THURBER ENGINEERING LTD.

August 5, 2022 File No.: 32123

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

Attention: Mr. Ed Szmata

ALBERTA TRANSPORTATION GRMP (CON0022165)
PEACE REGION (GRANDE PRAIRIE DISTRICT – NORTH)
INSTRUMENTATION MONITORING RESULTS – SPRING 2022

SECTION C

SITE GP031: HWY 740:02, SHAFTESBURY SLIDE

Dear Mr. Szmata:

This report provides the results of the annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation's Geohazard Risk Management Program for Peace Region Grande Prairie District – North (CON0022165).

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. FIELD PROGRAM AND INSTRUMENTATION STATUS

From September 2018 to October 2019, a landslide repair was completed at the Hwy 740:02 Shaftesbury Trail site. The repair involved the construction of a cast-in-place reinforced concrete tangent pile wall, a toe berm, a highway realignment, and site regrading and drainage measures. During construction, four slope inclinometers (SI18-P10, SI18-P30, SI18-P50 and SI18-P70) were installed in select piles to monitor deflections in the pile wall. The SIs were read on June 11, 2022, by Mr. Niraj Regmi, G.I.T. and Mr. Jayden Del Cid, both of Thurber Engineering Ltd.

The SIs were read using a RST Digital Inclinometer probe with a 2 ft. wheelbase and a RST Pocket PC readout. Inclinometer reading depths were defined as per cable markings with respect to the top of the inclinometer casing.

In addition to the SIs installed in the pile wall, four standpipe piezometers (SP17-3, SP17-4, SP17-5 and SP17-6) were installed by Thurber as part of a geotechnical investigation of the site in 2017. The standpipe piezometers were all removed during construction; however, historical standpipe piezometer readings are included in this report in Table PH031-2.

2. INTERPRETATION

2.1 General

SI plots with A and B directions are presented in Appendix A and are summarized below. Where movement has been recorded, the resultant plot (X direction, if applicable) and a rate of movement have also been provided. Historical piezometer readings are summarized below for reference.

2.2 Zones of Movement

Zones of new movement were not observed in the SIs since the previous readings in the spring of 2021.

Zones of movement are summarized in Table PH031-1 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.

THURBER

TABLE PH031-1
SPRING 2022 – HWY 740:02 SHAFTESBURY SLIDE
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 11, 2022

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)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI18-P10	September 27, 2019	3.1 mm over 1.8 m to 18.2 m depth in 45° direction	3.9 mm/yr in October 2020	Operational	July 7, 2021	No discernible movement	N/A	N/A
SI18-P30	September 27, 2019	3.2 mm over 1.7 m to 18.2 m depth in 20° direction	3.1 mm/yr in October 2020	Operational	July 7, 2021	0.8	0.8	-0.9
		3.0 mm over 0 m to 18.2 m depth in 20° direction	3.7 mm/yr in October 2020			0.3	0.3	-1.7
SI18-P50	September 27, 2019	2.7 mm over 1.7 m to 18.2 m depth in 321° direction	4.3 mm/yr in October 2020	Operational	July 7, 2021	0.6	0.6	1.2
		2.5 mm over 0 m to 18.2 m depth in 321° direction	4.7 mm/y in October 2020			0.3	0.3	<0.1
SI18-P70	September 27, 2019	4.8 mm over 1.6 m to 18.0 m depth in 351° direction	4.3 mm/yr in October 2020	Operational	July 7, 2021	1.5	1.6	0.6
		8.0 mm over 0 m to 18.0 m depth in 351° direction	3.6 mm/yr in July 2021			2.4	2.6	-1.0

Drawing 32123-PH031 in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

THURBER

TABLE PH031-2
SPRING 2022 – HWY 740:02 SHAFTESBURY SLIDE
STANDPIPE PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 11, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	CURRENT STATUS	MAXIMUM MEASURED WATER LEVEL BGS (m)	MEASURED WATER LEVEL BGS (m)	PREVIOUS READING BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
SP17-3	*June 2, 2017*	*15.5*	*Destroyed*	*DRY*	*N/A*	*DRY (Sep. 27, 2019)*	*N/A*
SP17-4	*June 10, 2017*	*16.2*	*Destroyed*	*DRY*	*N/A*	*DRY (Sep. 28, 2017)*	*N/A*
SP17-5	*June 3, 2017*	*15.7*	*Destroyed*	*6.8 (Sep. 28, 2017)*	*N/A*	*6.8 (Sep. 28, 2017)*	*N/A*
SP17-6	*June 4, 2017*	*14.7*	*Destroyed*	*0.6 (June 11, 2017)*	*N/A*	*1.8 (Sep. 27, 2017)*	*N/A*

Drawing 32123-PH031 in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

3. INTERPRETATION OF MONITORING RESULTS

The SIs were cast into their respective piles in the fall of 2018, were extended during the waler construction in the summer of 2019 and were initialized during the fall of 2019 instrumentation readings.

SI18-P10 showed no discernible movement over the length of the pile since the spring of 2021 readings. SI18-P10 has shown a cumulative pile head movement of 3.1 mm to date. SI18-P30 showed a rate of movement of 0.8 mm/yr over the length of the pile and a rate of movement of 0.3 mm/yr over the combined length of the pile and waler since the spring of 2021 readings. SI18-P30 has shown a cumulative pile head movement of 3.2 mm to date. SI18-P50 showed a rate of movement of 0.6 mm/yr over the length of the pile and a rate of movement of 0.3 mm/yr over the combined length of the pile and waler since the spring of 2021 readings. SI18-P50 has shown a total cumulative pile head movement of 2.7 mm to date. SI18-P70 showed a rate of movement of 1.6 mm/yr over the length of the pile and a rate of movement of 2.6 mm/yr over the combined length of the pile and waler since the spring of 2021 readings. SI18-P70 has shown a total cumulative pile head movement of 4.8 mm to date.

Overall, the SI readings show that the remediation measures have been effective in mitigating the landslide at this site.

There are no piezometers currently active at the site. Historical piezometers readings (prior to construction) are summarized in Table PH031-2 above.

4. RECOMMENDATIONS

4.1 Future Work

The instruments should be read again during the spring of 2023.

4.2 Instrumentation Repairs

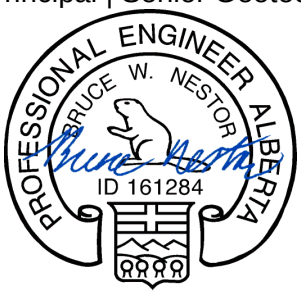
No instruments repairs are required at this time.

THURBER

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.
Renato Clementino, Ph.D., P.Eng.
Principal | Senior Geotechnical Engineer



August 5, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 72376
DATE: August 5, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Bruce Nestor, P.Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Appendix A
  - Field Inspector's report
  - Site Plan Showing Approximate Instrument Locations (Drawing No. 32123-GP031)
  - SI Reading Plots

