

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS GRMP
PEACE REGION – (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING - FALL 2024**



Site Number	Location	Name	Hwy	km
PH031	HWY 744:04 C1 57.7	Michelin Slide- Judah Hill	744:04	Km 57.7
Legal Description:		UTM Co-ordinates		
9-20-83-21 W5		11U E 483125.92	N	6229725.01

Current Monitoring:	21-Sep-2024	Previous Monitoring	22-May-2024
Instruments Read By:	Mr. Niraj Regmi, G.I.T and Mr. Nixson Mationg, of Thurber		

Instruments Read During This Site Visit			
Slope Inclometers (SIs): SI98-10i, SI10-4, SI10-7, and SI10-9	Pneumatic Piezometers (PN): PN10-4, PN10-6 to PN10-9	Vibration Wire Piezometers (VW): VW17-1 and VW17-2	Standpipe Piezometers (SP):
Load Cell (LC): N/A	Strain Gauges: N/A	SAAs: SAA10-8	Others:

Readout Equipment Used			
Slope Inclometers: Two RST Digital Inclometer probes with 2 ft wheelbases and RST Pocket PC readouts	Pneumatic Piezometers: RST C108 pneumatic piezometer readout	Vibrating Wire Piezometers: Campbell Scientific CR1000 datalogger	Standpipe Piezometers:
Load Cell:	Strain Gauges:	SAAs: Campbell Scientific CR1000 datalogger	Others:
Note: Attempted to download data for SAA and Vibrating Wire Piezometers from Campbell Scientific CR1000 datalogger, but internal battery was dead and couldn't be externally powered to retrieve data.			

Zones of New Movement:	None
Interpretation of Monitoring Results:	<p>Slope inclinometer SI98-10i, located beyond the toe of Michelin slide showed small incremental movements along six distinct shear planes, since the spring of 2024 readings. The multitude of distinct movement zones speaks to the complexity of ongoing valley wall deformations along Judah Hill. Since the slope indicator was installed in October 2000 the sum of the movements over all these zones is 378.5 mm. The movement rates in these zones has typically ranged between 1 mm/yr and 5 mm/yr with median rate below 3 mm/yr.</p> <p>The movement rates showed small changes (less than 2 mm/yr) since the previous readings in the spring of 2024 with the exception an approximately 3 mm/yr increase in movement rate measured in the zones over 14.1 m to 17.7 m (3.7 mm/yr) depth and over 23.2 m to 26.9 m (4.7 mm/yr) depth .</p> <p>Slope inclinometer SI10-4 is located close to the highway and has one well defined movement zone at 6 m depth in a clay strata, and several subtle movement zones lower down in clay and clay till layers. A rate of movement of 3.2 mm/yr was measured over 5.7 m to 6.9 m depth</p>

	<p>and a rate of movement of 1.6 mm/yr over 11.8 m to 17.9 m depth since the spring of 2024 readings. Average movement rates in both zones has typically been below 1.5 mm/yr and cumulative measurement movement is less than 15 mm. The last three datasets show a potential acceleration trend in the 6 m depth movement zone. The movement is in the direction of the active landslide in the Heart River valley slope, directly opposite from the Michelin Slide direction.</p> <p>SI10-7 showed three zones of movement. In the upper clay fill a movement rate of 1.5 mm/yr was measured over 1.9 m to 6.8 m depth; near a sand/clay transition a movement rate of 0.3 mm/yr was measured over 8.6 m to 9.8 m depth, and; in a lower clay layer 0.5 mm/yr was measured, over 14.1 m to 15.9 m depth, all since the spring of 2024 readings.</p> <p>As the datalogger battery was dead, no new readings could be downloaded for SAA10-8. The spring 2024 SI plots are included for SAA10-8.</p> <p>SI10-9 showed one distinct zone of movement and several more subtle movement zones. In the upper clay no discernible movement was measured over 6.5 m to 7.7 m. The more distinct movement zone was between 11.9 and 14.4 m in a sand layer, where a movement rate of 1.5 mm/yr was measured since the spring of 2024 readings.</p> <p>Pneumatic piezometers PN10-4 showed no change in groundwater level since the spring of 2024 readings. PN10-6, PN10-7, PN10-8, and PN10-9 showed increases in groundwater levels of 0.78 m, 0.63 m, 0.85 m, and 0.43 m, respectively, since the spring of 2024 readings. The groundwater levels of 7.53 m and 8.79 m measured in PN10-6 and PN10-7, respectively, were the highest measured since the instruments were initialized.</p>
Future Work:	The instruments should be read again in the Spring of 2025.
Instrumentation Repairs:	<p>The internal battery inside the CR1000 datalogger was found to be dead during the fall 2024 readings, and no readings could be downloaded. A new Campbell Scientific datalogger should be installed to replace the CR1000.</p> <p>The battery for the CR1000 datalogger station was replaced during the fall 2023 readings cycle, however, after subsequent battery power loss the datalogger data could not be retrieved. Our instrumentation repair proposal dated July 26, 2024, recommends a new enclosure large enough to contain a full-size 100-amp hour battery, and new solar panel be installed. During this installation, a new Campbell scientific datalogger will be installed.</p>
Additional Comments:	

Attachments:	<ul style="list-style-type: none"> ▪ Table PH031-1: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Slope Inclinometer Instrumentation Reading Summary ▪ Table PH031-2: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Pneumatic Piezometer Instrumentation Reading Summary ▪ Table PH031-3: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Vibrating Wire Piezometer Instrumentation Reading Summary ▪ Statement of Limitations and Conditions ▪ Appendix A <ul style="list-style-type: none"> □ Field Inspector's Report □ Site Plan Showing Approximate Instrument Locations (Drawing No. 32121 PH031) □ SI and SAA Reading Plots □ Figure PH031-1 (Piezometric Depths) □ Figure PH031-2 (Piezometric Elevations)
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We trust this report meets your requirements at present. If you have any questions, please contact the undersigned at your convenience.

Yours very truly,
Thurber Engineering Ltd.
Roger Skirrow, M.Sc., P. Eng.
Senior Geotechnical Engineer

Lucas Green, P.Eng.
Geotechnical Engineer

Table PH031-1: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Slope Inclinator Instrumentation Reading Summary

Date Monitored: September 21, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AT NOTED DEPTH SINCE INITIAL READING (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI98-10i	Oct. 27, 2000	95.6 mm over 6.1 m to 7.4 m depth in 314° direction	14.0 mm/yr in September 2017	Operational	May 22, 2024	0.5	1.4	1.1
		13.2 mm over 11.0 m to 12.2 m depth in 324° direction	2.9 mm/yr in October 2020			0.2	0.7	0.8
		91.0 mm over 14.1 m to 17.7 m depth in 314° direction	15.3 mm/yr in September 2017			1.2	3.7	3.1
		28.7 mm over 18.9 m to 20.2 m depth in 324° direction	5.0 mm/yr in September 2017			0.2	0.6	0.4
		35.4 mm over 21.4 m to 22.6 m depth in 341° direction	9.2 mm/yr in October 14, 2021			0.4	1.2	0.6
		114.6 mm over 23.2 m to 26.9 m depth in 324° direction	13.5 mm/yr in October 2021			1.6	4.9	2.8

Drawing 32121-PH031 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

Table PH031-1 – Continued... Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Slope Inclinometer Instrumentation Reading Summary

Date Monitored: September 21, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AT NOTED DEPTH SINCE INITIAL READING (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI94-43i	Oct. 27, 2000	59.0 mm over 24.8 m to 27.2 m depth in 282° direction	10.2 mm/yr in October 2020	Operational, not read during current readings	July 10, 2021	N/A	N/A	N/A
SI10-4	March 26, 2010	11.5 mm over 5.7 m to 6.9 m depth in 86° direction	3.2 mm/yr in September 2024	Operational	May 22, 2024	1.1	3.2	1.5
		8.4 mm over 11.8 m to 17.9 m depth in 86° direction	3.4 mm/yr in September 2011			0.5	1.6	2.6
SI10-5	March 26, 2010	225.9 mm over 0.9 m to 11.9 m depth in 120° direction	196.4 mm/yr in September 2011	Sheared at 2.1 m depth	September 21, 2011	N/A	N/A	N/A
SI10-6	March 26, 2010	237.5 mm over 0.9 m to 5.8 m depth in 120° direction	130.5 mm/yr in September 2013	Sheared at 3.0 m depth	June 1, 2014	N/A	N/A	N/A
		7.2 mm over 11.9 m to 14.3 m depth in 110° direction	6.8 mm/yr in September 2011			N/A	N/A	N/A

Drawing 32121-PH031 in Appendix A D provides a sketch of the approximate location of the monitoring instrumentation for this site.

Table PH031-1 – Continued... Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Slope Inclinometer Instrumentation Reading Summary

Date Monitored: September 21, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AT NOTED DEPTH SINCE INITIAL READING (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI10-7	March 26, 2010	29.4 mm over 1.9 m to 6.8 m depth in 325° direction	5.6 mm/yr in May 2010	Operational	May 22, 2024	0.5	1.5	0.5
		17.6 mm over 8.6 m to 9.8 m depth in 336° direction	4.0 mm/yr in September 2013			0.1	0.3	-0.5
		9.4 mm over 14.1 m to 15.9 m depth in 336° direction	5.0 mm/yr in September 2020			0.2	0.5	>-0.1
SI10-8*	March 4, 2010	52.1* mm over 15.0 m to 16.5 m depth in 321° direction	16.1 mm/yr in September 2013	SAA Installed in SI10-8 Casing (Dec 2014)	May 22, 2024	No Reading Downloaded	No Reading Downloaded	N/A
SI10-9	March 4, 2010	4.4 mm over 6.5 m to 7.7 m depth in 3° direction	1.8 mm/yr in September 2013	Operational	May 22, 2024	No Discernible Movement	N/A	-0.4
		25.2 mm over 11.9 m to 14.4 m depth in 3° direction	12.5 mm/yr in September 2013			0.5	1.5	0.5

Drawing 32121-PH031 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

* Total cumulative movement is based on the movement of the SI prior to SAA installation plus the total movement recorded in the SAA to date.

Table PH031-2: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Pneumatic Piezometer Instrumentation Reading Summary

Date Monitored: September 21, 2024

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED WATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT WATER LEVEL BGS (m)	PREVIOUS WATER LEVEL BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN98-10 (22835)	N/A	7.0	N/A	Damaged	6.59 in May 2004	N/A	N/A	N/A	N/A
PN98-10a (22827)	N/A	22.0	N/A	Damaged	8.64 in May 2009	N/A	N/A	N/A	N/A
PN10-4	March 26, 2010	19.4	516.401	Operational	18.37 in June 2020	0.7	19.33	19.33	0
PN10-5	March 5, 2010	16.9	514.950	Blocked	11.12 in May 2013	N/A	N/A	N/A	N/A
PN10-6	March 5, 2010	10.2	513.055	Operational	7.53 in September 2024	26.2	7.53	8.31	0.78
PN10-7	March 3, 2010	13.8	519.529	Operational	8.79 in September 2024	49.1	8.79	9.42	0.63
PN10-8	February 27, 2010	17.5	514.522	Operational	11.75 in September 2013	40.1	13.41	14.26	0.85
PN10-9	February 27, 2010	13.0	510.640	Operational	6.31 in September 2016	58.3	7.06	7.49	0.43

Drawing 32121-PH031 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

Notes:

PN - pneumatic piezometer.

BGS - below ground surface.

Table PH031-3: Fall 2024 – HWY 744:04 Judah Hill (Michelin Slide) Vibrating Wire Piezometer Instrumentation Reading Summary

Date Monitored: September 21, 2024

INSTRUMENT	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST RECORDED GROUNDWATER LEVEL (mBGS)	CURRENT GROUNDWATER DEPTH (mBGS)	PREVIOUS GROUNDWATER DEPTH (mBGS)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
VW17-1	June 6, 2017	502.52	514.52	Operational	10.40 on September 4, 2017	No Reading Downloaded	11.51	N/A
VW17-2	June 6, 2017	496.38	514.52	Operational	DRY	No Reading Downloaded	DRY	N/A

Drawing 32121-PH031 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



STATEMENT OF LIMITATIONS AND CONDITIONS

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This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

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5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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THURBER ENGINEERING LTD.

**ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS**

FALL 2024

**APPENDIX A
DATA PRESENTATION**

SITE PH031: HWY 744:04, JUDAH HILL (MICHELIN SLIDE)

**ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (PH031)
FALL 2024**

Location: Michelin Slide - Judah Hill (HWY 744:04 C1 57.664) File Number: 32121 Probe: RST SI SET 5R and 8R Cable: RST SI SET 5R and 8R	Readout: RST PN C108 Unit 4 Casing: 2.75, SI 94-43i 3.34 Temp: 10 Read by: NRM/NKR
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SLOPE INCLINOMETER (SI) READINGS

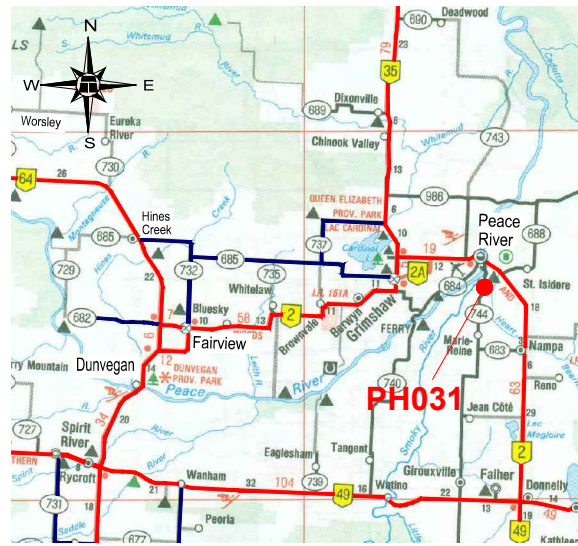
SI#	GPS Location (UTM 11)		Date	Stickup (m)	Depth from top of Casing (ft)	Magn. North A+ Groove degree	Current Bottom Depth Readings				Probe/ Reel #	Size (")	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-			
SI98-10i	483125.92	6229725.01	21-Sep-24	0.57	116 to 2	305	1483	-1479	-801	804	8R/8R	2.75	See notes
SI94-43i	482827.64	6229848.63	21-Sep-24	0.85	118 to 2	10	-8	22	3	7	8R/8R	3.34	Did not read due to bear den
SI10-4	483255.5	6229708.92	21-Sep-24	0.74	106 to 4	85	409	-397	5	-24	5R/5R	2.75	
SI10-7	483212.56	6229673.47	21-Sep-24	0.84	106 to 4	315	1228	-1217	-1557	1557	8R/8R	2.75	
SI10-9	483248.88	6229762.37	21-Sep-24	0.55	106 to 4	330	868	-854	-352	347	8R/8R	2.75	

