

January 10, 2022

Alberta Transportation  
Main Floor, Provincial Building  
9621 96 Avenue  
Peace River, Alberta  
T8S 1T4

**Ed Szmata**  
**Construction Technologist**

Dear Mr. Szmata:

**CON0022166 Peace Region (Grande Prairie District – South) GRMP Instrumentation Monitoring Site GP003; H40:38; km 52.134 Cutbank River (South) Section C – 2021 Spring Readings**

## **1 GENERAL**

Two slope inclinometers (SIs) (SI-2 and SI-3) and two pneumatic piezometers (PNs) (PN-3 and PN-5) were read at the GP003 site in the Peace Region (Grande Prairie District – South) (GP South) on June 28, 2021 by Mr. James Lyons, E.I.T. and Ms. Amy Miller, E.I.T. of Klohn Crippen Berger Ltd. (KCB). These instruments were read as part of the GP South geohazard-risk-management program (GRMP). The site is located on Hwy 40:38, km 52.134, south of the Cutbank River. The site coordinates are 6054593 N, 391085 E (UTM zone 11, NAD 83). A site plan is presented in Figure 1.

The geohazard at the GP003 site consists of a slide, channel erosion/degradation, groundwater seepage, and a large tension crack.

### **1.1 Instrumentation**

Instrumentation installation details are tabulated in Table 1.1. Locations of operable instruments are shown in Figure 1.

Four SIs (SI-1, SI-2, SI-3, and SI-11) and two PNs (PN-3 and PN-5) were installed in 1997 and 1998 to monitor depth of movement and groundwater conditions, respectively. SI-11, SI-1, SI-3, and PN-3 were installed near the shoulder of Hwy 40:38 and PN-5 and SI-2 were installed approximately 15 and 40 m downslope of Hwy 40:38, respectively. The instruments are protected with above-ground casing protectors. SI-1 and SI-11 are both inoperable.

The SIs were read using an RST Digitilt MEMS Inclinometer System with a metric inclinometer probe with a 0.5 m wheelbase. Prior to the spring 2021 monitoring program, the readings were obtained using an imperial RST Digital Inclinometer probe with a 2 ft wheelbase and an RST Pocket PC readout.

The PNs were read using an RST C109 pneumatic piezometer readout.

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**Table 1.1 Instrumentation Installation Details**

Instrument ID	Instrument Type	Date Initialized	Coordinates <sup>1</sup> (m)		Ground Surface Elevation (m)	Stick Up (m)	Depth Below Ground Surface (m)	Condition
			Northing	Easting				
SI-1	SI	Dec. 14, 1997	Unknown	Unknown	Unknown	Unknown	Unknown	Inoperable
SI-2	SI	Dec. 13, 1997	6054137	391025	763	0.69	11.5	Operational
SI-3	SI	Dec. 14, 1997	6054221	390991	764	0.58	19.5	Operational
<del>SI-11</del>	<del>SI</del>	<del>Oct. 5, 1997</del>	<del>Unknown</del>	<del>Unknown</del>	<del>Unknown</del>	<del>Unknown</del>	<del>Unknown</del>	<del>Inoperable</del>
PN-3	PN	May 22, 1998	6054221	390991	763	N/A	9.1	Operational
PN-5	PN	May 22, 1998	6054193	391005	765	N/A	7.6	Operational

**Notes:**

<sup>1</sup> Installation details were provided by AT and the previous consultant. Ground surface elevations were not provided for the SIs, so the ground surface elevation from adjacent instruments/piezometer tips if provided.

## 2 INTERPRETATION

### 2.1 General

For the operational SIs, the cumulative displacement, incremental displacement, and displacement-time data was plotted in the A-direction (i.e., the direction of the A0-groove) and the X-direction (i.e., the direction of maximum movement obtained at a skew angle from the A0-grooves). SI-2 and SI-3 have skew angles of 349° and 357°, respectively, measured clockwise from the direction of the A0-grooves.

For the operational PNs, the equivalent water level data was plotted relative to ground surface elevation and each instrument’s tip elevation.

The SI and piezometer 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 Initialized	Date of Previous Reading	Date 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 (mm)	Incremental Movement Recorded Since Previous Maximum Cumulative Movement Recorded (mm)	Rate of Movement (mm/year)		
									Previous Maximum	Current	Change from Previous Reading
SI-2 <sup>2</sup>	Dec. 13, 1997	Oct. 8, 2020	Oct. 8, 2020	Jun. 28, 2021	763.14	4.0	21.1	0.7	19.4	0.9	-5.2
SI-3	Dec. 14, 1997	Oct. 8, 2020	Oct. 8, 2020	Jun. 28, 2021	763.66	N/A – no discernible movement has been recorded					

**Notes:**

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

<sup>2</sup> There was a small data shift between the fall 2020 and spring 2021 readings when the SI probe was changed.

**Table 2.2 Pneumatic Piezometer Reading Summary**

Instrument ID	Date Installed	Date of Previous reading	Date of Most Recent Reading	Ground Surface Elevation (m)	Tip Depth (mbgs <sup>1</sup> )	Previous Water Level (mbgs <sup>1</sup> )	Current Water Level (mbgs <sup>1</sup> )	Change from Previous Reading (m)
PN-3	May 22, 1998	Oct. 8, 2020	Jun. 28, 2021	763	9.1	4.9	4.8	0.1
PN-5	May 22, 1998	Oct. 8, 2020	Jun. 28, 2021	765	7.6	6.9	5.9	1.0

**Notes:**

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

KCB reviewed the instrumentation data provided by the previous consultant and removed corrections applied to the historical SI data based on our experience. The instrumentation data obtained by KCB is generally consistent with the data obtained by the previous consultant.

The SI data plots presented herein include data for readings taken with both the previous consultants' and KCB's equipment.

## 2.2 Zones of Movement

For SI-2, there is a zone of distributed movement from approximately El. 759 m to El. 752 m and a more distinct zone of distributed movement from approximately El. 759 m to El. 760.5 m. There is also some movement from approximately El. 761 m to El. 763 m (i.e., 2 mbgs to ground surface).

For SI-3, there is no discernible zones of movement.

## 2.3 Interpretation of Monitoring Results

SI-2, which is located near the toe of the highway embankment, has been recorded movement at approximately the same elevation as Roseham Creek which is located at the toe of the highway embankment. Movement being recorded by SI-2 was relatively slow and constant between 1997 and 2015. However, between 2015 and 2021, the movement rates have significantly increased (e.g., approximately 1.6 mm/year to 16.8 mm/year, recorded in 2016 and 2019, respectively).

The increased rate of movement was also observed on site, when a larger-than-typical asphalt crack was observed during AT's 2015 annual inspection. The increased rate of movement may be caused by erosion at the toe of the highway embankment and groundwater seeping through the embankment fill.

PN-3 recorded a slight increase of 0.1 m since October 2020. PN-5 recorded an increase of 1.0 m in which is more than seasonal variations recorded previously by this instrument. The cause of the increase in PN-5 is unknown but may be due to the instrument ageing and starting to fail (it was installed in 1998). Seasonal variations in water levels doesn't seem likely because PN-3 has not recorded any increase and it was a dry spring and summer. The increase in water level at El. 757 corresponds to the depth at which movement is recorded in SI-02 which would appear to be consistent (higher water level, increased rate of movement). It could be that higher water levels are starting to hydraulically connect to PN-5, though it has taken a while for this to occur since increased movement started in 2015 and an increase in water level was only noted this spring.

An increased rate of movement was recorded in the spring 2021 readings. Depending on the fall readings, this may be due to the probe being changed from the one used by the last consultant. KCB may have to re-zero the SI using the spring 2021 readings as baseline.

If PN-3 starts to indicate variable readings (i.e., increases and decreases), AT may need to replace it.

### **3 RECOMMENDATIONS**

#### **3.1 Future Work**

All operational instruments should continue to be read once per year (spring).

In the spring of 2022, KCB will confirm the instrument coordinates and ground surface elevations with a handheld GPS (accuracy of  $\pm 5$  m), and where applicable, sticks up and reading depths with a tape measure, and azimuths of the SI A0-grooves with a compass.

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

#### **3.2 Instrument Repairs**

No instrument repairs are required.