THURBER

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

ALBERTA TRANSPORTATION
PEACE REGION (GRANDE PRAIRIE)
INSTRUMENTATION MONITORING RESULTS

SPRING 2022

APPENDIX A
DATA PRESENTATION

SITE GP031: HWY 740:02, SHAFTESBURY SLIDE

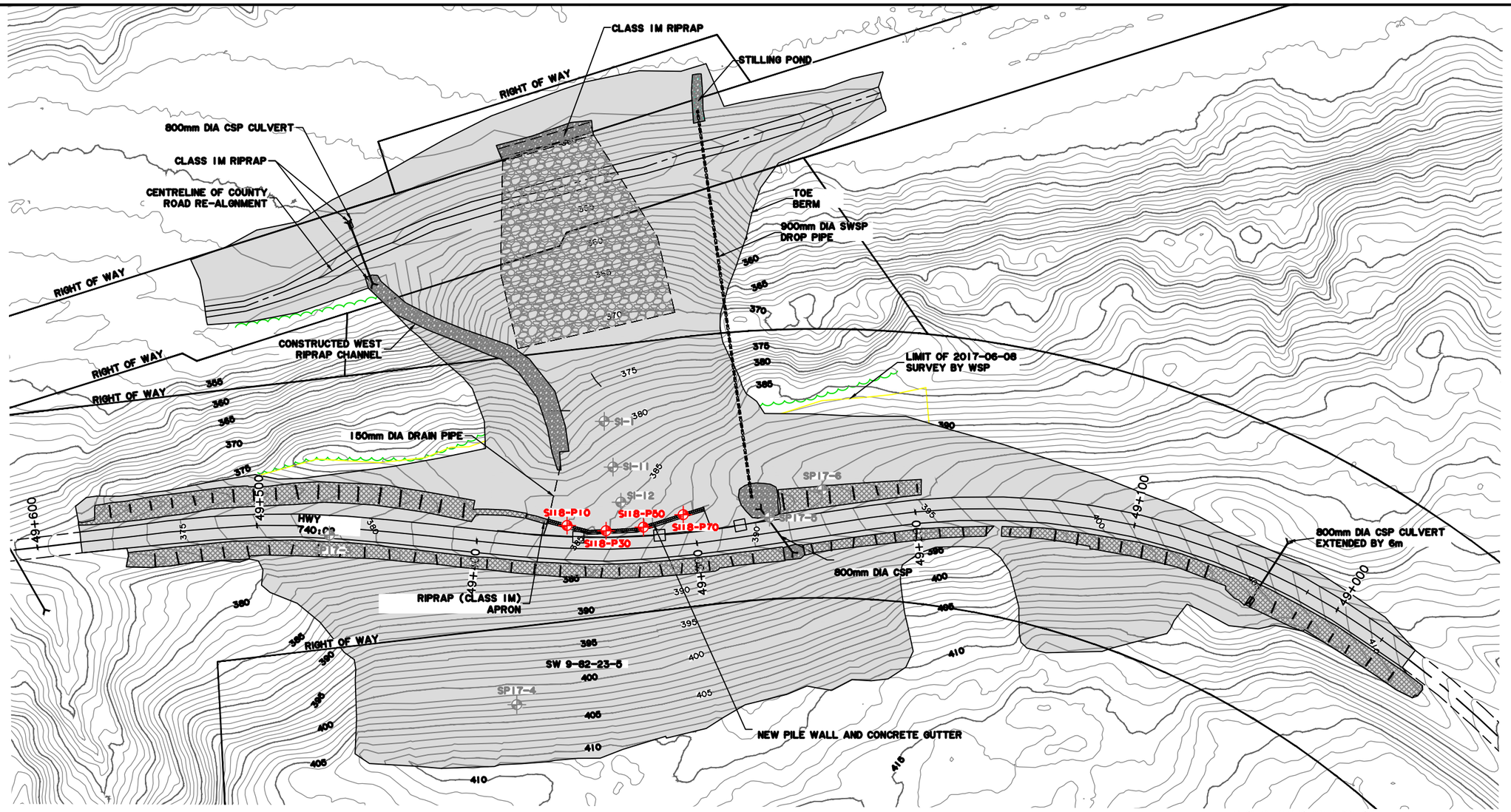
ALBERTA TRANSPORTATION
PEACE REGION (GRANDE PRAIRIE - NORTH DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (GP031)
SPRING 2022

Location:	Shaftesbury Trail South (Hwy 740:02 C1 49.332)	**Readout:**	
File Number:	32123	**Casing dia**	2.75
Probe:	RST SI SET 8R	**Temp:**	14
Cable:	RST SI SET 8R	**Read by:**	NKR/JD

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 11)		Date	Stickup (m)	Depth from top of casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-		
SI18-P10	466039	6216272	11-Jun-22	0.90	62 to 2	29	353	-339	-213	217	8R	
SI18-P30	466058	6216275	11-Jun-22	1.02	62 to 2	354	48	-88	-43	6	8R	
SI18-P50	466077	6216277	11-Jun-22	1.02	62 to 2	335	31	-23	506	-497	8R	
SI18-P70	466092	6216279	11-Jun-22	1.16	62 to 2	25	44	-36	446	-441	8R	

INSPECTOR REPORT



BASE PLAN PROVIDED BY WSP

LEGEND

- APPROXIMATE LOCATION INSTRUMENT
- APPROXIMATE LOCATION OF DAMAGED INSTRUMENT
- SCARP CRACK
- GUARD RAIL
- FENCE LINE
- TREE LINE
- PILE WALL
- SI SLOPE INCLINOMETER
- SP STANDPIPE PIEZOMETER

NOTES:

1. BASE PLAN PROVIDED BY WSP, SITE SURVEYED ON JUNE 8, 2017. CONTOURS OUTSIDE SURVEY LIMIT ARE FROM 2013 LIDAR DATA.
2. NAD83 UTM 11 COORDINATE SYSTEM.
3. CONTOUR INTERVALS 1.0m.

0 20 40 60 80 100 120m

SCALE 1:2000

Alberta

PEACE REGION
(GRANDE PRAIRIE DISTRICT NORTH)

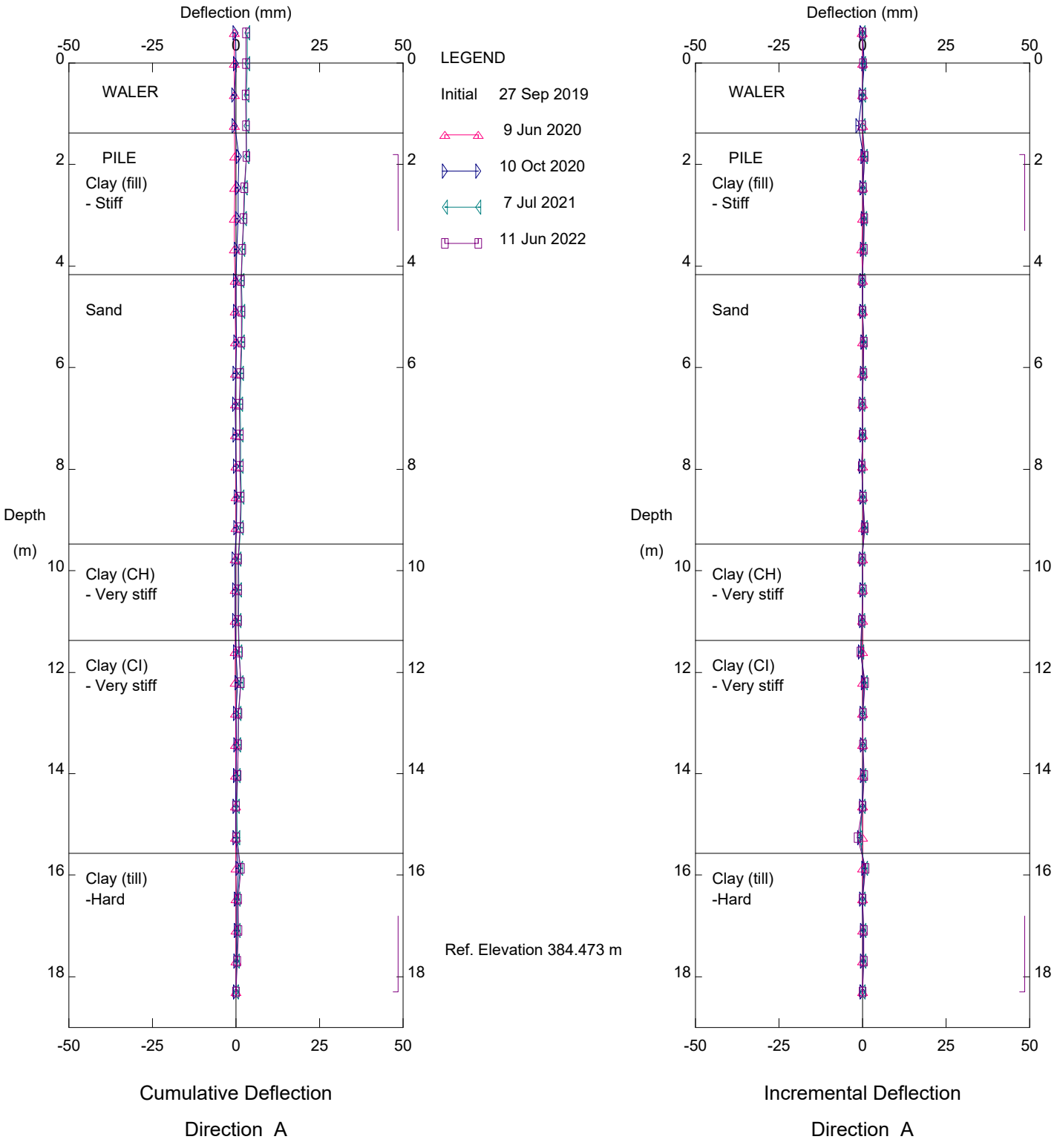
GP031: HWY 740:02 SHAFTESBURY SLIDE INSTRUMENT LOCATIONS

DWG No. 32123-GP031

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	RVC
SCALE	1:2000
DATE	AUGUST 2021
FILE No.	32123

THURBER ENGINEERING LTD.

