

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS GRMP
GRANDE PRAIRIE REGION –
(GRANDE PRAIRIE NORTH)
INSTRUMENTATION MONITORING - SPRING 2024**



Site Number	Location	Name	Hwy	km
PH023	HWY 64:02 km 24.10	Clear River East Hill (Site 5- Twin Pipes Landslide)	64:02	Km 24.1
Legal Description: 12-27-84-11 W6		UTM Co-ordinates		
		11U E 335453	N	6244315

Current Monitoring:	27-May-2024	Previous Monitoring	12-Oct-2023
Instruments Read By:	Mr. Niraj Regmi, G.I.T and Mr. Nixon Mationg, of Thurber		

Instruments Read During This Site Visit			
Slope Inclinometers (SIs): SI20-1, SI20-6, and SI20-7	Pneumatic Piezometers (PN): PN20-1A, 1B, 2A, 2B, 3A, 3B, 4A, 5A, 5B, 6A*, 6B*, 7A, 7B, 8A and 8B (6A and 6B read on May 8, 2024)	Vibration Wire Piezometers (VW): N/A	Standpipe Piezometers (SP): N/A
Load Cell (LC): N/A	Strain Gauges: N/A	SAs: N/A	Others:

Readout Equipment Used			
Slope Inclinometers: Two RST Digital Inclinometer probes with 2 ft. wheelbase and RST Pocket PC readouts	Pneumatic Piezometers: RST C108 pneumatic piezometer readout	Vibration Wire Piezometers:	Standpipe Piezometers:
Load Cell:	Strain Gauges:	SAs:	Others:
Notes:			

Discussion	
Zones of New Movement:	None
Interpretation of Monitoring Results:	<p>Overall, the SIs showed similar or accelerated rates of movement compared to the previous readings in the fall of 2023.</p> <p>SI20-1 showed current movement rates of 8.4 mm/yr over 3.7 m to 5.6 m depth and 2.6 mm/yr over 50.1 m to 54.3 m depth. SI20-7 showed rates of movement of 1.5 mm/yr over 17.8 m to 19.6 m and 1.9 mm/yr over 31.8 m to 33.6 m depth. SI 20-1 and 20-7 are about 600 m apart but both show comparable movement rates and elevation of the deeper movement zones (both SI are moving at about el 460 m) which is a confirmation of a very large and deeply seated movement mass</p> <p>Piezometers PN20-6A and PN20-6B were read on May 8, 2024 during the GRMP inspection to avoid the need for third party wildlife escort due to the known presence of bears in the area. The remaining piezometers were read on May 27, 2024 during the spring 2024 instrumentation readings.</p> <p>The groundwater levels in piezometers PN20-1A, PN20-1B, PN20-2A, PN20-2B, PN20-3A, PN20-5A, PN20-6B, PN20-7A, PN20-7B, and PN20-8A showed decreases in ground water levels ranging from 0.07</p>

	<p>m (in PN20-7A) to 1.97 m (in PN20-1A), since the fall of 2023 readings., PN20-8B showed an increase 0.36 m since the fall of 2023 readings. PN20-4A showed no change since the fall of 2023 readings.</p> <p>PN20-6A has shown a trend of decreasing pressures and readings to near 0 PSI and is likely malfunctioning.</p> <p>PN20-3B began functioning again during the spring 2024 readings and showed a ground water level increase of 0.14 m since the fall of 2022 readings, the last time it functioned.</p>
Future Work:	<p>The instruments should be read again in the fall of 2024. PN20-6A has malfunctioned for the last few reading cycles and should be removed from future readings.</p> <p>A third party wildlife escort should be considered to read PN20-6B due to the presence of a bear den near the instrument location.</p>
Instrumentation Repairs:	No instrument repairs are required at this time.
Additional Comments:	

Attachments:	<ul style="list-style-type: none">• Table PH023-1 Spring 2024 – HWY 64:02 Clear River East Hill (Site 5- Twin Pipes Landslide), Slope Inclinometer Instrumentation Reading Summary• Table PH023-2 Spring 2024 – HWY 64:02 Clear River East Hill (Site 5- Twin Pipes Landslide), Pneumatic Piezometer Instrumentation Reading Summary• Statement of Limitations and Conditions• APPENDIX A - PH023-1 SPRING 2024<ul style="list-style-type: none">○ Field Inspector's report○ Site Plan Showing Approximate Instrument Locations (Drawing No. 32123-PH023)○ SI Reading Plots○ Figure PH023-1 (Piezometric Elevations)○ Figure PH023-2 (Piezometric Depths)
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We trust this report meets your requirements at present. If you have any questions, please contact the undersigned at your convenience.

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

Lucas Green, P.Eng.
Geotechnical Engineer

Table Ph023-1 Spring 2024 – Hwy 64:02, Clear River East Hill (Site 5 – Twin Pipes Landslide) Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 27, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI-9	May 8, 1996	126.0 mm over 3.6 m to 7.9 m depth in 284° direction	159.3 mm/yr in October 2020	Sheared at 5.5 m below top of casing	October 18, 2021	N/A	N/A	N/A
		36.2 mm over 9.7 m to 11.6 m depth in 116° direction	43.0 mm/yr. in October 2020			N/A	N/A	N/A
		16.9 mm over 11.6 m to 13.4 m depth in 116° direction	14.7 mm/yr. in October 2020			N/A	N/A	N/A
SI20-1	October 11, 2020	91.7 mm over 3.7 m to 5.6 m depth in 7° direction	49.6 mm/yr in October 2022	Operational	October 12, 2023	5.3	8.4	4.0
		13.5 mm over 50.1 m to 54.3 m depth in 7° direction	5.0 mm/yr in June 2022			1.6	2.6	0
SI20-2	October 11, 2020	39.5 mm over 31.8 m to 34.2 m depth in 193° direction	59.6 mm/yr in July 2021	Sheared at 33.2 m below top of casing	October 18, 2021	N/A	N/A	N/A
		4.2 mm over 42.1 m to 43.4 m depth in 213° direction	7.1 mm/yr in October 2020			N/A	N/A	N/A
SI20-3	October 11, 2020	48.0 mm over 19.6 m to 21.4 m depth in 213° direction	75.1 mm/yr in July 2021	Sheared at 21.0 m below top of casing	October 18, 2021	N/A	N/A	N/A

Drawing 32123-PH023 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

Table Ph023-1 – Continued... Spring 2024 – Hwy 64:02, Clear River East Hill (Site 5 – Twin Pipes Landslide) Slope Inclinator Instrumentation Reading Summary

Date Monitored: May 27, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI20-4	October 11, 2020	49.8 mm over 6.2 m to 8.0 m depth in 197° direction	42.1 mm/yr in June 2022	Sheared at 7.6 m below top of casing	June 20, 2022	N/A	N/A	N/A
		6.1 mm over 60.4 m to 62.3 m depth in 187° direction	8.5 mm/yr in October 2020			N/A	N/A	N/A
SI20-5	October 11, 2020	70.9 mm over 9.4 m to 11.8 m depth in 200° direction	82.3 mm/yr in July 2021	Sheared at 11.6 m below top of casing	June 20, 2022	N/A	N/A	N/A
		74.7 mm over 31.3 m to 35.6 m depth in 200° direction	64.3 mm/yr in June 2022			N/A	N/A	N/A
SI20-6	October 11, 2020	33.9 mm over 18.3 m to 20.1 m depth in 230° direction	73.1 mm/yr in July 2021	Sheared at 20.1 m below top of casing	October 18, 2021	N/A	N/A	N/A
		36.8 mm over 28.1 m to 31.1 m depth in 230° direction	62.6 mm/yr in July 2021			N/A	N/A	N/A
SI20-7	October 11, 2020	32.2 mm over 17.8 m to 19.6 m depth in 195° direction	52.3 mm/yr in October 2022	Operational	October 12, 2023	1.0	1.5	9.3
		13.2 mm over 31.8 m to 33.6 m depth in 204° direction	6.5 mm/yr in June 2022			1.2	1.9	<-0.1

Drawing 32123-PH023 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site



Table Ph023-1 – Continued... Spring 2024 – Hwy 64:02, Clear River East Hill (Site 5 – Twin Pipes Landslide) Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 27, 2024

