ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS) INSTRUMENTATION MONITORING- SPRING 2025

Site Number	Location	Name	Hwy	km
NC025	HWY 646:04 C1 16.082	Lindbergh Hill	646:04	Km 16.1
Legal Description: 15-27-56-5 W4		**UTM Co-ordinates**		
		12U E 522385	N 5969334	

Current Monitoring:	22-May-2025	**Previous Monitoring**	5-June-2024
Instruments Read By:	Mr. Niraj Regmi, G.I.T and Mr. Godfred Etiendem, of Thurber		

Instruments Read During This Site Visit			
Slope Inclinometers (SIs): SI02-1 and SI07-1 to 07-3	**Pneumatic Piezometers (PN):** N/A	**Vibration Wire Piezometers (VW):** N/A	**Standpipe Piezometers (SP):** SP02-1 and SP02-4
Load Cell (LC): VC1463 through VC1468	**Strain Gauges:** N/A	**SAAs:** N/A	**Others:**

Readout Equipment Used			
Slope Inclinometers: RST Digital Inclinometer probe with 2 ft wheelbases and RST pocket readout	**Pneumatic Piezometers:**	**Vibration Wire Piezometers:**	**Standpipe Piezometers:** Heron dipmeter
Load Cell: RST Digital readout unit	**Strain Gauges:**	**SAAs:**	**Others:**
Notes:			

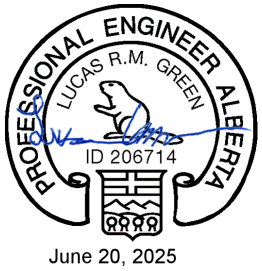
Discussion	
Zones of New Movement:	None
Interpretation of Monitoring Results:	SI02-1, installed in the south ditch of the highway, continued to show no discernible movement. The movements in the SIs installed in the piles were as follows: • SI07-1 = - 3.3 mm pile head movement over 0.4 m to 12.0 m depth • SI07-2 = 24.4 mm pile head movement over 0.3 m to 16.7 m depth • SI07-3 = 47.9 mm pile head movement over 0.2 m to 13.6 m depth. SI07-1, located in the western segment of the wall, showed rates of movement of 0.8 mm/yr and 1.4 mm/yr, over 0.4 m to 12.0 m depth and 0.4 m to 20.0 m depth, respectively since the spring 2024 readings. SI07-2, located in the middle segment of the pile wall, showed rates of movement of 1.2 mm/yr and 1.5 mm/yr, over 0.3 m to 11.2 m depth and 0.3 m to 16.7 m depth, respectively since the spring 2024 readings.

	SI07-3, located in the eastern segment of the wall, showed a rate of movement of 4.5 mm/yr over 0.2 m to 5.6 m depth, and a rate of movement of 4.0 mm/yr over 0.2 m to 13.6 m depth, since the spring of 2024 readings. Standpipe piezometer SP02-1 showed a decrease in groundwater level of 0.02 m since the spring of 2024 readings. SP02-4 showed an increase in groundwater level of 1.23 m since the spring of 2024 readings. Load cell VC1463 showed a decrease in measured load of 0.03 kN since the spring of 2024 readings, and a decrease of 46.50 kN since the spring of 2022 readings. The large decrease in the load in VC1463 is likely due to one of the vibrating wires functioning incorrectly. VC1464, VC1465, VC1466 and VC1468 showed increases in measured load of 0.16 kN, 5.41 kN, 0.37 kN, and 0.32 kN, respectively, since the spring of 2024 readings. VC1467 showed a decrease in measured load of 0.3 kN, since the spring of 2024 readings. VC1463, VC1464 and VC1467 currently have three of the four vibrating wire channels functioning so the measured load is the average of the functioning channels. VC1465 currently has only one wire functioning. In general, the instrumentation monitoring results indicate that the pile wall has performed well since construction completion.
Future Work:	The instruments should be read again in the spring of 2026.
Instrumentation Repairs:	No instrument repairs are required at this time.
Additional Comments:	

Attachments:	• Table NC025-1 Spring 2025 – HWY 646:02 Lindbergh Hill, Slope Inclinometer Instrumentation Reading Summary • Table NC025-2 Spring 2025 – HWY 646:02 Lindbergh Hill, Standpipe Piezometer Instrumentation Reading Summary • Table NC025-3 Spring 2025 – HWY 646:02 Lindbergh Hill, Load Cell Instrumentation Reading Summary • Statement of Limitations and Conditions • APPENDIX A – NC025-1 SPRING 2025 o Field Inspector's report o Site Plan Showing Approximate Instrument Locations (Drawing No. 32122-NC025) o SI Reading Plots o Figure NC025-1 (Piezometric Depths) o Figure NC025-2 (Load Cell Readings)

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.
Tarek Abdelaziz, Ph.D., P. Eng.
Partner | Senior Geotechnical Engineer



PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: June 20, 2025
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Lucas Green, P.Eng.
Geotechnical Engineer

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Table NC025-1: Spring 2025– Hwy 646:02 Lindbergh Hill Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 22, 2025

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI02-1	Sept. 9, 2002	No discernible movement	N/A	Operational	June 5, 2024	N/A	N/A	N/A
SI02-2	*Sept. 9, 2002*	*N/A*	*47.6 mm/yr between Sept. 2002 and Oct. 2002*	*Sheared off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*
SI02-3	*Sept. 9, 2002*	*N/A*	*52.8 mm/yr between Sept. 2002 and Oct. 2002*	*Sheared off*	*Oct. 2006*	*N/A*	*N/A*	*N/A*
SI02-4	*Sept. 9, 2002*	*N/A*	*65.1 mm/yr between Sept. 2002 and Oct. 2002*	*Sheared off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*
SI06-1	*Apr. 4, 2006*	*N/A*	*207.9 mm/yr between Apr. 2006 and May 2006*	*Sheared off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*
SI06-2	*Apr. 6, 2006*	*N/A*	*430.4 mm/yr between Apr. 2006 and May 2006*	*Sheared off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*

Drawing 32122-NC025 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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Table NC025-1 – Continued: Spring 2025 – Hwy 646:02 Lindbergh Hill Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 22, 2025

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI06-3	*Aug. 22, 2006*	*N/A*	*445.6 mm/yr between Aug. 22 and 30, 2006*	*Sheared Off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*
SI06-4	*Aug. 22, 2006*	*N/A*	*194.4 mm/yr between Aug. 22 and Aug. 30, 2006*	*Sheared Off*	*Oct. 12, 2006*	*N/A*	*N/A*	*N/A*
SI07-1 (Pile #14)	May 22, 2007	-3.3 over 0.4 m to 12.0 m depth in 20° direction	84.8 mm/yr between May 2007 and June 2007	Operational	June 5, 2024	0.8	0.8	1.4
		-1.4 over 0.4 m to 20.0 m depth in 20° direction	92.2 mm/yr between May 2007 and June 2007			1.4	1.4	2.7
SI07-2 (Pile #28)	May 22, 2007	21.6 over 0.3 m to 11.2 m depth in 20° direction	262.7 mm/yr between May 2007 and June 2007	Operational	June 5, 2024	1.2	1.2	1.5
		22.4 over 0.3 m to 16.7 m depth in 20° direction	258.0 mm/yr between May 2007 and June 2007			1.4	1.5	2.2

Drawing 32122-NC025 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

Table NC025-1 – Continued: Spring 2025 – Hwy 646:02 Lindbergh Hillslope Inclinometer Instrumentation Reading Summary

Date Monitored: May 22, 2025

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI07-3 (Pile #38)	May 22, 2007	45.1 over 0.2 m to 5.6 m depth in 10° direction	158.5 mm/yr between Jun. 2007 and July 2007	Operational	June 5, 2024	4.3	4.5	4.4
		47.9 over 0.2 m to 13.6 m depth in 10° direction	149.8 mm/yr between June 2007 and July 2007			3.9	4.0	3.4

Drawing 32122-NC025 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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Table NC025-2: Spring 2025 – Hwy 646:02 Lindbergh Hill Standpipe Piezometer Instrumentation Reading Summary

Date Monitored: May 22, 2025

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	CURRENT GROUNDWATER DEPTH BGS (m)	PREVIOUS GROUNDWATER DEPTH BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
SP02-1	N/A	998.320	1004.50	Operational	999.2 on May 7, 2007 (5.32 mBGS)	998.31 (6.19 mBGS)	998.33 (6.17 mBGS)	-0.02
SP02-3A	*N/A*	*993.99*	*1002.71*	*Destroyed*	*998.11 on Oct. 29, 2003 (4.6 mBGS)*	*N/A*	*N/A*	*N/A*
SP02-3	N/A	*990.44*	*1002.71*	*Destroyed*	*991.41 on Oct. 3, 2002 (11.3 mBGS)*	*N/A*	*N/A*	*N/A*
SP02-4	N/A	989.01	997.45	Operational	996.44 on May 24, 2017 (1.01 mBGS)	995.62 (1.83 mBGS)	994.39 (3.06 mBGS)	1.23
SP06-1	N/A	*986.09*	*1002.20*	*Destroyed*	*989.89 on May 30, 2006 (12.3 mBGS)*	*N/A*	*N/A*	*N/A*

Drawing 32122-NC025 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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Table NC025-3: Spring 2025 – Hwy 646:04 Lindbergh Hill Load Cell Instrumentation Reading Summary

Date Monitored: May 22, 2025

SERIAL #	ANCHOR NUMBER	DESIGN LOAD (kN)	DATE INSTALLED	MEASURED FORCE (kN)	PREVIOUS READING (kN)	CHANGE IN FORCE SINCE PREVIOUS READING (kN)
VC 1463	G37	240	Jul. 6, 2007	163.24*	163.27*	-0.03
VC 1464	G28U	240	Jul. 6, 2007	219.62*	219.46*	0.16
VC 1465	G28L	240	Jul. 6, 2007	154.23**	148.81**	5.42
VC 1466	G19L	330	Jul. 17, 2007	314.81	314.44	0.37
VC 1467	G9U	330	Jul. 6, 2007	275.29*	275.59*	-0.30
VC 1468	G19U	330	Jul. 6, 2007	232.87	232.55	0.32

Drawing 32122-NC025 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

* The estimated loads for VC1463, VC1464, and VC1467 are based on the average readings from 3 wires instead of 4.

