THURBER ENGINEERING LTD.

July 8, 2023 File No.: 32122

Alberta Transportation and Economic Corridors
Construction and Maintenance Division
North Central Region
Address
City/Province
Postal Code

Attention: Ms. Amy Driessen, P.Eng.

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS – SPRING 2023

SECTION C

SITE NC099: HWY 63:10 HANGINGSTONE RIVER BRIDGES

Dear Ms. Driessen:

This report provides the results of the bi-annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation and Economic Corridors Geohazard Risk Management Program for North Central – Athabasca and Fort McMurray Districts (CON0022163).

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

1. OBSERVATIONS

1.1 Field Program and Instrumentation Status

Twelve slope inclinometers (SI14-01 to SI14-02, SI15-05 to SI15-10, N-SI-01, N-SI-02, S-SI-01 and S-SI-02), twenty vibrating wire piezometers (PZ14-01 to PZ14-04, PZ15-01 to PZ15-12, PZ133638, PZ133647, PZ133682, and PZ133683) and four settlement gauges (SG14-01, SG14-02, SG1421034, and SG1421049) were read at the Hwy 63:10 Hangingstone River Bridges site on May 29, 2023 by Mr. Niraj Regmi, G.I.T. and Mr. Omar Elshimi, both of Thurber Engineering Ltd.

N-SI-01, N-SI-02, S-SI-01, S-SI-02, PZ133638, PZ133647, PZ133682, PZ133683, SG1421034 and SG1421049 were previously monitored by Tetra Tech Canada Inc. during the construction of

the new bridge of the highway southbound lanes. These instruments were last read by Tetra Tech in October 2022, and were added to the GRMP readings schedule in the spring of 2023.

The data from four vibrating wire piezometers (PZ133638, PZ133647, PZ133682, and PZ133683) and two settlement cells (SG1421034 and SG1421049) was downloaded from onsite dataloggers.

Vibrating wire Piezometer PZ133638 was found to have been malfunctioning since August 28, 2022. Settlement cell SG1421049 was found to have been malfunctioning since May 14, 2023. An attempt was made to read the settlement cell manually, but only the temperature sensor was working.

Site plans showing the approximate instrumentation locations are included in Appendix A.

The SIs were read using two RST Digital Inclinometer probes with 2 ft. wheelbases and RST Pocket PC readouts. Inclinometer reading depths were defined as per cable markings with respect to the top of the inclinometer casing. The vibrating wire piezometers and settlement gauges were read using an RST VW2106 readout.

2. DATA PRESENTATION

1.2 General

SI plots for A and B directions are presented in Appendix A. Where movement has been recorded the resultant plot (X direction, if applicable) and rate of movement have also been provided. Vibrating wire piezometer and settlement cell reading plots are also provided in Appendix A. The slope inclinometer, vibrating wire piezometer, and settlement cell reading summary tables are provided below. These tables also include instruments deleted from the GRMP program or not read during this monitoring event for future reference.

1.3 Zones of Movement

Zones of new movement were not observed in the SIs, previously monitored by Thurber, since the previous readings in the fall of 2022.

The following zones of movement were observed in N-SI-01, N-SI-02, S-SI-01 and S-SI-02, which were also monitored by Tetra Tech during the construction of the new bridge:

- N-SI-01: 1.5 m to 22.3 m
- N-SI-02: 3.4 m to 22.3 m

- S-SI-01: 2.1 m to 22.3 m
- S-SI-02: 0.3 m to 22.3 m

Additionally, the shear movement zones in N-SI-02 and S-SI-02 over 11.3 m to 13.1 m depth and 11.9 m to 13.1 m depth, respectively, are interpreted separately.

Zones of movement are summarized in Table NC099-1 below. This table also provides a historical account of the total movement, the depth of movement and the maximum rate of movement that has occurred at this site since the initialization of the slope inclinometers.

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Table NC099-1: Spring 2023 – Hwy 63:10 Hangingstone River Bridge Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF LATEST READING	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)
Cut Slope – Northbound Lane									
SI15-05	April 6, 2015	No discernible movement	N/A	Operational	May 29, 2023	September 22, 2022	N/A	N/A	N/A
SI15-06	March 4, 2015	No discernible movement	N/A	Operational	May 29, 2023	September 22, 2022	N/A	N/A	N/A
SI15-07	March 4 2015	No discernible movement	N/A	Operational	May 29, 2023	September 22, 2022	N/A	N/A	N/A
SI15-08	March 4 2015	No discernible movement	N/A	Operational	May 29, 2023	September 22, 2022	N/A	N/A	N/A
SI15-09	March 4, 2015	28.1 mm over 2.7 m to 4.0 m in 24° direction	13.0 on June 9, 2015	Operational	May 29, 2023	September 22, 2022	1.6	2.4	-6.9
		12.9 mm over 6.4 m to 7.6 m in 309° direction	4.9 on September 22, 2022				1.5	2.3	-2.6
		37.9 mm over 10.1 m to 11.9 m in 332° direction	46.9 on March 16, 2015				0.2	0.2	-0.7
SI15-10	March 4, 2015	3.0 mm over 11.9 m to 13.1 m in 303° direction	4.3 on March 16, 2015	Operational	May 29, 2023	September 22, 2022	0.2	0.2	-0.4
		5.0 mm over 16.2 m to 17.4 m in 348° direction	11.9 on March 16, 2015				<0.1	0.0	-0.8

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-1– Continued: Spring 2023 – Hwy 63:10 Hangingstone River Bridge Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF LATEST READING	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)
Hangingstone River Bridge Abutments – Northbound Lane									
SI14-01	September 4, 2014	251.1 mm over 6.1 m to 30.5 m in 229° direction	1447.1 on November 17, 2014	Operational	May 29, 2023	September 22, 2022	3.5	5.2	-1.2
SI14-02	August 29, 2014	168.8 mm over 5.5 m to 31.7 m in 54° direction	2686.7 on November 17, 2014	Operational	May 29, 2023	September 22, 2022	10.7	15.7	10.1
SI14-03	*September 17, 2014*	*42.1 mm over 15.2 m to 17.7 m in 165° direction*	*99.9 on November 17, 2014*	*Sheared at 18.9 m depth*	*N/A*	*September 14, 2018*	*N/A*	*N/A*	*N/A*
		79.1 mm 17.7 m to 20.7 m in 220° direction	*391.2 on November 17, 2014*				*N/A*	*N/A*	*N/A*
SI14-04	*September 19, 2014*	*89.2 mm over 13.7 m to 17.4 m in 30° direction*	*1919.2 on November 17, 2014*	*Sheared at 15.8 m depth*	*N/A*	*September 14, 2018*	*N/A*	*N/A*	*N/A*
		23.5 mm over 18.6 m to 20.4 m in 50° direction	*297.0 on November 17, 2014*				*N/A*	*N/A*	*N/A*

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-1– Continued: Spring 2023 – Hwy 63:10 Hangingstone River Bridge Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE REINITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF LATEST READING	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)
Hangingstone River Bridge - Southbound Lane									
N-SI-01	May 29, 2023	151.7 over 1.5 m to 22.3 m in 180° direction	1146.4 on July 22, 2021	Operational	May 29, 2023	October 5, 2022	7.5	11.6	-22.3
N-SI-02	May 29, 2023	115.7 over 3.4 m to 22.3 m in 116° direction	886.7 on July 22, 2021	Operational	May 29, 2023	October 5, 2022	2.7	4.1	-23.8
		46.2 over 11.3 to 13.1 m in 116° direction	377.6 on July 22, 2021				2.0	3.1	-6.4
S-SI-01	May 29, 2023	83.9 over 2.1 m to 22.3 m in 5° direction	726.1 on July 15, 2021	Operational	May 29, 2023	October 5, 2022	5.8	8.9	25.8
S-SI-02	May 29, 2023	83.2 over 0.9 m to 22.3 m in 27° direction	1596.4 on June 22, 2021	Operational	May 29, 2023	October 5, 2022	No discernible movement	N/A	10.9
		23.7 over 11.9 m to 13.1 m in 27° direction	138.44 on July 15, 2021				6.0	9.3	-5.5

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-2: Spring 2023– Hwy 63:10 Hangingstone River Bridge Vibrating Wire Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM GROUNDWATER ELEV. (m)	CURRENT GROUNDWATER ELEV. (m)	PREVIOUS GROUNDWATER ELEV. (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
Cut Slope – Northbound Lane								
PZ15-01 (31269)	March 4, 2015	512.86	533.27	Operational	516.71 on June 27, 2021	516.41	516.56	-0.15
PZ15-02 (31268)	March 4, 2015	504.63	533.27	Operational	518.13 on March 16, 2015	515.55	515.69	-0.14
PZ15-03 (31267)	March 4, 2015	514.10	533.99	Operational	519.34 on March 4, 2015	517.37	517.68	-0.31
PZ15-04 (31266)	March 4, 2015	505.10	533.99	Operational	519.03 on March 4, 2015	515.95	516.07	-0.12
PZ15-05 (31261)	March 4, 2015	514.19	524.62	Operational	516.83 on March 4, 2015	514.21	514.24	-0.03
PZ15-06 (31260)	March 4, 2015	505.08	524.62	Operational	516.63 on March 4, 2015	508.72	508.77	-0.05
PZ15-07 (31259)	March 4, 2015	517.88	528.88	Operational	520.20 on March 4, 2015	517.60	517.95	-0.35
PZ15-08 (31258)	March 4, 2015	508.89	528.88	Operational	518.50 on March 4, 2015	515.67	515.99	-0.32
PZ15-09 (31265)	March 4, 2015	514.32	516.62	Operational	516.37 on September 2, 2016	515.06	515.07	-0.01

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-2– Continued: Spring 2023– Hwy 63:10 Hangingstone River Bridge Vibrating Wire Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM GROUNDWATER ELEV. (m)	CURRENT GROUNDWATER ELEV. (m)	PREVIOUS GROUNDWATER ELEV. (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
Cut Slope – Northbound Lane– Continued								
PZ15-10 (31264)	March 4, 2015	505.33	516.62	Operational	513.62 on September 2, 2016	510.59	509.83	0.76
PZ15-11 (31263)	March 4, 2015	516.88	520.83	Operational	519.40 on March 16, 2015	518.28	518.37	-0.09
PZ15-12 (31262)	March 4, 2015	509.87	520.83	Operational	518.69 on March 16, 2015	517.03	517.15	-0.12
Hangingstone River Bridge Abutments – Northbound Lane								
PZ14-01 (30106)	September 17, 2014	482.17	504.00	Operational	497.31 on November 8, 2014	495.38	495.55	-0.17
PZ14-02 (30107)	September 17, 2014	487.17	504.00	Operational	497.65 on September 17, 2014	491.62	491.98	-0.36
PZ14-03 (30109)	September 19, 2014	481.92	502.80	Operational	502.14 on November 11, 2014	495.19	495.31	-0.12
PZ14-04 (30108)	September 19, 2014	486.92	502.80	Operational	500.82 on November 11, 2014	494.19	494.28	-0.09

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-2– Continued: Spring 2023– Hwy 63:10 Hangingstone River Bridge Vibrating Wire Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM GROUNDWATER ELEV. (m)	CURRENT GROUNDWATER ELEV. (m)	PREVIOUS GROUNDWATER ELEV. (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
Hangingstone River Bridge – Southbound Lane								
PZ133682	May 23, 2021	486.23	503.00	Operational	499.57 on July 21, 2021	498.90	499.22	-0.32
PZ133647	May 23, 2021	482.23	503.00	Operational	489.80 on July 21, 2021	488.60	489.20	-0.60
PZ133638	*May 21, 2021*	*487.25*	*501.80*	*Malfunctioning*	*502.14 on November 11, 2014*	*N/A*	*492.23 (Aug. 28, 2022)*	*N/A*
PZ133683	May 21, 2021	482.30	501.80	Operational	495.32 on July 13, 2021	493.49	494.03	-0.54

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

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Table NC099-3: Spring 2023 – Hwy 63:10 Hangingstone River Bridge Settlement Gauge Instrumentation Reading Summary

Date Monitored: May 29, 2023

INSTRUMENT #	DATE INITIALIZED	CURRENT STATUS	CURRENT SETTLEMENT (mm)	PREVIOUS SETTLEMENT (mm)	CHANGE IN SETTLEMENT (mm) (1)
Hangingstone River Bridge Abutments – Northbound Lane					
SG14-01	September 17, 2014	Operational	-215.84	-197.69	18.15
SG14-02	September 19, 2014	Operational	-351.88	-341.94	9.94
Hangingstone River Bridge Abutments – Southbound Lane					
SG1421049	*May 23, 2021*	*Malfunctioning*	*N/A*	*151.43 (Oct. 5, 2023)*	*N/A*
SG1421034	May 21, 2021	Operational	-164.19	-149.98	14.21

Drawings 32122-NC099-1 to 32122-NC099-3 in Appendix A provide sketches of the approximate location of the monitoring instrumentation for this site.

(1) Negative (-) change in settlement indicates an upward movement (heave) of the ground surface and positive (+) change in settlement indicates a downward movement (settlement) of the ground surface.

3. INTERPRETATION OF MONITORING RESULTS

3.1. Northbound Lane Instruments

Slope inclinometers SI15-05 through SI15-08 have shown no discernible movement since initialization.

Slope inclinometer SI15-09 shows current rates of movement of 2.4 mm/yr, 2.3 mm/yr and 0.2 mm/yr over 2.7 m to 4.0 m depth, 6.4 m to 7.6 m depth, and 10.1 m to 11.9 m depth, respectively, since the fall of 2022 readings. SI15-10 showed rates of movement of 0.2 mm/yr over 11.9 m to 13.1 m depth and 0 mm/yr over 16.2 m to 17.4 m depth since the fall of 2022 readings.

SI14-01, located in the pile wall of the bridge north approach fill, showed a rate of movement of 5.2 mm/yr over the length of the pile from 6.1 m to 30.5 m depth, corresponding to an incremental movement of 3.5 mm since the fall of 2022 readings. SI14-02, located in the pile wall of the bridge south approach fill, shows a current rate of movement of 15.7 mm/yr over the length of the pile from 5.5 m to 31.7 m depth. Overall, SI14-01 appears to be slowing from the relatively high movement rates observed over the past several readings cycles. The rate of movement in SI14-02 increased by 10.7 mm/yr since the fall of 2022 readings, and current rate of movement in the SI is the highest recorded since October 3, 2016. The current pile head movements in SI14-01 and SI14-02 are 251.1 mm and 168.8 mm, respectively.

The groundwater levels decreased in vibrating wire piezometers in PZ15-01, PZ15-02, PZ15-03, PZ15-04, PZ15-05, PZ15-06, PZ15-07, PZ15-08, PZ15-09, PZ15-11, and PZ15-12 since the fall of 2022 readings. The decreases in groundwater level ranged from 0.01 m in PZ15-09 to 0.35 m in PZ15-07. The groundwater level increased in PZ15-10 by 0.76 m since the fall of 2022 readings.

PZ14-01 and PZ14-02, installed in the north approach fill, showed decreases in groundwater level of 0.17 m and 0.36 m, respectively, since the fall of 2022 readings. PZ14-03 and PZ14-04, installed in the south approach fill, also showed decreases in groundwater level of 0.12 m and 0.09 m, respectively, since the fall of 2022 readings. The vibrating wire piezometer readings are summarized in Table NC099-2.

SG14-01 and SG14-02 showed increases in ground settlement of 18.15 mm and 9.94 mm, respectively, since the fall of 2022 readings. The settlement gauge readings are summarized in Table NC099-3.

Plots of the northbound lane instruments, for both the bridge and cut slope, are shown on Figures NC099-1 through NC099-10 in Appendix A.

3.2. Southbound Lane Instruments

Slope inclinometer N-SI-01, located in the pile wall of the bridge north approach fill , showed a rate of movement of 11.6 mm/yr over 1.5 m to 22.3 m depth, corresponding to a decrease in the rate of movement of 22.3 mm/yr since the previous reading in October 2022. Slope inclinometer N-SI-02, installed through the north abutment fill into the underlying bedrock, showed a rate of movement of 4.1 mm/yr over 3.4 m to 22.3 m depth, corresponding to a decrease in rate of movement of 23.8 mm/yr since the last reading in October of 2022. Slope inclinometer N-SI-02 also showed a rate of movement of 3.1 mm/yr over 11.3 m to 13.1 m depth since the last reading in October of 2022.

Slope inclinometer S-SI-01, located in the pile wall of the bridge south approach fill , showed a rate of movement of 8.9 mm/yr over 2.1 m to 22.3 m depth, corresponding to an increase in rate of movement of 25.8 mm/yr since they were last read in October of 2022. Slope inclinometer S-SI-02, installed through the south abutment fill and into the underlying bedrock, showed no discernible movement over 2.1 m to 22.3 m depth since they were last read in October of 2022. Slope inclinometer S-SI-02 also showed a rate of movement of 9.3 mm/yr over 11.9 m to 13.1 m depth since the last reading in October of 2022.

The current pile head movements in N-SI-01 and S-SI-01 are 151.7 mm and 83.9 mm, respectively.

PZ133682, PZ1333647 and PZ133683, installed to monitor the pore water pressures within the bridge approach fills, showed decreases in groundwater level of 0.32 m, 0.60 m, and 0.54 m, respectively, since the previous readings in October 2022. PZ133638 has not functioned since August 28, 2022. The vibrating wire piezometer readings are summarized in Table NC099-2.

SG1421034, installed below the south abutment fill, showed an increase ground settlement of 14.21 mm since the previous readings in October 2022. SG1421034, installed below the north abutment fill, is currently not functioning. This settlement gauge stopped functioning on May 15, 2023. However, SG1421034 was showing a trend of rapidly increasing negative settlement (heave) for several months before it stopped functioning altogether, indicating that this instrument was likely starting to malfunction at this point. The settlement gauge readings are summarized in Table NC099-3.

The vibrating wire piezometer and settlement gauge reading plots for the southbound lane instruments are shown on Figures NC099-11 to NC099-12 in Appendix A.

4. RECOMMENDATIONS

1.4 4.1. Future Work

The instruments should be read again in the fall of 2023.

Vibrating wire piezometer PZ133638 and settlement sell SG1421049 should be removed from the readings program, as manual readings of these instruments during the current readings cycle determined that both instruments were not functioning.

The instrumentation data should be compared to the design criteria to confirm that the bridges are performing as intended.

1.5 4.2. Instrumentation Repairs

No instrument repairs are required at this time.

5. CLOSURE

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.
Principal | Senior Geotechnical Engineer

PROFESSIONAL ENGINEER ALBERTA
BRUCE W. NESTOR
ID 161284

July 12, 2023

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 91085
DATE: July 12, 2023
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Bruce Nestor, P.Eng.
Geotechnical Engineer
/ak

Attachments:

- Statement of Limitations and Conditions
- Appendix A
  - Field Inspector's report
  - Site Plan Showing Approximate Instrument Locations (Drawing No. 32122-NC099-1 to 32122-NC099-3)
  - SI Reading Plots
  - Figures NC099-1 to NC099-12 (Piezometric Depths and Settlement Plots)

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

THURBER ENGINEERING LTD.

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

SPRING 2023

APPENDIX A
DATA PRESENTATION AND SITE PLANS

SITE NC099: HWY 63:10 HANGINGSTONE RIVER BRIDGE

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC099)
SPRING 2023

Location:	Hwy 63:10 over Hangingstone River (BF75907)	**Readout:**	RST VW 2106 Unit 3
File Number:	32122	**Casing Diameter**	2.75"/3.34"
Probe:	RST Set 5R & 8R	**Temp (deg C):**	18
Cable:	RST Set 5R & 8R	**Read by:**	NKR/OTE

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location UTM 12 V		Date	Stickup (m)	Depth from top of Casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Northing	Easting					A+	A-	B+	B-		
SI14-01	6252664	476931	29-May-23	1.27	99 to 5	222	-73	83	225	-238	5R/5R	Casing Size 2.75"
SI14-02	6252634	476895	29-May-23	1.28	103 to 3	60	90	-82	260	-266	5R/5R	Casing Size 2.75"
SI15-05	6252255	476637	29-May-23	0.52	118 to 4	308	-598	612	47	-65	5R/5R	Casing Size 3.34"
SI15-06	6252220	476535	29-May-23	0.61	118 to 2	308	-535	550	132	-109	8R/8R	Casing Size 3.34"
SI15-07	6252299	476609	29-May-23	0.48	88 to 4	318	-213	226	247	-266	5R/5R	Casing Size 3.34"
SI15-08	6252246	476520	29-May-23	0.47	88 to 2	306	-306	326	45	-31	8R/8R	Casing Size 3.34"
SI15-09	6252336	476583	29-May-23	0.52	58 to 4	295	-323	339	46	-69	5R/5R	Casing Size 3.34"
SI15-10	6252283	476495	29-May-23	0.55	58 to 2	304	-265	286	445	-432	8R/8R	Casing Size 3.34"

VIBRATING WIRE PIEZOMETER (VW) READINGS

VW#	Date	Reading		Identification	Monitoring	Datalogger	UTM 12 V		Comment
		B Unit	Temp.	Number	Station	Serial	Northing	Easting	
PZ14-01	29-May-23	7882.1	4.6	30106	MS-01	3906	6252624	476955	Manual Reading
PZ14-02	29-May-23	8552.7	5	30107	MS-01	3906	6252624	476955	Manual Reading
PZ14-03	29-May-23	7720.3	4.9	30108	MS-02	3905	6252660	476918	Manual Reading
PZ14-04	29-May-23	8202.4	4.9	30109	MS-02	3905	6255572	-23127	Manual Reading
PZ15-01	29-May-23	8650.4	4.1	31269	-	-	6252255	476637	Attached to SI15-05
PZ15-02	29-May-23	8075.4	4.1	31268	-	-	6252255	476637	Attached to SI15-05
PZ15-03	29-May-23	8650.5	3.7	31267	-	-	6252220	476535	Attached to SI15-06
PZ15-04	29-May-23	8083.3	3.8	31266	-	-	6252220	476535	Attached to SI15-06
PZ15-05	29-May-23	8912	4.2	31261	-	-	6252299	476609	Attached to SI15-07
PZ15-06	29-May-23	8678.5	4.2	31260	-	-	6252299	476609	Attached to SI15-07
PZ15-07	29-May-23	8912.1	4.1	31259	-	-	6252246	476520	Attached to SI15-08
PZ15-08	29-May-23	8423.7	3.8	31258	-	-	6252246	476520	Attached to SI15-08
PZ15-09	29-May-23	8845.1	2	31265	-	-	6252336	476583	Attached to SI15-09
PZ15-10	29-May-23	8457.7	4	31264	-	-	6252336	476583	Attached to SI15-09
PZ15-11	29-May-23	8917.3	2.3	31263	-	-	6252283	476495	Attached to SI15-10
PZ15-12	29-May-23	8301.7	4.3	31262	-	-	6252283	476495	Attached to SI15-10

SETTLEMENT CELL READINGS

SC#	Date	Reading		Identification	Monitoring	Datalogger	3TM EBA Scaled		Comment
		B Unit	Temp.	Number	Station	Serial	Northing	Easting	
SG14-01	29-May-23	5472.7	4.1	1428194	MS-01	3906	6255616	-23070	Manual Reading
SG14-02	29-May-23	6161.9	4.2	1428195	MS-02	3905	6255572	-23127	Manual Reading

INSPECTOR REPORT

MS-01 and MS-02 take manual readings

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC099)
SPRING 2023

Location:	Hwy 63:10 over Hangingstone River (BF75907) - South Bridge	**Readout:**	
File Number:	32122	**Casing Diameter**	2.75"/3.34"
Probe:	RST Set 8R	**Temp (deg C):**	21
Cable:	RST Set 8R	**Read by:**	NKR/OTE

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location UTM 12 V		Date	Stickup (m)	Depth from top of Casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Northing	Easting					A+	A-	B+	B-		
N-SI-01	6252711	476897	29-May-23	0.96	98 to 2	143	-624	644	-323	340	8R	
N-SI-02	6252718	476901	29-May-23	0.92	112 to 2	103	14	-20	-207	215	8R	
S-SI-01	6252692	476862	29-May-23	0.63	98 to 2	10	97	-80	-204	215	8R	
S-SI-02	6252681	476858	29-May-23	1.2	108 to 2	32	-438	455	-116	127	8R	

VIBRATING WIRE PIEZOMETER (VW) READINGS

VW#	Date	Reading		Identification	Monitoring	Datalogger	UTM 12 V		Comment
		B Unit	Temp.	Number	Station	Serial	Northing	Easting	
PZ133682	29-May-23	-	-	-	North	-	6252758	476875	Downloaded
PZ133647	29-May-23	-	-	-	North	-	6252758	476875	"
PZ133638	29-May-23	-	-	-	South	-	6252716	476828	Malfunctioning "
PZ133683	29-May-23	-	-	-	South	-	6252716	476828	"

SETTLEMENT CELL READINGS

SC#	Date	Reading		Identification	Monitoring	Datalogger	3TM EBA Scaled		Comment
		B Unit	Temp.	Number	Station	Serial	Northing	Easting	
SG1421049	29-May-23	No Reading	4.2	-	North	DT 2055B 12464	6252758	476875	MS-1, Downloaded
SG1421034	29-May-23	-	-	-	South	DT2055 12463	6252716	476828	MS-2, Downloaded

INSPECTOR REPORT

- Measure stickups, azimuths and coordiantes for SIs, coordinates for datalogger stations.
All of the SI's were initialized
MS-1 SG142049 sensor is damaged recently, took manual readings as well no date only thermal sensor working.

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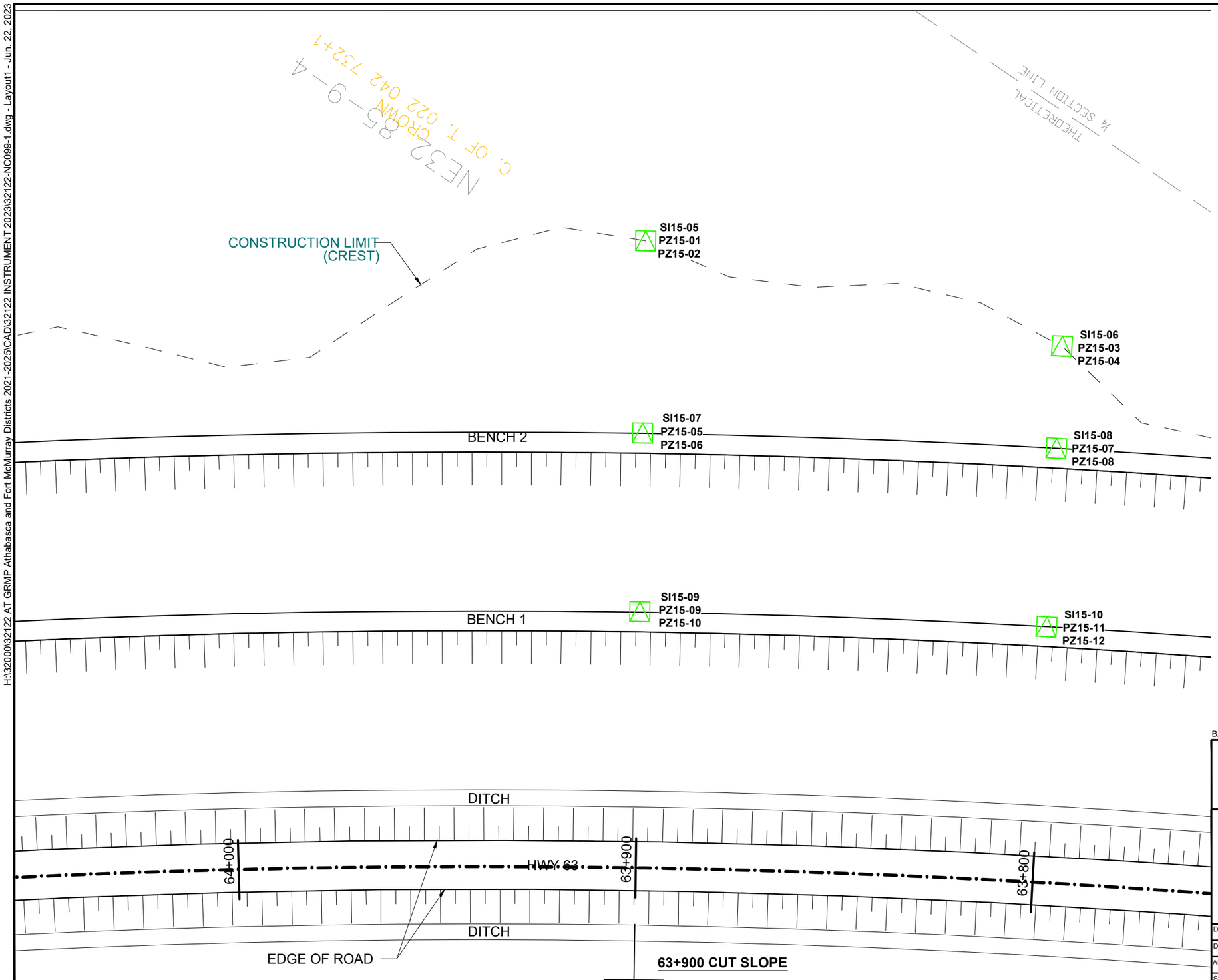

LEGEND

VIBRATING WIRE PIEZOMETERS

INCLINOMETER

0 10 20 30 40 50 60m

SCALE 1:1000

BASE PLAN PROVIDED BY TETRA TECH

Alberta

NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)

NC099: HWY 63:08 HANGINGSTONE RIVER BRIDGE
STA. 63+900 CUT SLOPE
SITE PLAN SHOWING APPROXIMATE
INSTRUMENT LOCATIONS (NORTHBOUND LANE)

DWG No. 32122-NC099-1

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:1000
DATE	JUNE 2023
FILE No.	32122

THURBER ENGINEERING LTD.

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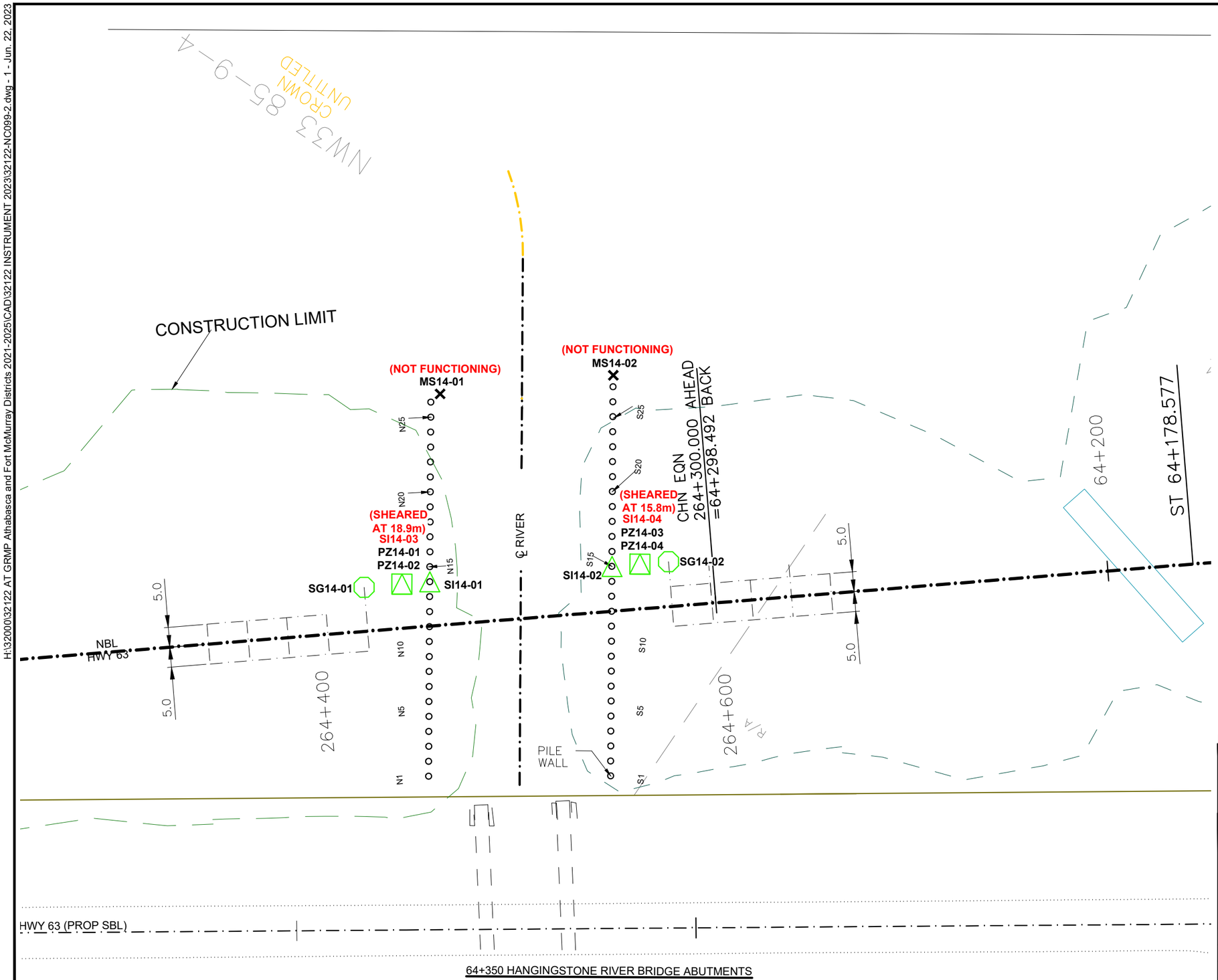

64+350 HANGINGSTONE RIVER BRIDGE ABUTMENTS

LEGEND

- VIBRATING WIRE PIEZOMETERS
- INCLINOMETER
- SETTLEMENT GAUGE
- MONITORING STATION

NOTE:
DRAWING DOES NOT SHOW FINAL ALIGNMENT AND HIGHWAY BRIDGE FOR FOR SOUTHBOUND LANE, CONSTRUCTED 2022

0 10 20 30 40 50 60m
SCALE 1:1000

BASE PLAN PROVIDED BY TETRA TECH

Alberta

NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
NC099: HWY 63:08 HANGINGSTONE RIVER BRIDGE
STA. 64+350 ABUTMENTS
SITE PLAN SHOWING APPROXIMATE
INSTRUMENT LOCATIONS (NORTHBOUND LANE)

DWG No. 32122-NC099-2

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:1000
DATE	JUNE 2023
FILE No.	32122

THURBER ENGINEERING LTD.