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

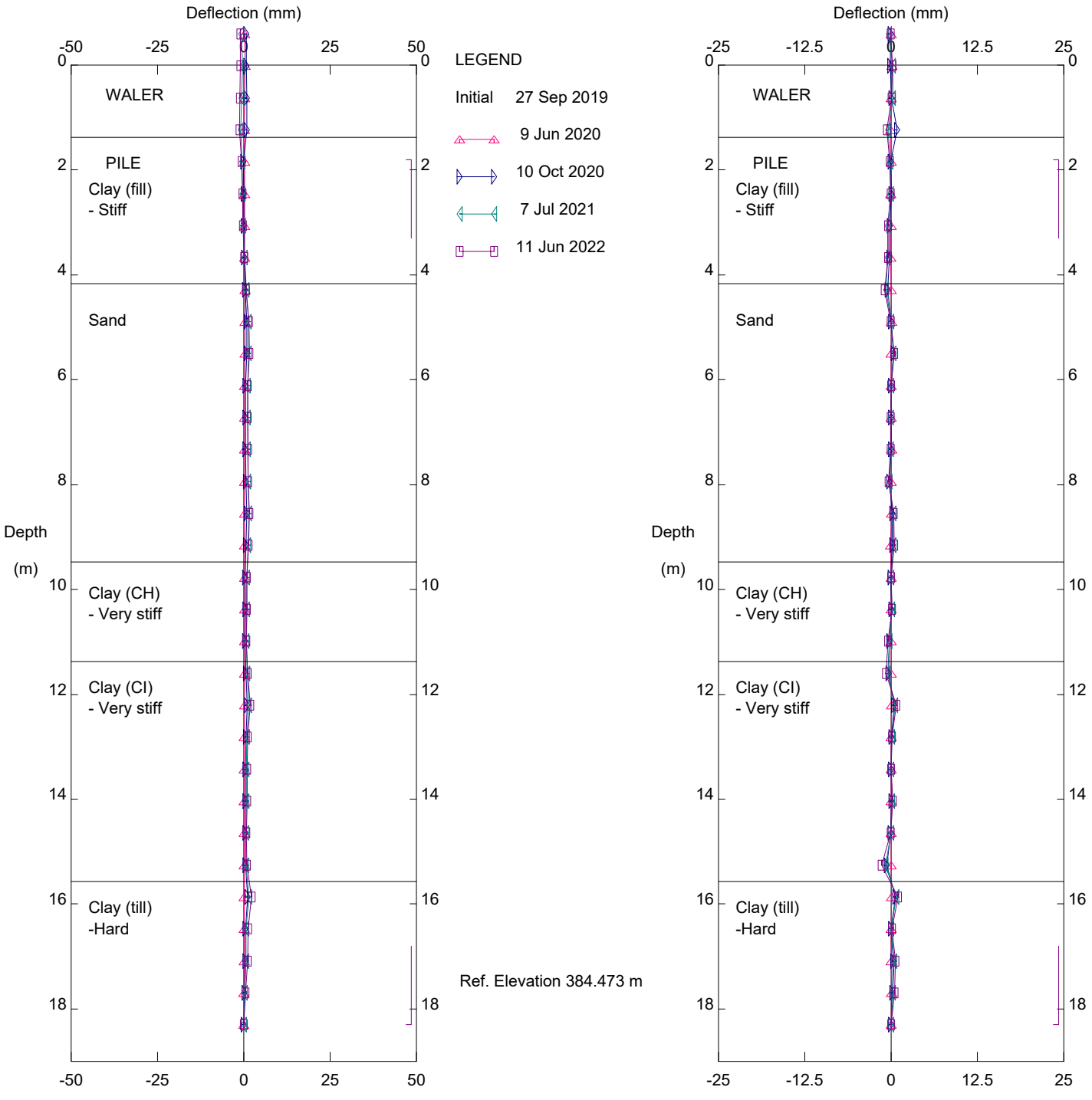
Direction A

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P10

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P10.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