PNEUMATIC PIEZOMETER READINGS

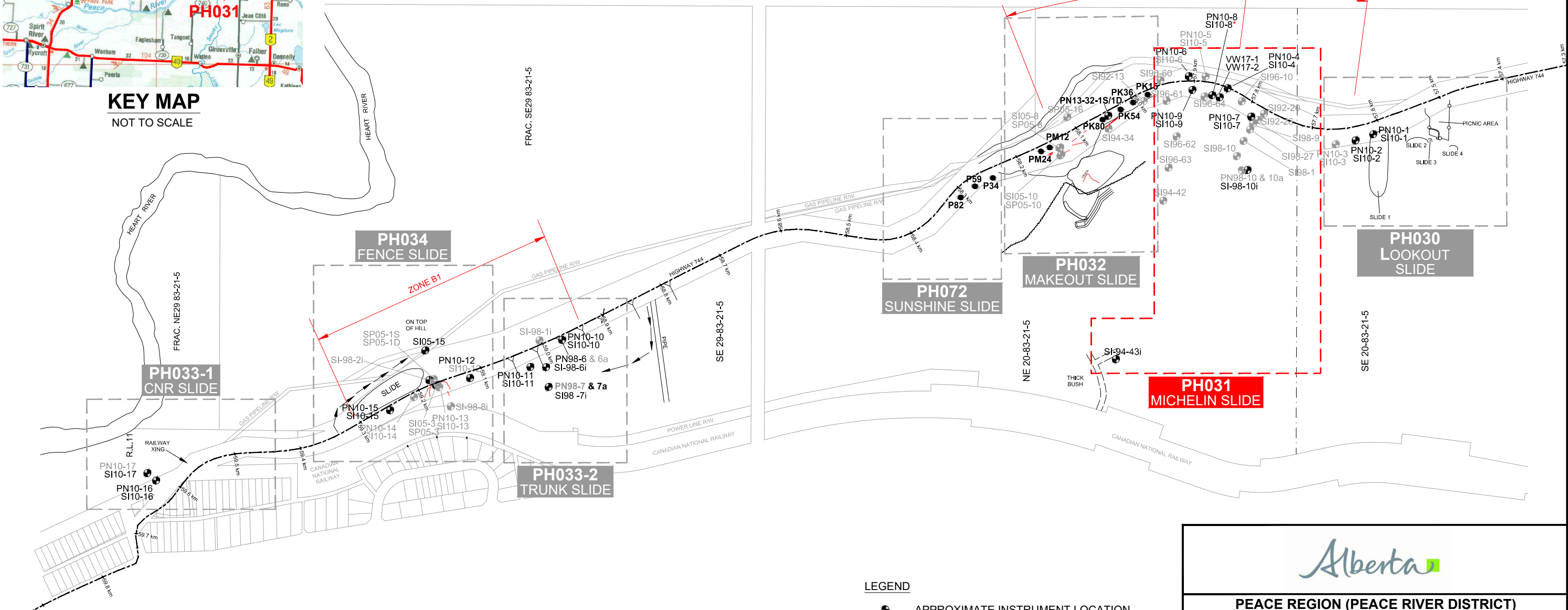
PN#	GPS Location (UTM 11)		Date	Reading (kPa)	Identification Number
	Easting (m)	Northing (m)			
10-4	483255.50	6229708.92	21-Sep-24	0.7	33094
10-6	483273.71	6229767.84	21-Sep-24	26.2	33084
10-7	483212.56	6229673.47	21-Sep-24	49.1	33085
10-8	483245.04	6229732.33	21-Sep-24	40.1	33082
10-9	483248.88	6229762.37	21-Sep-24	58.3	33087

INSPECTOR REPORT

For SI98-10i multiply readings by 2 to get the plot in Gtilt.
* Slowly increased
CR1000 data logger downloaded , No data table in program. Internal battery of cr1000 module is drained, so the CR1000 will need to be replaced.



KEY MAP
NOT TO SCALE



NOTE:
* A SHAPE ACCELEROMETER ARRAY (SAA) WAS INSTALLED INSIDE THE SI10-08 CASING IN DECEMBER 2014.

LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- INSTRUMENT NOT IN USE
- PN PNEUMATIC PIEZOMETER
- SP STANDPIPE PIEZOMETER
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- APPROXIMATE PILE LOCATION



PEACE REGION (PEACE RIVER DISTRICT)

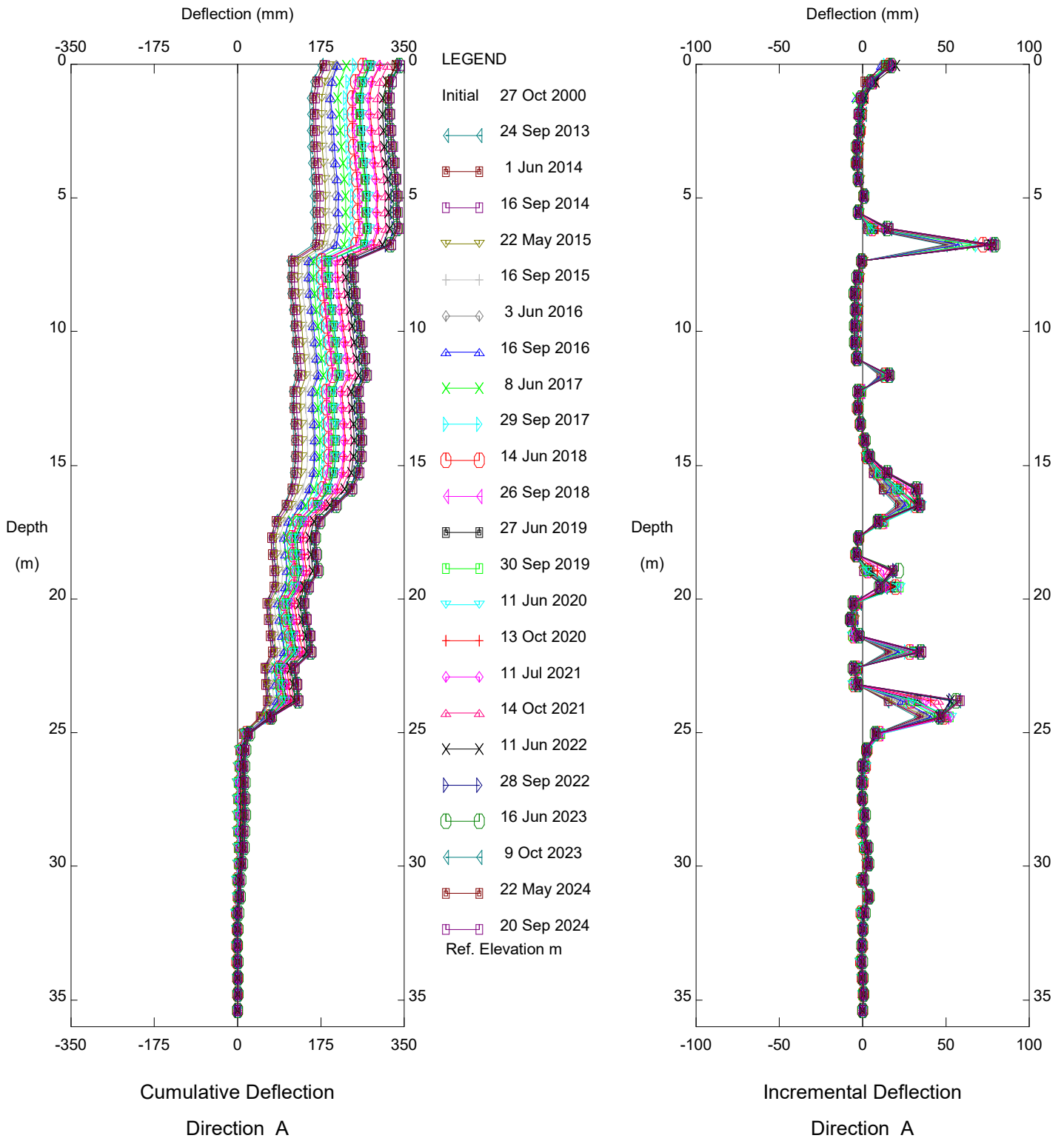
PH031: HWY 744:04 - JUDAH HILL (MICHELIN SLIDE) INSTRUMENT LOCATIONS

DWG No. 32121-PH031

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	APPROX. 1:6000
DATE	SEPTEMBER 2021
FILE No.	32121



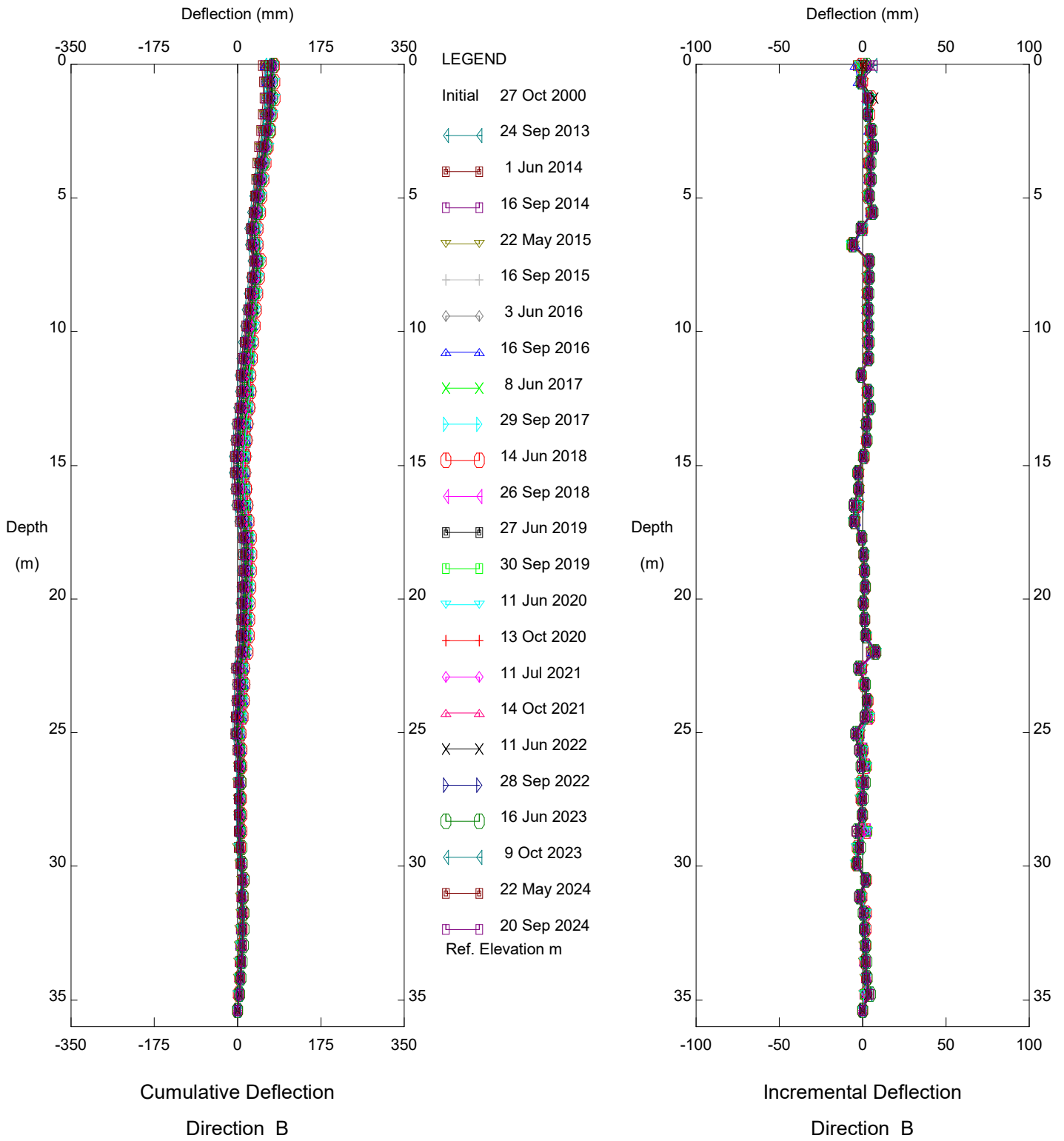
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinometer SI98-10i

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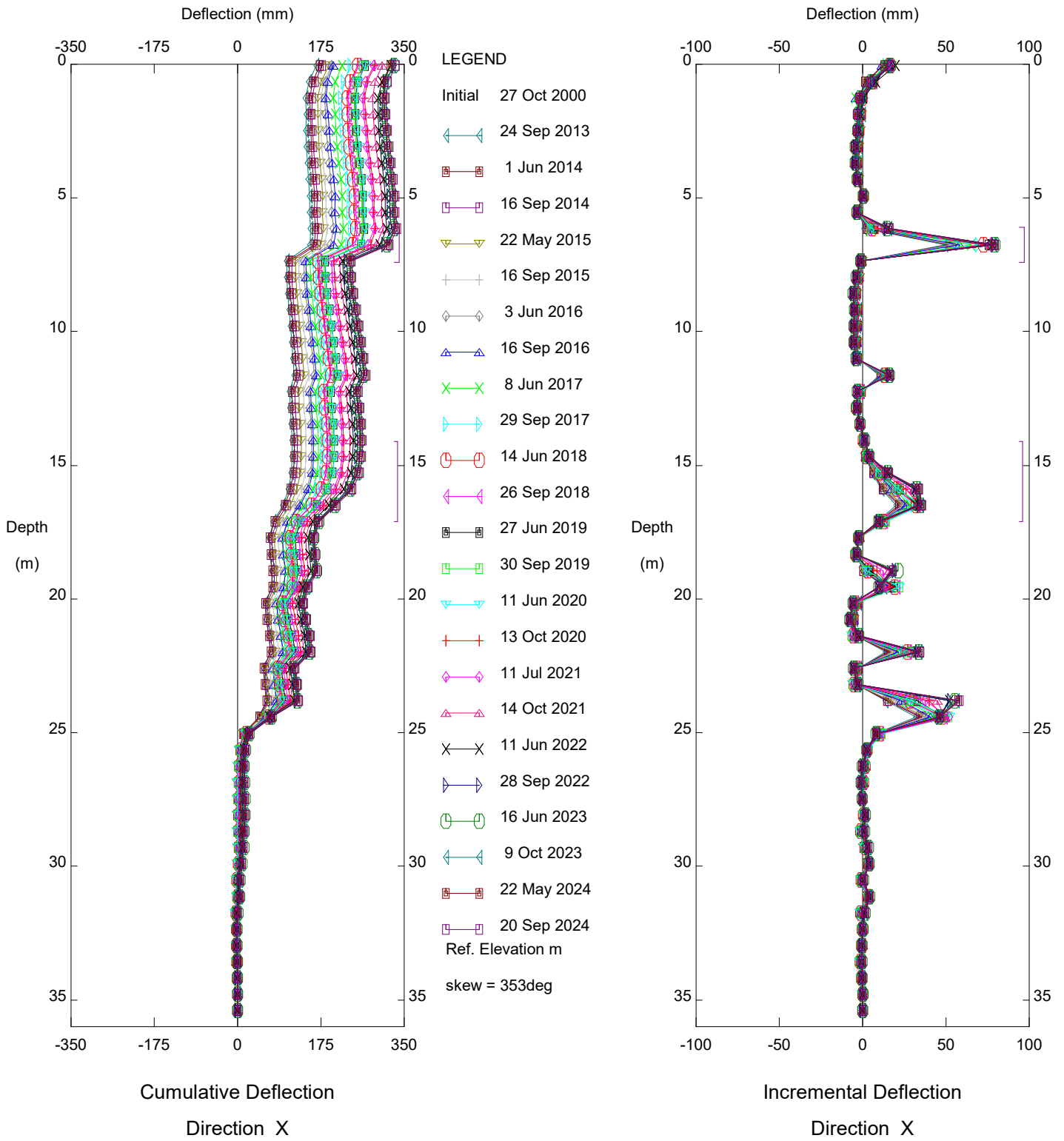
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HWY 744:04 - STA. 57+700 to 58+000, Inclinometer SI98-10i