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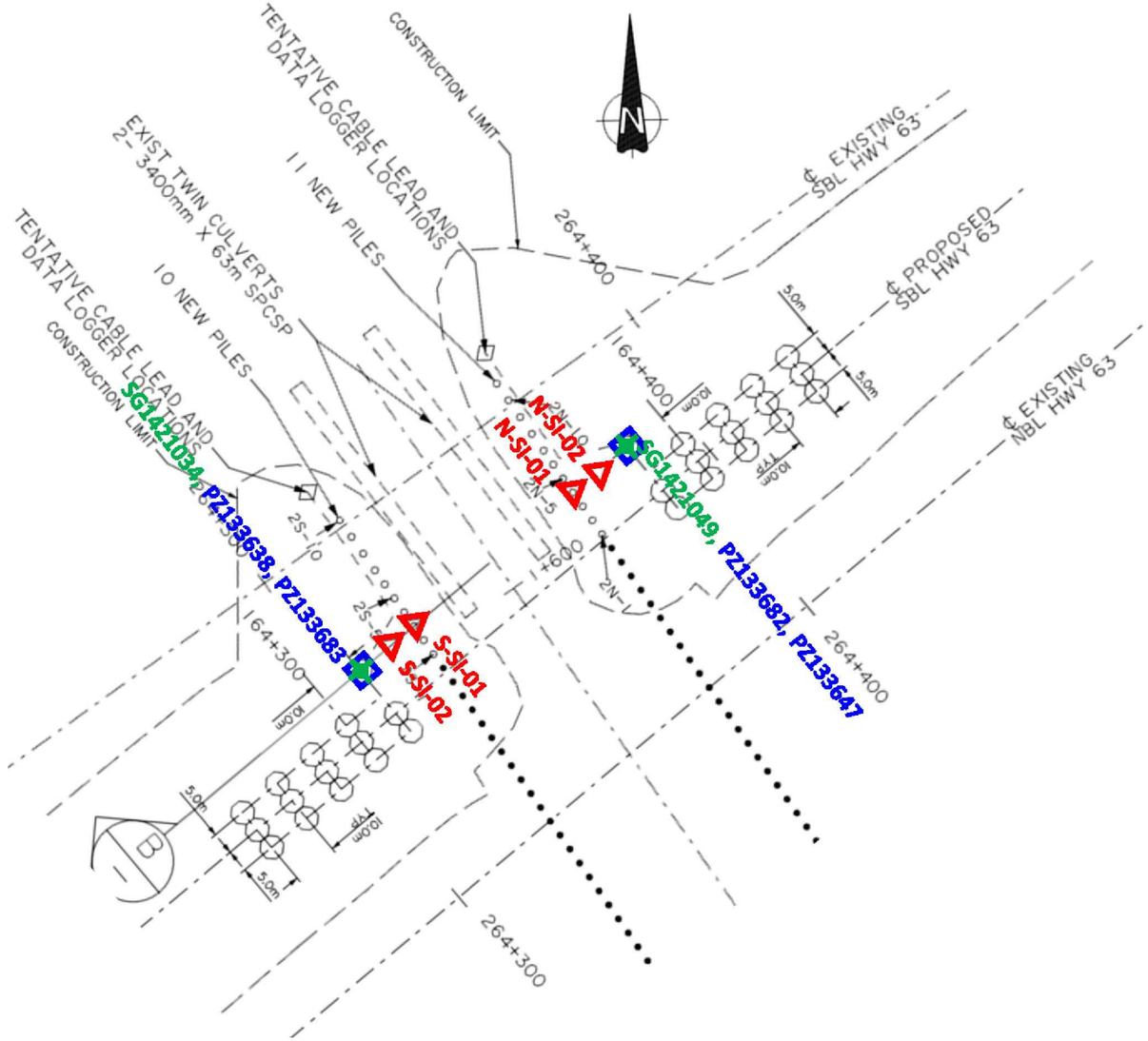
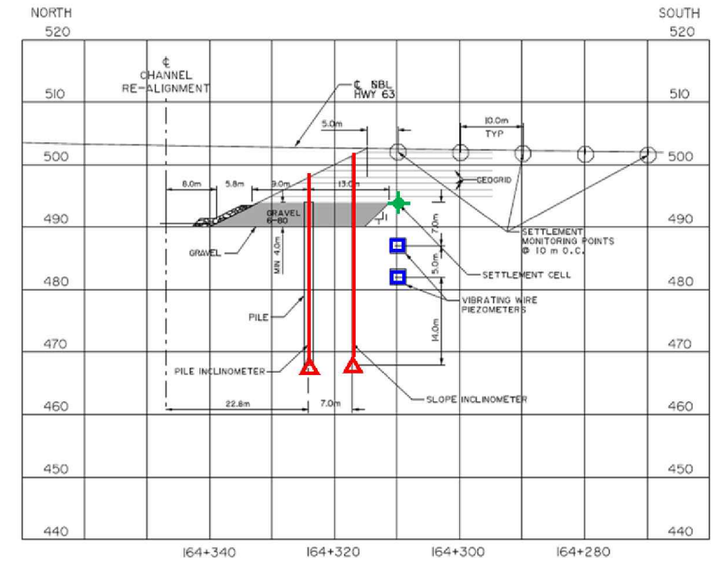




SECTION 'B'
SCALE 1:500
SEE DWG# 44746-P FOR PILE WALL DRAWING

LEGEND

- VIBRATING WIRE PIEZOMETERS
- INCLINOMETER
- SETTLEMENT MONITORING POINT
- SETTLEMENT CELL
- DATA LOGGER
- CABLE LEAD

0 10 20 30 40 50 60 70 m
SCALE 1:1250

BASE PLAN PROVIDED BY TETRA TECH

Alberta

NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
NC099: HWY 63:08 HANGINGSTONE RIVER BRIDGE

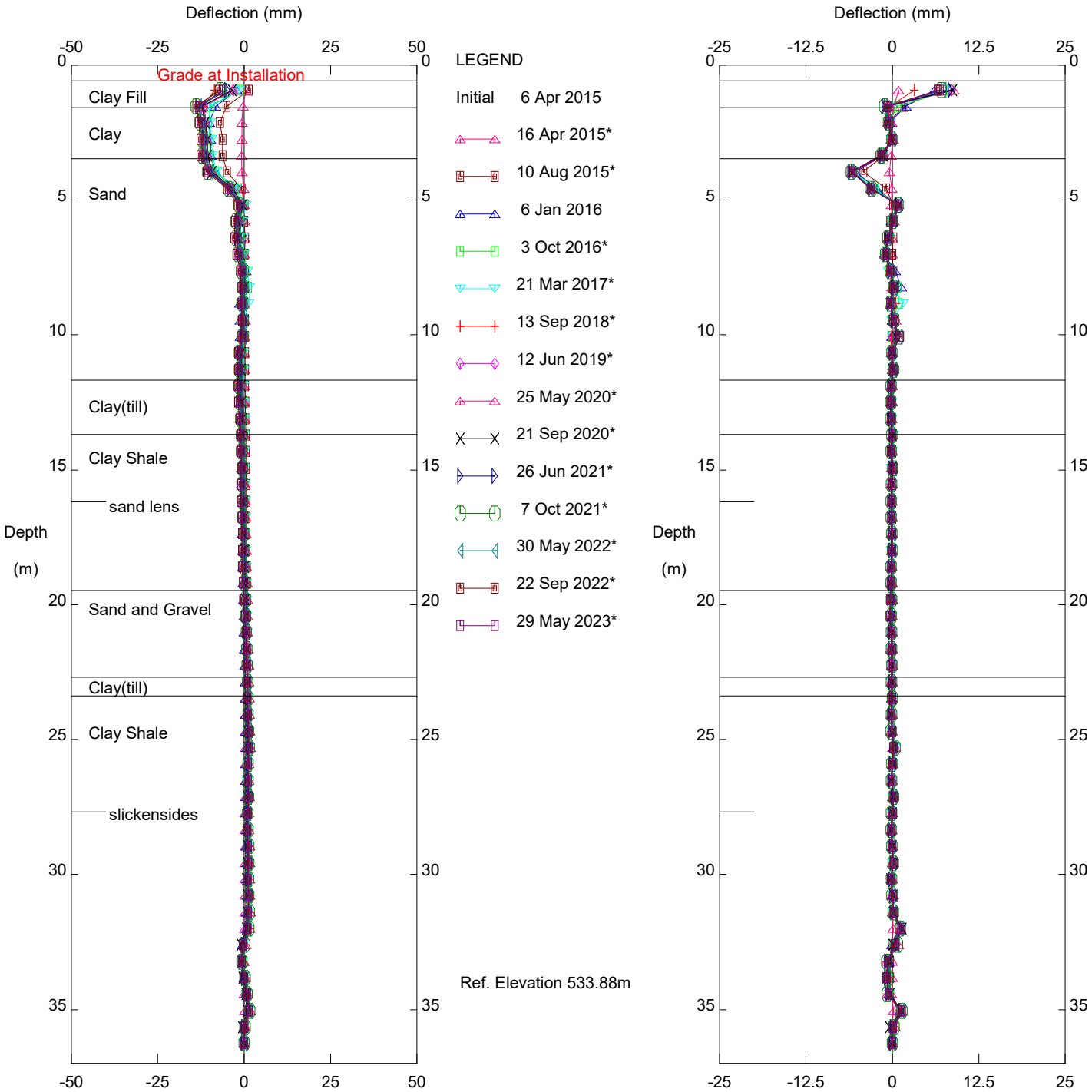
SITE PLAN SHOWING APPROXIMATE INSTRUMENT LOCATIONS (SOUTHBOUND LANE)

DWG No. 32122-NC099-3

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:1250
DATE	JUNE 2023
FILE No.	32122

THURBER ENGINEERING LTD.

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 Cut Slope - Crest, Inclinometer 15-05

Alberta Transportation

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

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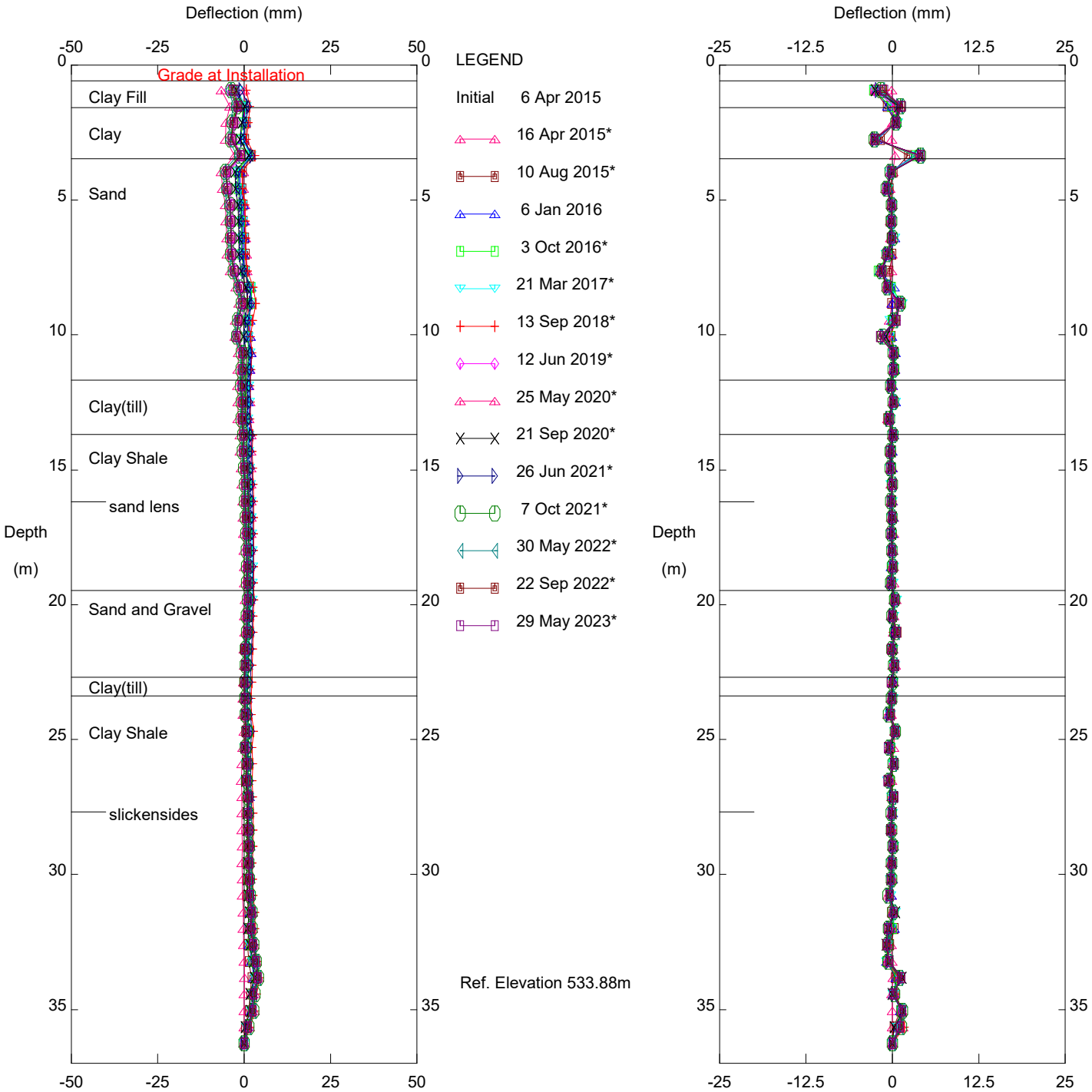

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Crest, Inclinometer 15-05

Alberta Transportation

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

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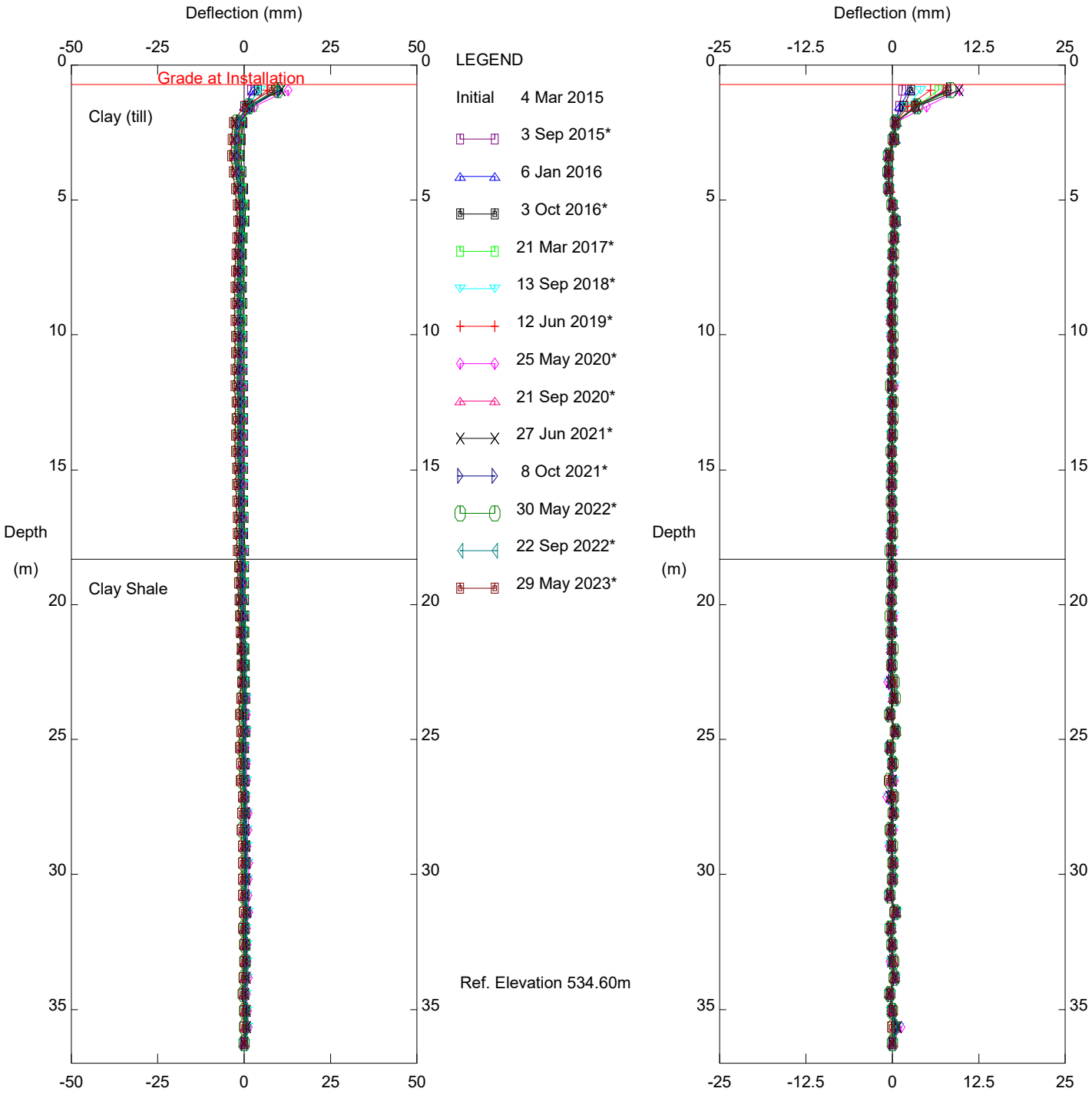

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 Cut Slope - Crest, Inclinometer 15-06

Alberta Transportation

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

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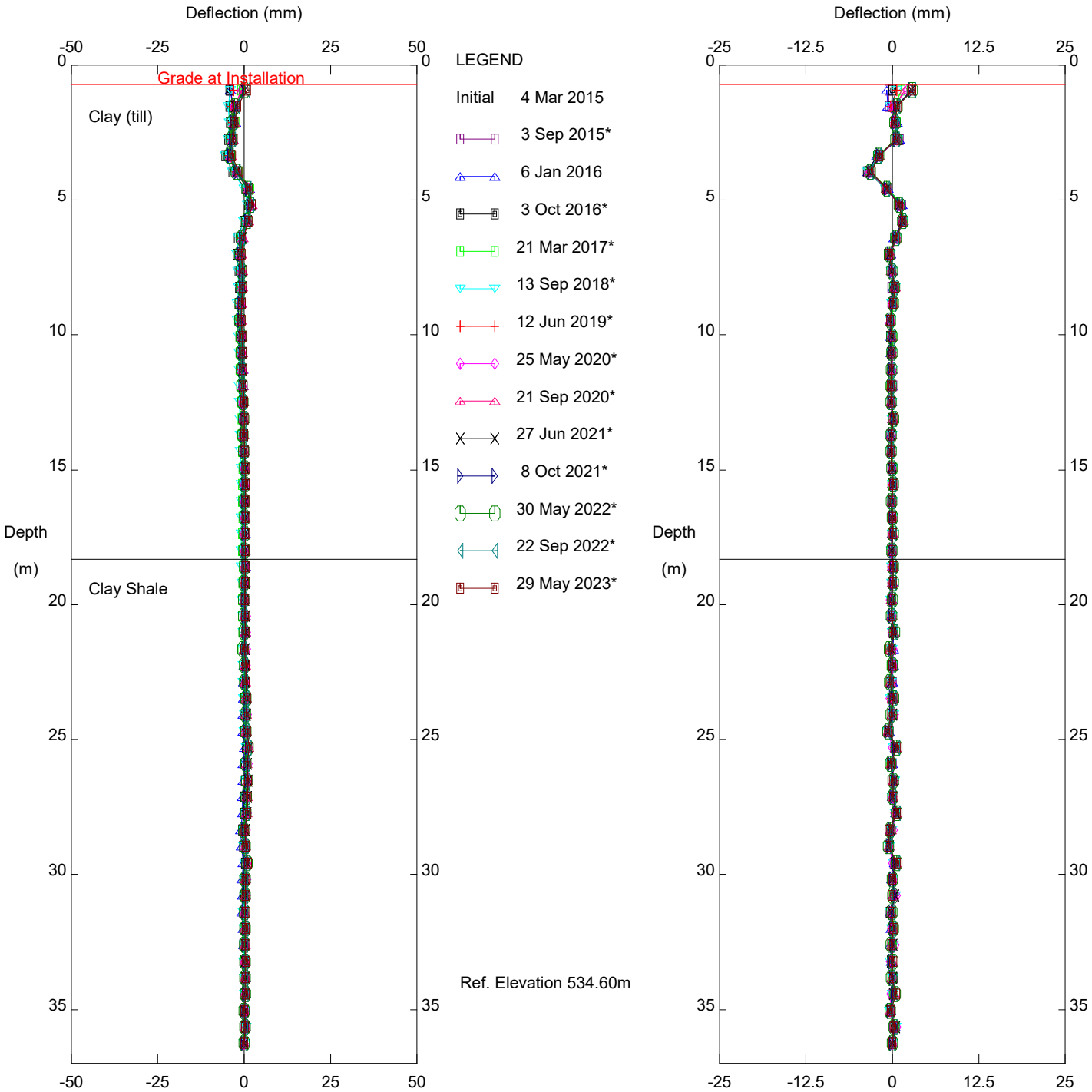
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Crest, Inclinometer 15-06

Alberta Transportation

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

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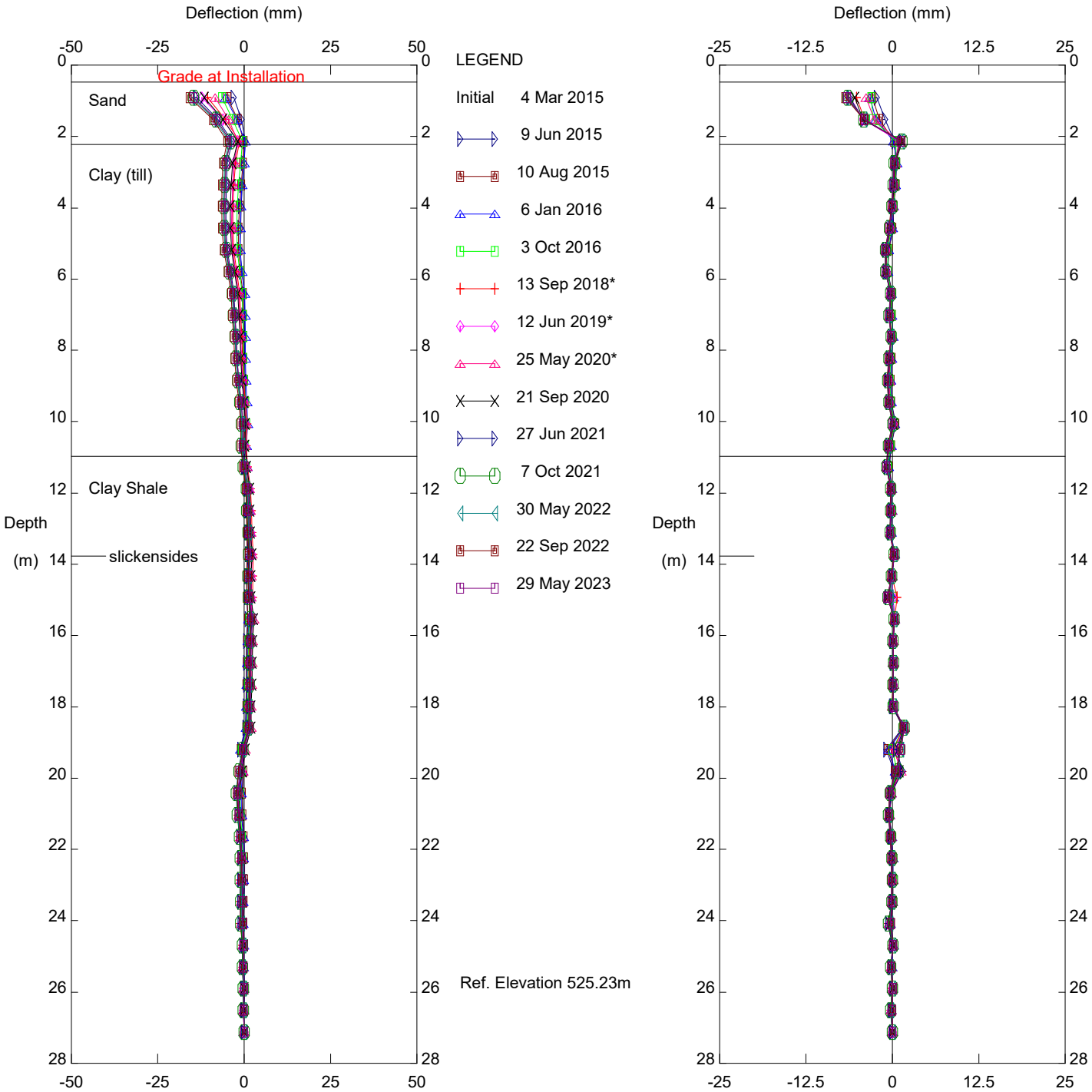

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 Cut Slope - Bench 2, Inclinometer 15-07

Alberta Transportation

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

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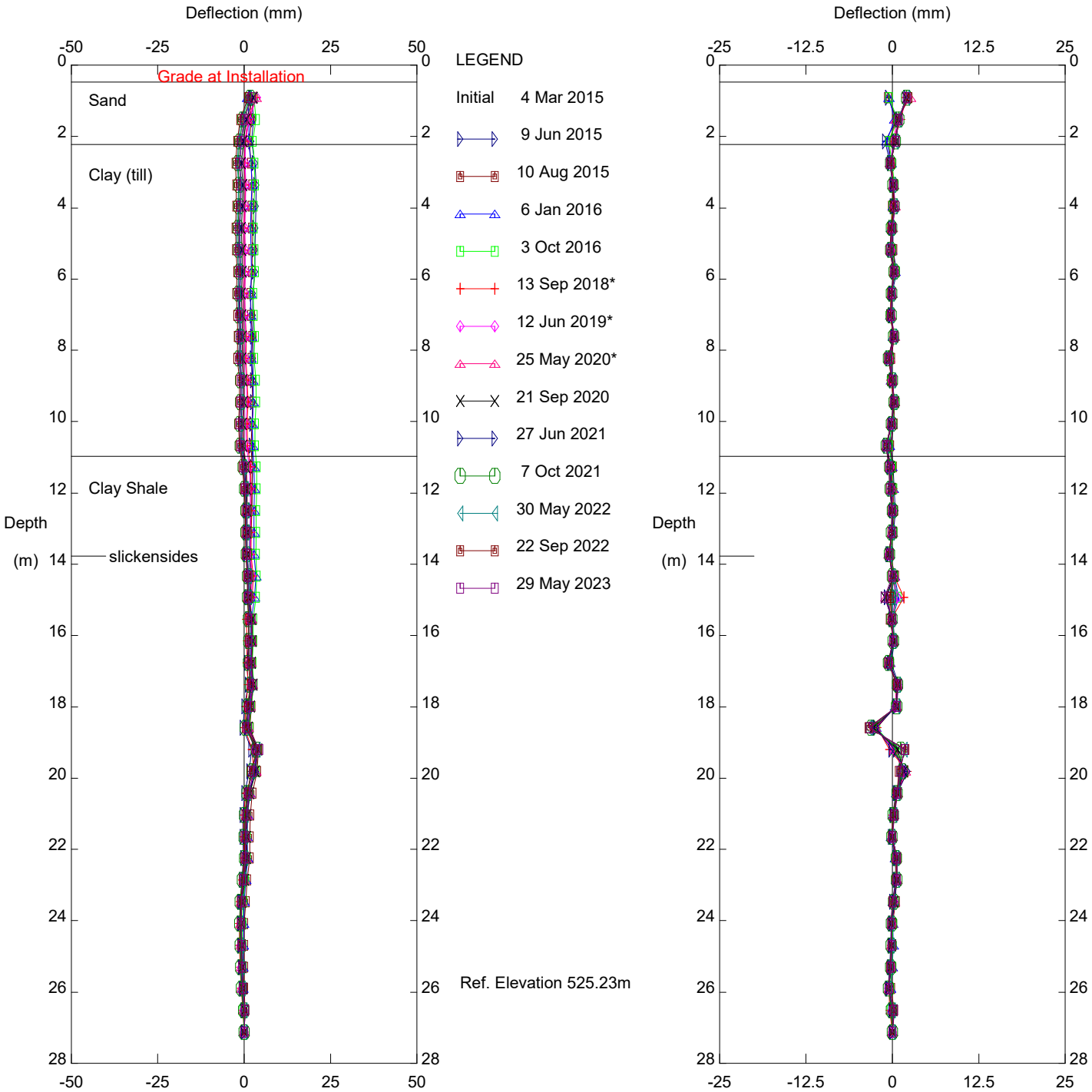

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Bench 2, Inclinometer 15-07

Alberta Transportation

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

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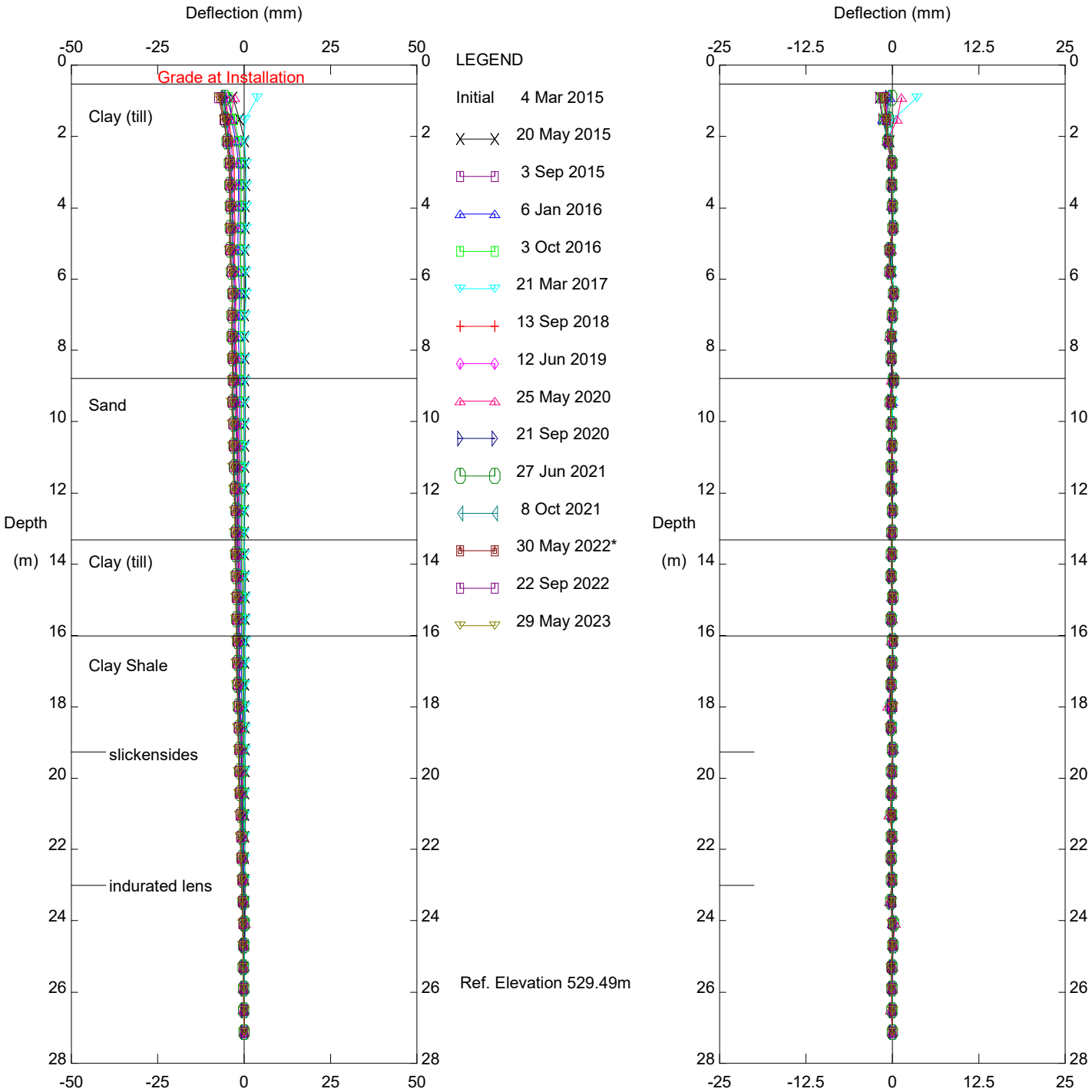

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 Cut Slope - Bench 2, Inclinometer 15-08

Alberta Transportation

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

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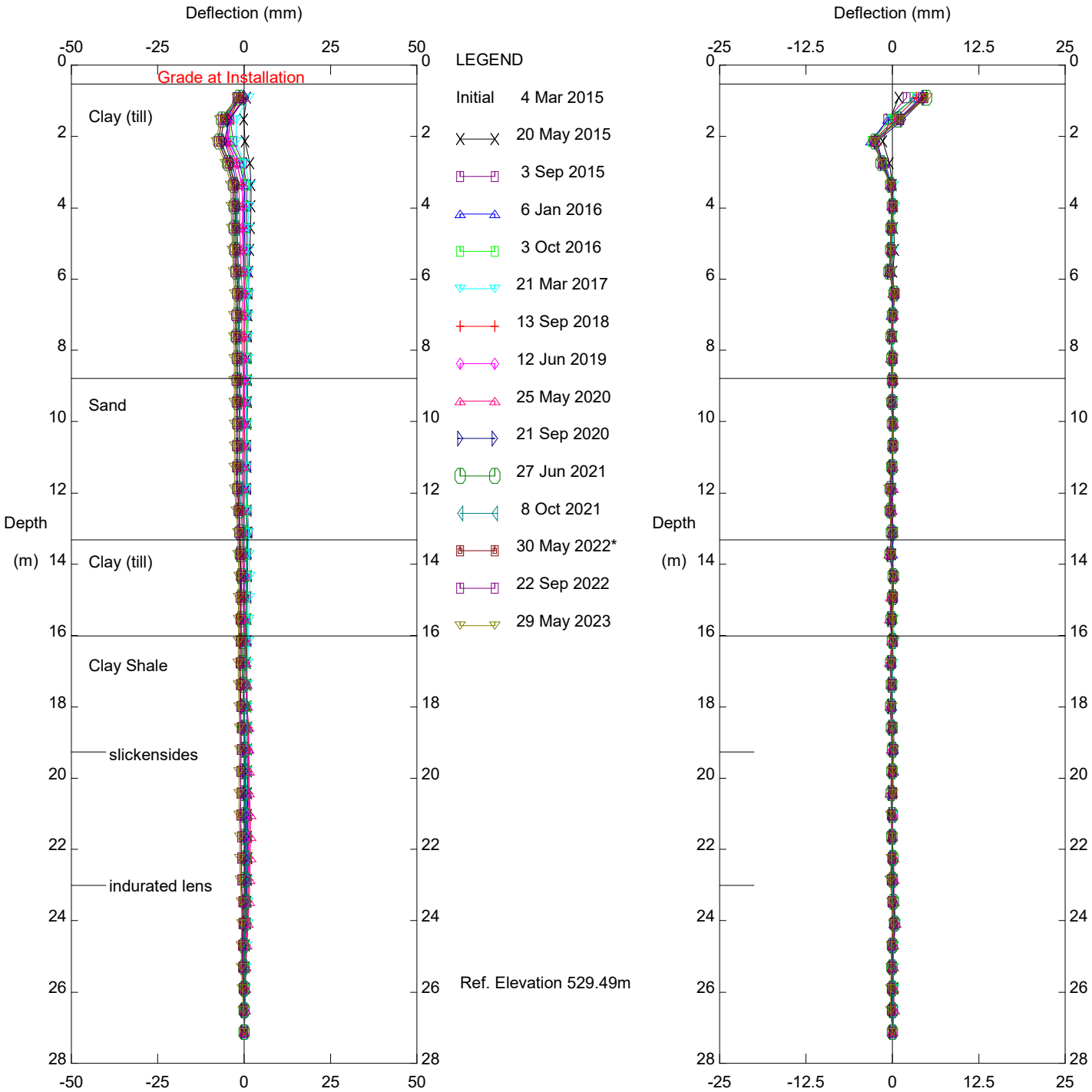

