2022 ANNUAL REPORT

Long-Term Permafrost and Groundwater Monitoring Program

Red Dog Mine Tailings Storage Facility

February 2023

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Acronyms and Abbreviations

EPA	(US) Environmental Protection Agency
ft amsl	feet above mean sea level
ft bgs	feet below ground surface
Kohms	kilo-ohms
Kuna	Kuna Engineering, LLC
QA/QC	Quality Assurance and Quality Control
SEP	Supplemental Environmental Program
TAK	Teck Alaska, Inc.
WMCI	Water Management Consultants, Inc.
WRWP	Well Replacement Work Plan

1 Introduction

The Long-Term Permafrost and Groundwater Monitoring Program (the Monitoring Program) was established as an outcome of the Supplemental Environmental Project (SEP) and the Consent Decree between Cominco Alaska, Inc. (now Teck Alaska Incorporated) and the United States Environmental Protection Agency (EPA), entered into on November 25, 1997 (US v. Cominco Alaska Incorporated, Civil Action A97-267CV). The Monitoring Program was developed to monitor the potential effects of the Tailings Impoundment Facility (now called the Tailings Storage Facility, TSF) on permafrost and groundwater in the areas of the TSF Main Dam, the Overburden Stockpile, and background locations downgradient of the TSF within the Red Dog Creek and Bons Creek drainages. The Consent Decree requires the submission of an annual report to provide a data collection summary, a quality assurance and quality control (QA/QC) summary, and a description of the status of the monitoring program. This report follows a similar format and content as previously submitted reports, including the most recent annual report submitted in February 2021 for calendar year 2022 (Kuna 2021).

A review of the data from 2022 did not show any significant changes in permafrost depths or groundwater elevations in the area of the Red Dog Mine (RDM) Tailings Storage Facility (TSF).

2 Background

The Red Dog Mine is a lead-zinc mine located in northwestern Alaska approximately 50 miles northeast of Kotzebue, Alaska and 107 miles north of the Arctic Circle within the DeLong Mountains. The mine is owned by NANA Regional Corporation and operated by Teck Alaska (TAK). Figures 1 illustrates the regional setting and layout of the mine and its support facilities. As illustrated on Figure 1, the mine consists primarily of several open pits (ore bodies) and associated support facilities. Support facilities include an ore milling and a concentration facility, an employee housing area, a construction camp, an asphalt paved runway, and a power generation facility. The site also includes approximately 300 acres of waste rock piles and a tailings storage facility (impoundment) behind two earthen dams (the main and back dams). The pond is used for storage of tailings (under water) and receives drainage from the open pit areas, natural surface run-off, and process waters from the milling operation. Following treatment, water is discharged from the pond during summer months. The original Red Dog ore body is no longer being actively mined and is instead receiving waste rock from the mining of the Aqqaluk ore body.

The tailings pond has the potential to affect both permafrost and groundwater in one or more adjacent watersheds/drainages. To document these potential effects, a ground temperature and groundwater level monitoring program began in the mid-1990s as part of the Groundwater Monitoring Supplemental Environmental Project (SEP). Results from this project are documented in the project's report (Water Management Consultants, Inc. 2001b) and form the basis for the Long-Term Permafrost and Groundwater Monitoring Plan (WMCI 2001a). Long-term monitoring is intended to demonstrate the continuity of the permafrost and the minimal flow of groundwater beneath and from the TSF. The continuity of subsurface frozen conditions is critical to ensuring that any impacts from dissolved metals in the impoundment do not affect the adjacent watersheds.

The key elements of the Monitoring Program are:

- The quarterly monitoring of sixteen thermistors at background sites, the overburden stockpile, and within and downgradient from main dam area;
- The quarterly monitoring of nine piezometers at background sites and the main dam area;
- Data reduction, presentation, and management;
- Annual data reporting; and,
- Assessment of pertinent data trends on a five-year basis.

3 2022 Data Collection

TAK personnel collect the data from the project thermistors and piezometers (see listing in Appendix A). This data is then submitted to Kuna Engineering (Kuna). Appendix B contains a table of the raw data. Kuna is then responsible for the data reduction, presentation, and management.

The RDM thermistor and piezometer monitoring locations are illustrated on Figure 3 (northern portion), Figure 4 (central portion), and Figure 5 (southern portion).

Table 1 provides a summary of the quarterly data collection dates for the active thermistor strings, and Table 2 provides a summary of the quarterly data collection dates for the active piezometers.

Table 1. Summary of the 2022 Quarterly Thermistor Data Collection

Thermistors	Associated Figure	General Location	Sampling Dates			
			1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
T-96-015	Figure 2	Red Dog Creek	1/20/22*	4/11/22	7/9/22	10/21/22
T-95-005	Figure 2	Dam Area	1/20/22*	4/11/22	7/9/22	10/21/22
T-96-010	Figure 2	Dam Area	-	6/29/22	-	-
T-97-028	Figure 2	Dam Area	1/20/22*	4/11/22	7/9/22*	10/21/22
T-97-029	Figure 2	Dam Area	1/20/22*	4/11/22	7/9/22*	10/21/22
T-97-030	Figure 2	Dam Area	1/20/22*	4/11/22	7/9/22*	10/21/22
T-14-110	Figure 2	Tailing Impoundment	1/20/22	4/12/22	-	10/19/22
T-95-004	Figure 2	Dam area	-	-	-	-
T-05-061	Figure 2	Dam area	-	4/20/22	7/9/22	8/15/22
T-95-008 #2	Figure 3	Overburden Stockpile	1/10/22	4/12/22	7/9/22	10/21/22*
T-96-013	Figure 3	Overburden Stockpile	1/20/22*	4/11/22	6/30/22	10/21/22
T-96-021	Figure 3	Overburden Stockpile	1/10/22	4/12/22	7/9/22	10/21/22
T-96-022	Figure 3	Overburden Stockpile	1/10/22	4/12/22	7/11/22	10/21/22
T-96-023	Figure 3	Overburden Stockpile	1/10/22	4/20/22	7/9/22	10/21/22
T-96-012	Figure 3	Bons Creek	1/10/22	4/12/22	7/9/22	10/21/22
T-96-012s	Figure 3	Bons Creek	1/10/22	4/12/22	7/9/22	10/21/22
T-21-013	Figure 3	Overburden Stockpile	-	5/25/22	**	**

Note: ** = T-21-13 is continuously logged and data is available on the logger but was not able to be added to this report; it will be included in future reports. Hyphens (-) indicate that data was not collected. * Indicates inaccurate readings.

Table 2. Summary of the 2022 Quarterly Piezometer Data Collection

Piezometer	Associated Figure	General Location	Sampling Dates			
			1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
P-96-015	Figure 2	Red Dog Creek	1/12/22	4/11/22	7/9/22	10/21/22
P-96-010	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
P-97-028	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
SPP-97-002	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
P-08A	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
P-08B	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
P-97-020	Figure 2	Dam Area	1/10/22	4/11/22	7/9/22	10/21/22
P-96-013	Figure 3	Overburden Stockpile	1/11/22	4/11/22	7/9/22	10/21/22
P-97-012	Figure 3	Bons Creek	1/13/22	4/12/22	7/9/22	10/21/22
P-21-013	Figure 3	Overburden Stockpile	3/1/22	5/22/22	7/9/22	10/21/22

Wells T-96-010 and T-95-004 have missing data throughout 2022 due to the inadvertent burial of the extension cables during the 2021 Main Dam raise and the development of a new seepage pond below the Main Dam. Both thermistor cables will be cut and spliced in spring/summer 2023 and data downloads will resume. Other thermistors have no readings during winter months due to the complete burial of the well in snow.

The 2018 SEP Well Replacement Work Plan (2018 SEP WRWP, Golder 2018) describes the replacement details for an existing thermistor string and piezometer, P/T-96-013. This site is located at the south end of the TSF, within the Kivalina Overburden Stockpile (Figure 3). The original piezometer and thermistor wells were installed in 1996 as part of the SEP Phase I project. This site is replaced by the P/T-21-13 well, completed late in 2021. The piezometer is installed to a total depth of 610 feet bgs with dual VWPs located at this depth. The thermistor string is installed to a total depth of 490 feet bgs and has 24 sensors, identical to T-96-013. The thermistor for this well is connected to a continuous data logger and data is available for download as necessary. A comparison report was submitted in June 2022 for the P/T-21-13 and P-96-13 and T-96-13 (Kuna 2022a).

4 Data Management and Reporting

As previously described, the reading and collection of the data from the thermistors and piezometers was performed by TAK personnel in 2022. This data was periodically provided to Kuna to upload to the Red Dog Mine groundwater monitoring database. Microsoft Access™ and Excel™ software are used to generate the tables and graphical plots of the data.

4.1 Thermistor Data Collection

Data collected from the thermistor cables is measured as a resistance value, in kilo-ohms (kohms) using a Dryden Instrumentation T5KMUK Automated Thermistor String Reader. The measured resistance values are subsequently converted to temperatures using calibration coefficients for each thermistor sensor. A calibrated digital temperature acquisition cable was used to measure ground temperature at replacement site T-14-110; similar to the T21-13 thermistor string, the temperature data is logged and available for download on a periodic basis as necessary. All measured values are reviewed for errors

available for download on a periodic basis as necessary. All measured values are reviewed for errors and omission, and then uploaded to the database. Note that for thermistor string T21-13, data was not able to be downloaded for the second half of 2022, however this data is available on the datalogger and will be included in future reports.

Some thermistor measurements are not representative of true/valid measurements (i.e., where the measurements are less than zero (0) kohms or greater than 300 kohms). These measurements may also represent issues with the sensors or cable breaks/shorts. These measurements are not uploaded to the database. The out-of-range values are shaded red in the raw data table presented in Appendix C.

4.2 Piezometer Data Collection

As with the thermistor readings, TAK personnel are responsible for providing the measurements from the vibrating wire piezometers (VWPs) and the associated barometric pressure readings from the mine meteorological station. The VWP measurements (via pressure transducers) are then converted by Kuna to groundwater elevations using the individual transducer calibration coefficients, site elevations, and barometric pressure readings. The calibration coefficients for each of the VWPs was determined during installation. Following conversion and a quality control review, the 2022 data was uploaded to the database.

4.3 Data Analyses

The ground temperature measurements collected from the sixteen thermistor monitoring locations are graphed using three types of graphs/plots as presented in Appendix D (separate plots for each thermistor string):

- Temperature trumpet plots of data for all years (separate color for each year/quarter);
- Temperature plots of data for the 2022 data according to depth (for each quarter of measurements); and
- Average temperature plots of the 2022 data according to depth.

The piezometer data are presented in Appendix D as time series graphs of groundwater elevation and depth.

For each graph, the measurements are presented as auto range and scale limited. The auto range plots represent the validated measurements (i.e., those not eliminated as described previously). For visual clarity, scale limited plots only include data within a limited range and excludes most outliers. Note the outliers are individual nodes that are likely caused by intermittent connections and therefore do not represent true changes in temperature or water elevation.

5 Summary of Data QA/QC and Data Considerations

Copies of the quarterly report data checklists are provided in Appendix E, with the quarterly data field reporting forms. The checklists are completed by Kuna following the receipt of the quarterly data and sent back to TAK personnel to enable the recollection of data as necessary. Standard operating procedures developed for the monitoring program included taking duplicate measurements to ensure different operators and or equipment would not impact representativeness of the data.

According to the 1997 consent decree, a full analysis and interpretation of the data will be provided in the next 5-year monitoring report to be submitted in 2026. A 5-year report covering the years 2017 – 2021 was submitted in Spring 2022 (Kuna 2022b).

5.1 Thermistor QA/QC

Duplicate measurements for at least 1 thermistor string from each quarter were collected from the Dryden Instruments T5KMUK data logger and the Dryden Switchbox Fluke multimeter system. Variations in the thermistor measurements were also compared to previously collected data and trends. The thermistor QA/QC data is presented in Table 3. Although a QA/QC form was not completed for the 4th quarter of 2022, duplicate measurement of string T96-12s did occur and the data exists in the project database.

Table 3. Summary of 2022 Thermistor QA/QC Data

Quarter	Date	Thermistor	Multi-meter Start Time	Comments
1st Quarter	1/31/22	T-96-12	16:16	Nodes 12, 13, and 21 read zero.
2nd Quarter	4/11/22	T-96-15	16:26	
3rd Quarter	7/11/22	T-96-12	16:48	
4th Quarter				Not recorded

5.2 Piezometer QA/QC

Piezometer QA/QC consists of a duplicate reading within five minutes of the first piezometer reading each quarter. Table 4 presents a summary of the QA/QC data for 2022.

Table 4. Summary of 2022 Piezometer QA/QC Data

Quarter	Date	Piezometer	Comments
1st Quarter	1/10/22	P-97-12	6172.1 m/m at 0.2°C
2nd Quarter	4/11/22	P-96-13	7532.6 m/m @ 0.6°C
3rd Quarter	7/11/22	P-96-12	Value not recorded.
4th Quarter	10/21/22	P-96-15	Value not recorded.

5.3 Thermistor System Maintenance

The thermistor measurements from 2022 indicate that several are malfunctioning (i.e., out of range readings, Appendix F) and require replacement or repair. Shorts or discontinuities may also exist in the cabling/wiring for each thermistor at certain depths. Out-of-range readings may be indicative of these issues.

A program is currently in place to replace the surface connector cables (a common point of failure), as needed, and to clean all analog thermistor cables with a mild acid wash (using DeoxIT D5). The outcome of this program will be described in the 2023 Annual Report, to be submitted in the next year (2024).

5.4 Piezometer System Maintenance

Most of the VWPs are functioning, with limited erroneous measurements in 2022. The only data with an outlier was SPP-97-002 on January 10, 2022, with a reading over 300% greater than the 5 year average. This outlier was removed from dataset portrayed in the Appendix E plots.

6 Summary and Conclusions

The data collected in 2022 for the SEP is generally consistent with the data from prior quarters and years. The Red Dog Mine area is characterized by a "warm" permafrost that exhibits temperatures of just a few degrees below freezing. This permafrost layer is continuous from roughly 40 – 80 feet bgs to 150 – 200 ft bgs, with gradual warming occurring at deeper depths. Permafrost is no longer present in the area immediately below the dam, however permafrost is present continuously in the downgradient areas. Groundwater elevations are generally consistent with past years, with flows generally towards Red Dog Creek, except in the back dam area where a flow divide exists, around the south side of the overburden stockpile, separating the Bons Creek drainage from the Red Dog Creek drainage.

7 References

Golder, 2018. Technical Memorandum – Work Plan for Proposed 2018 SEP Well Replacement, Red Dog Mine, Alaska.

Kuna Engineering, 2021. 2020 Annual Report, Long-Term Permafrost and Groundwater Monitoring Program for the Tailings Impoundment Facility, February 2021.

Kuna Engineering, 2022a. Technical Memorandum, Comparison of PT96-13 and PT21-113.

Kuna Engineering, 2022b. Data Analysis Report, 2017 – 2021, Long-Term Permafrost and Groundwater Monitoring Program, April 2022.

Water Management Consultants, Inc. (WMCI), 2001a, *Red Dog Mine – Long-Term Permafrost and Groundwater Monitoring Plan for the Tailing Impoundment*, March 2001.

Water Management Consultants, Inc. (WMCI), 2001b, *Red Dog Mine – Phase III Hydrologic Characterization of the Tailings Impoundment*, March 2001.

Appendix A
Listing of SEP Thermistors and Piezometers

SEP GW Instrument Information

Station ID	Type	No. Nodes (thermistors only)	Location	Status	Instrument Depth	Notes
P-08A	piezometer		Dam Area	Active	153	
P-08B	piezometer		Dam Area	Active	178	
P-21-013	piezometer [(1) (2)]		Overburden Stockpile	Active	610	Replaces P-96-013; 2 VWPs, both at 610 ft bgs
P-96-010	piezometer		Dam Area	Active	197.2	
P-96-013	piezometer		Overburden Stockpile	Active	544.4	
P-96-015	piezometer		Bons Creek	Active	300	
P-97-012	piezometer		Bons Creek	Active	460.52	
P-97-020	piezometer		Dam Area	Active	410	
P-97-028	piezometer		Dam Area	Active	48.5	
P-99-007R	piezometer		Tailing Impoundment	Inactive	-	Flooded
SPP-97-002	piezometer		Dam Area	Active	unknown	
T-05-061	thermistor	6	Dam Area	Active	58	
T-14-110	thermistor [(1)]		Tailing Impoundment	Active	unknown	Replaced T-95-007
T-21-013	thermistor [(1)]	44	Overburden Stockpile	Active	490	Replaces T-96-013
T-95-004	thermistor		Dam Area	Active	400	Cable repair scheduled for Spring 2023
T-95-005	thermistor		Dam Area	Active	400	
T-95-007	thermistor		Tailing Impoundment	Inactive	400	
T-95-008	thermistor	24	Overburden Stockpile	Inactive	260	
T-95-008#2	thermistor	24	Overburden Stockpile	Active	260	Replaced T-95-008
T-96-010	thermistor		Dam Area	Active	360	
T-96-012	thermistor	24	Bons Creek	Active	490	
T-96-012S	thermistor	24	Bons Creek	Active	490	
T-96-013	thermistor	24	Overburden Stockpile	Active	490	
T-96-015	thermistor	14	Red Dog Creek	Active	210	
T-96-020	thermistor	24	Dam Area	Inactive	470	
T-96-021	thermistor	24	Overburden Stockpile	Active	122	
T-96-022	thermistor	24	Overburden Stockpile	Active	122	
T-96-023	thermistor	24	Overburden Stockpile	Active	112	
T-97-028	thermistor	24	Dam Area	Active	235	
T-97-029	thermistor	24	Dam Area	Active	235	
T-97-030	thermistor	24	Dam Area	Active	275	

Notes:

(1) Digital type instruments. T-21-13 is connected to a continuous data logger.