## 4 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. (KCB). The report has been prepared for the exclusive use of Alberta Transportation (Client) for the specific application to the Peace Region Geohazard Risk Management Program (Contract No. CON0022166) 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. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

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

Yours truly,

**KLOHN CRIPPEN BERGER LTD.**



James Lyons, E.I.T.  
Civil Engineer

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

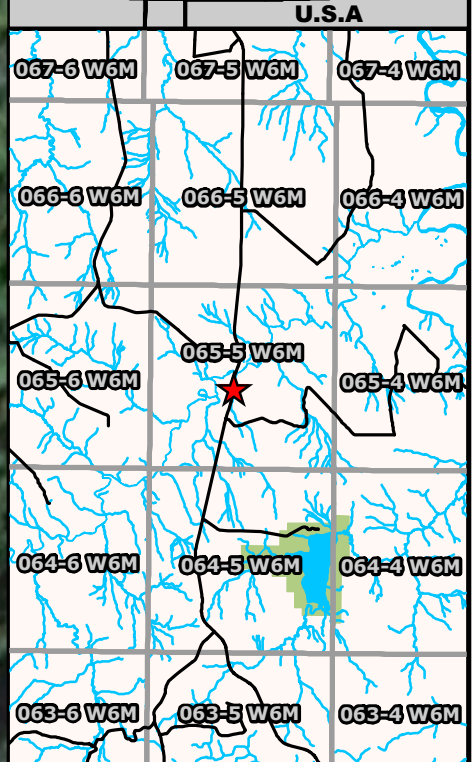
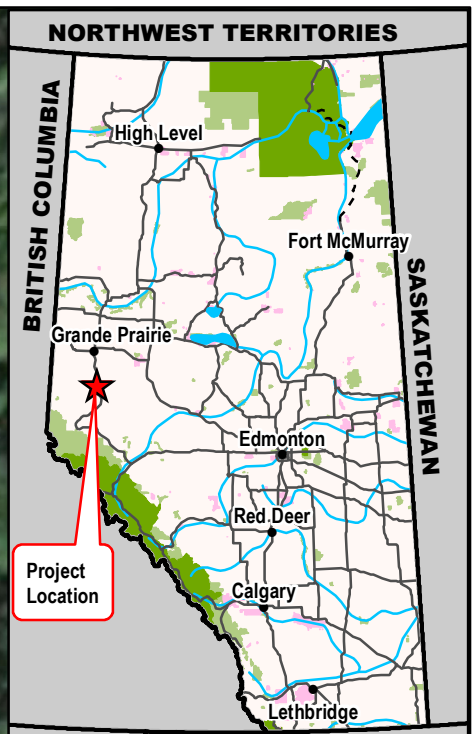
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### ATTACHMENTS

Figure  
Appendix I      Instrumentation Plots

## FIGURE

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- Legend**
- ◆ Pneumatic Piezometer (PN)
  - ▣ Slope Inclinator (SI)
  - Watercourse
  - ||| Bank Slumping
  - Flow Direction



Time: 17:55:57 PM  
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NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM Zone 11N  
 3. IMAGE SOURCE: Microsoft Bing

CLIENT

PROJECT	PEACE REGION (GRANDE PRAIRIE DISTRICT - SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM	
TITLE	Site Plan GP003 Cutbank River (South) Hwy 40:38, km 52.134	
SCALE	PROJECT No.	FIG No.
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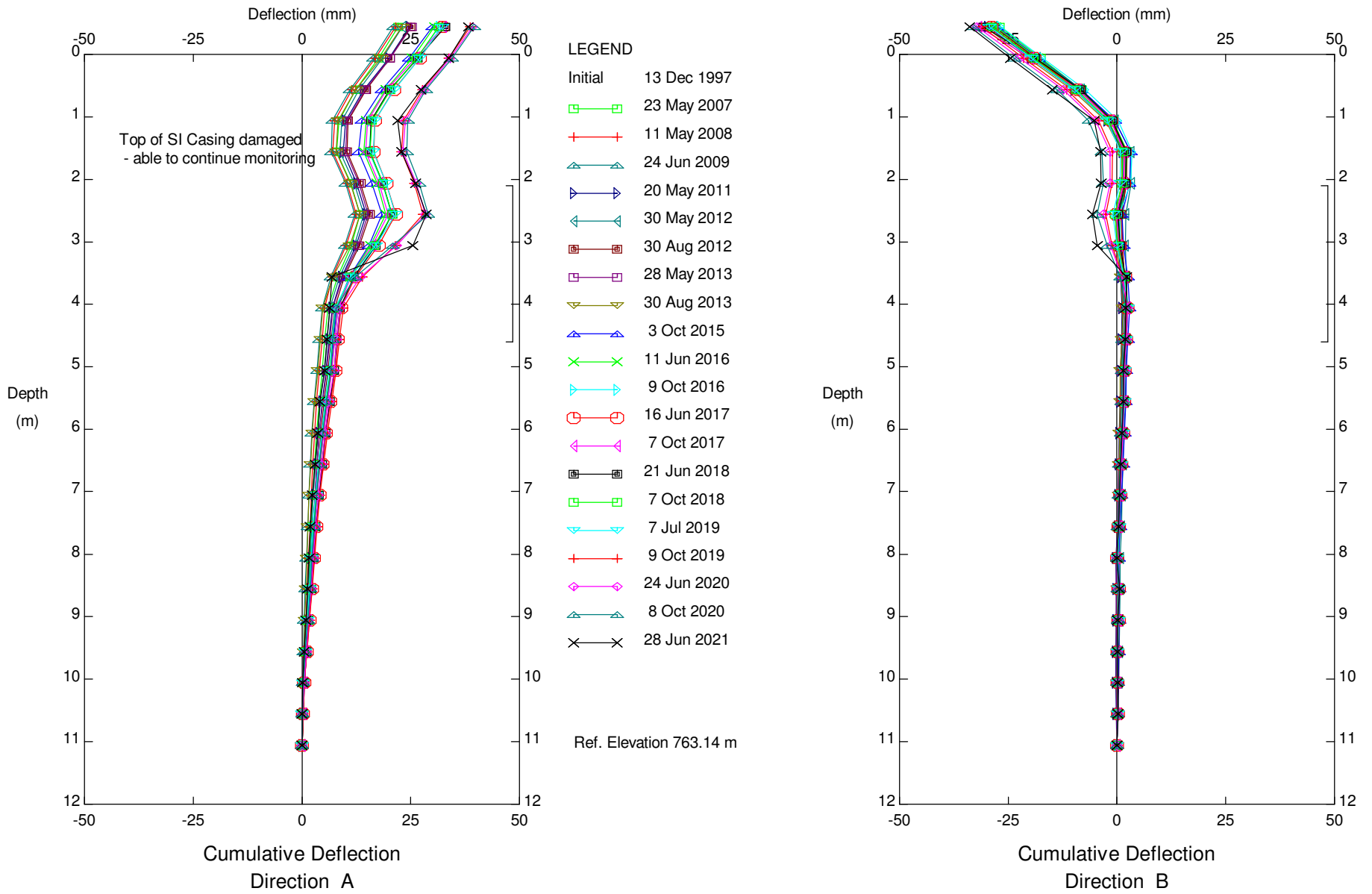