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Bench 2, Inclinometer 15-08

Alberta Transportation

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

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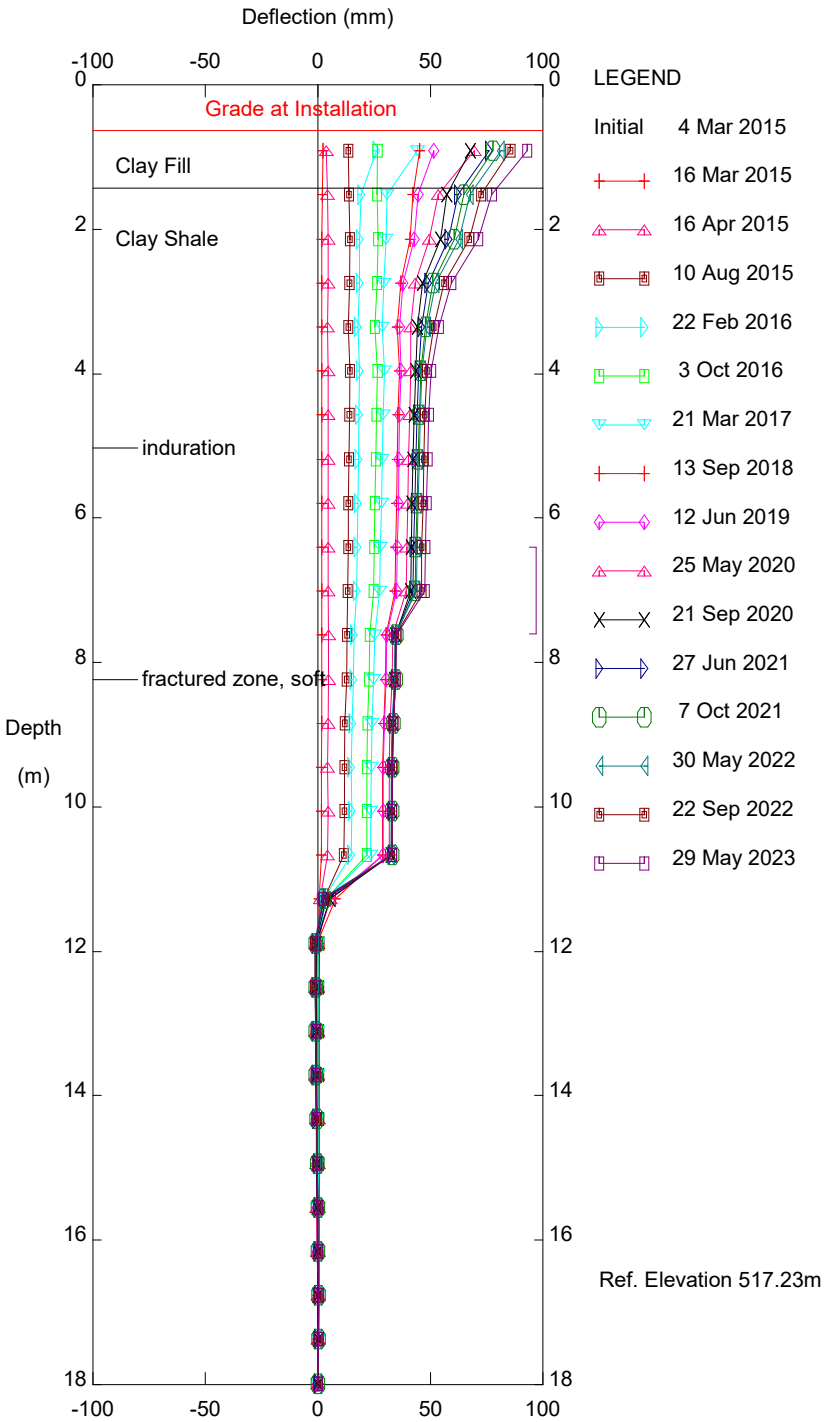
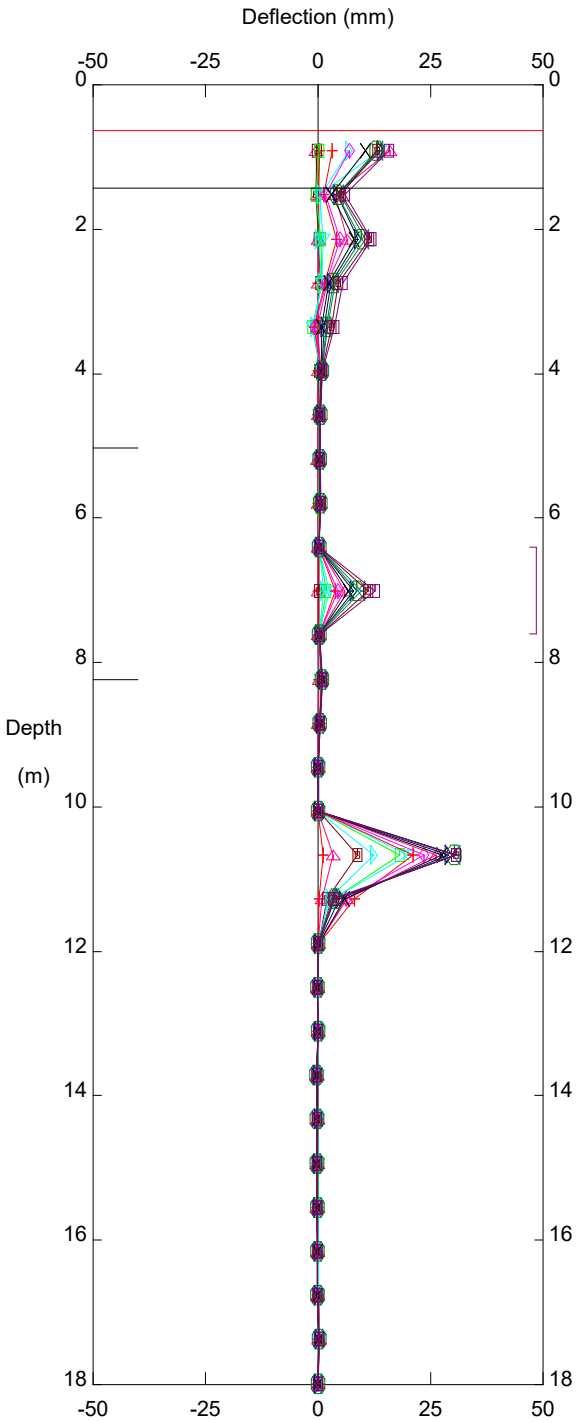


Cumulative Deflection

Direction A



Incremental Deflection

Direction A

NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

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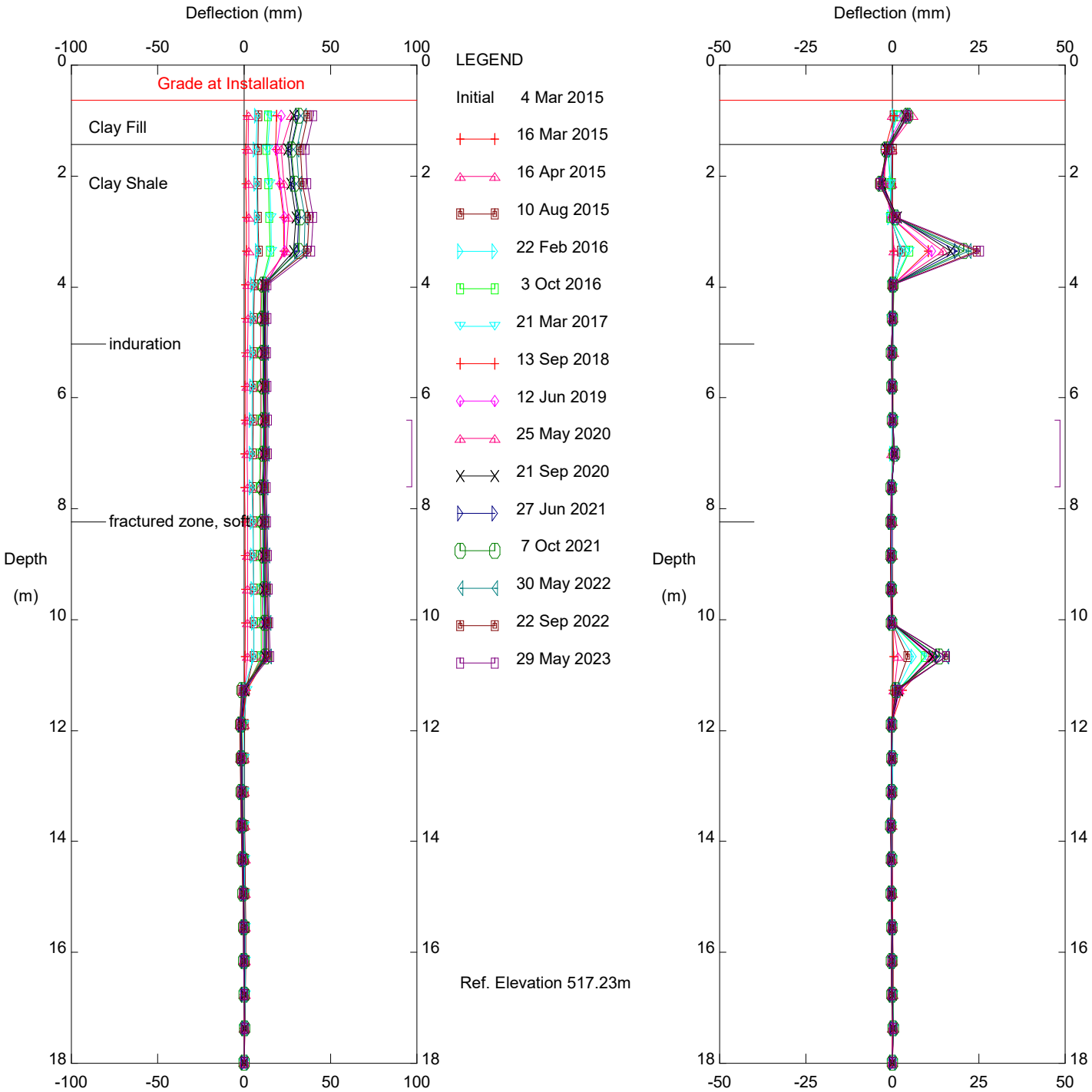

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

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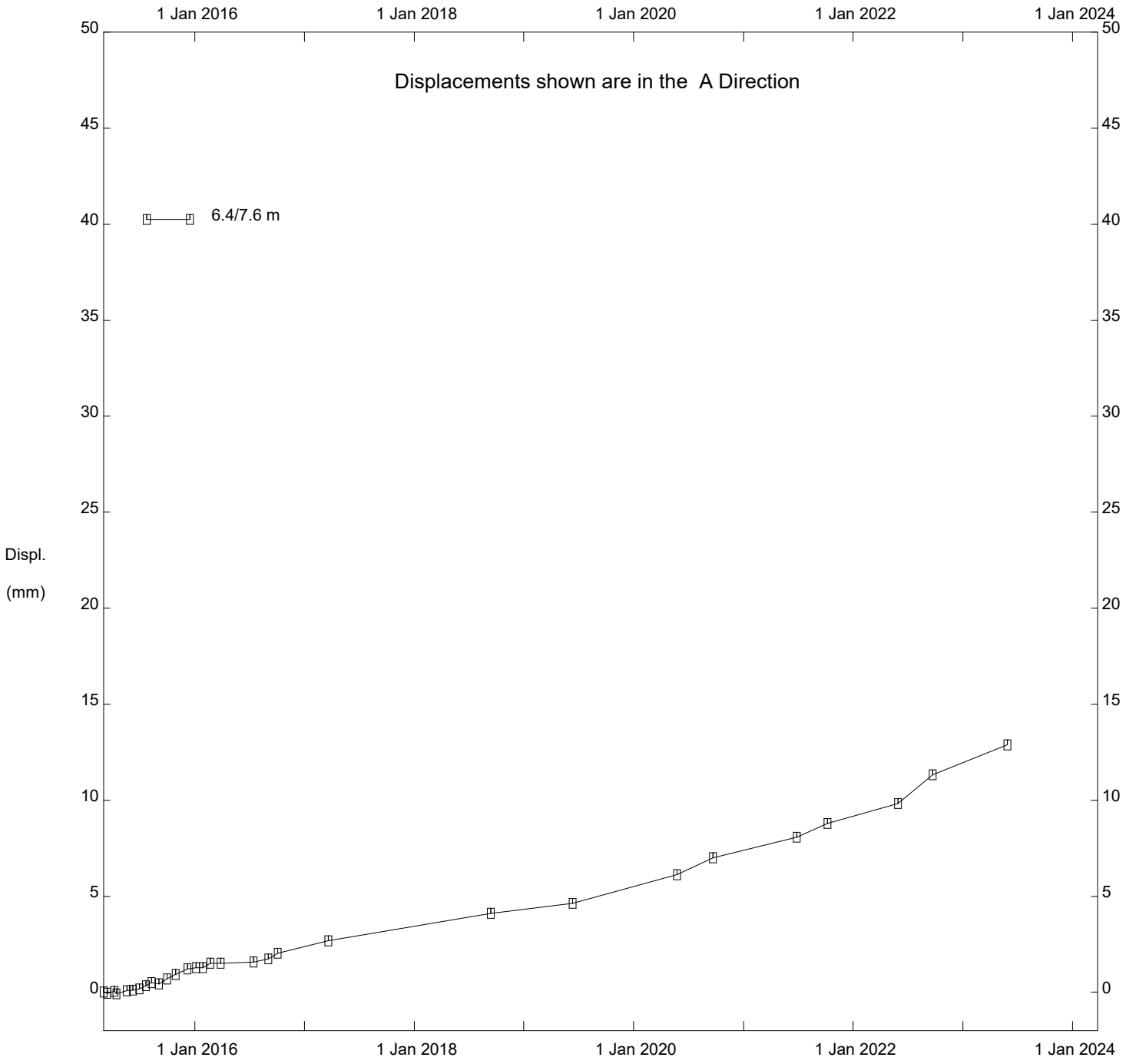
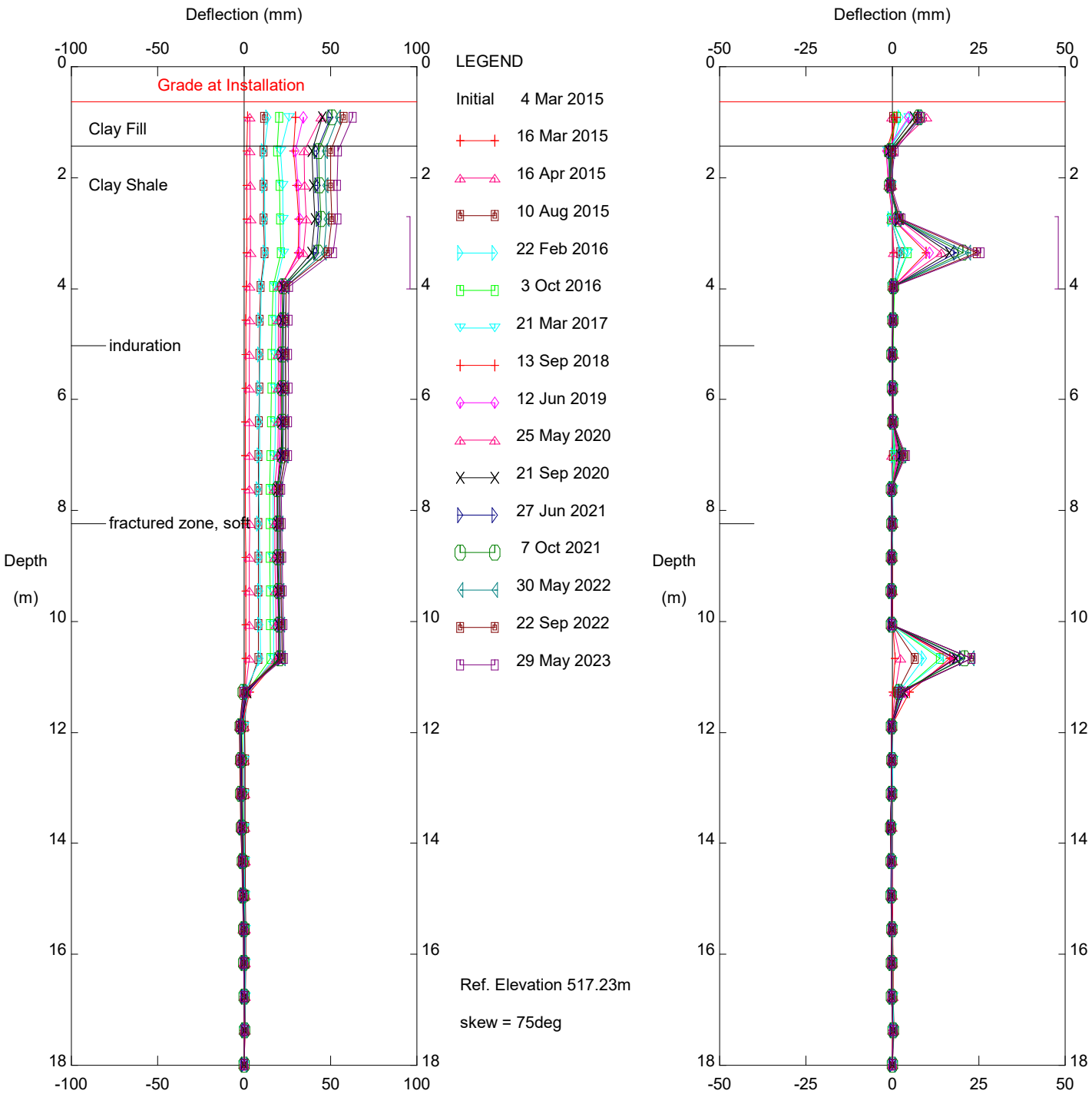


NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

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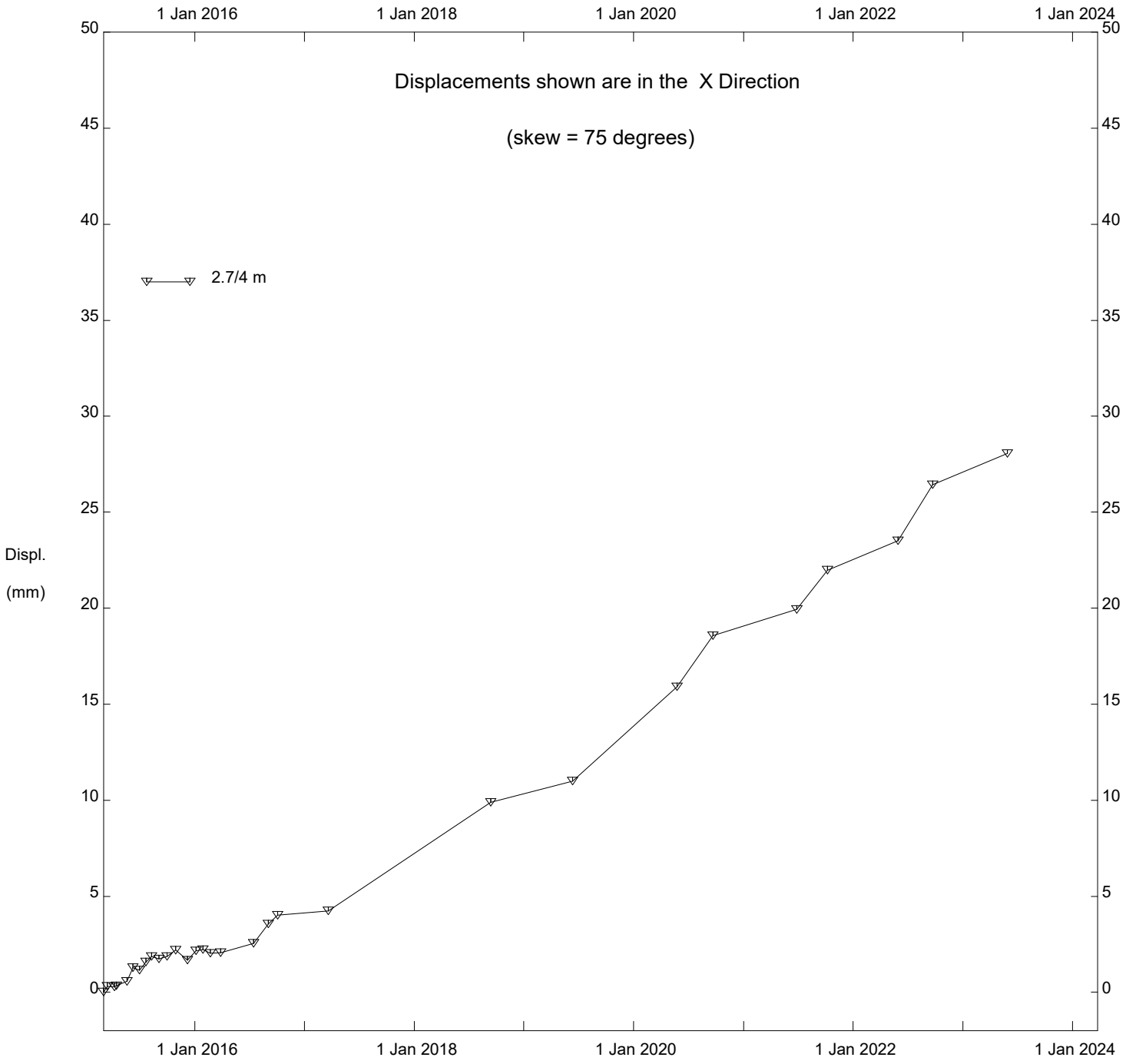
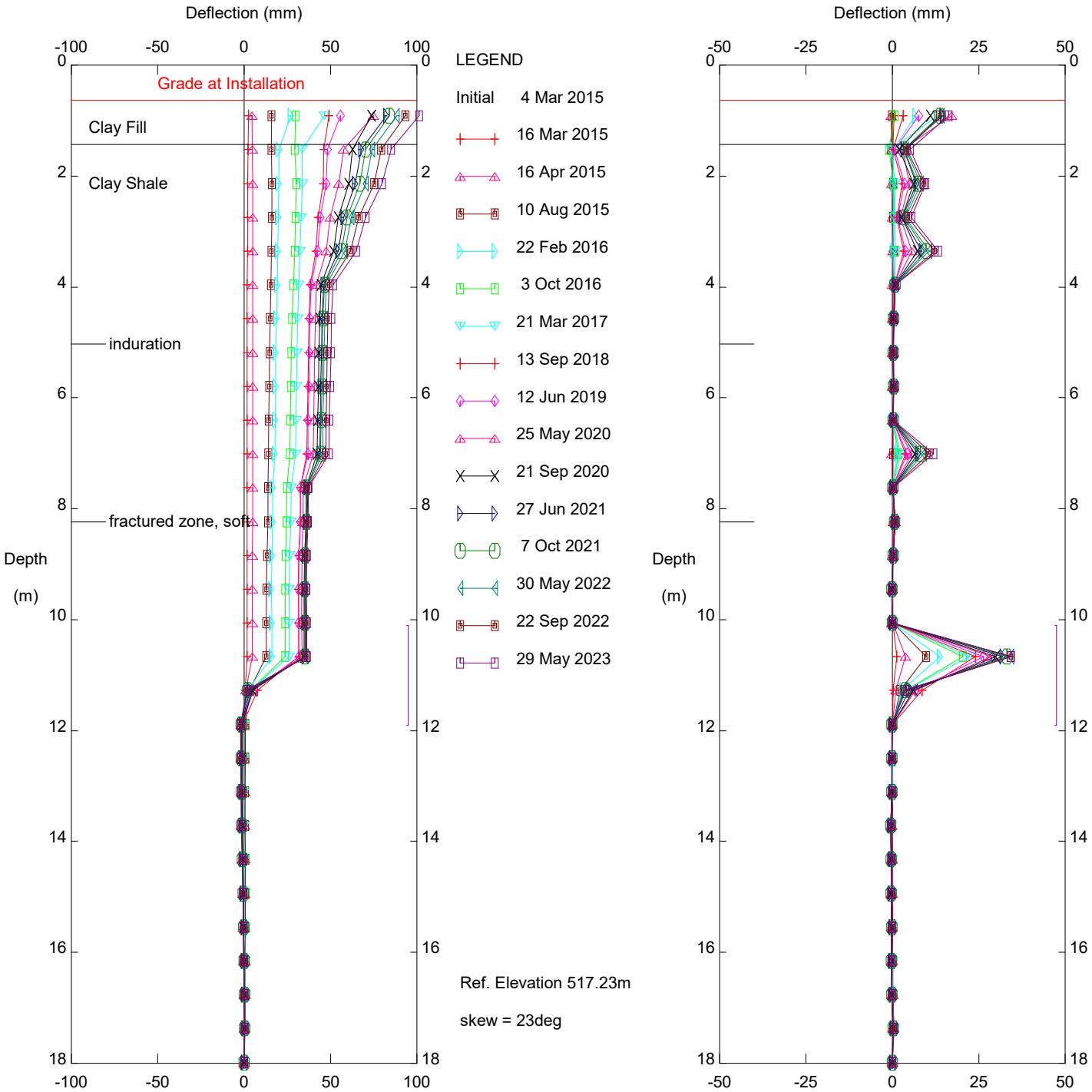
Thurber Engineering Ltd.



NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

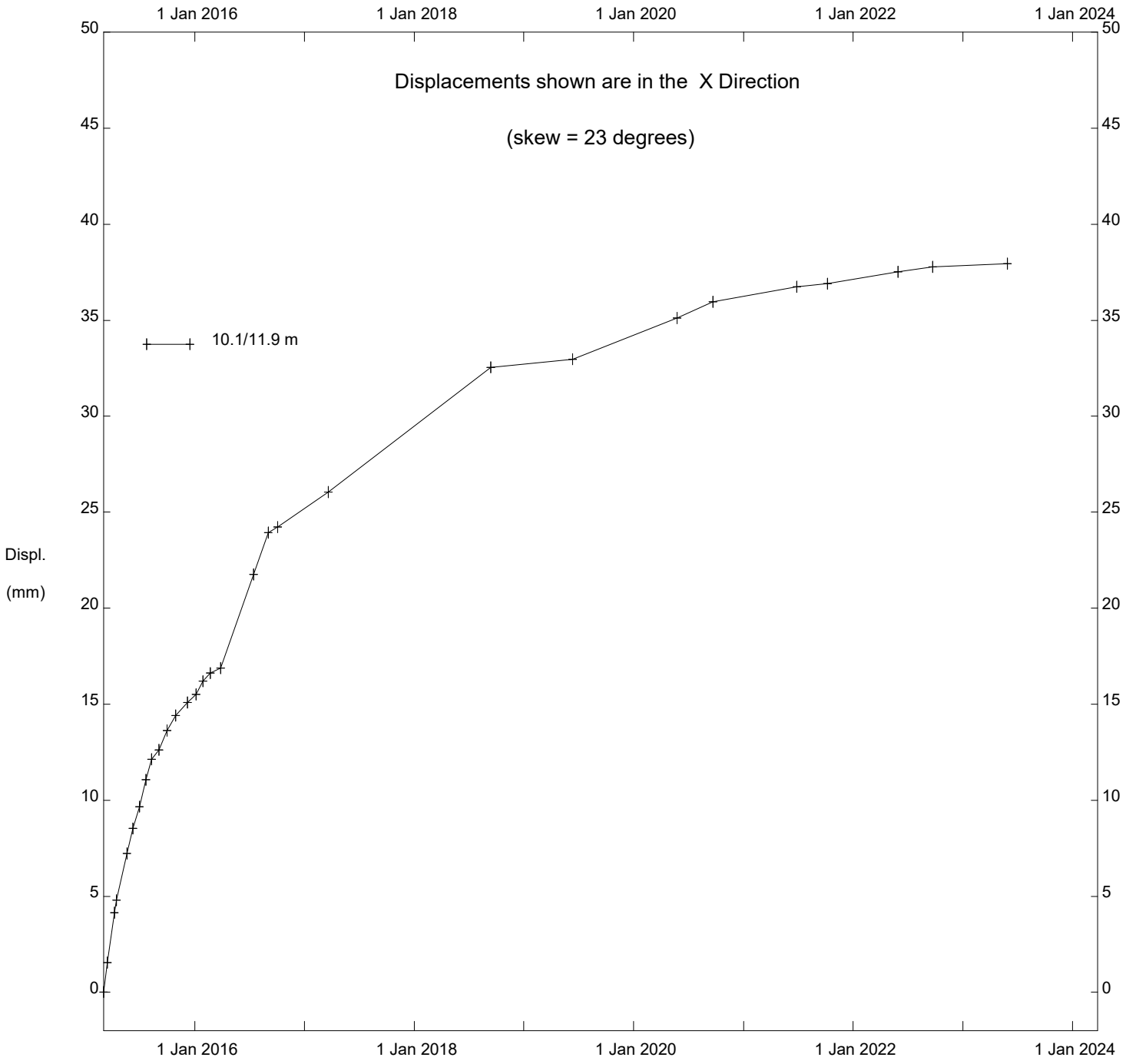
Direction X

NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\15-09.gtl

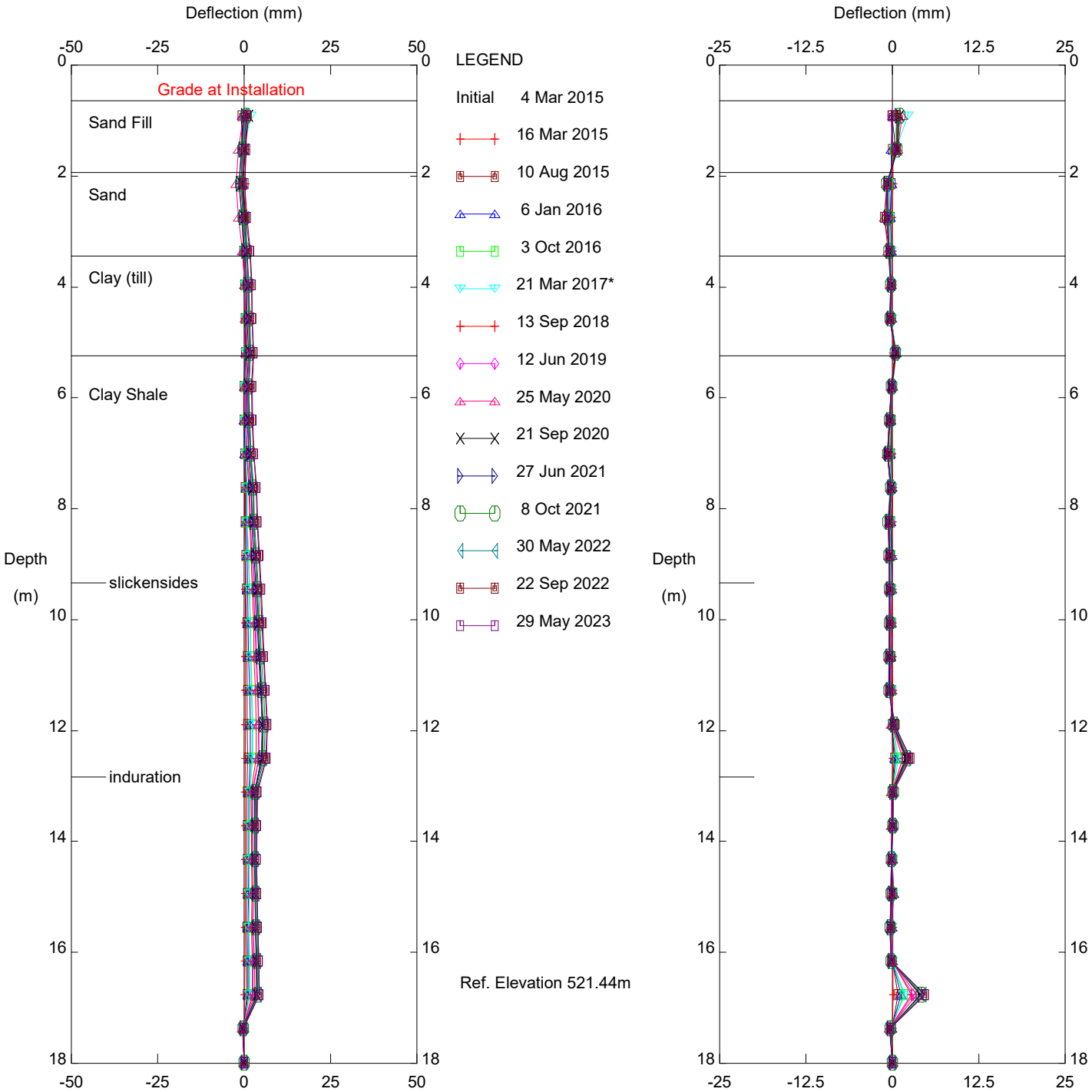
Thurber Engineering Ltd.