Listing of instruments is from WMCI 2001 Long-Term Groundwater and Permafrost Monitoring Plan.

Appendix B
Figures

- Figure 1 – Mine Layout
- Figure 2 – Main Dam Area
- Figure 3 – Overburden Stockpile/Back Dam Area

AQQALUK PIT
MAIN PIT
MAIN WASTE DUMP
MILL AND CAMP FACILITIES
MAIN DAM BEACH
TAILINGS IMPOUNDMENT
MINE DAM
BACK DAM BEACH
OVERBURDEN STOCKPILE
AIRSTRIP
Middle Fork Red Dog Creek
North Fork Red Dog Creek
Red Dog Creek
Bons Creek

Legend

Contour Line (50 Ft)

Streams

0 0.25 0.5 1 Miles

N

Notes:
1. Coordinate system is NAD83 Zone 7N, units are US feet.
2. Background imagery is from GINA, 2020, contour lines are from 2021 topography.

The information in this map is for planning purposes only and is not to be used as a legal document.

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Red Dog Mine Supplemental Environmental Program
Long Term Permafrost and Groundwater Monitoring Program

2022 Annual Report

MINE LAYOUT

File Name: RDM_SEP_GW_TemplateLandscape1	Date: 3/29/2022	Job No. 165.030386	Approved: JCR/MLN	Figure: 1

Legend

- Ground Temperature (Thermistor)
- Groundwater (Piezometer)
- Inactive Groundwater (Piezometer)
- Stream
- Contour Line (50 Ft)

N

0 450 900 1,800 Feet

Notes:
1. Coordinate system is NAD83 Zone 7N, units are US feet.
2. Background imagery is from CGG Ortho, 2021, contour lines are from 2021 topography.

The information in this map is for planning purposes only and is not to be used as a legal document.

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MAIN DAM AREA

File Name: RDM_SEP_GW_TemplateLandscape2	Date: 4/8/2022	Job No. 165.030437	Approved: JCR/MLN	Figure: 2

Overview Map

BACK DAM

BACK DAM BEACH

T-96-013

T-21-013

P-21-013

P-96-013

OVERBURDEN STOCKPILE

T-96-021

T-95-008 #2

T-96-023

T-96-022

T-96-012S

T-96-012

P-97-012

1000

Legend

- Inactive Groundwater (Piezometer)
- Ground Temperature (Thermistor)
- Groundwater (Piezometer)
- Stream
- Contour Line (50 Ft)

N

0 450 900 1,800 Feet

Notes:
1. Coordinate system is NAD83 Zone 7N, units are US feet.
2. Background imagery is from CGG Ortho, 2021, contour lines are from 2021 topography.

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OVERBURDEN STOCKPILE/ BACK DAM AREA

File Name: RDM_SEP_GW_TemplateLandscape3	Date: 4/8/2022	Job No. 165.030437	Approved: JCR/MLN	Figure: 3

Appendix C
Raw Thermistor Data

APPENDIX B - THERMISTOR DATA READINGS 2020

Site ID	Num Therm	Date/Time	pt-01	pt-02	pt-03	pt-04	pt-05	pt-06	pt-07	pt-08	pt-09	pt-10	pt-11	pt-12	pt-13	pt-14	pt-15	pt-16	pt-17	pt-18	pt-19	pt-20	pt-21	pt-22	pt-23	pt-24
T96-12s	24	1/10/22 3:59 PM	39.33	40.567	34.736	22.734	18.733	17.206	16.459	16.483	16.546	16.641	39.723	16.703	16.73	16.712	16.758	16.868	9999.9	16.852	16.849	16.874	16.918	16.93	16.95	16.899
T96-12	24	1/10/22 4:01 PM	16.669	16.718	16.896	16.957	17.043	17.077	17.124	17.177	17.179	17.159	17.208	9999.9	9999.9	17.036	16.922	16.917	16.789	16.656	16.528	16.374	9999.9	16.147	16.012	15.884
T95-8 #2	24	1/10/22 4:26 PM	20.019	16.721	16.787	16.948	16.94	16.956	16.941	16.924	17.005	17.006	17.011	16.985	9999.9	17.051	17	17.036	17.041	17.023	17.05	17.073	17.066	17.056	17.115	17.142
T95-8 #2	24	1/10/22 4:27 PM	20.019	16.721	16.787	16.952	16.94	16.955	16.941	16.924	17.005	17.006	17.01	16.984	9999.9	17.05	17	17.036	17.04	17.023	17.05	17.073	17.065	17.056	17.114	17.142
T96-21	24	1/10/22 4:39 PM	40.487	17.928	14.894	13.649	13.143	13.36	13.152	13.318	13.508	13.784	14.072	14.446	14.916	15.388	15.67	16.105	16.499	16.601	16.6	16.751	16.798	16.835	16.863	16.921
T96-22	24	1/10/22 4:43 PM	40.896	20.161	9999.9	14.498	14.097	14.255	14.68	9999.9	15.581	15.955	16.303	16.603	16.738	16.788	9999.9	16.954	16.983	16.949	17.03	17.05	17.06	17.125	11.528	17.126
T96-23	24	1/10/22 4:46 PM	9999.9	9999.9	16.631	15.139	14.463	14.423	14.687	15.461	15.928	16.436	16.662	16.776	-9999	16.873	16.791	17.197	16.965	16.974	17.078	17.103	17.018	16.722	17.148	17.215
T96-15	14	1/20/22 11:04 AM	16.705	16.89	16.86	9999.9	16.705	16.89	16.864	16.863	16.772	16.695	16.657	16.571	16.523	16.506										
T97-30	24	1/20/22 11:17 AM	-13.38	13.369	13.539	13.754	14.115	13.767	13.984	14.126	14.189	-13.15	-14.14	-13.81	-87.71	-9999	14.959	-137	14.745	15.004	15.026	0.0404	14.978	-395	19.177	-20.15
T97-29	24	1/20/22 11:20 AM	13.968	13.955	14.106	-9999	-18.88	-2668	-38.31	-44.19	14.715	14.415	15.423	-8523	-14.72	15.642	15.723	15.793	15.556	15.336	15.271	-12.42	21.537	14.952	14.884	-13.76
T97-28	24	1/20/22 11:23 AM	13.922	13.821	13.811	13.851	13.717	13.695	13.824	13.962	14.045	14.124	14.24	14.425	14.675	14.726	14.876	15.041	15.186	15.154	15.256	15.273	15.376	-1624	2267.9	15.295
T95-5	24	1/20/22 11:31 AM	15.564	15.081	15.748	16.381	16.52	16.656	16.726	16.765	16.781	16.802	16.823	16.768	16.841	16.74	16.688	16.667	16.612	9999.9	16.351	16.177	16.059	15.879	15.725	15.543
T05-61	6	1/20/22 11:37 AM	-43.55	16.375	16.868	-59.2	-9999	16.725																		
T05-61	6	1/20/22 11:37 AM	30.929	16.376	16.966	57.984	-9999	16.731																		
T96-23	24	4/20/22 3:45 PM	213.8	230.1	16.78	15.981	15.391	15.309	15.038	15.285	16.101	16.425	16.633	16.664	16.725	16.748	16.546	16.809	16.83	16.574	16.983	16.927	16.924	16.604	17.033	16.985
T05-61	24	4/20/22 4:11 PM	37.17	28.56	16.234	60.57	9999	16.683																		
T96-13	24	4/11/22 1:55 PM	17.077	16.484	14.641	16.32	16.723	17.417	17.244	16.879	16.976	17.023	17.094	17.129	19.042	19.664	18.185	17.142	121.9	17.284	19.372	16.839	16.752	16.593	16.552	16.384
T97-30	24	4/11/22 2:26 PM	14.051	14.055	14.027	14.092	13.904	13.803	13.838	13.928	13.996	14.085	14.235	14.434	14.674	14.73	14.879	15.127	15.187	15.155	15.256	15.272	15.425	1780	718.4	15.296
T97-29	24	4/11/22 2:32 PM	14.036	13.971	14.106	9999	16.68	2642	21.19	49.7	14.676	14.367	19.113	9216	14.69	15.607	15.682	15.805	15.526	15.256	15.247	12.62	14.36	15.165	14.898	13.74
T97-28	24	4/11/22 2:38 PM	13.38	13.406	13.534	13.747	14.139	13.754	13.988	14.114	14.163	13.1	14.06	13.72	86.92	9999.9	14.964	147.7	15.08	14.999	15.025	0.0393	14.961	400.3	19.139	20.45
T96-15	14	4/11/22 3:31 PM	16.885	16.883	16.862	16.862	16.77	16.695	16.656	16.571	16.522	16.505	16.405	16.331	16.279	16.223										
T95-8 #2	24	4/12/22 7:29 AM	21.282	17.103	16.426	16.965	16.812	16.779	16.851	16.879	16.915	16.993	16.978	16.973	16.997	16.952	16.85	16.8	16.673	16.619	16.391	16.288	16.426	16.763	17.016	17.098
T96-12s	24	4/12/22 7:41 AM	20.488	17.554	19.418	18.126	17.443	16.982	16.554	16.507	16.532	16.622	16.697	16.682	16.712	16.693	16.74	16.772	9999.9	16.836	16.838	16.864	16.917	16.924	16.944	16.901
T96-12	24	4/12/22 7:44 AM	16.653	16.64	16.835	16.911	16.981	17.005	17.049	17.043	17.051	16.963	17.021	2904	2799	16.99	16.828	16.775	16.693	16.516	16.333	16.197	1259	0.0018	15.971	15.879
T96-21	24	4/12/22 8:02 AM	22.327	18.861	15.835	14.543	13.695	13.597	13.17	13.188	13.326	13.638	14.007	14.437	14.936	15.387	15.684	16.026	16.498	16.598	16.618	16.738	16.803	16.821	16.863	16.919
T96-22	24	4/12/22 8:14 AM	21.347	20.491	9999.9	15.547	14.913	14.767	14.929	9999.9	15.538	15.878	88.34	16.6	16.736	16.757	9999.9	16.898	16.975	16.892	17.023	17.04	17.052	16.949	11.126	17.024
T95-5	24	4/11/22 2:54 PM	15.861	15.296	15.446	16.207	16.317	16.206	16.166	16.096	15.759	16.515	15.574	15.615	16.011	16.714	16.579	16.446	16.53	297.4	15.952	15.859	15.676	15.405	15.311	15.434
T96-23	24	4/20/22 3:45 PM	213.8	230.1	16.78	15.981	15.391	15.309	15.038	15.285	16.101	16.425	16.633	16.664	16.725	16.748	16.546	16.809	16.83	16.574	16.983	16.927	16.924	16.604	17.033	16.985
T05-61	24	4/20/22 4:11 PM	37.17	28.56	16.234	60.57	9999	16.683																		
T96-23	24	4/20/22 3:45 PM	213.8	230.1	16.78	15.981	15.391	15.309	15.038	15.285	16.101	16.425	16.633	16.664	16.725	16.748	16.546	16.809	16.83	16.574	16.983	16.927	16.924	16.604	17.033	16.985
T05-61	24	4/20/22 4:11 PM	37.17	28.56	16.234	60.57	9999	16.683																		
T96-12	24	7/9/22 1:49 PM	15.995	16.694	16.877	16.948	17.036	17.073	17.113	17.172	17.173	17.155	17.24	9999.9	9999.9	17.037	16.923	16.869	16.79	16.662	16.532	16.378	9999.9	16.153	16.017	15.893
T96-12s	24	7/9/22 1:51 PM	5.2764	4.3445	4.3218	5.5774	9.5431	13.839	16.427	16.545	16.567	16.647	16.678	16.686	16.712	16.689	16.734	16.76	9999.9	16.832	16.819	16.852	16.883	16.918	16.939	16.89
T96-21	24	7/9/22 2:26 PM	4.208	8.3092	12.464	13.925	14.249	14.334	13.682	13.523	13.552	13.798	14.123	14.515	14.951	15.407	15.692	16.078	16.517	16.611	16.62	16.751	16.821	16.852	16.872	16.936
T96-22	24	7/9/22 3:02 PM	4.3559	7.2829	9999.9	14.903	15.176	15.129	15.182	9999.9	15.564	15.879	16.261	16.601	16.728	16.778	9999.9	16.928	16.984	16.956	17.027	17.05	17.058	16.807	10.868	16.844
T96-23	24	7/9/22 3:09 PM	9999.9	9999.9	8.2674	11.037	12.233	13.523	14.326	15.404	15.73	16.009	15.909	16.772	16.68	16.35	16.237	16.113	16.107	16.852	16.292	17.041	16.86	-15.7	16.976	17.002
T96-13	24	7/9/22 3:21 PM	12.518	17.779	14.83	16.271	16.805	-21.89	17.273	16.889	16.983	17.03	17.098	17.13	19.082	19.746	18.205	17.16	17.177	17.004	19.405	16.838	16.868	16.628	16.56	16.391
T95-8 #2	24	7/9/22 3:45 PM	14.707	17.097	16.871	16.927	16.942	16.959	16.942	16.928	17.006	17.008	17.012	-28.92	17.041	17.063	17.001	17.049	17.04	17.024	17.049	17.075	17.09	17.074	17.132	17.16
T95-5	24	7/9/22 4:02 PM	-9999	-9999	14.13	15.878	15.956	16.33	16.505	16.644	16.716	16.758	16.784	-20.58	16.828	16.777	16.79	16.751	16.69	-16.66	16.611	-9999	16.35	16.179	16.062	15.882
T05-61	6	7/9/22 4:25 PM	-90.61	33.506	-36.96	-53.86	-73.6	16.621																		
T97-28	24	7/9/22 4:33 PM	-9999	9999.9	9999.9	9999.9	-9999	-9999	-9999	9999.9	-9999	-9999	9999.9	-9999	-9999	-9999	-9999	-9999	9999.9	-9999	-9999	9999.9	9999.9	9999.9	-9999	9999.9
T97-28	24	7/9/22 4:33 PM	-9999	9999.9	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999	9999.9	9999.9	-9999	9999.9	9999.9	9999.9	-9999	9999.9	9999.9	9999.9	-9999	-9999	-9999	-9999
T97-29	24	7/9/22 4:35 PM	-9999	-9999	9999.9	-9999	-9999	-9999	-9999	-9999	-9999	-9999	-9999	9999.9	-9999	9999.9	-9999	-9999	-9999	-9999	9999.9	-9999	-9999	-9999	9999.9	-9999
T97-30	24	7/9/22 4:36 PM	-9999	9999.9	-9999	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	-9999	9999.9	-9999	-9999	9999.9	-9999	-9999	9999.9	9999.9	9999.9	-9999	-9999	-9999	9999.9
T96-15	14	7/9/22 4:48 PM	-9999	16.885	16.859	16.86	16.769	16.694	16.656	16.572	16.522	16.507	16.405	16.33	16.28	16.223										
T96-15	14	7/9/22 4:50 PM	9999.9	16.885	16.859	16.859	16.769	16.694	16.656	16.572	16.522	16.507	16.405	16.33	16.28	16.223										
T96-22	24	7/11/22 3:26 PM	9.5995	9.5432	4978	14.792	15.085	15.116	15.177	1345.7	15.525	15.856	16.25	16.597	16.551	16.777	-5316	16.88	16.967	16.89	17.023	17.038	17.034	16.806	10.846	16.826
T96-12	24	7/11/22 3:47 PM	15.806	16.582	16.83	16.856	16.97	17.039	17.088	17.069	17.111	16.024	16.778	-2998	9999.9	16.953	16.21	16.93	16.284	16.065	15.861	15.402	-127.3	14.61	14.27	15.85
T05-61	6	8/15/22 2:01 PM	-121.3	34.364	-53.78	-65.69	7739.7	17.374																		
T05-61	6	8/15/22 2:02 PM	-122	-34.1	-53.4	-64.73	-9263	17.373																		