** The estimated load for VC1465 is only based on one operating vibrating wire.

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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.

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ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS

SPRING 2025

APPENDIX A
DATA PRESENTATION AND SITE PLANS

SITE NC025: HWY 646:04 LINDBERGH HILL

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC025)
SPRING 2025

Location:	Lindberg Hill (HWY 646:04 C1 16.082)	**Readout:**	RST Vibrating wire readout 2106, unit 1/DGSI Dipmeter
File Number:	32122	**Casing Diameter:**	2.75"
Probe:	RST SET 8R	**Temp:**	12
Cable:	RST SET 8R	**Read by:**	NKR/GE

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 12)		Date	Stickup m	Depth from top of casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel		
	Easting (m)	Northing (m)					A+	A-	B+	B-	#	Size (")	Remarks
SI02-1	522385.00	5969334.00	22-May-25	0.82	49 to 3	16	-619	728	-721	-728	8R	2.75	
SI07-1*	522428.20	5969328.17	22-May-25	0.47	67 to 5	5	194	-175	-292	298	8R	2.75	***
SI07-2*	522428.20	5969328.17	22-May-25	0.66	61 to 5	5	-43	60	342	-337	8R	2.75	
SI07-3*	522428.20	5969328.17	22-May-25	0.76	49 to 3	355	496	-483	119	-117	8R	2.75	

STANDPIPE PIEZOMETER (SP) READINGS

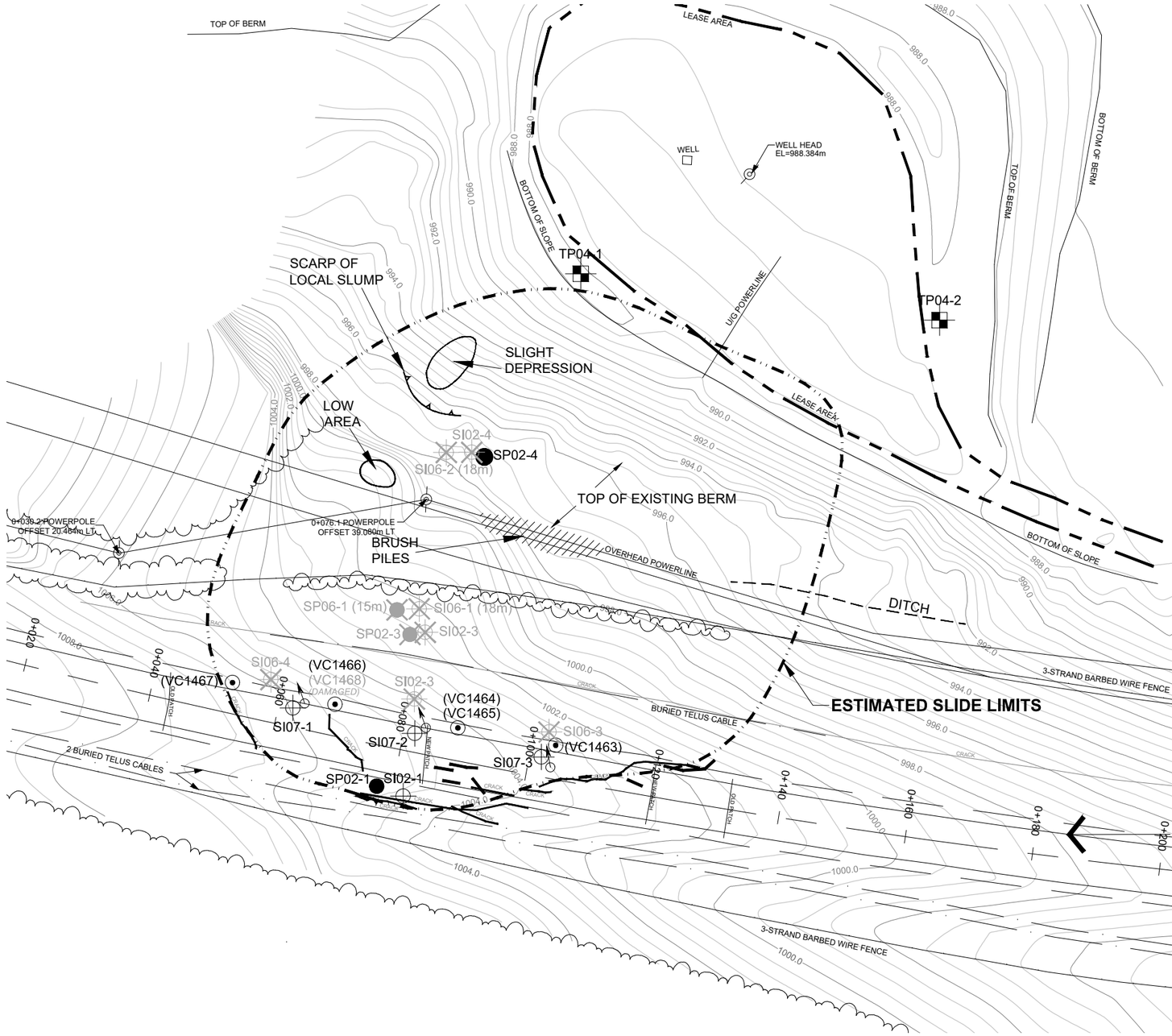
SP#	GPS Location (UTM 12)		Date	Stick-up (m)	Reading below top of casing (m)	Bottom Pipe Depth (below top of casing (m)
	Easting (m)	Northing (m)				
SP02-1	522398.88	5969352.84	22-May-25	0.86	7.05	7.06
SP02-4	522393.12	5969402.21	22-May-25	0.77	2.60	9.14

LOAD CELL (VC) READINGS

Anchor#	VC#	GPS Location		Date	Reading B(units)	Temp degree C
		Latitude	Longitude			
G9U	VC1467	-	-		6335.4/6742.8/6855.0	8.6
G19U	VC1468	-	-		6511.1/6609.5/6254.9/6672.9	7.5
G19L	VC1466	-	-		6447.2/6070.6/6352.0/6676.2	7.1
G28U	VC1464	-	-		6411.9/6739.7/6479.0	10.5
G28L	VC1465	-	-		6792.9	**Not Working
G37	VC1463	-	-		6707.3/6717.0/6705.0	9.6

INSPECTOR REPORT

*SI07-1,2,3 were installed in the wall.
Use RST with 1 ft extension.
***SI07-1 hard to pull at 6 ft
Note: 4 SENSOR ON VW MONITOR SETTING
** Temp. sensor not working, only one Vibrating wire functioning



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LEGEND

- TEST PIT
- SLOPE INCLINOMETER (OPERATIONAL)
- STANDPIPE PIEZOMETER
- DAMAGED
- SLOPE INCLINOMETER (SHEARED OFF)
- LOAD CELL
- DIRECTION OF MOVEMENT IN SLOPE INCLINOMETER

0 10 20 30 40 50m
SCALE 1:750

BASE PLAN SURVEYED BY EXH ENGINEERING SCIENCES LTD.

Alberta

NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
NC025: HWY 646:04 (km 16)
WEST LINDBERGH HILL SLIDE
SITE PLAN SHOWING APPROXIMATE INSTRUMENT LOCATIONS
DWG No. 32122-NC025

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:750
DATE	JULY 2021
FILE No.	32122