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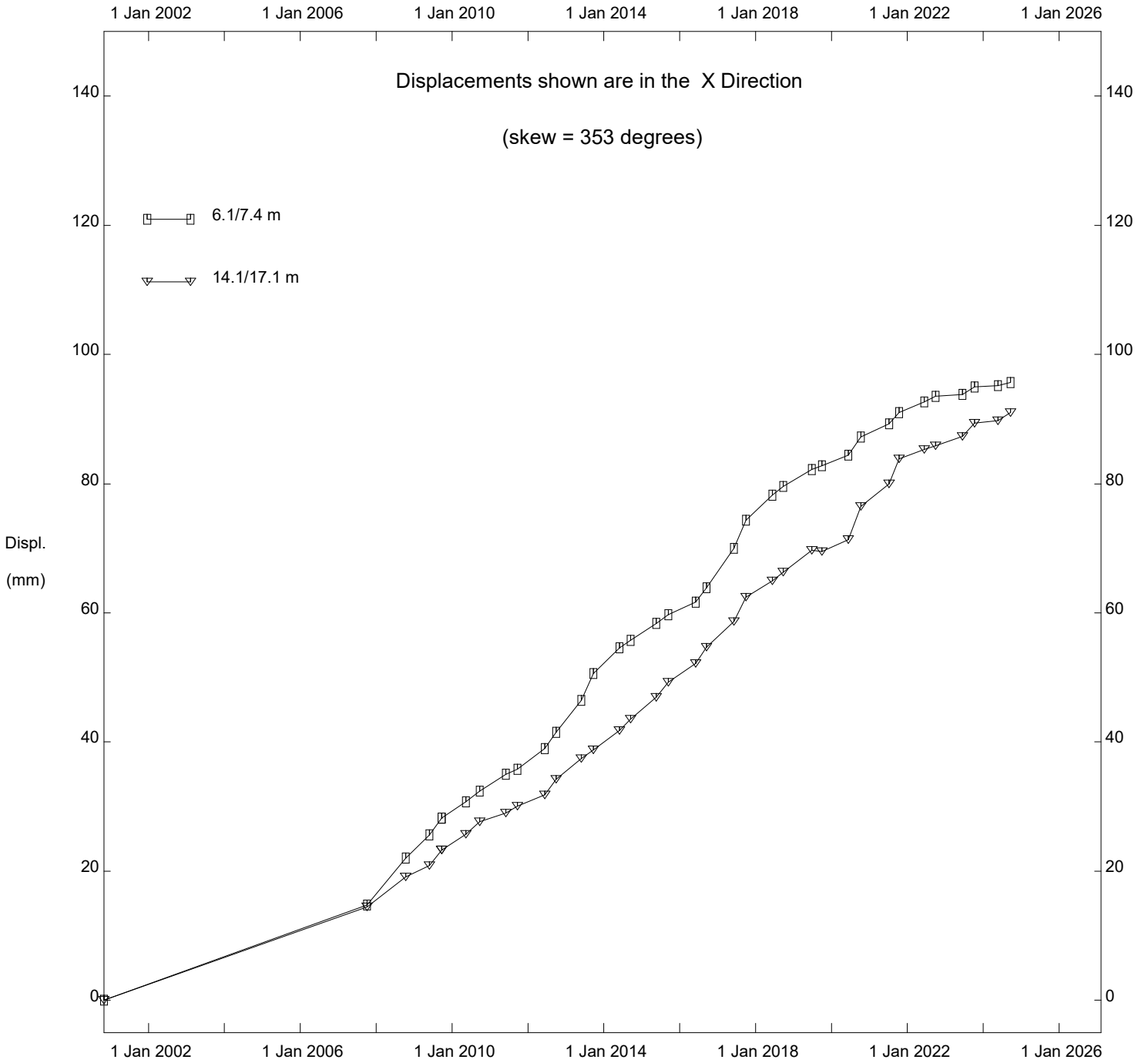
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinometer SI98-10i

Alberta Transportation

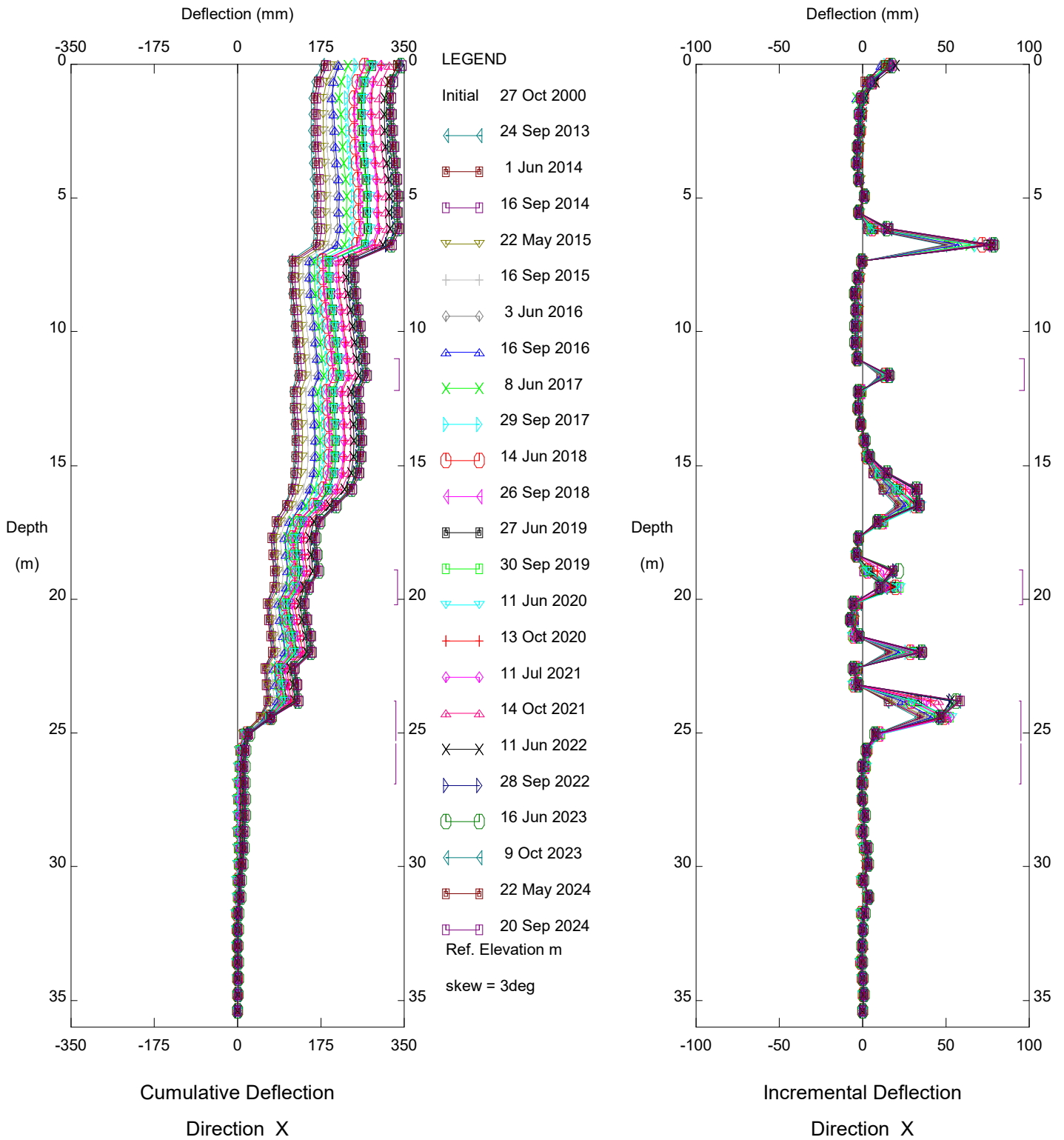
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinator SI98-10i

Alberta Transportation

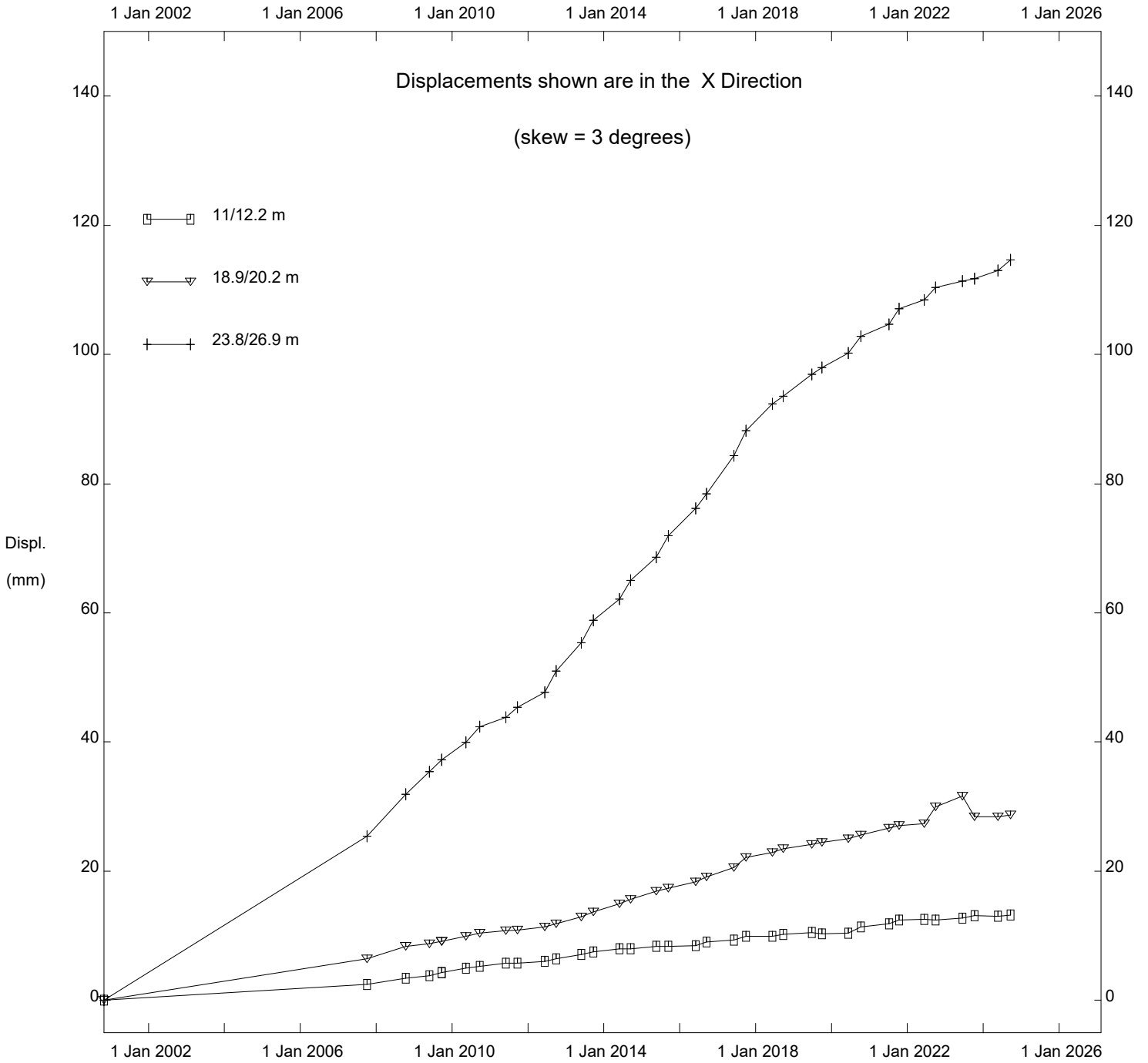
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinometer SI98-10i

Alberta Transportation

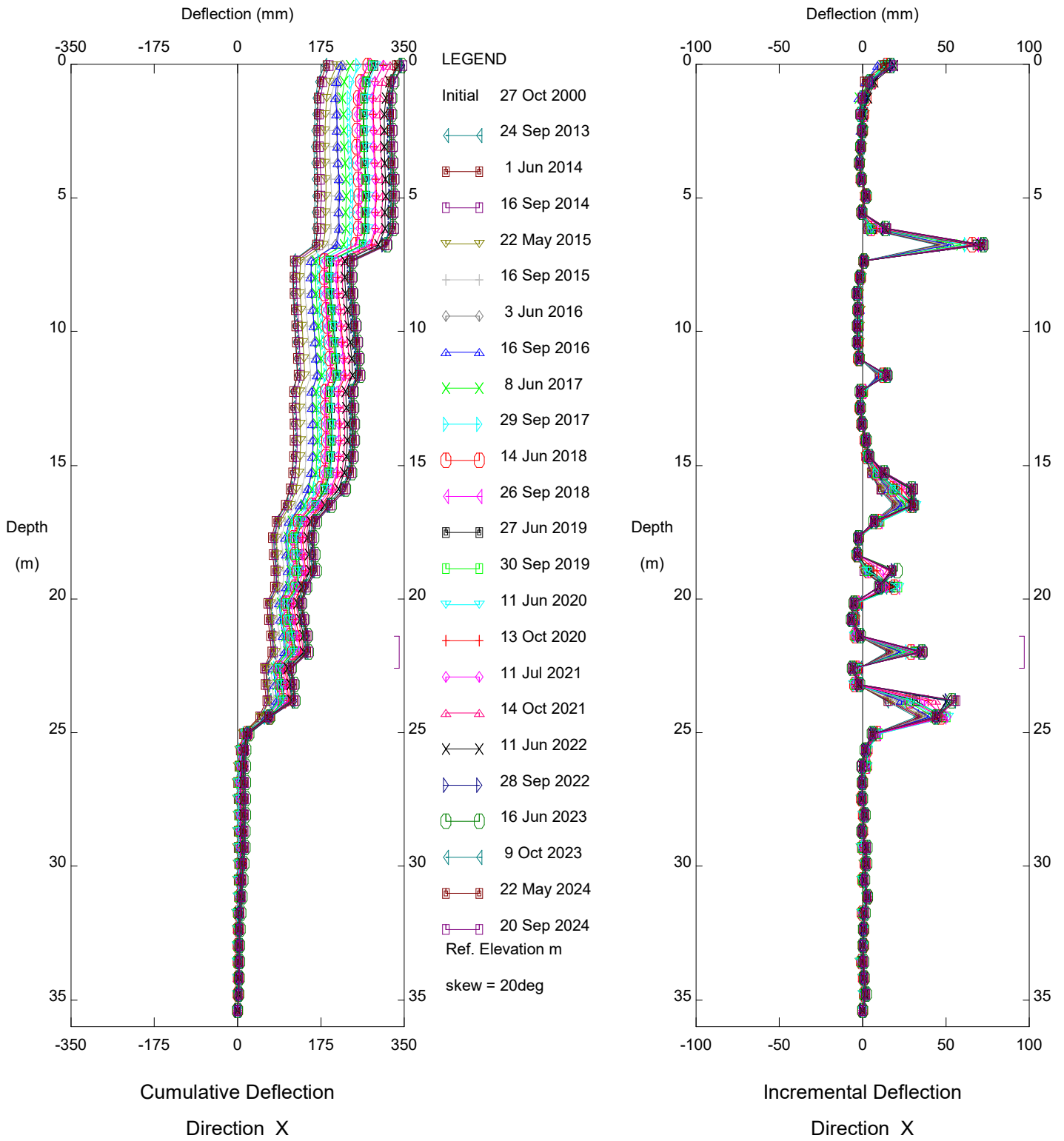
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinator SI98-10i