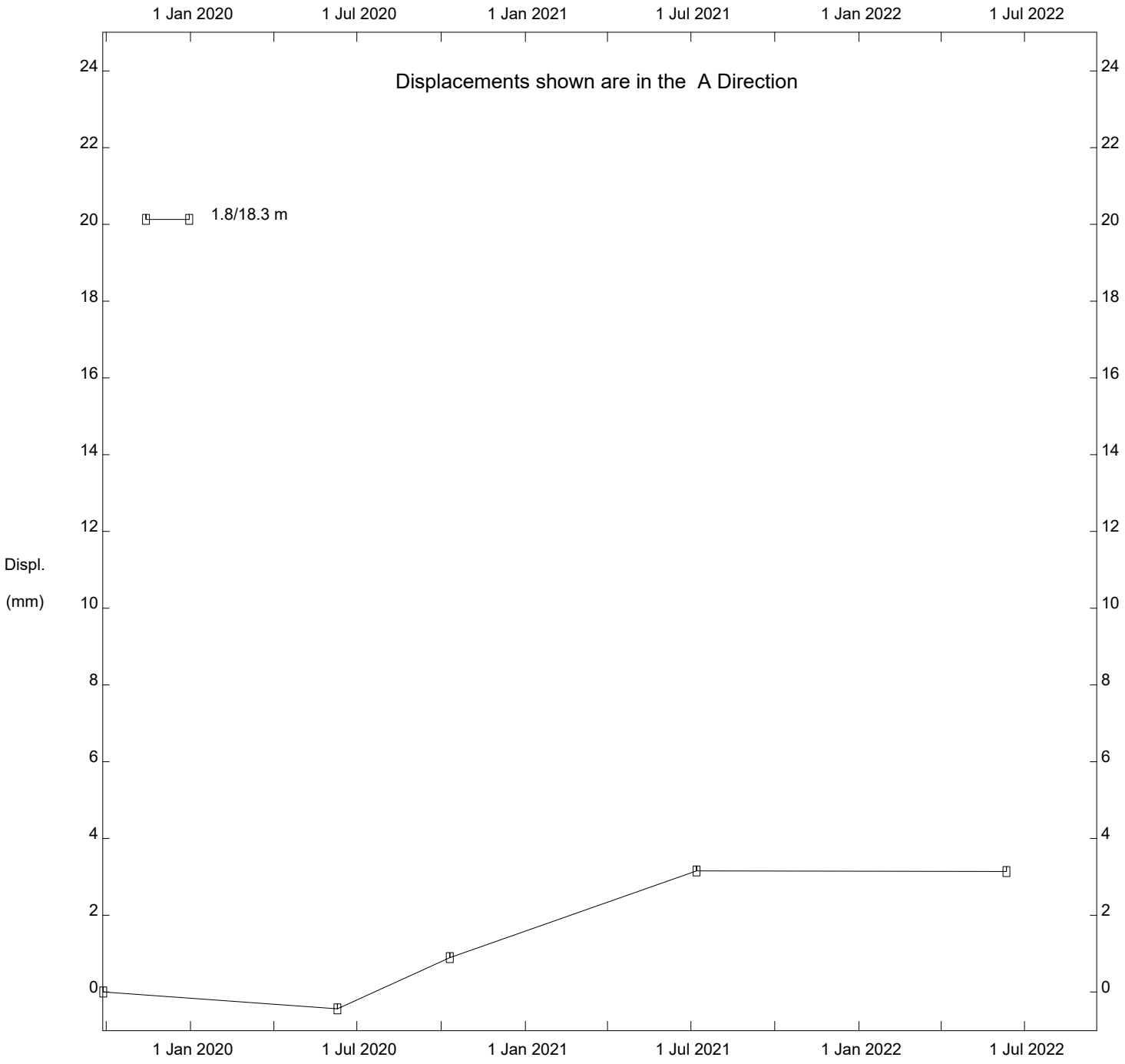
Direction B

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P10

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P10.gtl

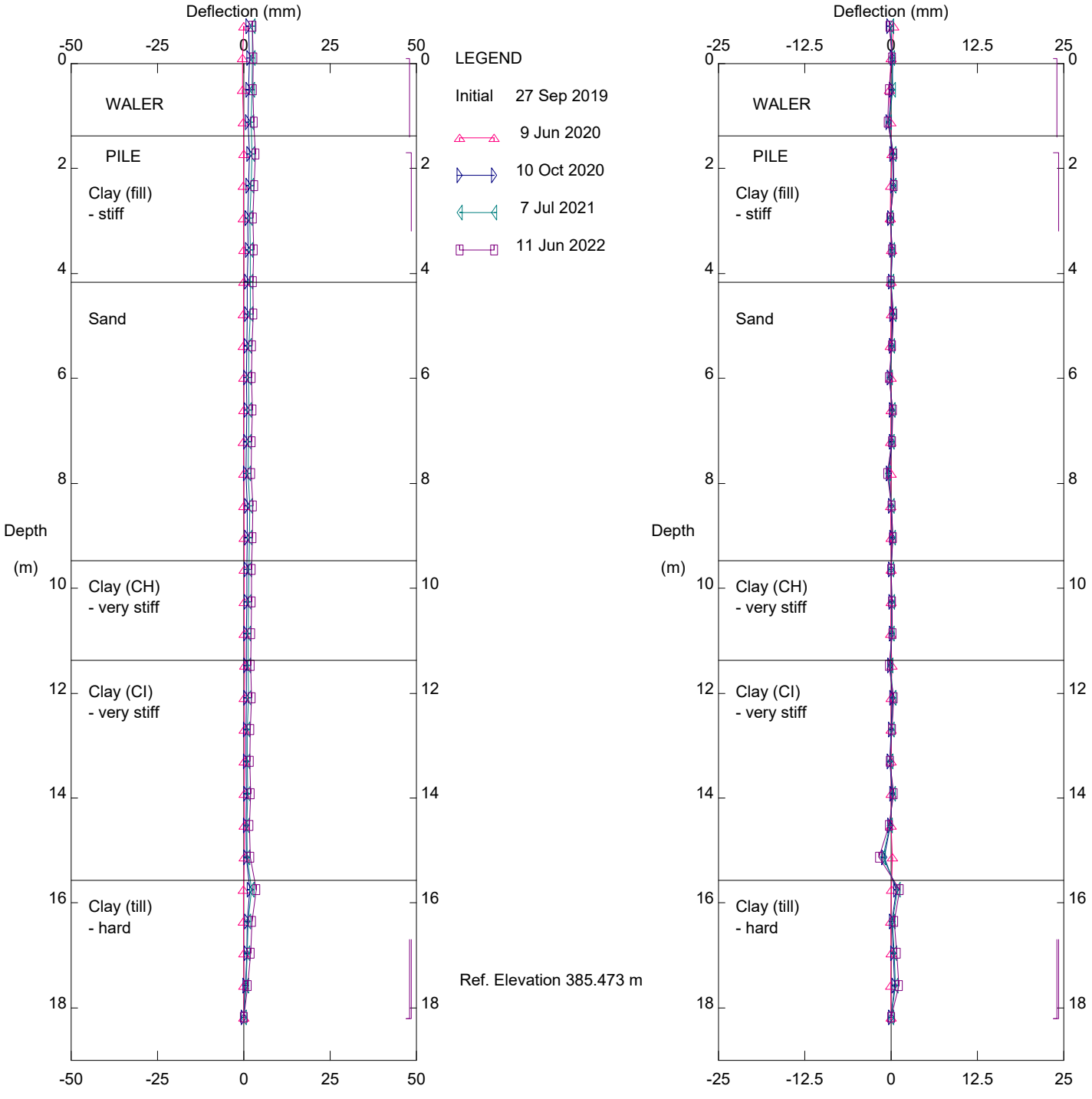
Thurber Engineering Ltd



Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P10

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

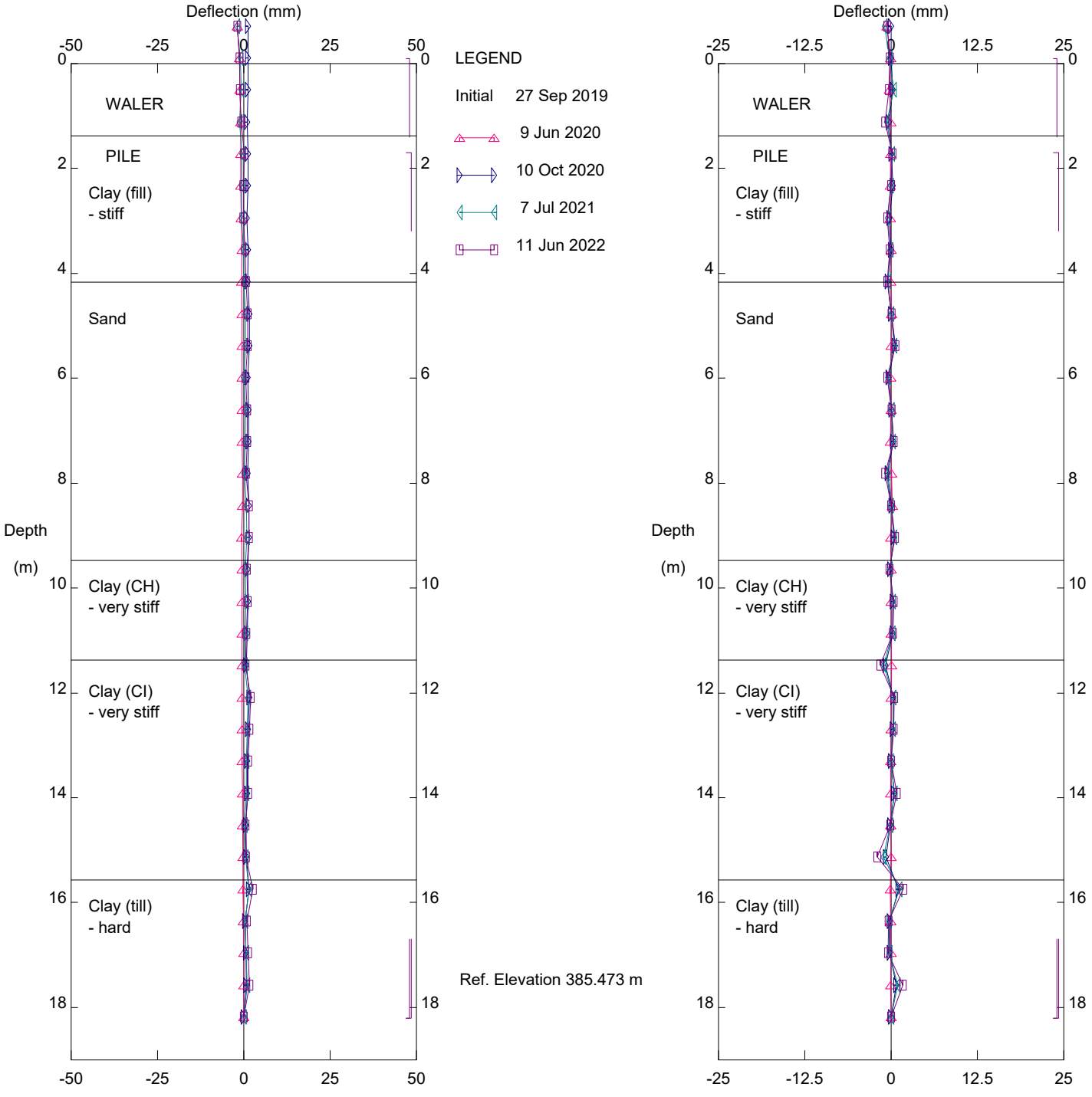