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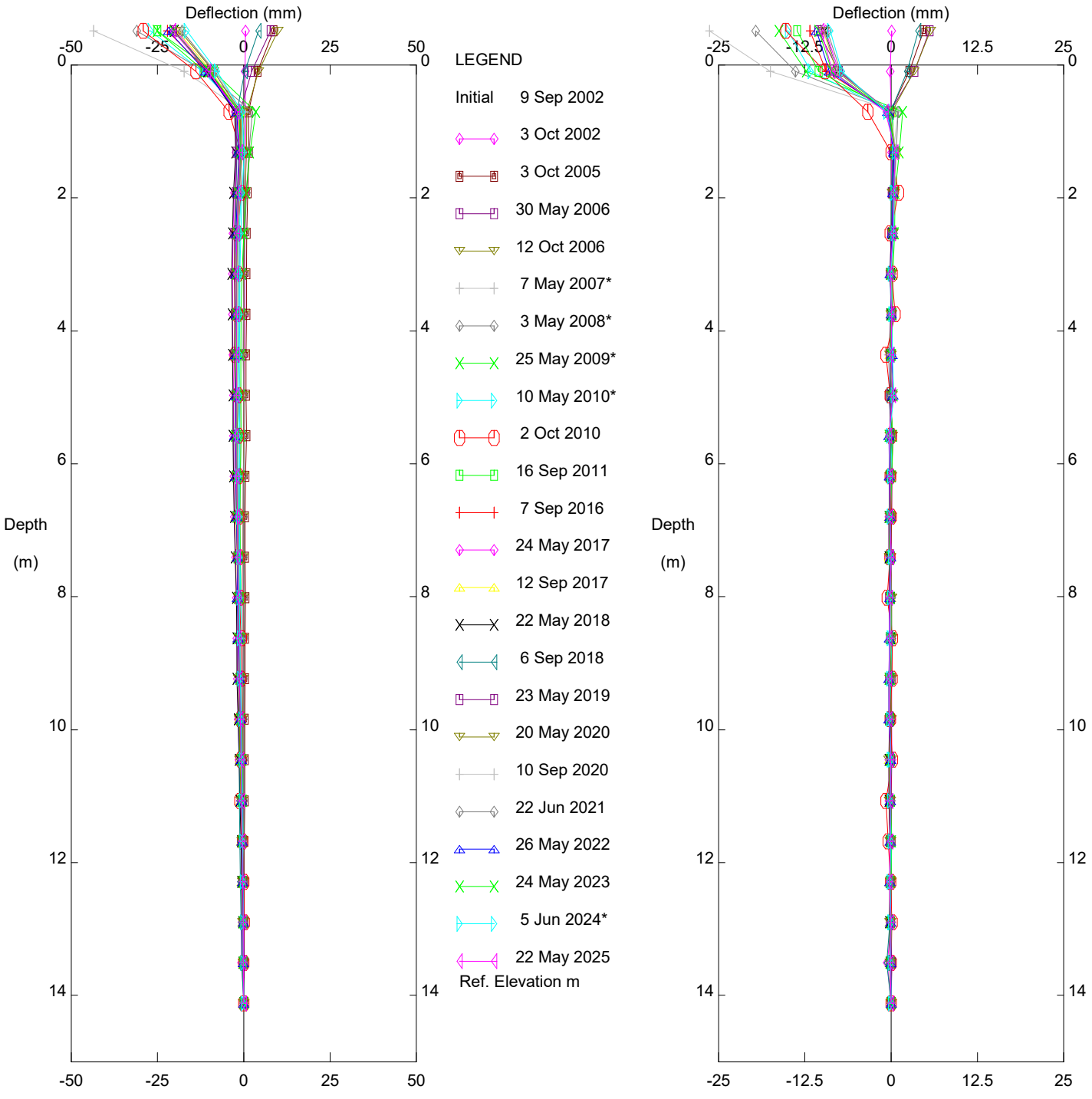

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

HWY 646:04 Lindbergh Hill, Inclinometer SI02-1

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

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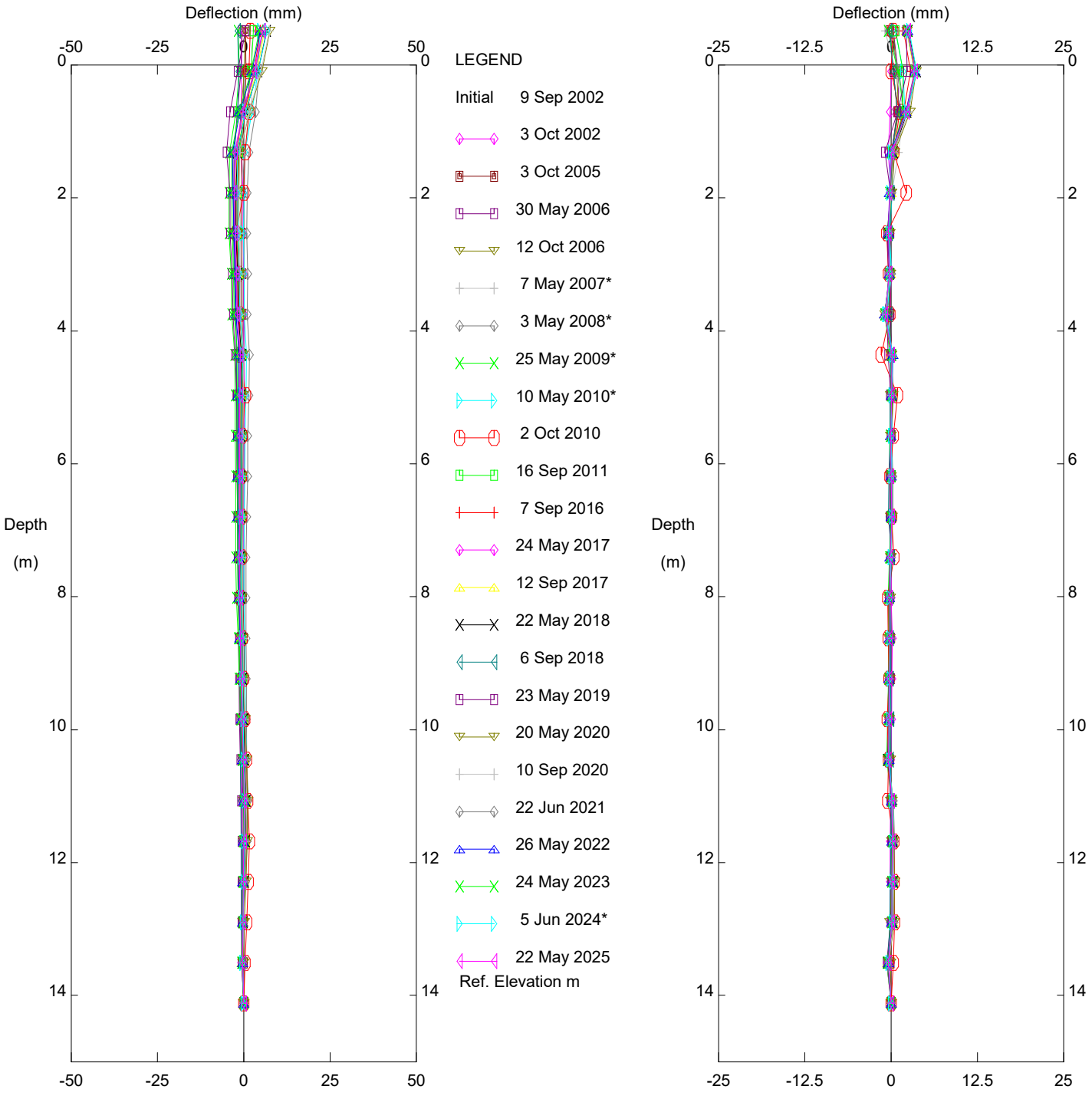

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

HWY 646:04 Lindbergh Hill, Inclinometer SI02-1

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

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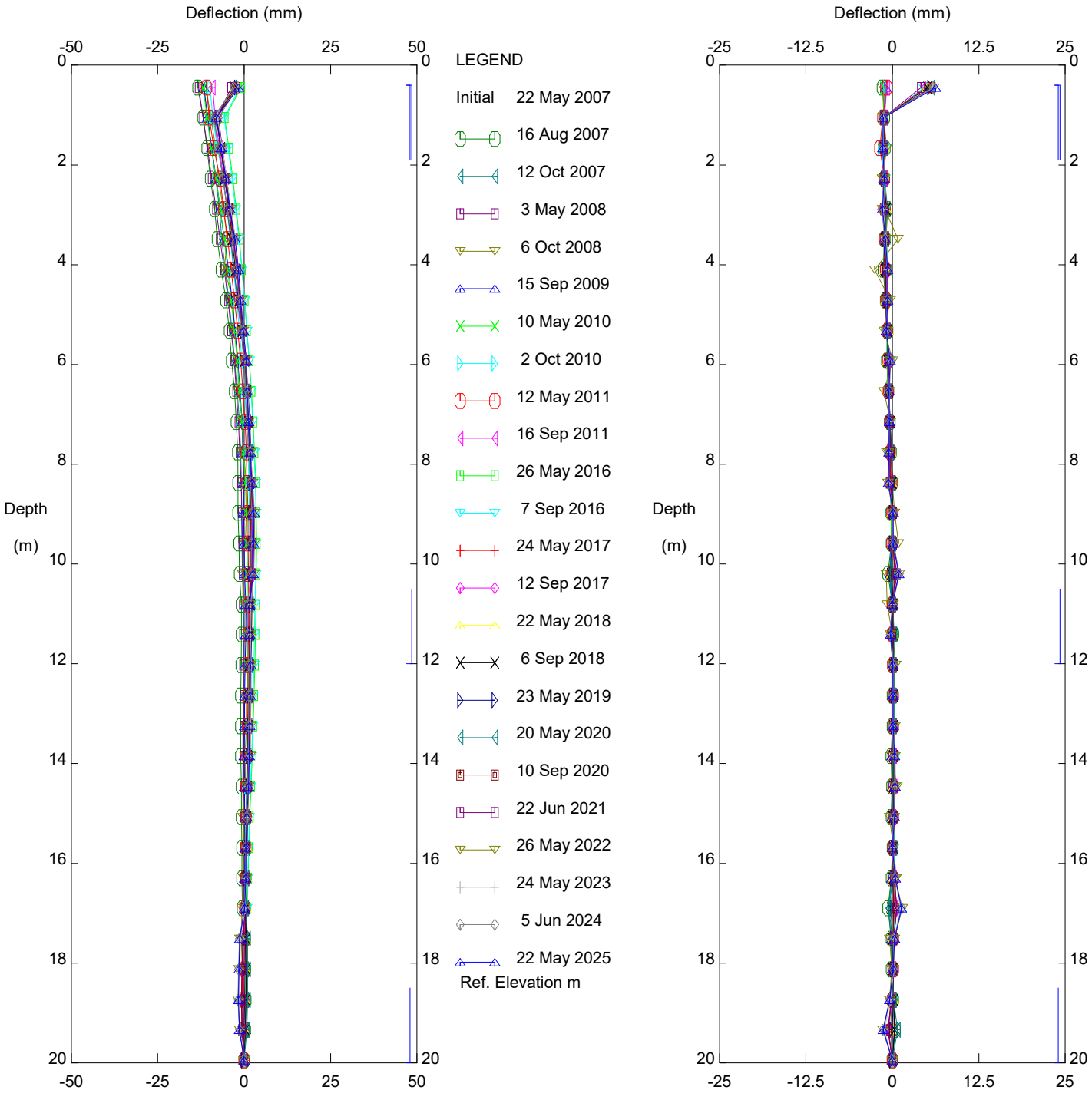

