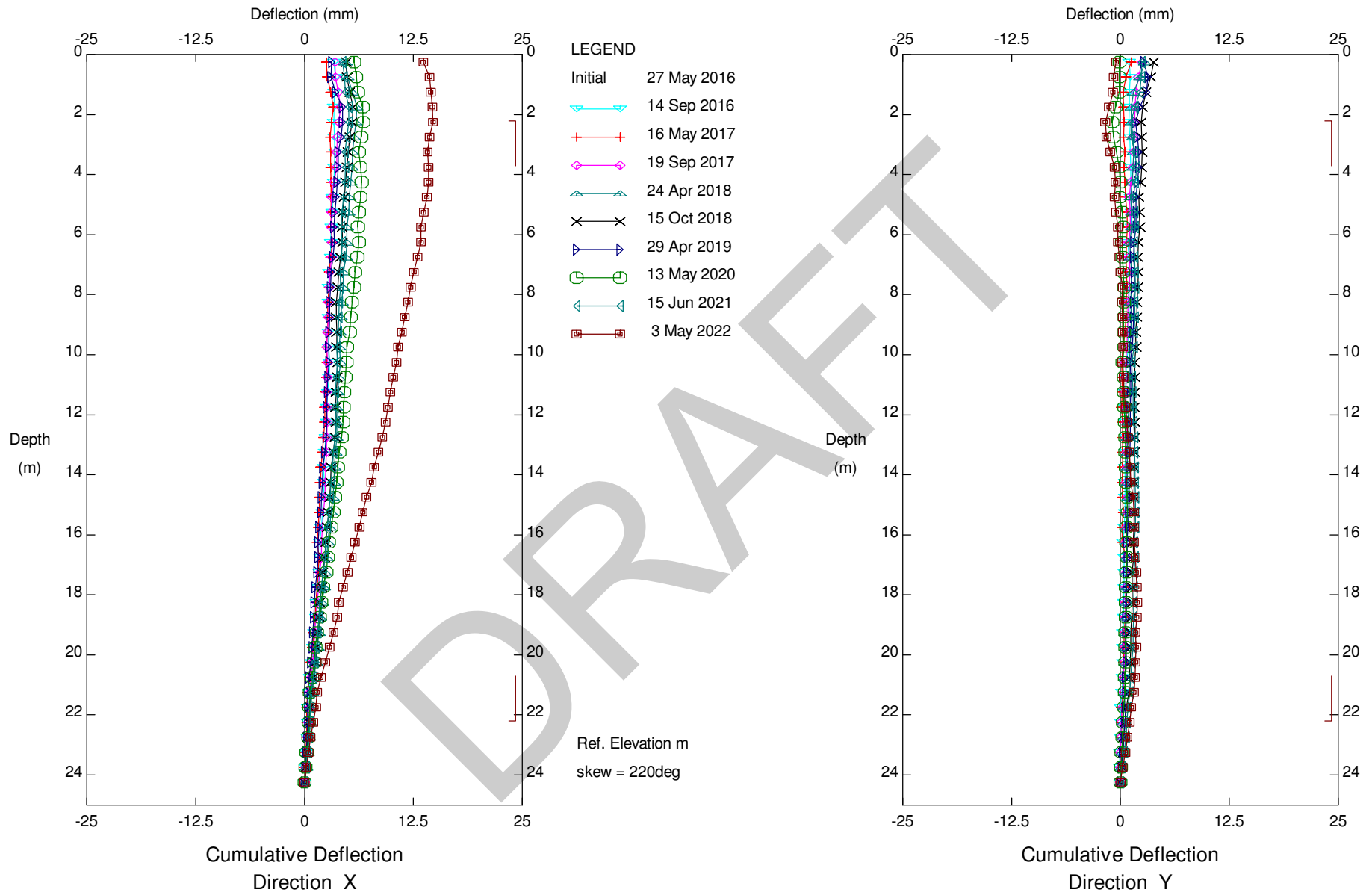
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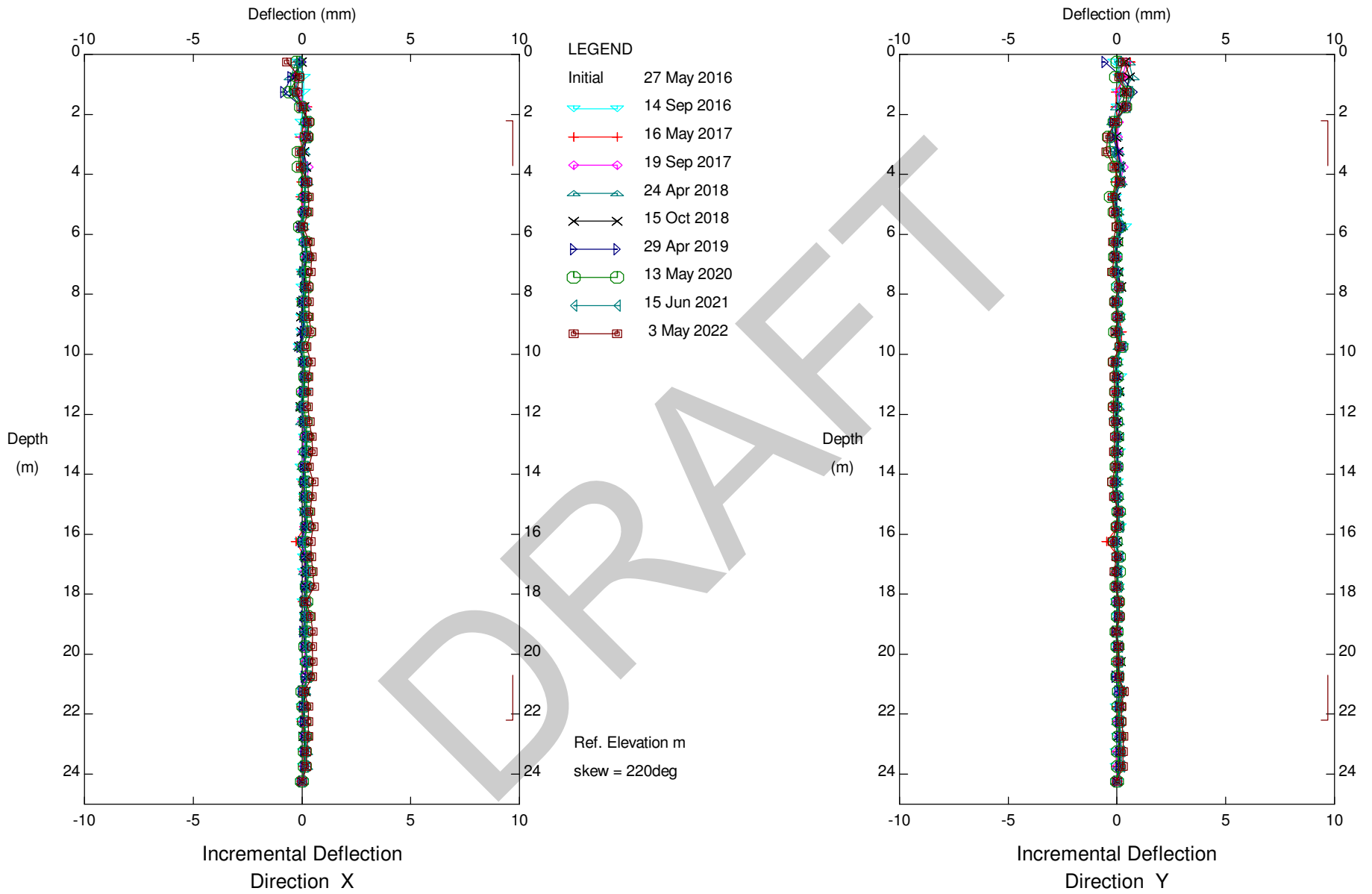
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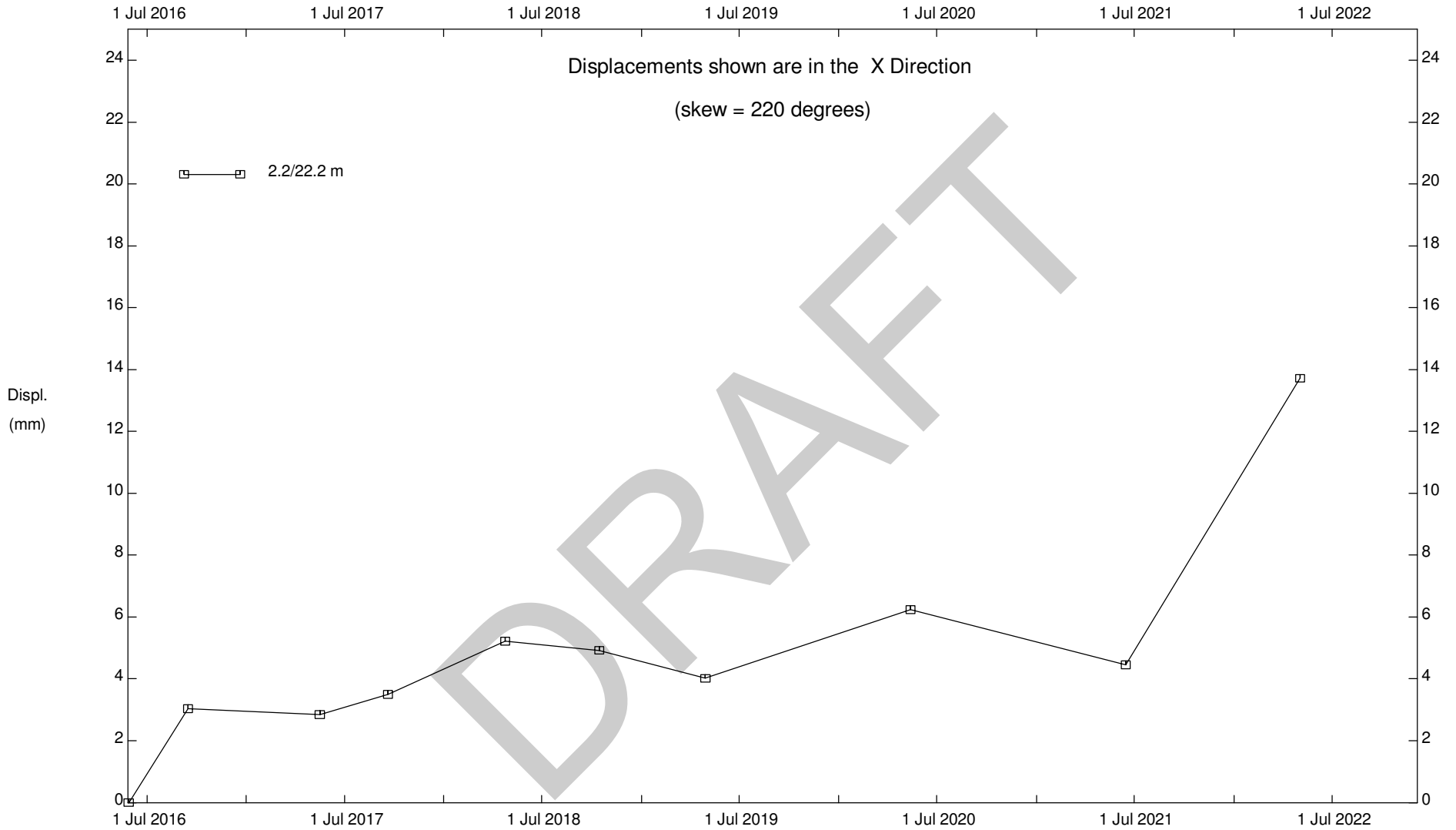