Alberta Transportation

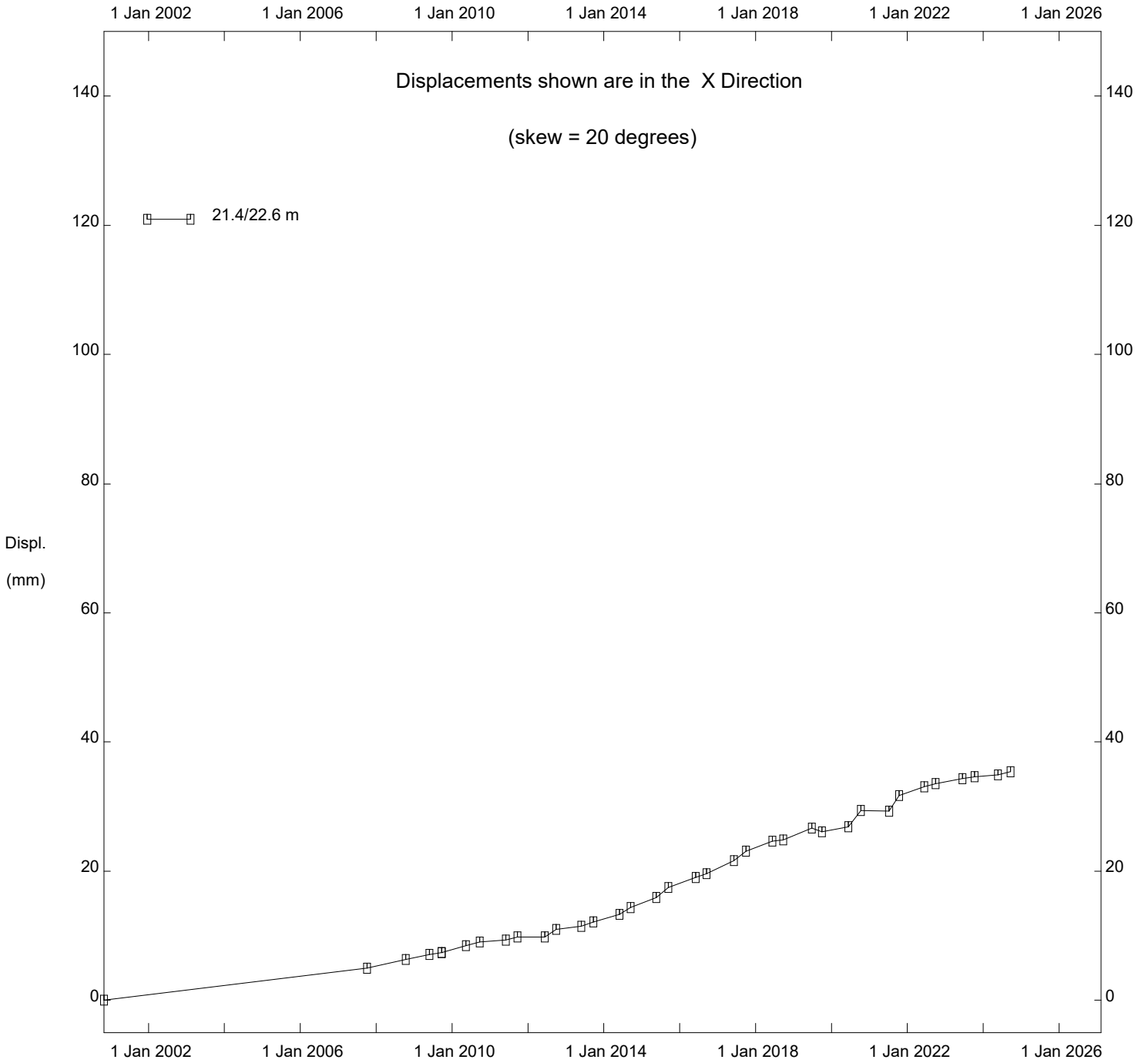
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinometer SI98-10i

Alberta Transportation

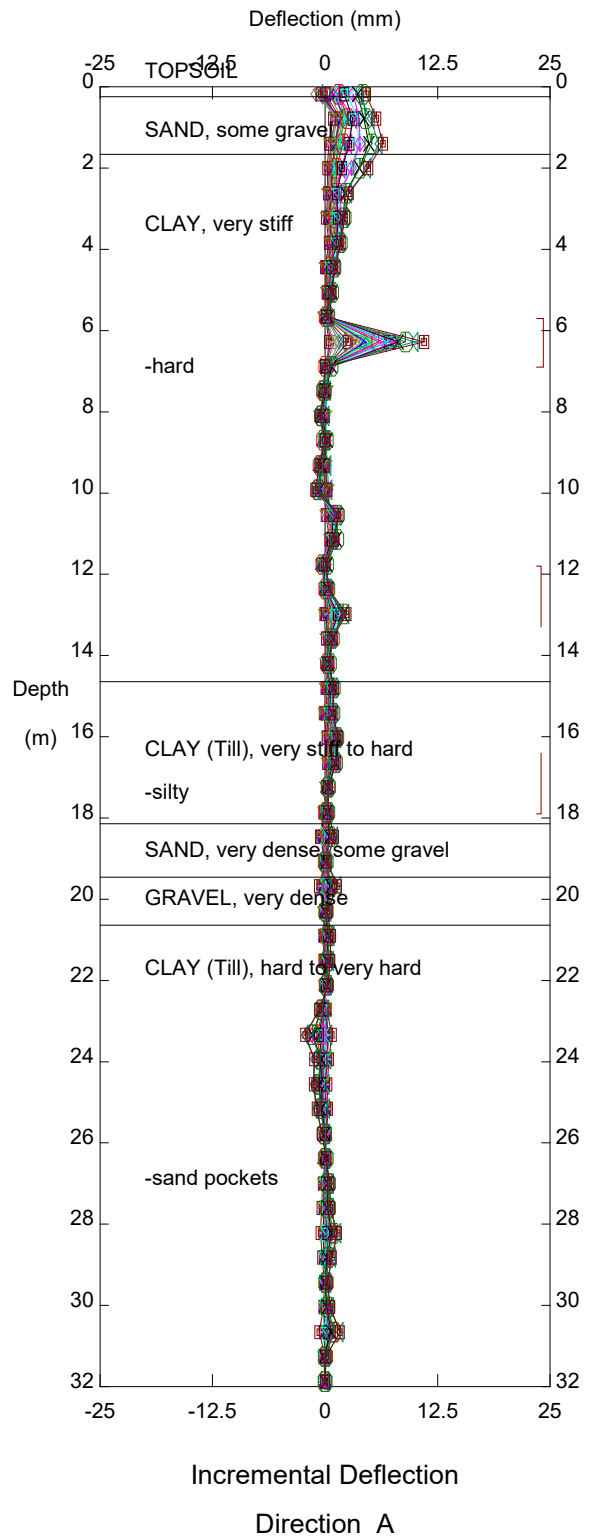
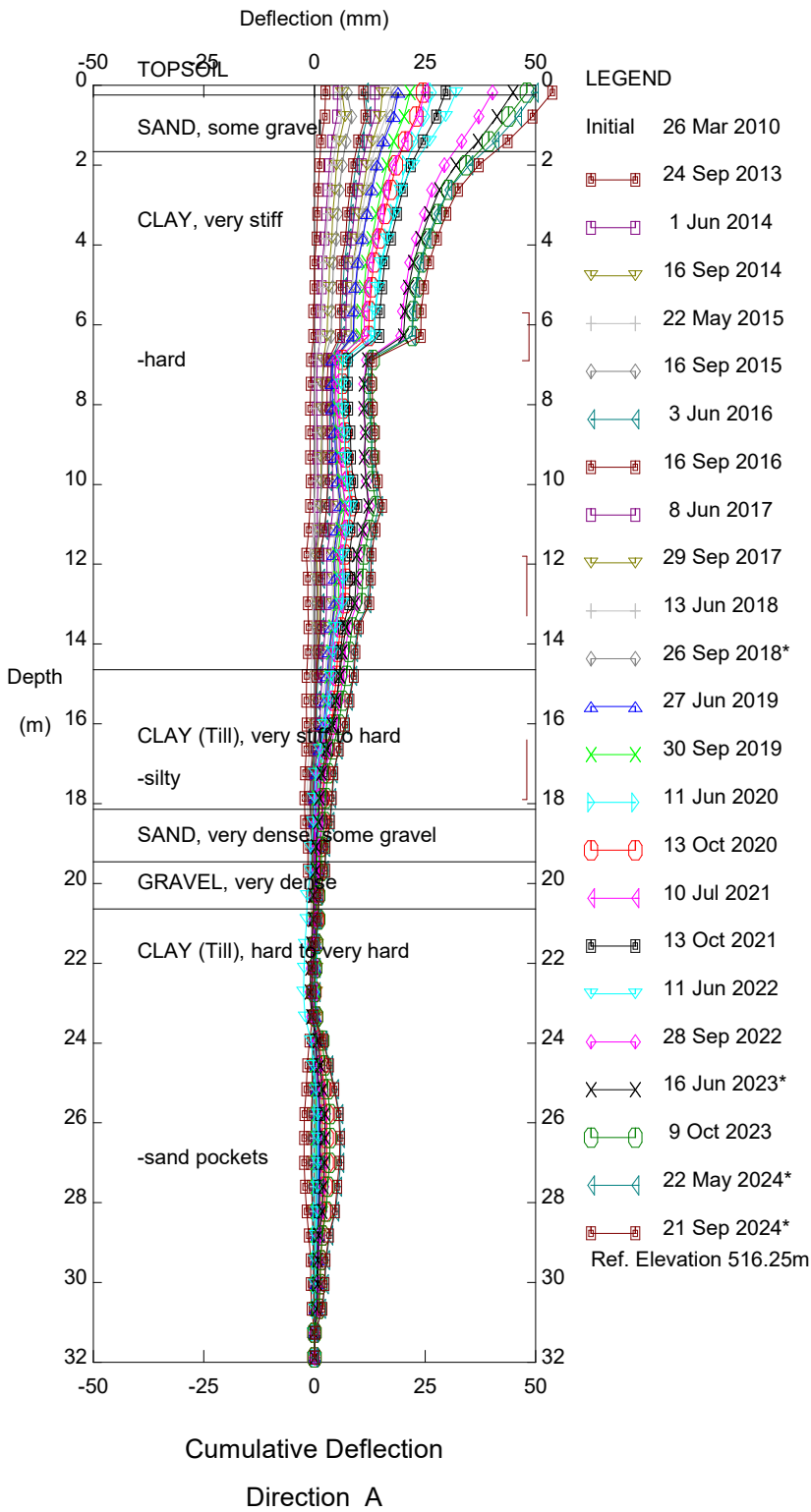
Thurber Engineering Ltd.



HWY 744:04 - STA. 57+700 to 58+000, Inclinator SI98-10i

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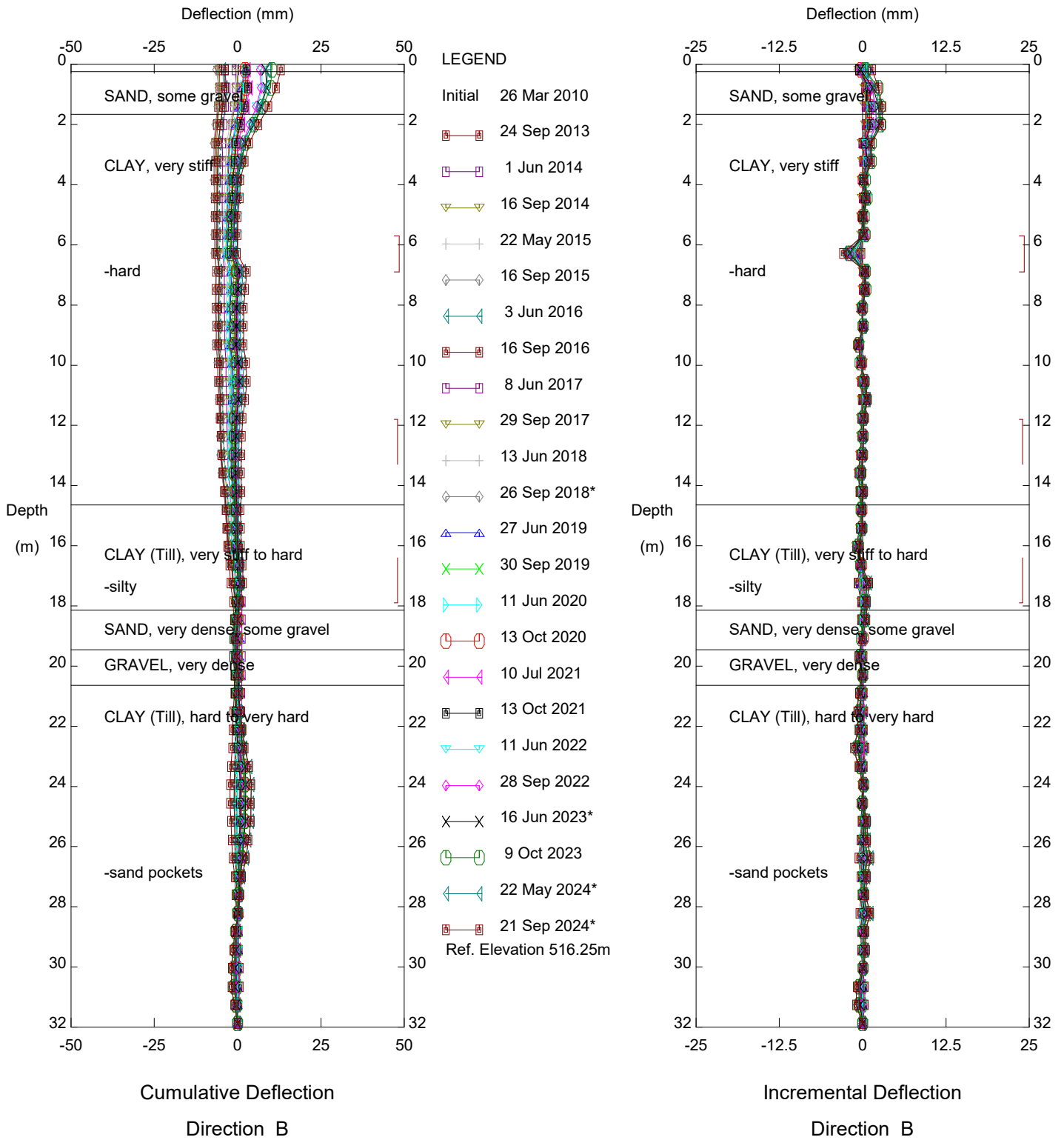


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Sets marked * include zero shift and/or rotation corrections.