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

HWY646:04 Lindbergh Hill, Inclinometer SI07-1

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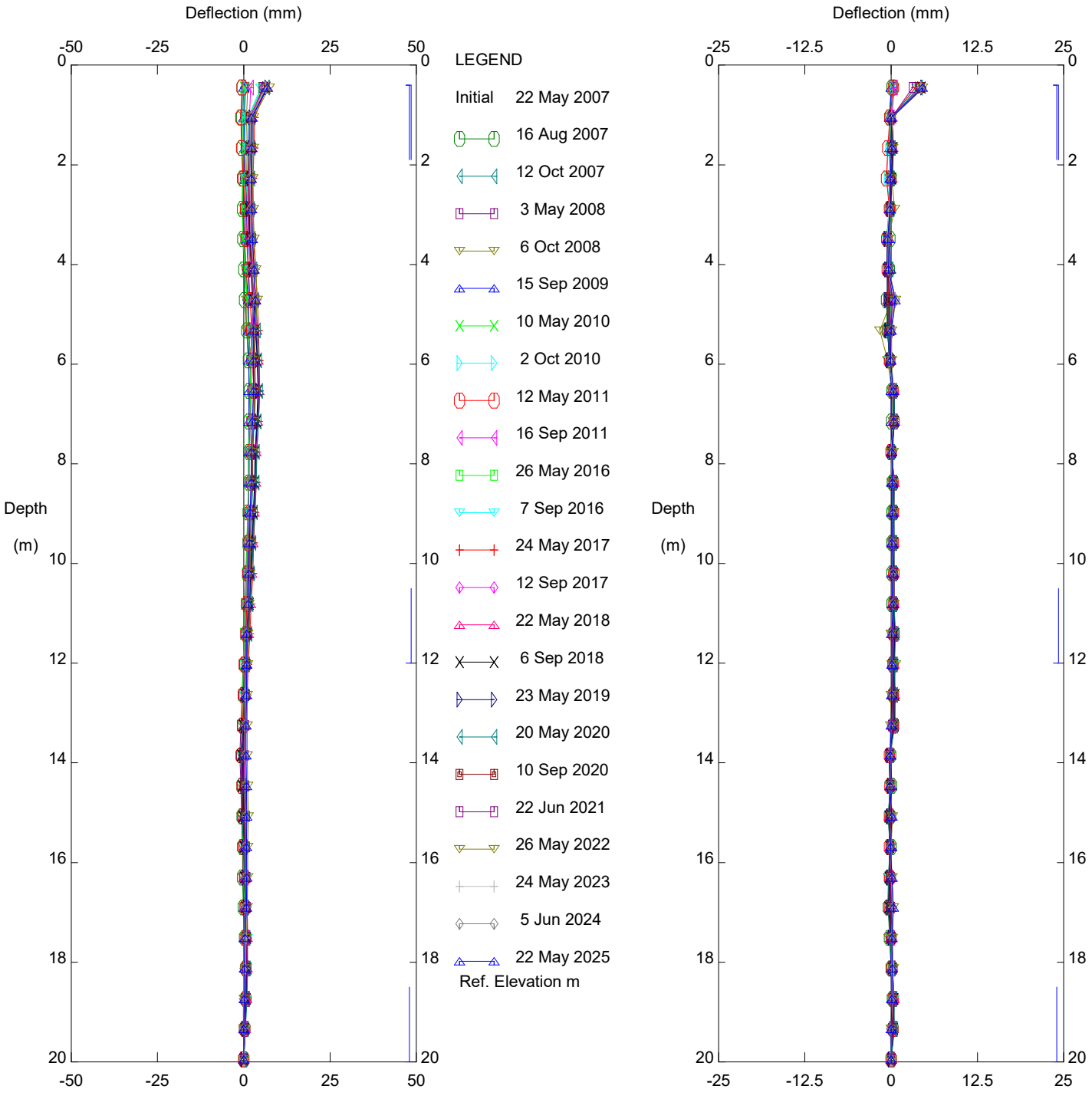

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

HWY646:04 Lindbergh Hill, Inclinometer SI07-1

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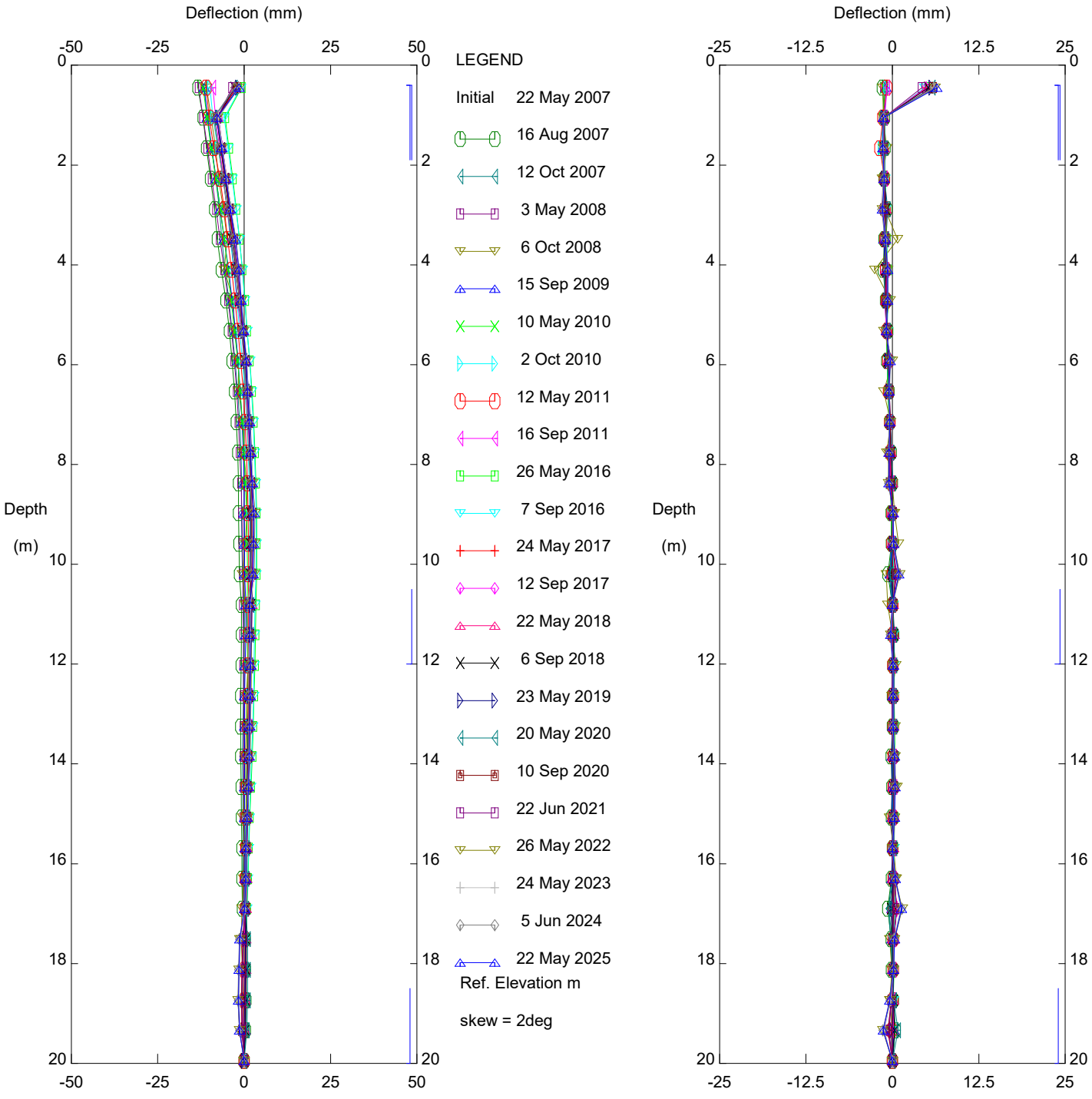