# APPENDIX I

## Instrumentation Plots

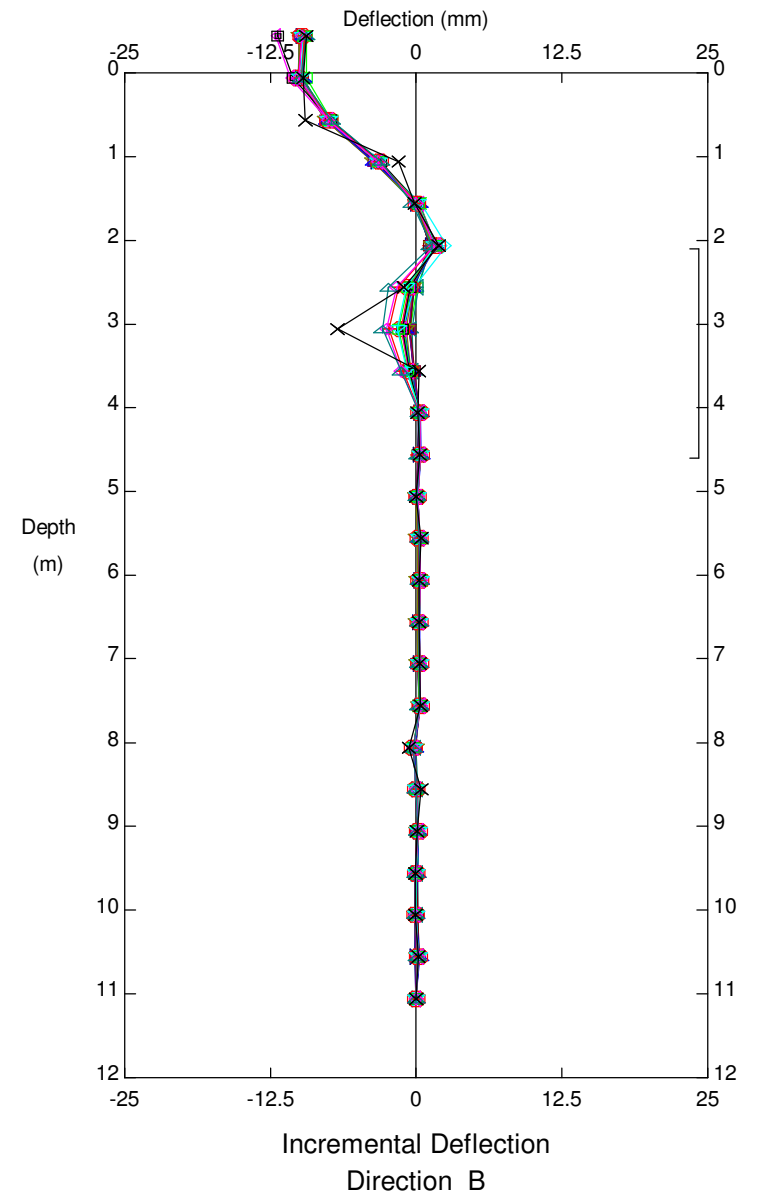
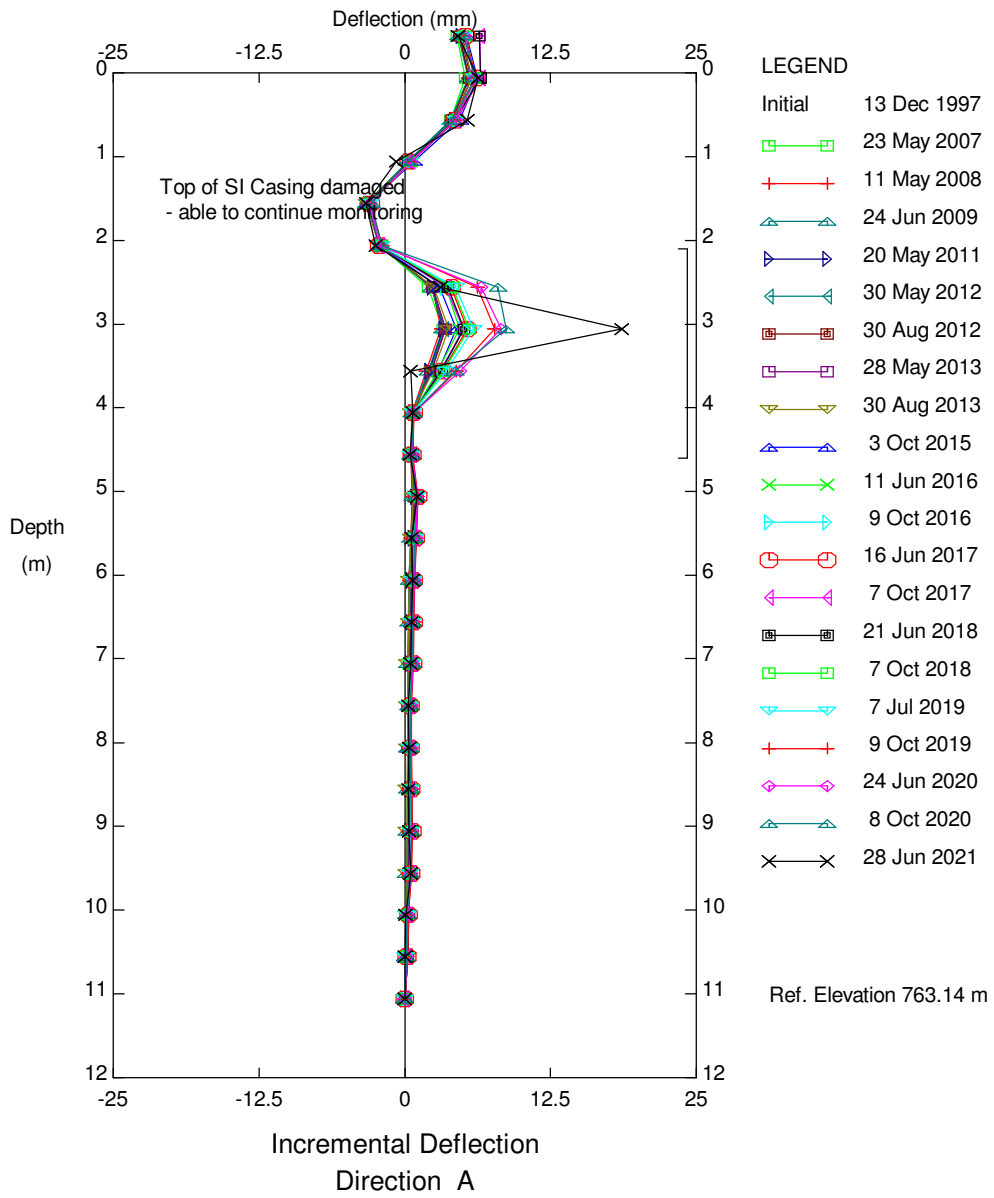
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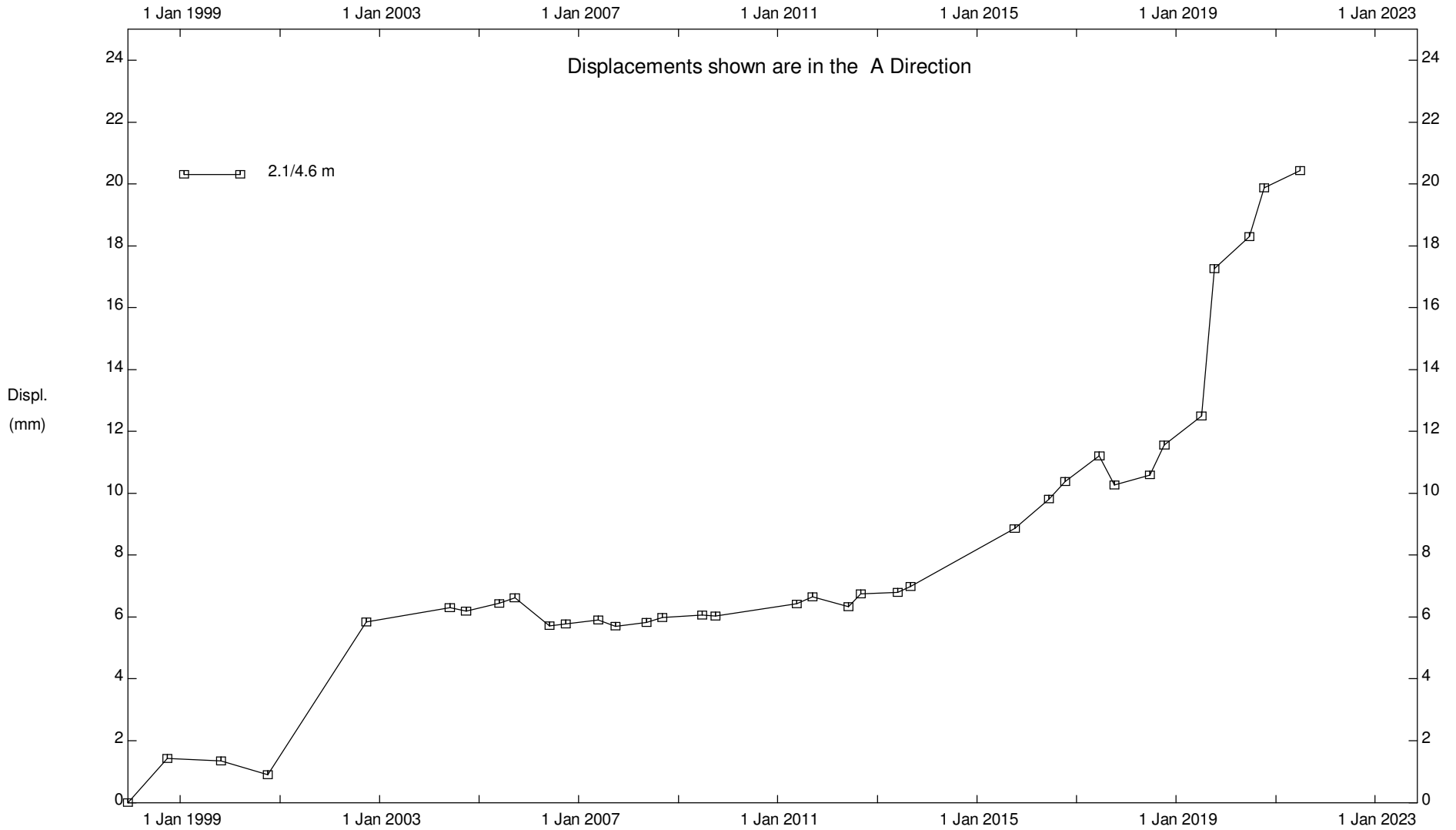
GP003; H40:38, Cutbank River (South), Inclinometer SI-02  
Alberta Transportation

