THURBER ENGINEERING LTD.

November 22, 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 – FALL 2022

SECTION C

SITE BF71824: HWY 64:04 MONTAGNEUSE RIVER CULVERT

Dear Mr. Szmata:

This report provides the results of the bi-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

In 2018, a 6.6 m diameter bridge culvert was installed at the Hwy 64:04 Montagneuse River Culvert site, 15 km northwest of Hines Creek, Alberta. During construction, 2 slope inclinometers (SI18-1 and SI18-2) were installed on the south and north sides of the highway centerline, respectively. Four pneumatic piezometers (PN18-1A, PN18-1B, PN18-2A and PN18-2B) were installed in the same test holes as the SIs (two in each borehole). The SIs and piezometers were monitored during construction and the SI casings were extended as fill for the new culvert was placed.

The SIs and piezometers were read on October 2, 2022 by Mr. Niraj Regmi, G.I.T. and Mr. Kyle Crooymans, both of Thurber Engineering Ltd.

The SIs were read using an 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. The pneumatic piezometers were read using a RST C108 pneumatic piezometer readout.

2. DATA PRESENTATION

2.1 General

SI plots for A and B directions are included in Appendix A.

Slope inclinometer and piezometer reading summary tables are provided below.

2.2 Zones of Movement

Zones of new movement were not observed in the SIs since the previous readings in the spring of 2022.

Table BF71824-1 below provides a summary of the current and historical SI readings at the site.

THURBER

TABLE BF71824-1
FALL 2022 – HWY 64:04 MONTAGNEUSE RIVER CULVERT
SLOPE INCLINOMETER READING SUMMARY

Date Monitored: October 2, 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)
SI18-1	November 19, 2018 (reinitialized)	No discernible movement	N/A	Operational	June 22, 2022	N/A	N/A	N/A
SI18-2	November 19, 2018 (reinitialized)	No discernible movement	N/A	Operational	June 22, 2022	N/A	N/A	N/A

Drawing BF71824 in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

THURBER

TABLE BF71824-2
FALL 2022 – HWY 64:04 MONTAGNEUSE RIVER CULVERT
PNEUMATIC PIEZOMETER READING SUMMARY

Date Monitored: October 2, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED WATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER ELEVATION (m)	PREVIOUS GROUNDWATER ELEVATION (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN18-1A (37851)	September 4, 2018	13.39	660.92	Operational	652.69 on October 2, 2022	50.6	652.69	652.13	0.56
PN18-1B (37688)	September 4, 2018	18.72	660.92	Operational	649.58 on October 30, 2018	50.0	647.30	647.84	-0.54
PN18-2A (37690)	September 4, 2018	9.65	660.87	Operational	656.07 on October 30, 2018	38.7	655.17	655.11	0.06
PN18-2B (37689)	September 4, 2018	15.74	660.87	Operational	655.79 on June 22, 2022	100.2	655.35	655.79	-0.44

Drawing BF71824 in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this.

Notes:
PN - pneumatic piezometer.
BGS - below ground surface.

3. INTERPRETATION OF MONITORING RESULTS

SI18-1 and SI18-2 were installed during construction and monitored during fill placement. The SIs were extended as the fill was placed. The SIs were reinitialized on November 19, 2018, towards the end of construction, to alleviate some of the erroneous movements that were caused by backfill around the SI casings.

SI18-1 and SI18-2 have not shown any persistent movement trends since they were reinitialized.

Pneumatic piezometers PN18-1A and PN18-2A showed increases in groundwater levels of 0.56 m, and 0.06 m, respectively, since the spring of 2022 readings. The current groundwater level measured in PN18-1A is the highest level measured since it was initialized. PN18-1B, and PN18-2B showed a decrease in groundwater level of 0.54 m and 0.06 m, respectively, compared to the spring of 2022 readings. The pneumatic piezometer readings are plotted in Figure BF71824-1 (by elevation) and Figure BF71824-2 (by depth) in Appendix A.