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
<i>SI20-8</i>	<i>October 11, 2020</i>	<i>48.4 mm over 34.1 m to 36.6 m depth in 194° direction</i>	<i>53.0 mm/yr in June 2022</i>	<i>Sheared at 36.2 m below top of casing</i>	<i>October 18, 2021</i>	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>

Drawing 32123-PH023 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site



Table Ph023-2 Spring 2024 – Hwy 64:02, Clear River East Hill (Site 5 – Twin Pipes Landslide) Pneumatic Piezometer Instrumentation Reading Summary

Date Monitored: May 27, 2024

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER ELEVATION (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER ELEVATION (m)	PREVIOUS GROUNDWATER ELEVATION (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN20-1A (38006)	October 11, 2020	27.43	515.79	Operational	506.64 on October 12, 2023	160.0	504.67	506.64	-1.97
PN20-1B (38581)	October 11, 2020	57.91	515.79	Operational	492.82 on October 11, 2020	286.8	487.13	488.25	-1.12
PN20-2A (38240)	October 11, 2020	5.79	506.27	Operational	506.46 on June 20, 2022	47.6	505.33	505.47	-0.14
PN20-2B (37405)	October 11, 2020	36.58	506.27	Operational	497.81 on October 11, 2020	251.7	495.35	495.92	-0.57
PN20-3A (38242)	October 11, 2020	15.24	497.13	Operational	491.73 on October 12, 2023	95.8	491.66	491.87	-0.21
PN20-3B (37402)	October 11, 2020	30.48	497.13	Operational	491.89 on February 18, 2021	244.1	491.54	491.40 (Oct. 1, 2022)	0.14
PN20-4A (38241)	October 11, 2020	6.40	517.15	Operational	511.10 on November 26, 2020	0.7	510.82	510.82	0.00
PN20-4B (38580)	October 11, 2020	51.82	517.15	Non-operational	469.06 on November 26, 2020	N/A	N/A	469.06 (Nov. 26, 2020)	N/A

Drawing 32123-PH023 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

Table Ph023-2 – Continued... Spring 2024 – Hwy 64:02, Clear River East Hill (Site 5 – Twin Pipes Landslide) Pneumatic Piezometer Instrumentation Reading Summary

Date Monitored: May 27, 2024

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER ELEVATION (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER ELEVATION (m)	PREVIOUS GROUNDWATER ELEVATION (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN20-5A (37853)	October 19, 2020	7.62	490.91	Operational	486.45 on June 20, 2022	23.4	485.68	485.54	-0.14
PN20-5B (37403)	October 19, 2020	49.99	490.91	Damaged	450.62 on October 19, 2020	0.7	N/A	440.99 (June 20, 2022)	N/A
PN20-6A (38005)	October 11, 2020	15.24	489.15	Operational	484.11 on July 15, 2021	0.7	473.98	474.12	-0.14
PN20-6B (37404)	October 11, 2020	38.40	489.15	Operational,	468.82 on October 11, 2020	80.7	458.98	460.45	-1.47
PN20-7A (38007)	October 11, 2020	13.41	492.55	Operational	484.56 on June 20, 2022	51.7	484.42	484.49	-0.07
PN20-7B (38528)	October 11, 2020	53.34	492.55	Operational	450.81 on October 11, 2020	41.4	443.43	444.70	-1.27
PN20-8A (38239)	October 11, 2020	27.43	488.99	Operational	475.41 on October 1, 2022	131.7	474.99	475.13	-0.14
PN20-8B (38583)	October 11, 2020	44.20	488.99	Operational	469.75 on October 24, 2020	210.3	466.24	465.88	0.36

Drawing 32123-PH023 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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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.

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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.

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

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THURBER ENGINEERING LTD.

**ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP (CON0022165)
PEACE REGION (GRANDE PRAIRIE DISTRICT – NORTH)
INSTRUMENTATION MONITORING RESULTS**

SPRING 2024

**APPENDIX A
DATA PRESENTATION**

**SITE PH023: HWY 64:02, CLEAR RIVER EAST HILL
(SITE 5 – TWIN PIPES LANDSLIDE)**

**ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
PEACE REGION (GRANDE PRAIRIE - NORTH DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (PH023)
SPRING 2024**

Location: Clear River East Hill - Site 5 (HWY 64:02 C1 24.101)	Readout: RST PN C108 Unit 4
File Number: 32123	Casing Size: 2.75
Probe: RST SI Set 8R	Temp: 16
Cable: RST SI Set 8R	Read by: NKR/NRM

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 #	Size (")	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-			
SI20-1	335453	6244315	27-May-24	0.83	196 to 2	340	-119	138	-43	24	8R/8R	2.75	
SI20-7	334956	6244086	27-May-24	0.82	178 to 2	180	-72	85	78	-82	5R/5R	2.75	

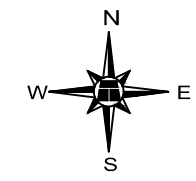
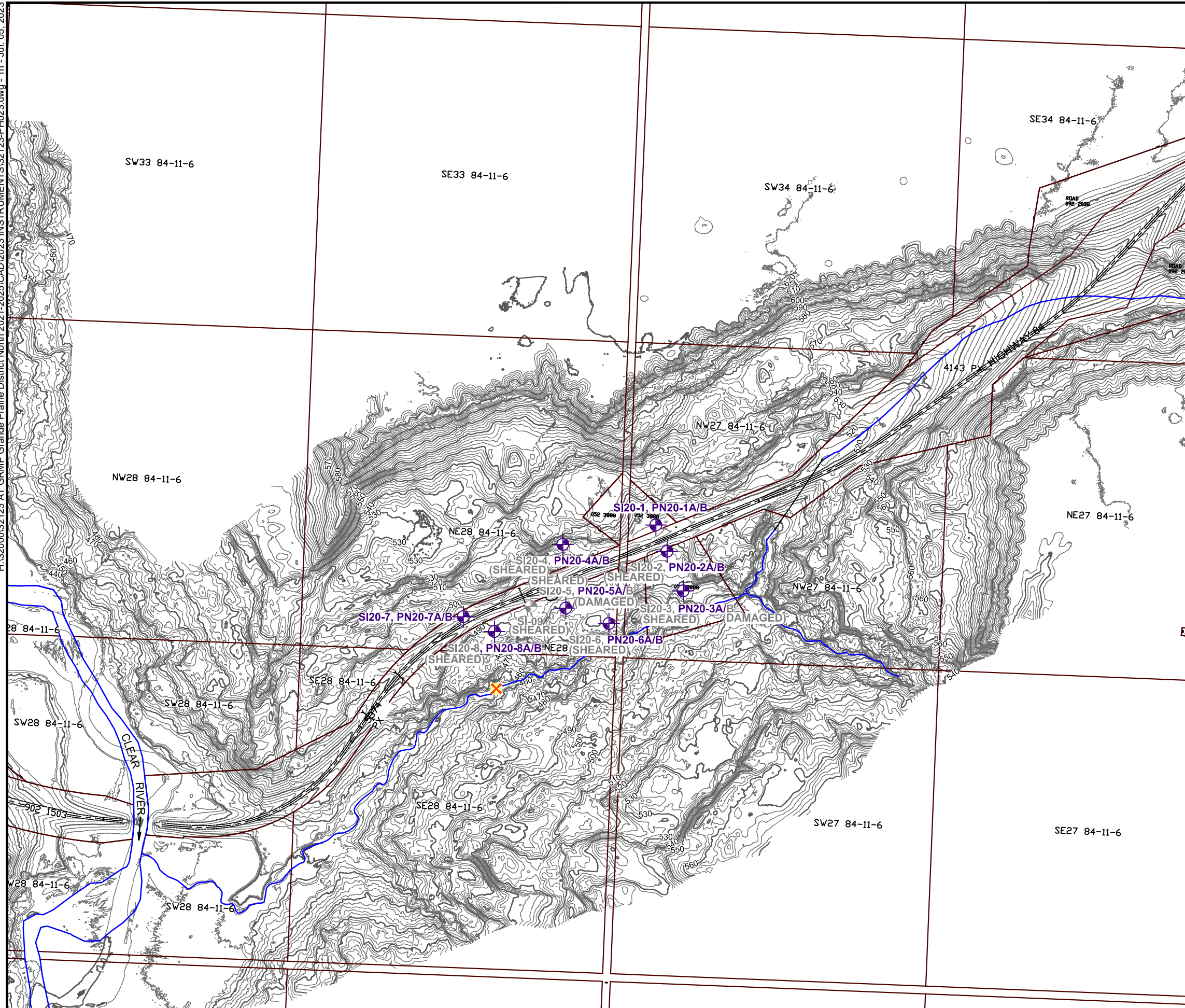
PNEUMATIC PIEZOMETER (PN) READINGS