### Klohn Crippen Berger - Calgary



GP003; H40:38, Cutbank River (South), Inclinator SI-02  
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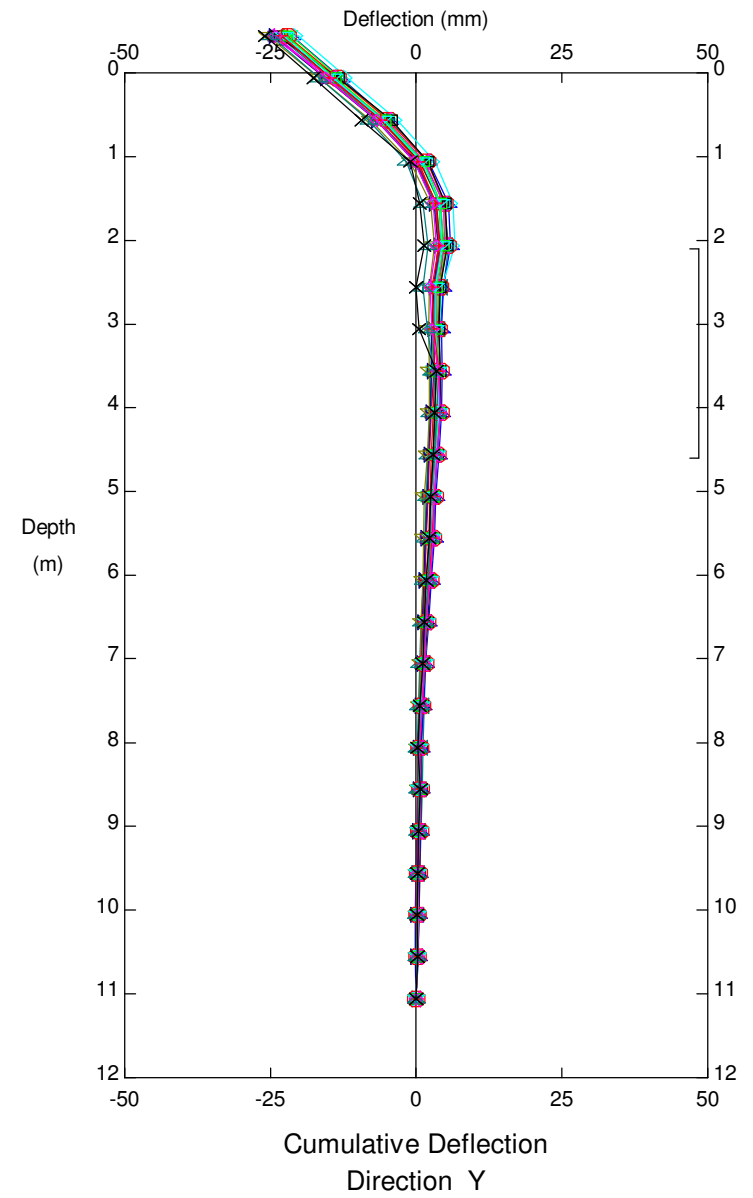
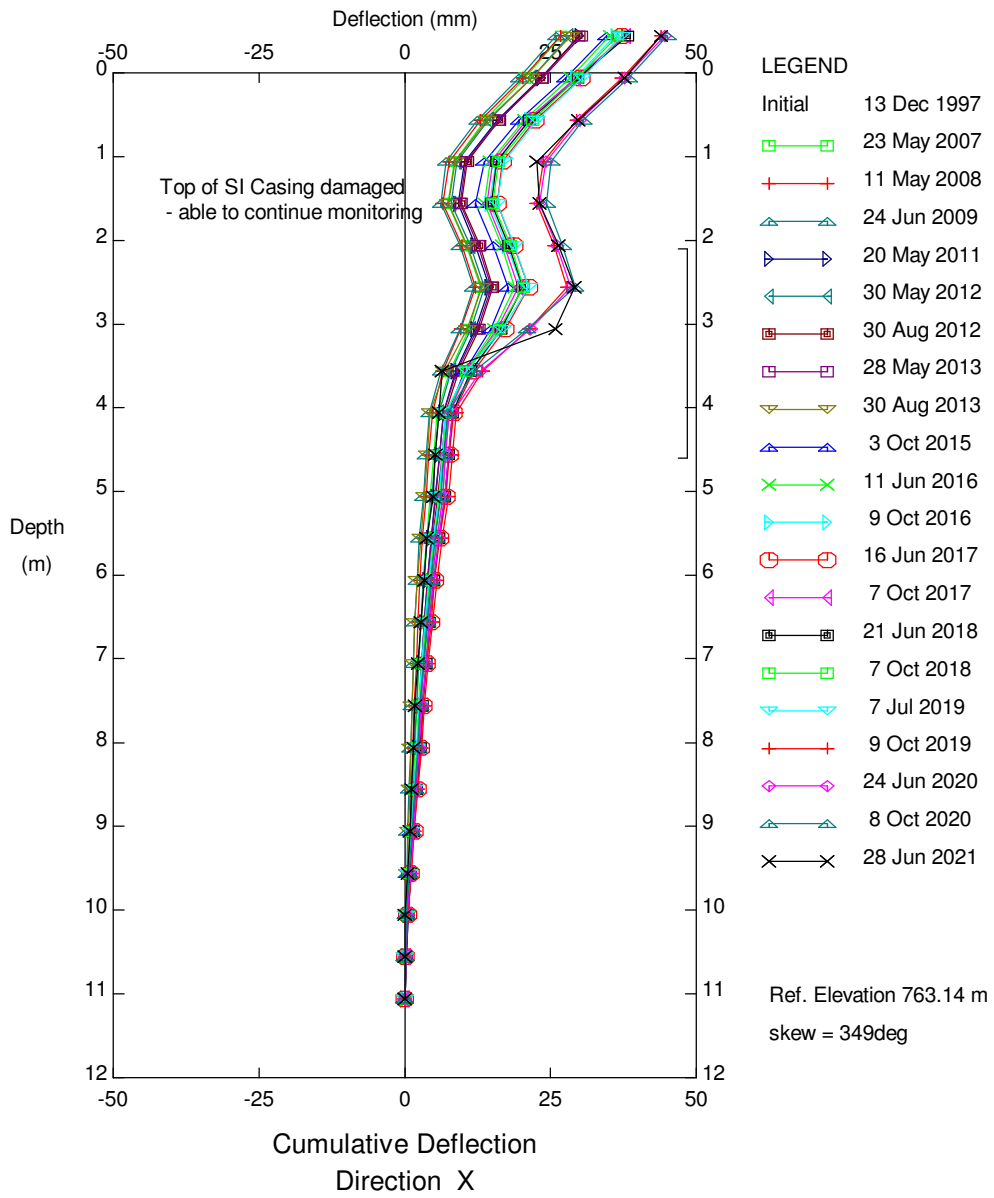
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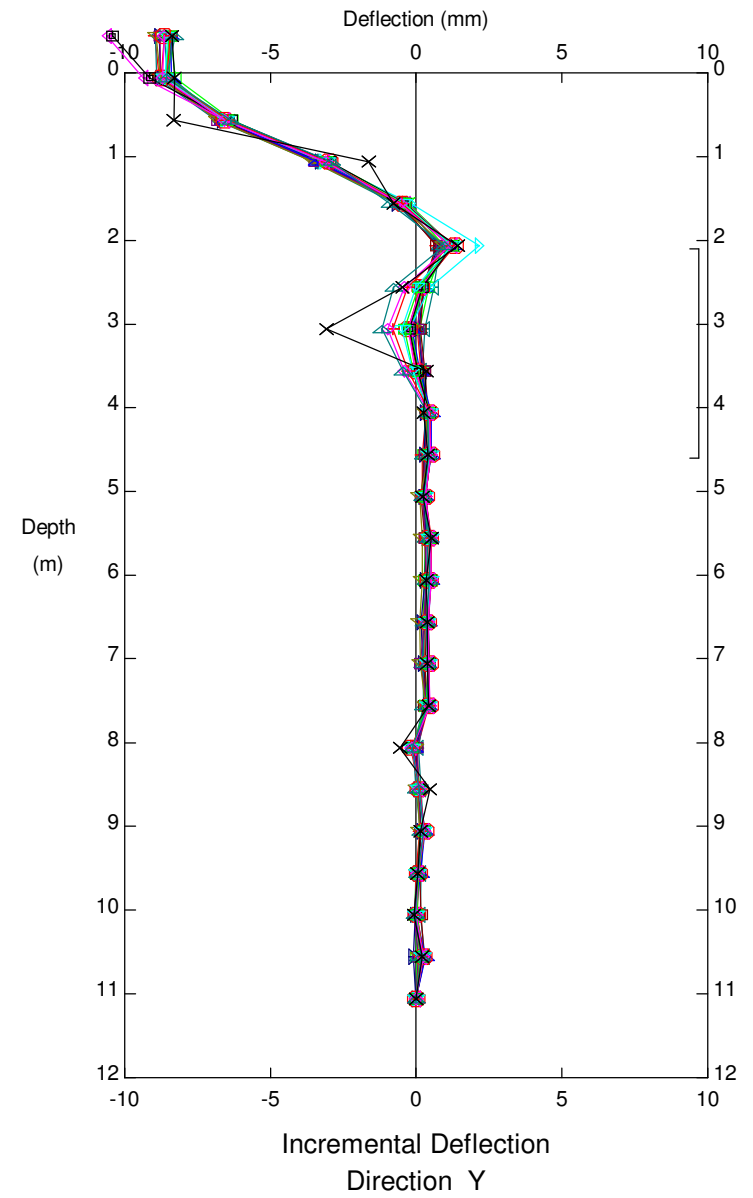
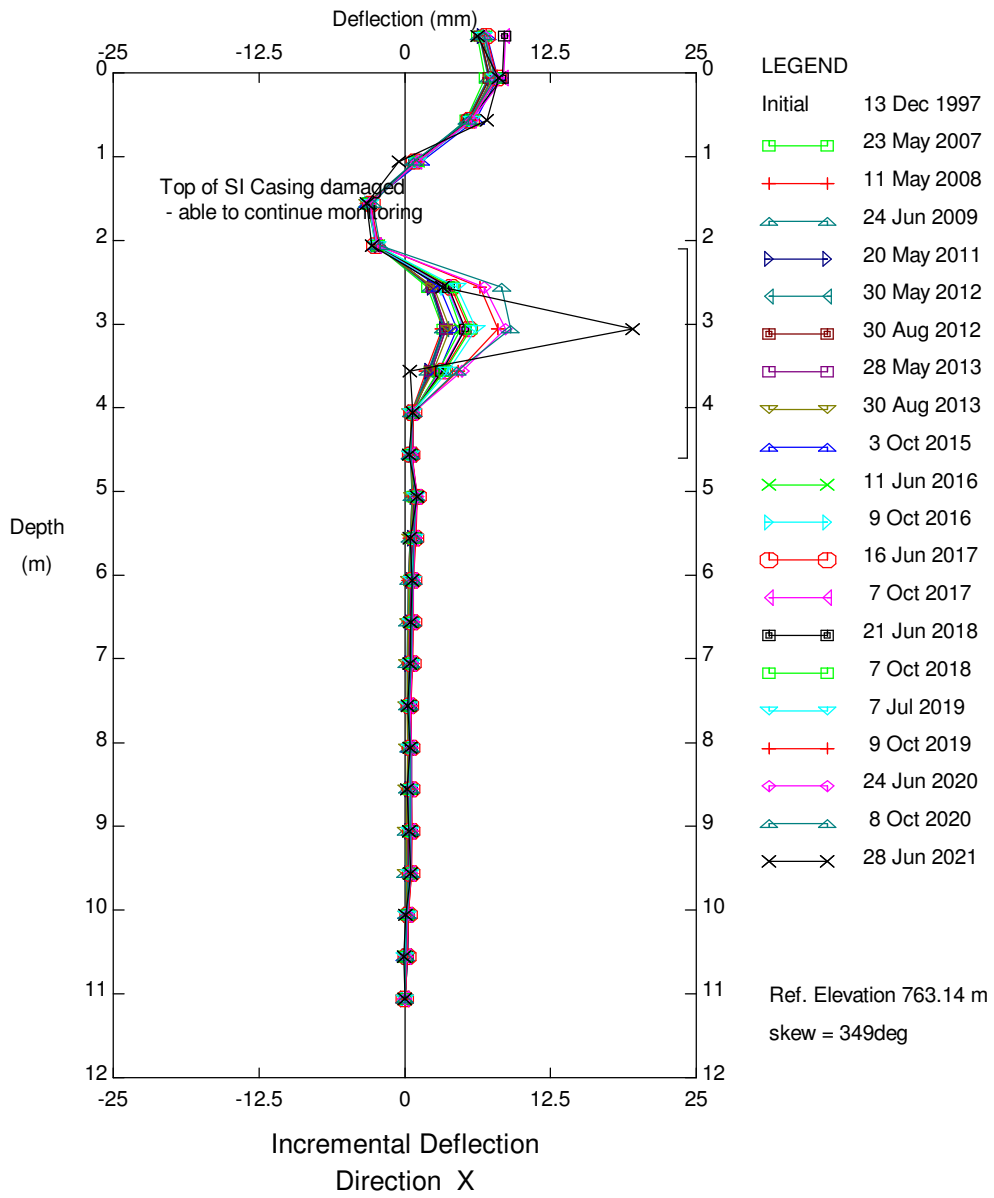
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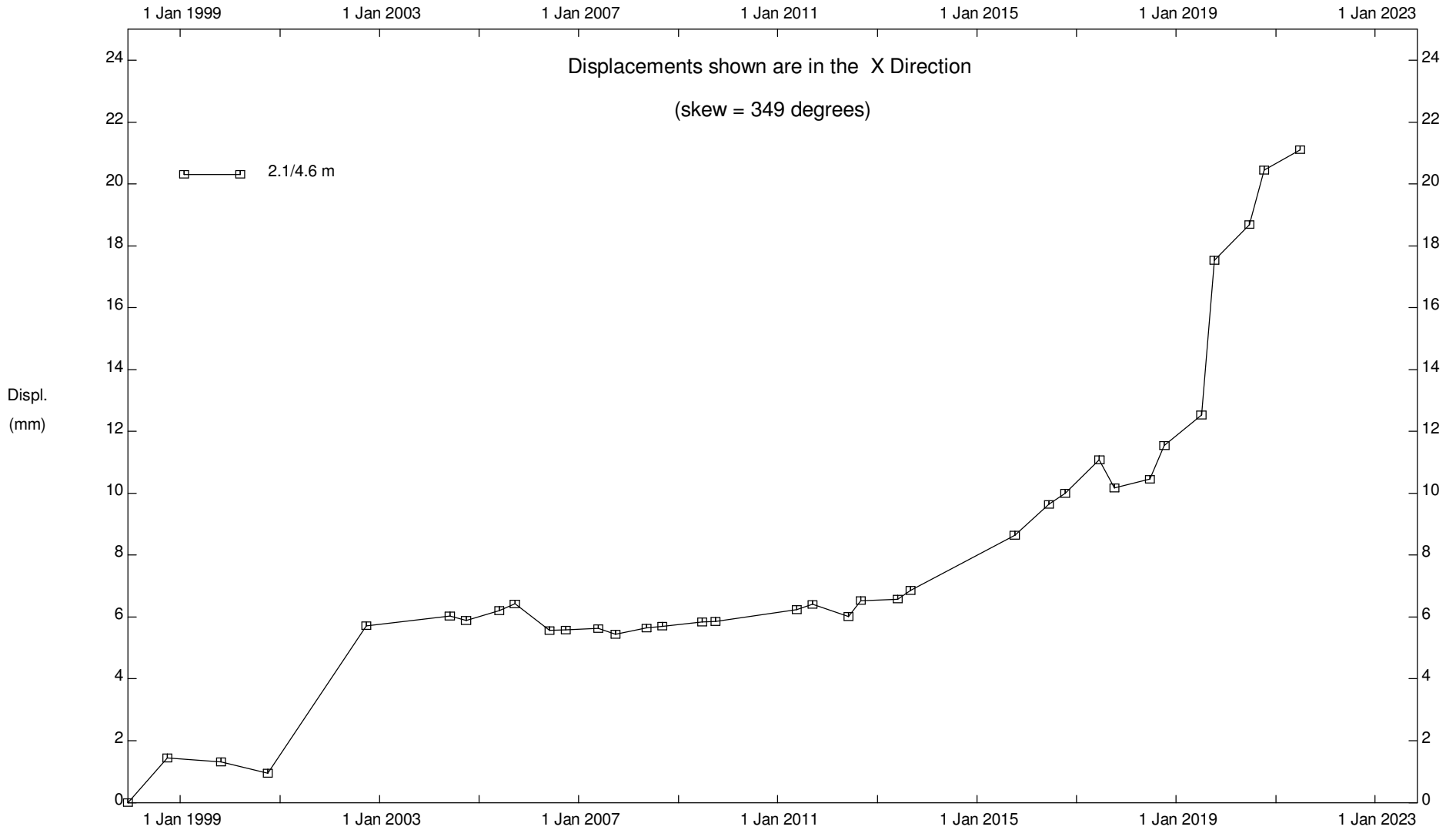