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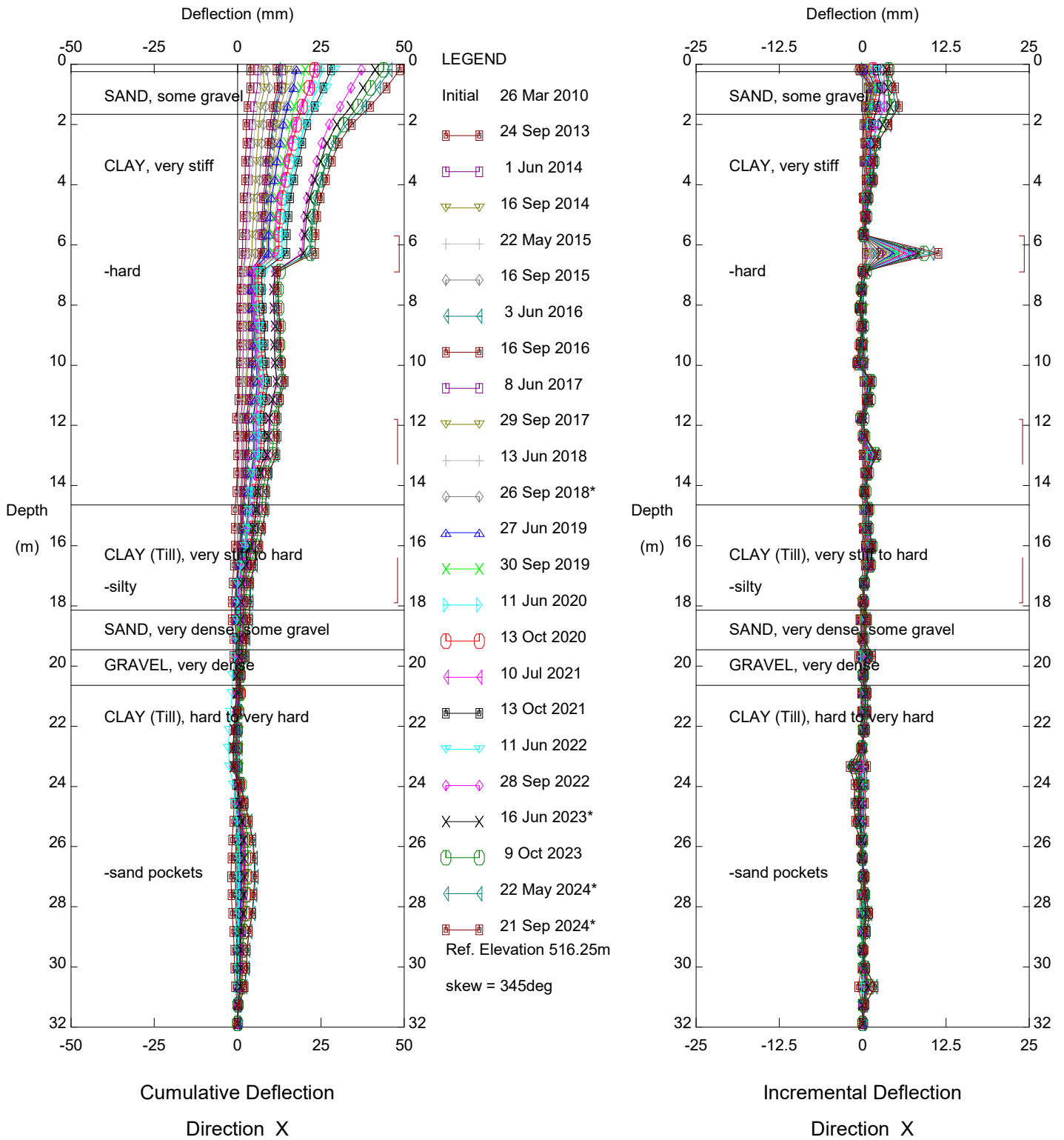


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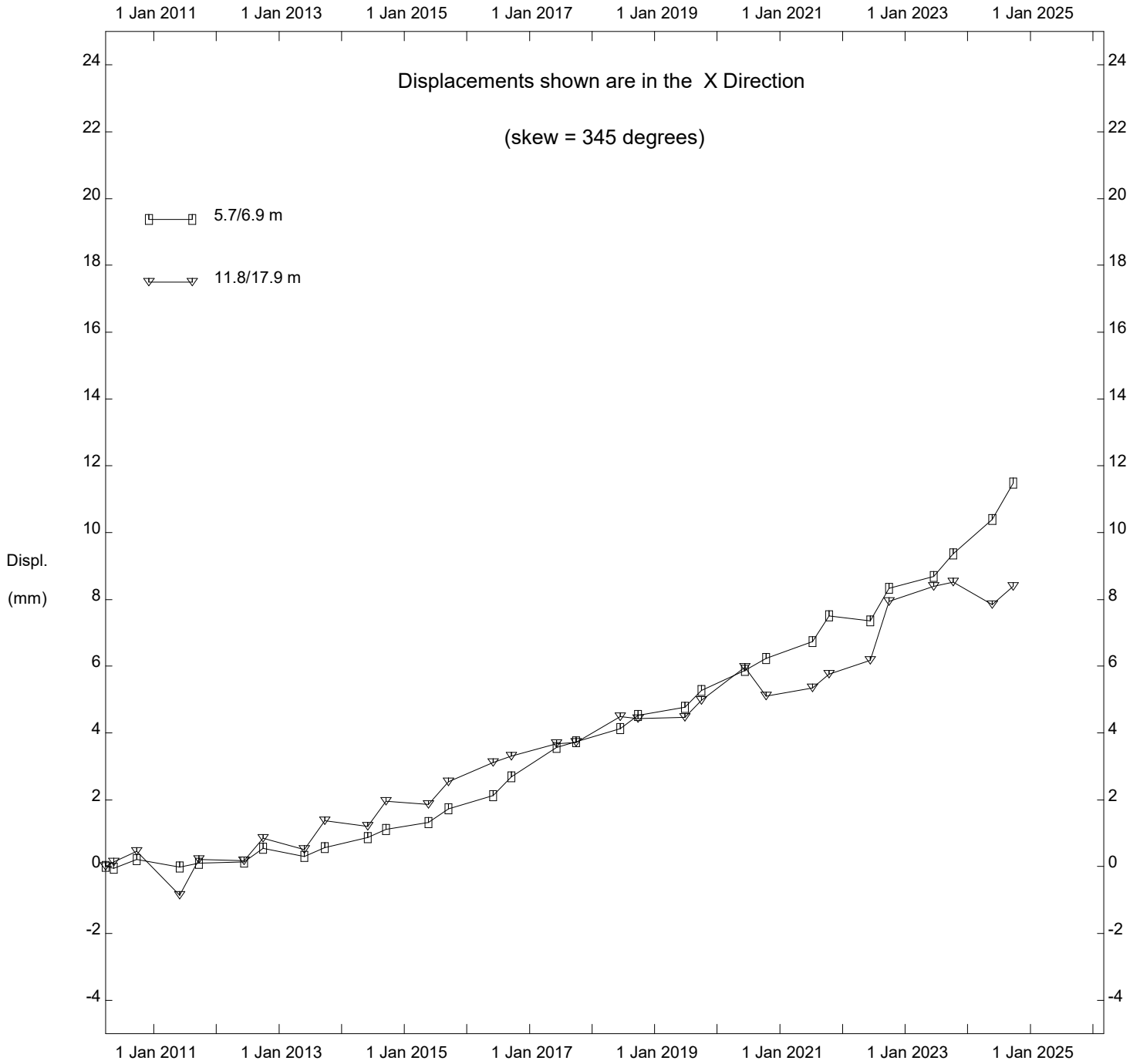


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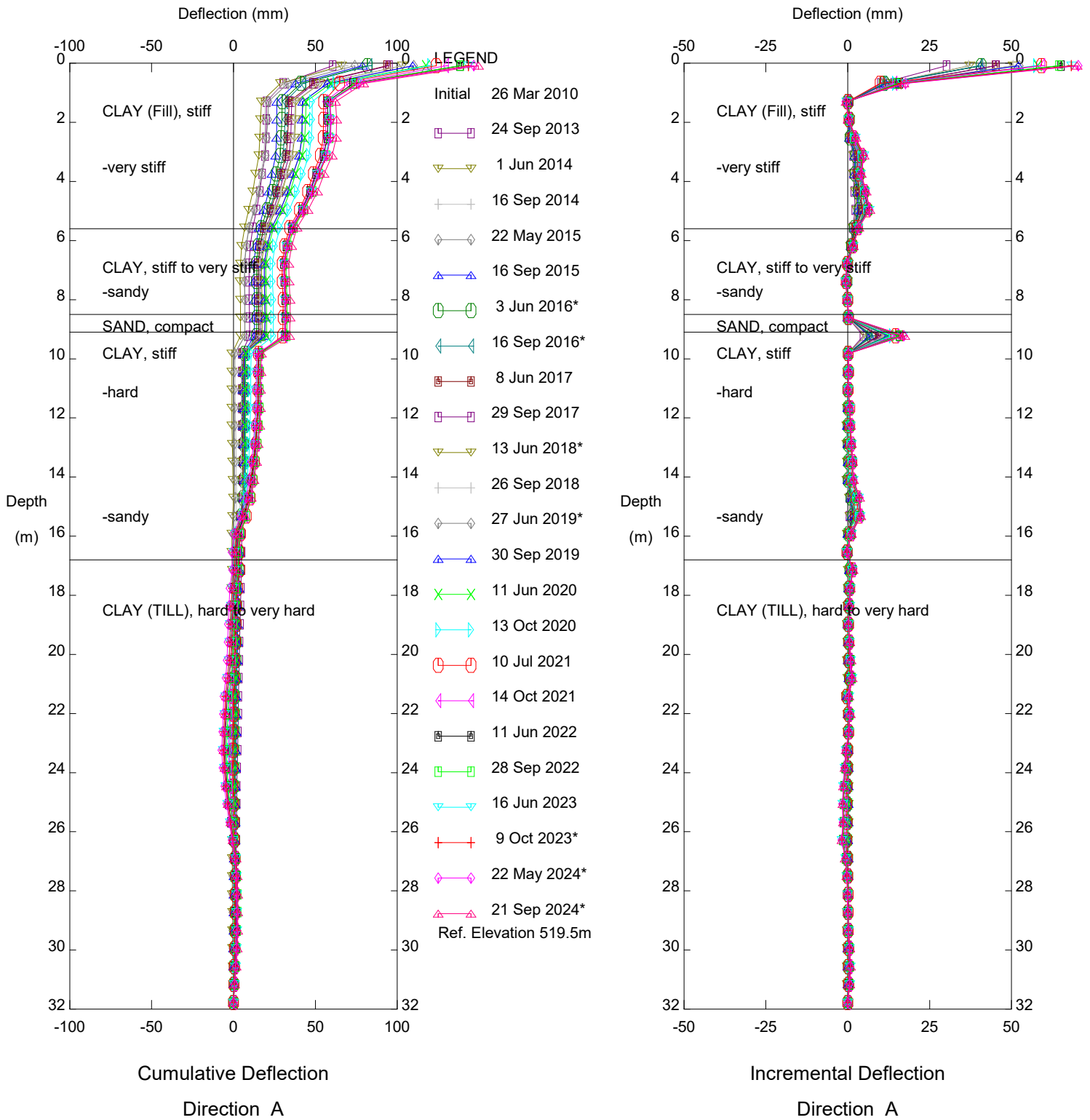
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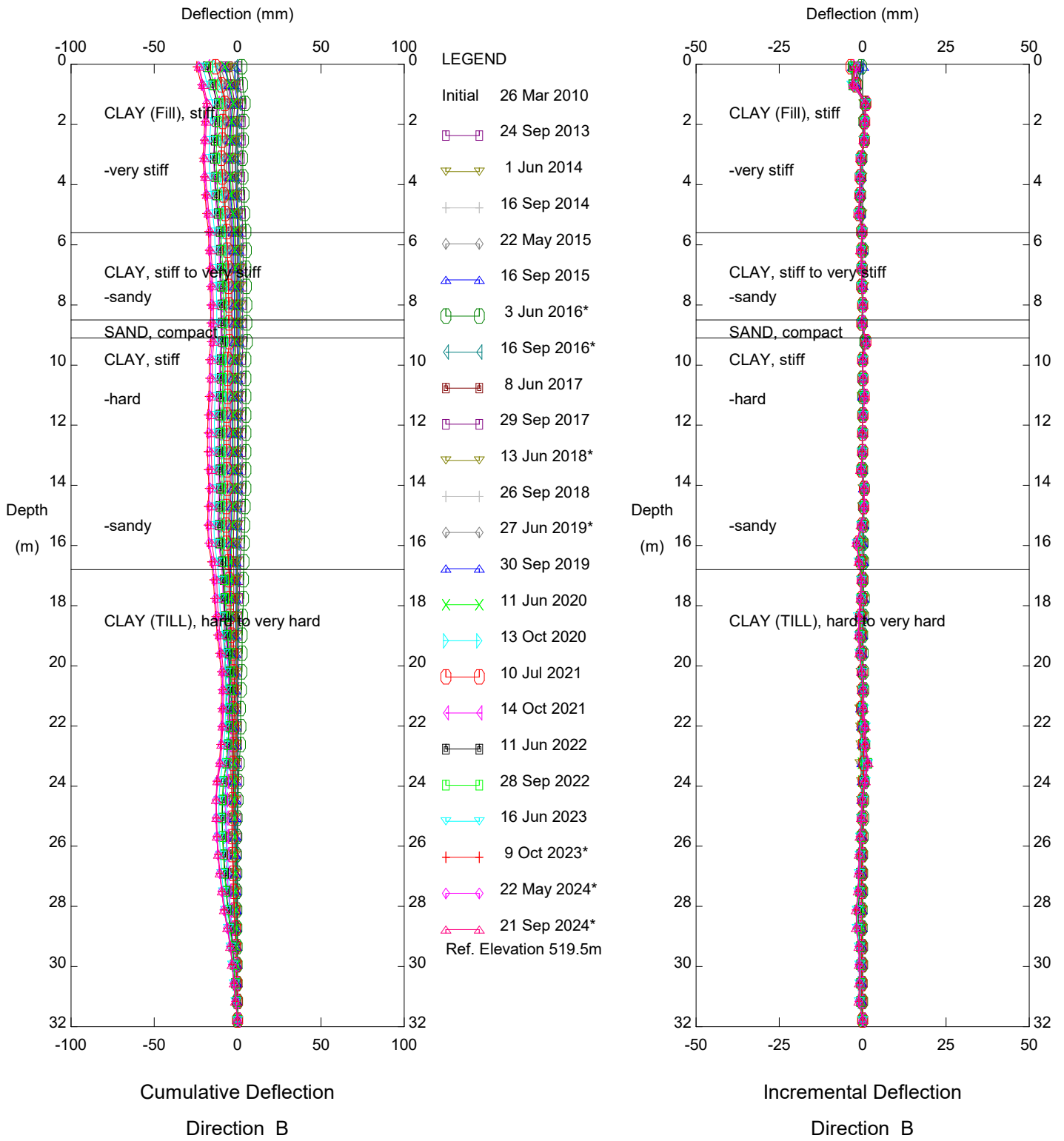