4. RECOMMENDATIONS

4.1 Future Work

Given the favorable response of the instruments it is considered that the reading frequency could be reduced to once per year with the next reading in the fall of 2023.

4.2 Instrumentation Repairs

No instrument 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.
Don Proudfoot, M.Eng., P. Eng.
Principal | Senior Geotechnical Engineer

PROFESSIONAL ENGINEER ALBERTA
BRUCE W. NESTOR
ID 161284

November 22, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 51674
DATE: November 23, 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-BF71824)
  - SI Reading Plots
  - Figure BF71824-1 (Pneumatic Piezometer Elevations)
  - Figure BF71824-2 (Pneumatic Piezometer Depths)

THURBER

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

FALL 2022

APPENDIX A
DATA PRESENTATION

SITE BF71824: HWY 64:04 (MONTAGNEUSE RIVER CULVERT)

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.

ALBERTA TRANSPORTATION
PEACE REGION (GRANDE PRAIRIE - NORTH DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (BF71824)
FALL 2022

Location:	Hwy 64:04 Montagneuse River Culvert (BF71824)	**Readout:**	RST PN C108 Unit 1
File Number:	32123	**Casing Diameter:**	2.75"
Probe:	RST SI Set 8R	**Temp:**	18
Cable:	RST SI Set 8R	**Read by:**	KTC/NKR

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location		Date	Stickup (m)	Depth from top of **casing** (ft)	Azimuth of A+ Groove degree	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-		
SI18-1	392632.00	6247201.00	02-Oct-22	0.47	106 to 2	285°	-480	496	1205	-1200	8R/8R	
SI18-2	392577.00	6247250.00	02-Oct-22	0.69	104 to 2	78°	-111	132	-104	106	8R/8R	*

PNEUMATIC PIEZOMETER (PN) READINGS

PN#	GPS Location (UTM 11)		Date	Reading (kPa)	Identification Number
	Easting (m)	Northing (m)			
PN18-1A	392632.00	6247201.00	02-Oct-22	50.6	37851
PN18-1B	392632.00	6247201.00	02-Oct-22	50	37688
PN18-2A	392577.00	6247250.00	02-Oct-22	38.7	37690
PN18-2B	392577.00	6247250.00	02-Oct-22	100.2	37689

INSPECTOR REPORT

* Stiff at 14ft

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2021 INSTRUMENTS\32123-BF71824.dwg - 1 - Sep. 21, 2021

BLOCK 1 LOT 1
PLAN 152 1411
GLEN ALLEN HOOVER AND
HOPE CONSTANCE HOOVER
HINES CREEK, ALBERTA
COT: 152 088 592

NW 9-85-5-6
HER MAJESTY THE QUEEN IN RIGHT OF ALBERTA
AS REPRESENTED BY MINISTER OF HIGHWAYS
EDMONTON, ALBERTA
COT 22W229