GP003; H40:38, Cutbank River (South), Inclinator SI-02  
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GP003; H40:38, Cutbank River (South), Inclinator SI-02  
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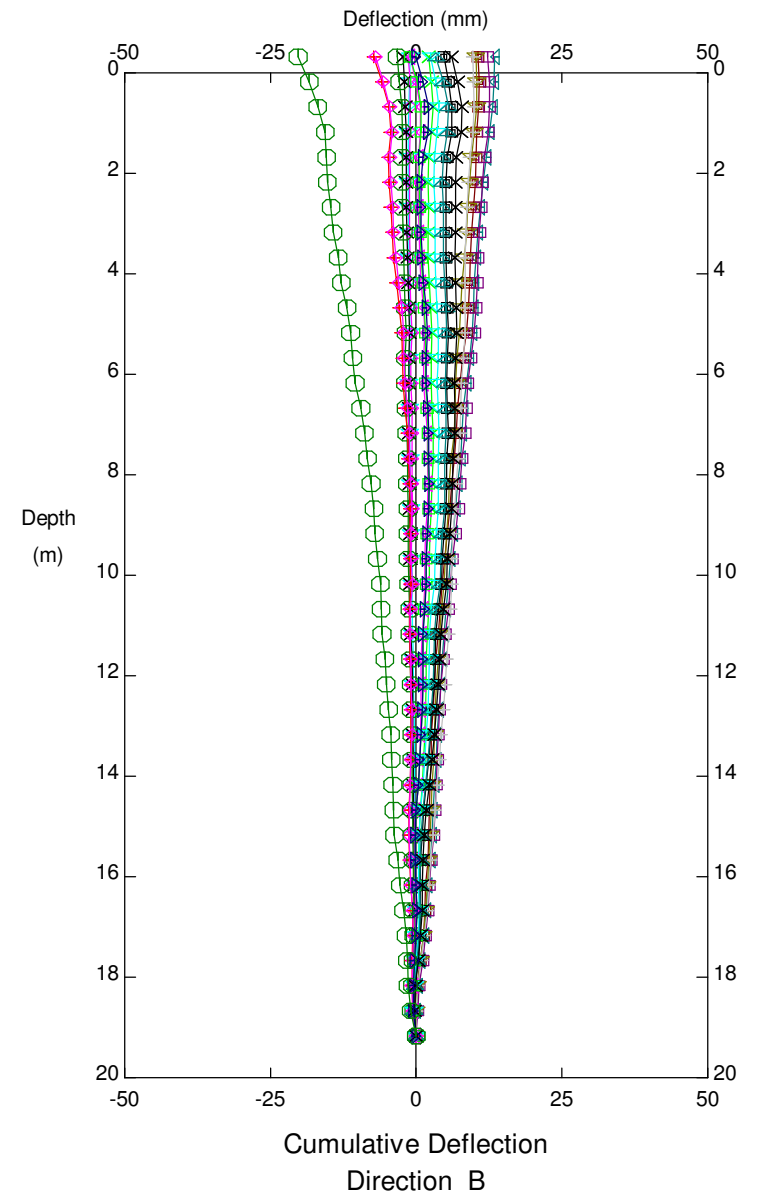
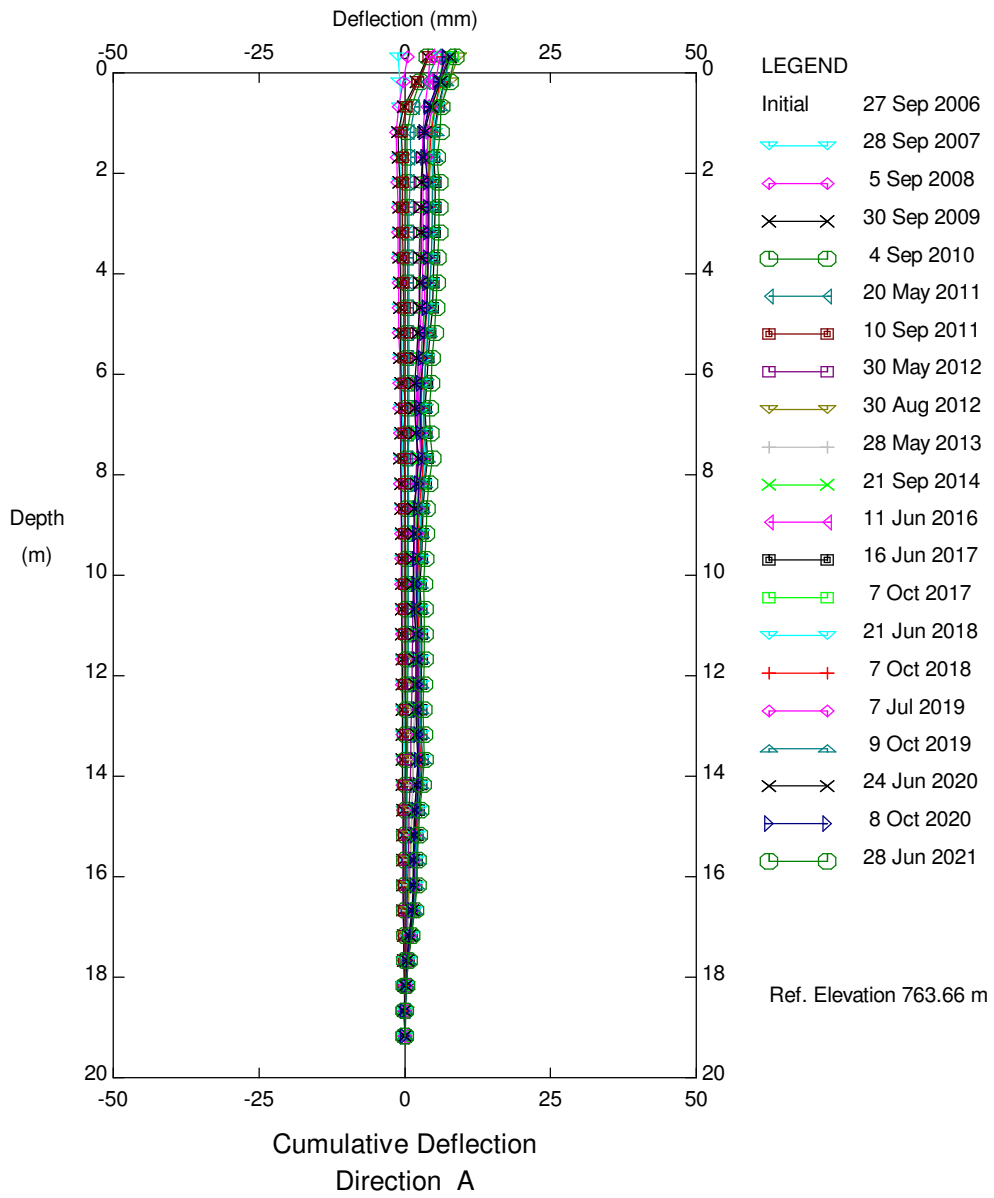
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GP003; H40:38, Cutbank River (South), Inclinometer SI-02