PH031 Judah Hill Michelin Slide, Inclinometer SI10-7

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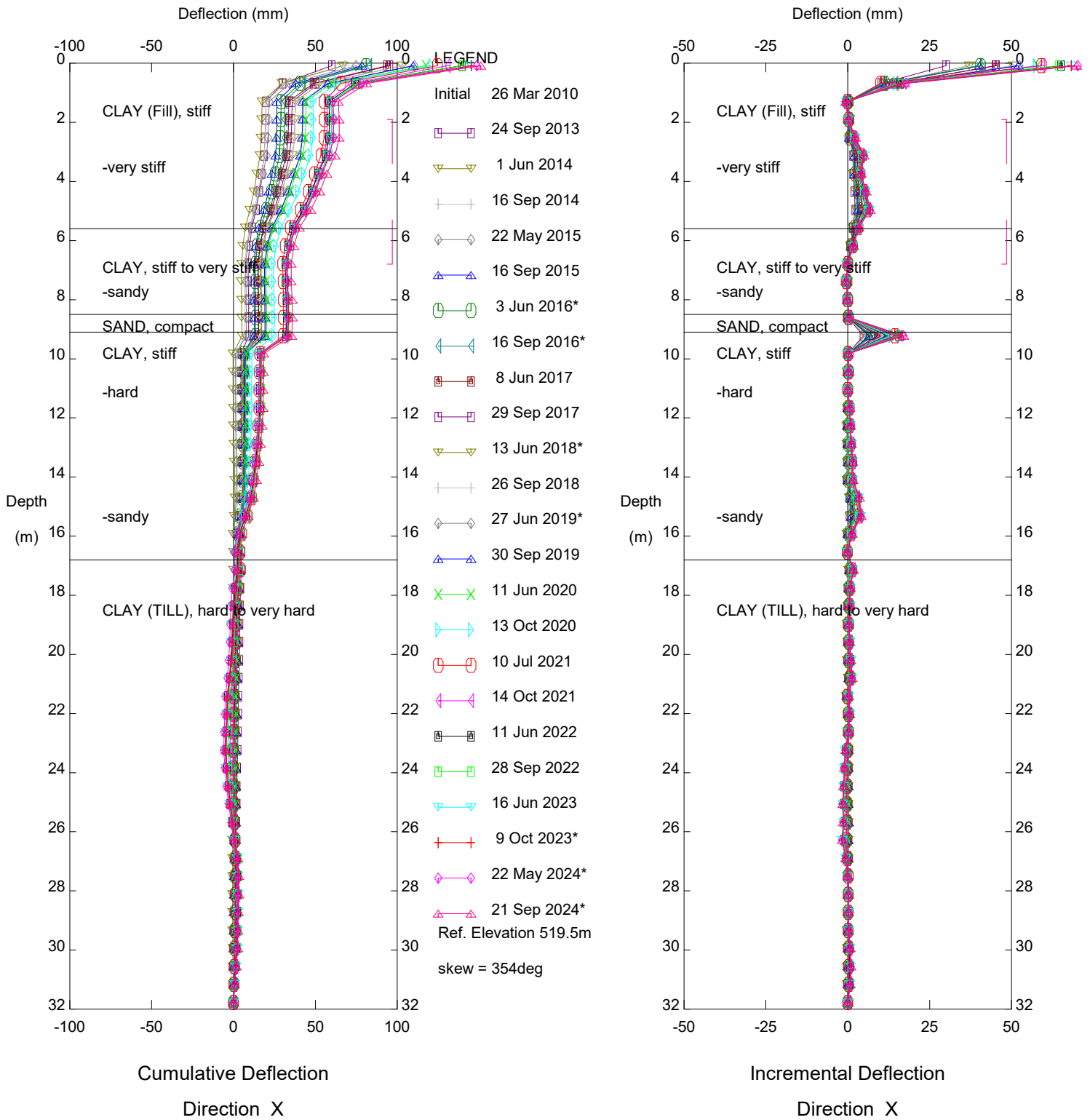


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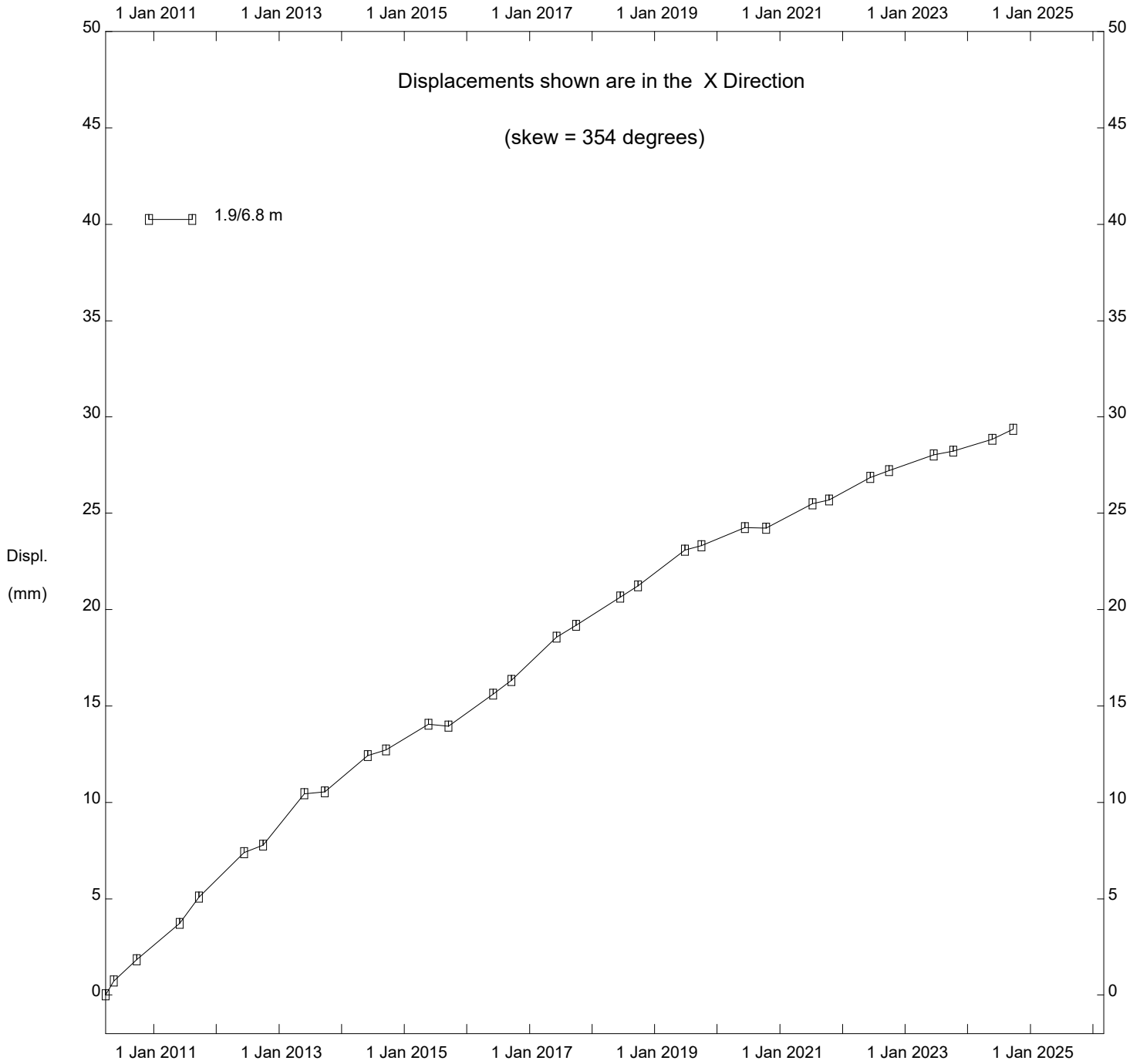


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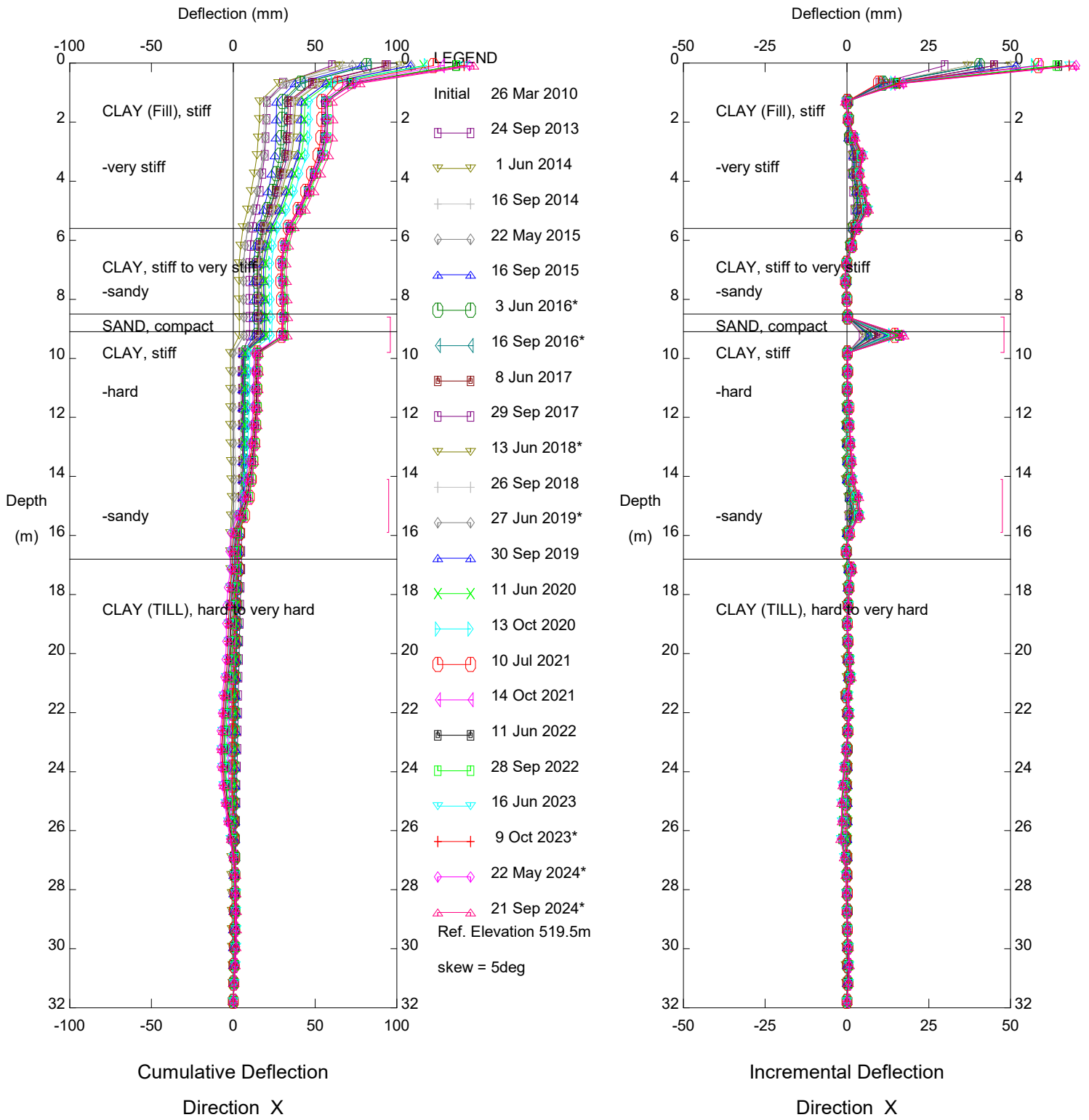
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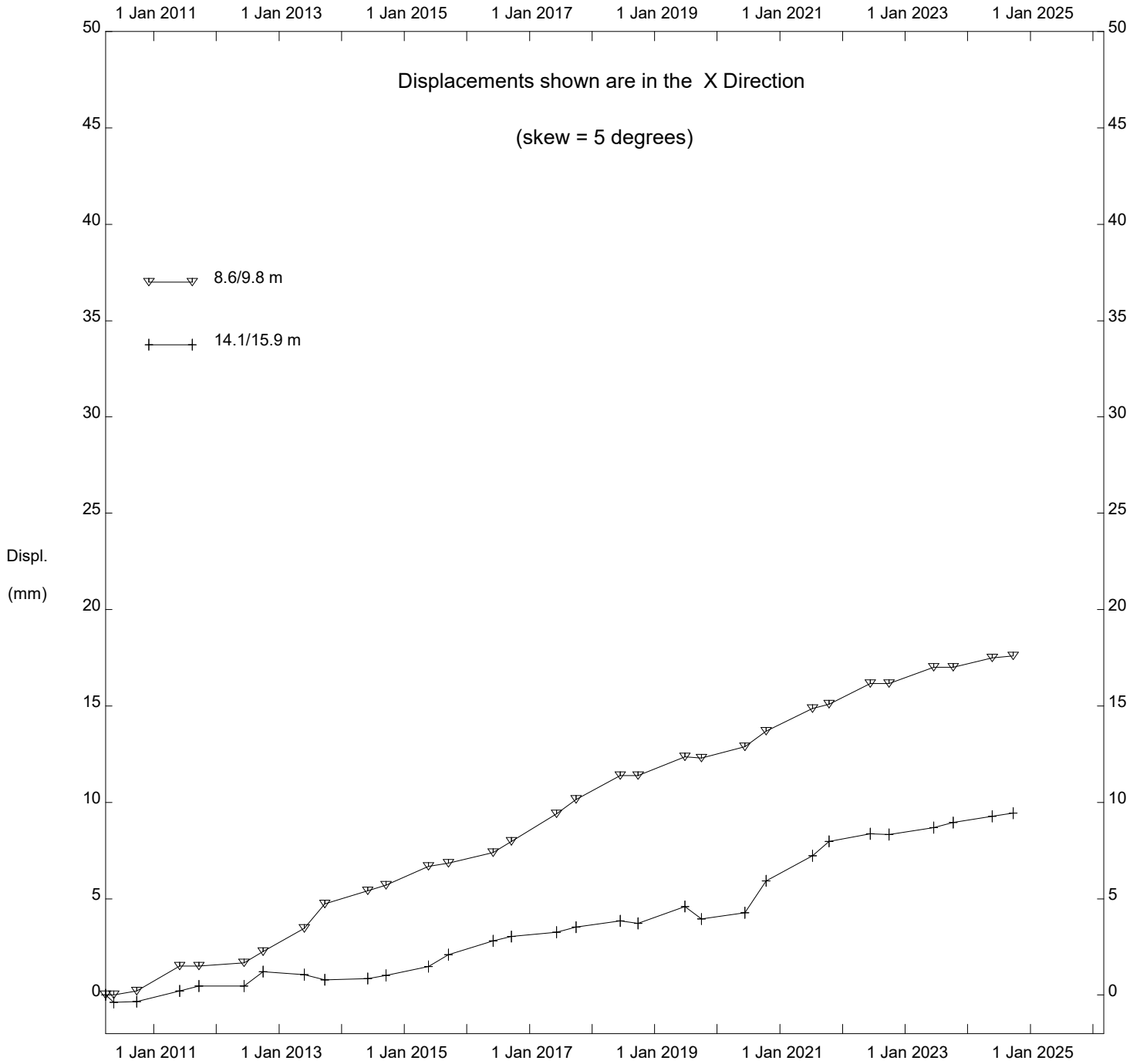