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

HWY646:04 Lindbergh Hill, Inclinometer SI07-1

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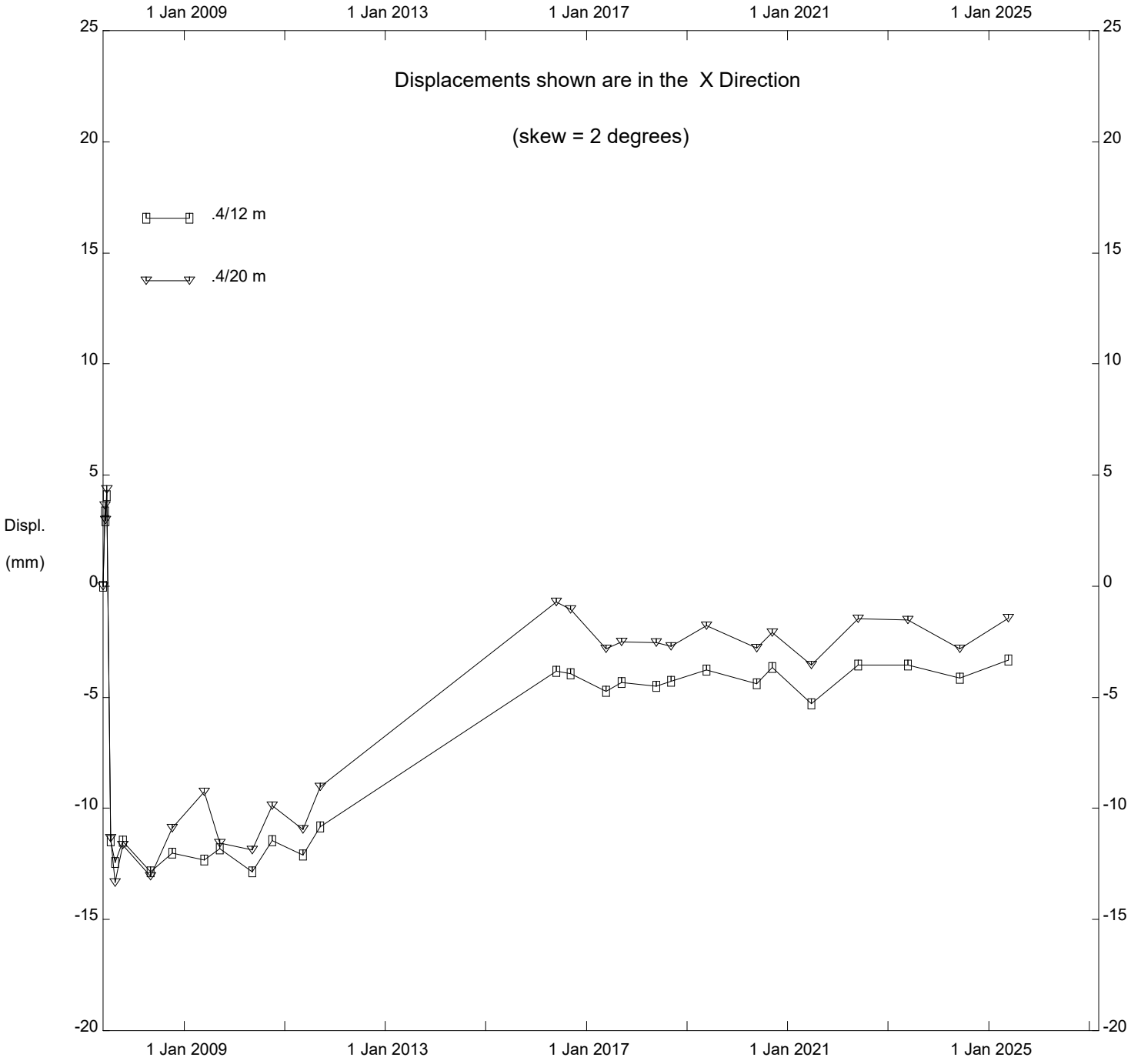

HWY646:04 Lindbergh Hill, Inclinometer SI07-1

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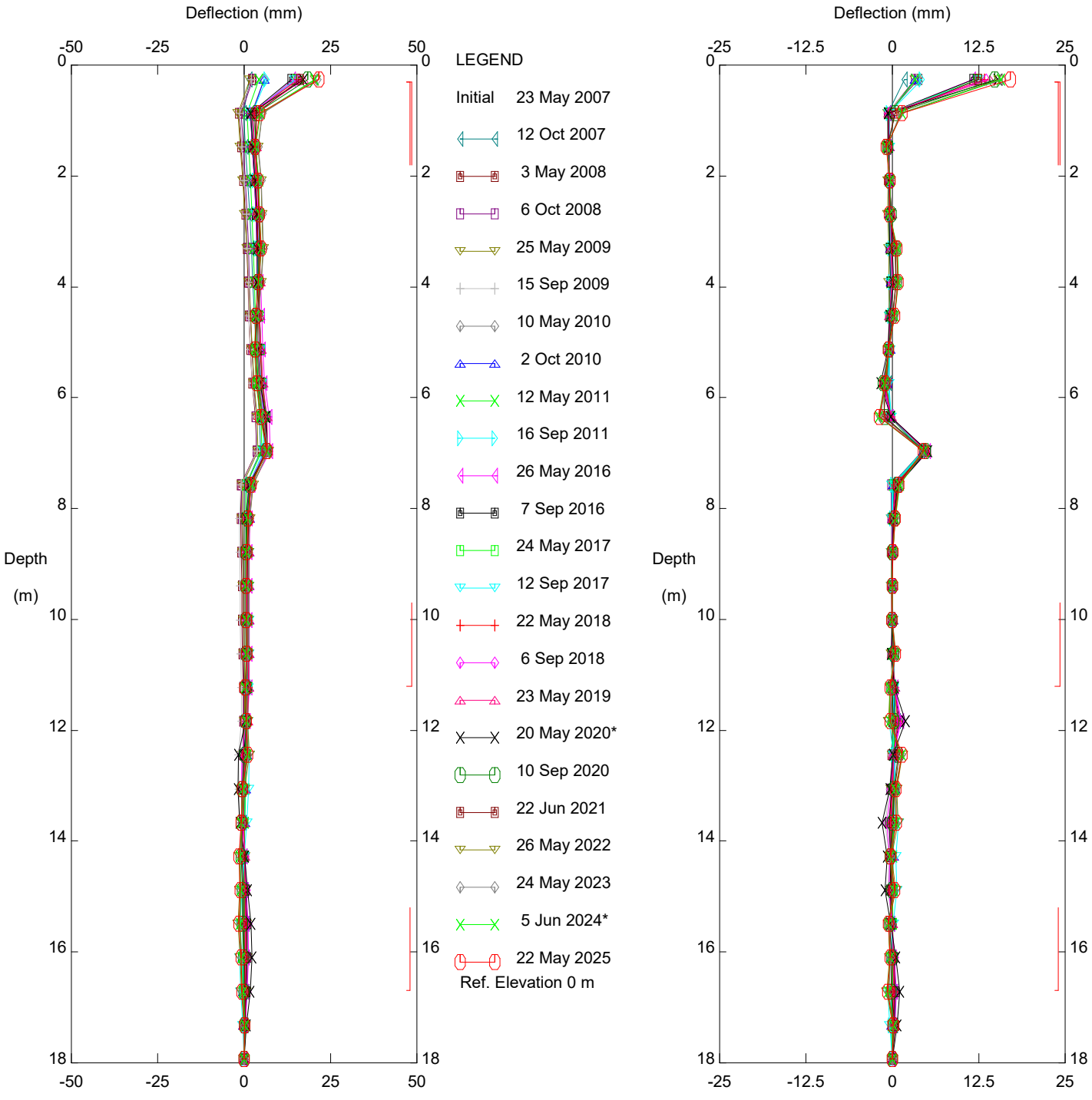

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

HWY646:04 Lindbergh Hill, Inclinometer SI07-2

Alberta Transportation

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

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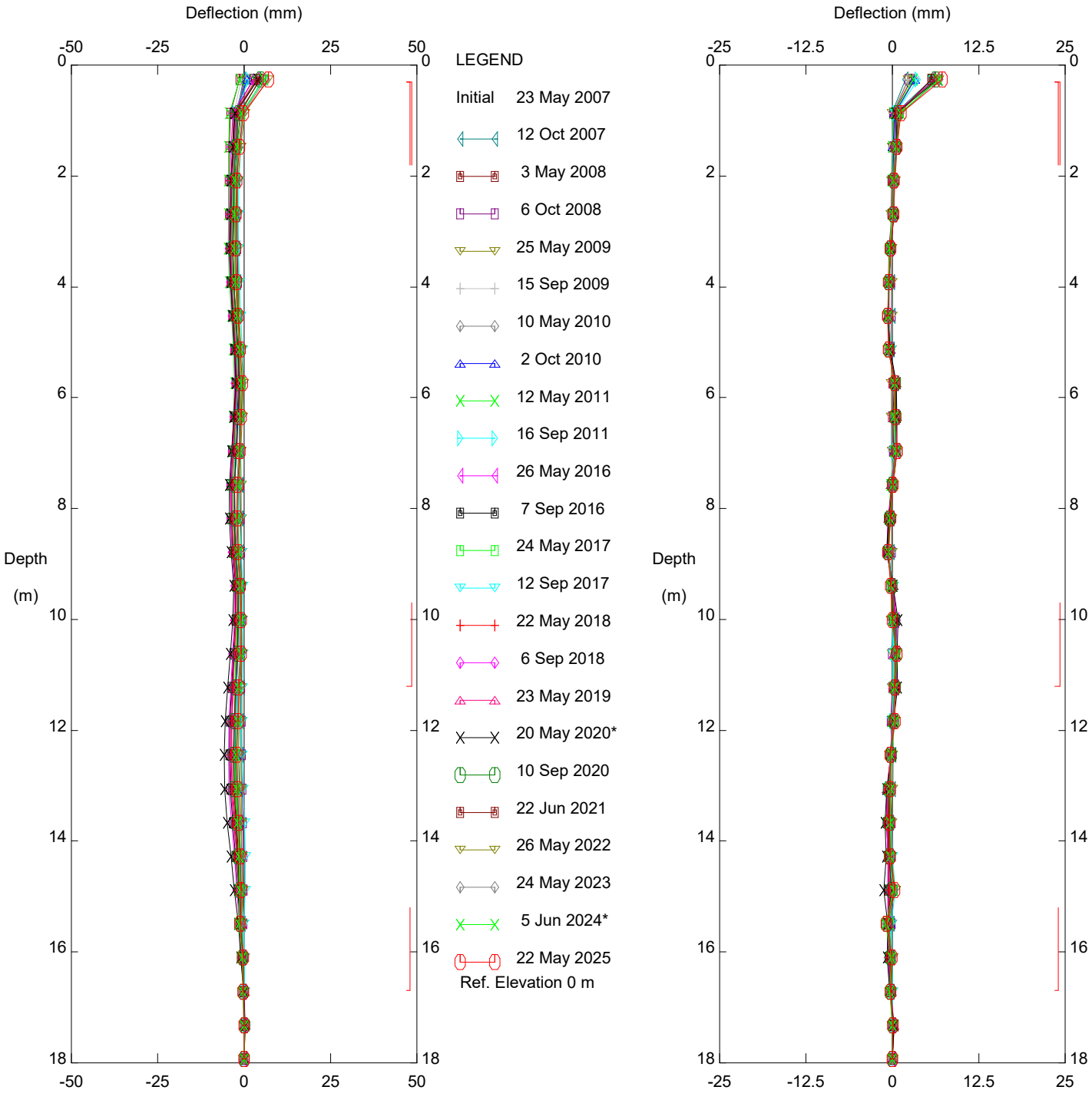
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