PN#	GPS Location (UTM 11)		Date	Reading Psi	Identification Number
	Easting (m)	Northing (m)			
PN20-1A	335453	6244315	27-May-24	23.2	38006
PN20-1B	335453	6244315	27-May-24	41.6	38581
PN20-2A	335476	6244253	27-May-24	6.9	38240
PN20-2B	335476	6244253	27-May-24	36.5	37405
PN20-3A	335579	6244143	27-May-24	13.9	38242
PN20-3B	335579	6244143	27-May-24	35.4	37402
PN20-4A	335200	6244260	27-May-24	0.1	38241
PN20-5A	335235	6244111	27-May-24	3.4	37853
PN20-6A*	335332	6244073	08-May-24	0.1	38005
PN20-6B*	335332	6244073	08-May-24	11.7	37404
PN20-7A	334956	6244086	27-May-24	7.5	38007
PN20-7B	334956	6244086	27-May-24	6	38582
PN20-8A	332430	5933825	27-May-24	19.1	38239
PN20-8B	332430	5933825	27-May-24	30.5	38583




INSPECTOR REPORT

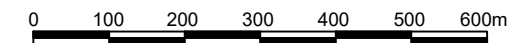
Read during site inspection as a group to avoid the need for bear escort services.

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2023 INSTRUMENTS\32123-PH023.dwg - 1n - Jul. 05, 2023



LEGEND

-  APPROXIMATE INSTRUMENT LOCATION
-  PISCES TRANSECT 4.5 LOCATION (NAD83 ZN11 COORDINATES = 335041E 6243896N)
-  APPROXIMATE TRIBUTARY CENTERLINE



SCALE 1:10000

BASE PLAN PROVIDED BY WSP (LIDAR UAV FLOWN SEPT 29/30, 2020)



**PEACE REGION
(GRANDE PRAIRIE DISTRICT NORTH)**

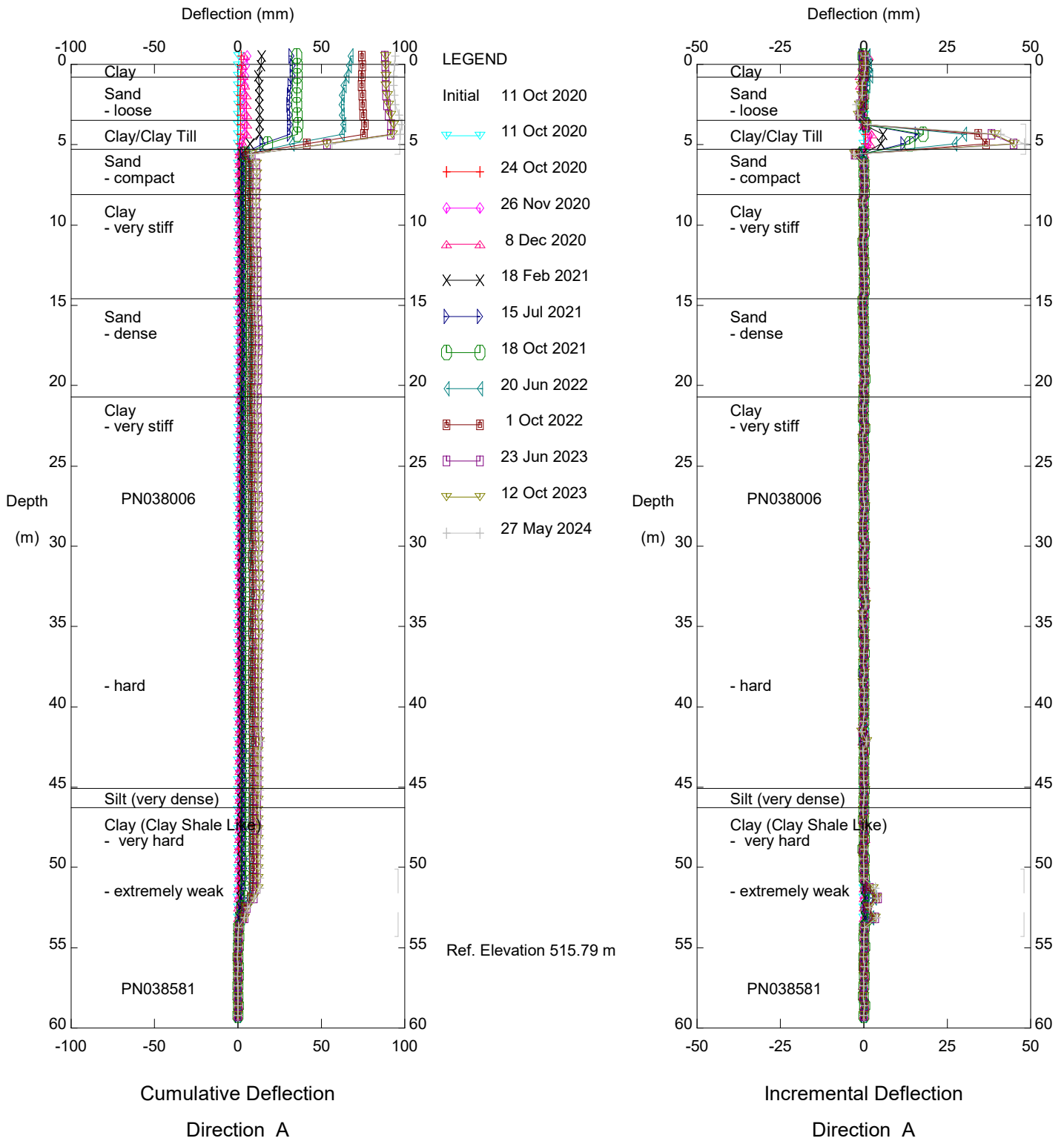
**PH023: HWY 64:02 - CLEAR RIVER EAST HILL
SITE PLAN SHOWING APPROXIMATE
INSTRUMENT LOCATIONS**