NC099 Cut Slope - Bench 1, Inclinometer 15-09

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

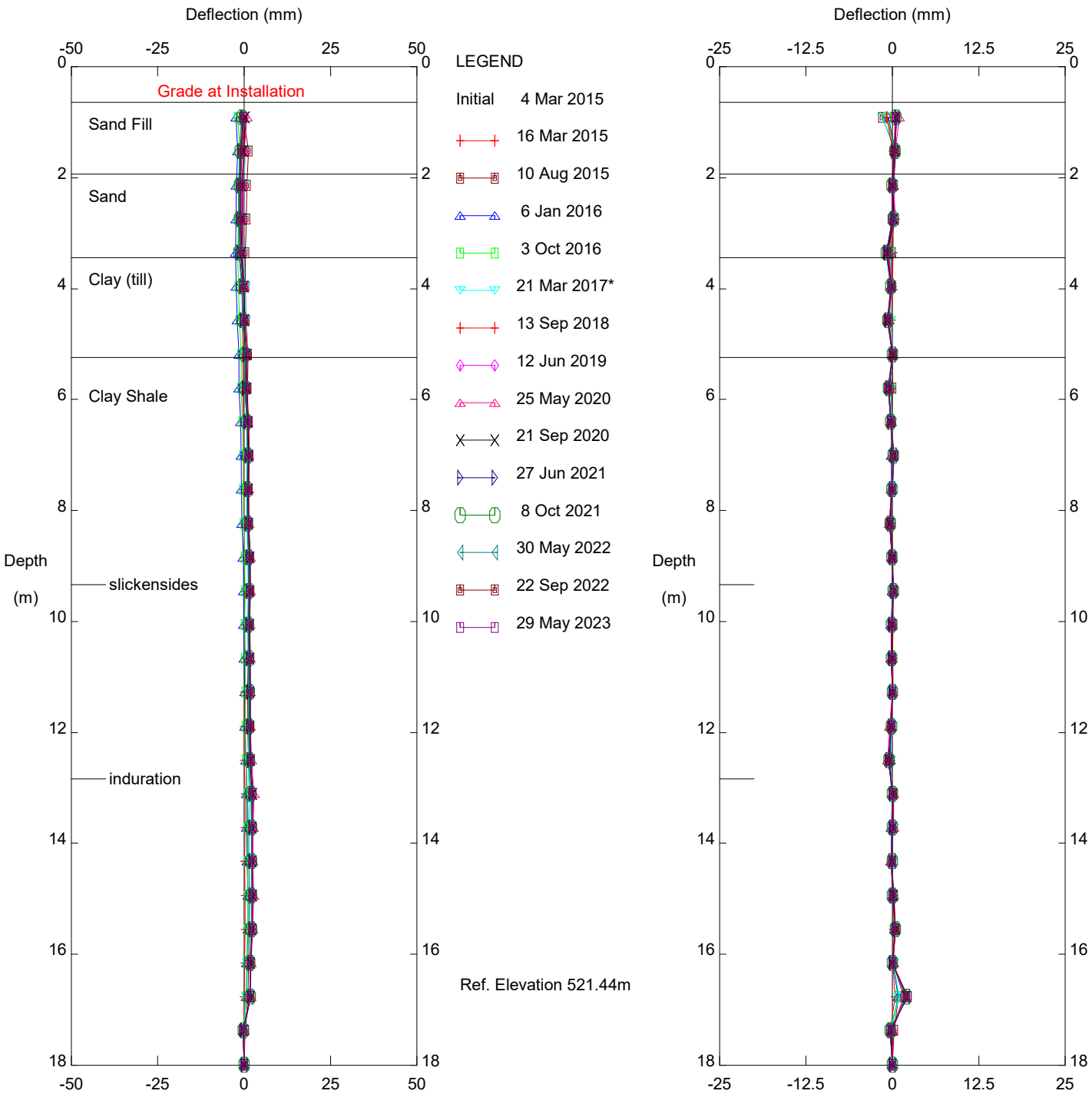
NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\15-10.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

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

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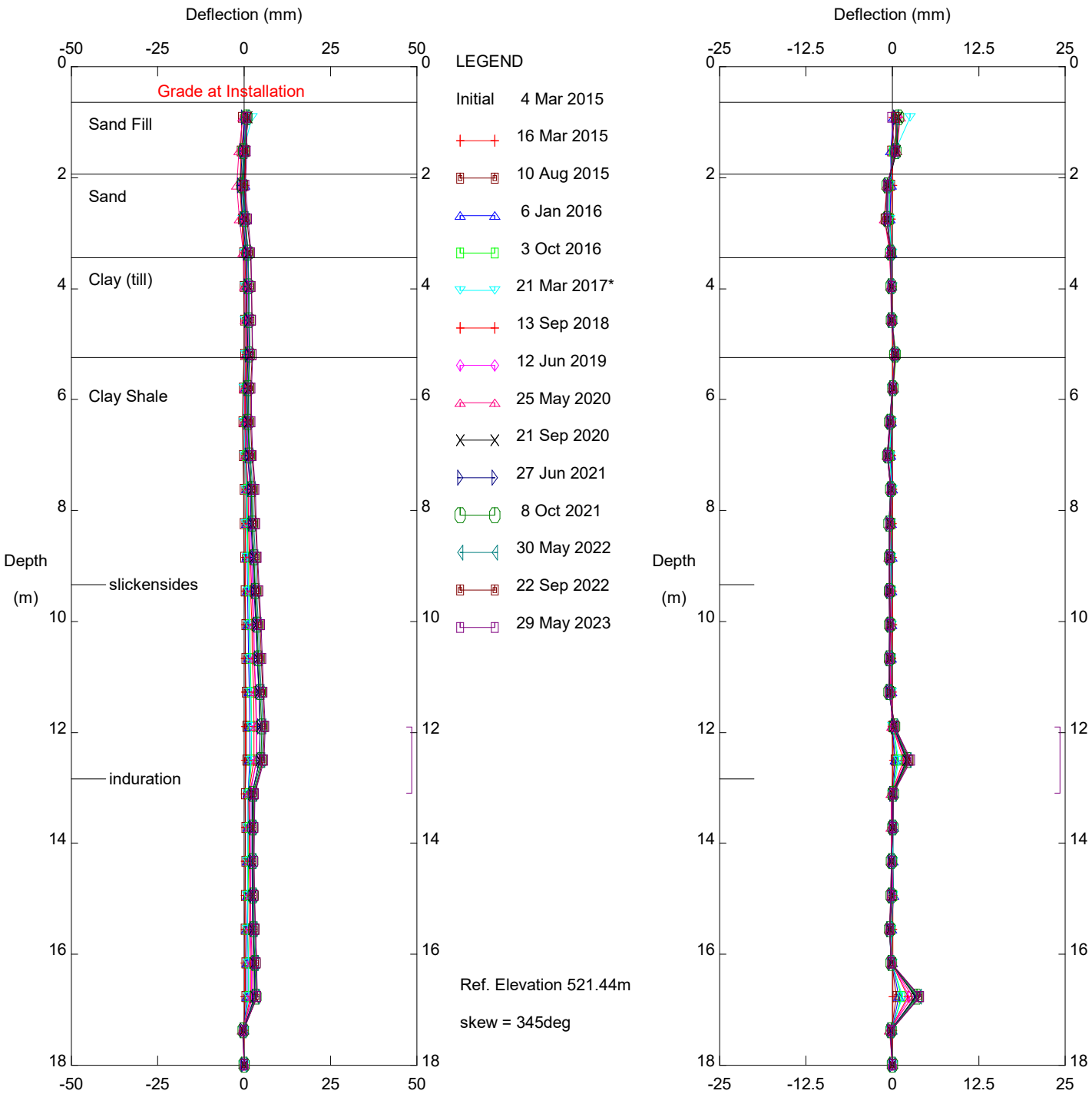
Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

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

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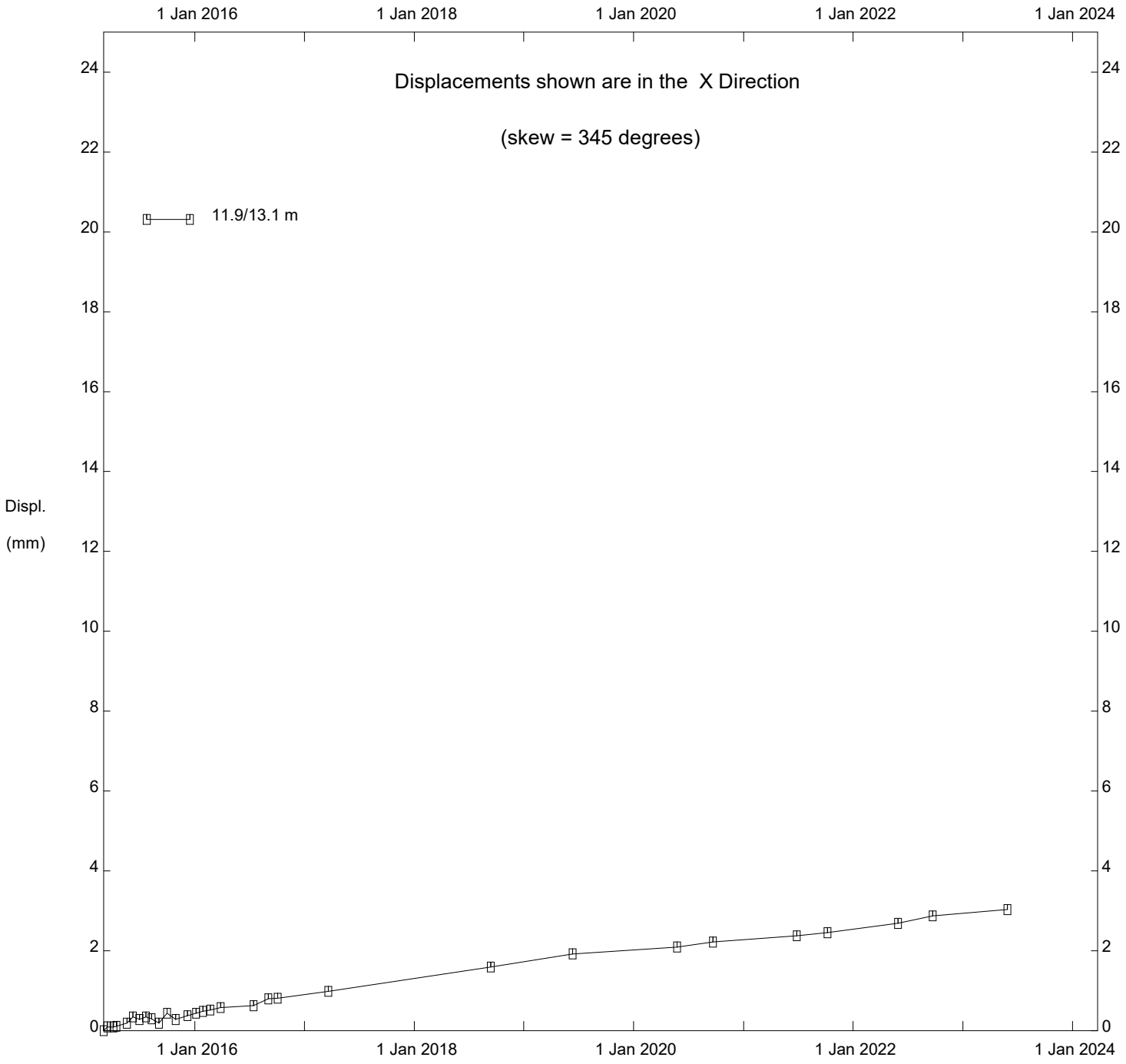
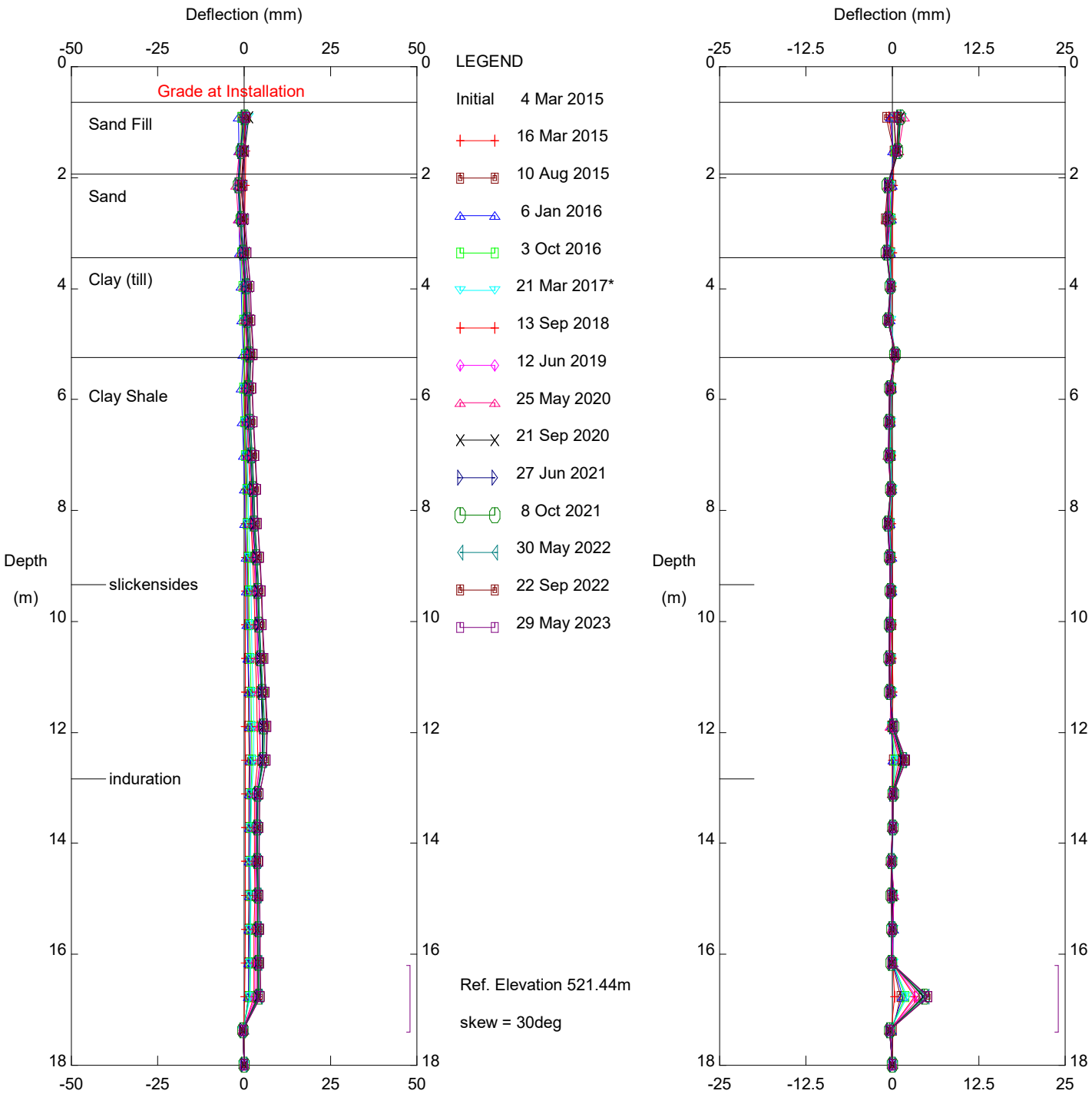


NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

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

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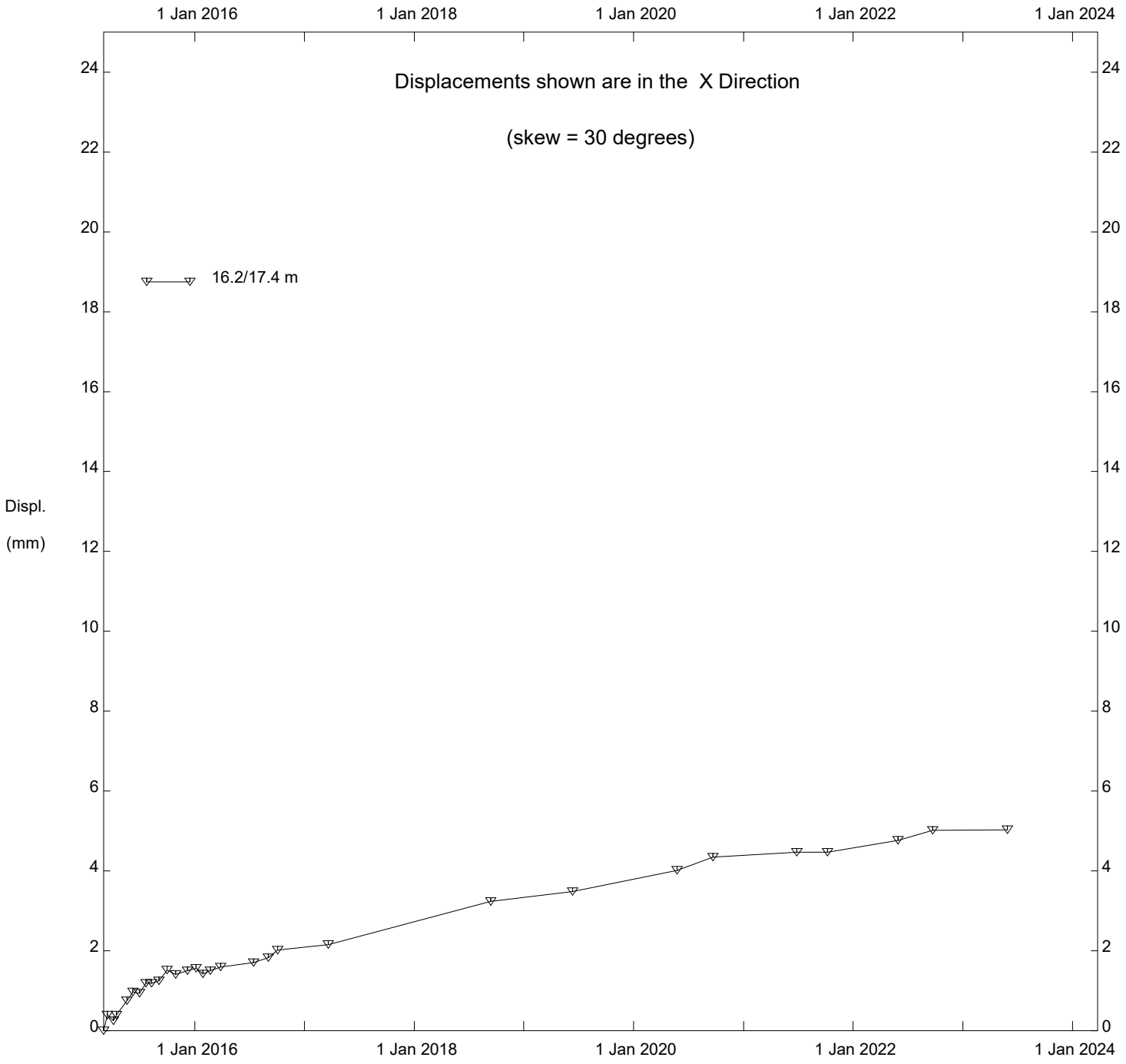
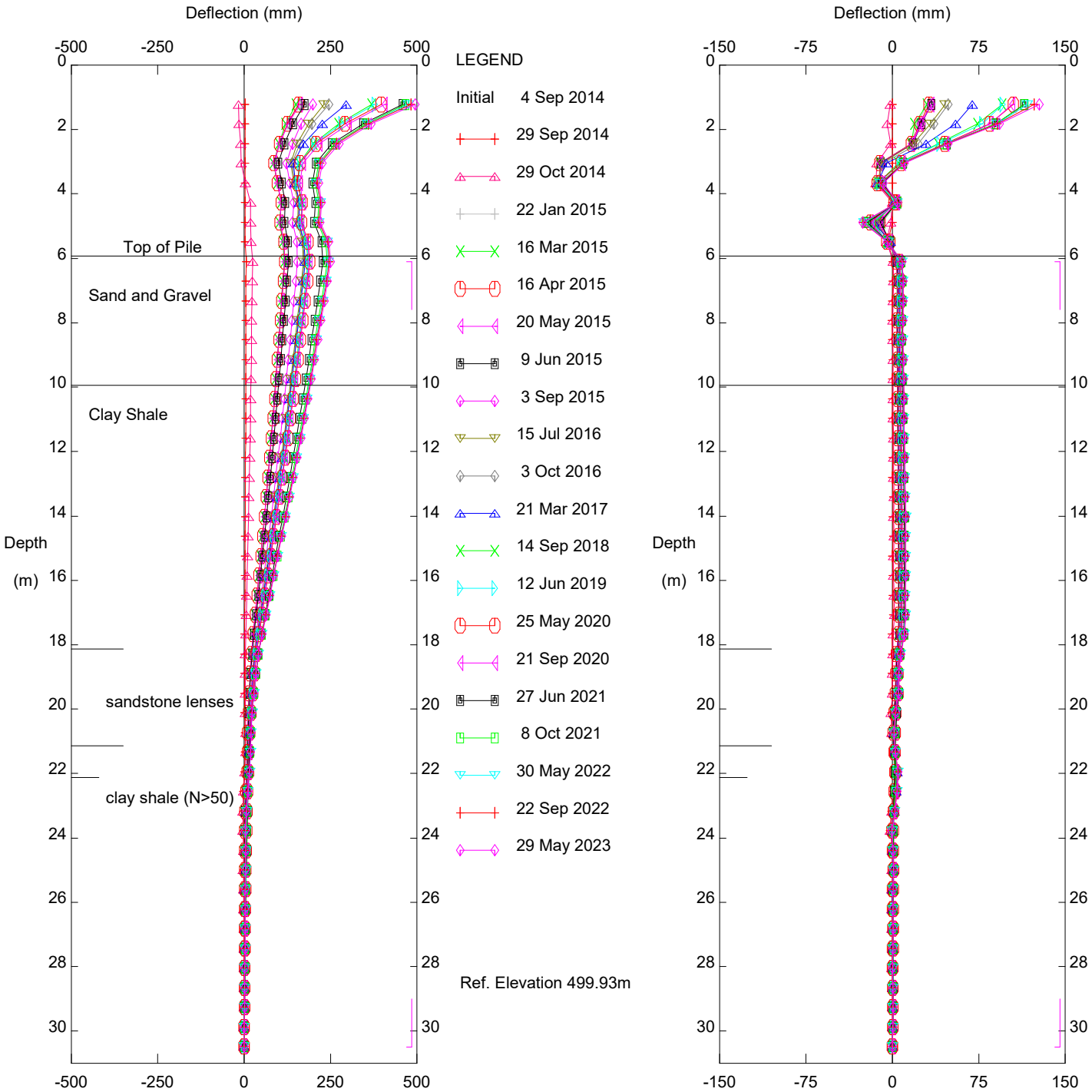
Thurber Engineering Ltd.



NC099 Cut Slope - Bench 1, Inclinometer 15-10

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 North Slope Stability Pile Wall, Inclinometer 14-01

Alberta Transportation

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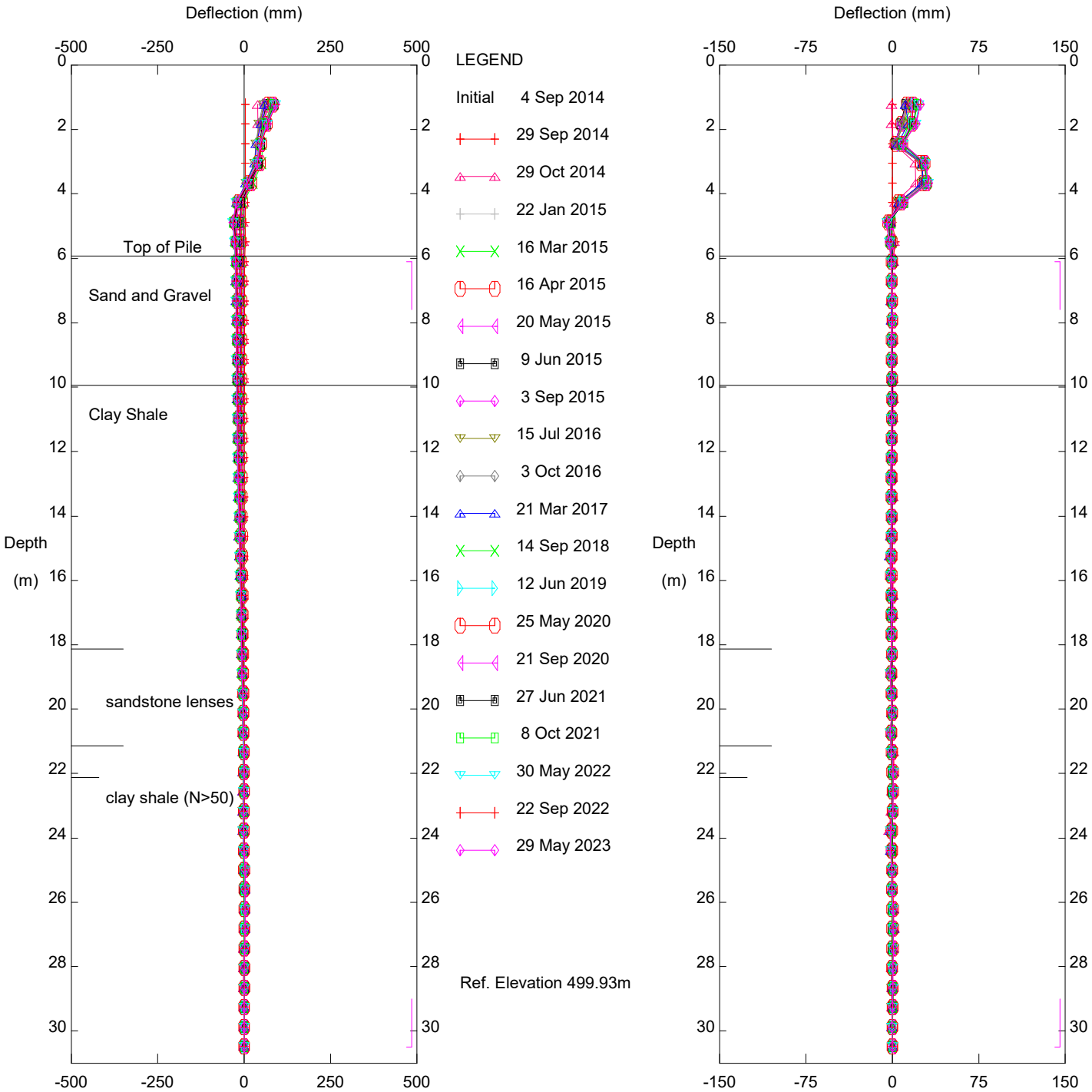
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 North Slope Stability Pile Wall, Inclinometer 14-01

Alberta Transportation

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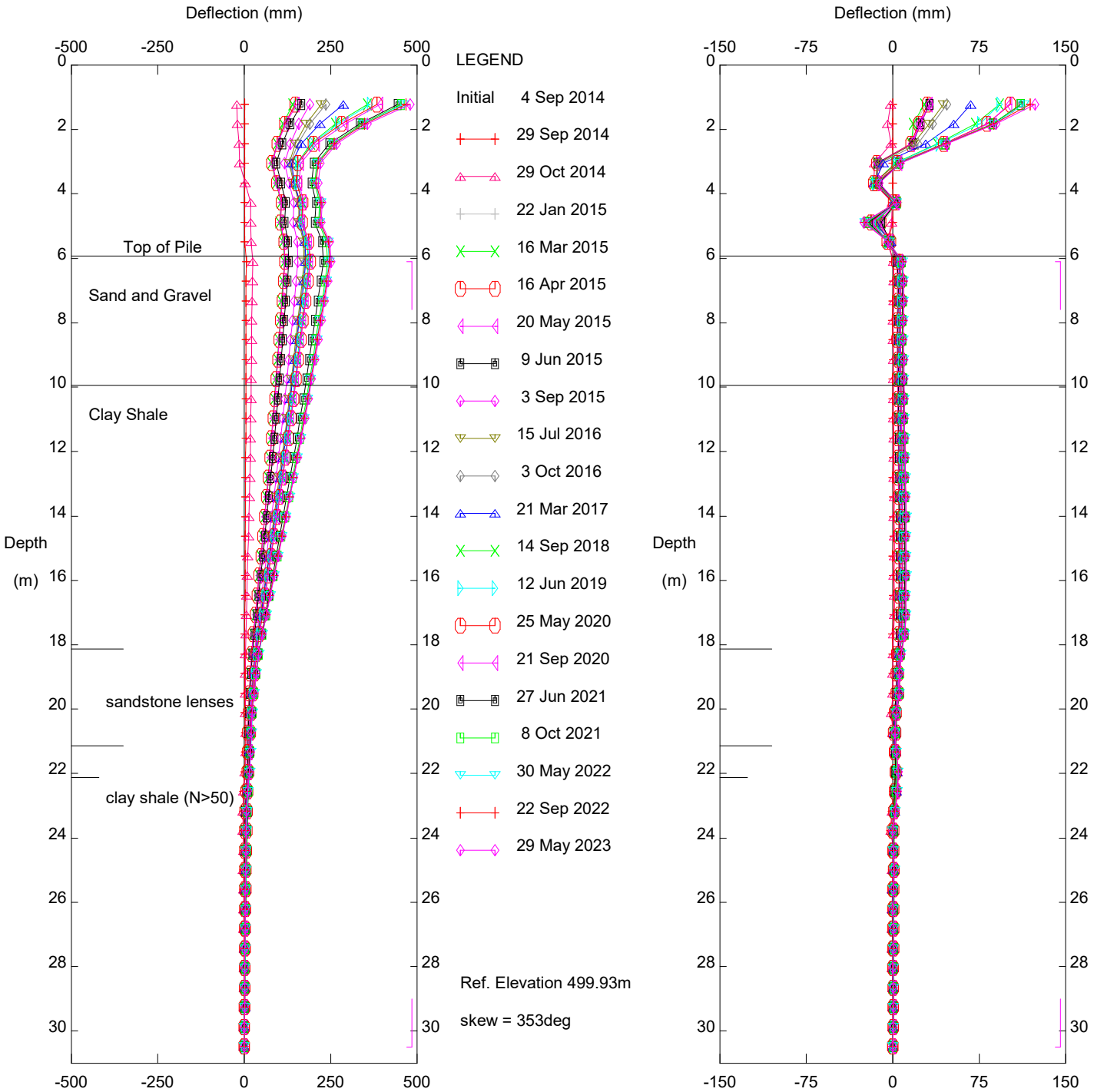

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

NC099 North Slope Stability Pile Wall, Inclinometer 14-01

Alberta Transportation

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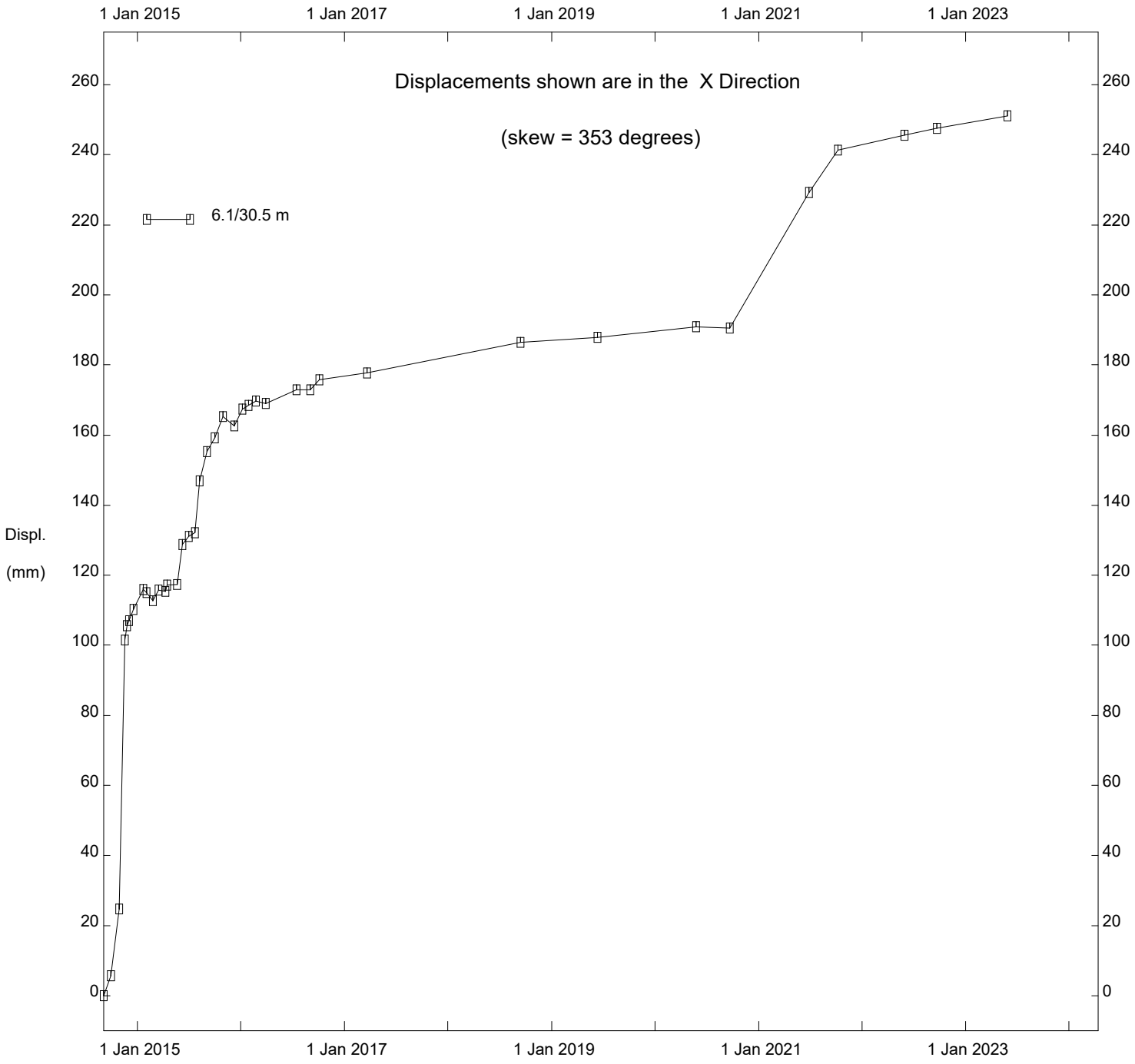
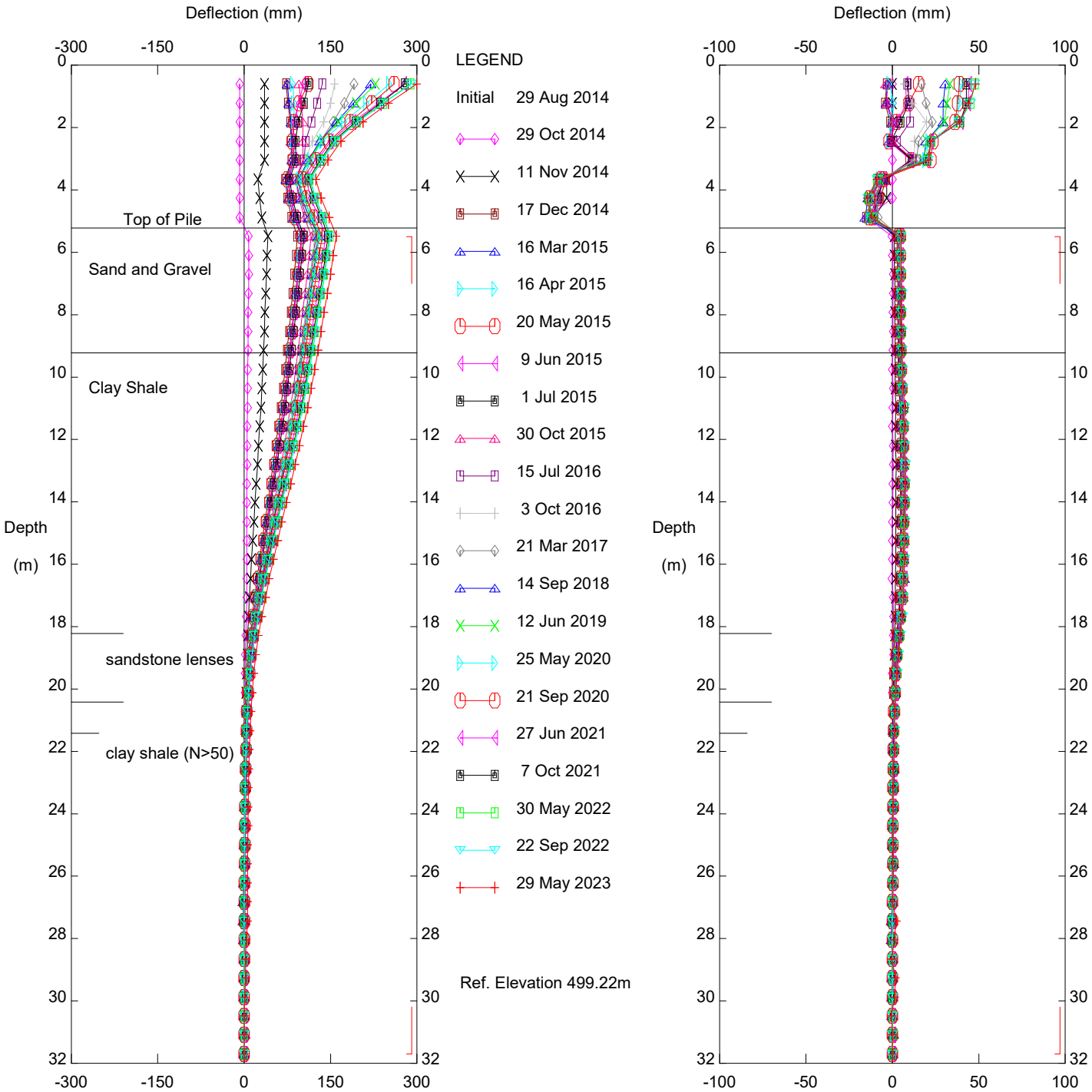