Direction A

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P30

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P30.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

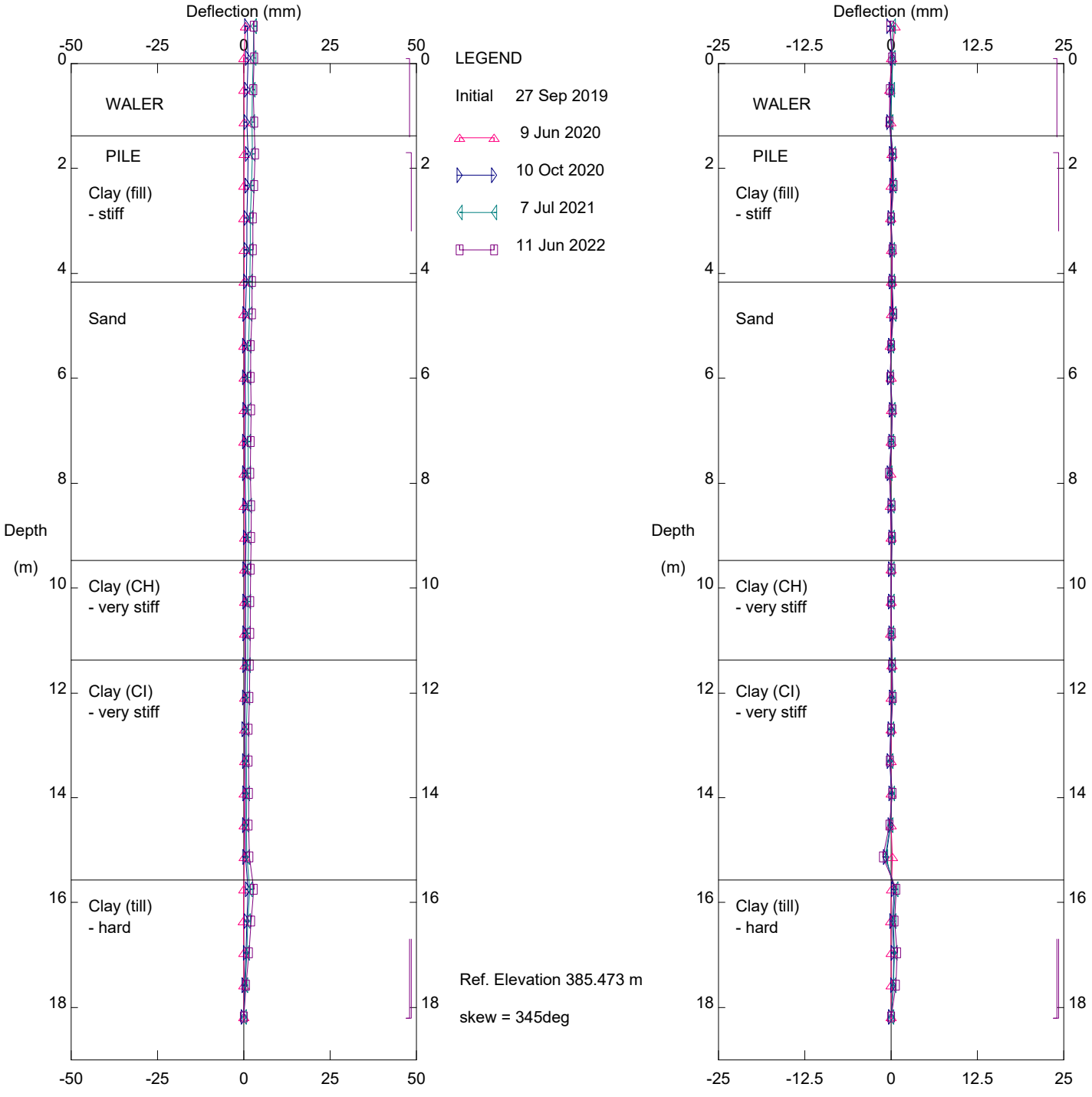
Direction B

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P30

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P30.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