DWG No. 32123-PH023

DRAWN BY	ML
DESIGNED BY	BNW
APPROVED BY	DWP
SCALE	1:10000
DATE	JULY 2023
FILE No.	32123



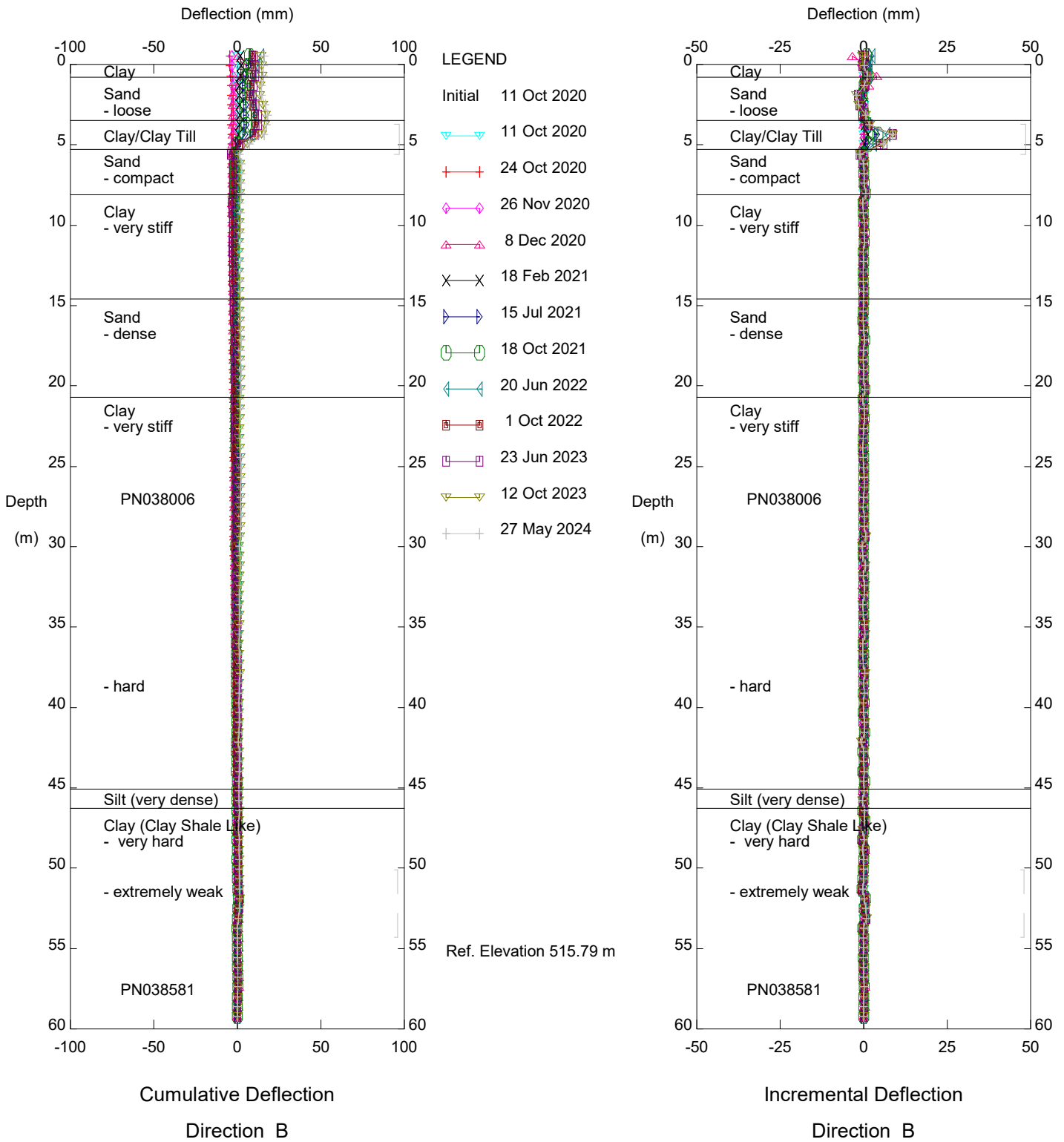
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-1

Alberta Transportation

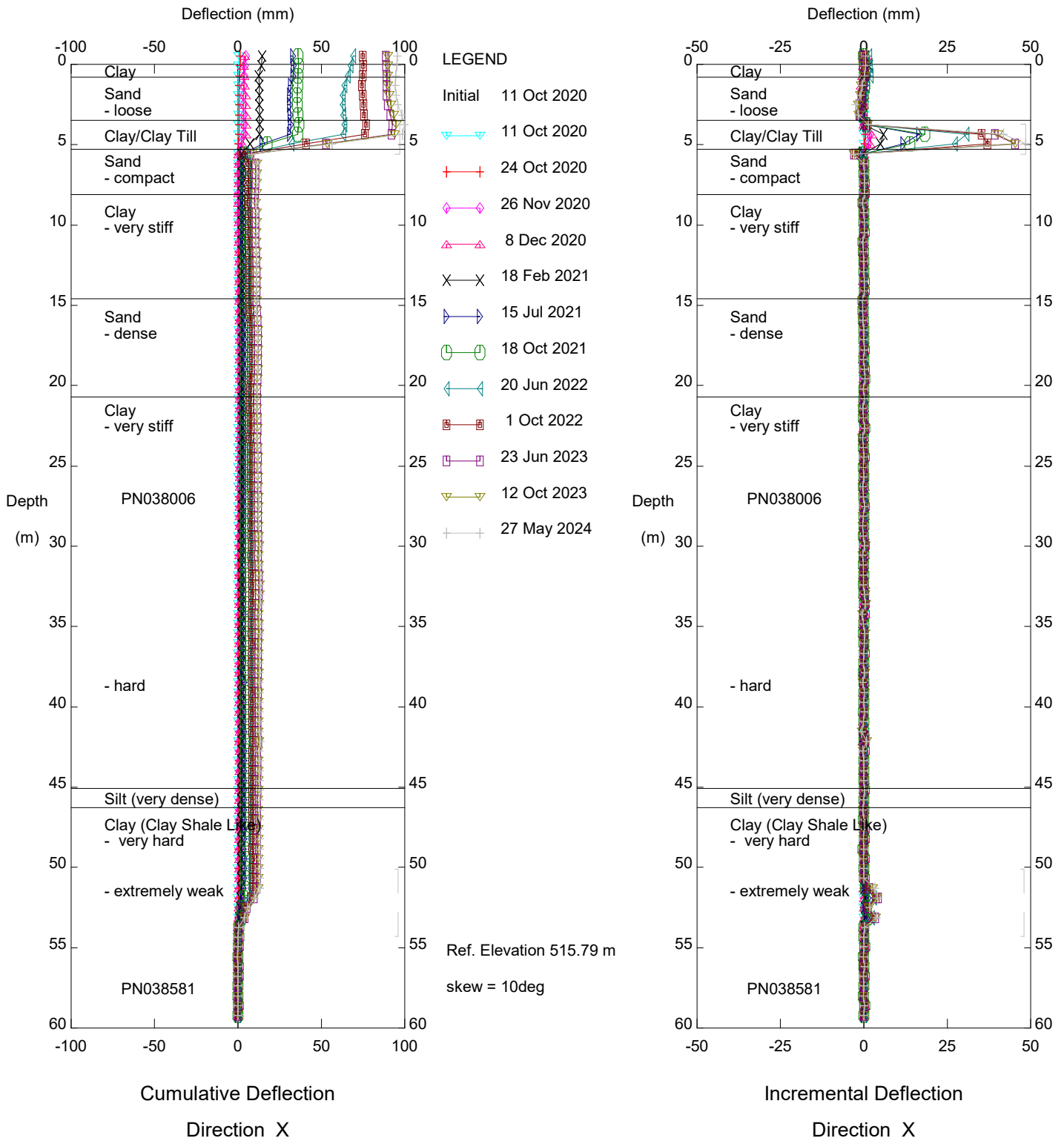
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-1