SW 9-85-5-6
RICKY G. MILLER AND
LEITH H. MILLER
HINES CREEK, ALBERTA
COT: 872 127 084

NE 8-85-5-6
BUDGELL'S CONTRACTING LTD.
HINES CREEK, ALBERTA
COT: 032 093 876

NE 8-85-5-6
BUDGELL'S CONTRACTING LTD.
HINES CREEK, ALBERTA
COT: 032 093 876

EXISTING UNDERGROUND COMMUNICATIONS CABLE
POWER LINES
HINES CR
9.10 EXISTING
12.6 PROPOSED
16+520 80 m LT
TOP OF BANK (TYP)
EDGE OF WATER (TYP)
MONTAGNEUSE RIVER
CP2
THI2-5
THI2-6
THI2-4A
THI2-3
THI2-7
SI18-1 / PN18-1A/B
SI18-2 / PN18-2A/B
NEW R/W
EXISTING R/W
EXISTING WEST CULVERT 4.0 m EQUIVALENT DIAMETER SPCSP x 99 m TO BE REMOVED AND DISPOSED
EXISTING EAST CULVERT 4.0 m EQUIVALENT DIAMETER SPCSP x 99 m LINED WITH 3.6 m DIAMETER SPCSP CULVERT x 60 m TO BE BACKFILLED AND GROUTED
FULL CONCRETE END TREATMENT (TYP BOTH ENDS)
CLASS 2 ROCK RIPRAP TO BE PLACED 0.8 m THICK (TYP)
EXISTING CHANNEL TO BE LEFT OPEN TO RETAIN FISH HABITAT (TYP UPSTREAM AND DOWNSTREAM)
16+480 80 m RT
FLOW
CPI
P 2 BRIDGE PLAQUE (TYPICAL BOTH SIDES)
INSTALL ROUND DEEP CORRUGATED STRUCTURAL PLATE (DCSP) CULVERT ON SQUARE TO ℄ HIGHWAY 64 LOCATED AT STATION 16+467.000
HIGH TENSION CABLE BARRIER (HTCB) INCLUDING CRASHWORTHY END TREAMENTS STA 16+390.000 TO 16+570.000.
20.12
3 DELINEATOR GUIDE POSTS SEE DWG TEB_3.51 (TYP)
INSTALL GEOGRID BETWEEN STA 16+445.000 AND 16+490.000
REMOVE AND DISPOSE OF EXISTING GUARDRAIL
EXISTING FENCE TO BE REMOVED (TYP)
VARIES
℄ HWY 64
CLEARDALE
16+329.632 PP 26.496m RT
16+329.751 PP
3 m WIDE BENCH ON BACKSLOPES HIGHER THAN 6 m (TYP) REFER TO GEOTECHNICAL INVESTIGATION FOR DETAILS