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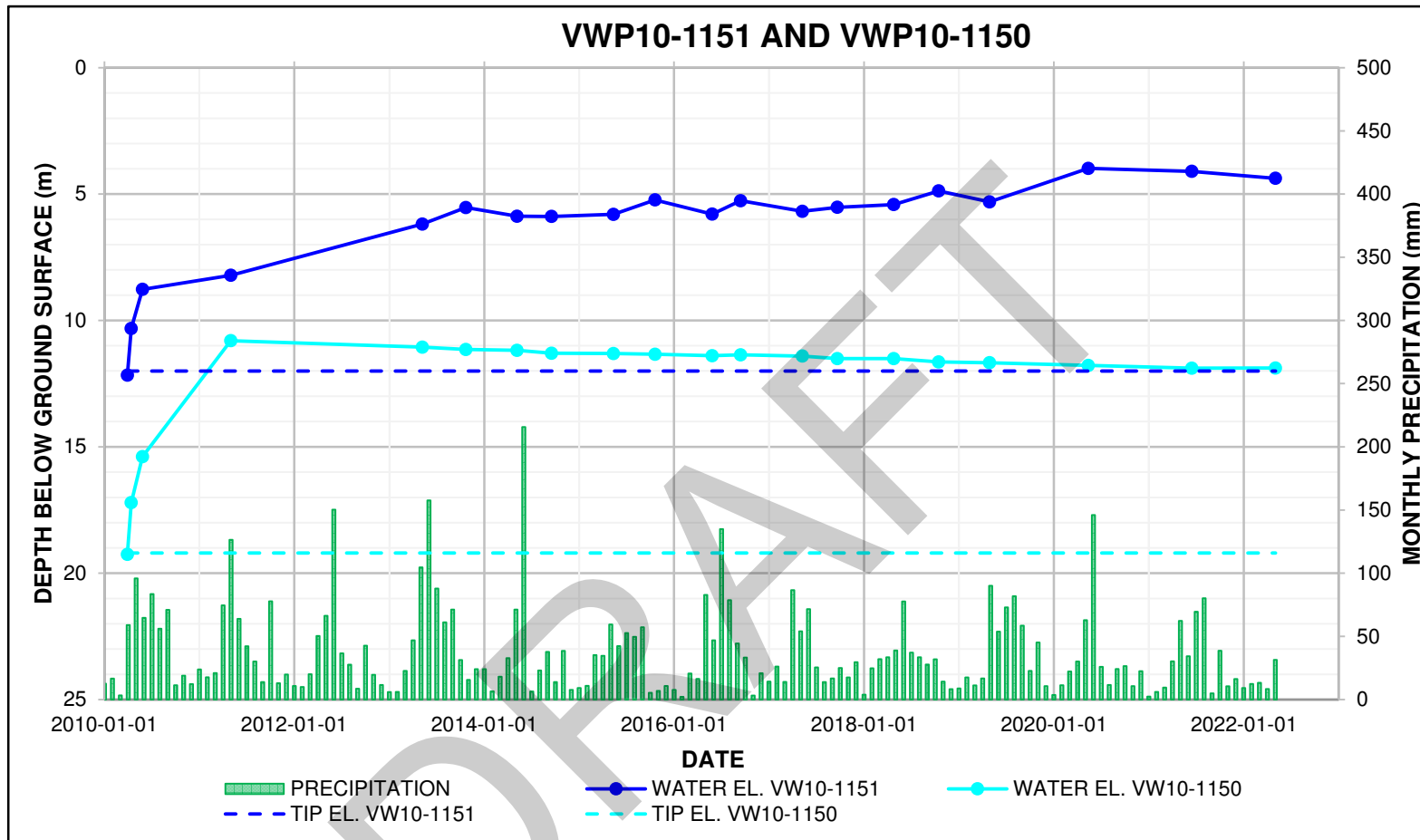
S037; H533:02, Spring Hill Creek, Inclinometer SI10-2  
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S037; H533:02, Spring Hill Creek, Inclinator SI10-2

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**NOTES:**

1. MONTHLY PRECIPITATION DATA OBTAINED FROM THE ALBERTA CLIMATE INFORMATION SERVICE (ACIS) DATABASE, REFERENCING LEGAL SUBDIVISION T015R29-W4.

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PROJECT

SOUTHERN REGION GEOHAZARD RISK  
MANAGEMENT PROGRAM

TITLE

Piezometer Data  
S037 - Spring Hill Creek  
Hwy 533:02, km 21.9 to 22.3

SCALE

PROJECT No.

A05116A03

FIG No.