HWY646:04 Lindbergh Hill, Inclinometer SI07-2

Alberta Transportation

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

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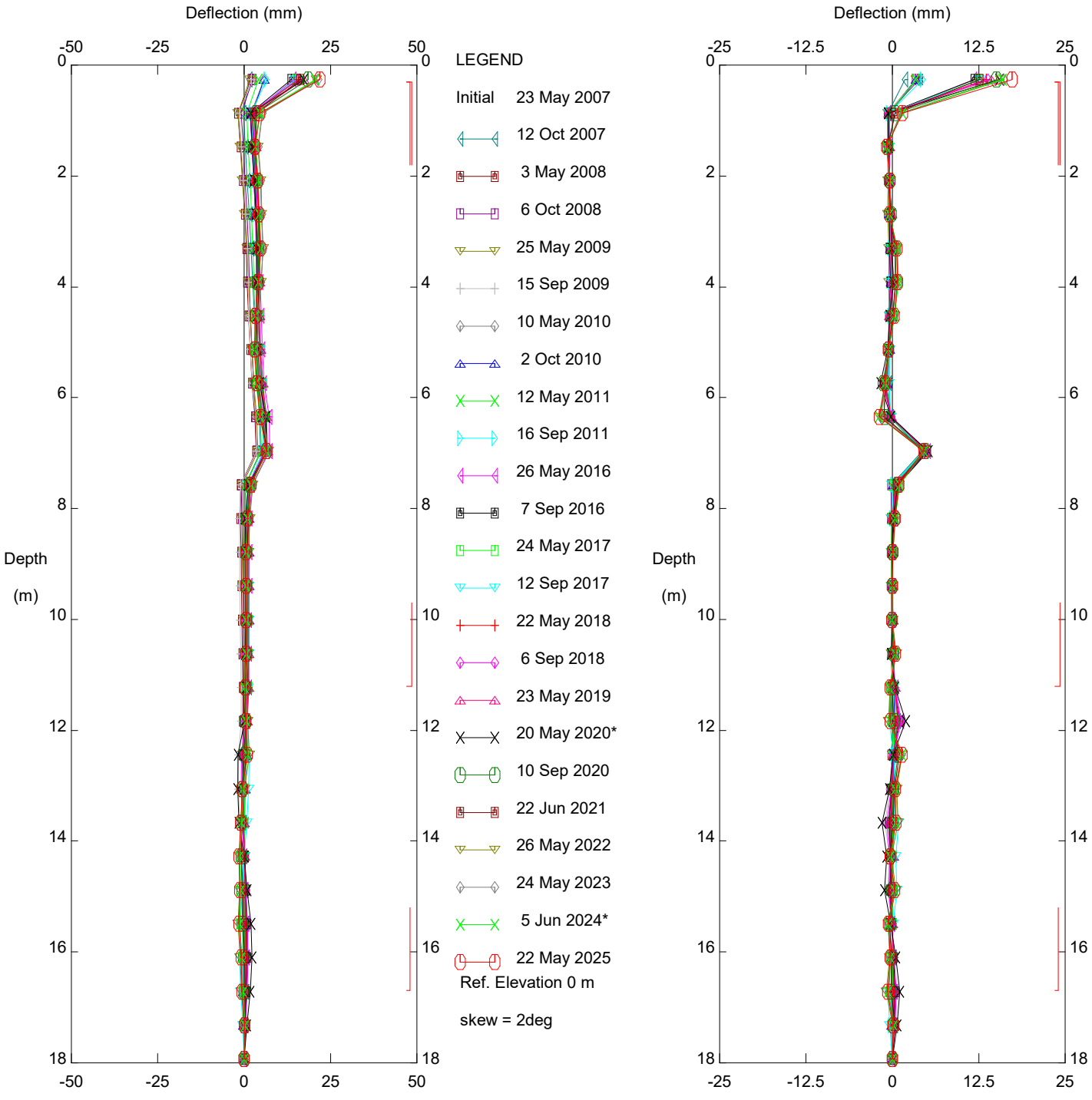
Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

HWY646:04 Lindbergh Hill, Inclinometer SI07-2

Alberta Transportation

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

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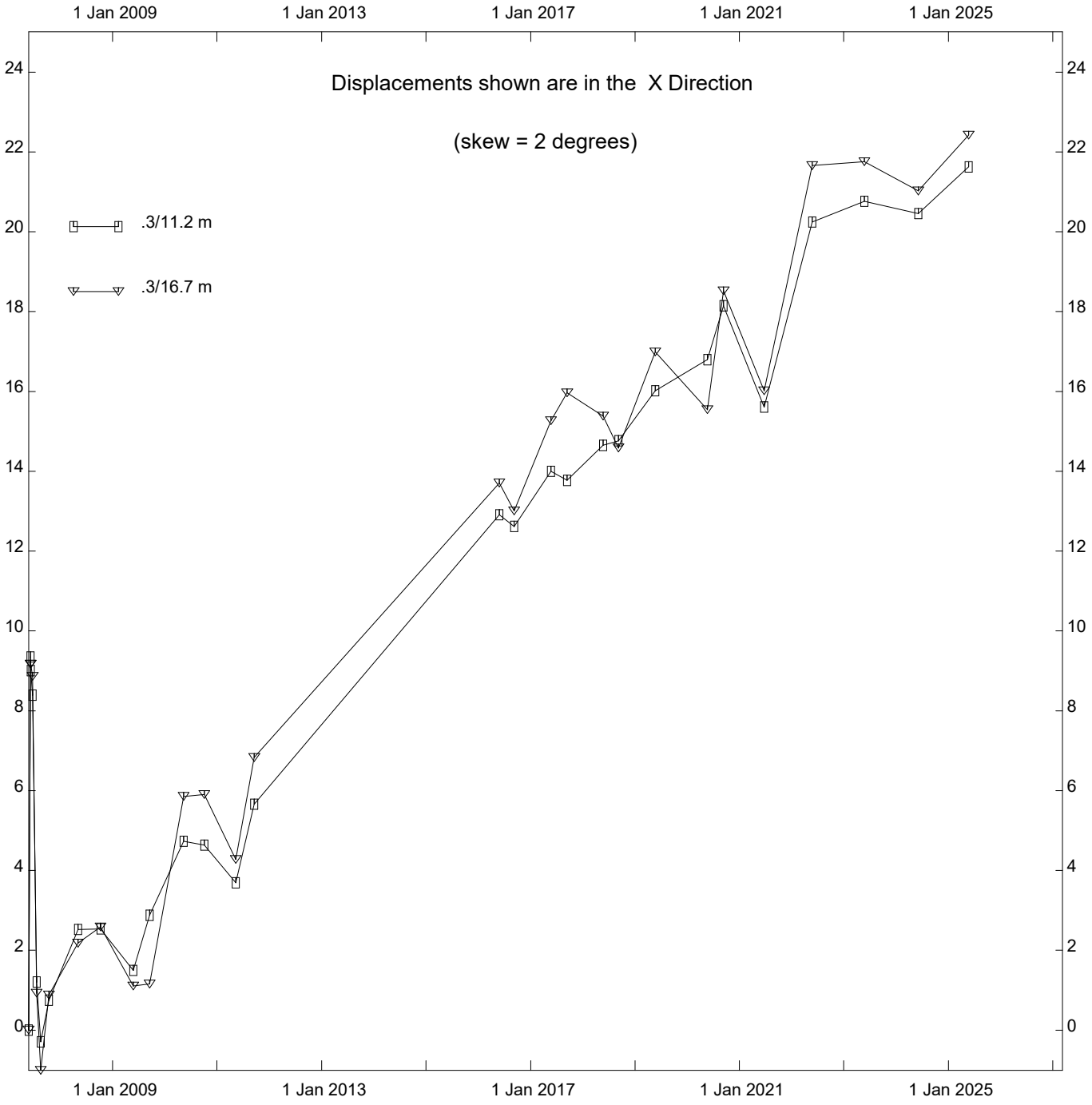
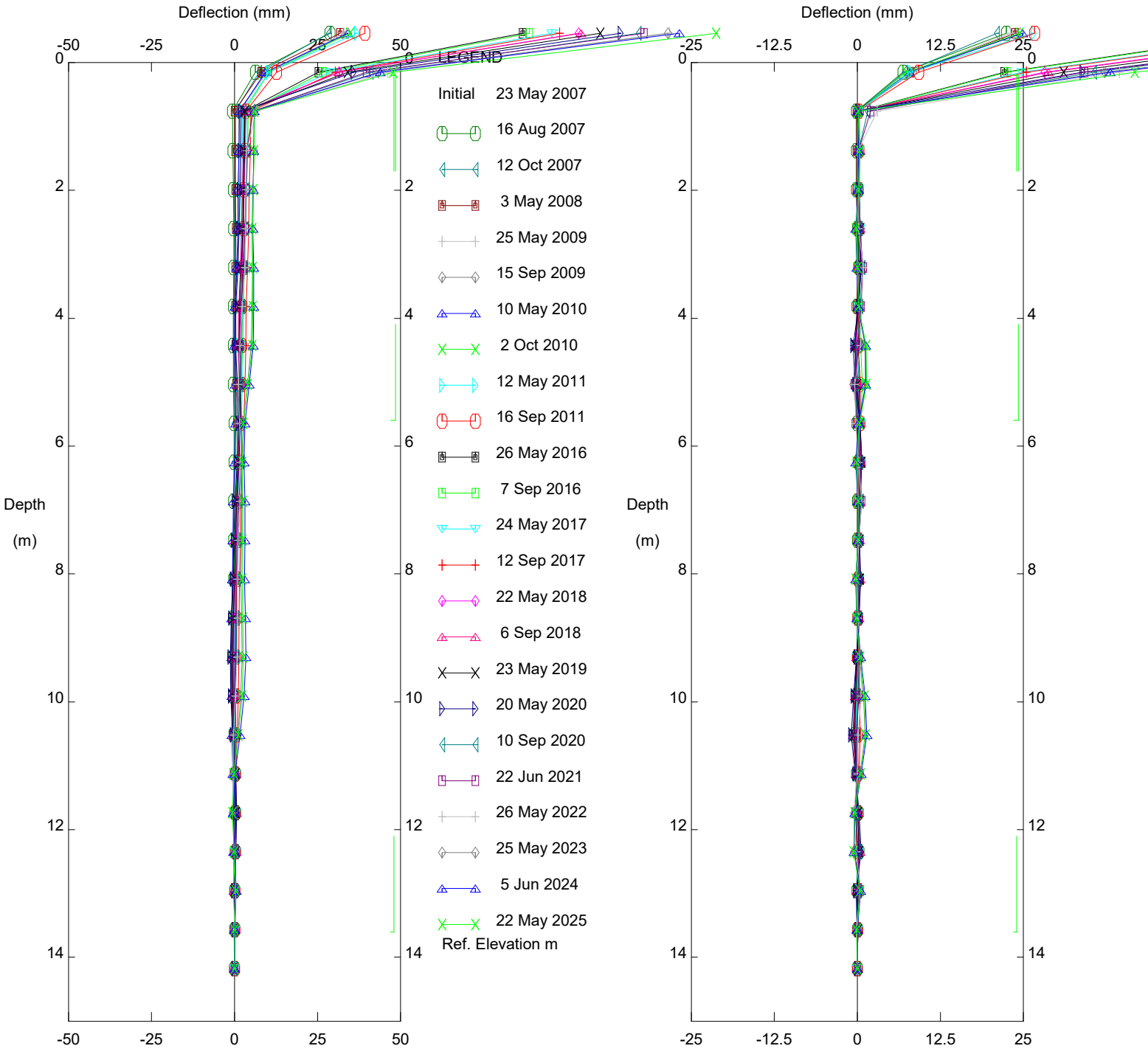