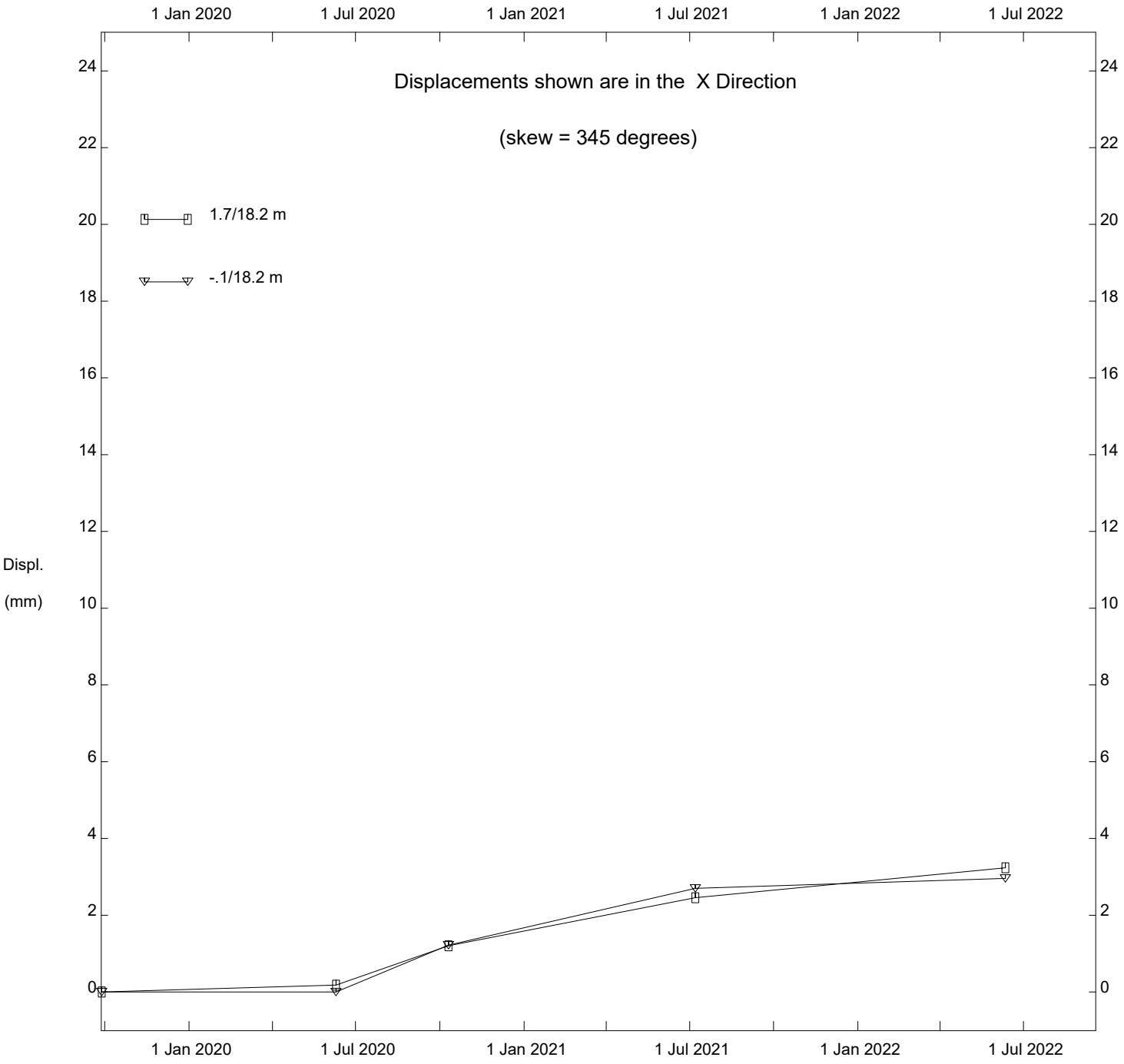
Direction X

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P30

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P30.gtl

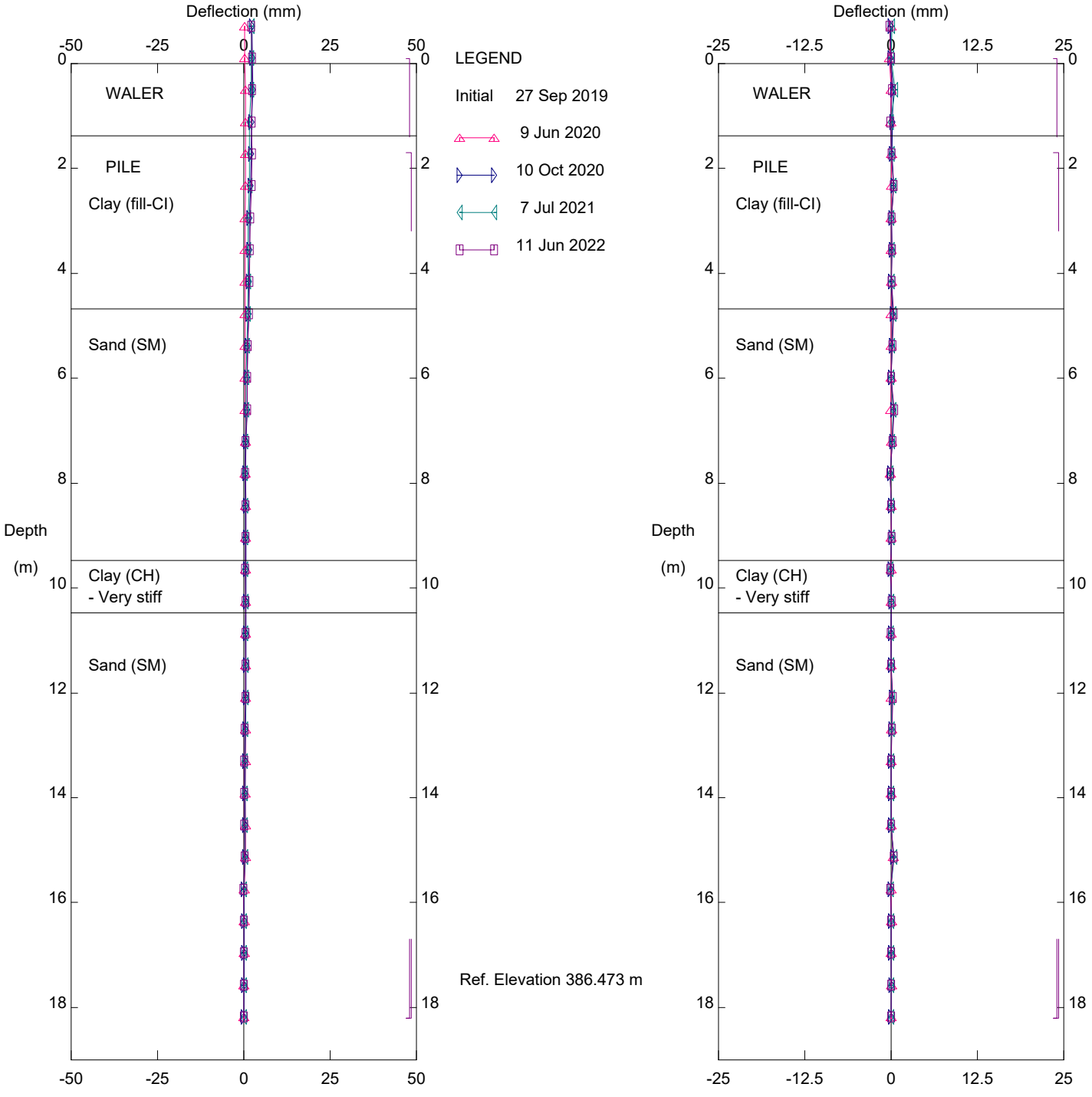
Thurber Engineering Ltd



Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P30

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

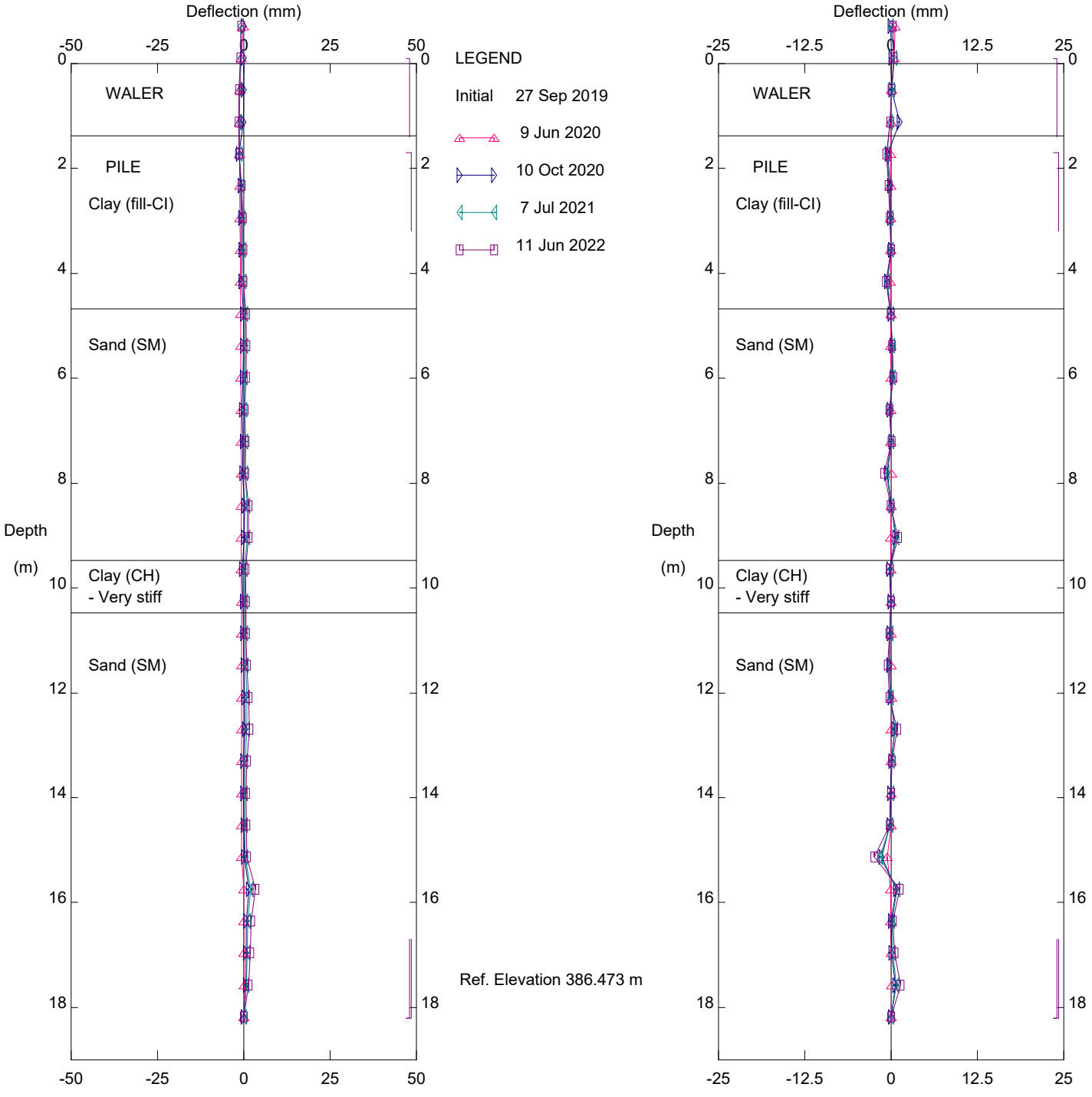
Direction A

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P50

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P50.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

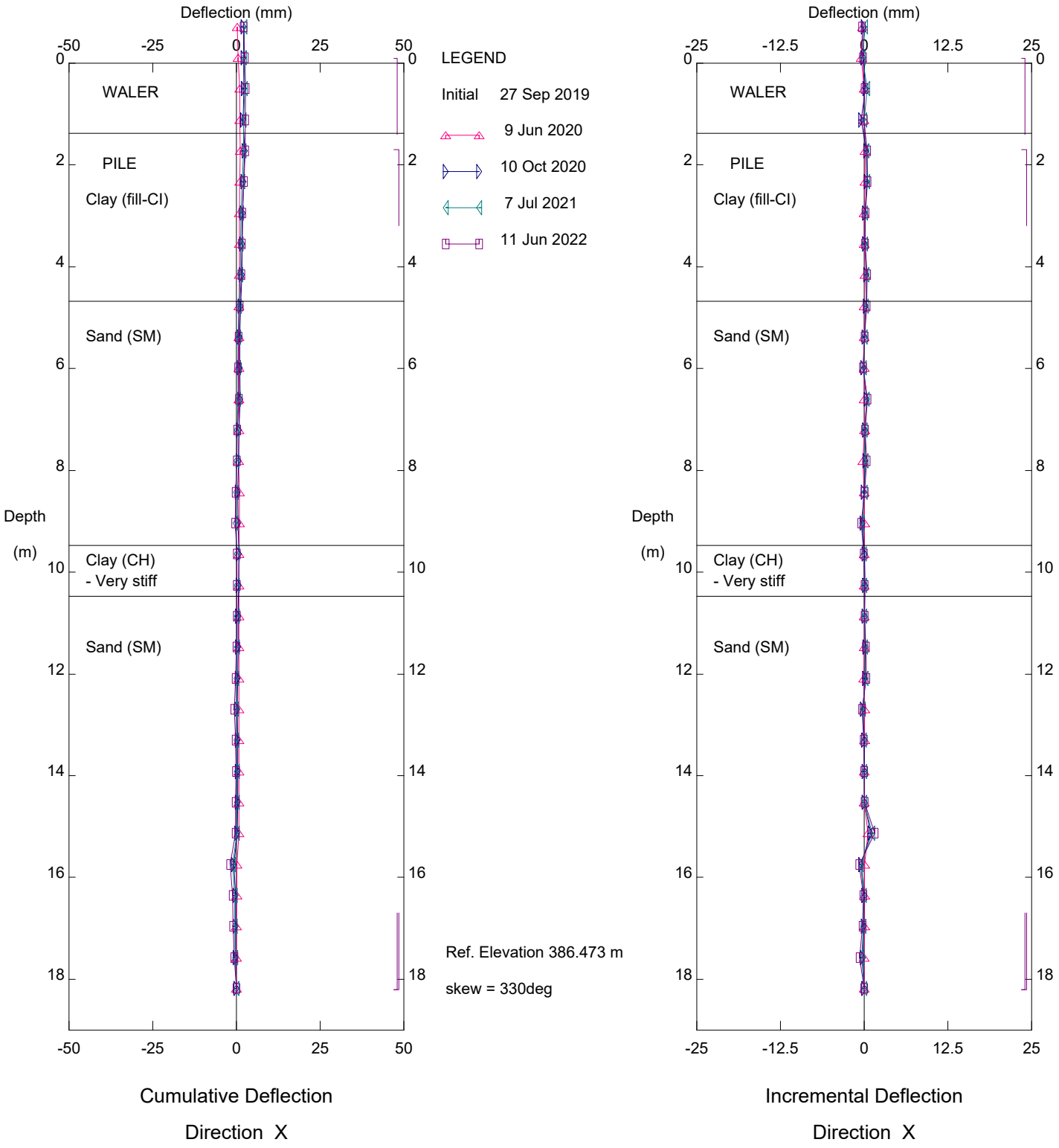
Direction B

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P50

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P50.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