NC099 North Slope Stability Pile Wall, Inclinometer 14-01

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

NC099 South Slope Stability Pile Wall, Inclinometer 14-02

Alberta Transportation

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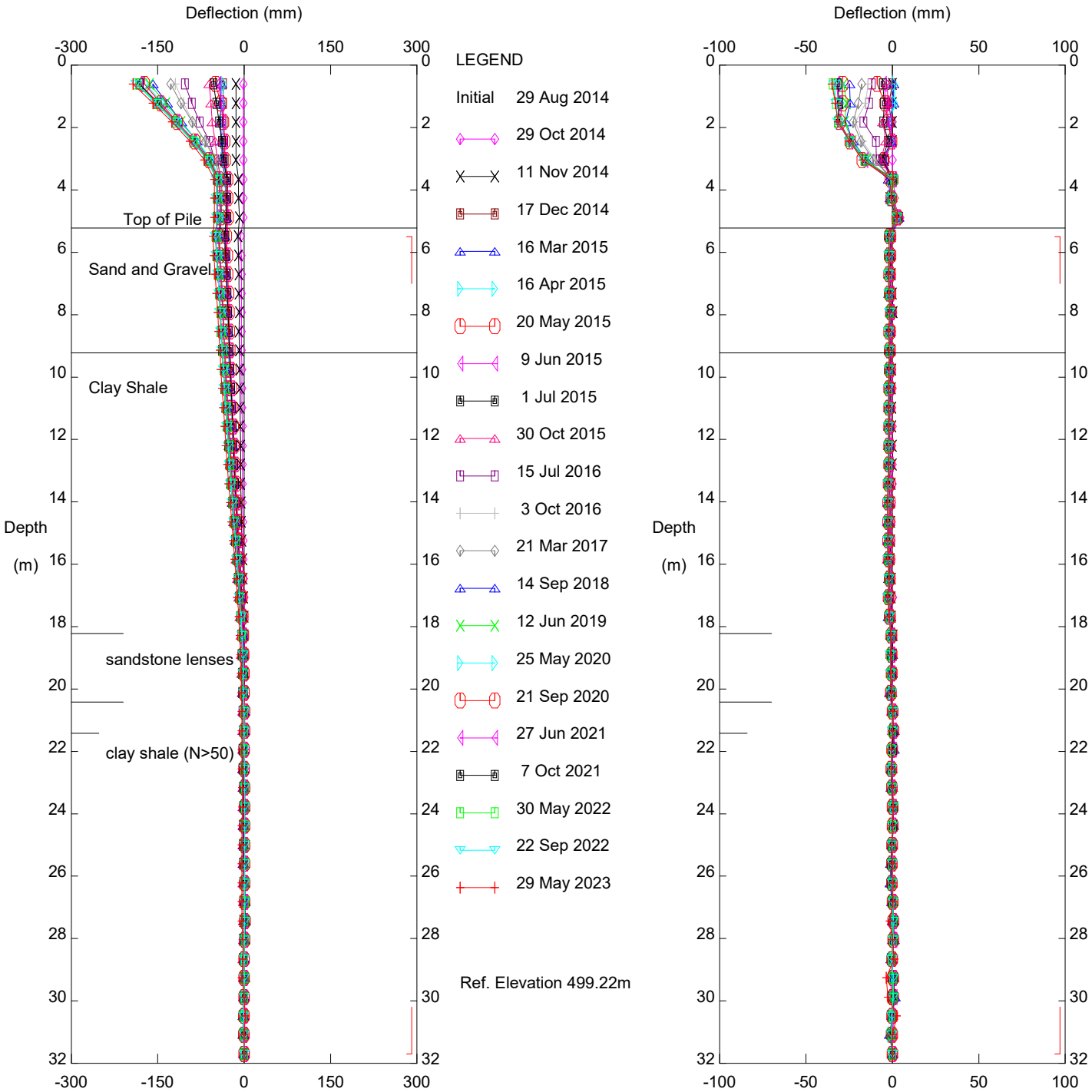

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

NC099 South Slope Stability Pile Wall, Inclinometer 14-02

Alberta Transportation

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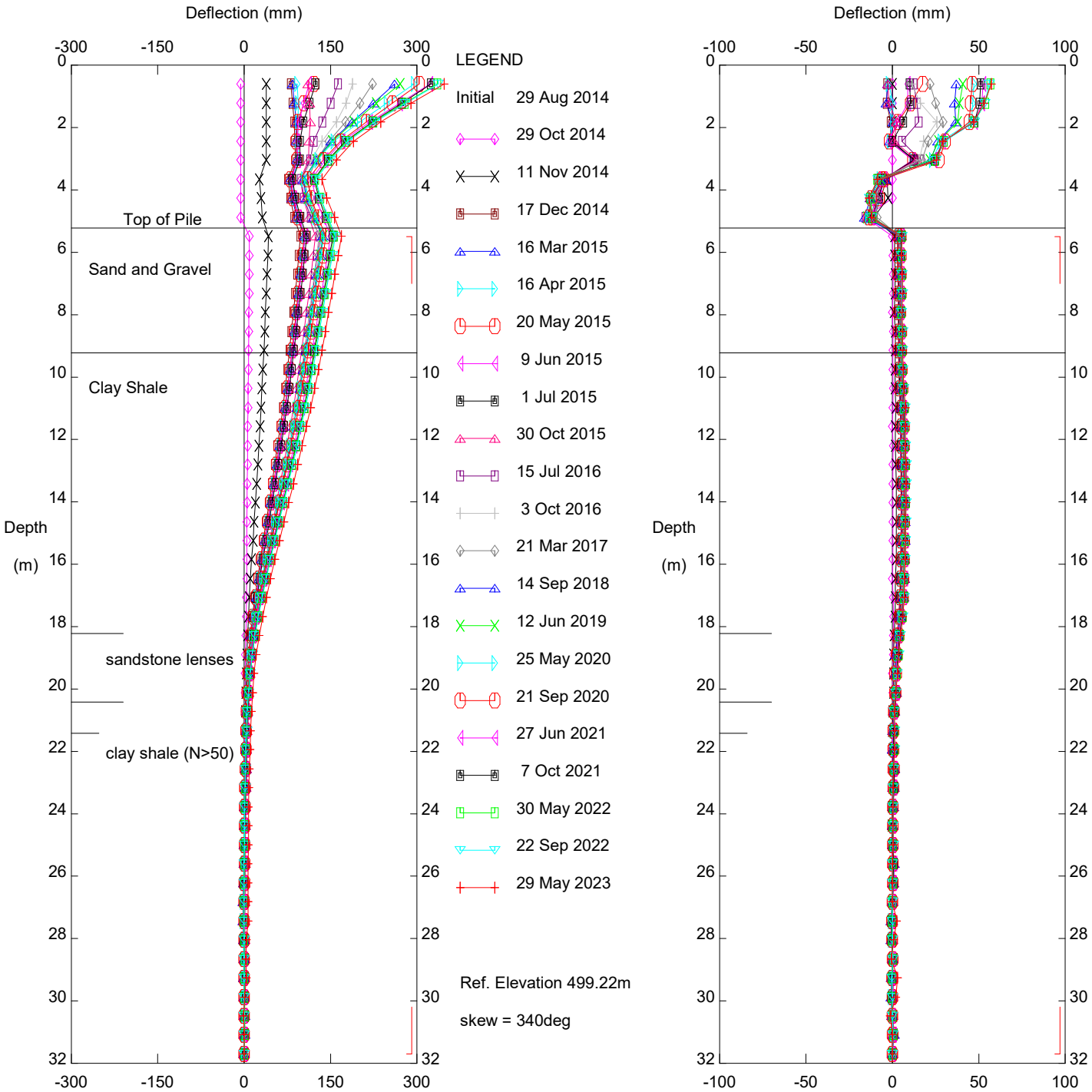

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

NC099 South Slope Stability Pile Wall, Inclinometer 14-02

Alberta Transportation

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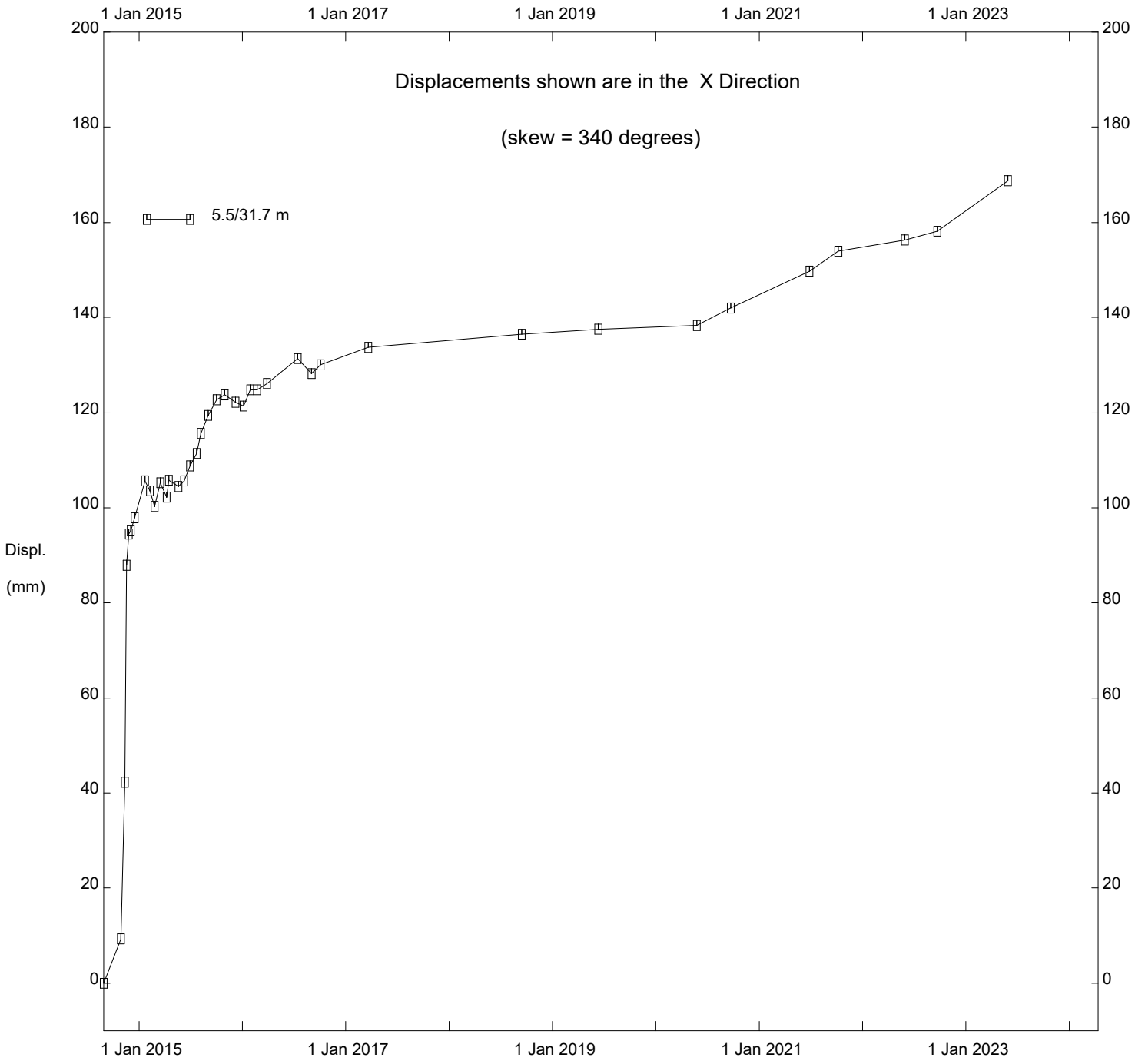
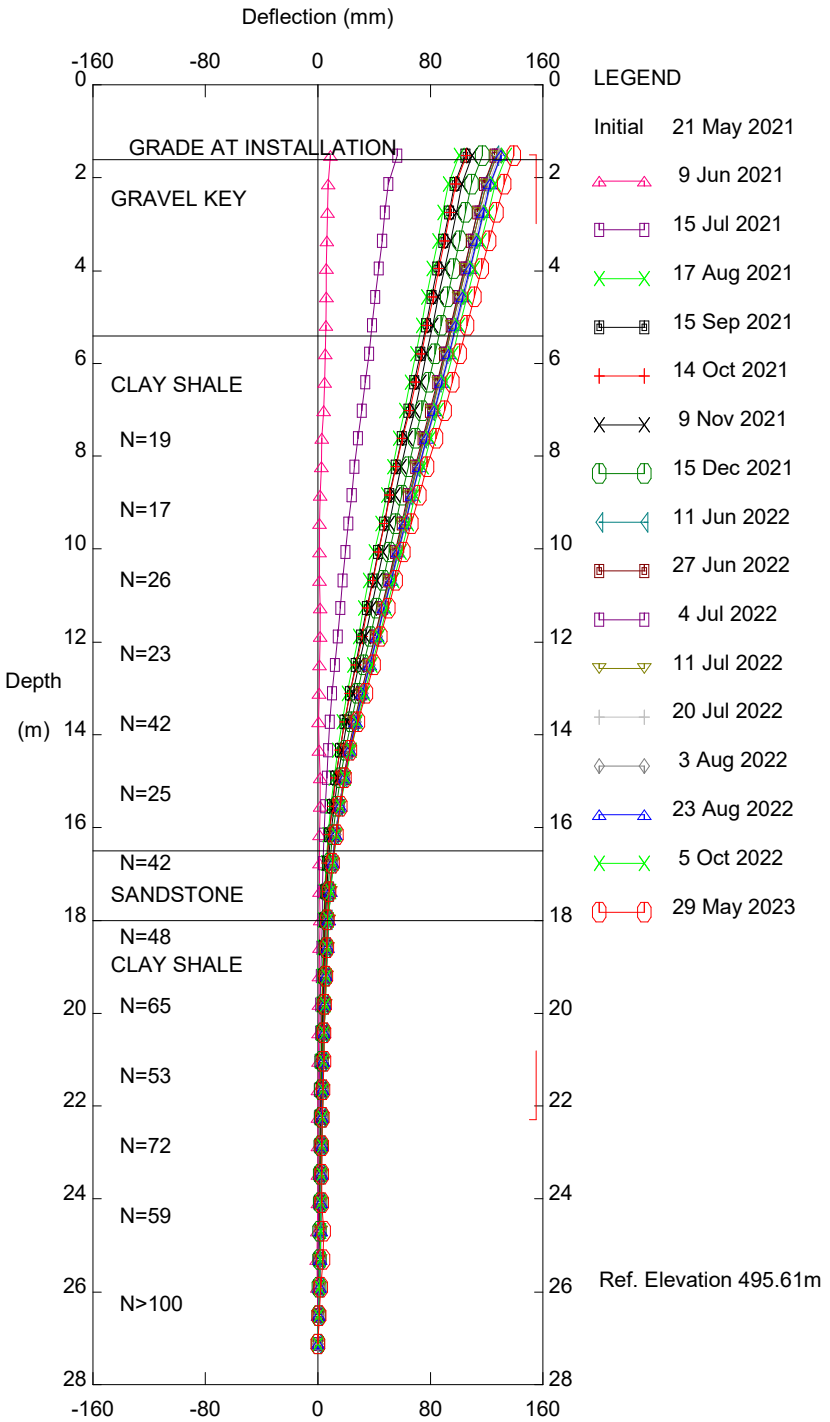


NC099 South Slope Stability Pile Wall, Inclinometer 14-02

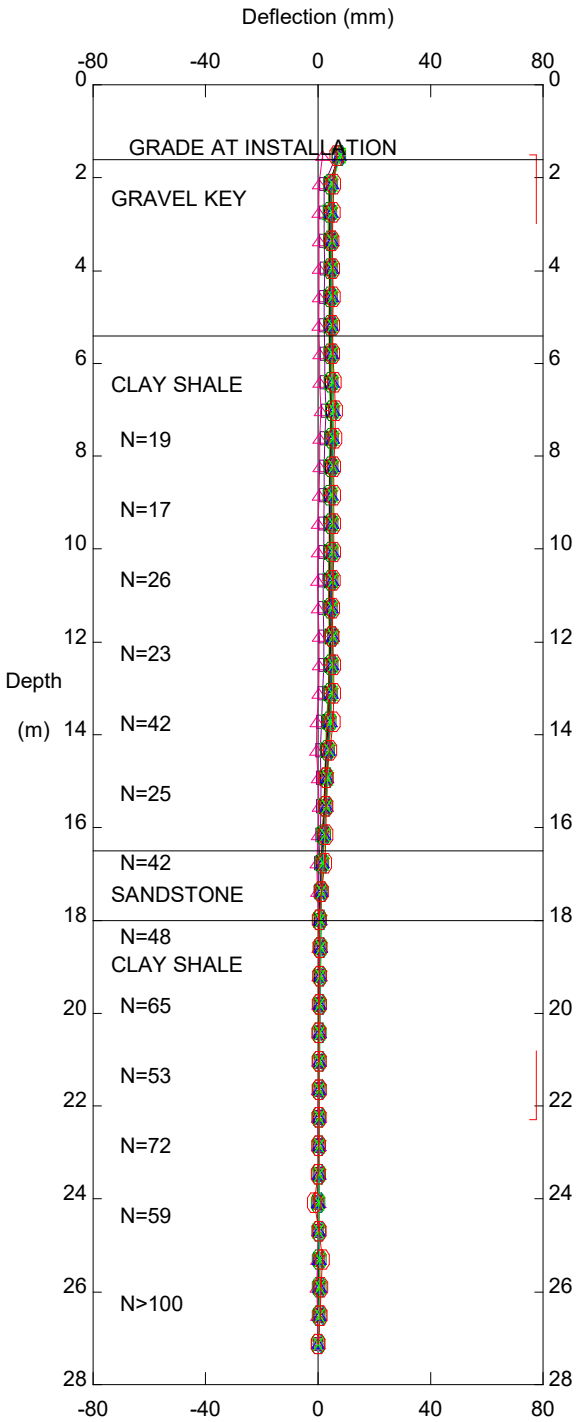
Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

Pile Wall, Inclinometer N-SI-01

STRATIGRAPHY INFERRED FROM N-SI-02

Hangingstone Bridge North Abutment

STRATIGRAPHY INFERRED FROM N-SI-02

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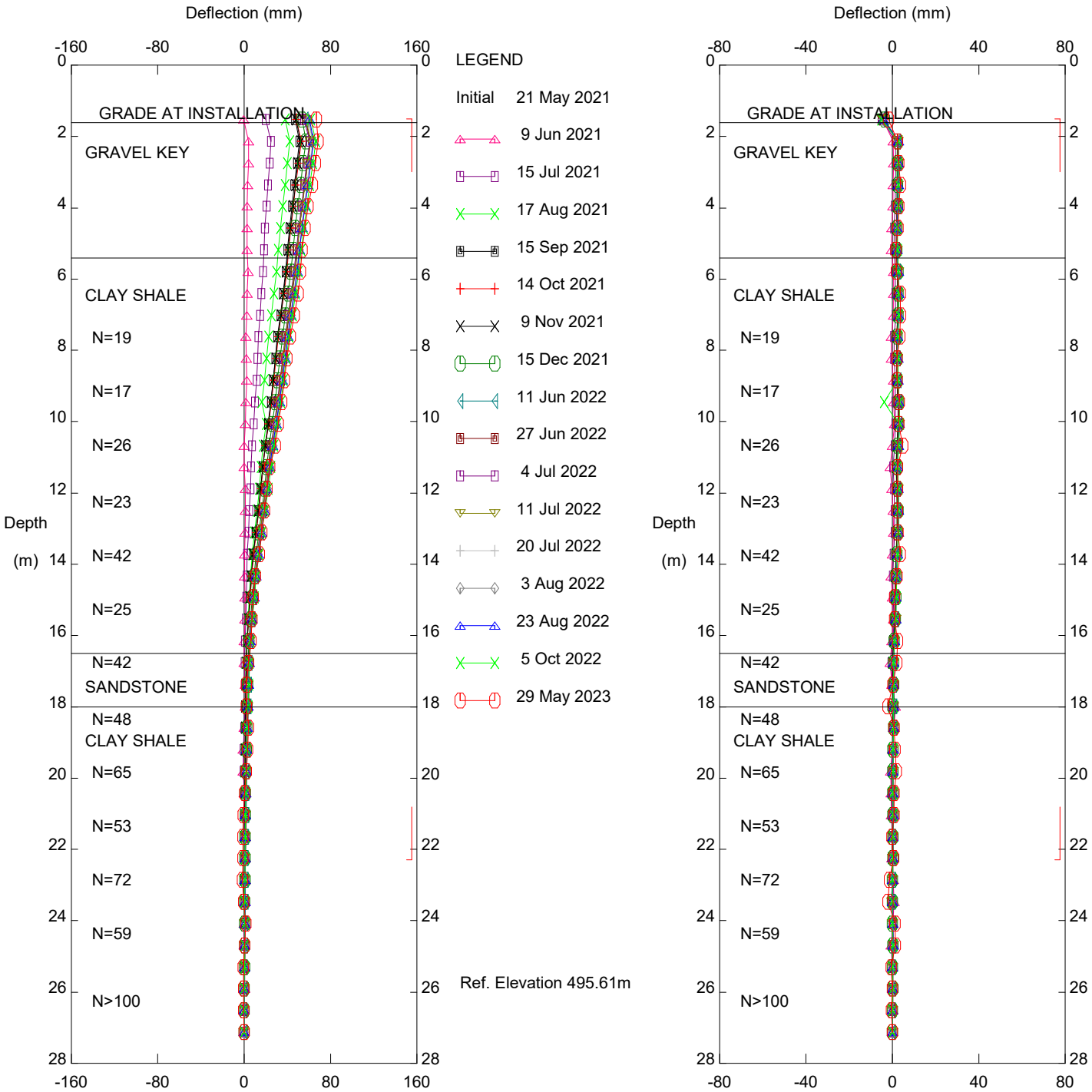
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Pile Wall, Inclinometer N-SI-01

STRATIGRAPHY INFERRED FROM N-SI-02

Hangingstone Bridge North Abutment

STRATIGRAPHY INFERRED FROM N-SI-02

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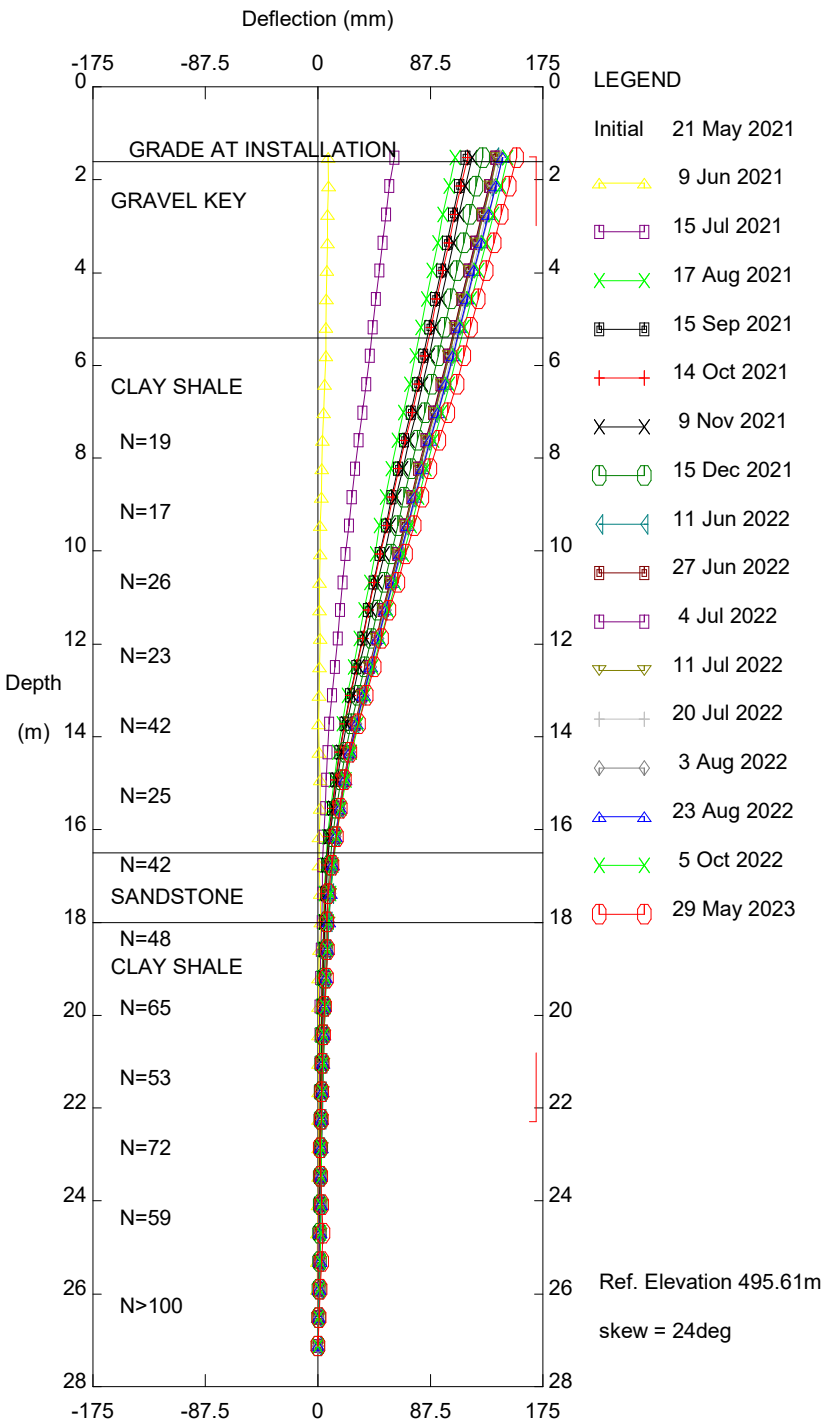
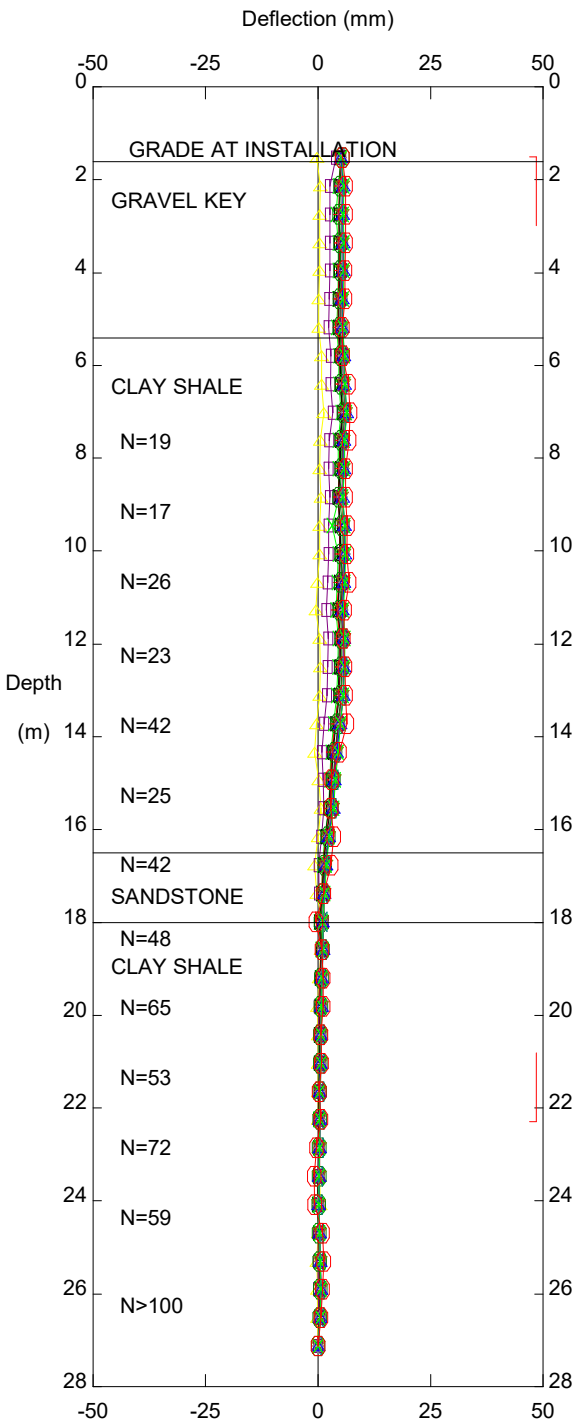


Cumulative Deflection

Direction X



Incremental Deflection

Direction X

Pile Wall, Inclinometer N-SI-01

Hangingstone Bridge North Abutment

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\N-SI-01_bwn.gtl

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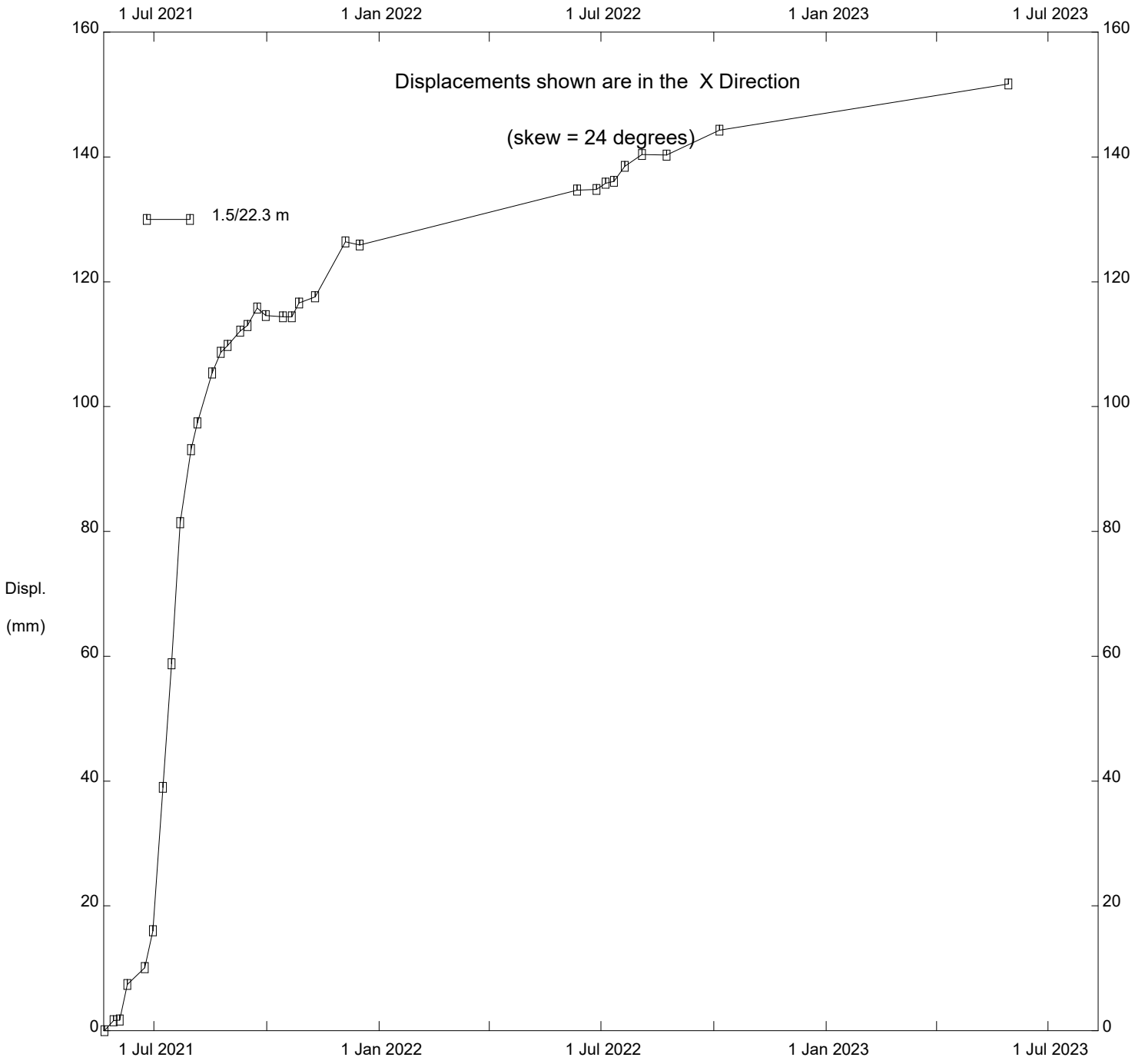
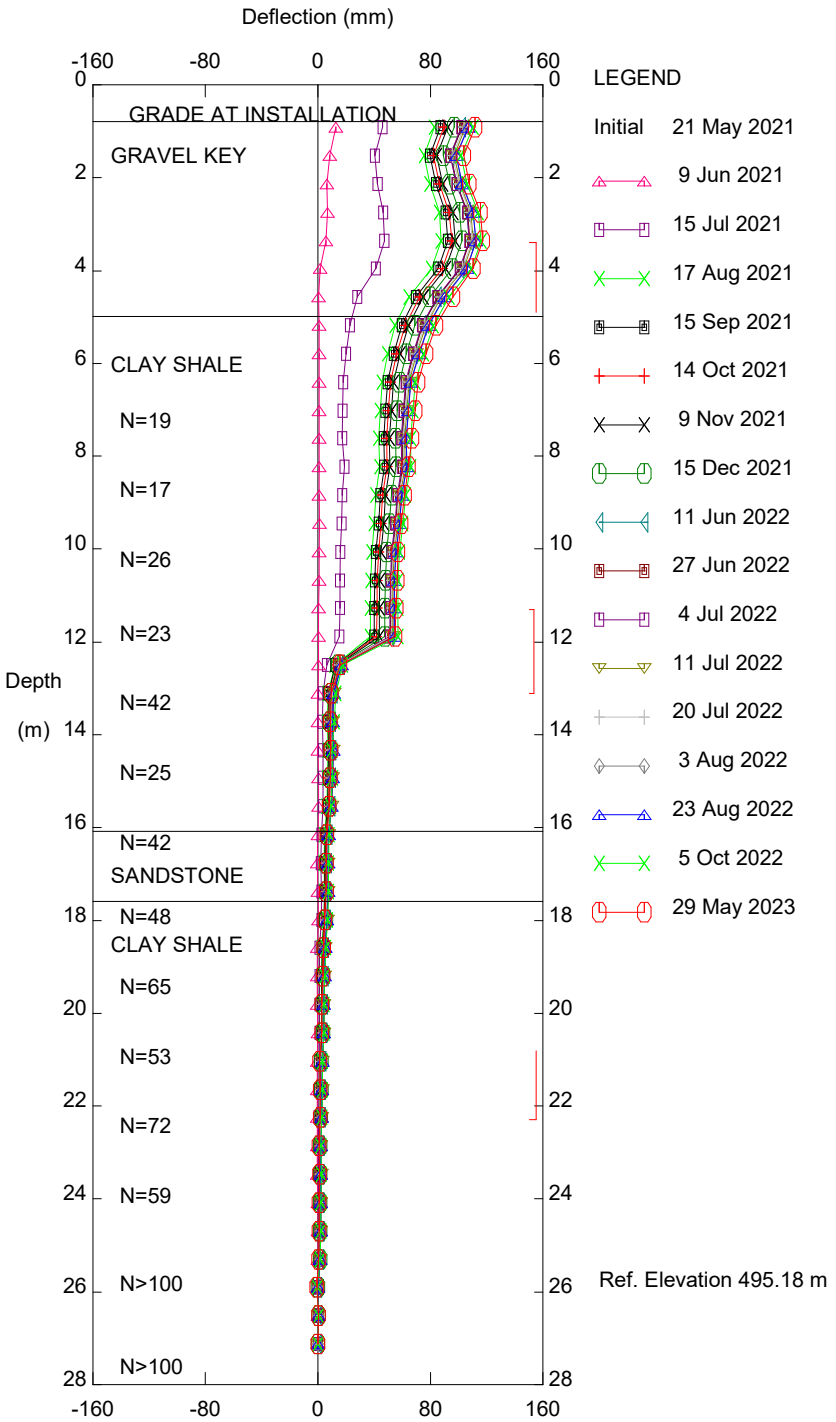