HWY646:04 Lindbergh Hill, Inclinometer SI07-2

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

HWY646:04 Lindbergh Hill, Inclinometer SI07-3

Alberta Transportation

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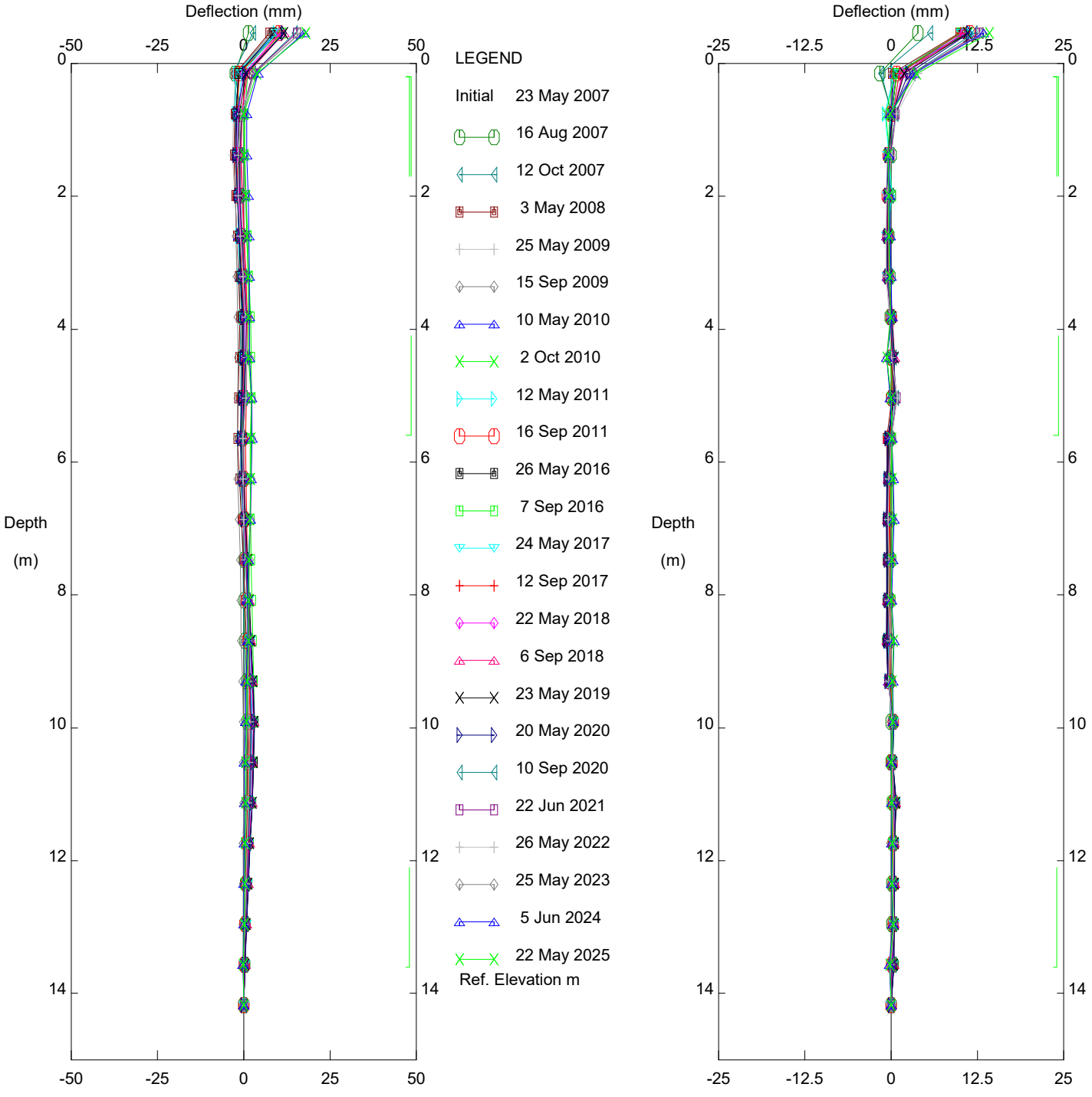

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

HWY646:04 Lindbergh Hill, Inclinometer SI07-3

Alberta Transportation

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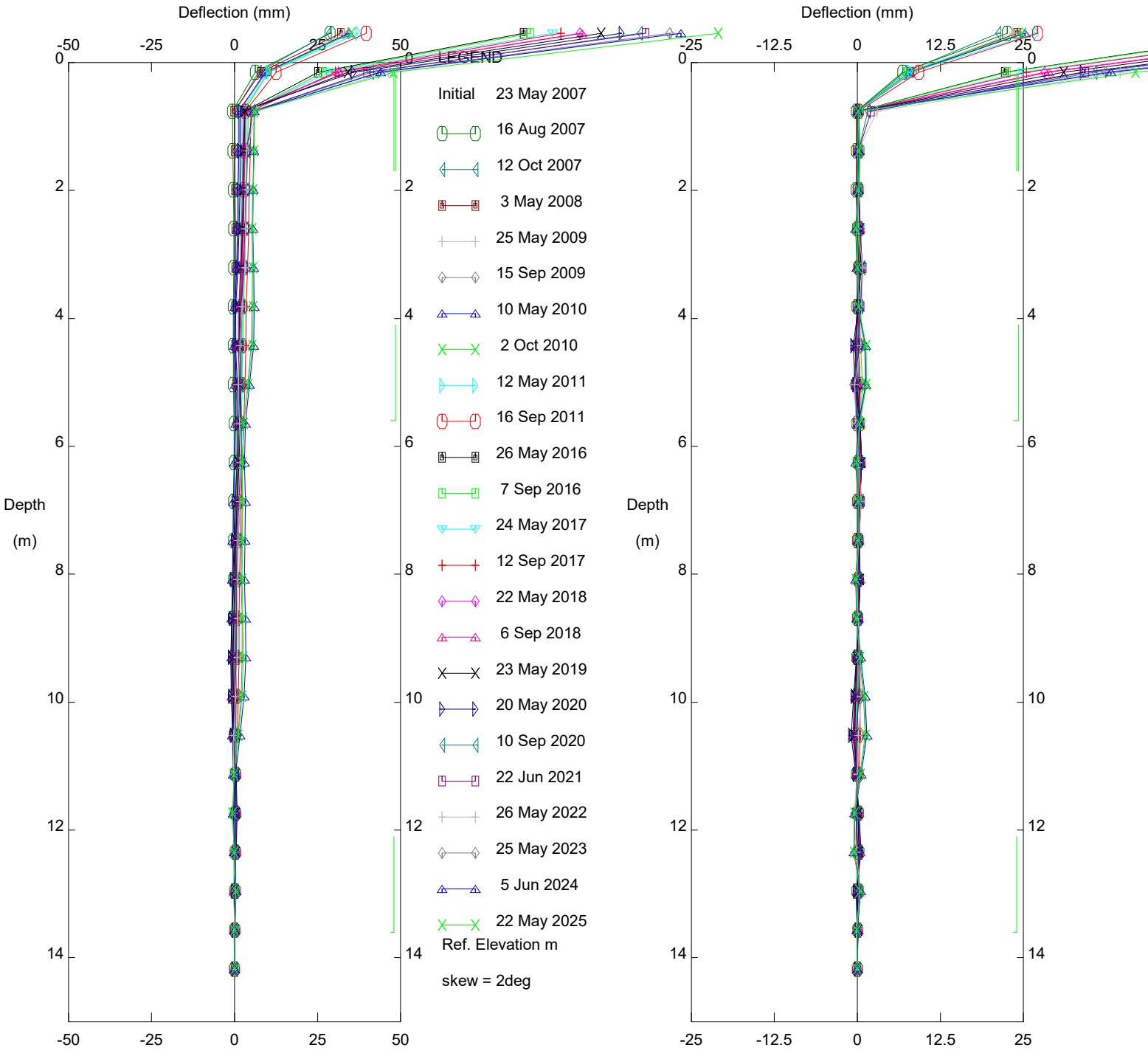