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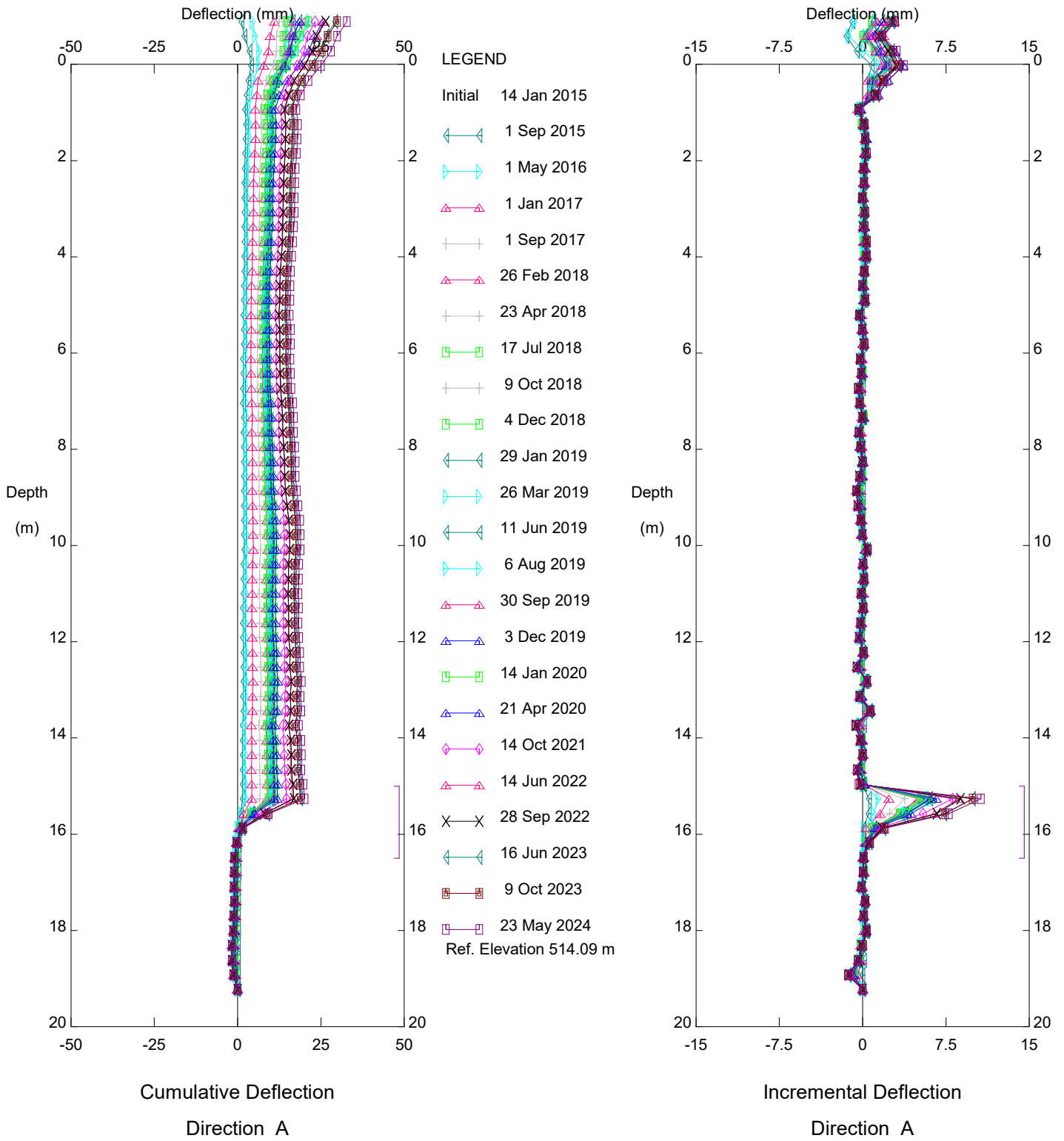
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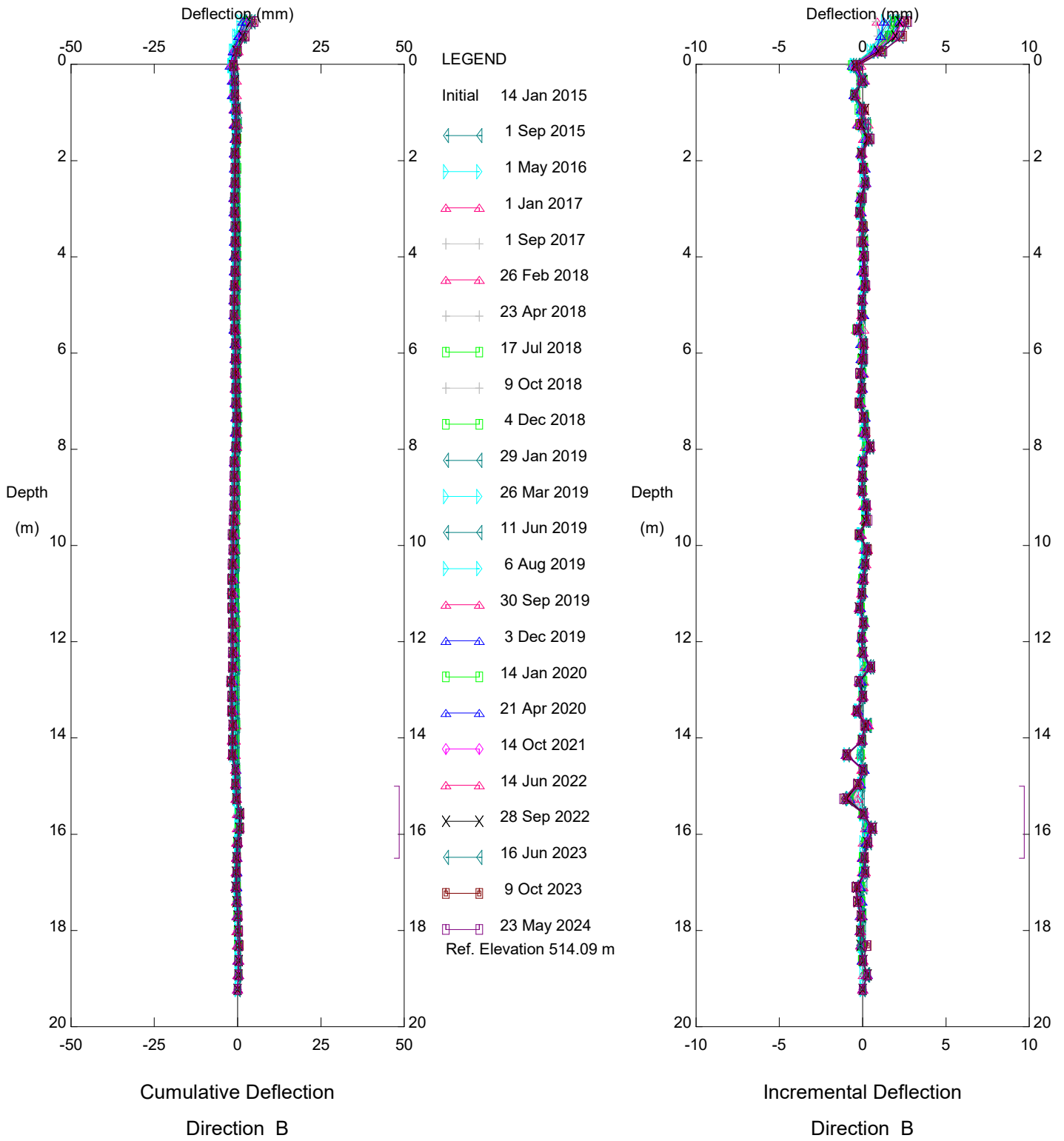
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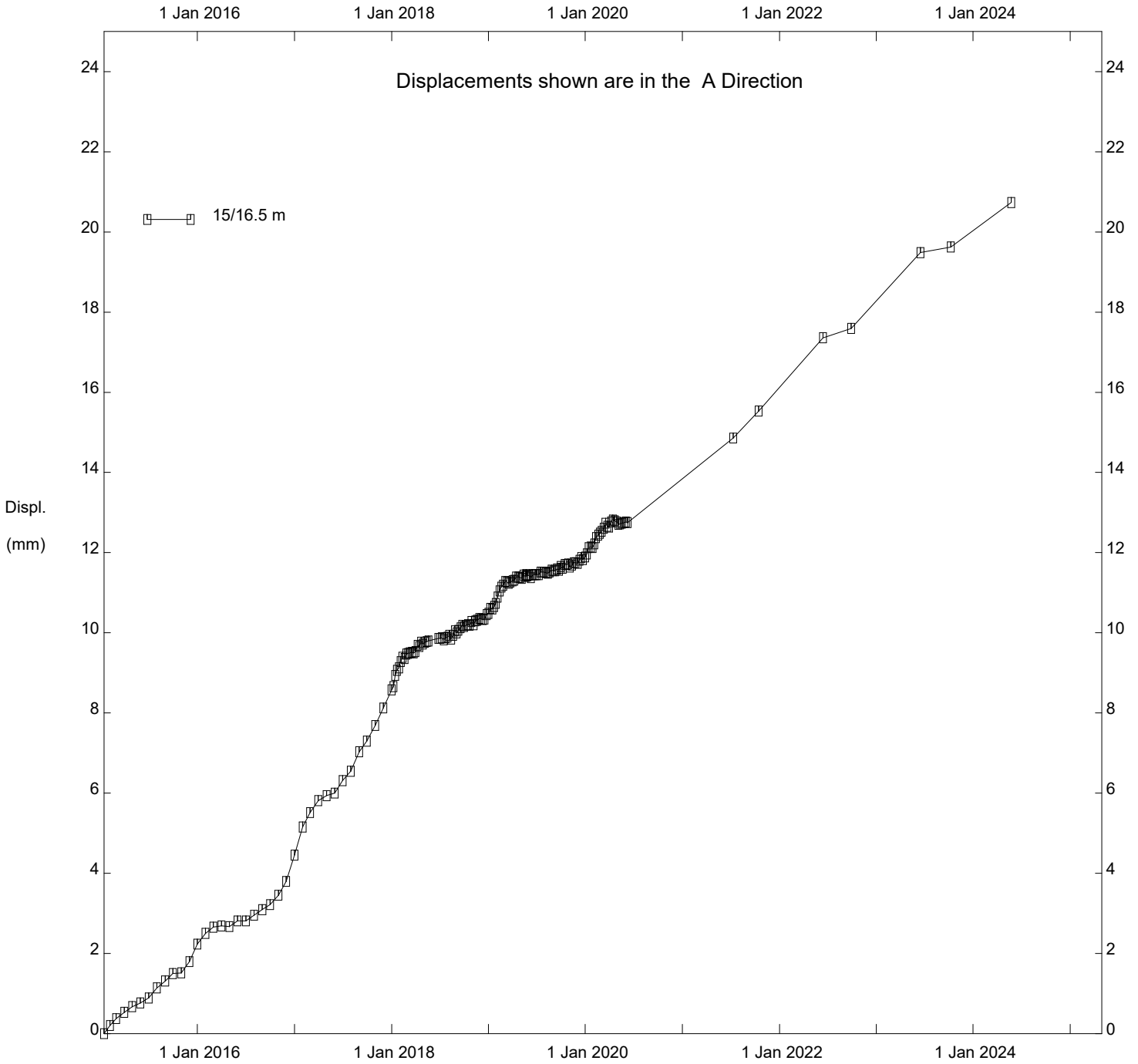
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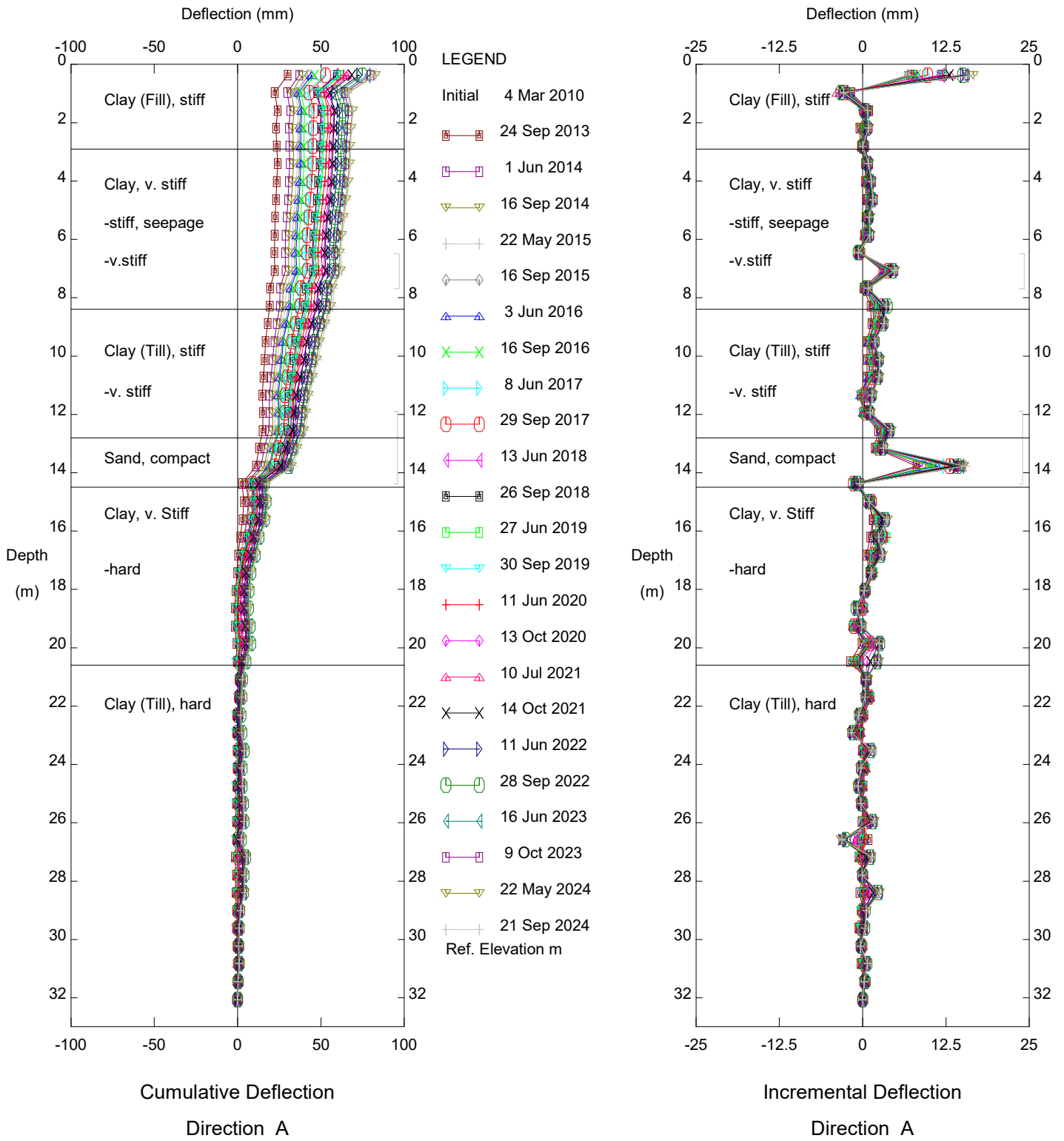
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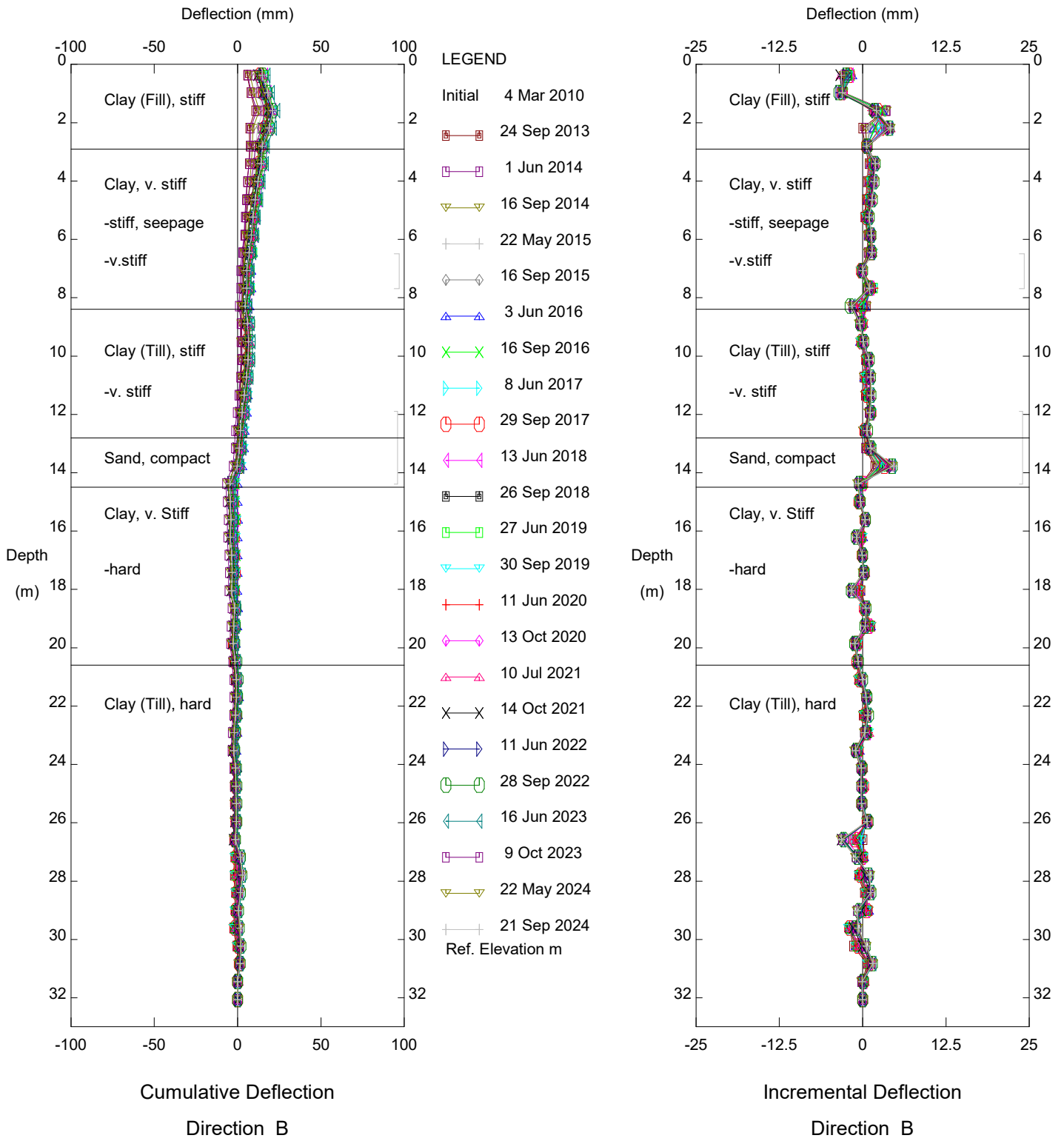