Alberta Transportation

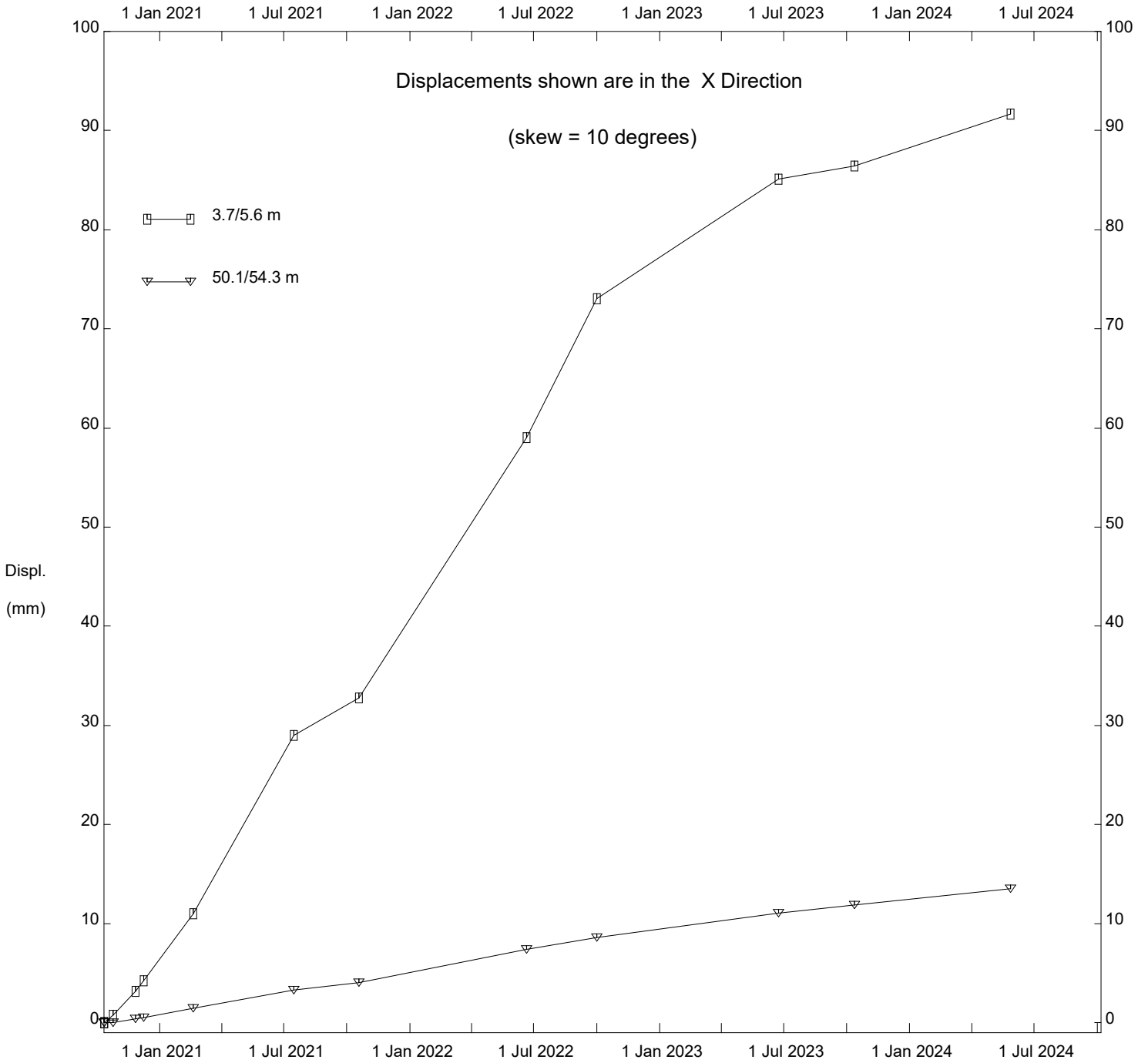
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-1

Alberta Transportation

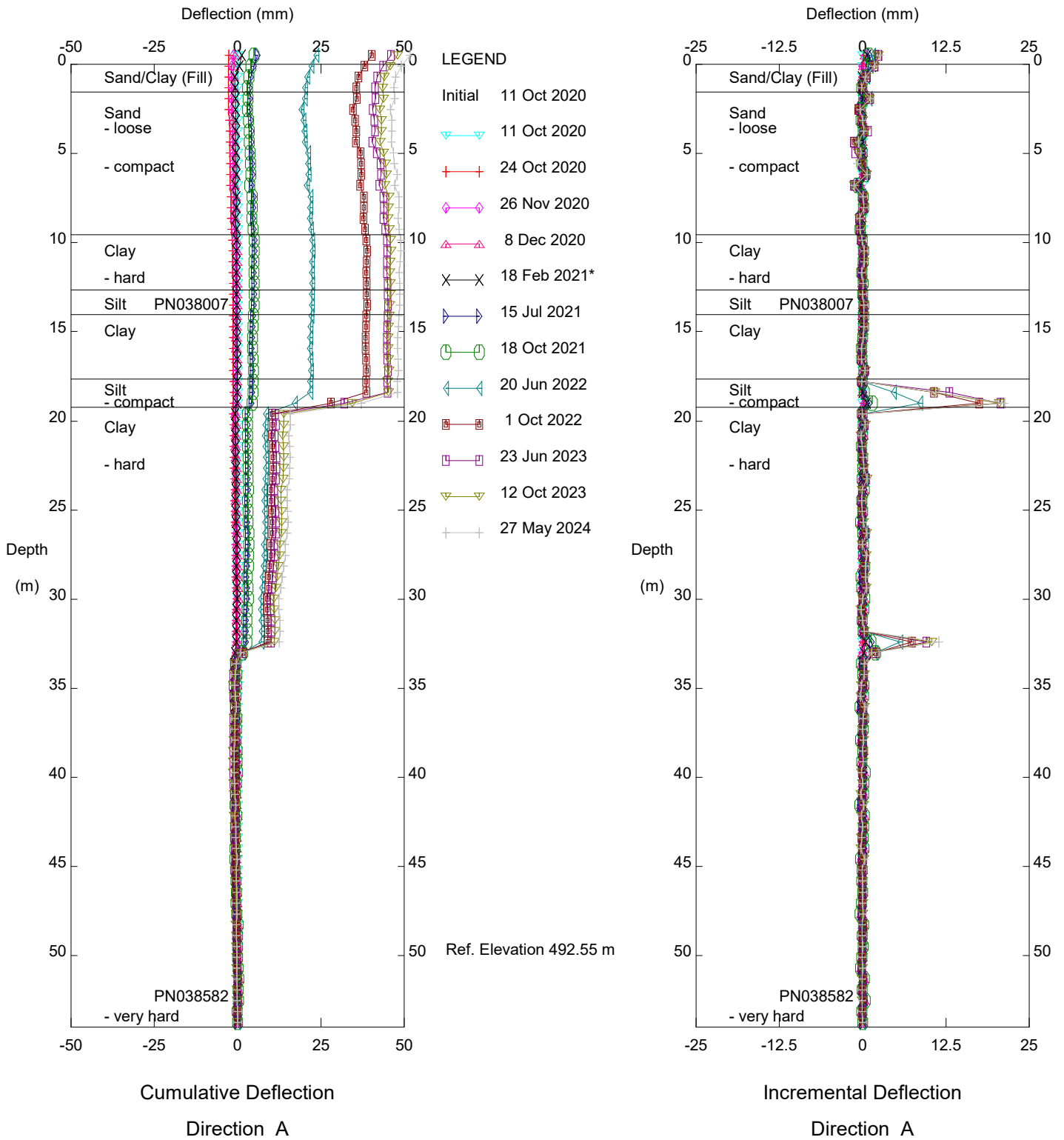
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinator SI20-1

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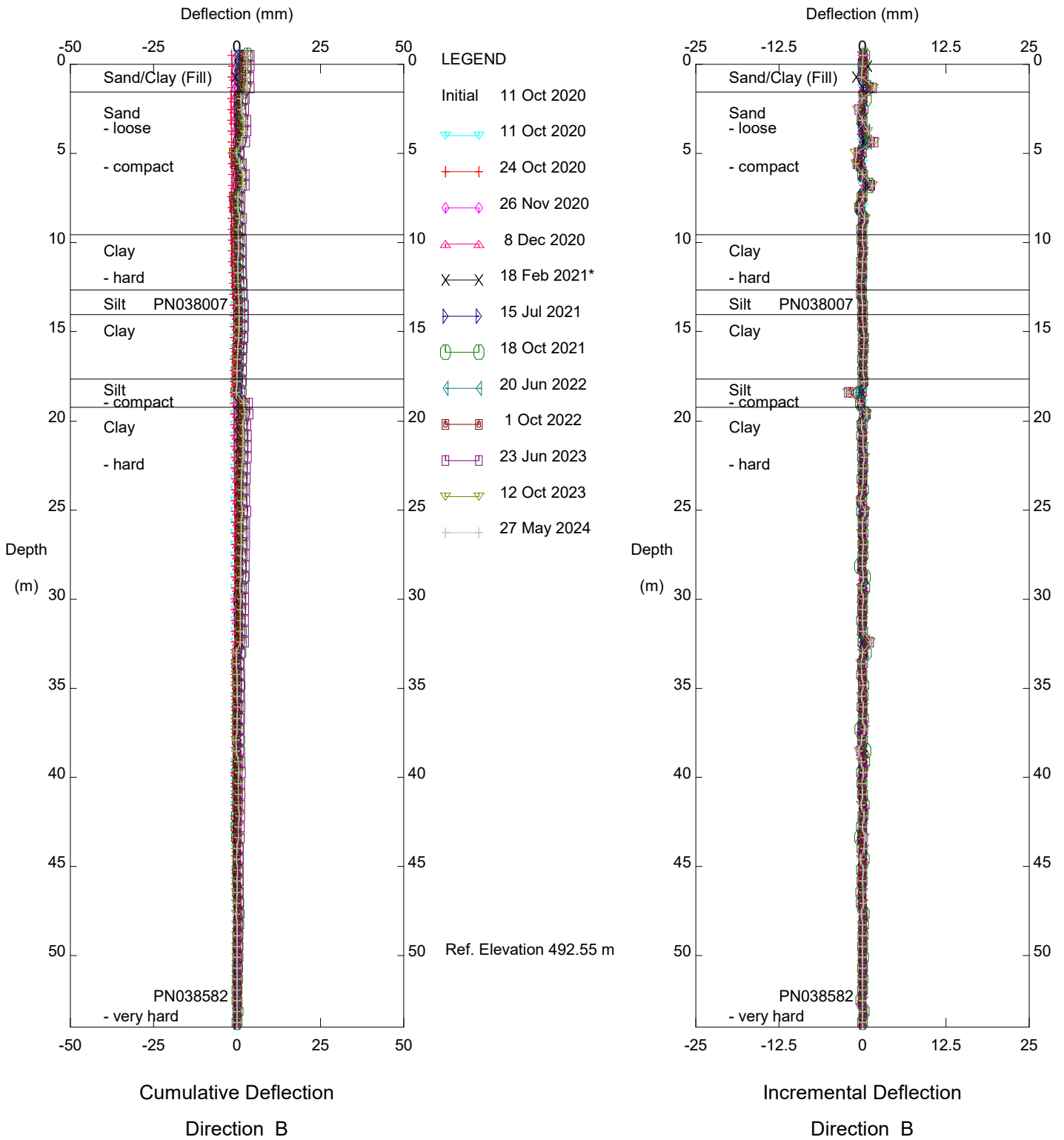


Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-7

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

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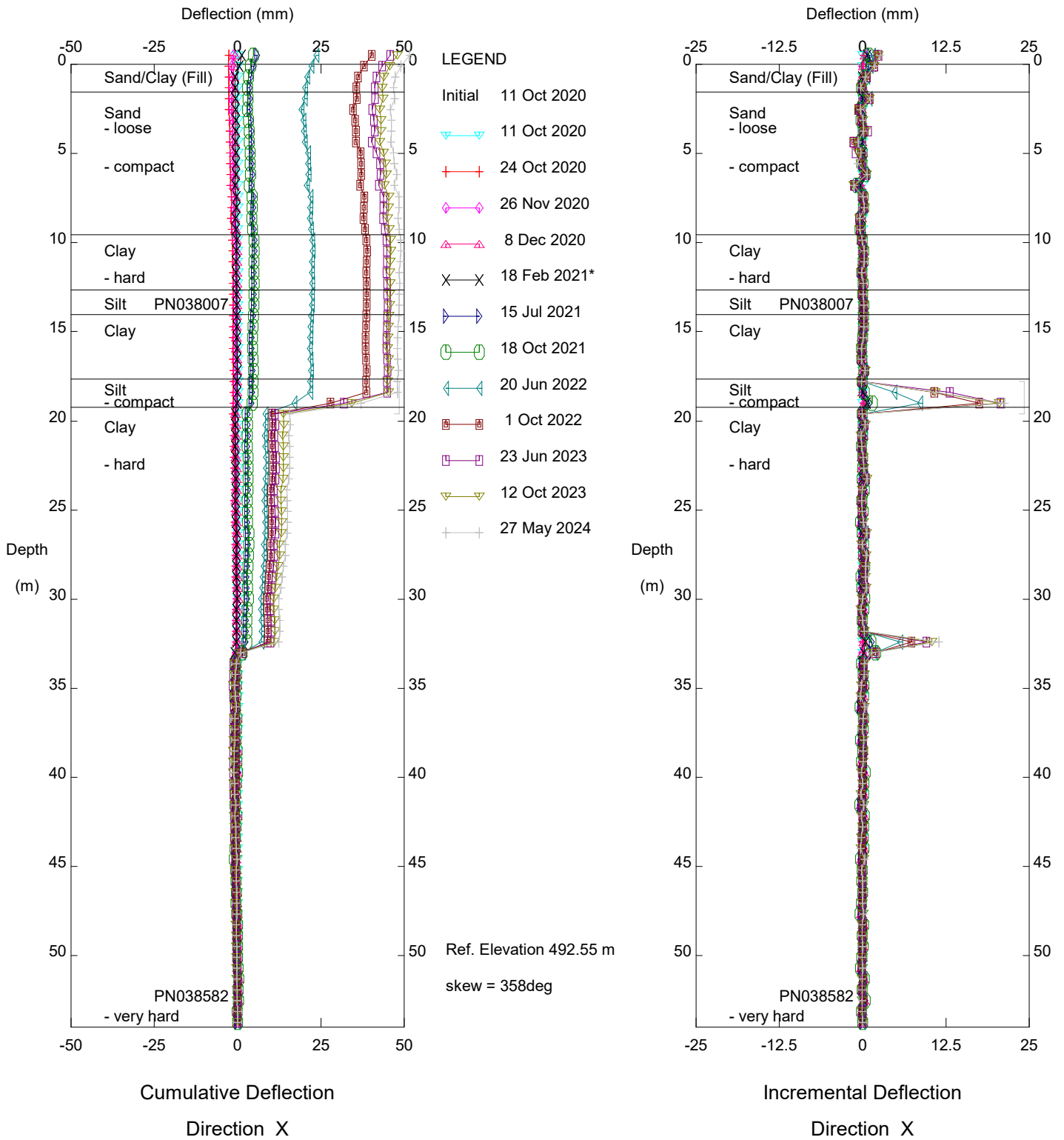


Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-7

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

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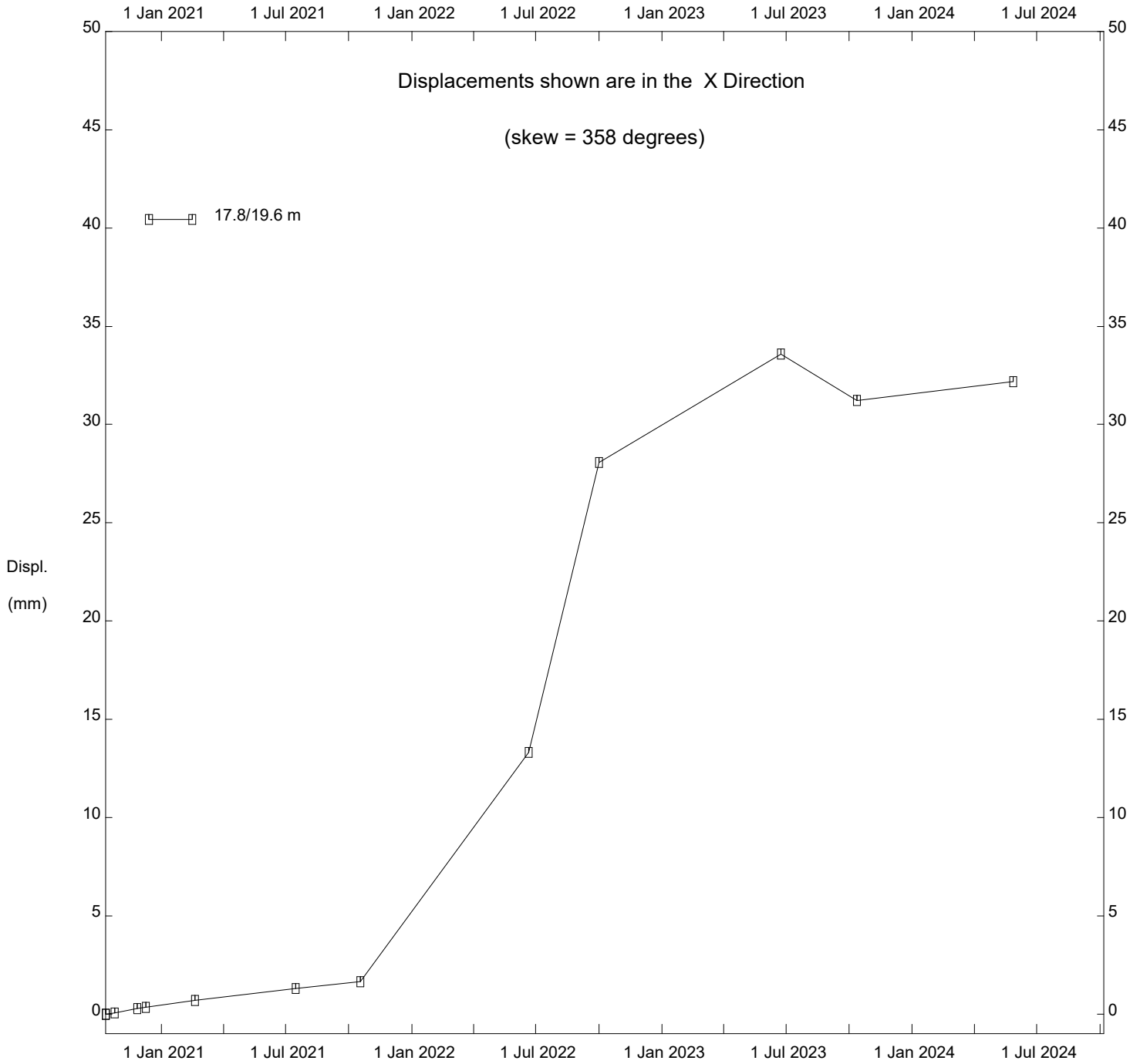


Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-7

Alberta Transportation

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

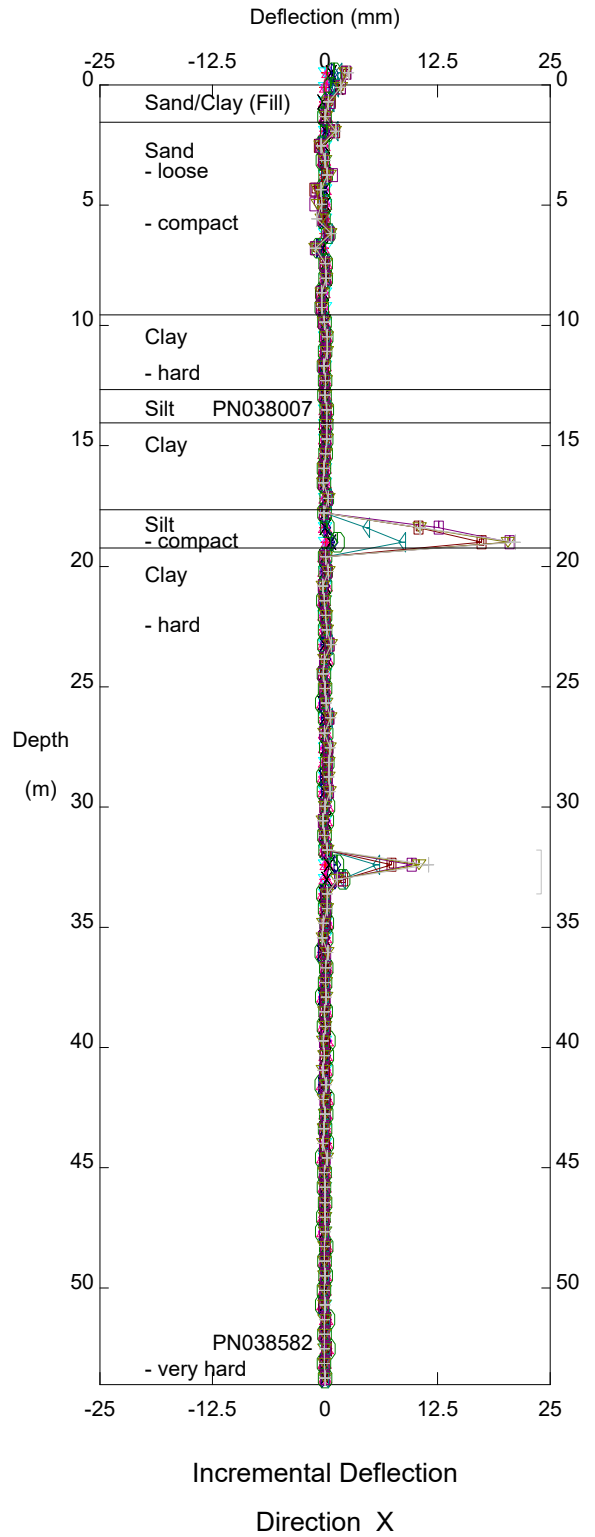
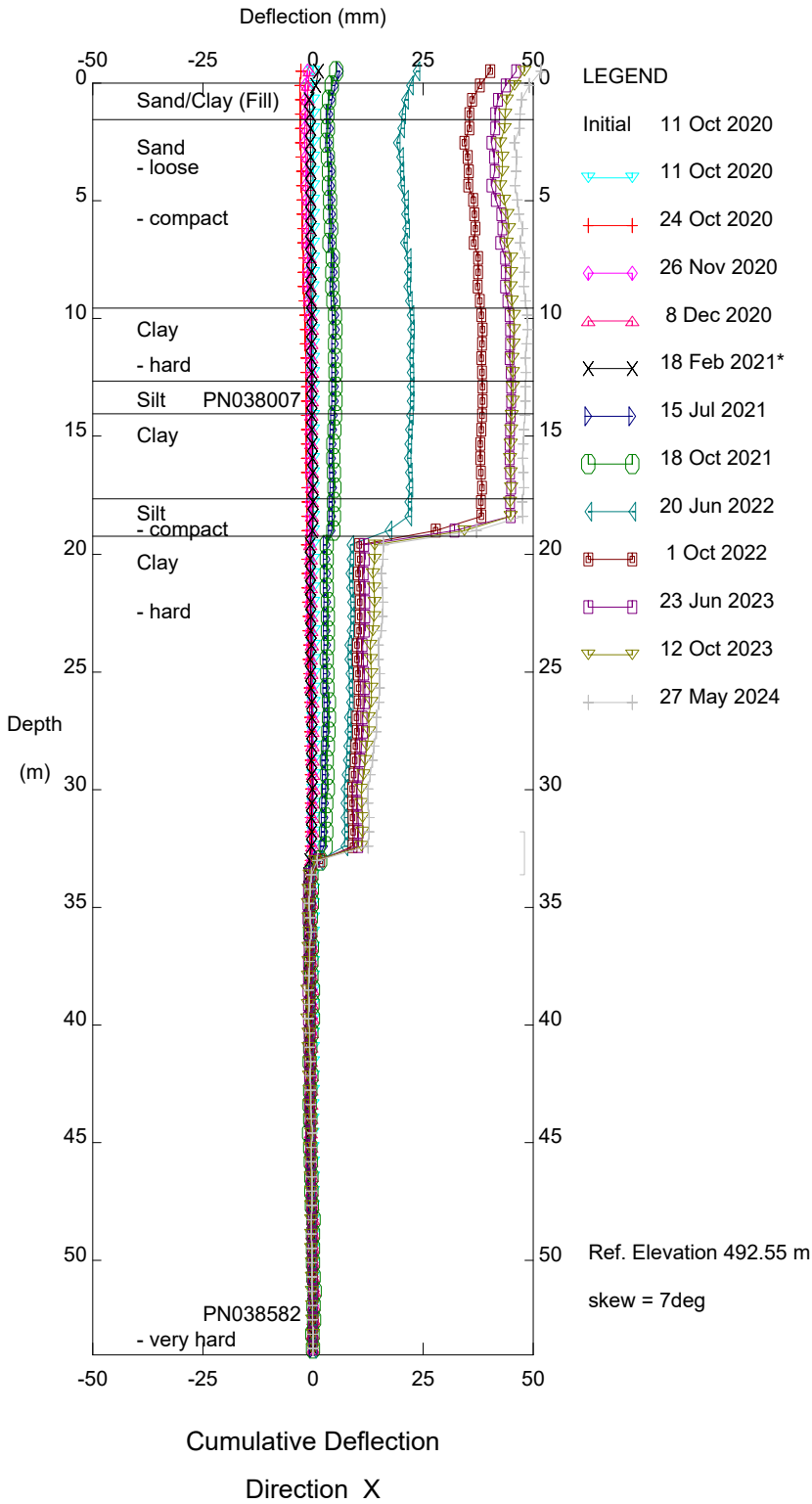
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinator SI20-7