LEGEND
APPROXIMATE INSTRUMENT LOCATION

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

BASE PLAN FROM ALBERTA TRANFORTATION

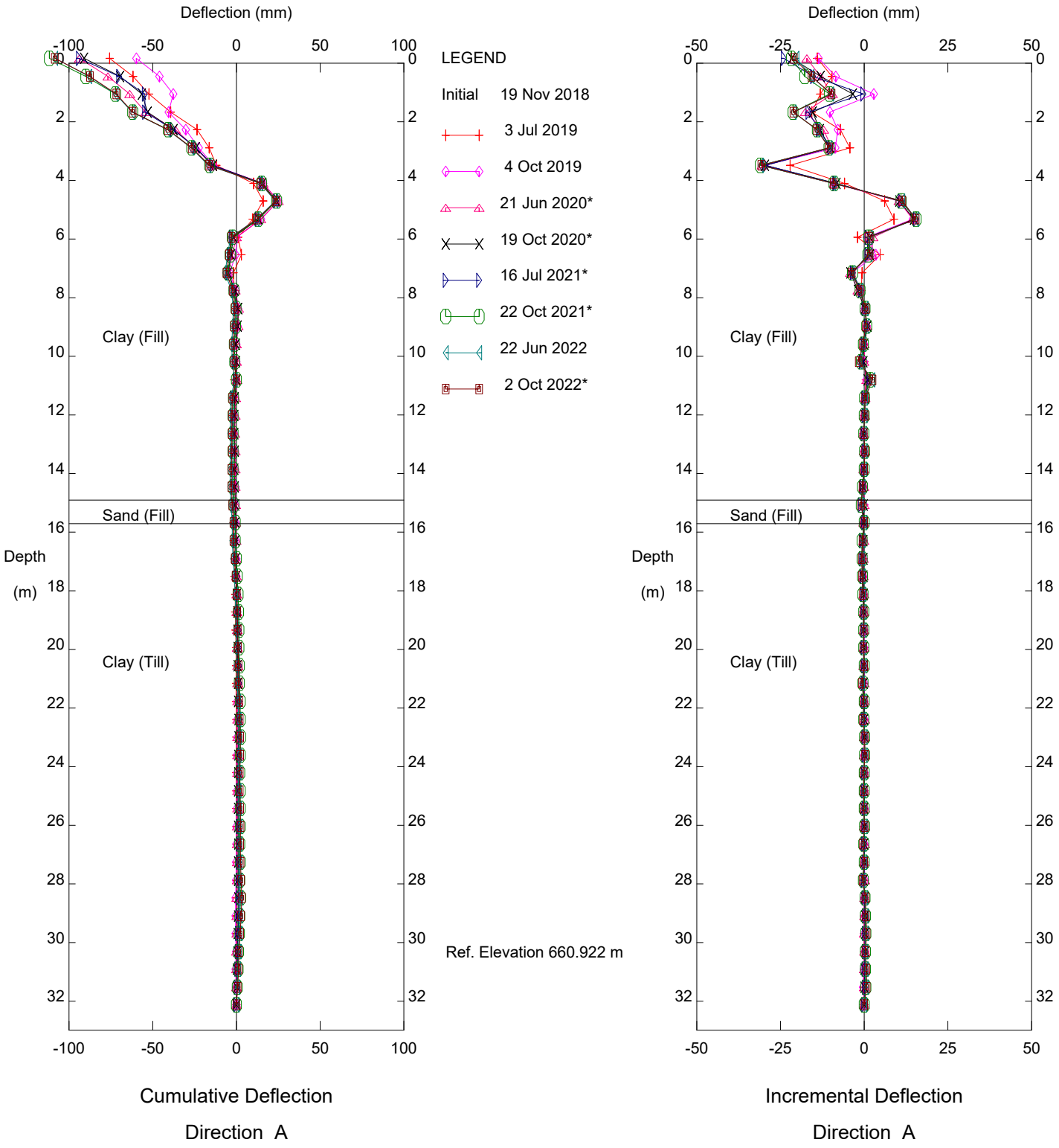
Alberta

PEACE REGION
(GRANDE PRAIRIE DISTRICT NORTH)
MONTAGNEUSE RIVER CULVERT
ON HWY 64, 15 km NW OF HINES CREEK
SITE PLAN SHOWING APPROXIMATE INSTRUMENT LOCATIONS
DWG No. 32123-BF71824

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	1:1000
DATE	SEPTEMBER 2021
FILE No.	32123

THURBER ENGINEERING LTD.