Pile Wall, Inclinometer N-SI-01

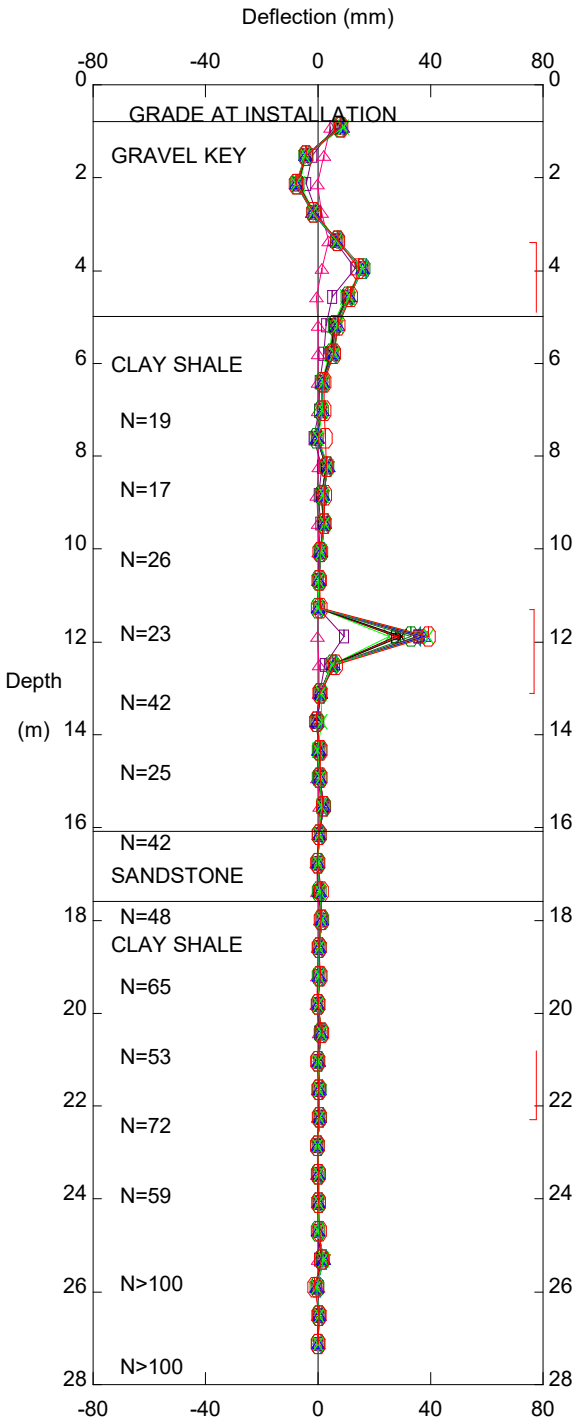
Hangingstone Bridge North Abutment

Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

In Ground, Inclinometer N-SI-02

Hangingstone Bridge North Abutment

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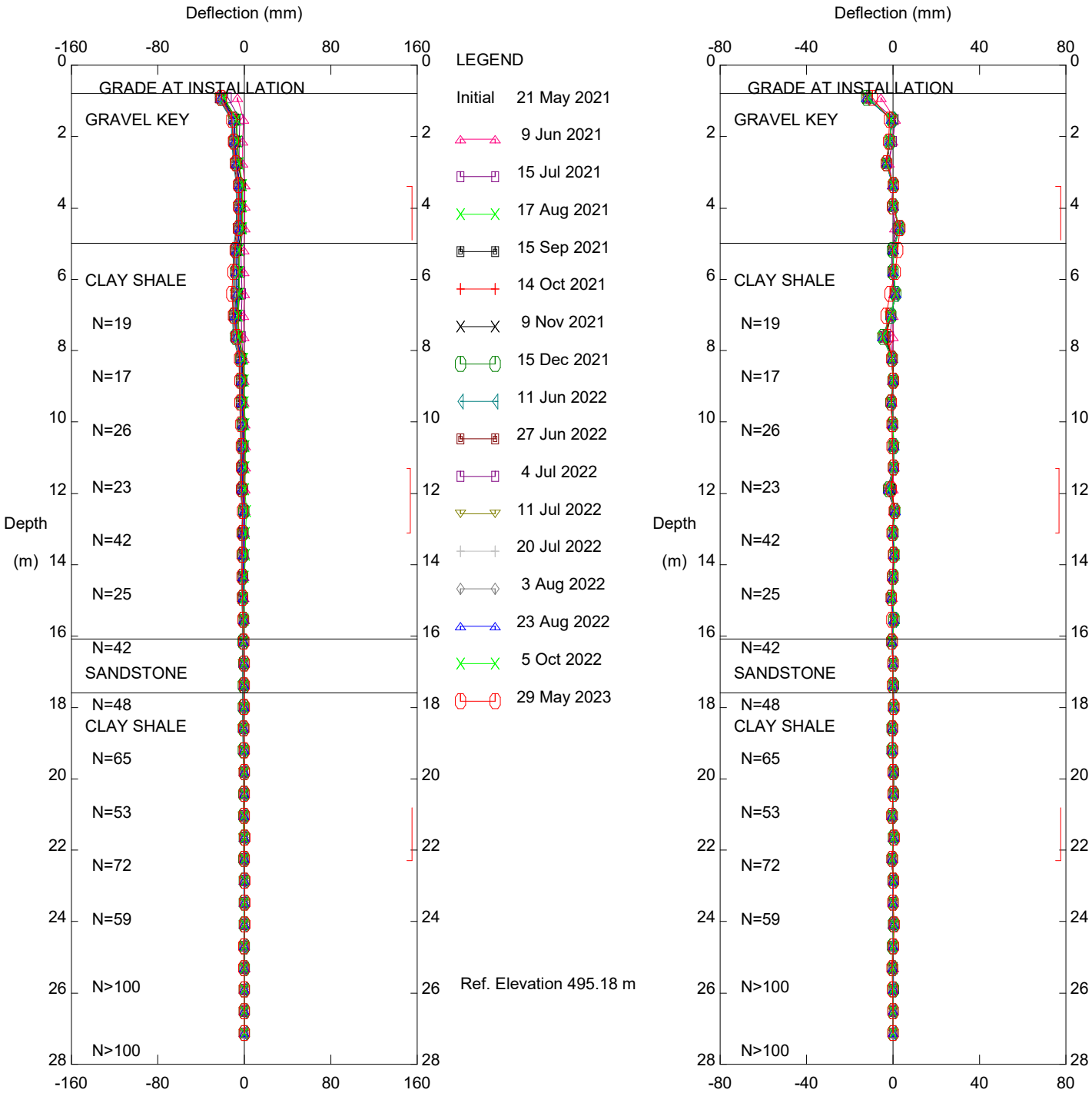

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

In Ground, Inclinometer N-SI-02

Hangingstone Bridge North Abutment

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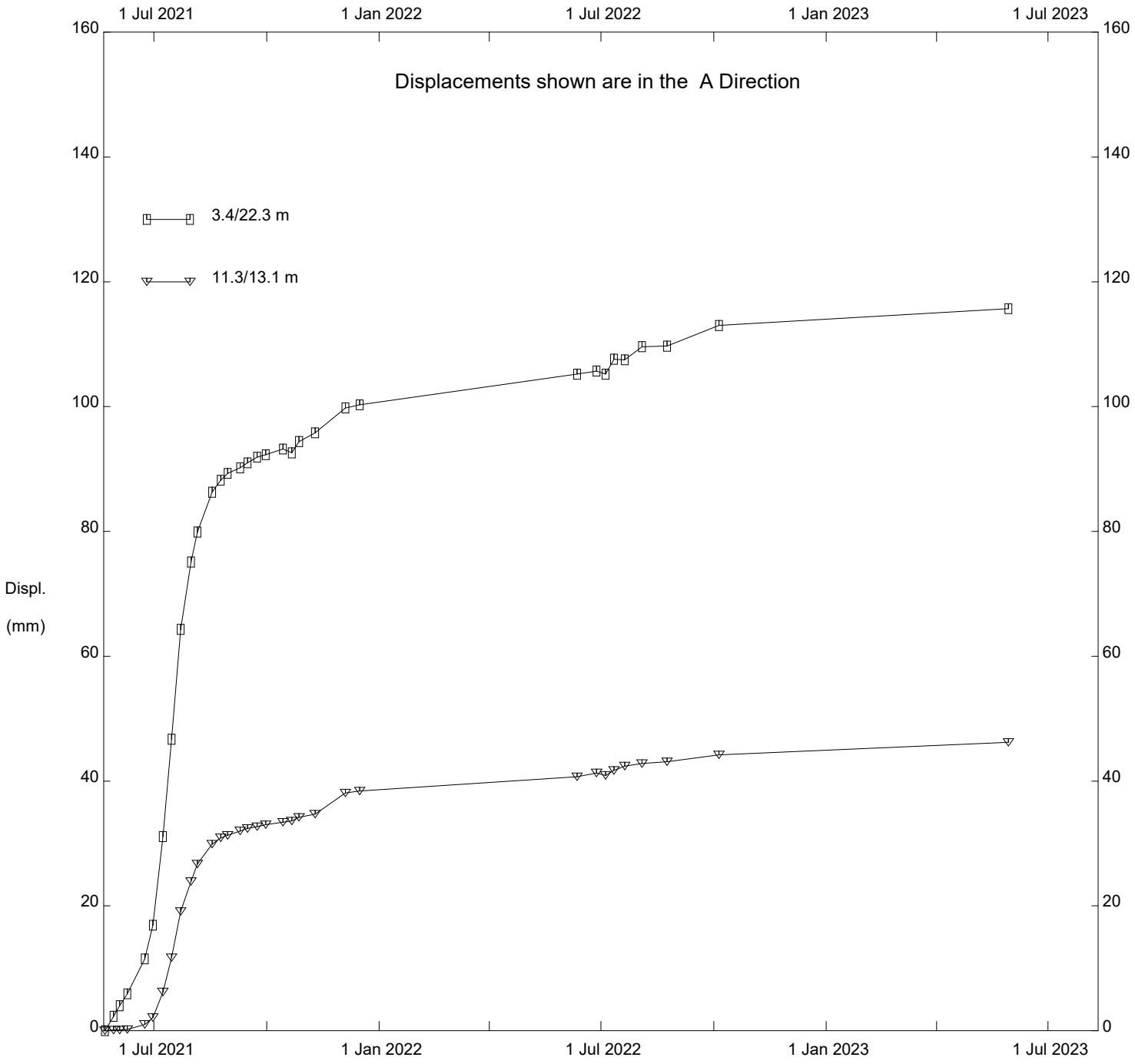
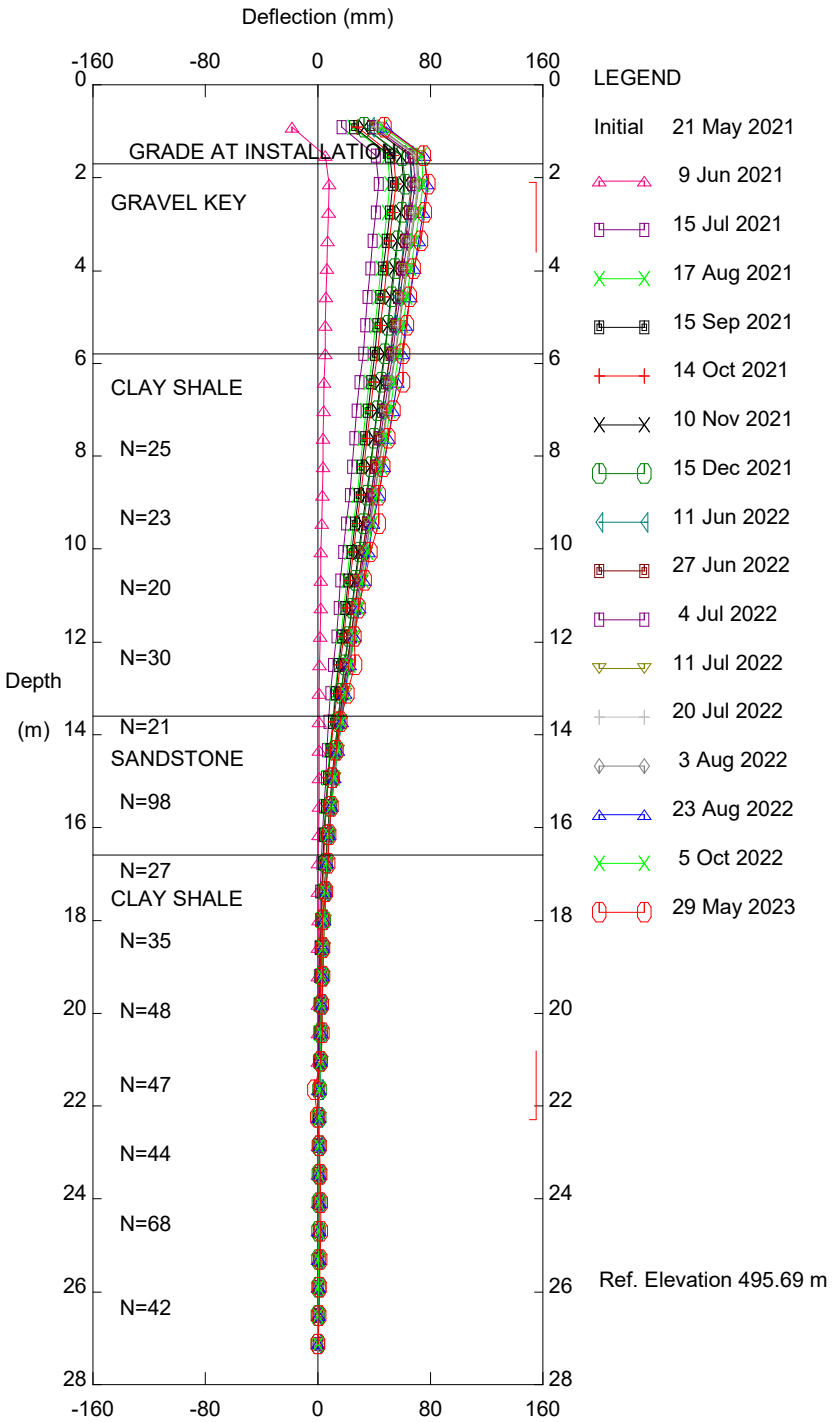
Thurber Engineering Ltd.



In Ground, Inclinometer N-SI-02

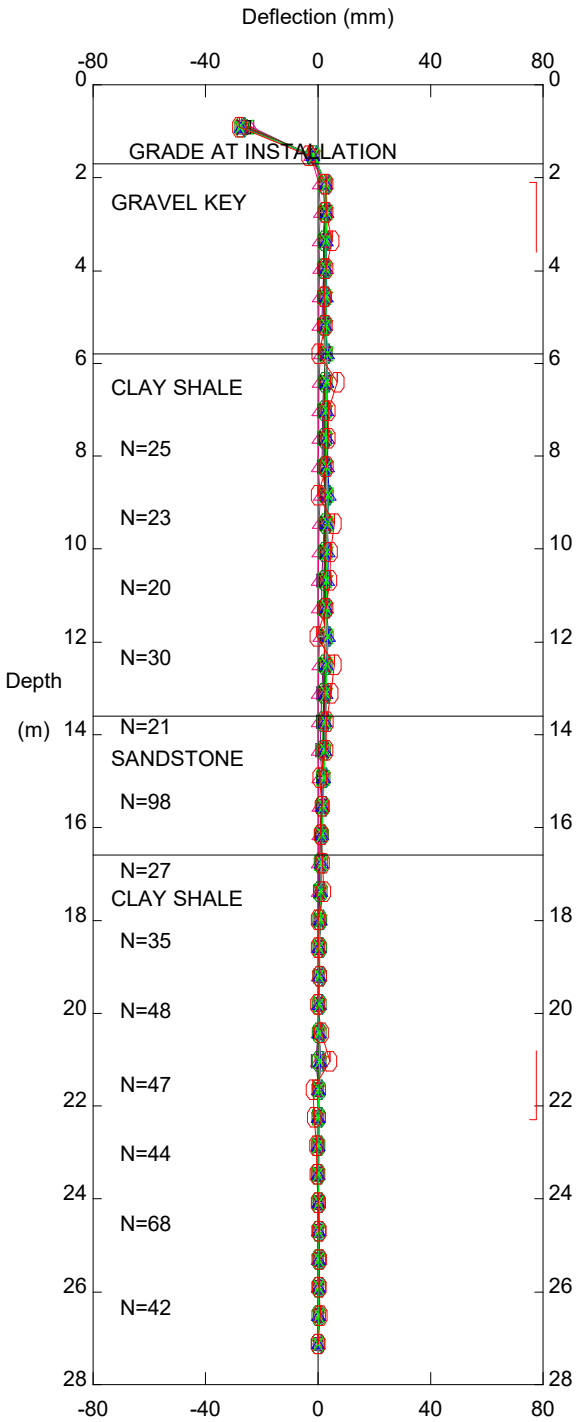
Hangingstone Bridge North Abutment

Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

Pile Wall, Inclinometer S-SI-01

STRATIGRAPHY INFERRED FROM S-SI-02

Hangingstone Bridge South Abutment

STRATIGRAPHY INFERRED FROM S-SI-02

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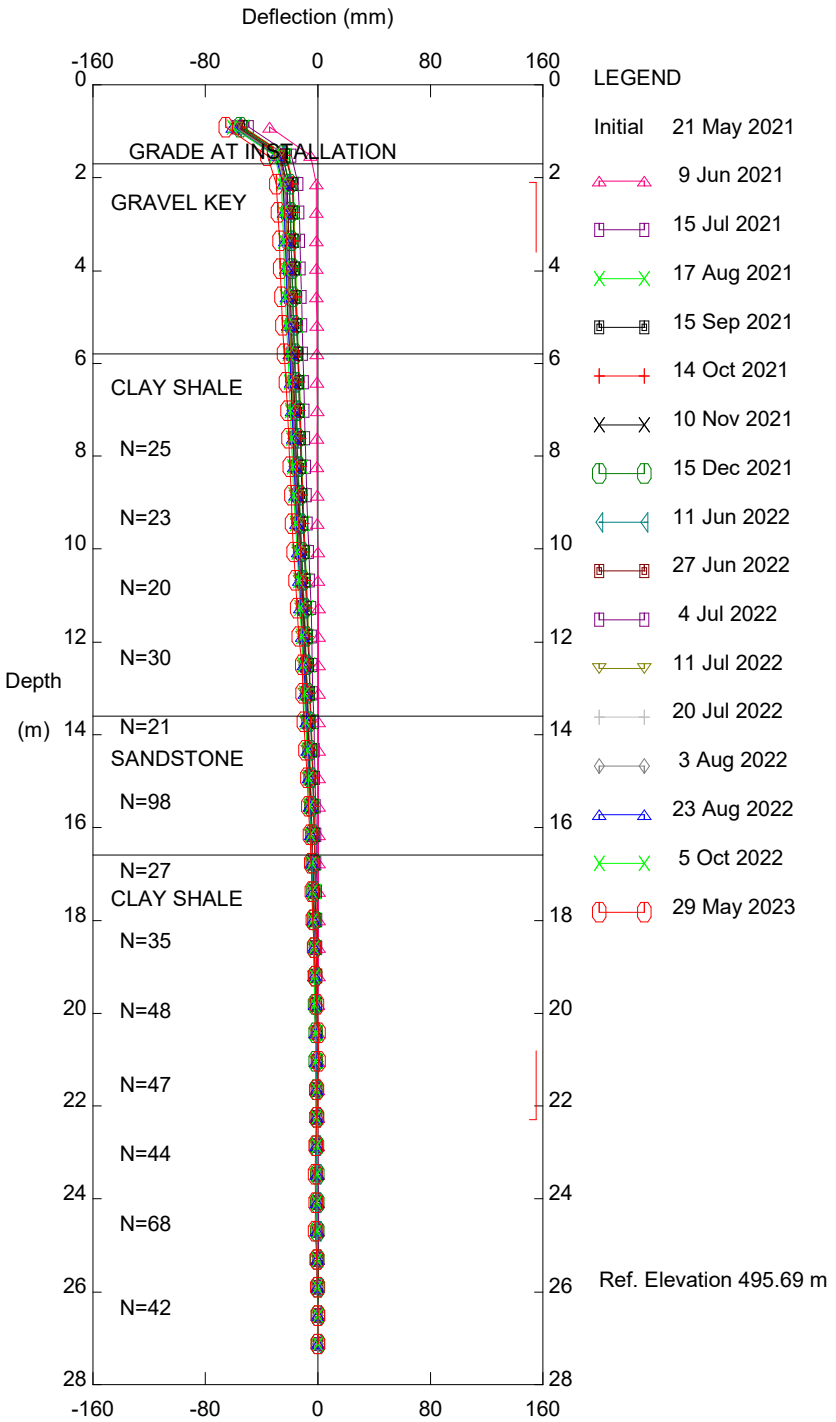
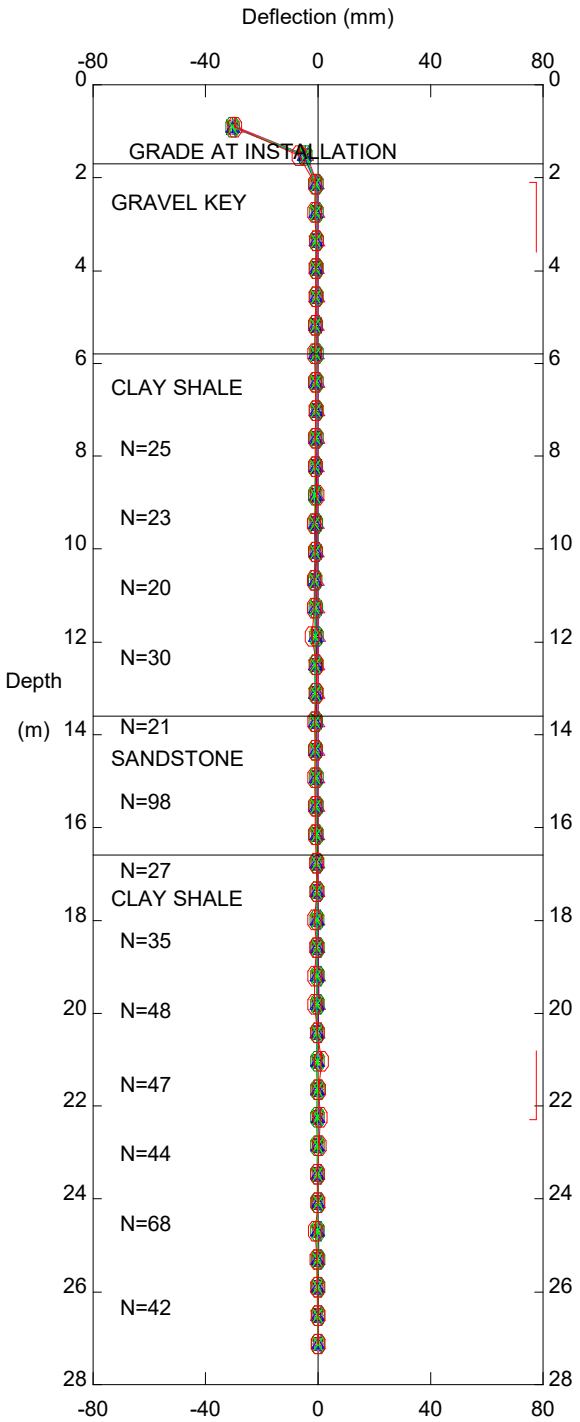
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

Direction B

Pile Wall, Inclinometer S-SI-01

STRATIGRAPHY INFERRED FROM S-SI-02

Hangingstone Bridge South Abutment

STRATIGRAPHY INFERRED FROM S-SI-02

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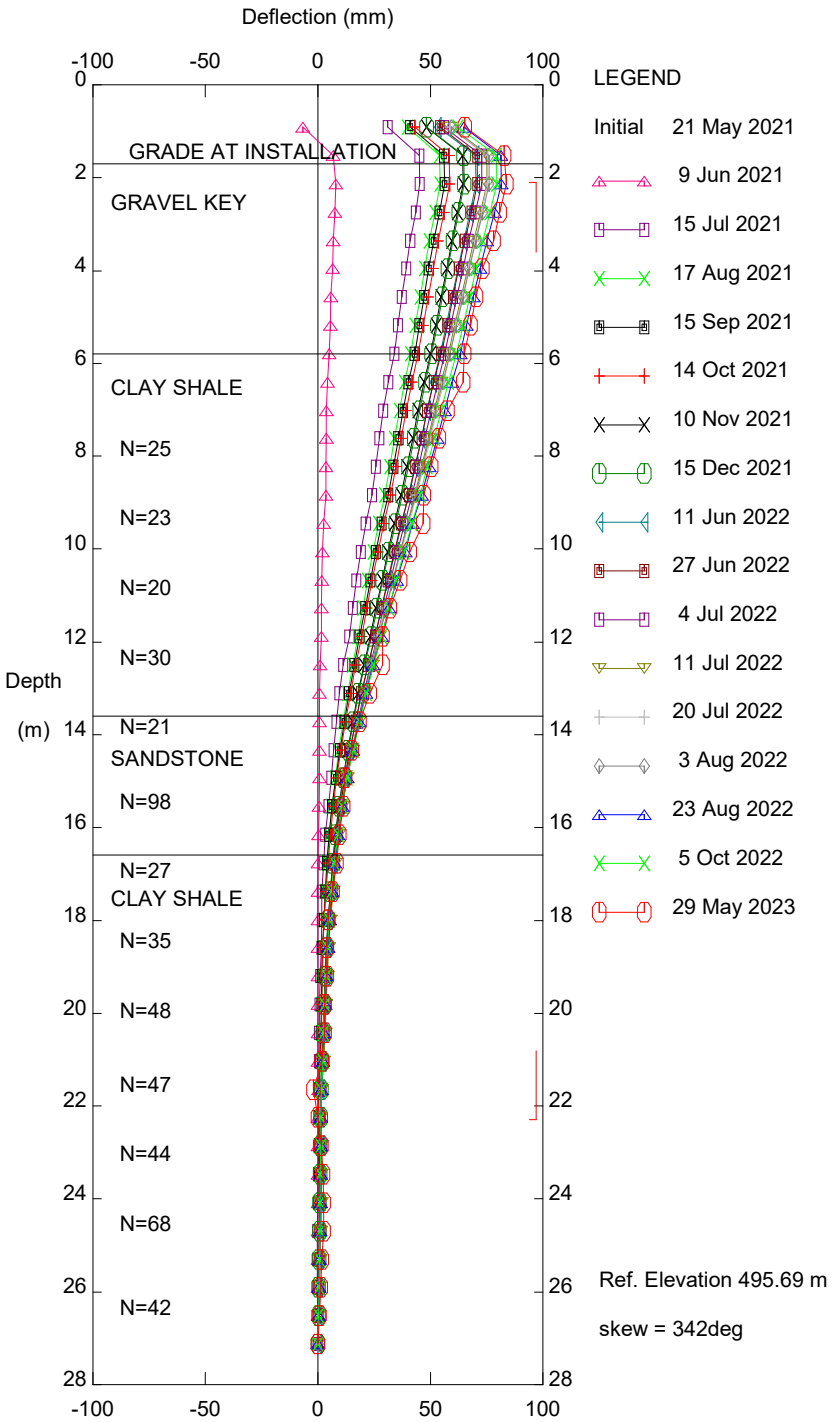
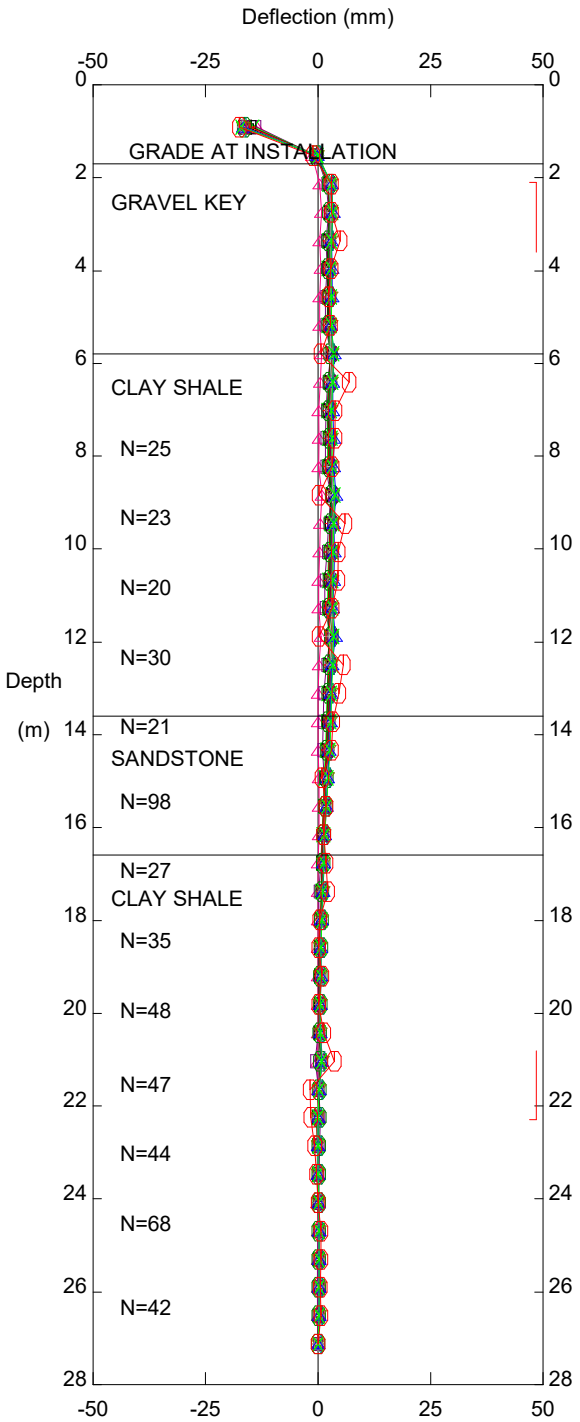
Thurber Engineering Ltd.



Cumulative Deflection

Direction X



Incremental Deflection

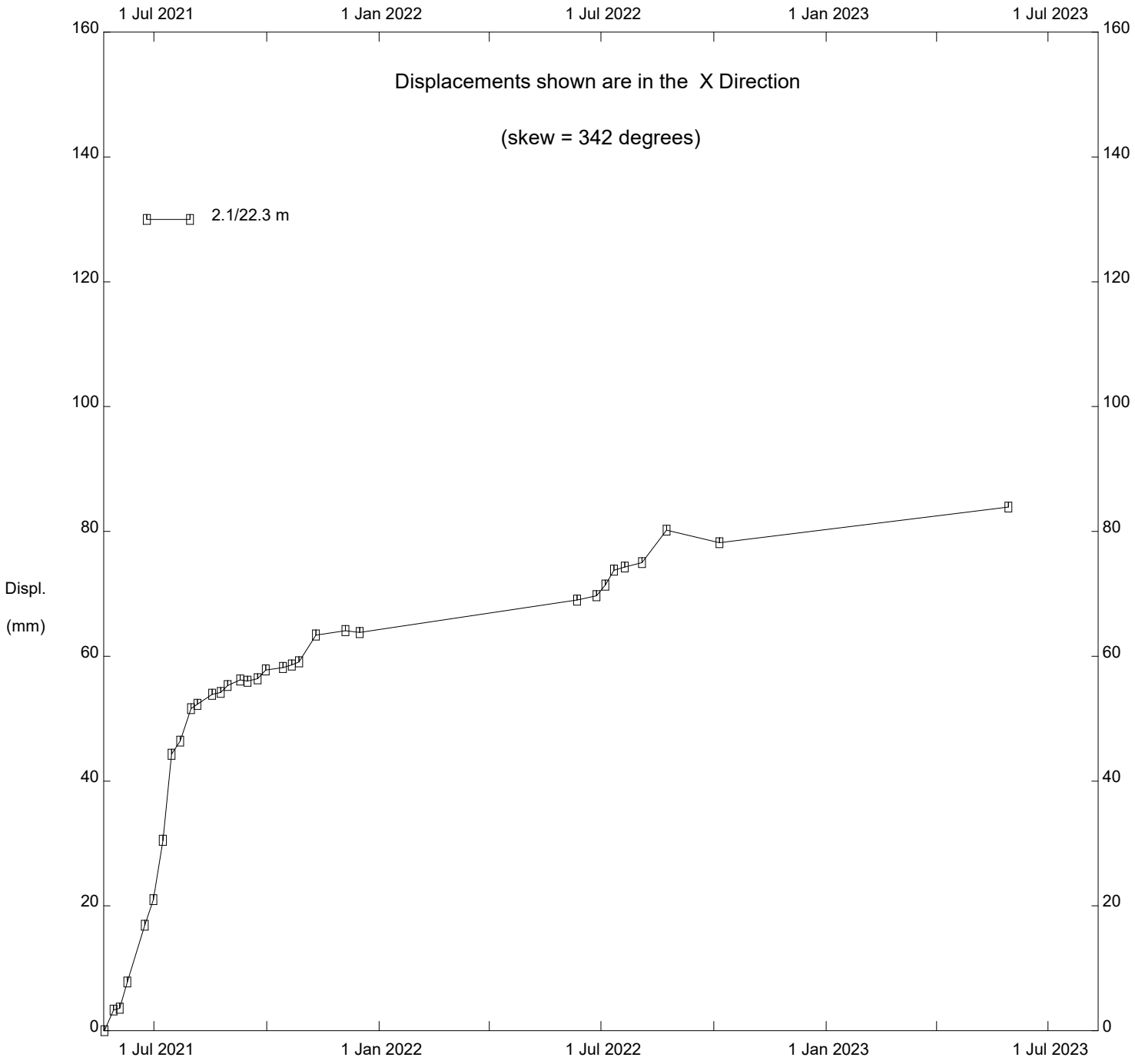
Direction X

Pile Wall, Inclinometer S-SI-01

Hangingstone Bridge South Abutment

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\S-SI-01_bwn.gtl

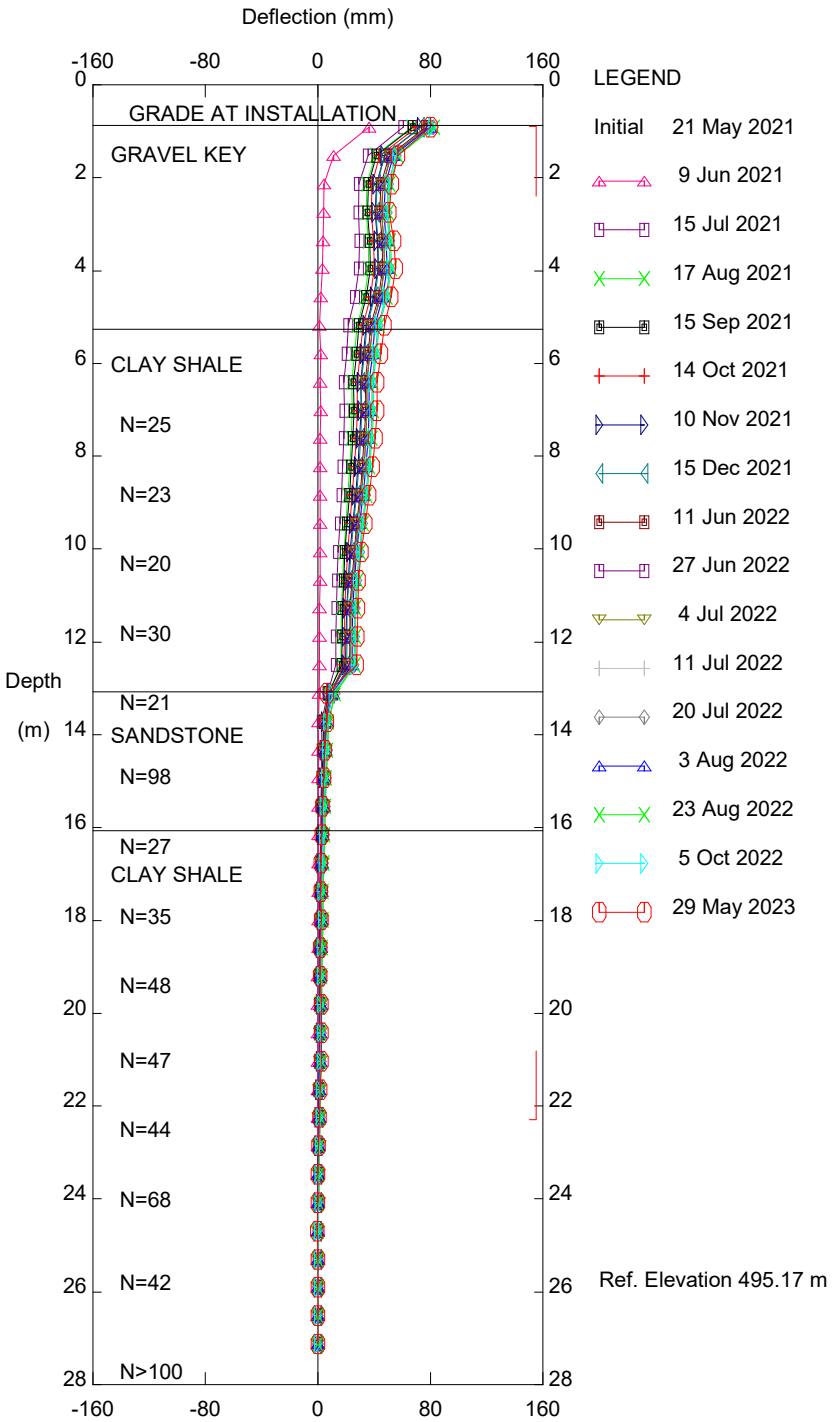
Thurber Engineering Ltd.