APPENDIX B - THERMISTOR DATA READINGS 2020

Site ID	Num Therm	Date/Time	pt-01	pt-02	pt-03	pt-04	pt-05	pt-06	pt-07	pt-08	pt-09	pt-10	pt-11	pt-12	pt-13	pt-14	pt-15	pt-16	pt-17	pt-18	pt-19	pt-20	pt-21	pt-22	pt-23	pt-24
T96-12	24	10/21/22 9:32 AM	16.182	16.69	16.868	16.937	17.022	17.052	17.1	17.161	17.164	16.722	16.829	-561.9	-1744	16.988	16.742	-9999	16.523	16.461	16.239	16.126	9999.9	-0.293	15.324	15.318
T96-12	24	10/21/22 9:34 AM	16.181	16.694	16.868	16.927	17.022	17.055	17.1	17.161	17.164	16.777	16.793	-561.9	-1705	16.993	16.76	9999.9	16.558	16.468	16.243	16.135	-2877	-3.669	15.214	15.188
T96-12s	24	10/21/22 9:35 AM	17.04	17.131	17.146	16.779	16.405	16.216	16.248	16.349	16.512	16.629	16.668	16.653	16.713	16.686	16.73	20.581	9999.9	16.826	16.806	16.742	9999.9	16.912	17.055	-1905
T95-8 #2	24	10/21/22 9:50 AM	15.57	16.743	16.672	16.513	16.43	16.523	16.654	16.512	16.598	16.392	16.502	16.254	16.503	16.812	16.848	-16.85	16.773	16.749	16.801	16.712	-9999	16.726	16.938	16.986
T96-21	24	10/21/22 10:07 AM	16.886	15.272	13.06	12.514	12.706	13.437	13.429	13.591	13.724	13.923	14.121	14.456	14.905	15.326	15.669	-16.08	16.488	16.56	16.544	16.682	16.745	16.815	16.872	16.93
T96-21	24	10/21/22 10:08 AM	16.893	15.292	13.065	12.499	12.705	13.438	13.43	13.595	13.729	13.93	14.124	14.461	14.901	15.325	15.673	-16.09	16.486	16.499	16.532	16.682	-16.66	16.827	16.567	16.933
T96-23	24	10/21/22 10:17 AM	-6068	-5770	15.22	13.25	12.827	13.45	13.876	14.757	15.783	15.962	15.872	16.73	16.648	16.285	16.364	16.348	16.077	16.695	16.294	16.719	-16.92	16.049	16.884	16.971
T96-23	24	10/21/22 10:18 AM	-7484	-6832	15.234	13.241	12.867	13.314	13.729	14.822	15.766	16.033	15.782	16.591	16.61	16.3	16.4	16.527	16.153	16.682	16.02	16.533	16.936	16.045	16.891	16.962
T96-22	24	10/21/22 10:22 AM	16.755	16.141	-9255	12.981	13.473	14.135	14.735	-495.3	15.823	16.163	16.26	16.386	16.62	16.692	-4398	-9999	16.959	16.806	16.743	16.64	17.066	16.808	10.724	16.541
T96-13	24	10/21/22 2:02 PM	-114.4	21.642	15.146	24.445	18.002	9999.9	17.266	16.898	16.997	24.79	17.1	17.138	19.114	19.859	18.434	17.235	17.341	-18.81	-71.68	16.838	-16.78	16.876	-18.75	16.426
T96-13	24	10/21/22 2:03 PM	-62.34	15.364	14.257	19.745	17.225	17.594	17.274	16.906	16.989	17.034	17.1	17.136	19.116	19.833	18.237	33.484	51.205	17.239	19.499	16.832	16.776	16.581	16.566	16.39
T97-28	24	10/21/22 3:30 PM	-13.41	13.519	13.476	13.697	14.118	13.722	13.908	14.033	14.057	-12.77	-13.79	-13.55	-90.89	-8633	-14.19	-119.9	-232.7	15.114	14.967	0.034	-14.98	-435.9	19.125	-20.41
T97-29	24	10/21/22 3:32 PM	14.156	13.943	14.144	-15.01	-18.21	-1733	14.564	-43.4	14.596	14.221	-14.61	-1611	-14.39	15.457	15.573	-9999	15.441	15.163	15.241	-12.11	14.429	-14.49	14.888	-13.41
T97-30	24	10/21/22 3:33 PM	14.344	14.133	14.136	14.162	14.115	14.051	14.004	13.999	14.012	14.077	14.143	14.384	14.667	14.728	14.873	9999.9	15.183	15.14	15.242	15.229	15.389	-2537	4592.9	15.271
T96-15	14	10/21/22 4:04 PM	16.798	16.809	16.842	16.76	16.39	16.58	16.514	16.297	16.022	16.326	16.312	16.157	16.171	16.164										
T95-5	24	10/21/22 4:21 PM	13.718	14.865	15.943	16.329	16.459	16.616	16.697	16.722	16.67	16.76	16.809	16.753	16.749	16.74	16.679	-9999	16.603	9999.9	16.324	16.156	16.01	15.847	15.741	15.557
T96-12s	24	10/21/22 4:34 PM	16.62	16.912	16.274	16.425	16.385	16.212	16.248	16.349	16.484	16.622	16.667	16.568	16.698	16.686	16.731	9999.9	-9999	16.823	16.736	16.754	16.815	16.889	16.925	16.755
T14-110*	24	1/20/2022 23:59	0.44	0.38	0.13	0	-0.13	-0.06	-0.13	-0.06	0	0	0.06	0.06	0.13	0.19	0.25	0.32	0.44	0.57	0.7	0.82	1.01	1.14	1.33	1.52
T14-110*	24	4/12/2022 23:59	0.12	0.32	0.13	0	-0.13	-0.06	-0.13	-0.13	0	0	0.06	0.13	0.13	0.25	0.25	0.32	0.44	0.57	0.7	0.82	1.01	1.14	1.33	1.45
T14-110*	24	10/19/2022 13:00	1.52	0.25	0.06	0	-0.13	-0.06	-0.13	-0.13	0	0	0	0.06	0.13	0.19	0.25	0.38	0.44	0.57	0.7	0.82	1.01	1.14	1.33	1.52

Notes:

Num of Therms = total number of thermistor sensors at each site (string)

Date/Time = mm/dd/yy hh:mm

Measurements are shown in kohms. *T14-110 measurements are in Celsius

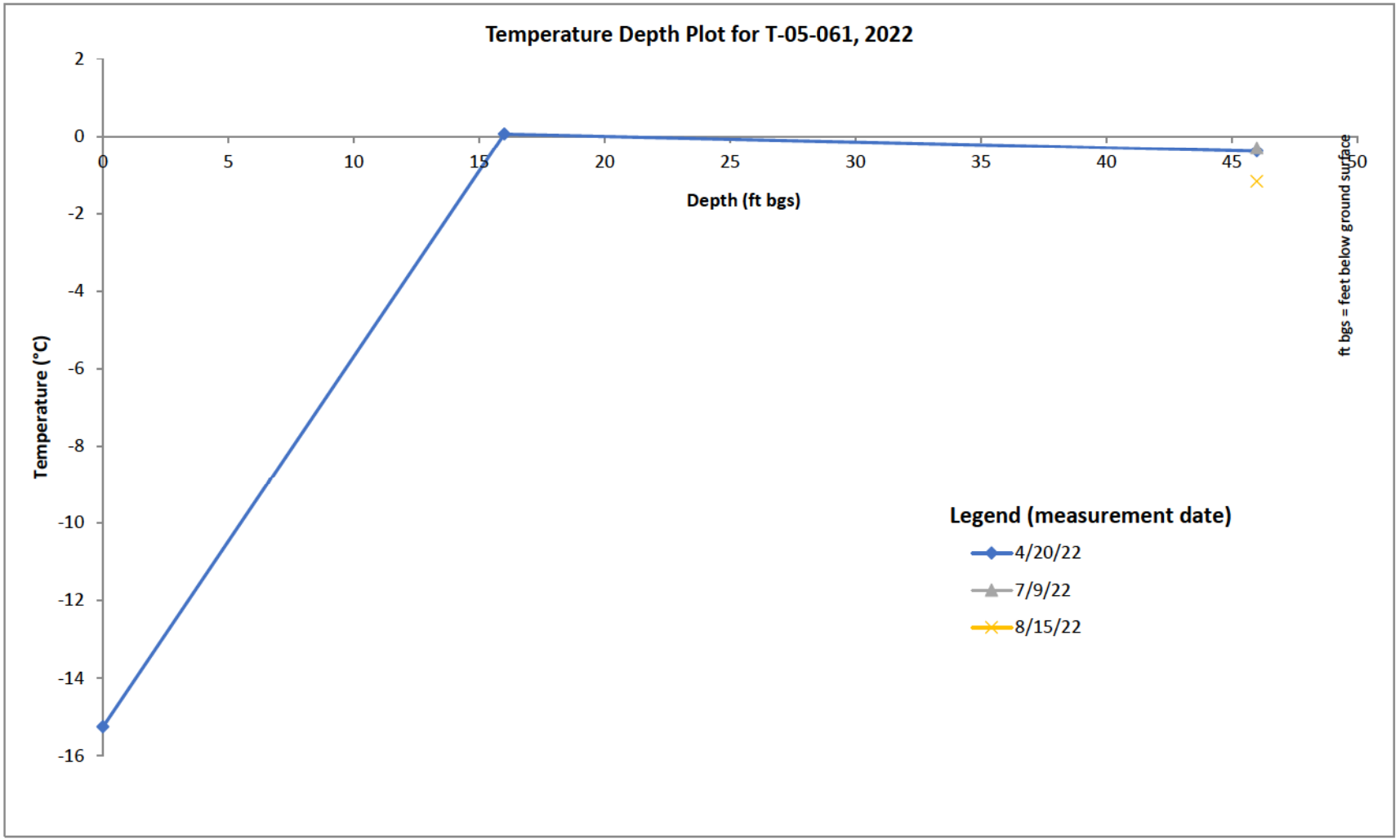
Red highlighted data represent measurements that are outside of database criteria and omitted from the database.

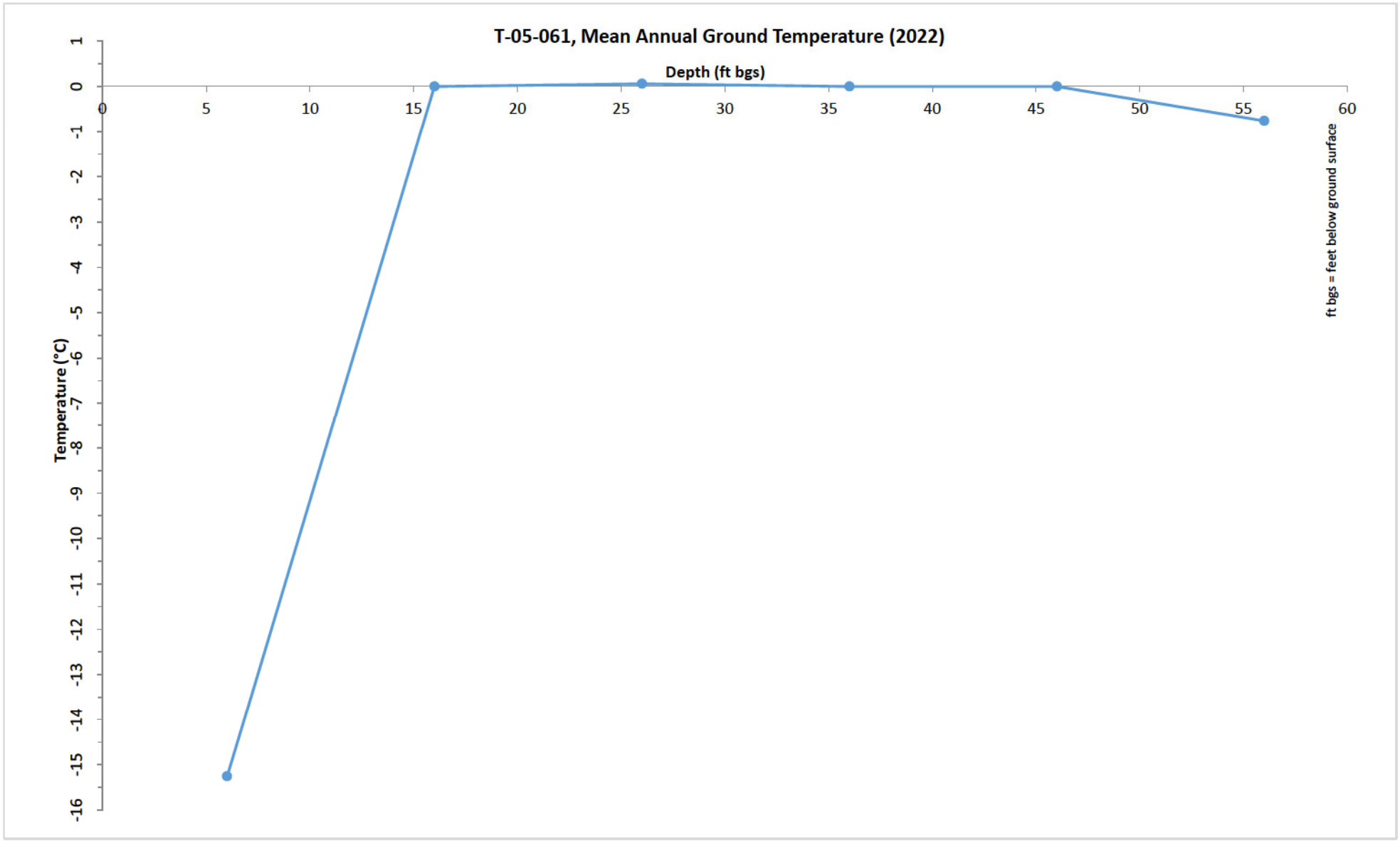
Appendix D
Thermistor Plots

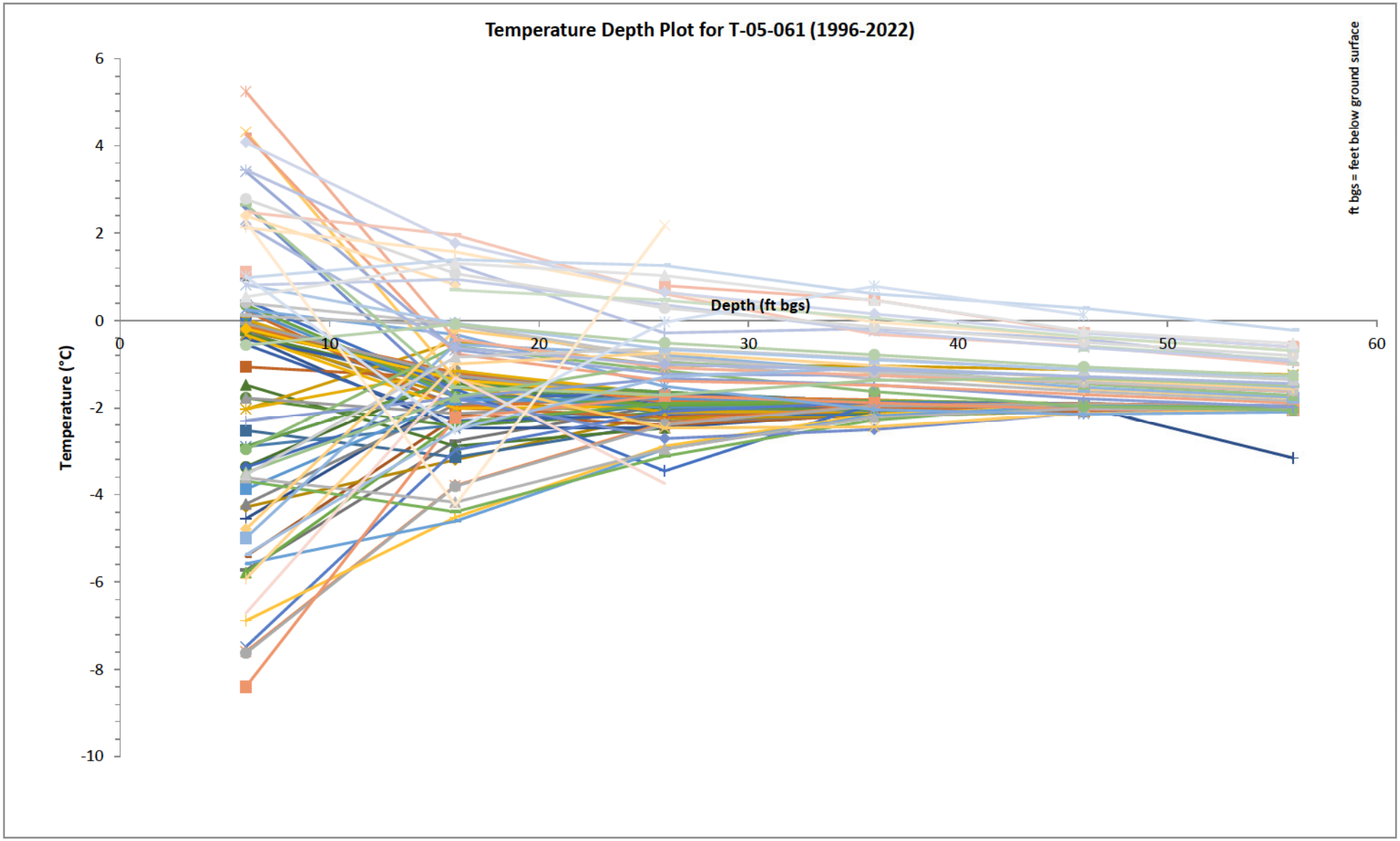
3 plots per thermistor:

- 2022 quarterly temperatures vs. depth
- 2022 average temperature vs. depth
- Cumulative temperature vs. depth (by quarter)

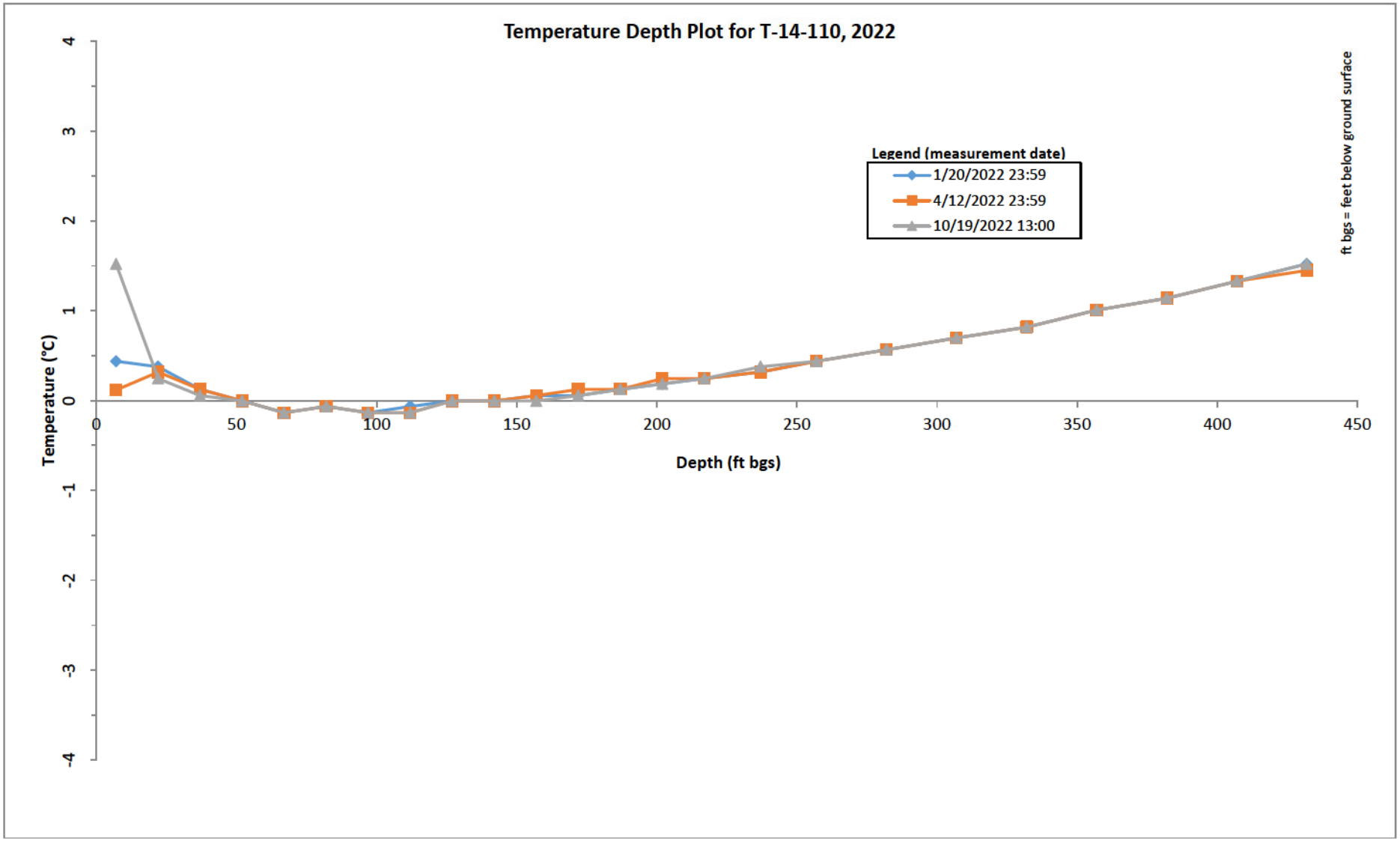
Thermistor T-05-61

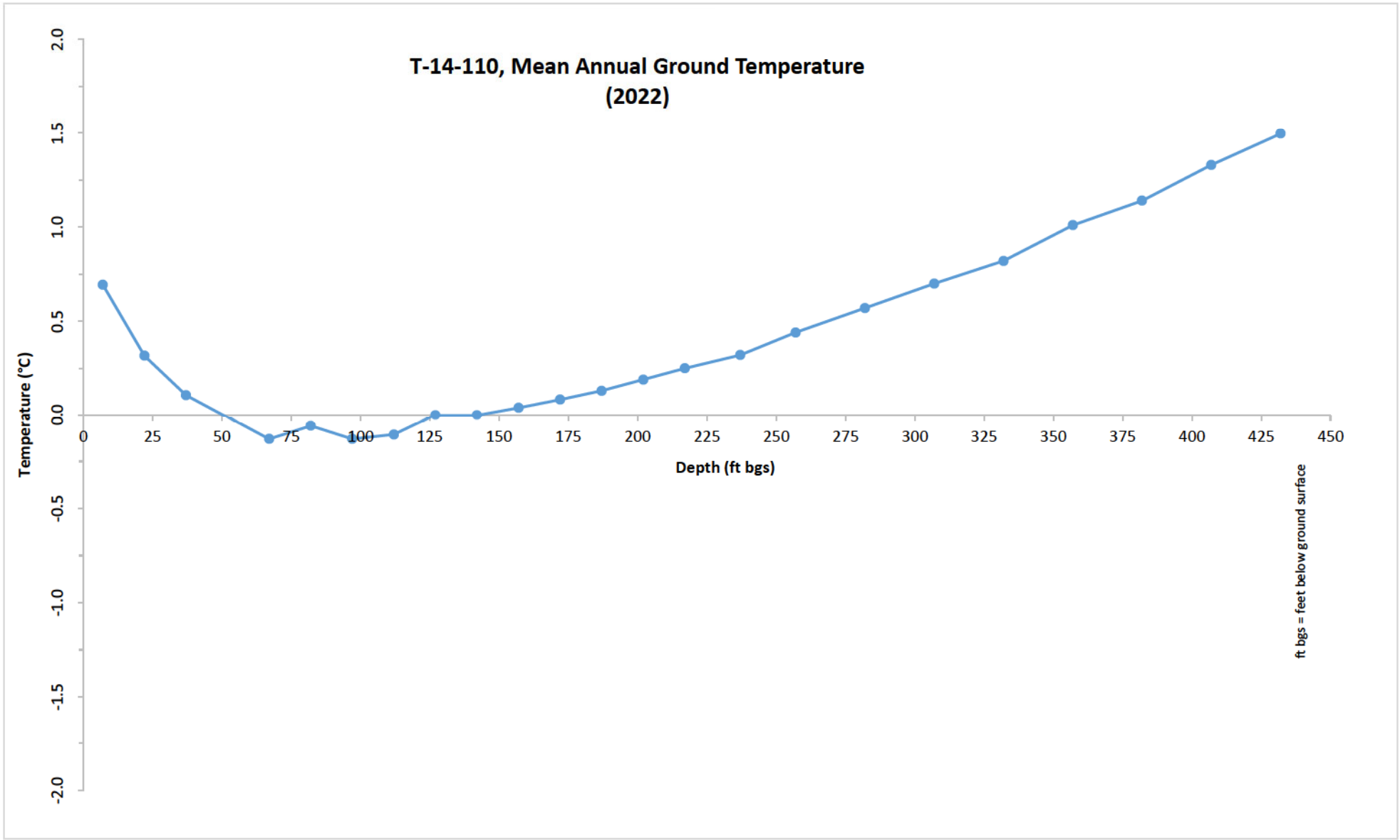

Temperature Depth Plot for T-05-061, 2022
Temperature (°C)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
5
10
15
20
25
30
35
40
45
50
Depth (ft bgs)
ft bgs = feet below ground surface
Legend (measurement date)
4/20/22
7/9/22
8/15/22

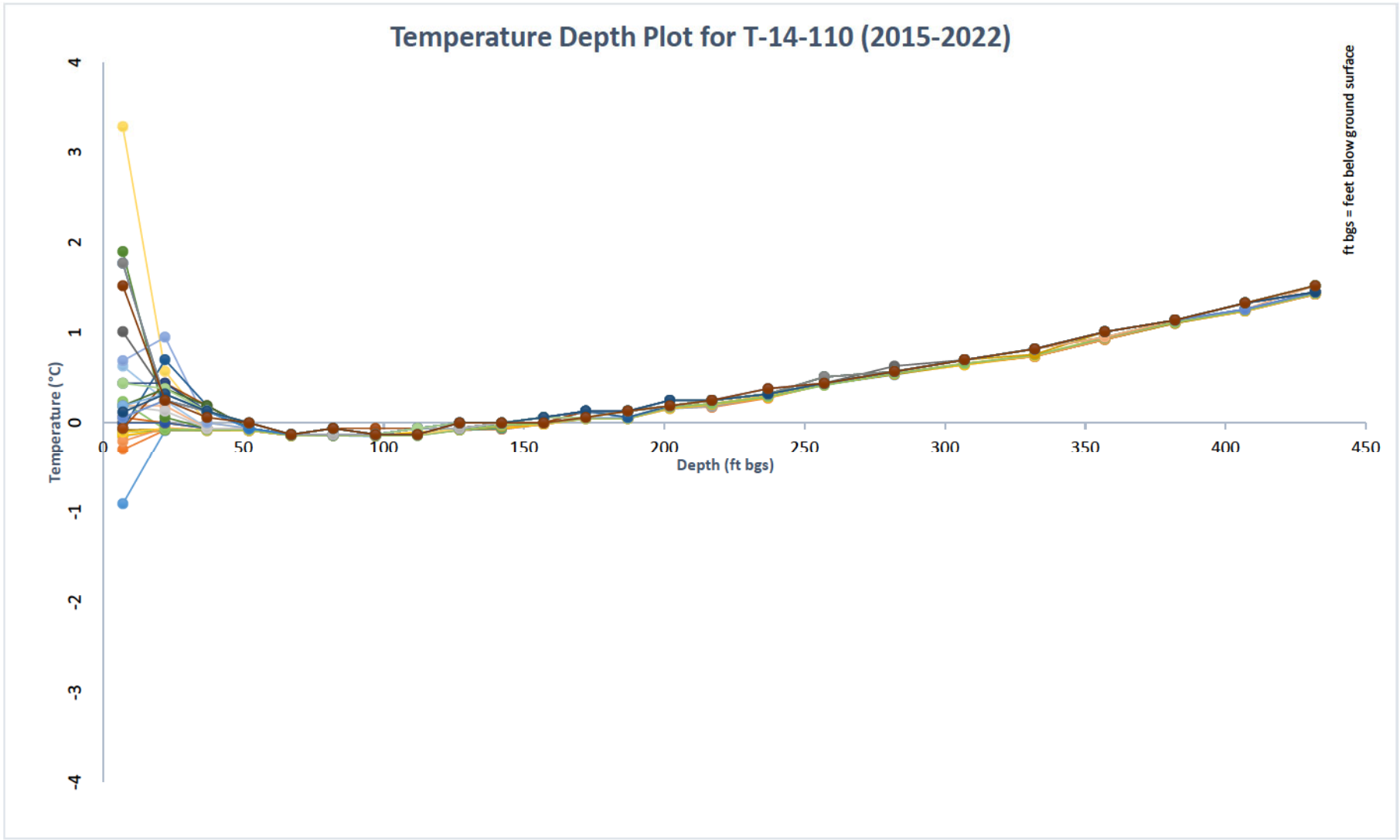

T-05-061, Mean Annual Ground Temperature (2022)
Depth (ft bgs)
Temperature (°C)
ft bgs = feet below ground surface
0
5
10
15
20
25
30
35
40
45
50
55
60
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16


Temperature Depth Plot for T-05-061 (1996-2022)
Temperature (°C)
Depth (ft bgs)
ft bgs = feet below ground surface
6
4
2
0
-2
-4
-6
-8
-10
0
10
20
30
40
50
60