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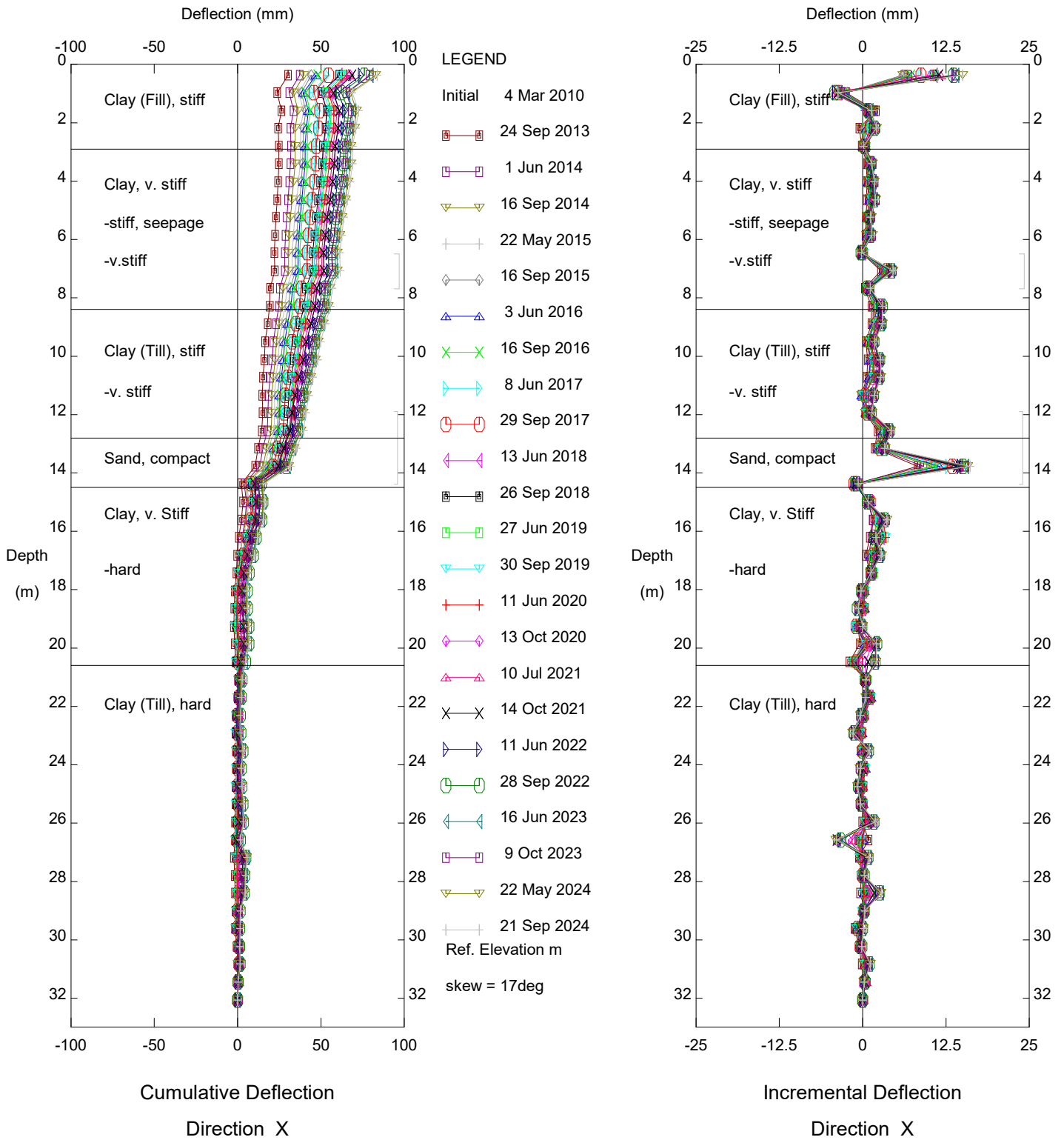
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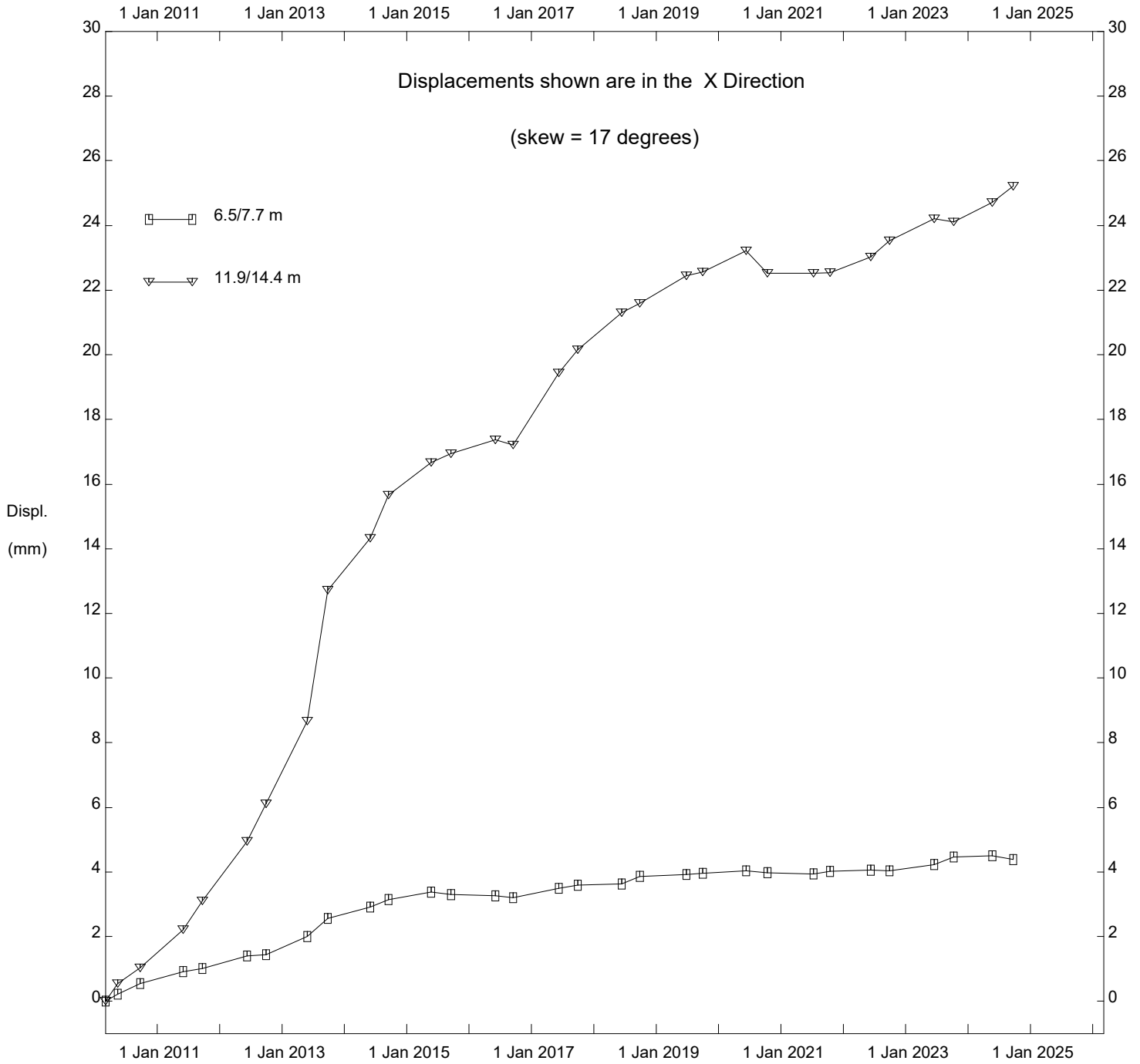
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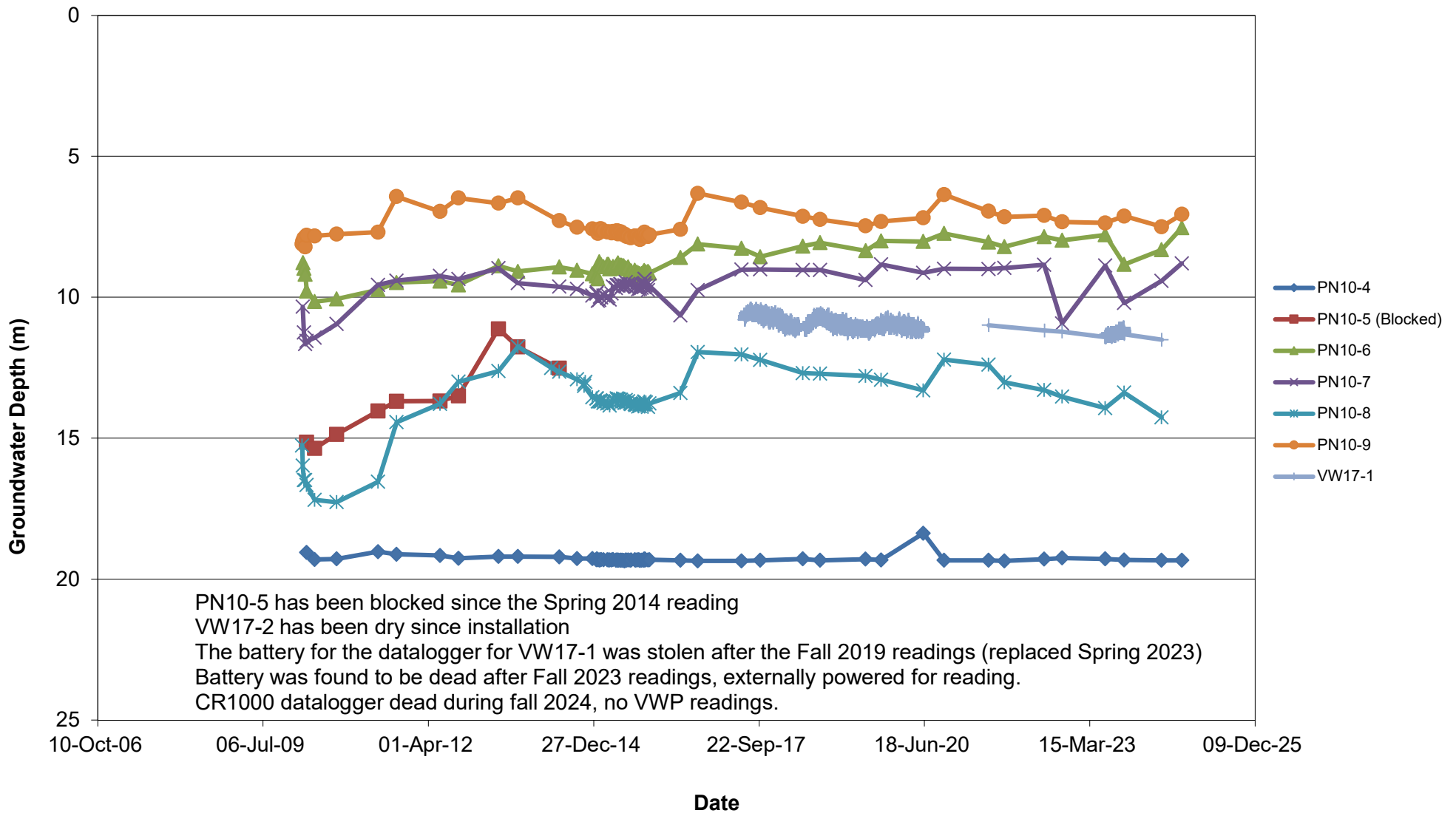
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**FIGURE PH031-1
PIEZOMETRIC DEPTHS FOR HWY 744:04 JUDAH HILL (MICHELIN SLIDE)**



**FIGURE PH031-2
PIEZOMETRIC ELEVATIONS FOR HWY 744:04 JUDAH HILL (MICHELIN SLIDE)**