Pile Wall, Inclinometer S-SI-01

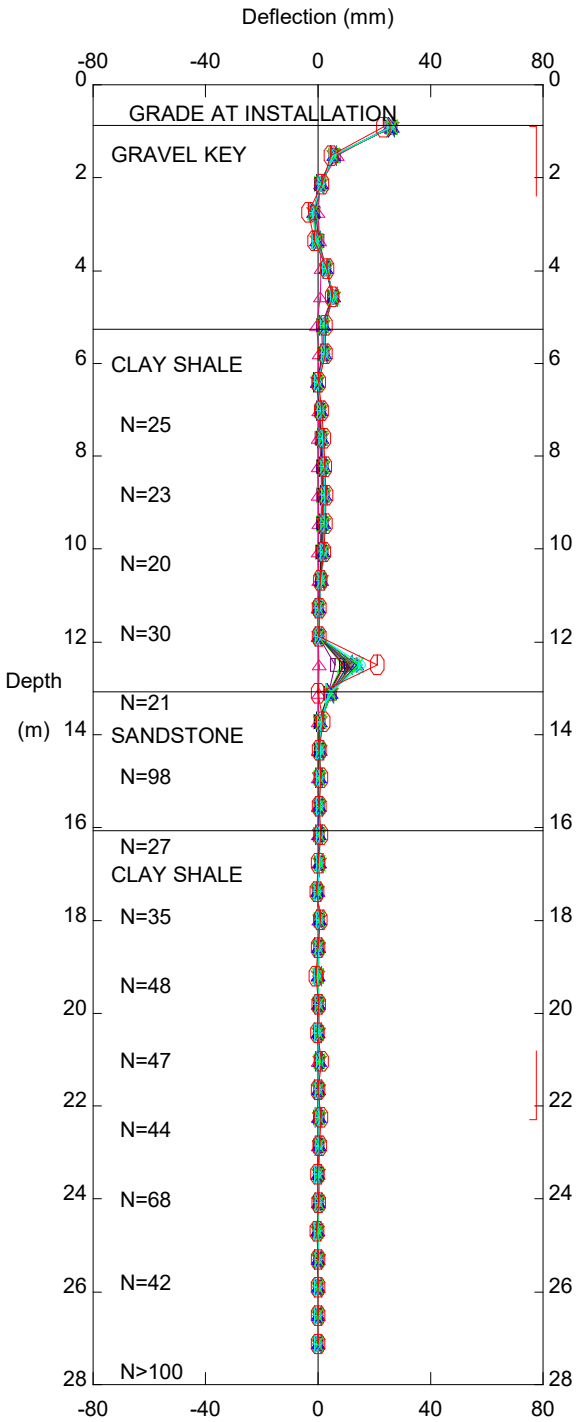
Hangingstone Bridge South Abutment

Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

In Ground, Inclinometer S-SI-02

Hangingstone Bridge South Abutment

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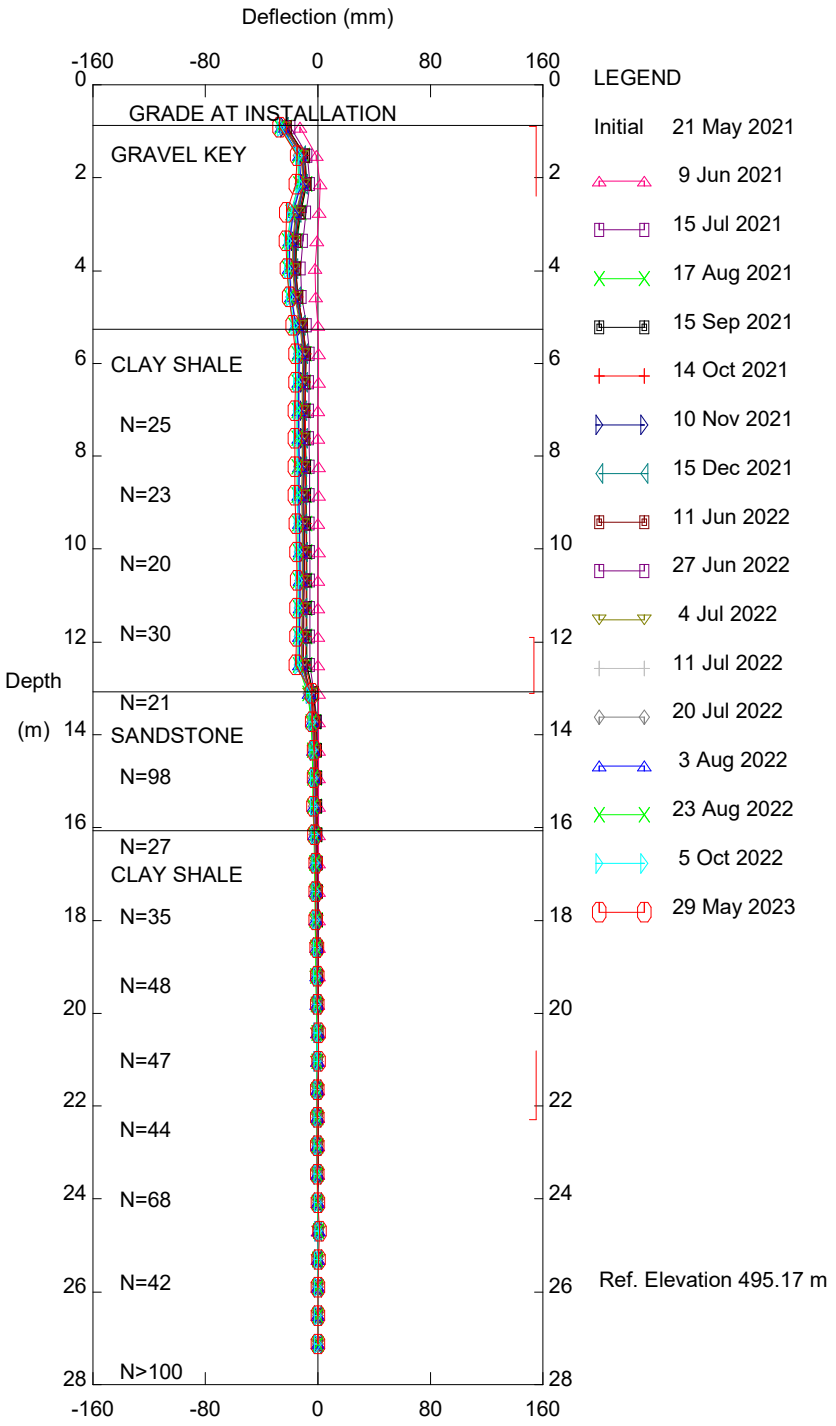
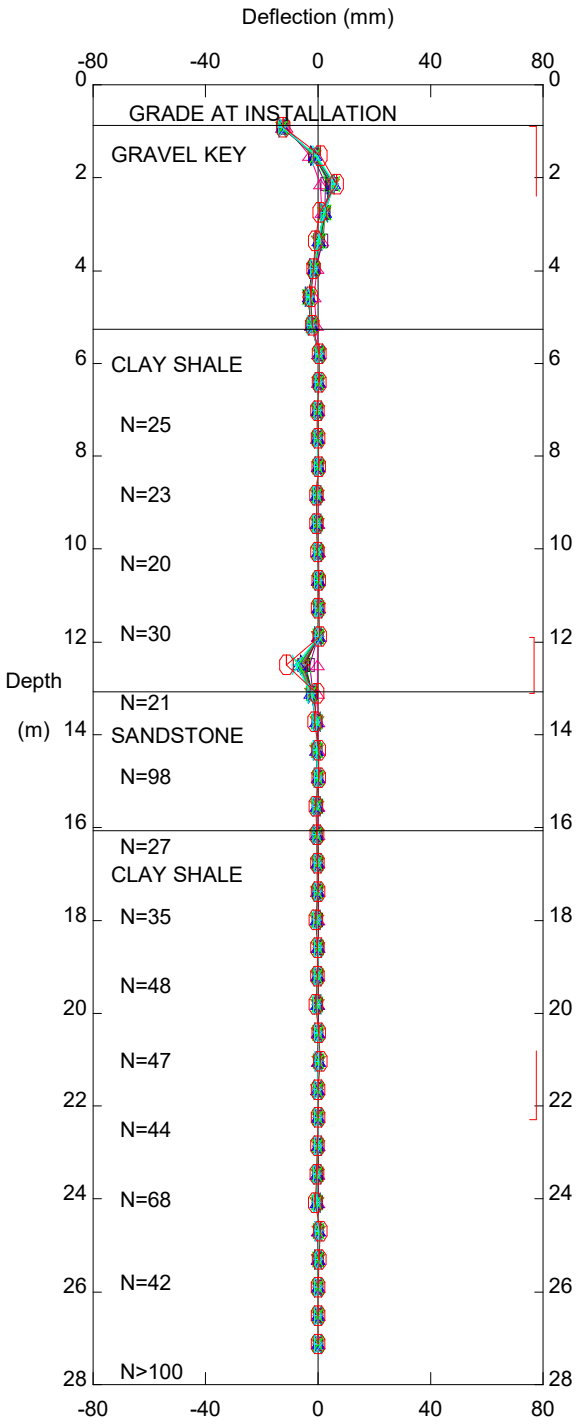
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

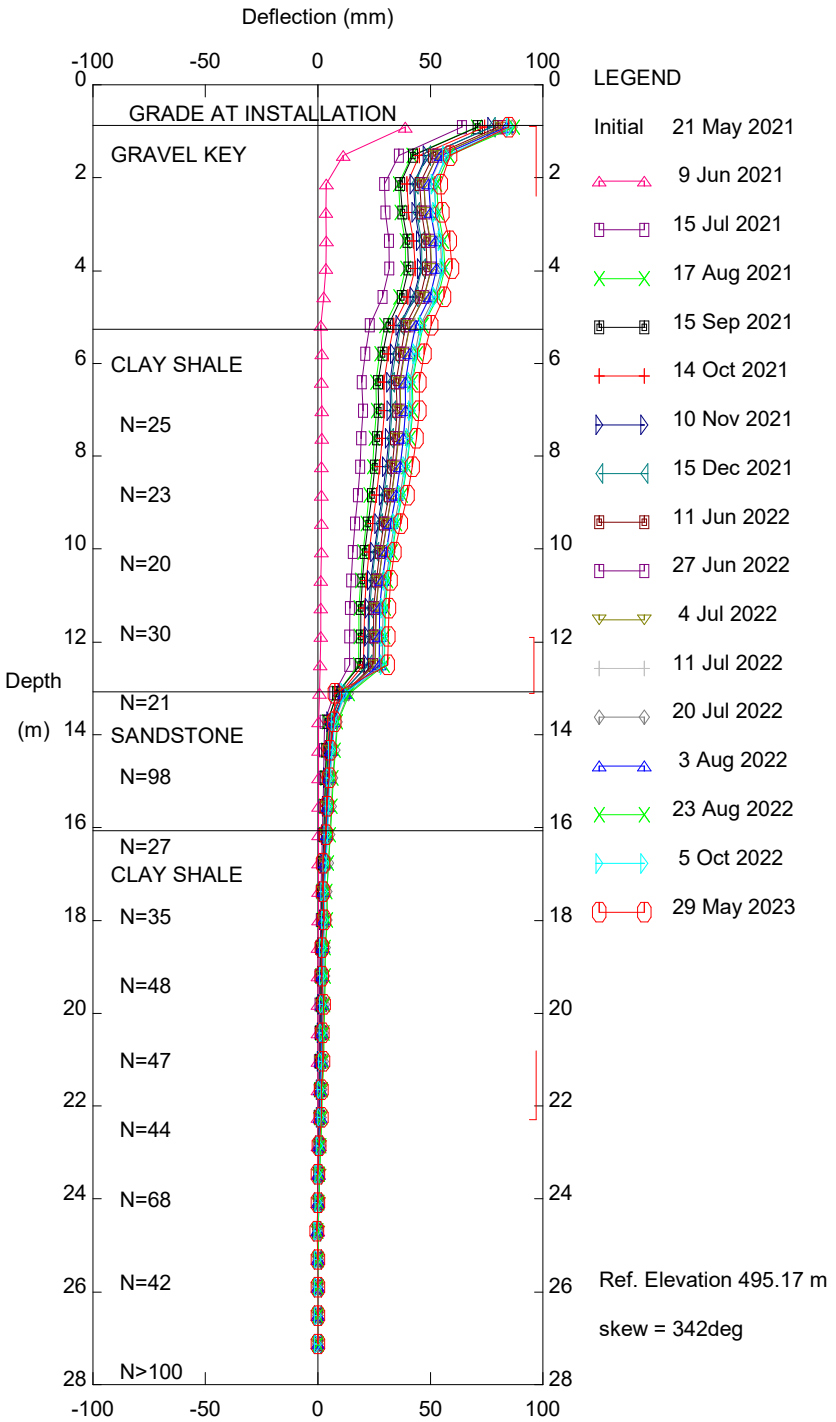
Direction B

In Ground, Inclinometer S-SI-02

Hangingstone Bridge South Abutment

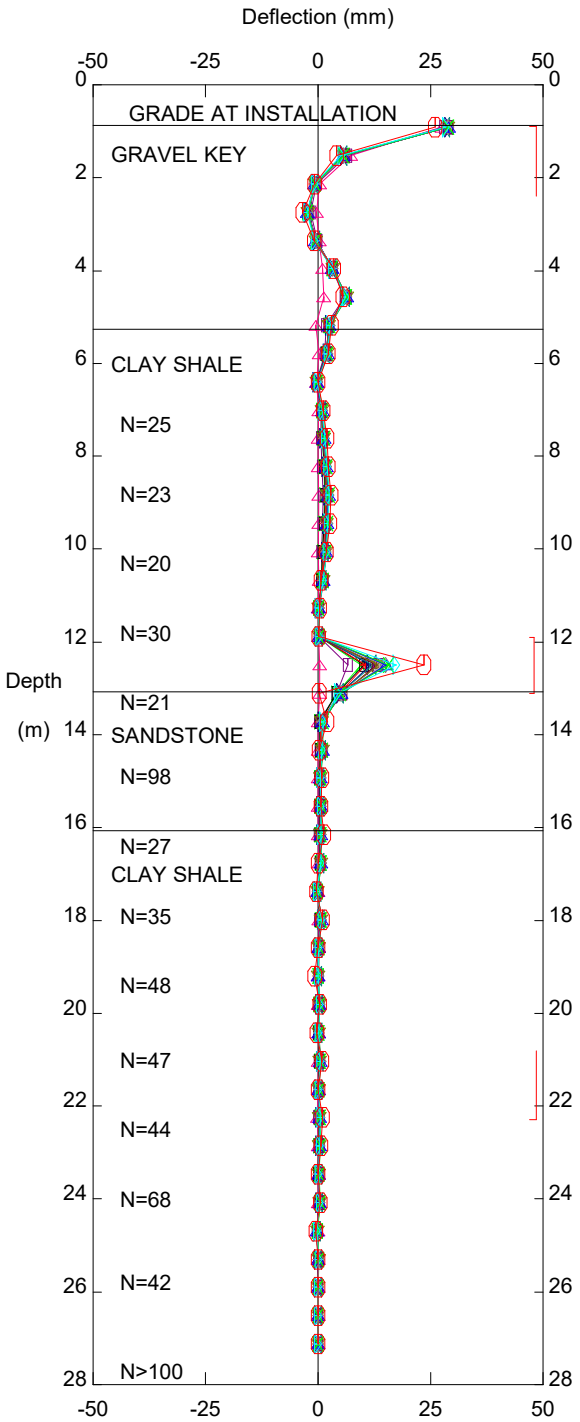
H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\S-SI-02_bwn.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction X



Incremental Deflection

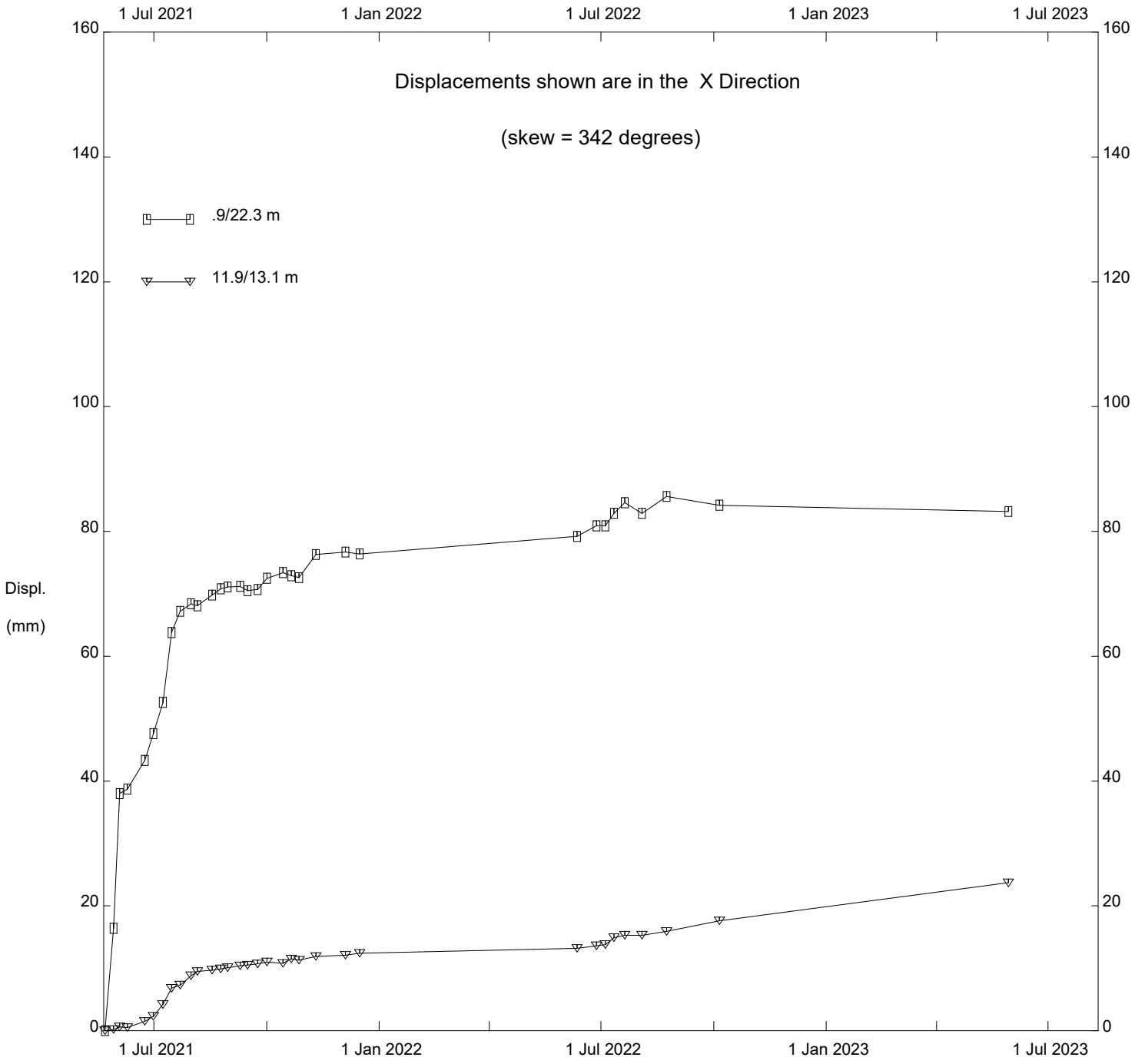
Direction X

In Ground, Inclinometer S-SI-02

Hangingstone Bridge South Abutment

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2023A-Spring\SI Readings\NC99\S-SI-02_bwn.gtl

Thurber Engineering Ltd.

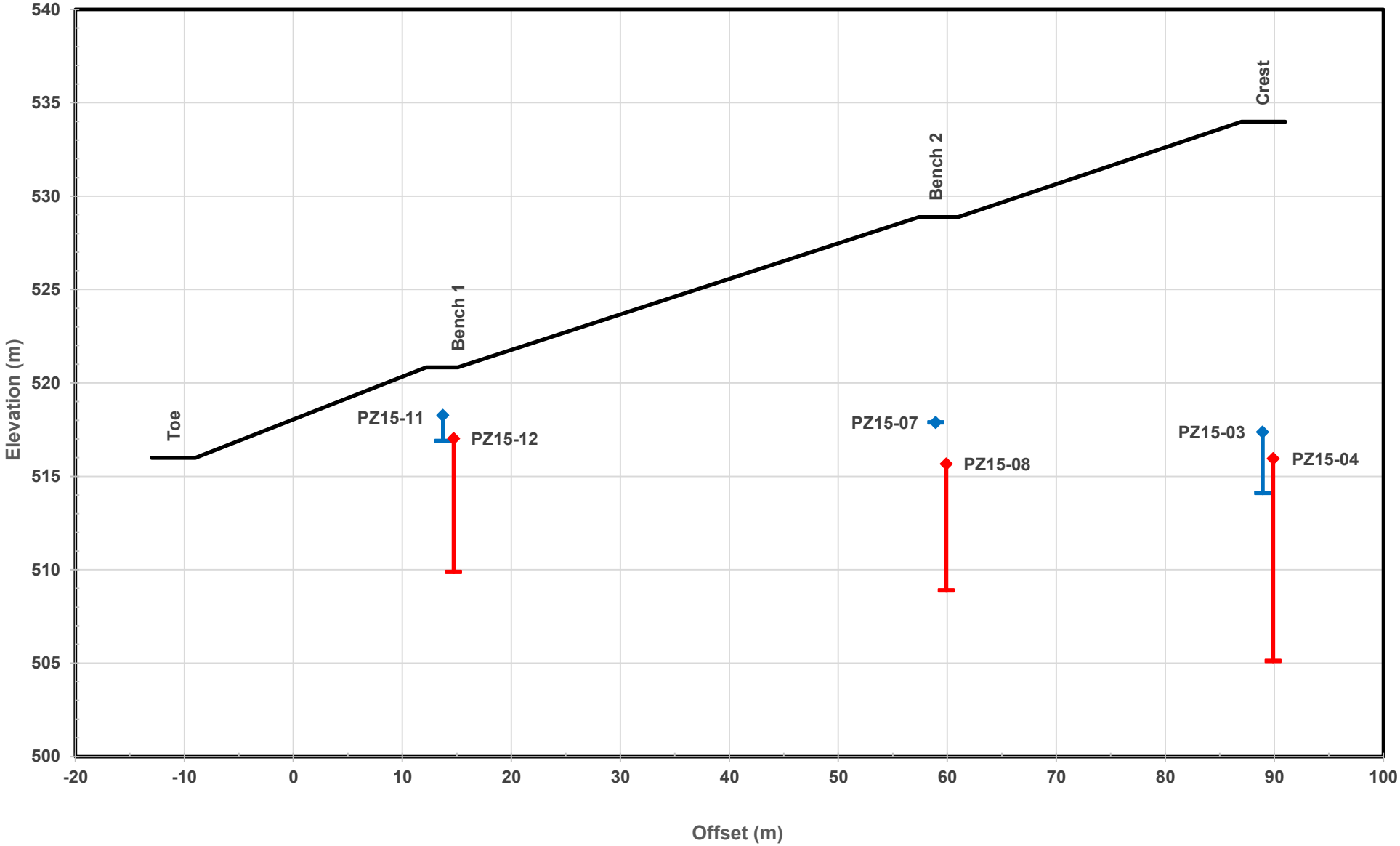


In Ground, Inclinometer S-SI-02

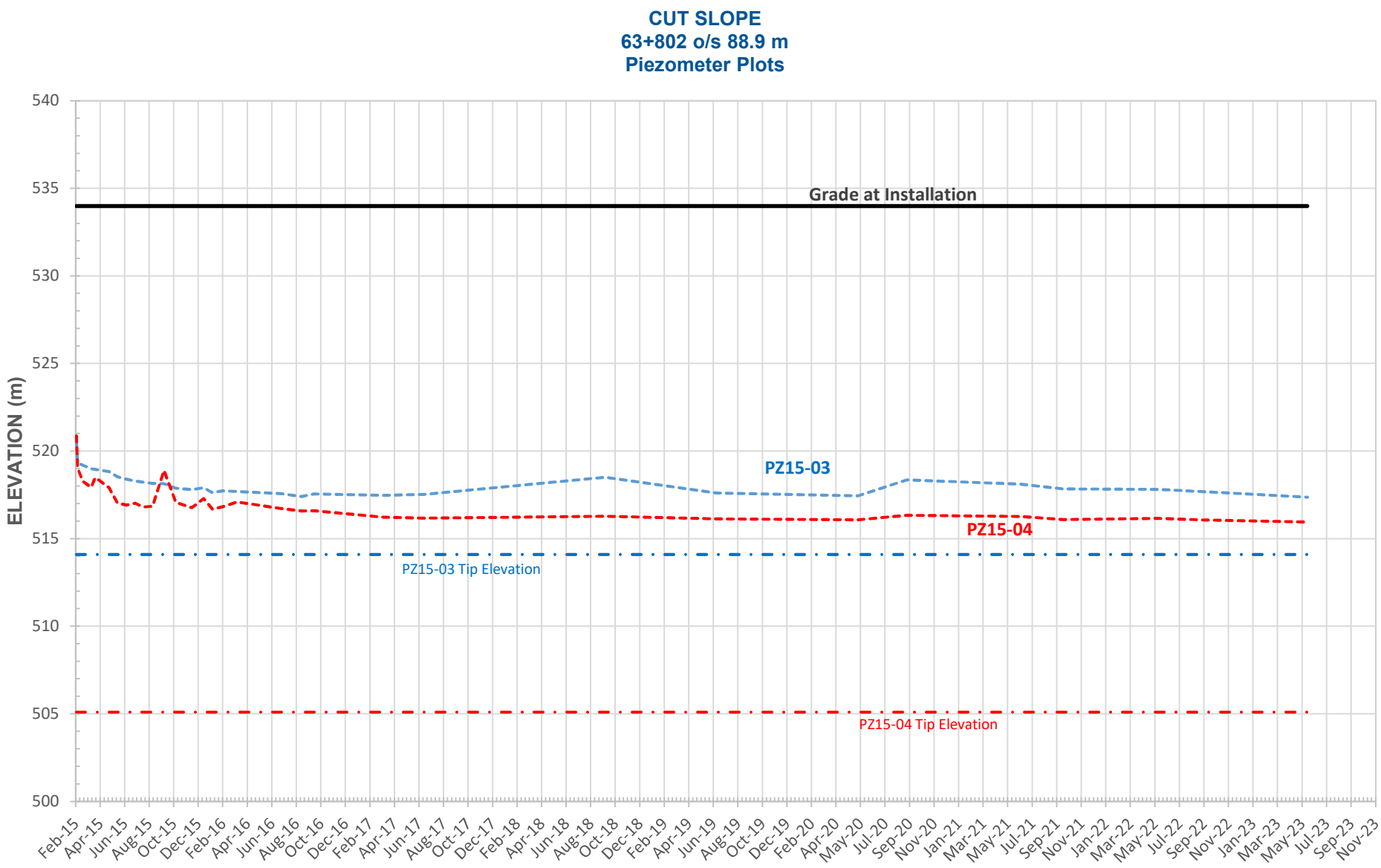
Hangingstone Bridge South Abutment

Northbound Lane Instruments (Figures NC099-1 to NC099-10)

PIEZOMETER PLOT
63+800



NC099-1


CUT SLOPE
63+802 o/s 88.9 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ15-03
PZ15-04
PZ15-03 Tip Elevation
PZ15-04 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18
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Feb-19
Apr-19
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Feb-20
Apr-20
May-20
Jul-20
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Nov-20
Jan-21
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May-21
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Nov-21
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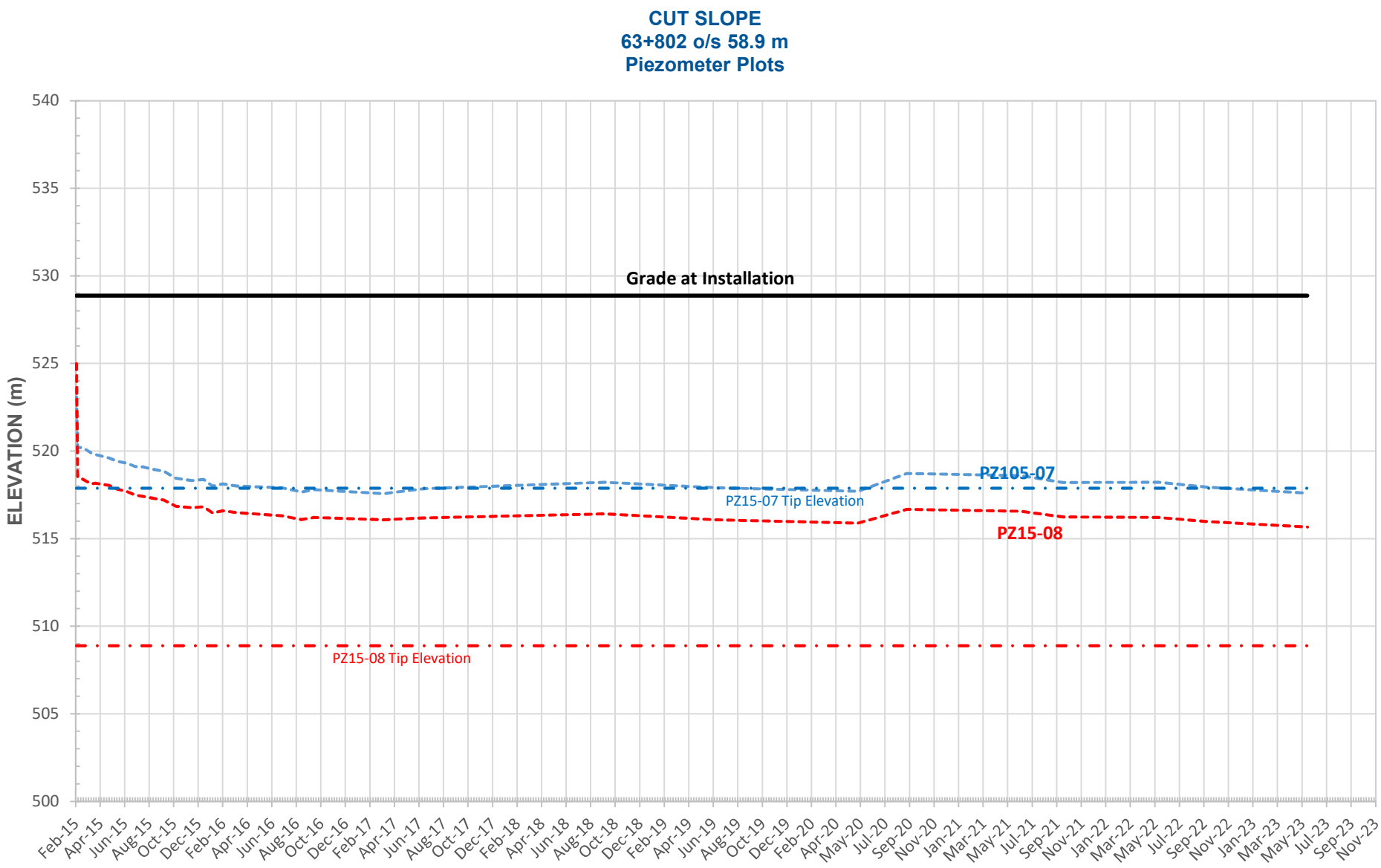
Mar-22
May-22
Jul-22
Sep-22
Nov-22
Jan-23
Mar-23
May-23
Jul-23
Sep-23
Nov-23


CUT SLOPE
63+802 o/s 58.9 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ105-07
PZ15-07 Tip Elevation
PZ15-08
PZ15-08 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
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Jun-19
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Apr-20
May-20
Jul-20
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Nov-20
Jan-21
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Nov-21
Jan-22
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May-22
Jul-22
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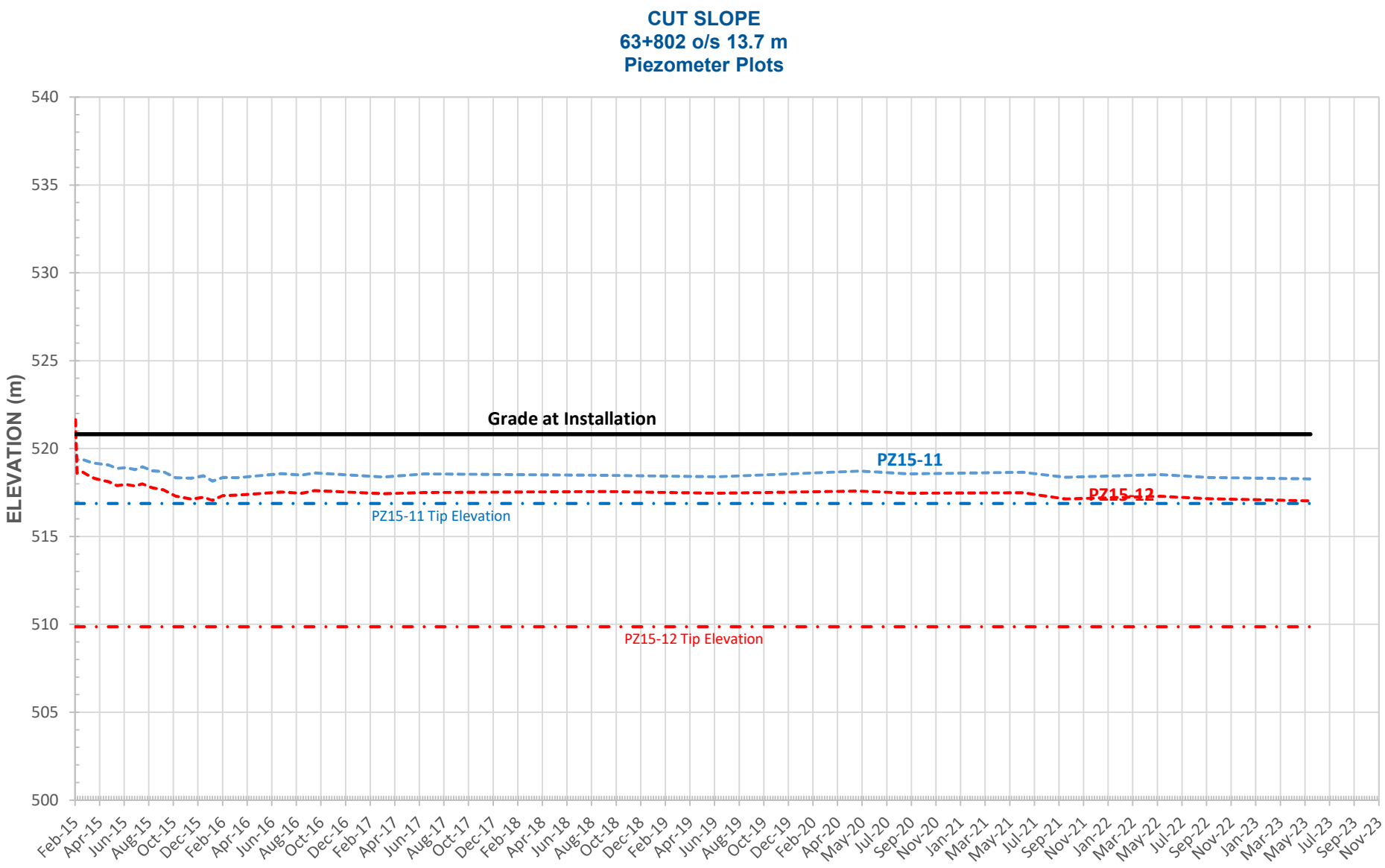
Nov-22
Jan-23
Mar-23
May-23
Jul-23
Sep-23
Nov-23