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

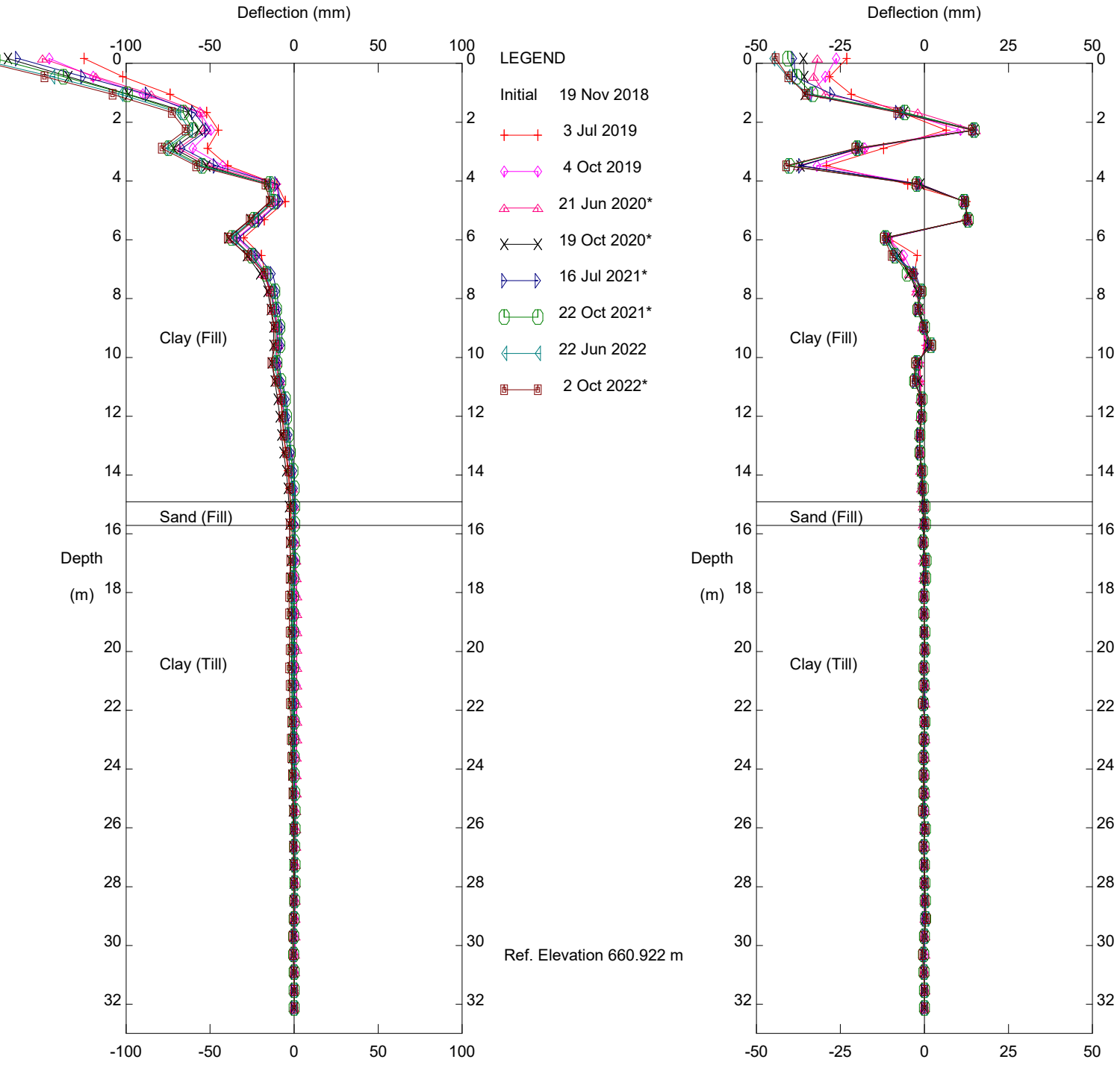
Hwy 64:04 Montagneuse River (BF71824), Inclinometer SI18-1

Alberta Transportation

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

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022B-Fall\SI Readings\BF71824 (Montagneuse)\SI18-1.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