Alberta Transportation

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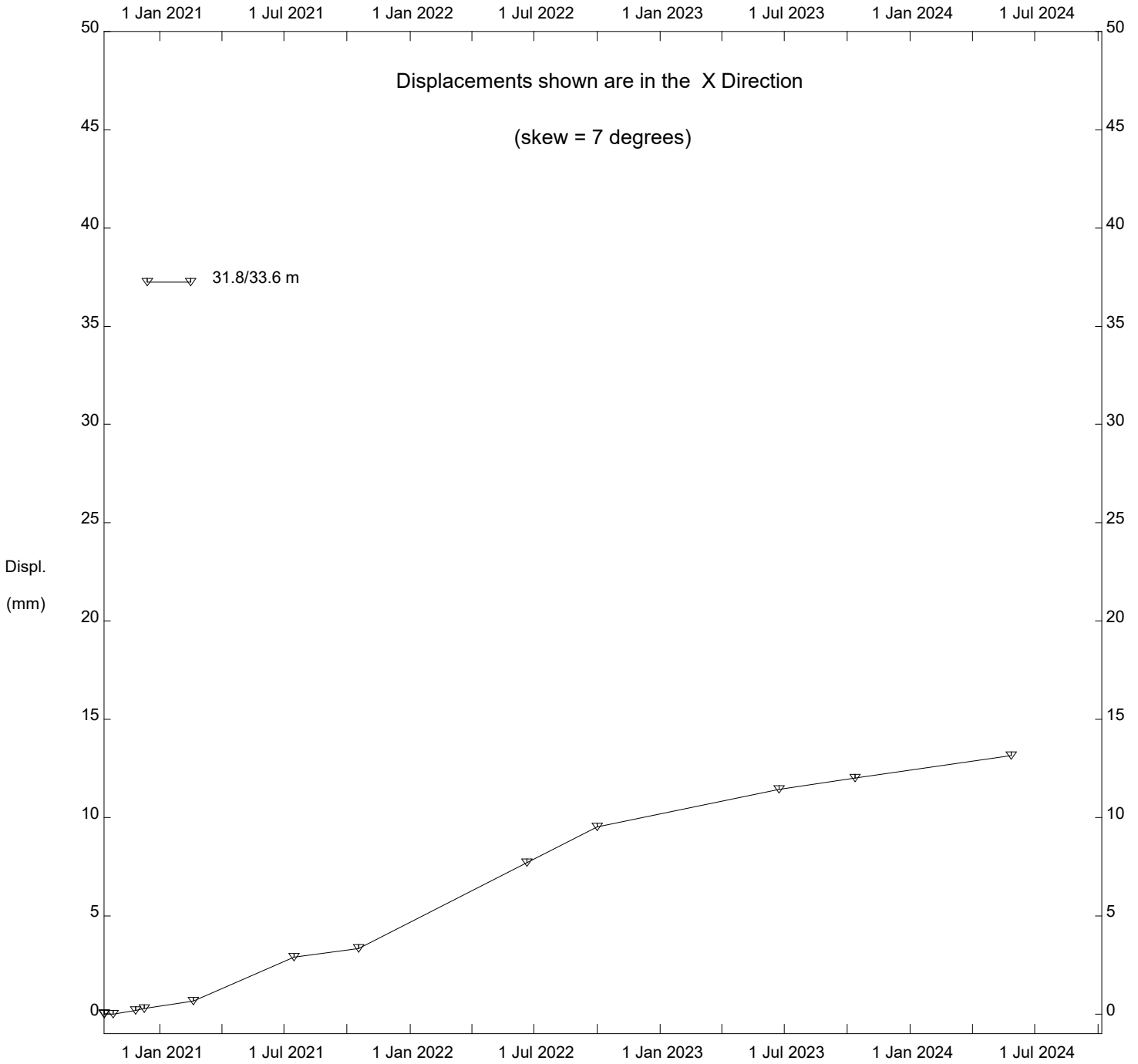


Hwy 64:02 Twin Pipes Landslide (PH023), Inclinometer SI20-7

Alberta Transportation

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

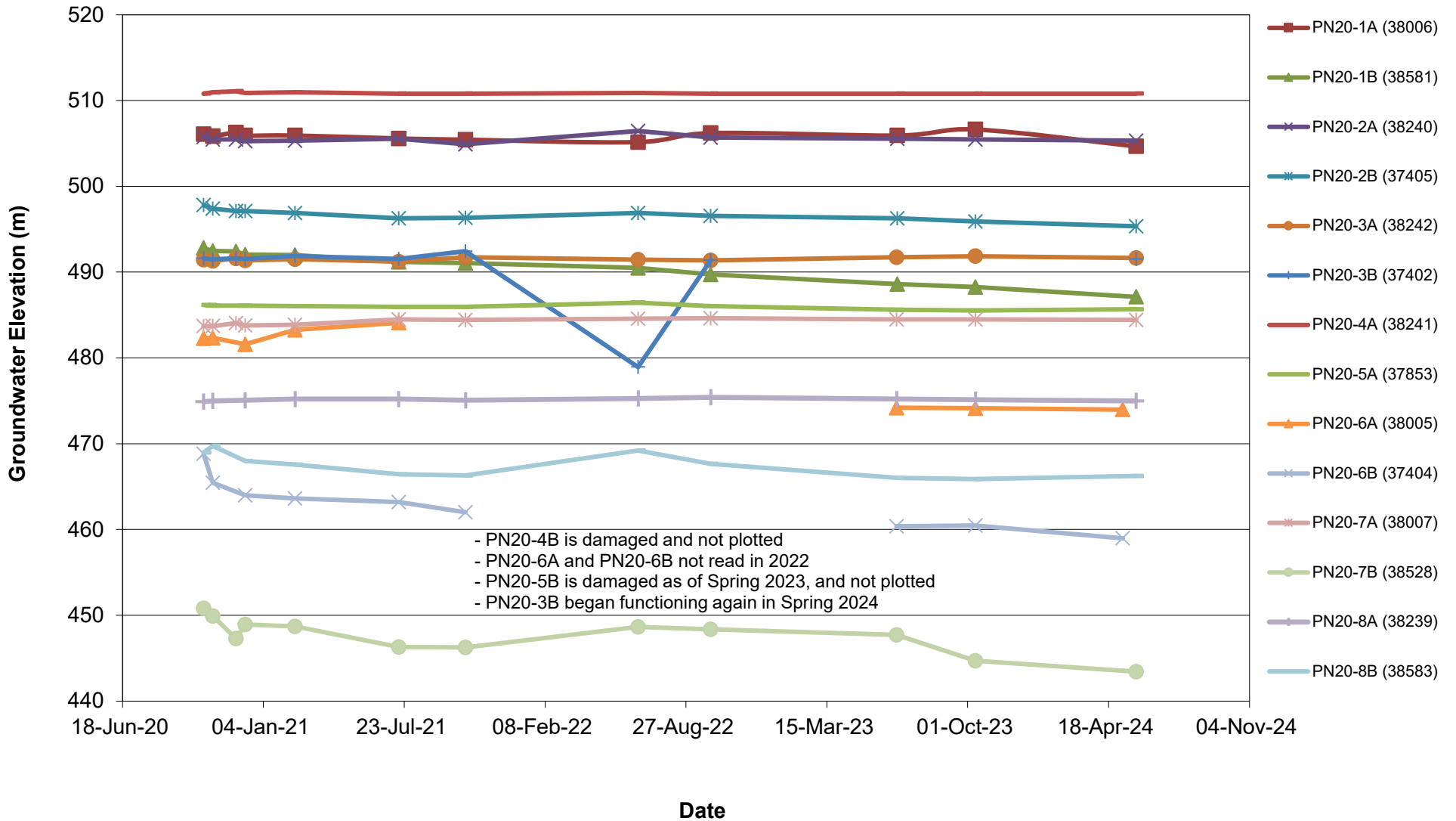
Thurber Engineering Ltd.



Hwy 64:02 Twin Pipes Landslide (PH023), Inclinator SI20-7

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**FIGURE PH023-1
HWY 64:02 - CLEAR RIVER EAST HILL - (SITE #5)
PIEZOMETRIC ELEVATIONS**



**FIGURE PH023-2
HWY 64:02 - CLEAR RIVER EAST HILL - (SITE #5)
PIEZOMETRIC DEPTHS**