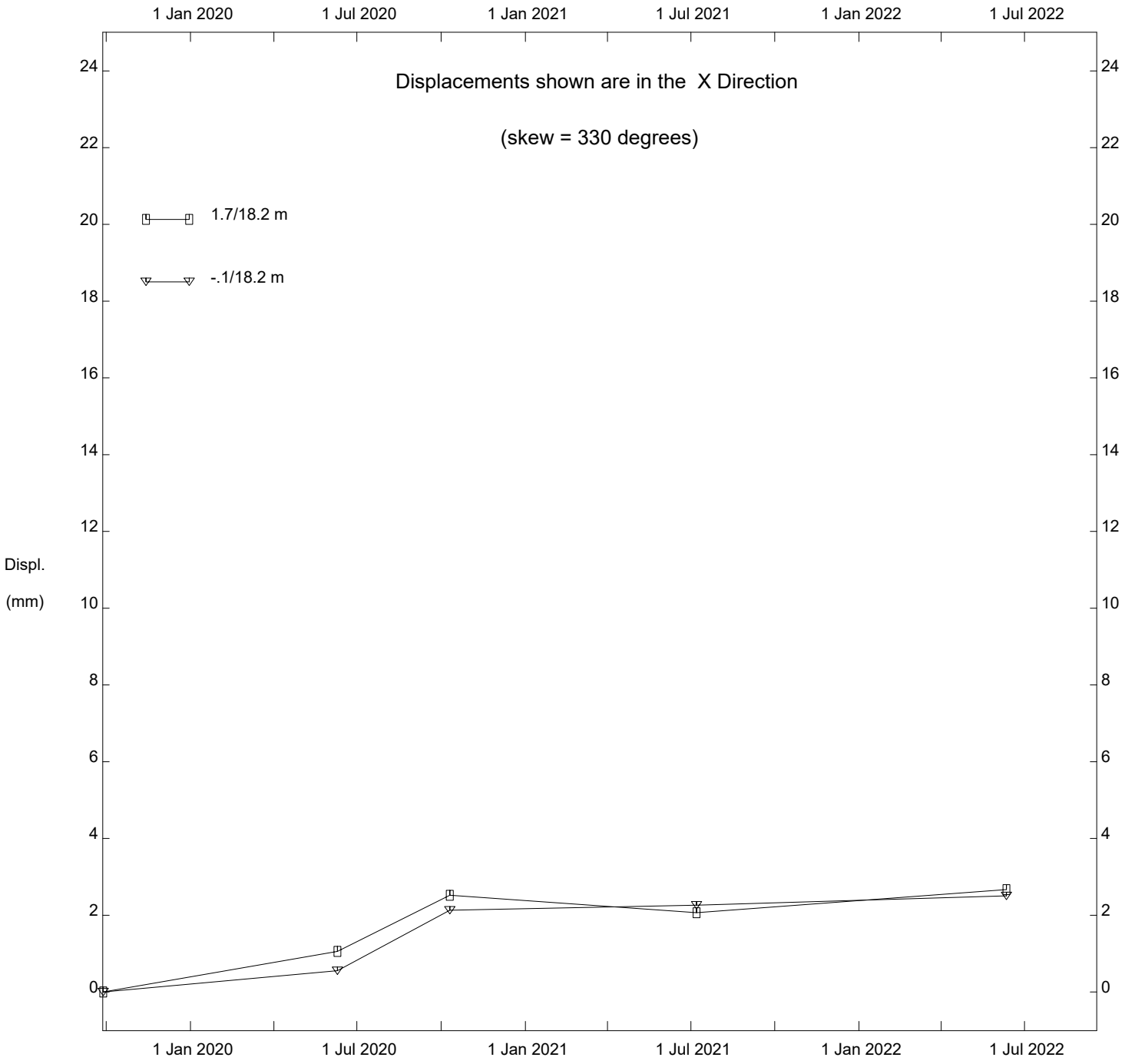
Direction X

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P50

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P50.gtl

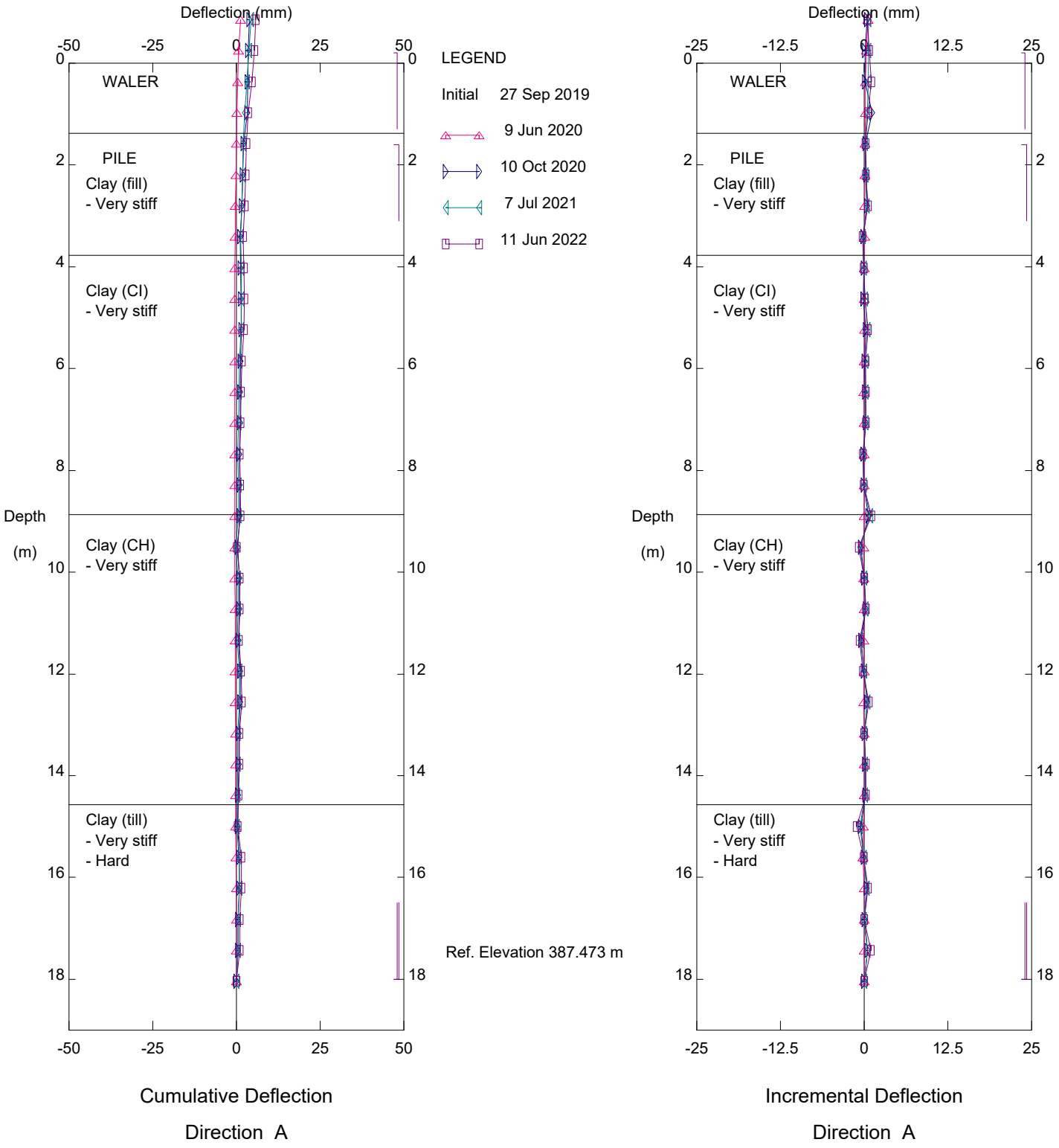
Thurber Engineering Ltd



Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P50

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

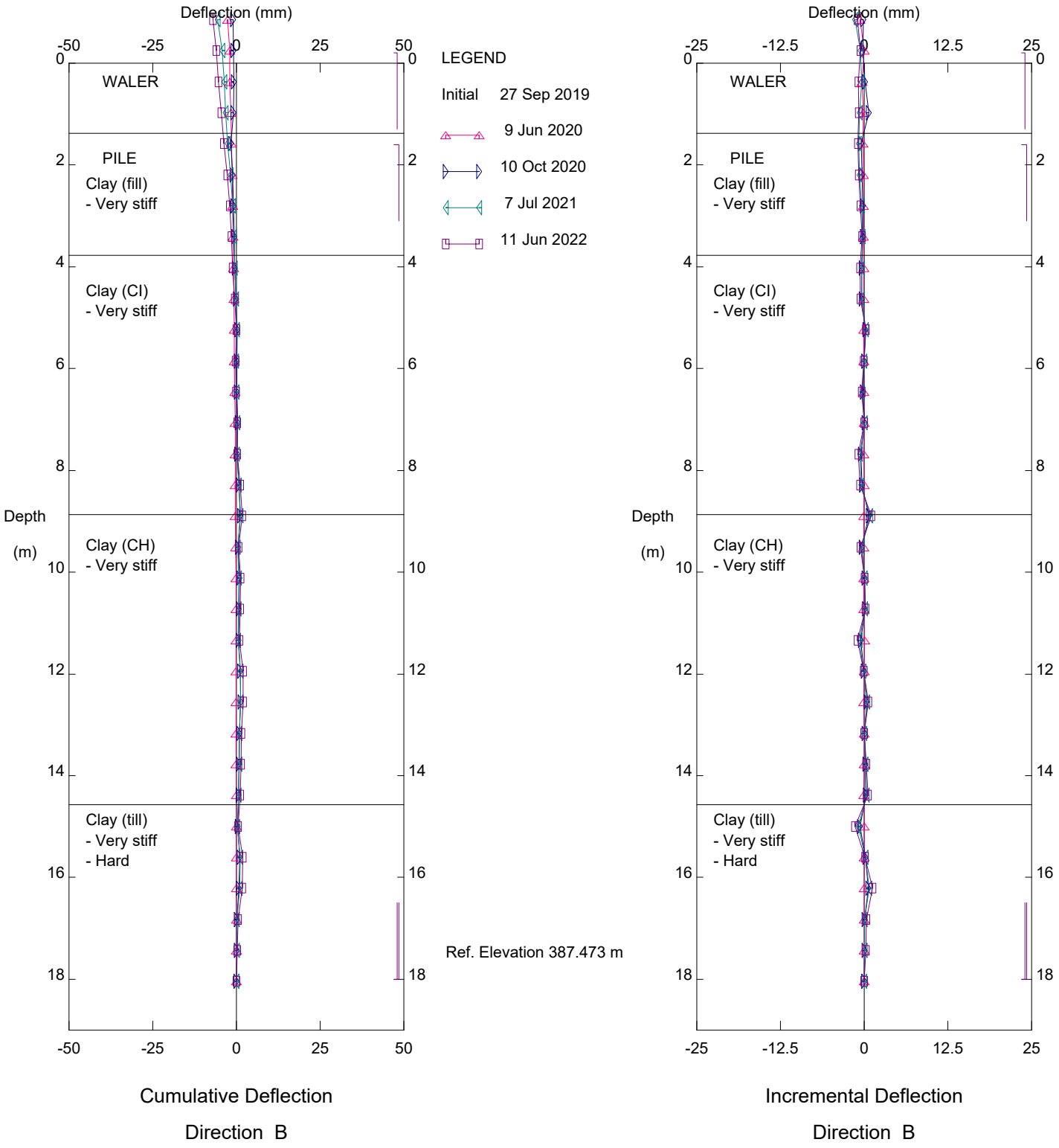
Direction A

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P70

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P70.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