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

HWY646:04 Lindbergh Hill, Inclinometer SI07-3

Alberta Transportation

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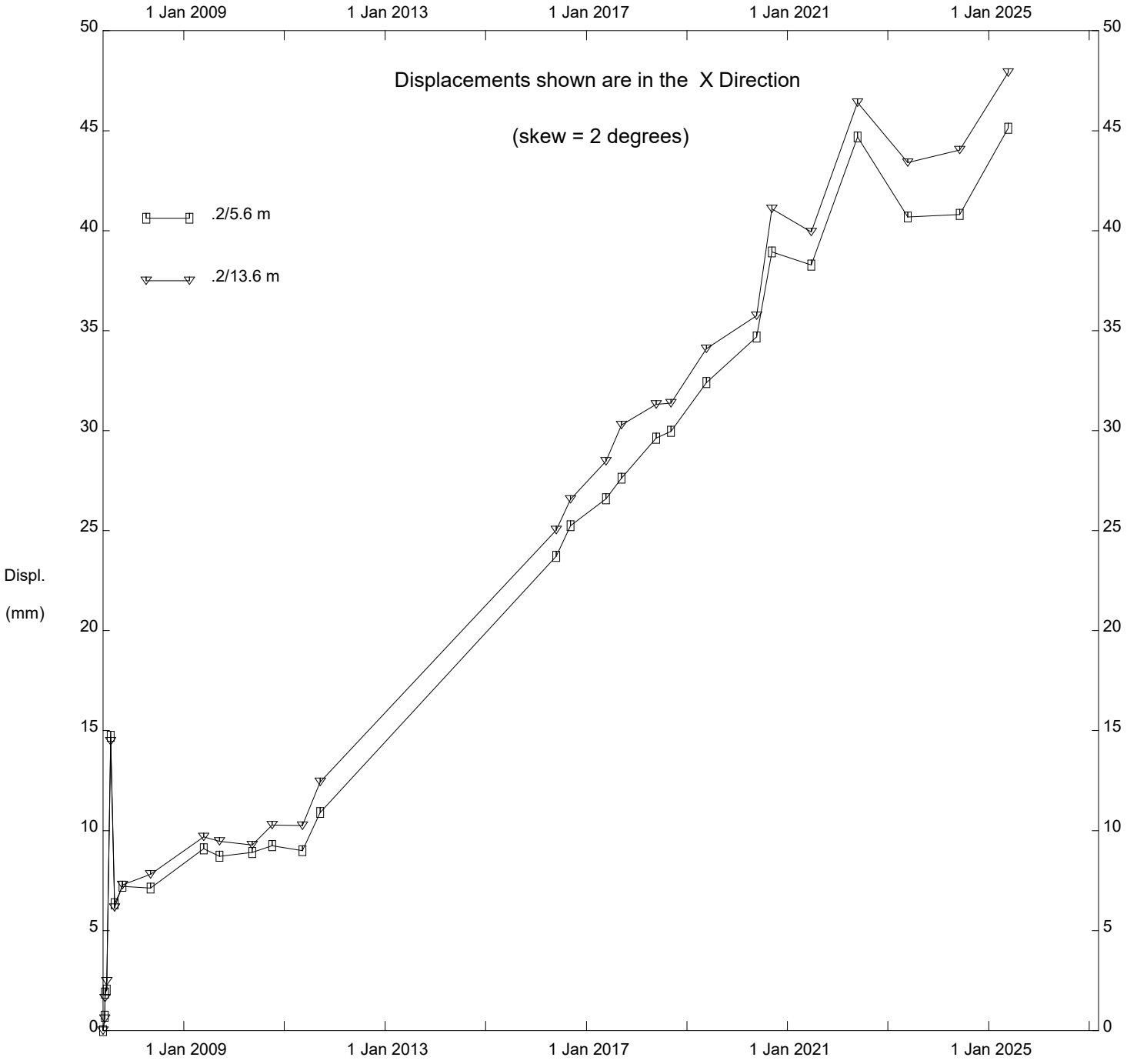

HWY646:04 Lindbergh Hill, Inclinometer SI07-3

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FIGURE NC025-1
STANDPIPE PIEZOMETER DATA FOR HWY 646:04, LINDBERG HILL

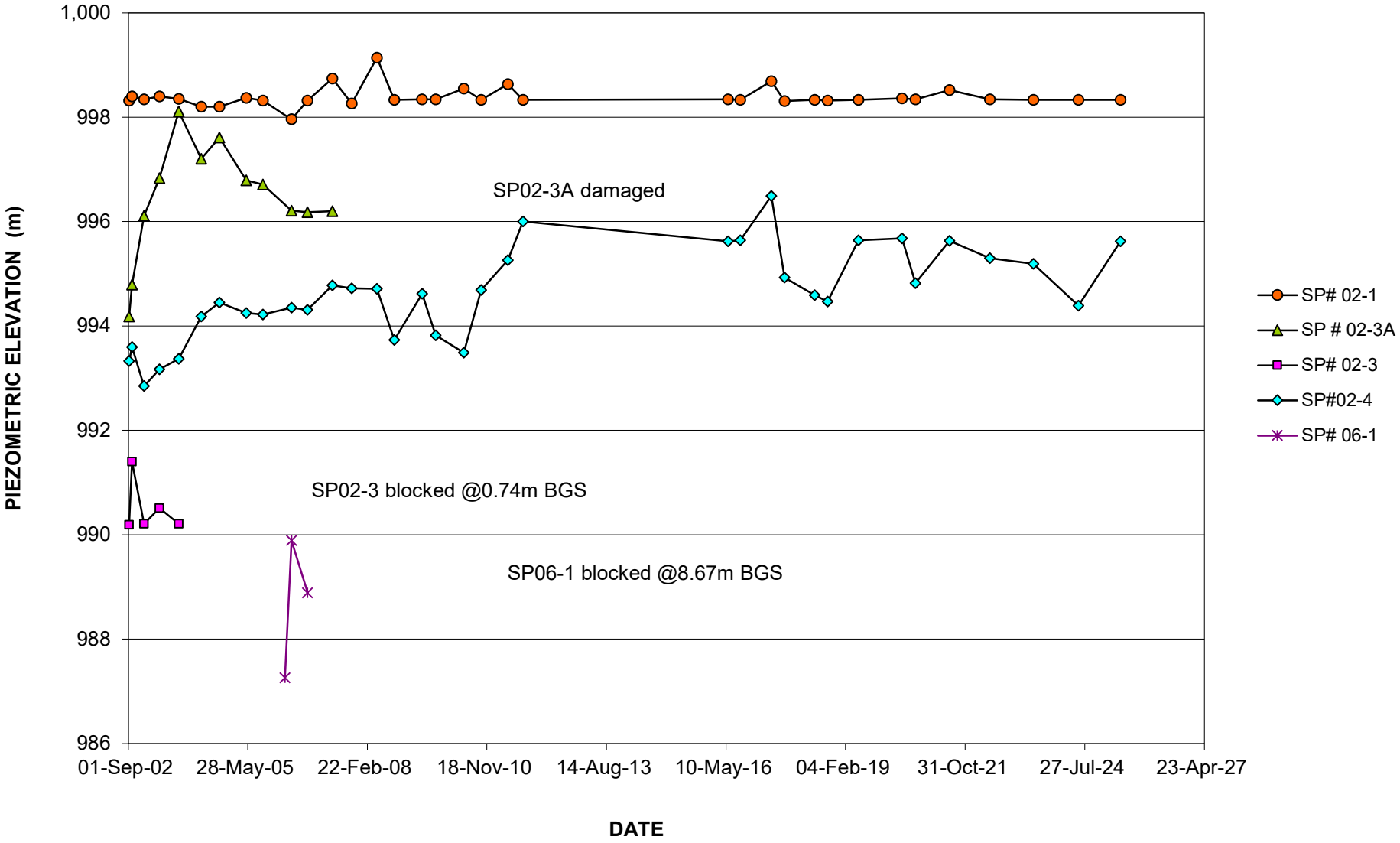

FIGURE NC025-2
LOAD CELL DATA FOR HWY 646:04, LINDBERG HILL