CUT SLOPE
63+802 o/s 13.7 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ15-11
PZ15-12
PZ15-11 Tip Elevation
PZ15-12 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
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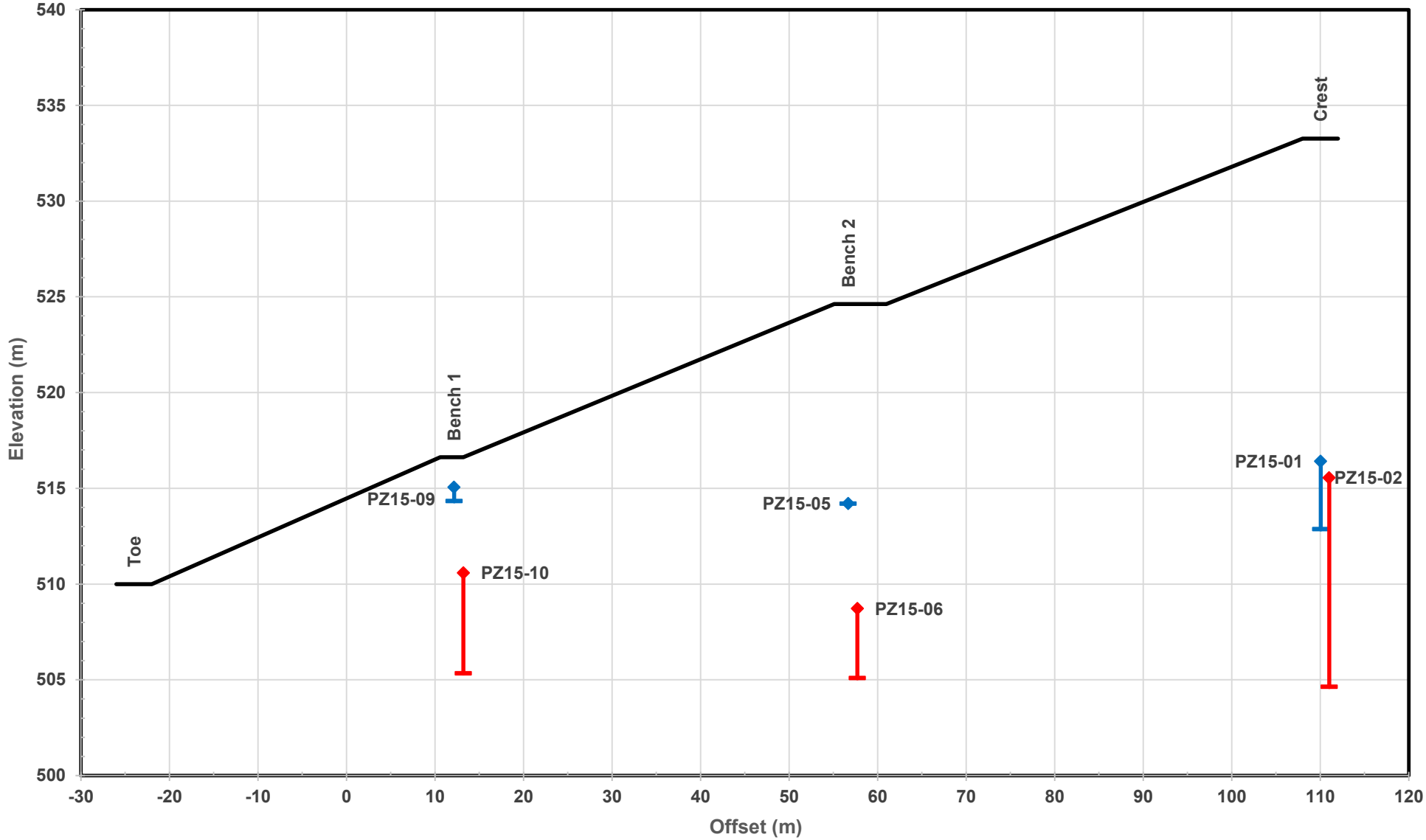
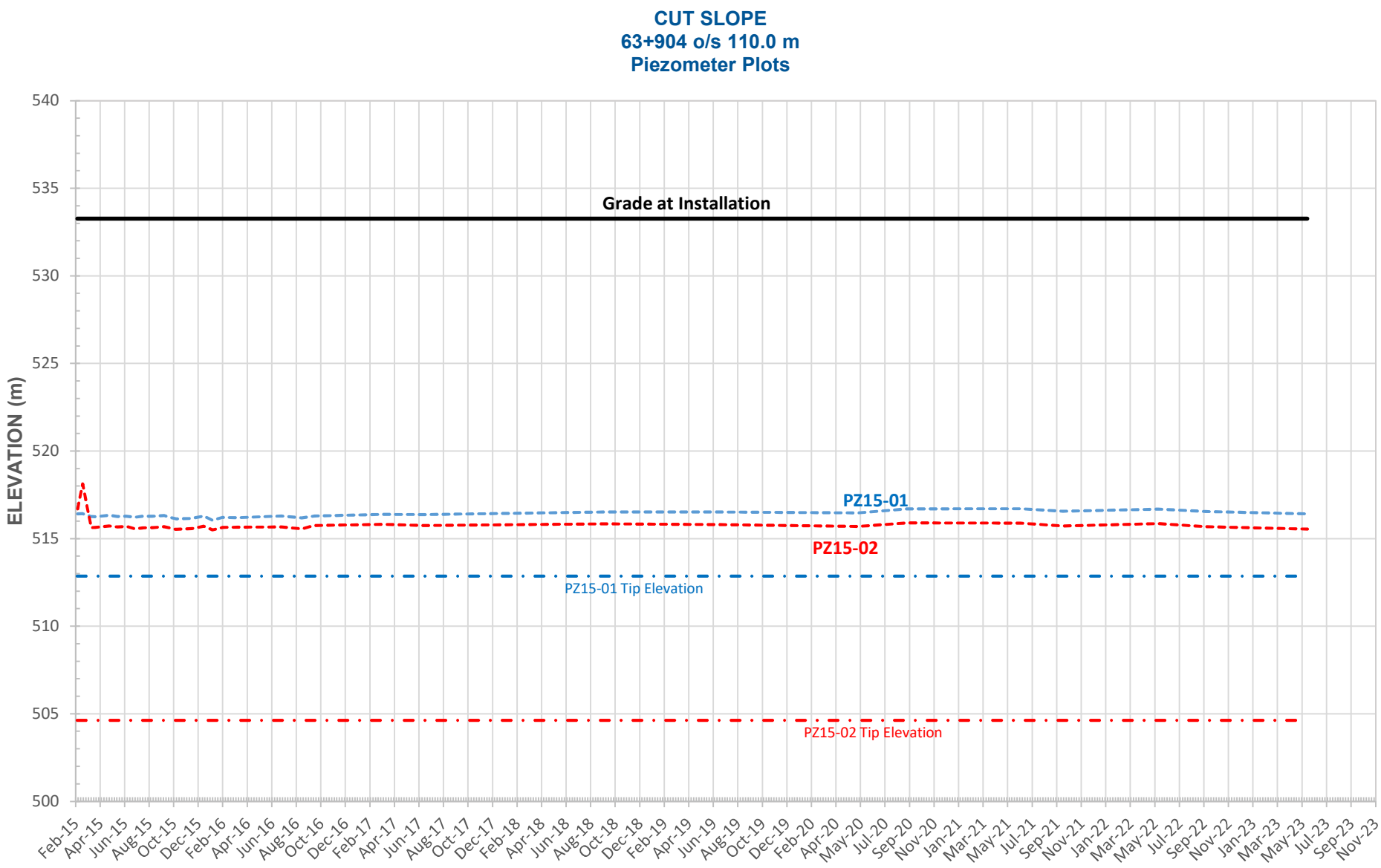
Jul-23
Sep-23
Nov-23

PIEZOMETER PLOT
63+900



NC099-5


CUT SLOPE
63+904 o/s 110.0 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ15-01
PZ15-02
PZ15-01 Tip Elevation
PZ15-02 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
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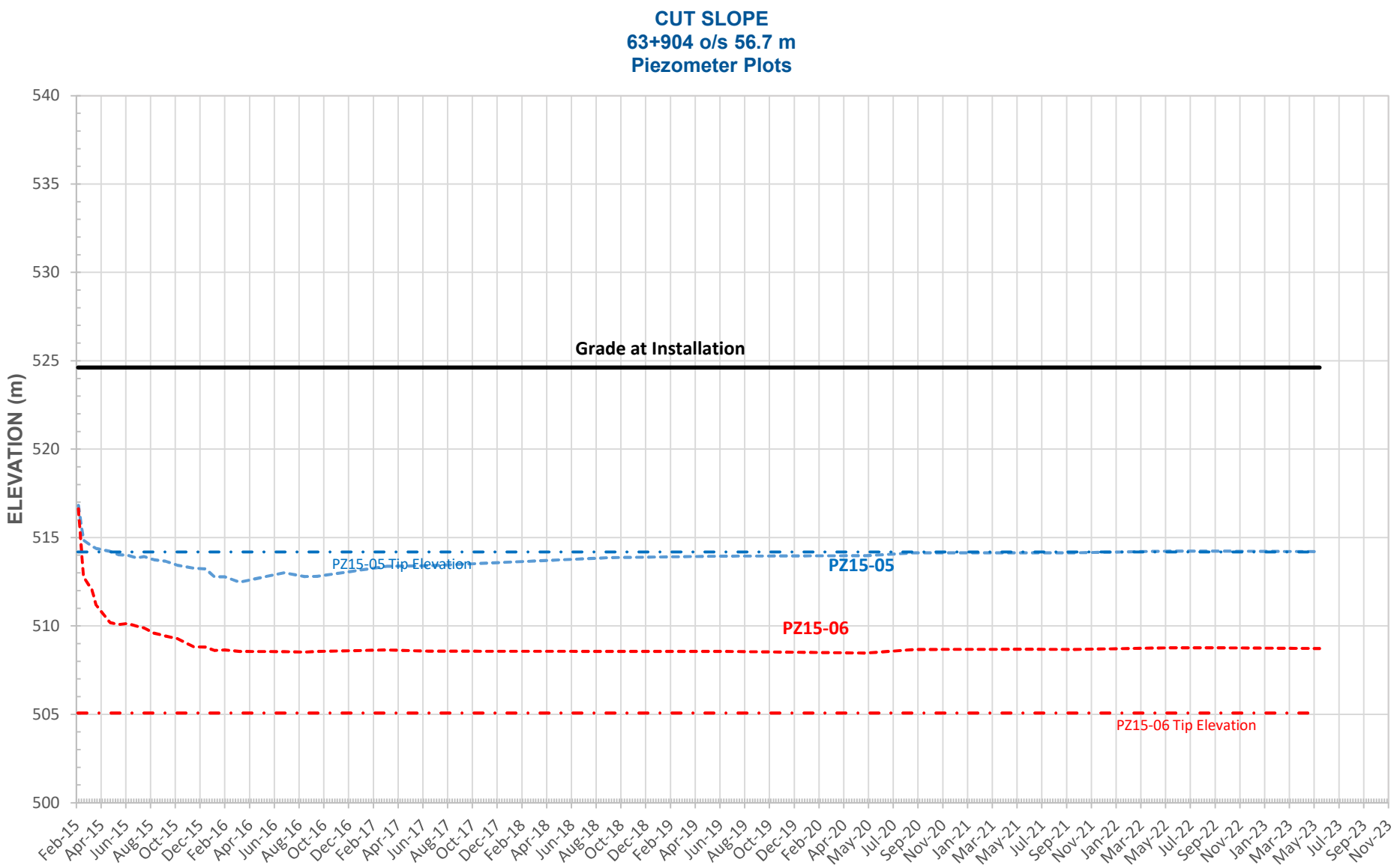
Nov-23


CUT SLOPE
63+904 o/s 56.7 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ15-05 Tip Elevation
PZ15-05
PZ15-06
PZ15-06 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
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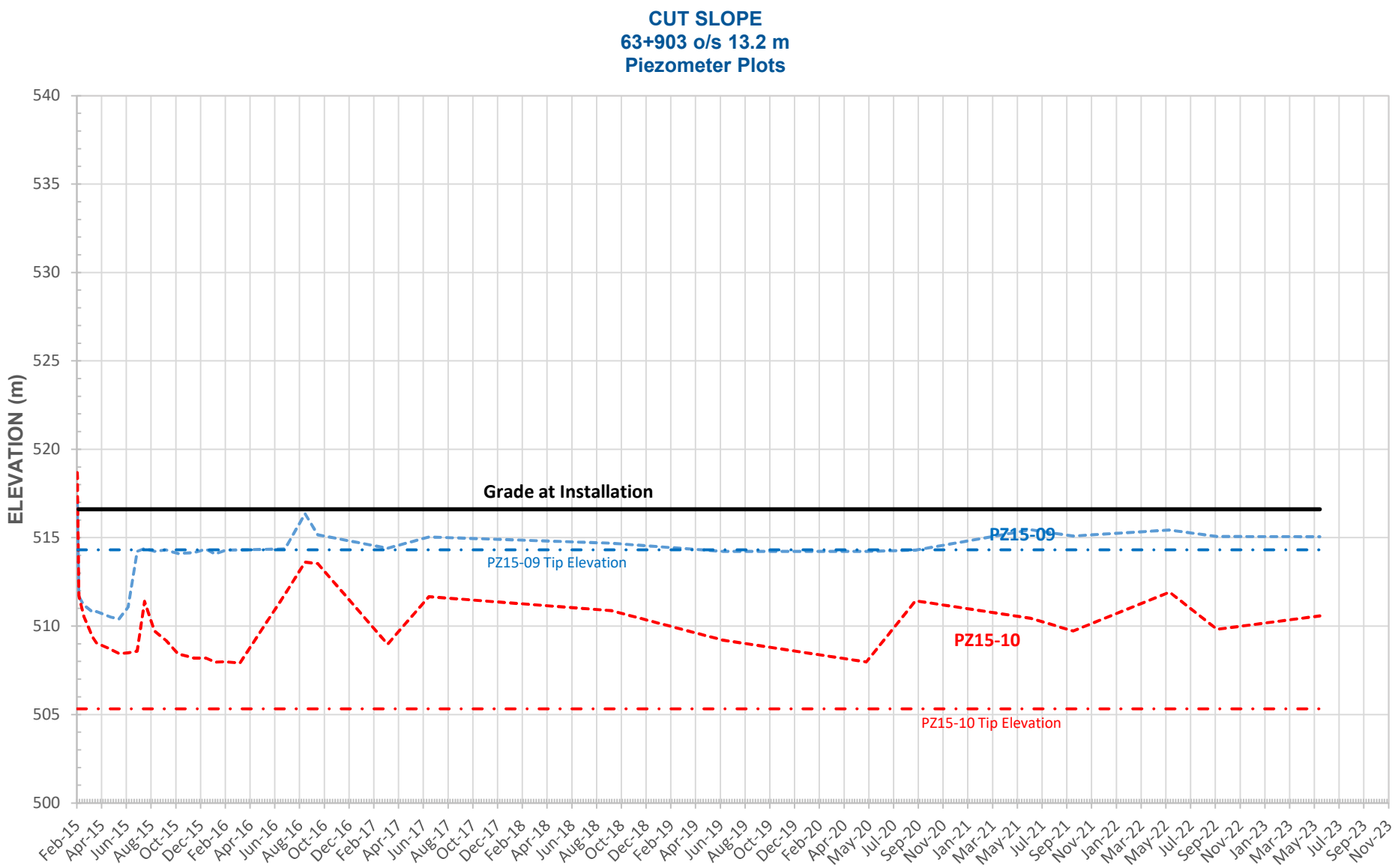
Nov-23


CUT SLOPE
63+903 o/s 13.2 m
Piezometer Plots
ELEVATION (m)
540
535
530
525
520
515
510
505
500
Grade at Installation
PZ15-09
PZ15-09 Tip Elevation
PZ15-10
PZ15-10 Tip Elevation
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
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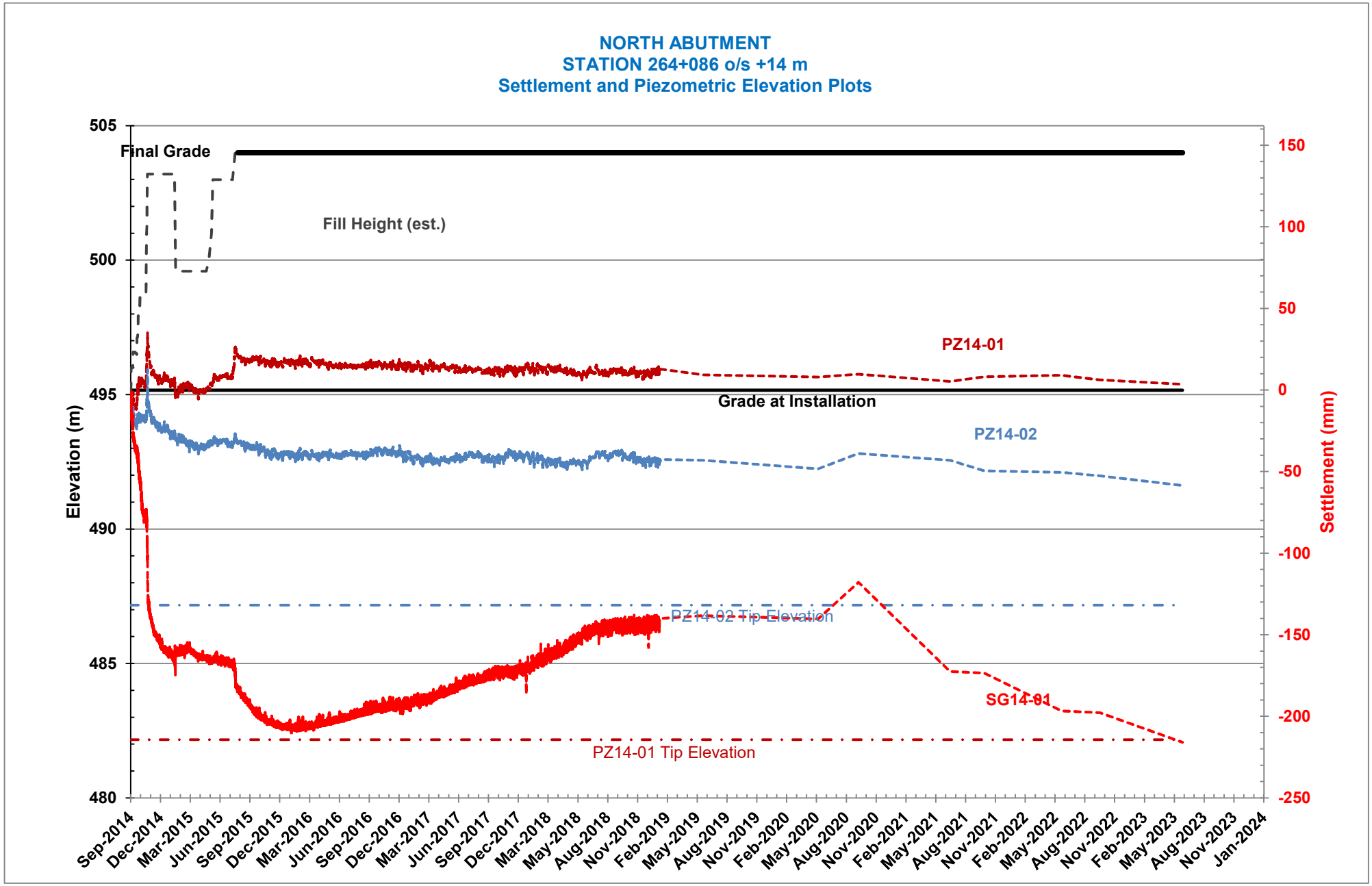
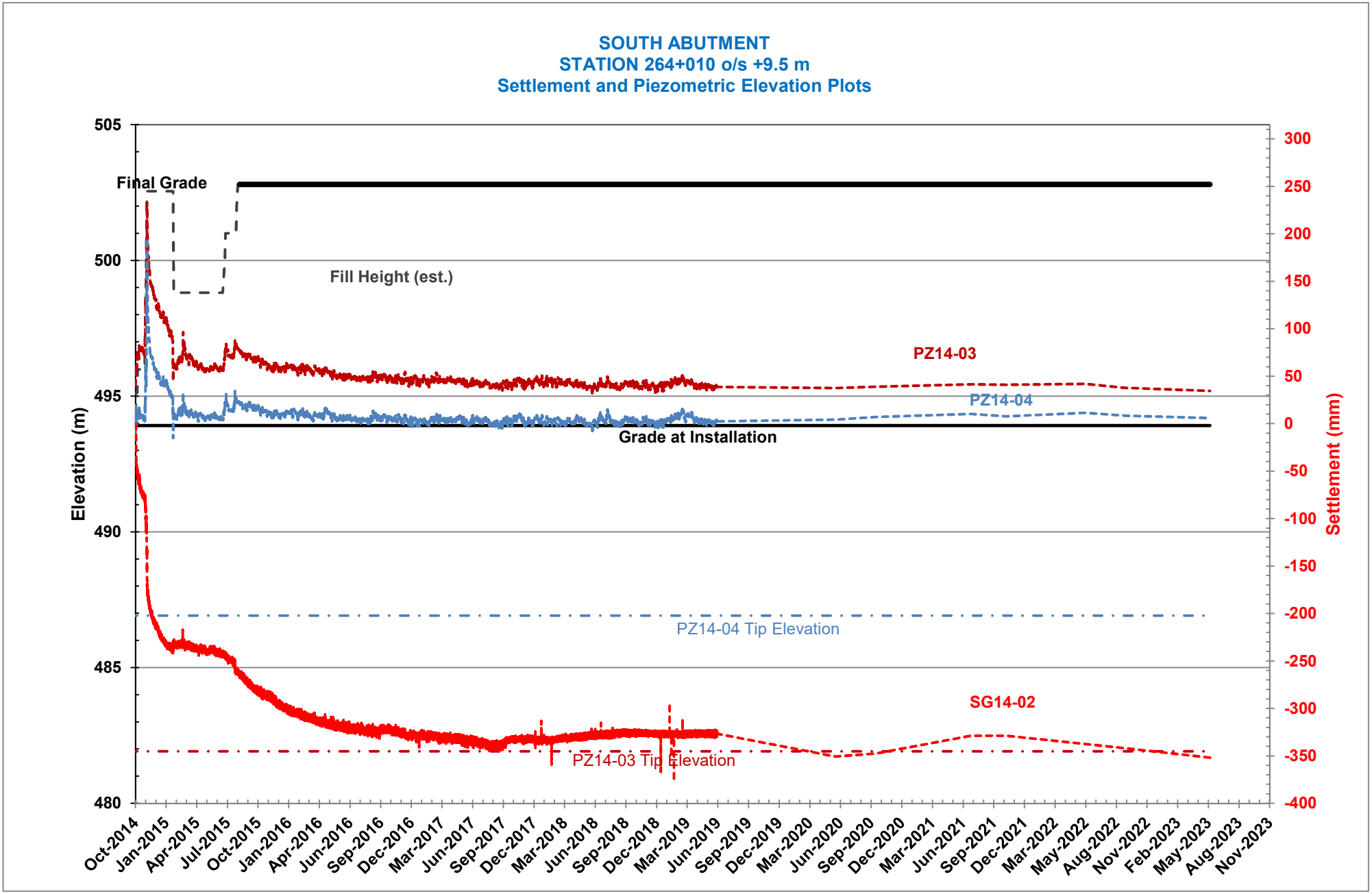
Nov-23


NORTH ABUTMENT
STATION 264+086 o/s +14 m
Settlement and Piezometric Elevation Plots
Final Grade
Fill Height (est.)
PZ14-01
Grade at Installation
PZ14-02
PZ14-02 Tip Elevation
SG14-01
PZ14-01 Tip Elevation
Elevation (m)
Settlement (mm)
505
500
495
490
485
480
150
100
50
0
-50
-100
-150
-200
-250
Sep-2014
Dec-2014
Mar-2015
Jun-2015
Sep-2015
Dec-2015
Mar-2016
Jun-2016
Sep-2016
Dec-2016
Mar-2017
Jun-2017
Sep-2017
Dec-2017
Mar-2018
May-2018
Aug-2018
Nov-2018
Feb-2019
May-2019
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Nov-2020
Feb-2021
May-2021
Aug-2021
Nov-2021
Feb-2022
May-2022
Aug-2022
Nov-2022
Feb-2023
May-2023
Aug-2023
Nov-2023
Jan-2024


SOUTH ABUTMENT
STATION 264+010 o/s +9.5 m
Settlement and Piezometric Elevation Plots
Elevation (m)
Settlement (mm)
Final Grade
Fill Height (est.)
PZ14-03
PZ14-04
Grade at Installation
PZ14-04 Tip Elevation
SG14-02
PZ14-03 Tip Elevation
505
500
495
490
485
480
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
Oct-2014
Jan-2015
Apr-2015
Jul-2015
Oct-2015
Jan-2016
Apr-2016
Jun-2016
Sep-2016
Dec-2016
Mar-2017
Jun-2017
Sep-2017
Dec-2017
Mar-2018
Jun-2018
Sep-2018
Dec-2018
Mar-2019
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Dec-2019
Mar-2020
Jun-2020
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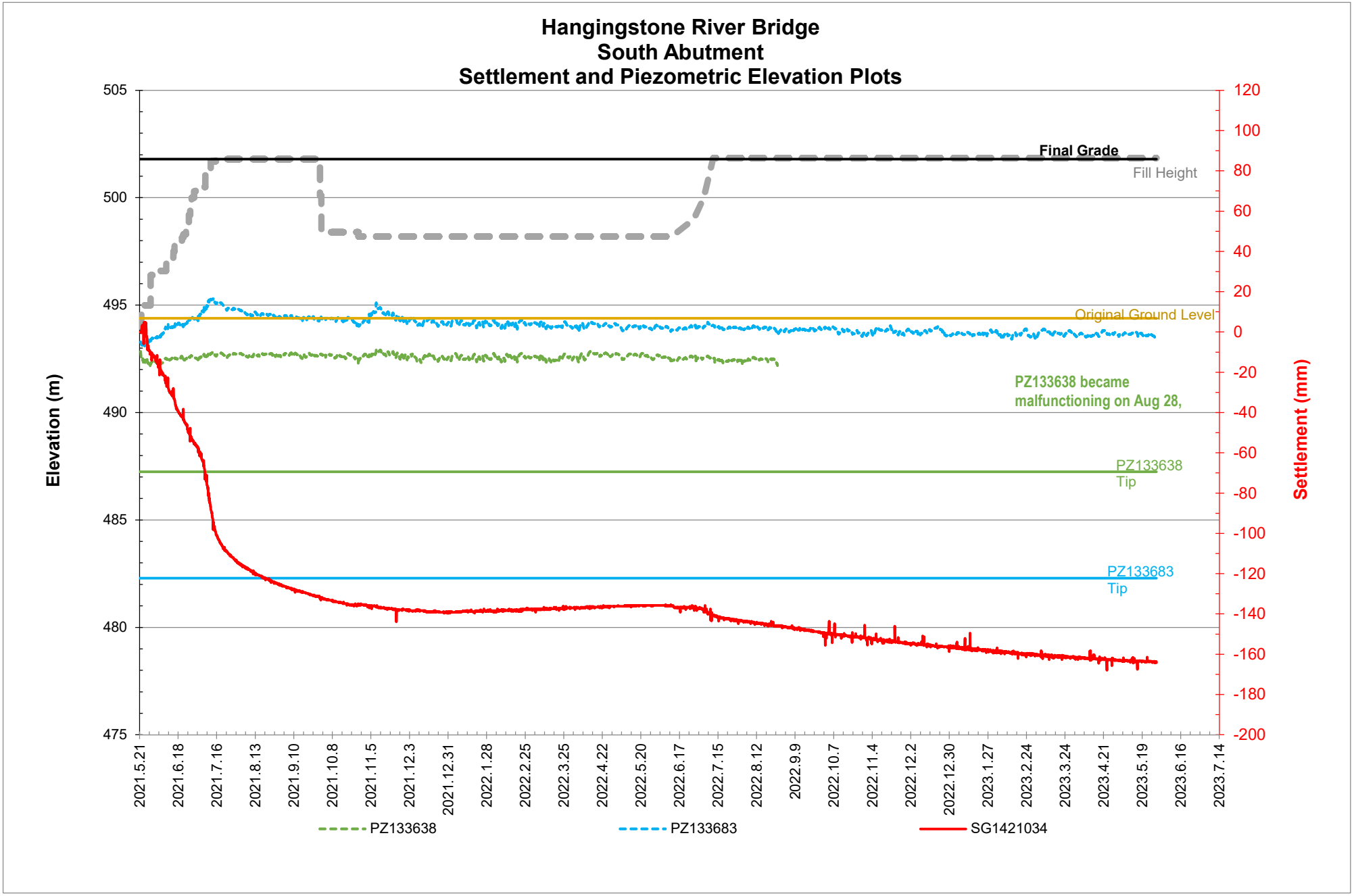
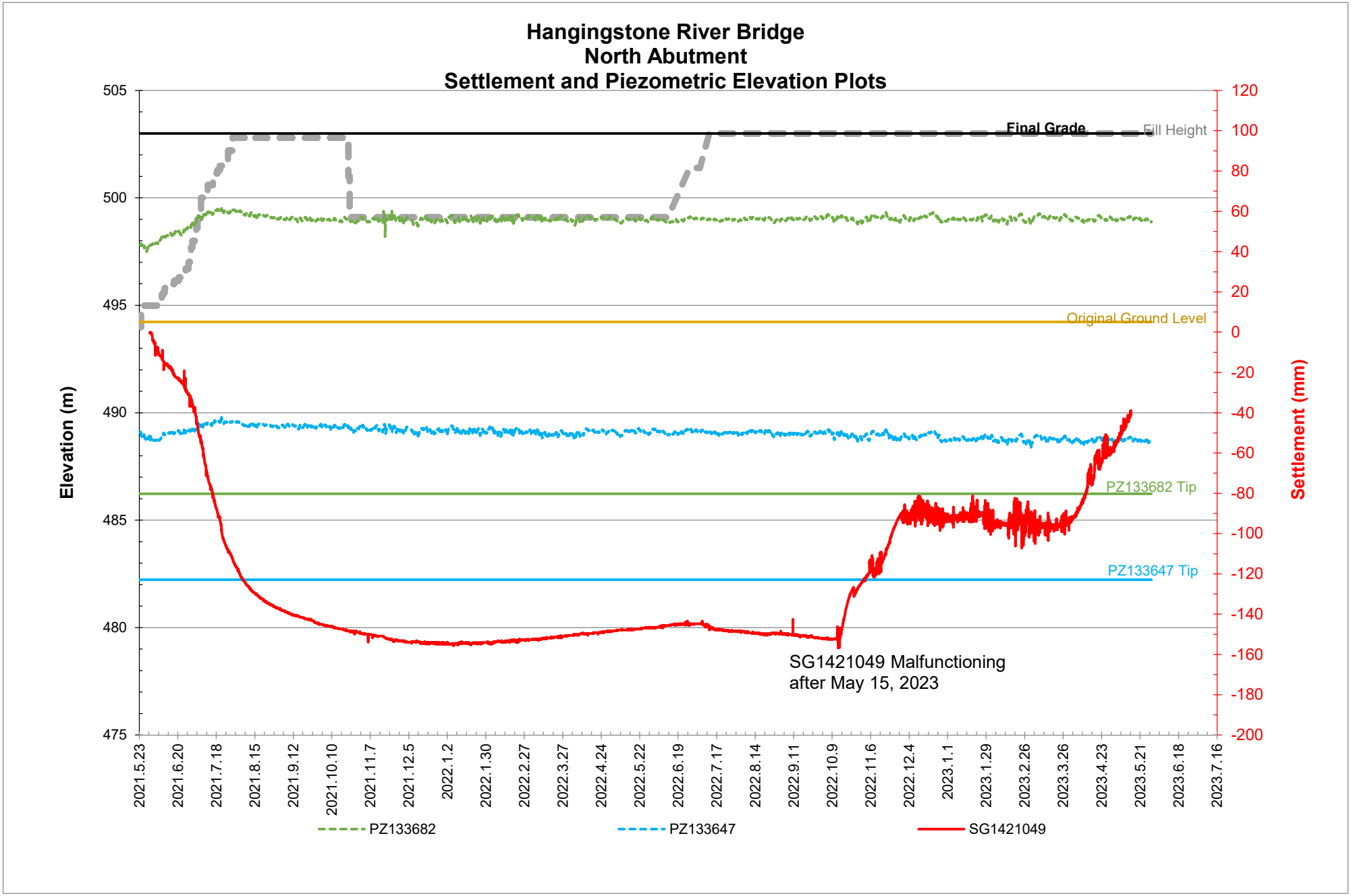
Dec-2020
Mar-2021
Jun-2021
Sep-2021
Dec-2021
Mar-2022
May-2022
Aug-2022
Nov-2022
Feb-2023
May-2023
Aug-2023
Nov-2023

Southbound Lane Instruments (Figures NC099-11 to NC099-12)


Hangingstone River Bridge
South Abutment
Settlement and Piezometric Elevation Plots
Elevation (m)
Settlement (mm)
Final Grade
Fill Height
Original Ground Level
PZ133638 became malfunctioning on Aug 28,
PZ133638 Tip
PZ133683 Tip
PZ133638
PZ133683
SG1421034


Hangingstone River Bridge
North Abutment
Settlement and Piezometric Elevation Plots
Elevation (m)
Settlement (mm)
Final Grade
Fill Height
Original Ground Level
PZ133682 Tip
PZ133647 Tip
SG1421049 Malfunctioning
after May 15, 2023
PZ133682
PZ133647
SG1421049