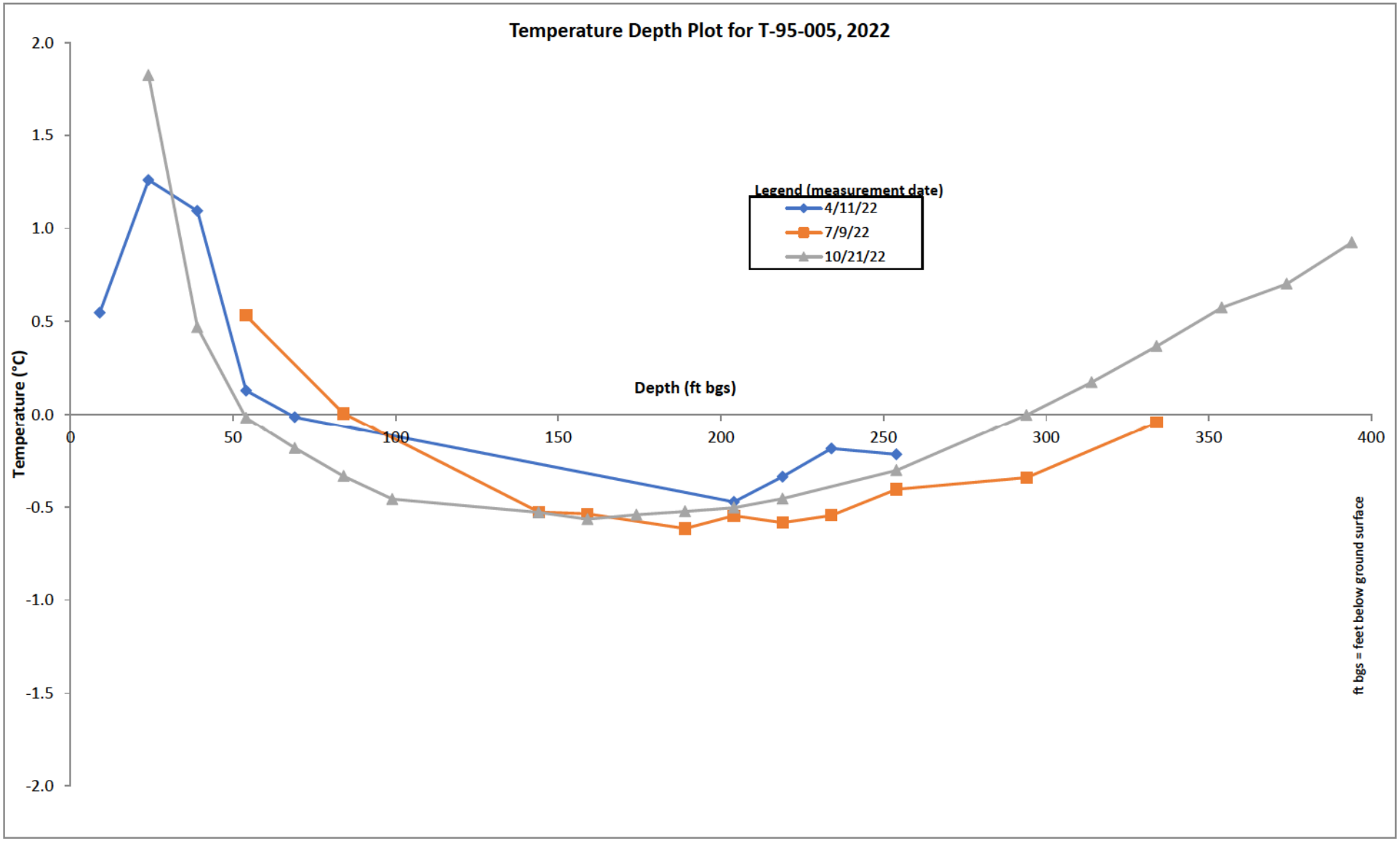
Thermistor T-14-110

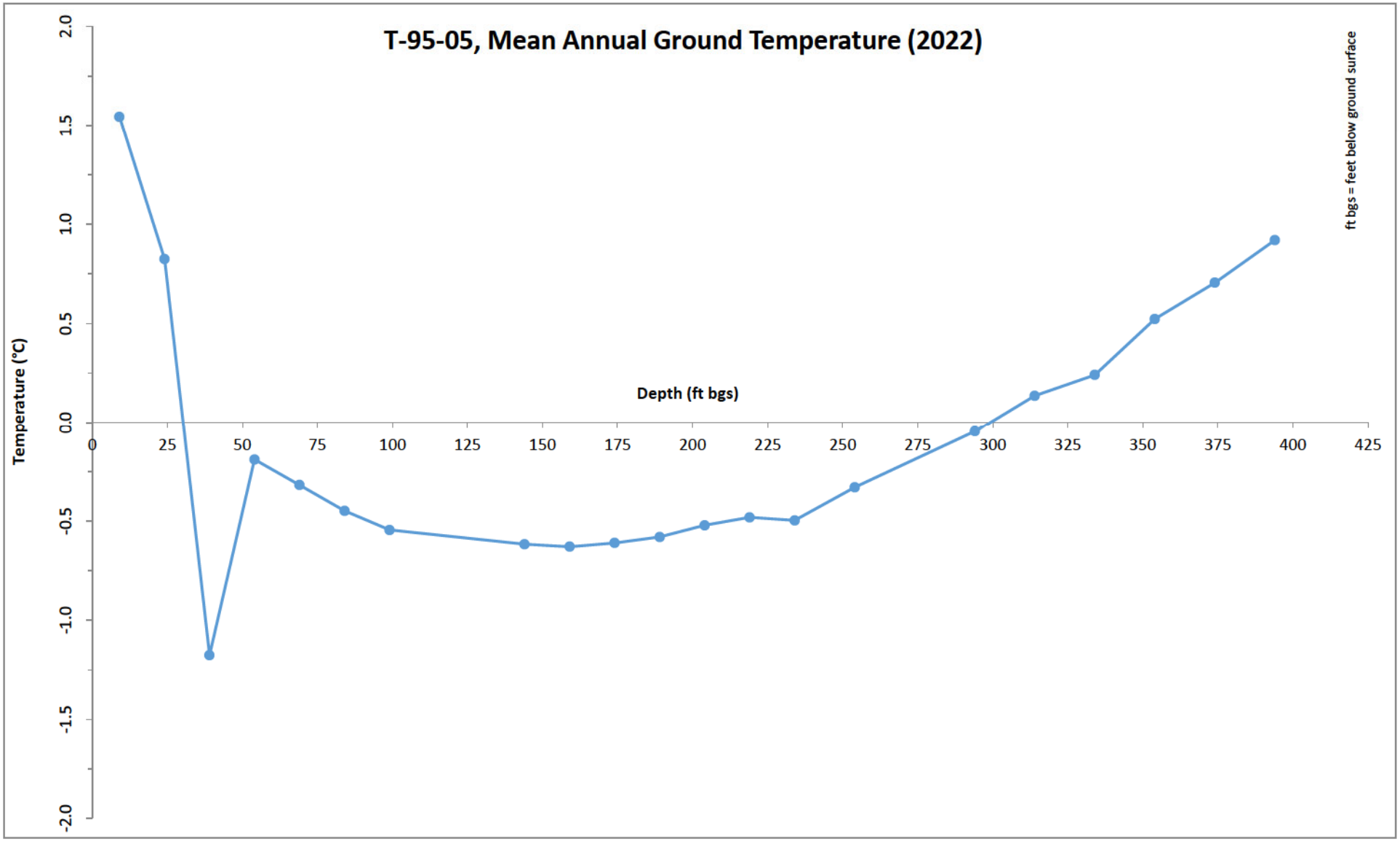

Temperature Depth Plot for T-14-110, 2022
Legend (measurement date)
1/20/2022 23:59
4/12/2022 23:59
10/19/2022 13:00
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft bgs)
4
3
2
1
0
-1
-2
-3
-4
0
50
100
150
200
250
300
350
400
450

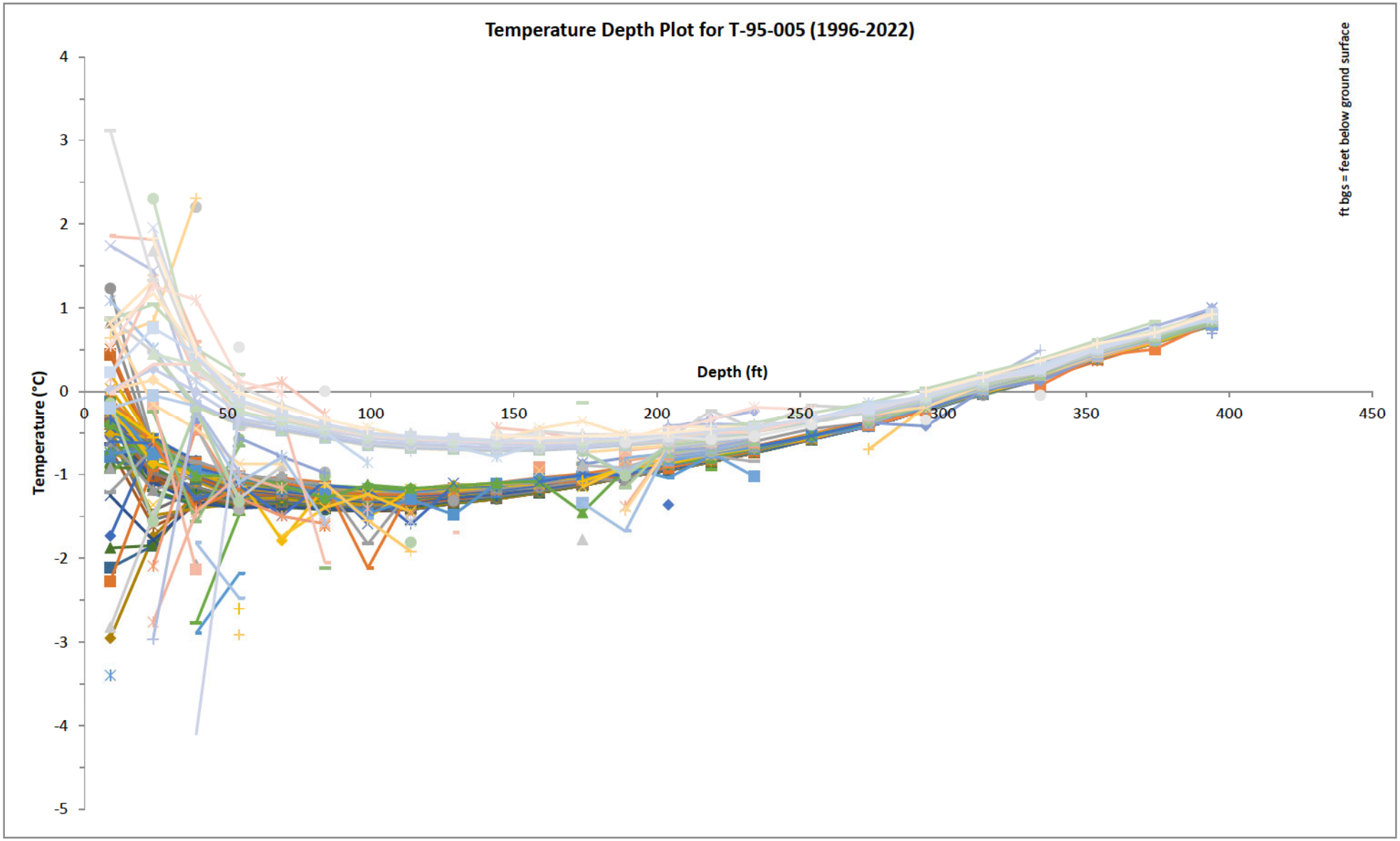

T-14-110, Mean Annual Ground Temperature
(2022)
Temperature (°C)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-14-110 (2015-2022)
Temperature (°C)
4
3
2
1
0
-1
-2
-3
-4
0
50
100
150
200
250
300
350
400
450
Depth (ft bgs)
ft bgs = feet below ground surface

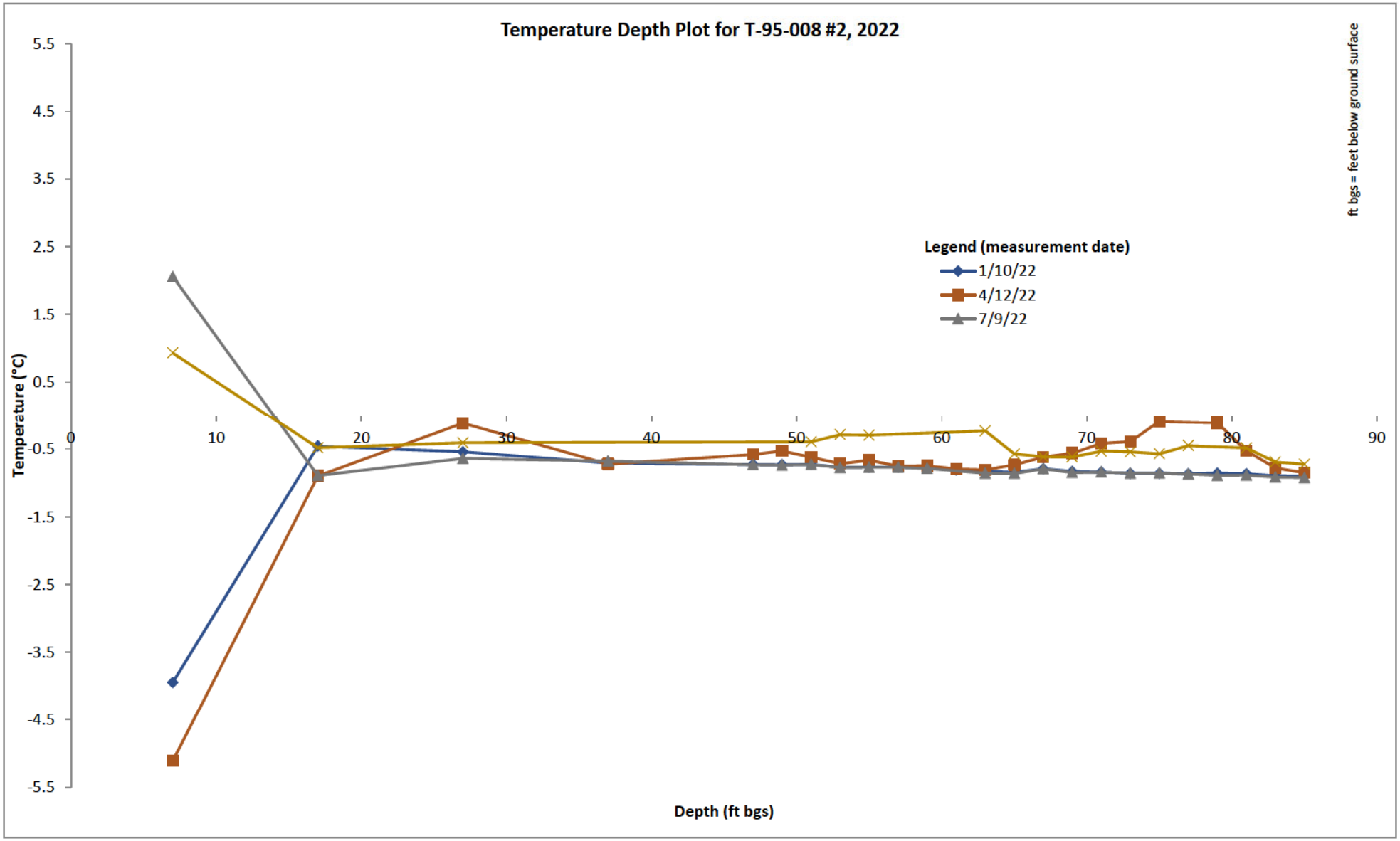
Thermistor T-95-05

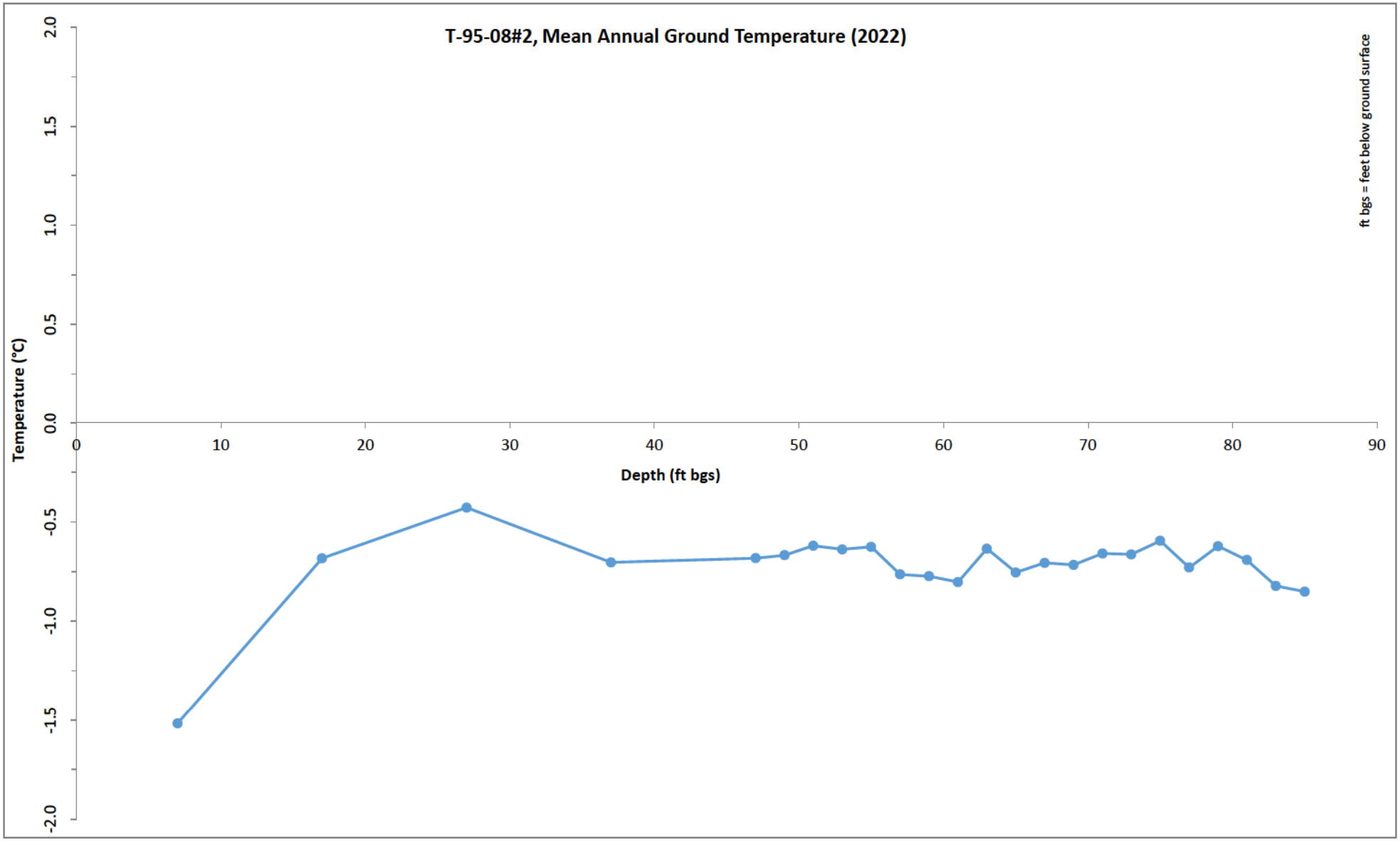

Temperature Depth Plot for T-95-005, 2022
Legend (measurement date)
4/11/22
7/9/22
10/21/22
Temperature (°C)
Depth (ft bgs)
ft bgs = feet below ground surface
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
50
100
150
200
250
300
350
400