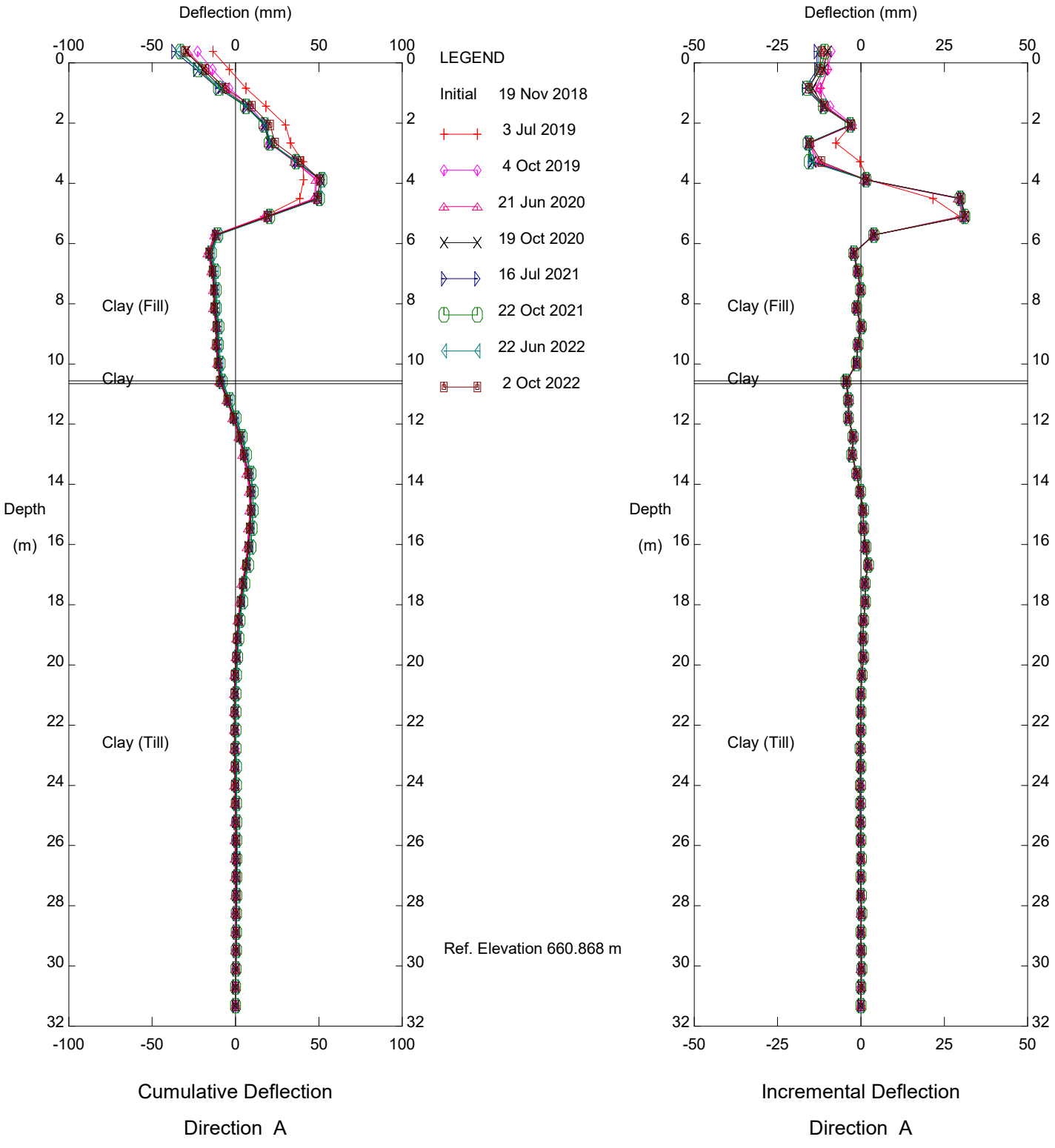
Hwy 64:04 Montagneuse River (BF71824), Inclinometer SI18-1

Alberta Transportation

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

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022B-Fall\SI Readings\BF71824 (Montagneuse)\SI18-1.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