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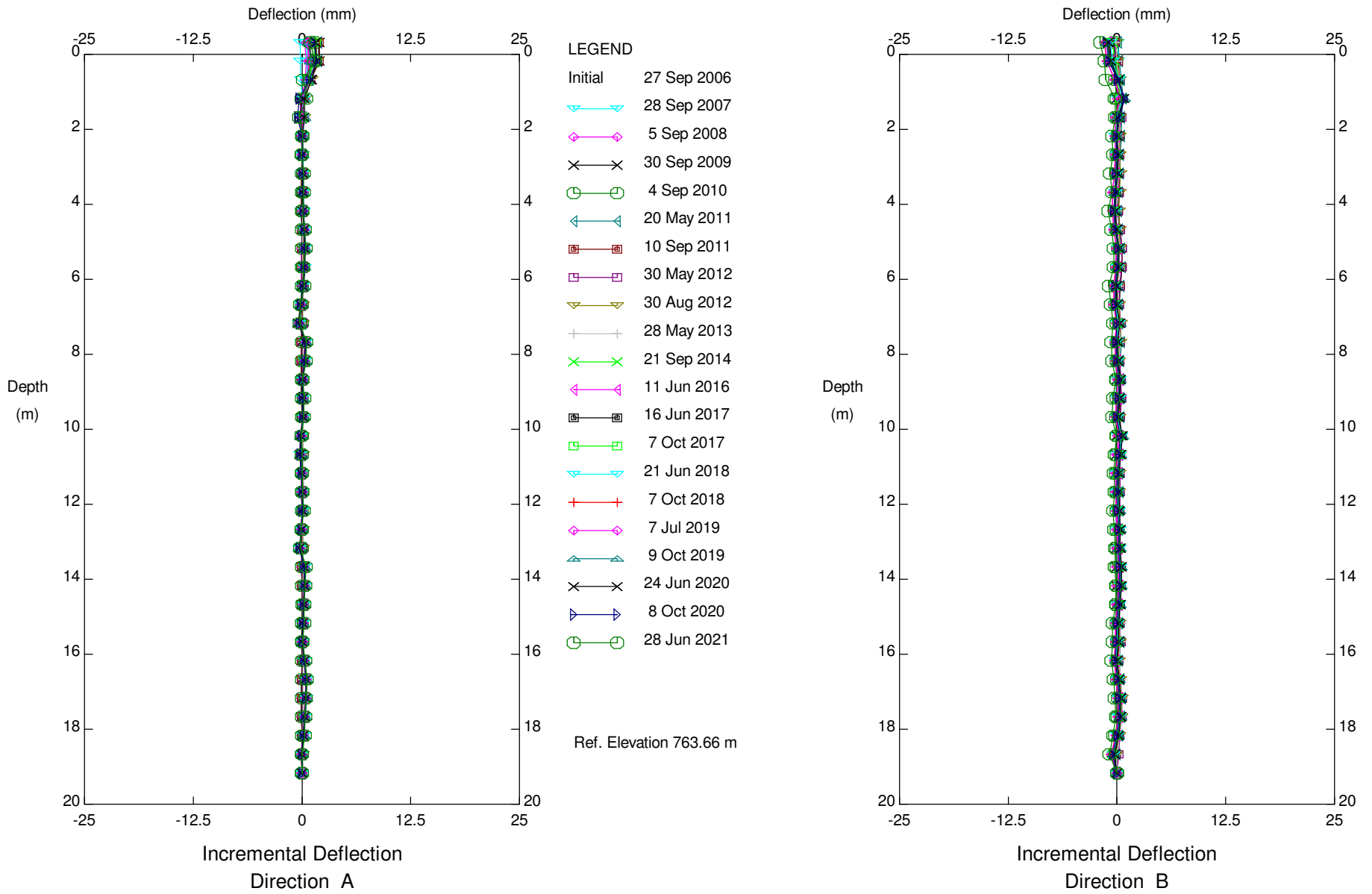
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GP003; H40:38, Cutbank River (South), Inclinator SI-03  
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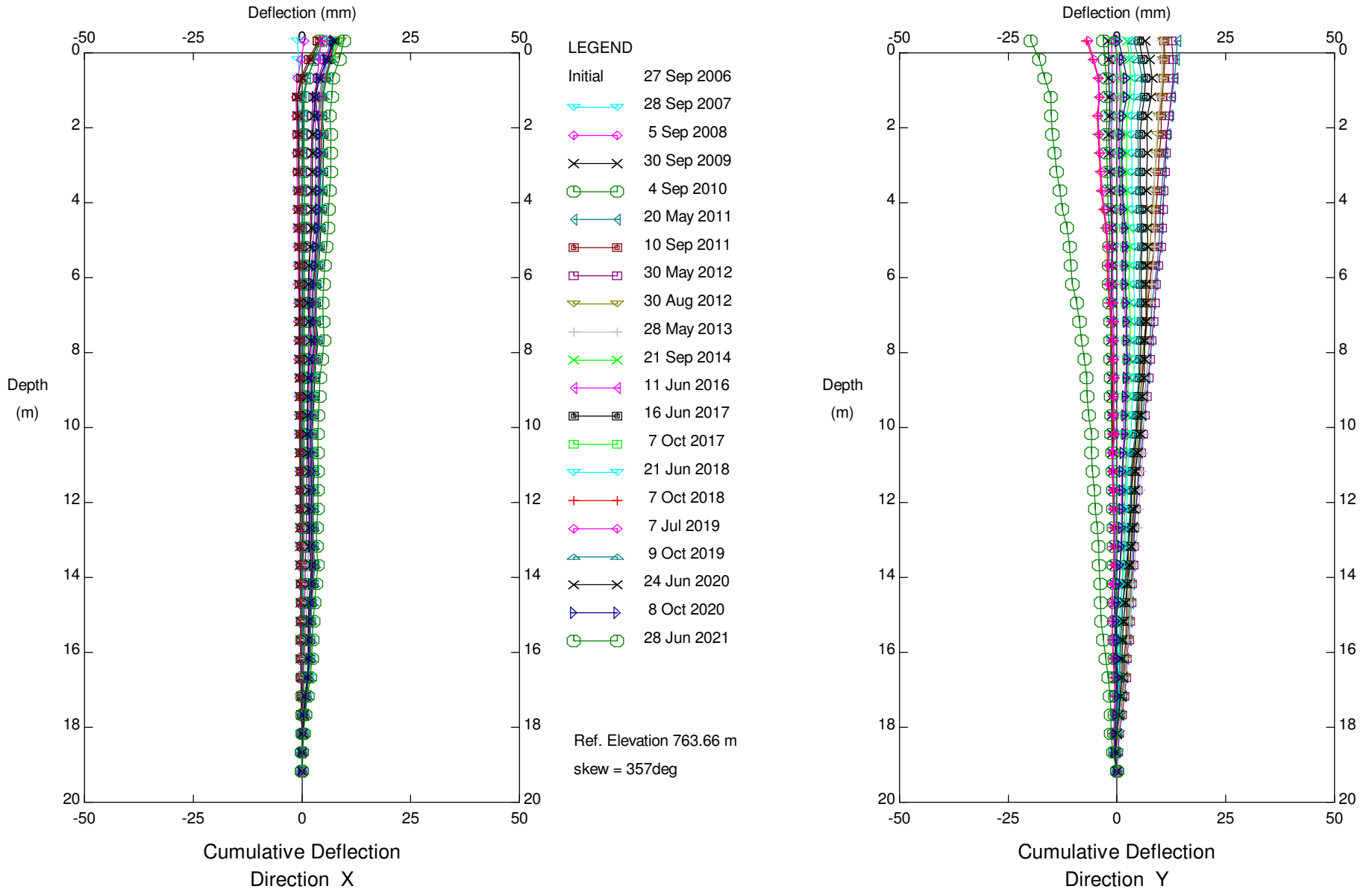