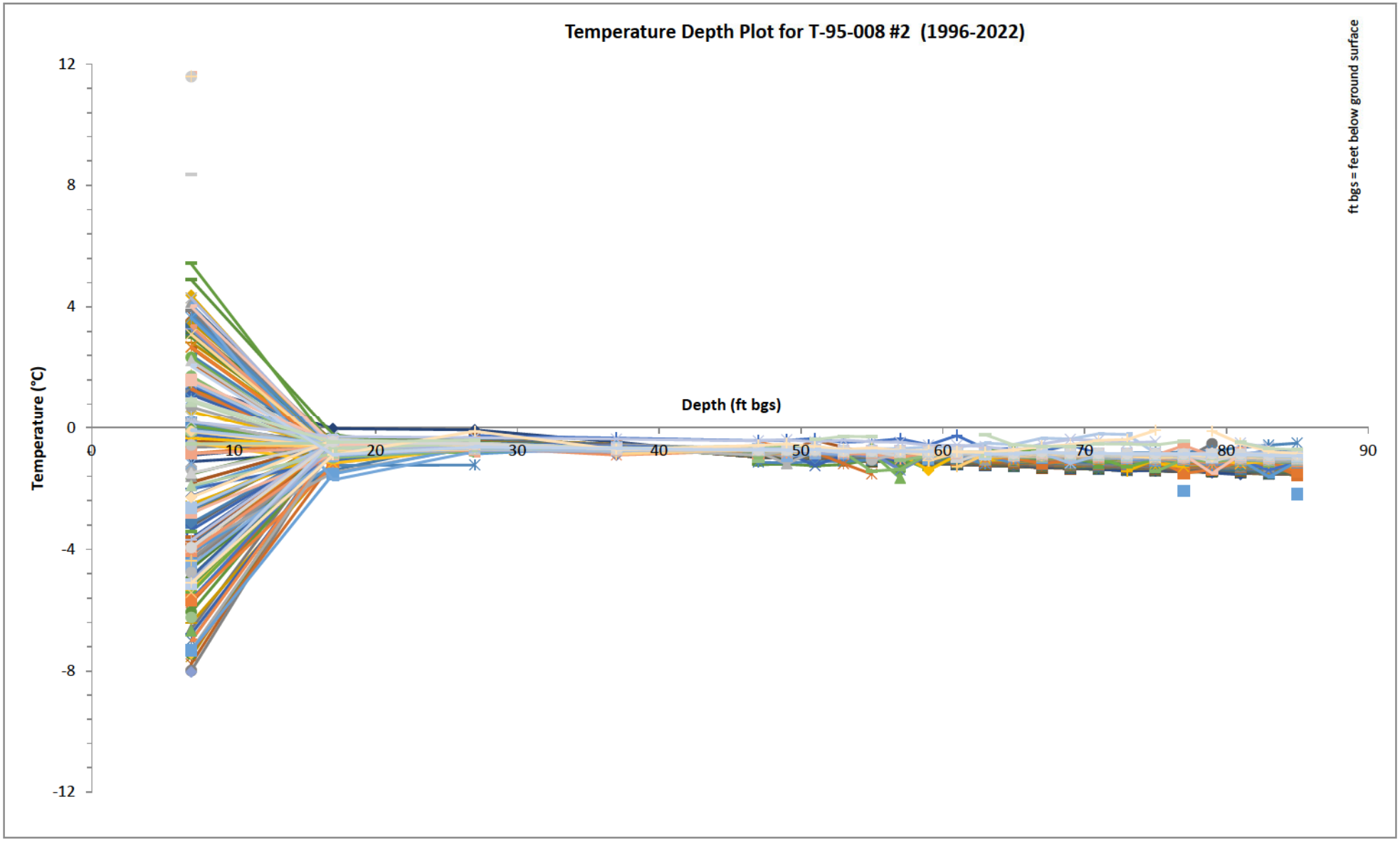

T-95-05, Mean Annual Ground Temperature (2022)
Temperature (°C)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
ft bgs = feet below ground surface


Temperature Depth Plot for T-95-005 (1996-2022)
Temperature (°C)
Depth (ft)
ft bgs = feet below ground surface
4
3
2
1
0
-1
-2
-3
-4
-5
0
50
100
150
200
250
300
350
400
450

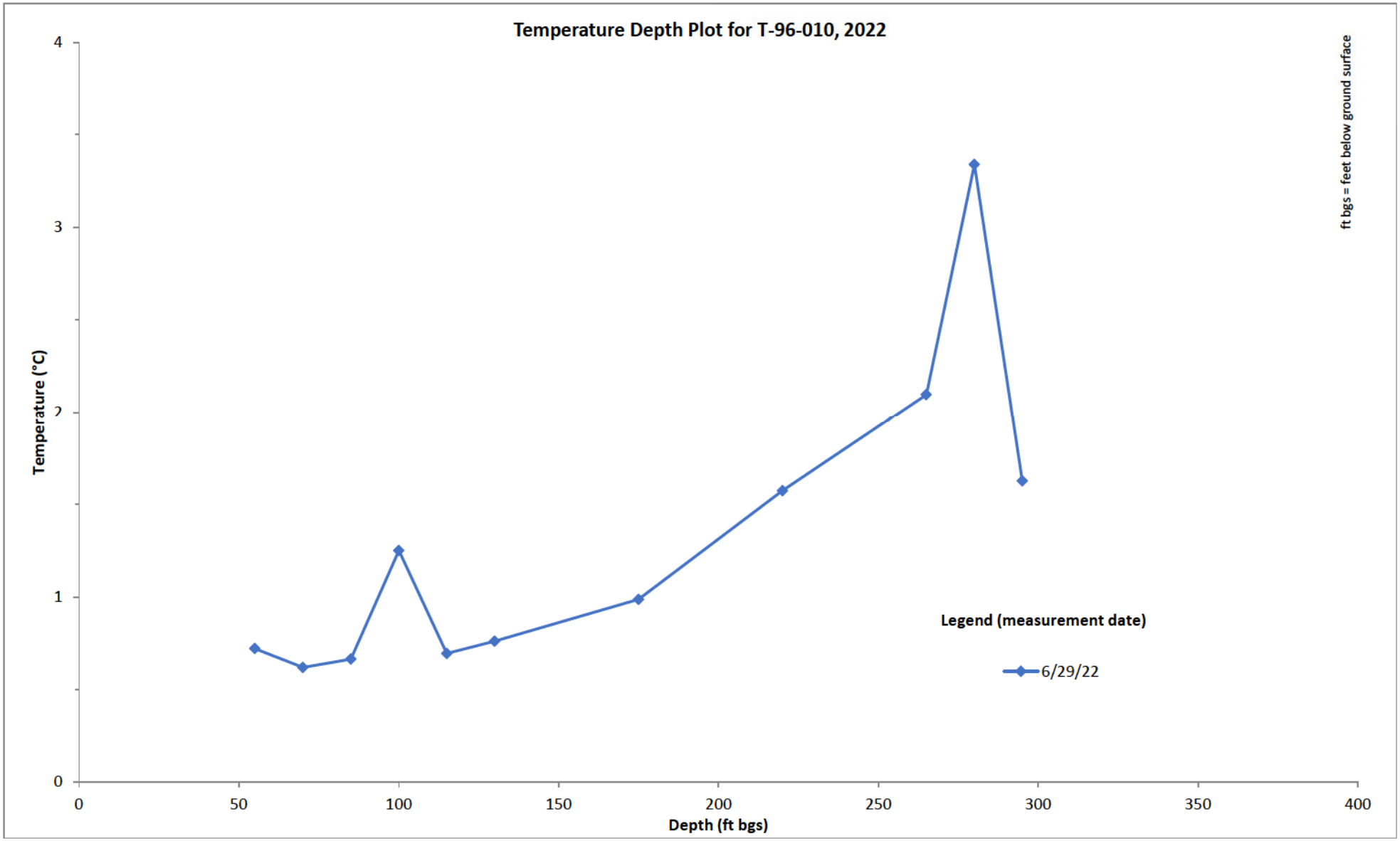
Thermistor T-95-08#2

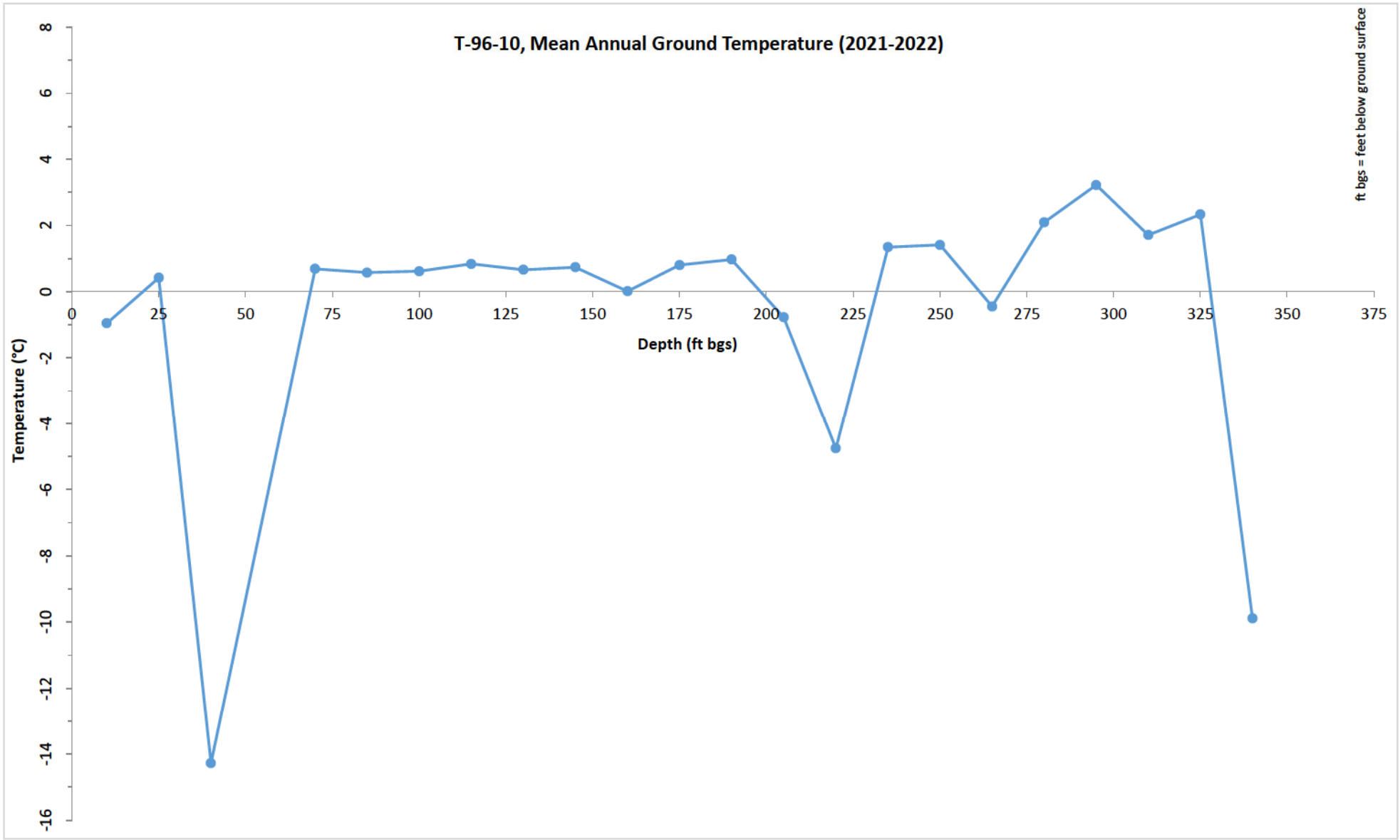

Temperature Depth Plot for T-95-008 #2, 2022
ft bgs = feet below ground surface
Legend (measurement date)
1/10/22
4/12/22
7/9/22
Temperature (°C)
Depth (ft bgs)
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
-4.5
-5.5
0
10
20
30
40
50
60
70
80
90

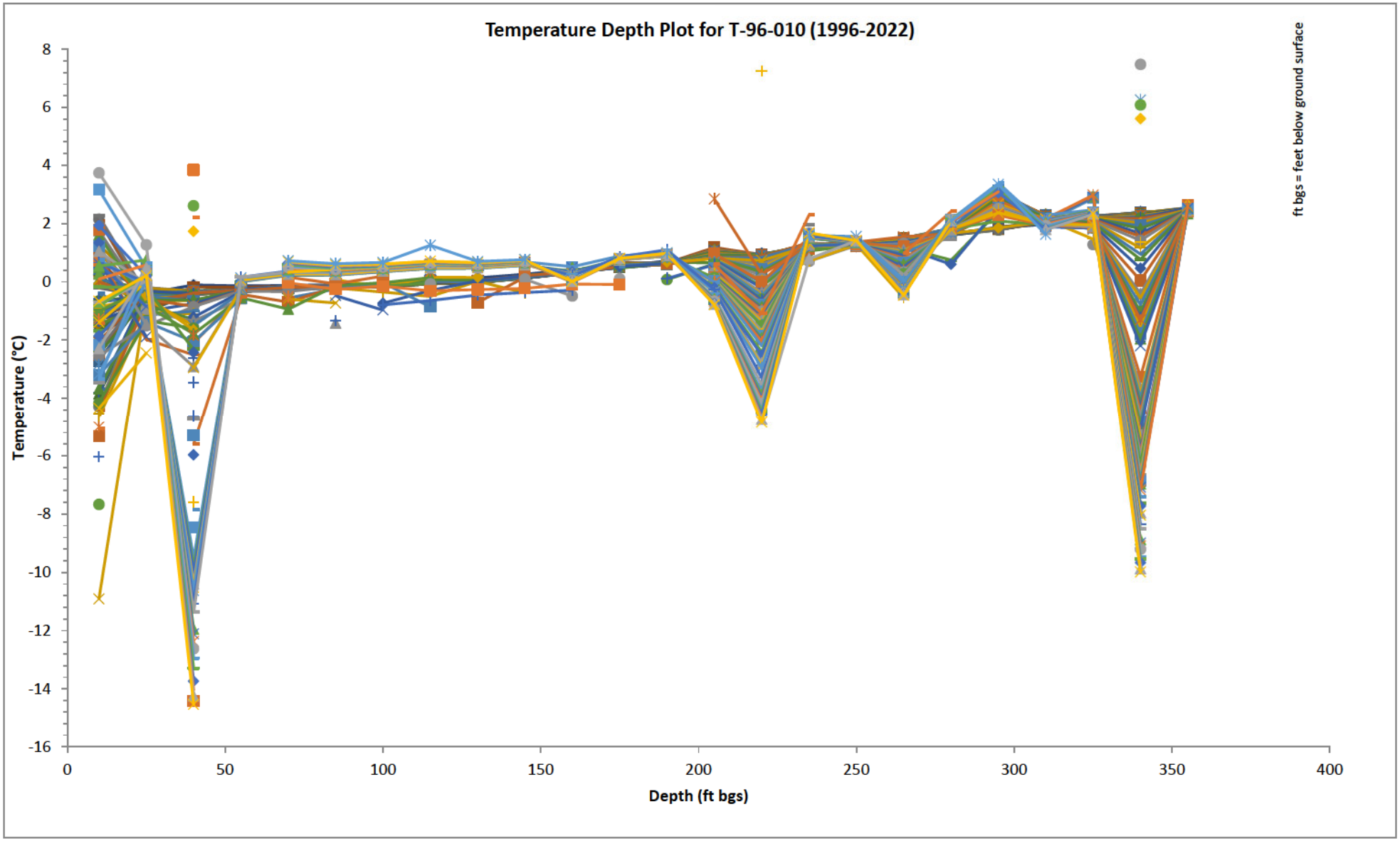

T-95-08#2, Mean Annual Ground Temperature (2022)
Temperature (°C)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
10
20
30
40
50
60
70
80
90
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-95-008 #2 (1996-2022)
Temperature (°C)
Depth (ft bgs)
ft bgs = feet below ground surface
12
8
4
0
-4
-8
-12
0
10
20
30
40
50
60
70
80
90