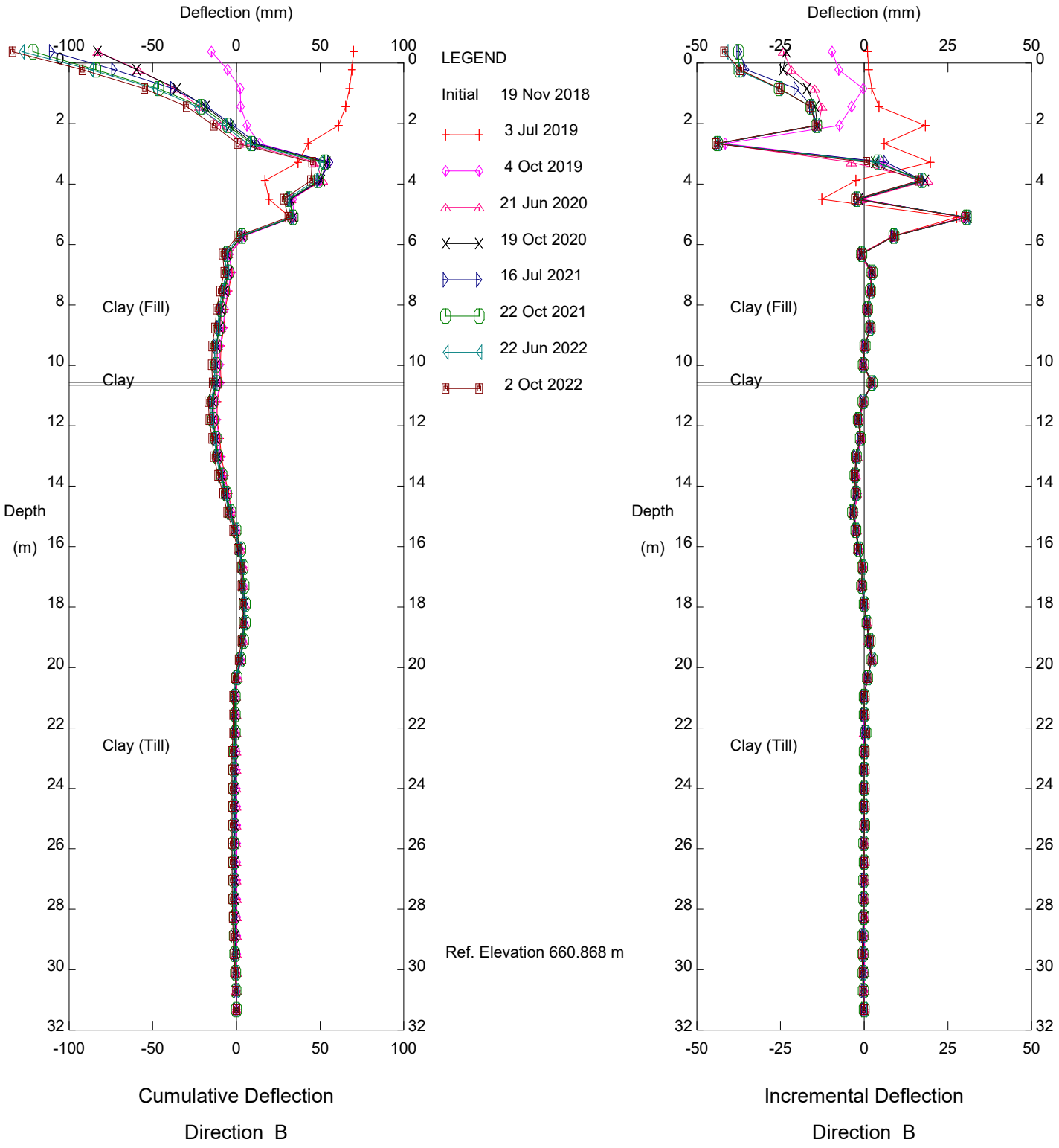
Direction A

Hwy 64:04 Montagneuse River (BF71824), Inclinometer SI18-2

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022B-Fall\SI Readings\BF71824 (Montagneuse)\SI18-2.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Hwy 64:04 Montagneuse River (BF71824), Inclinometer SI18-2

Alberta Transportation

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\Section C\2022B-Fall\SI Readings\BF71824 (Montagneuse)\SI18-2.gtl