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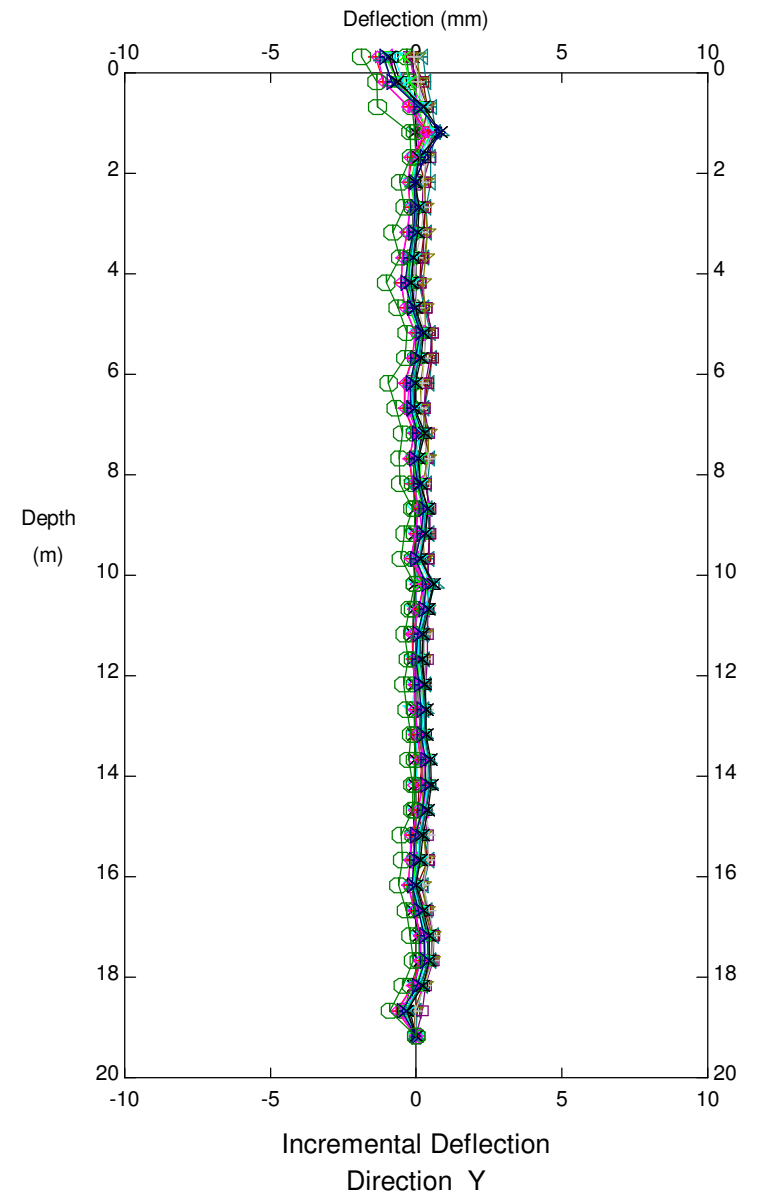
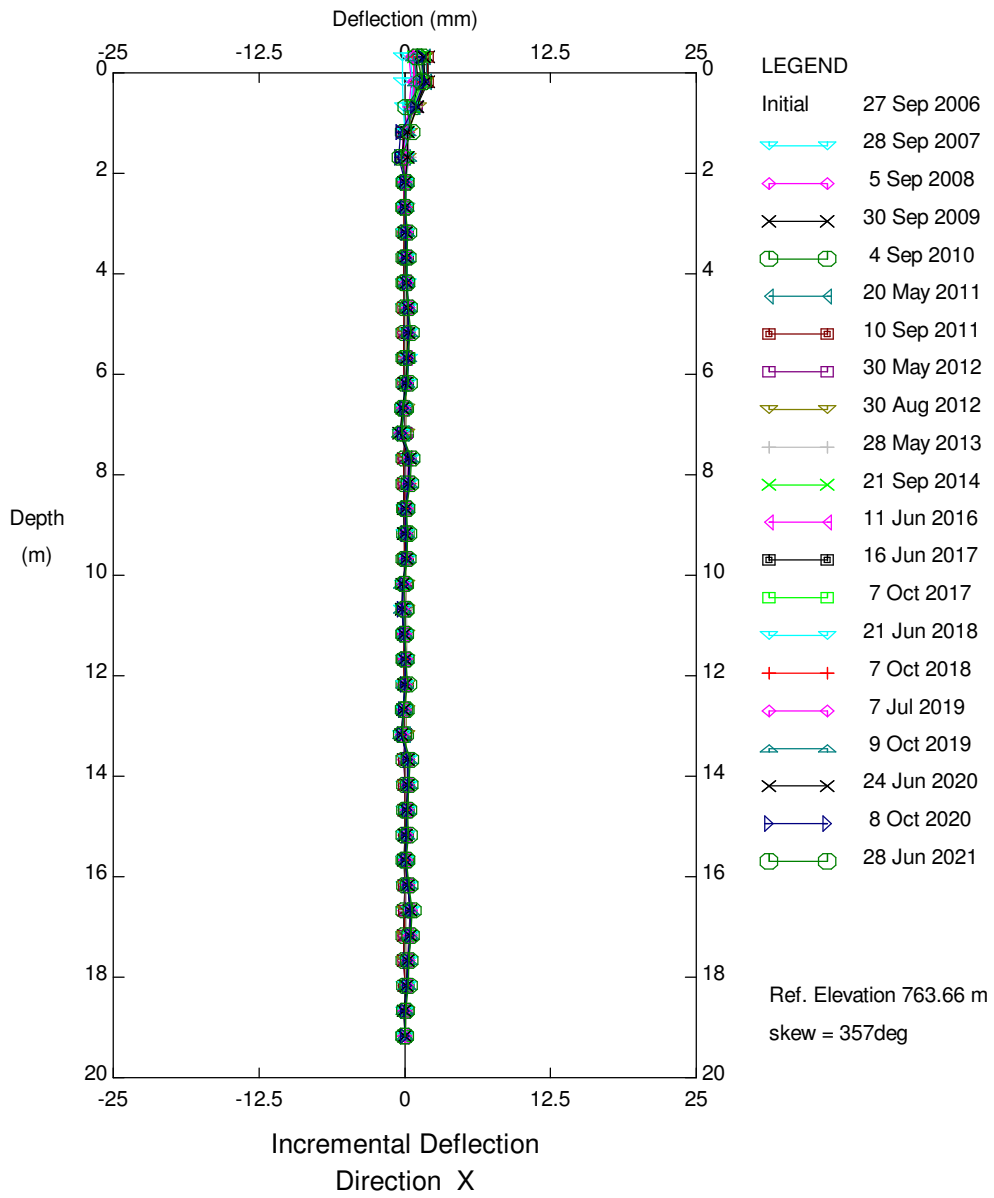
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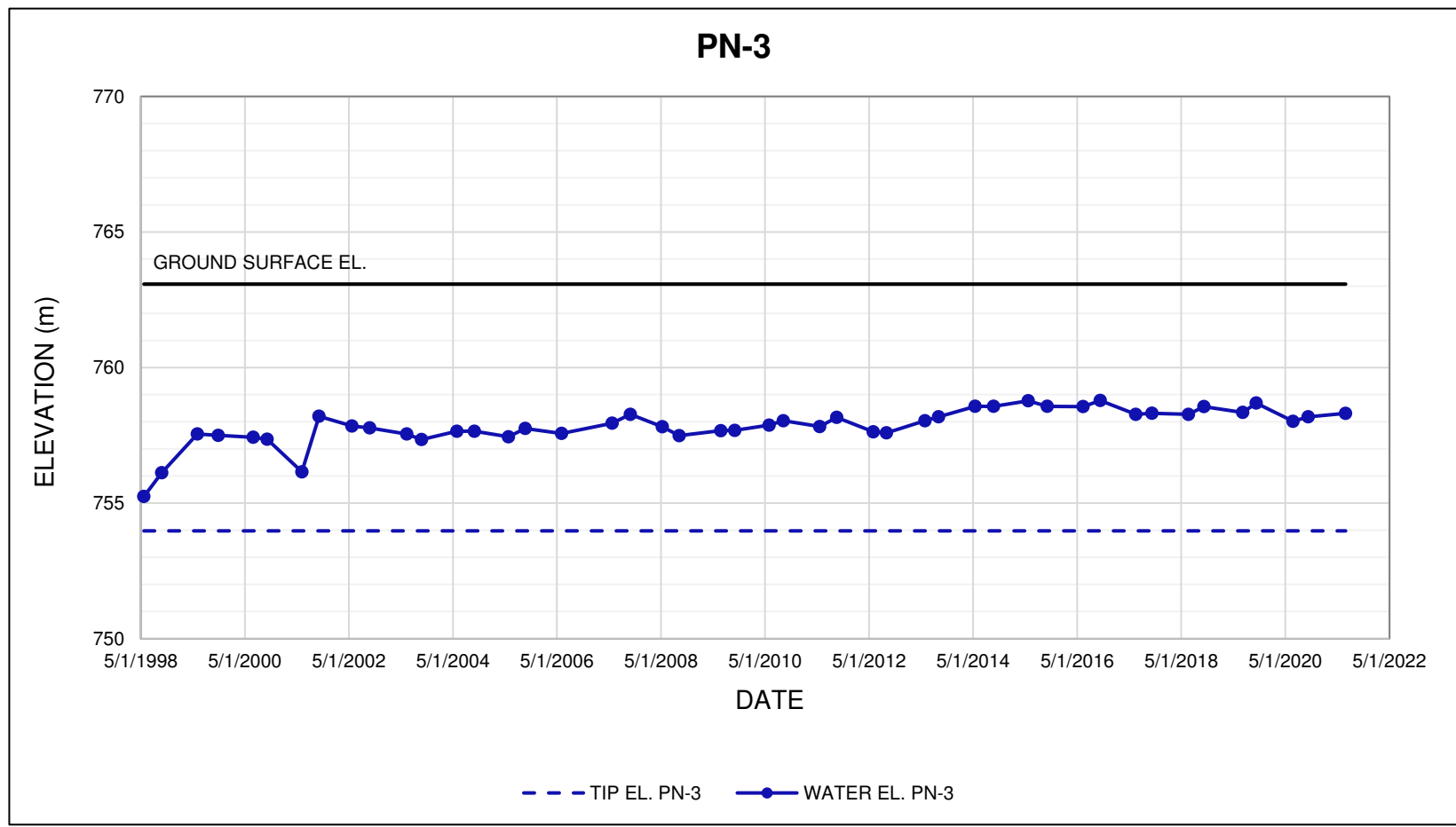