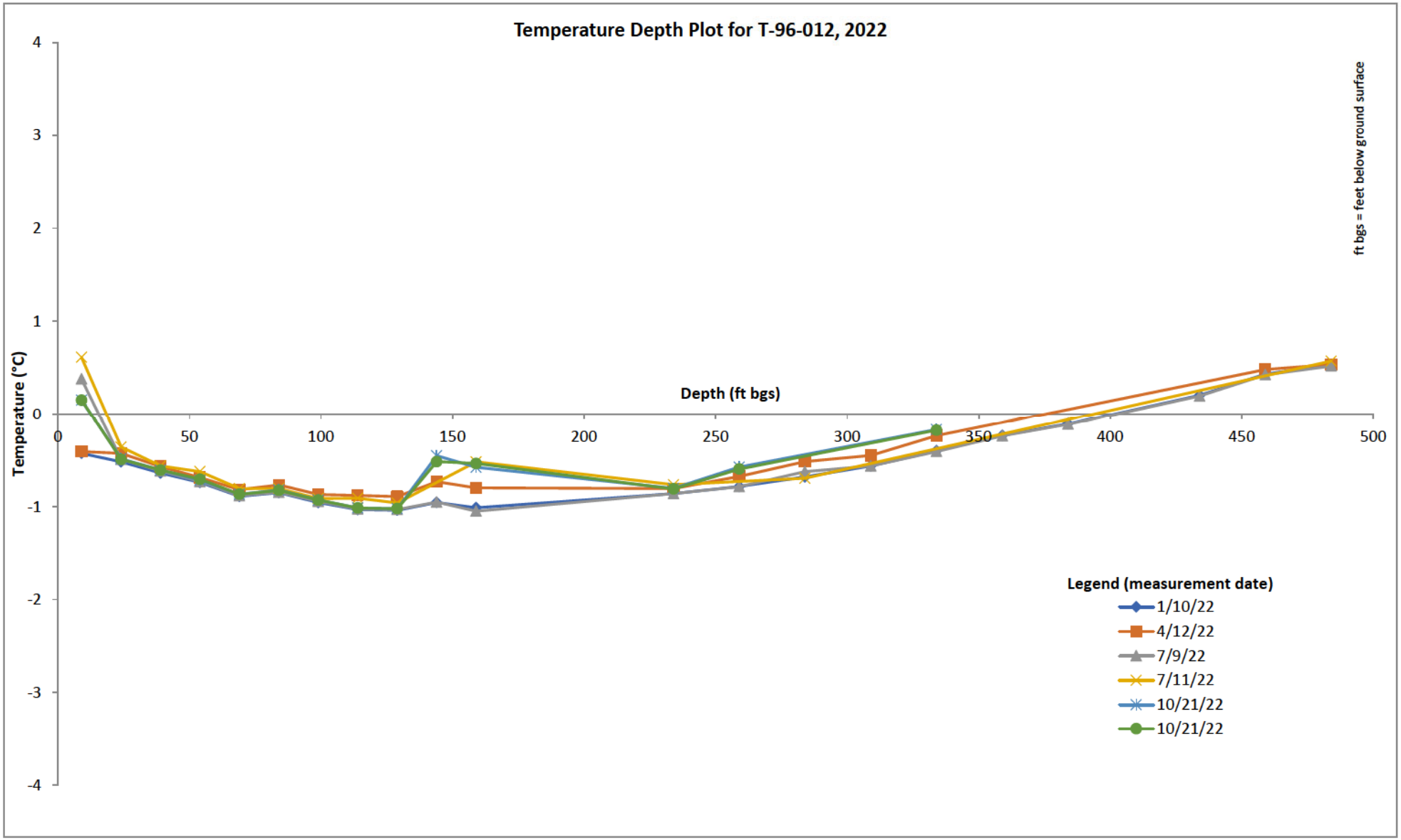
Thermistor T-96-10

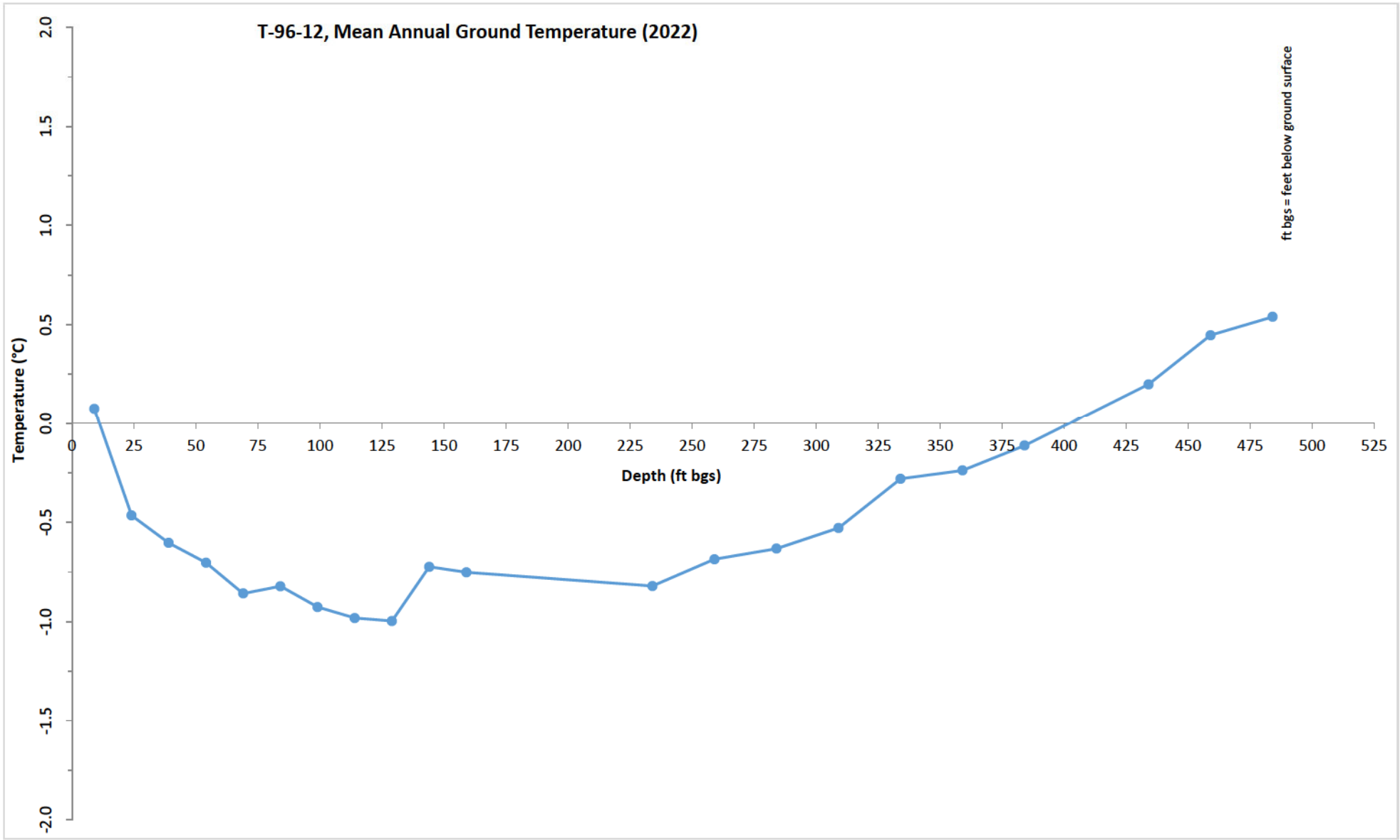

Temperature Depth Plot for T-96-010, 2022
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft bgs)
0
1
2
3
4
0
50
100
150
200
250
300
350
400
Legend (measurement date)
6/29/22

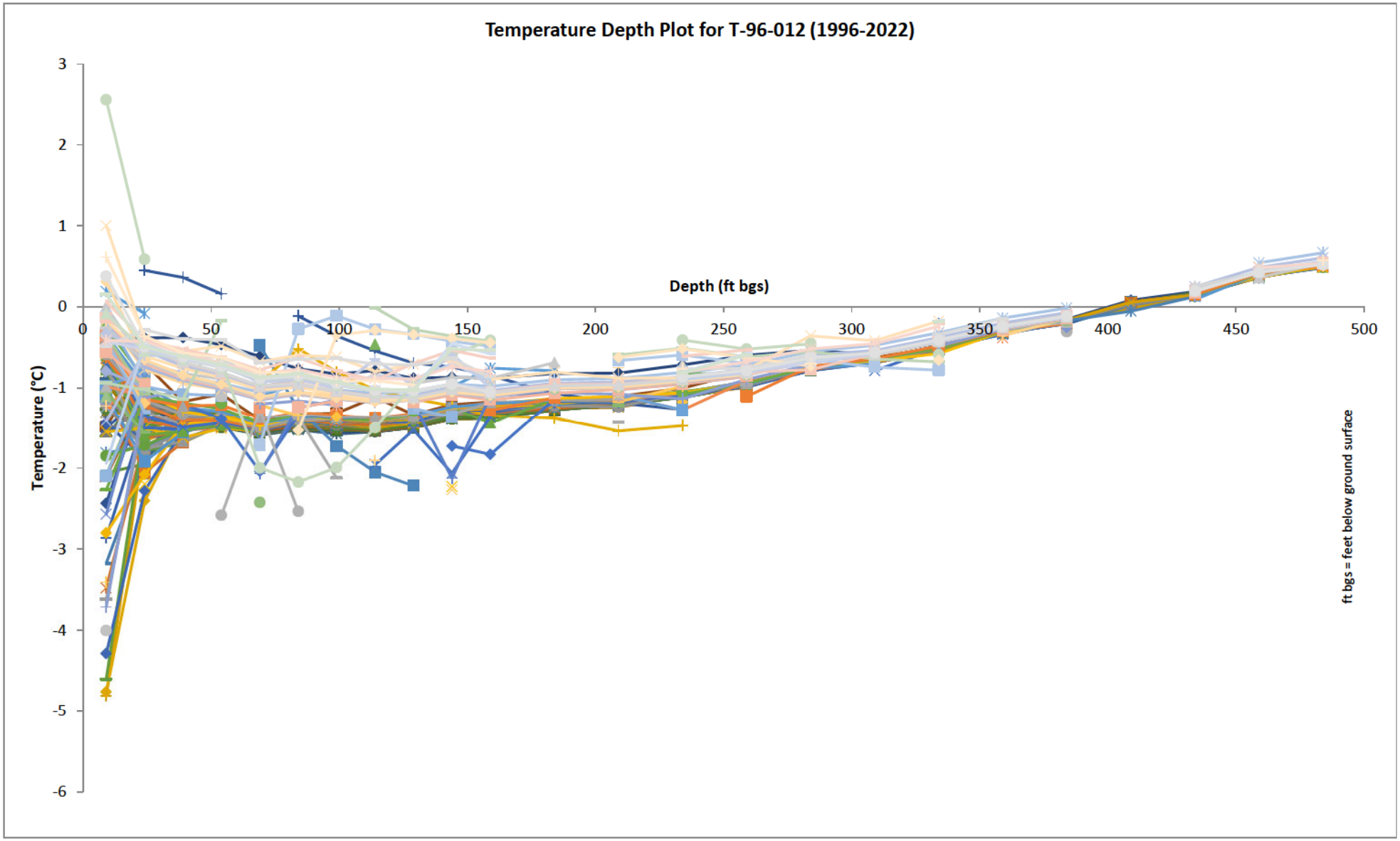

T-96-10, Mean Annual Ground Temperature (2021-2022)
Temperature (°C)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-010 (1996-2022)
Temperature (°C)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
ft bgs = feet below ground surface

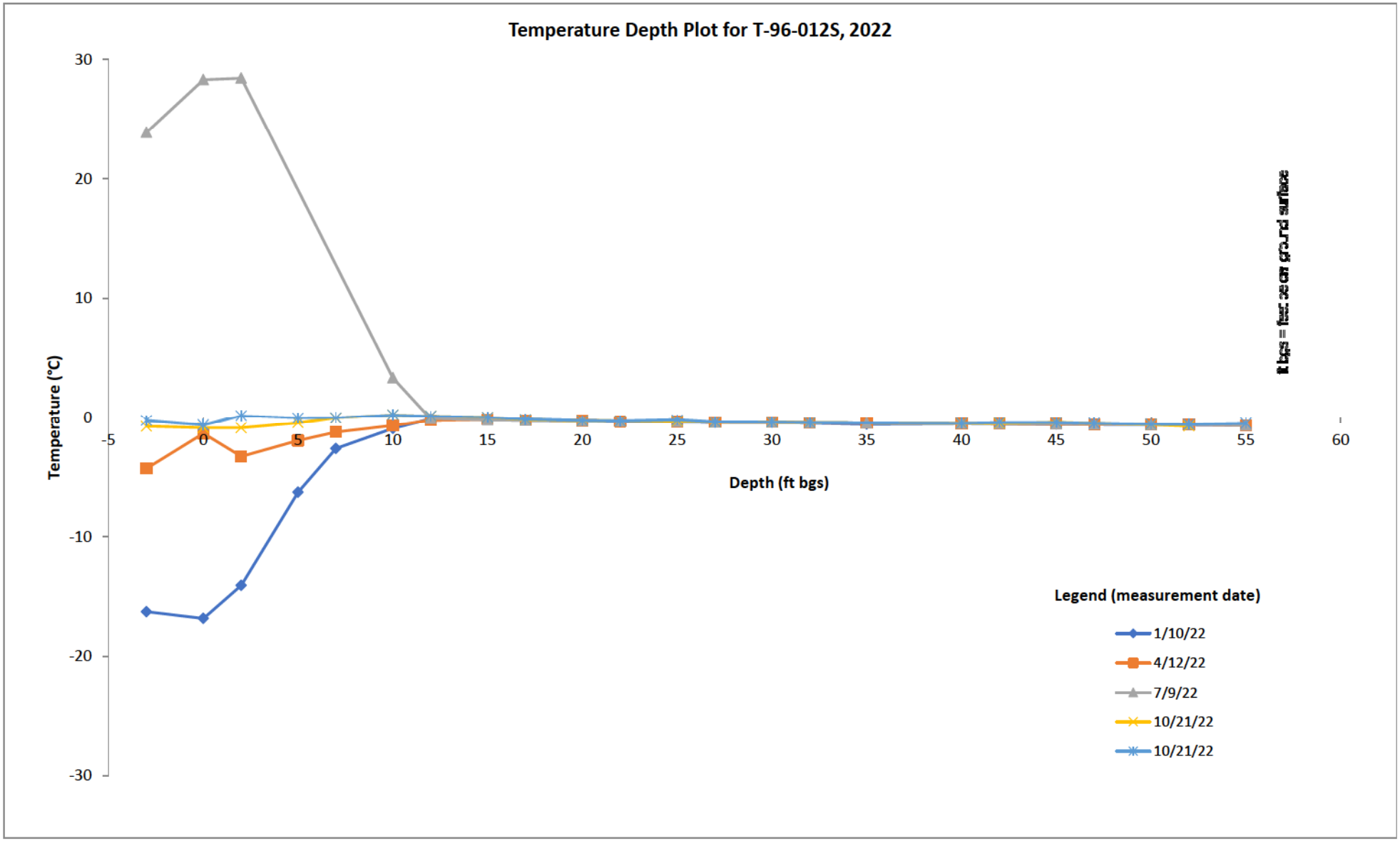
Thermistor T-96-12

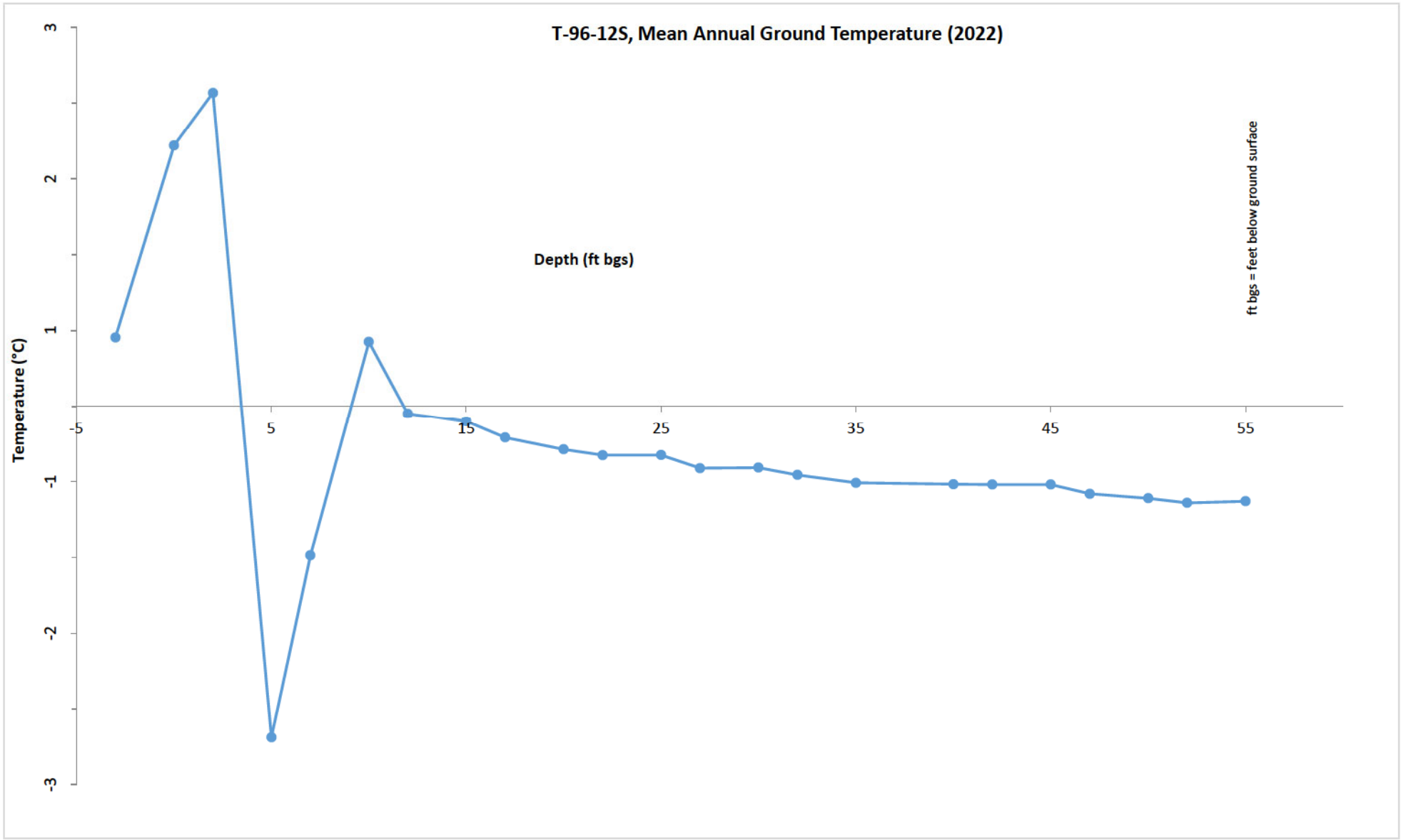

Temperature Depth Plot for T-96-012, 2022
Temperature (°C)
Depth (ft bgs)
ft bgs = feet below ground surface
4
3
2
1
0
-1
-2
-3
-4
0
50
100
150
200
250
300
350
400
450
500
Legend (measurement date)
1/10/22
4/12/22
7/9/22
7/11/22
10/21/22
10/21/22