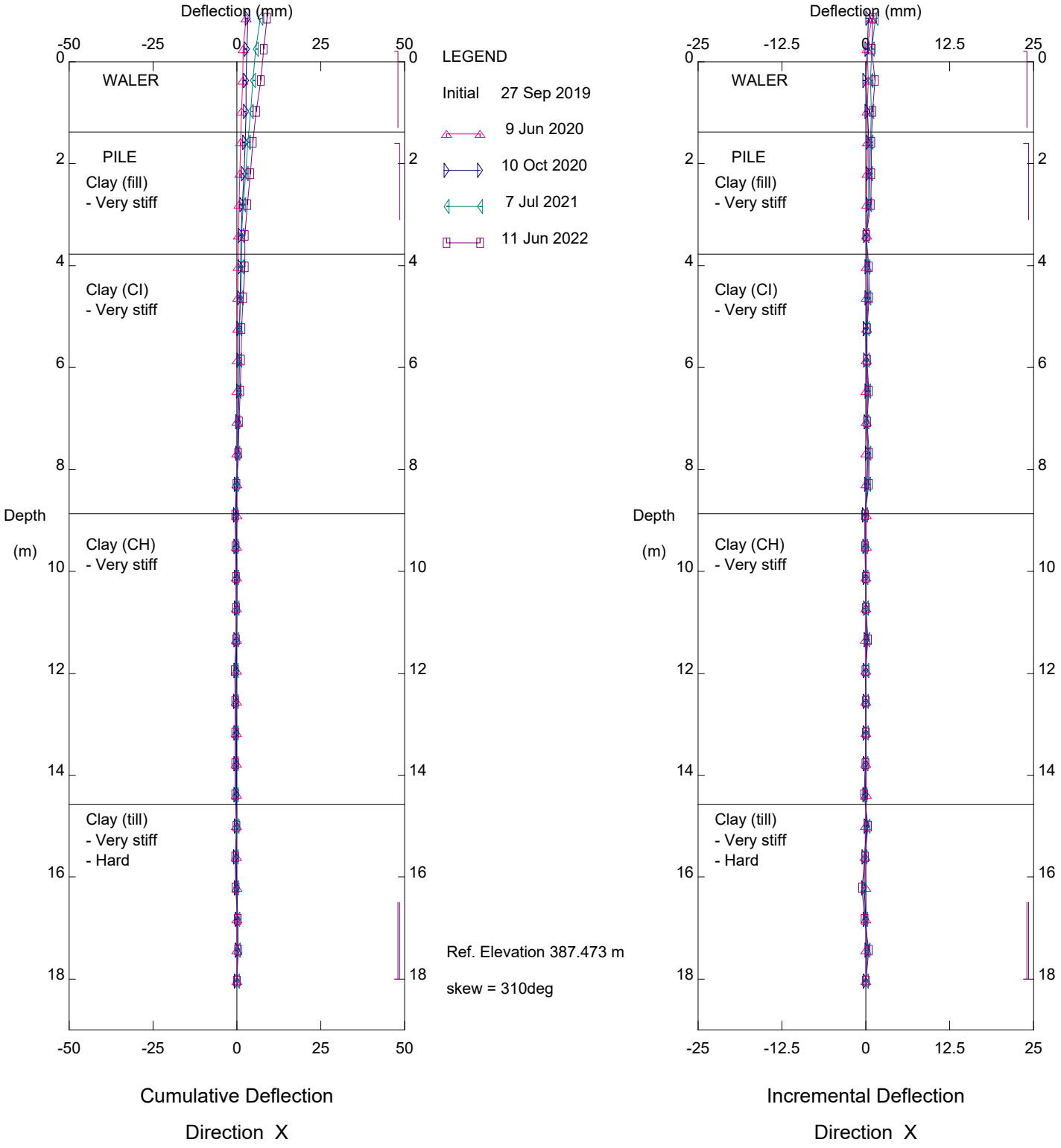
Direction B

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P70

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P70.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

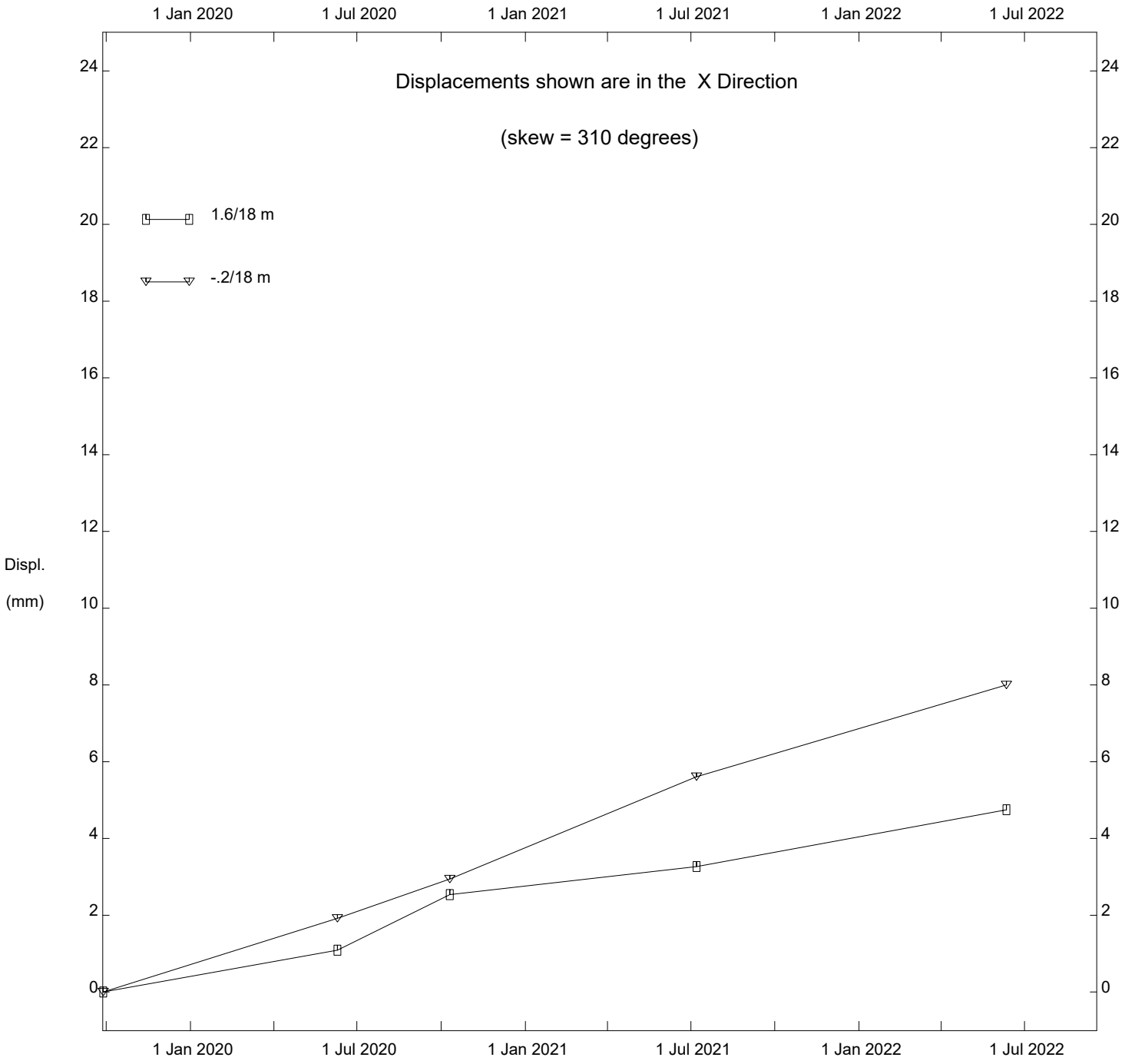
Direction X

Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P70

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022A-Spring\SI Readings\GP031\SI18-P70.gtl

Thurber Engineering Ltd



Hwy 740:02 Shaftesbury Trail, Inclinometer SI18-P70

Alberta Transportation