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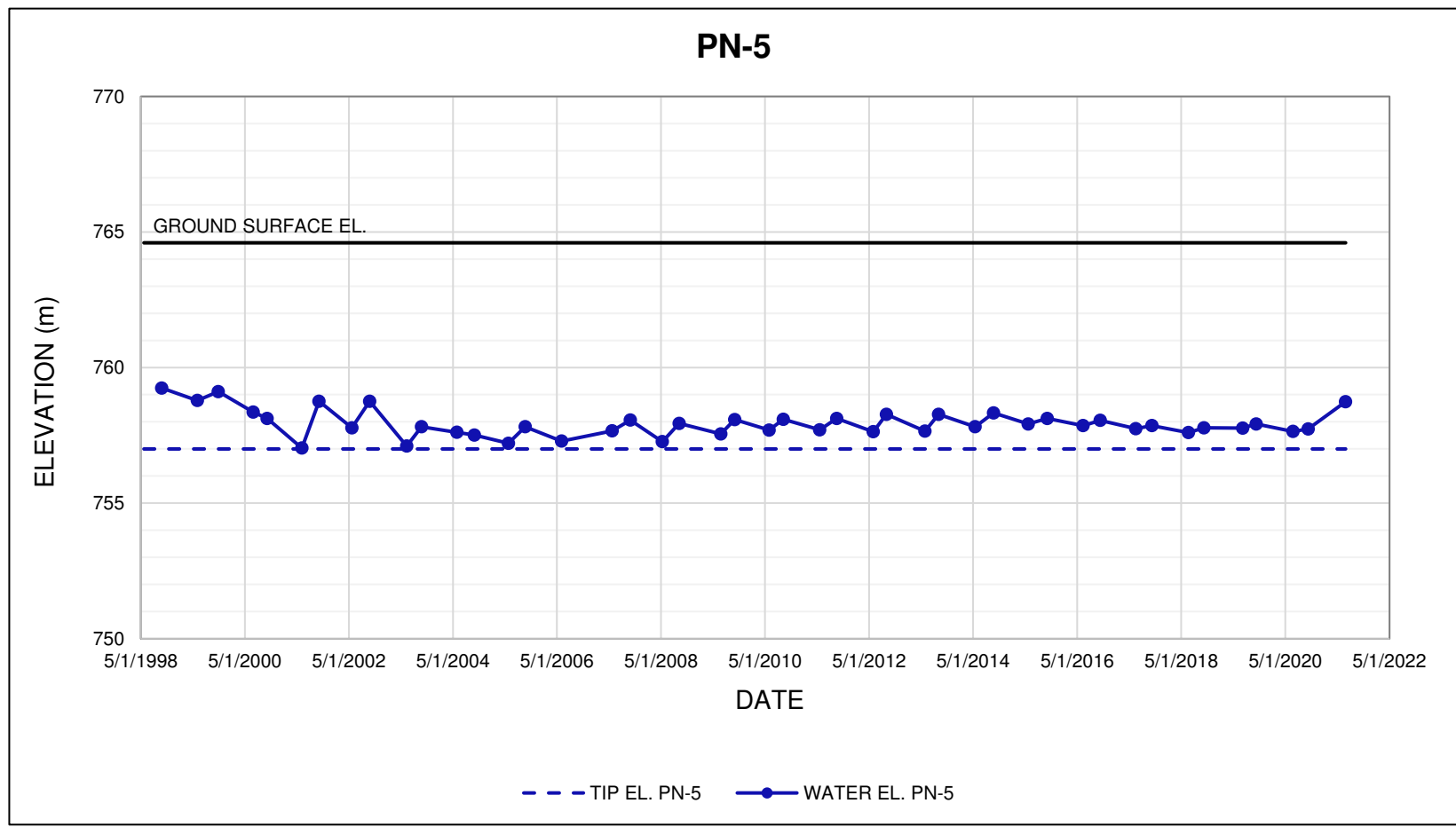
GP003; H40:38, Cutbank River (South), Inclinometer SI-03  
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**Notes:**



1. Piezometer data obtained before the spring 2021 reading on June 28, 2021 was provided to KCB by Alberta Transportation (AT) on June 25, 2021.

<p>CLIENT</p>	<p>PROJECT PEACE REGION (GRANDE PRAIRIE DISTRICT - SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM</p>
	<p>TITLE Piezometer Data GP003 - Cutbank River (South) Hwy 40:38, km 52.134</p>
<p>SCALE</p>	<p>PROJECT No. A05116A01     FIG No.</p>



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