FIGURE BF71824-1
PIEZOMETRIC ELEVATIONS FOR HWY 64:04 MONTAGNEUSE RIVER CULVERT

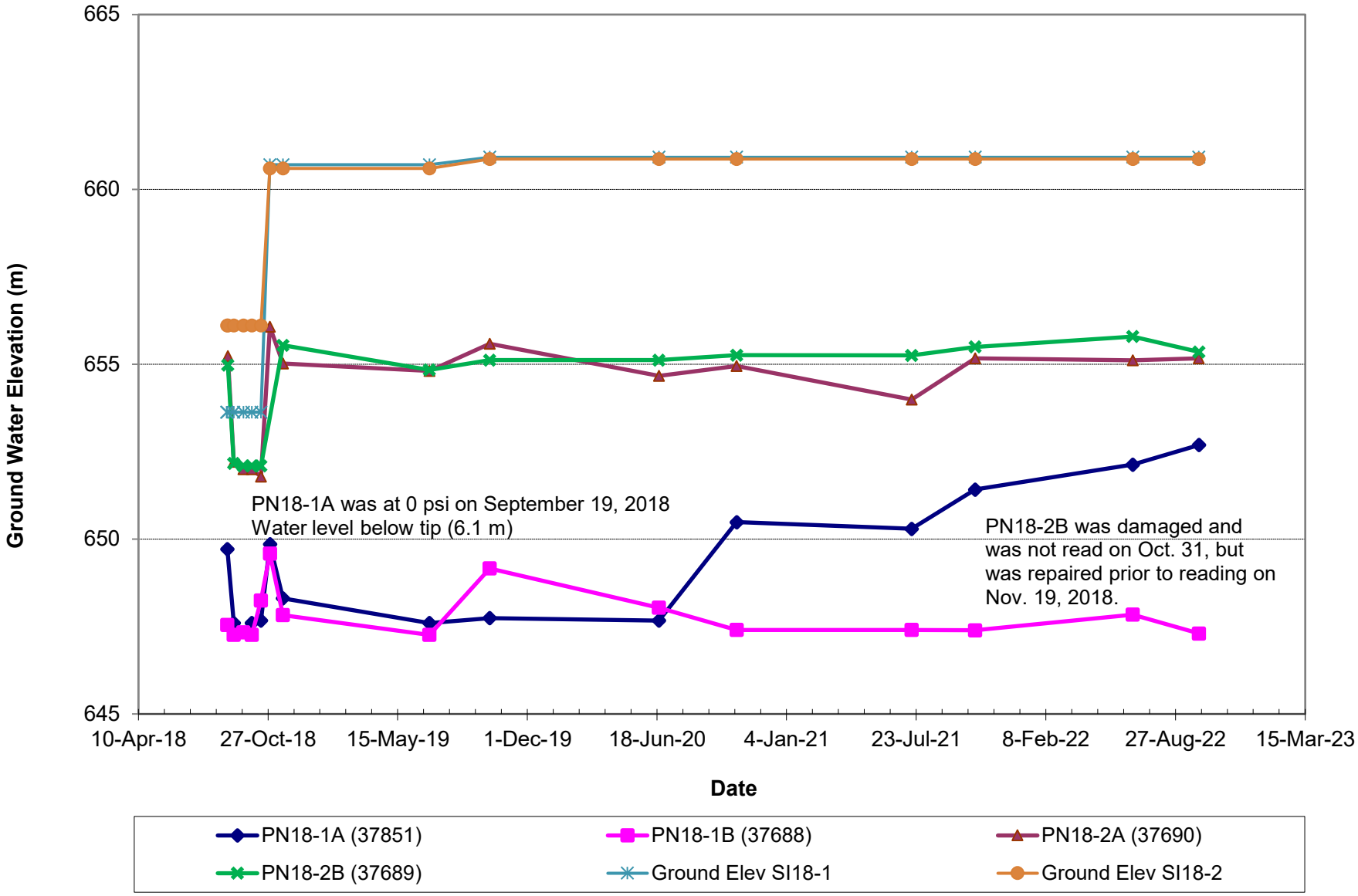


FIGURE BF71824-2
PIEZOMETRIC DEPTHS FOR HWY 64:04 MONTAGNEUSE RIVER CULVERT