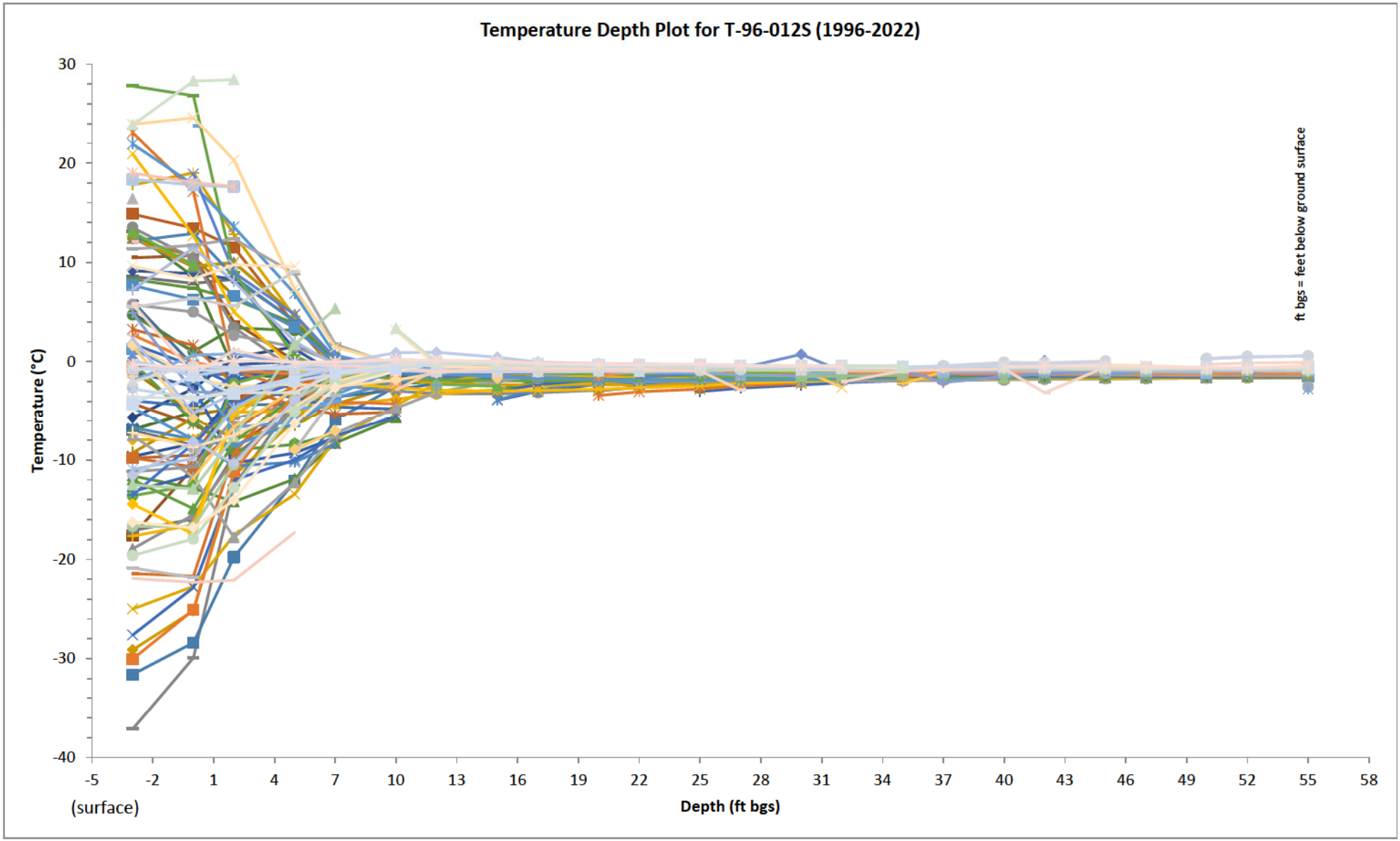

T-96-12, Mean Annual Ground Temperature (2022)
Temperature (°C)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
475
500
525
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-012 (1996-2022)
Depth (ft bgs)
Temperature (°C)
3
2
1
0
-1
-2
-3
-4
-5
-6
0
50
100
150
200
250
300
350
400
450
500
ft bgs = feet below ground surface

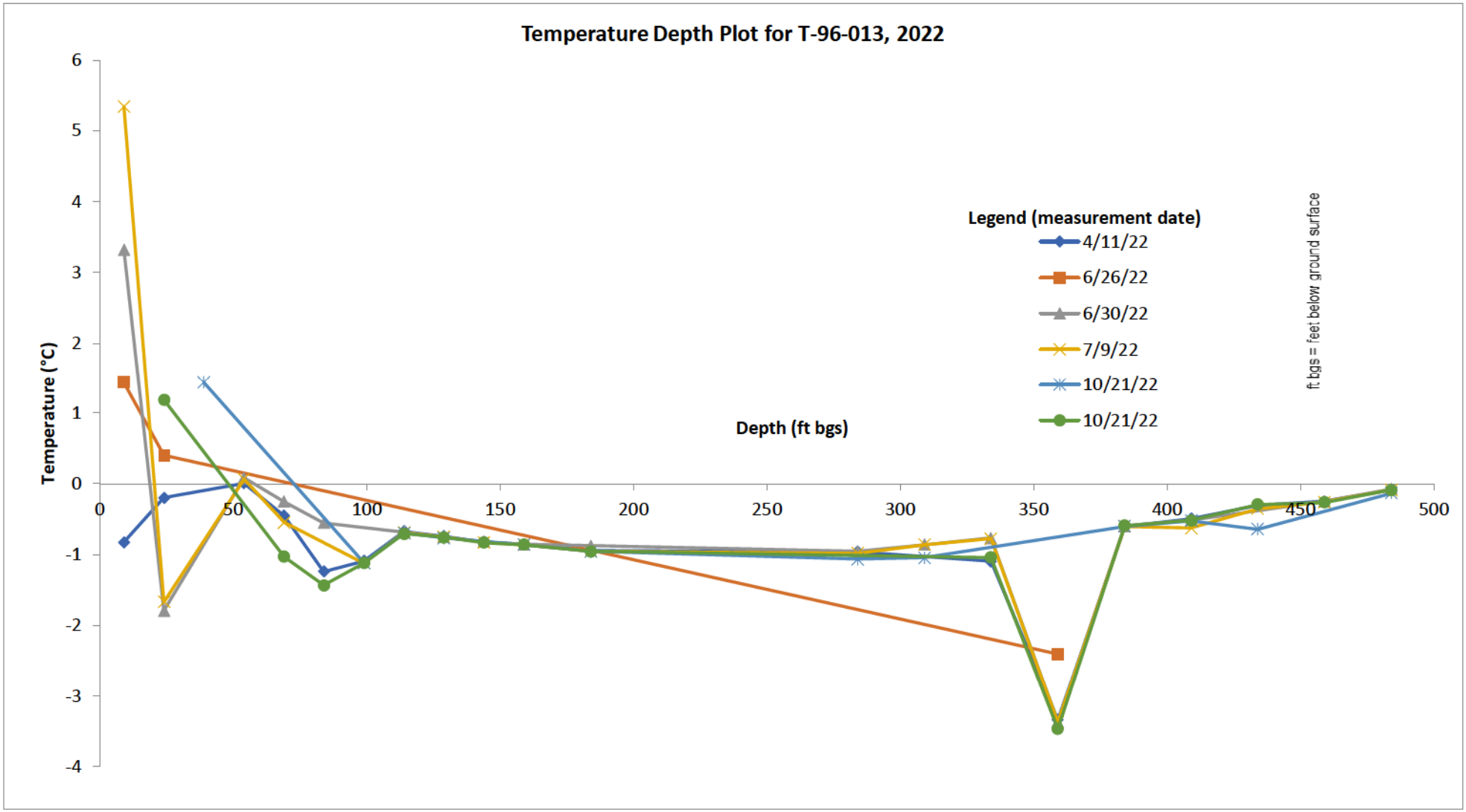
Thermistor T-96-12S

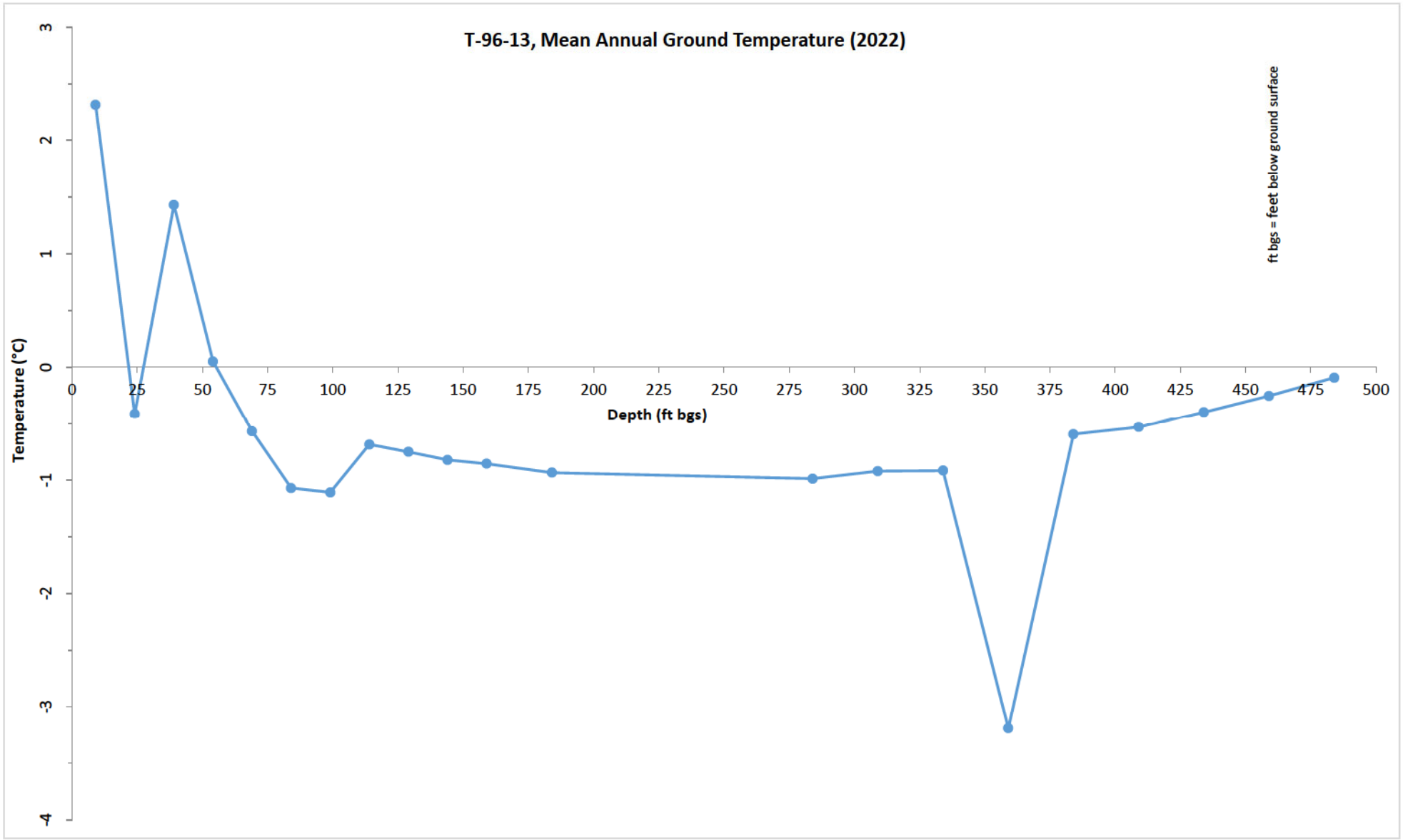

Temperature Depth Plot for T-96-012S, 2022
Temperature (°C)
30
20
10
0
-10
-20
-30
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Depth (ft bgs)
ft bgs = feet below ground surface
Legend (measurement date)
1/10/22
4/12/22
7/9/22
10/21/22
10/21/22

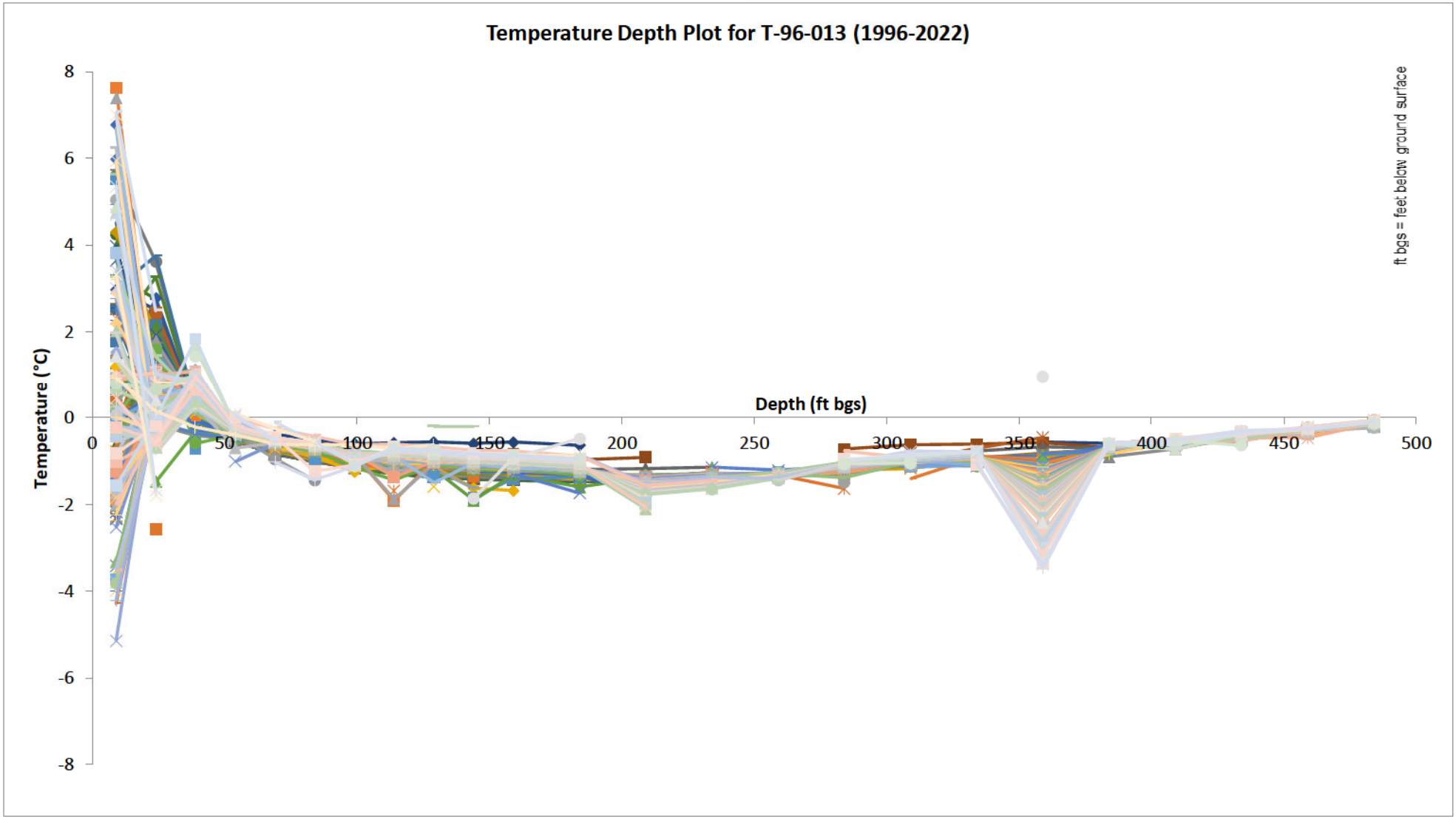

T-96-12S, Mean Annual Ground Temperature (2022)
Temperature (°C)
3
2
1
-1
-2
-3
-5
5
15
25
35
45
55
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-012S (1996-2022)
Temperature (°C)
30
20
10
0
-10
-20
-30
-40
-5
-2
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
(surface)
Depth (ft bgs)
ft bgs = feet below ground surface

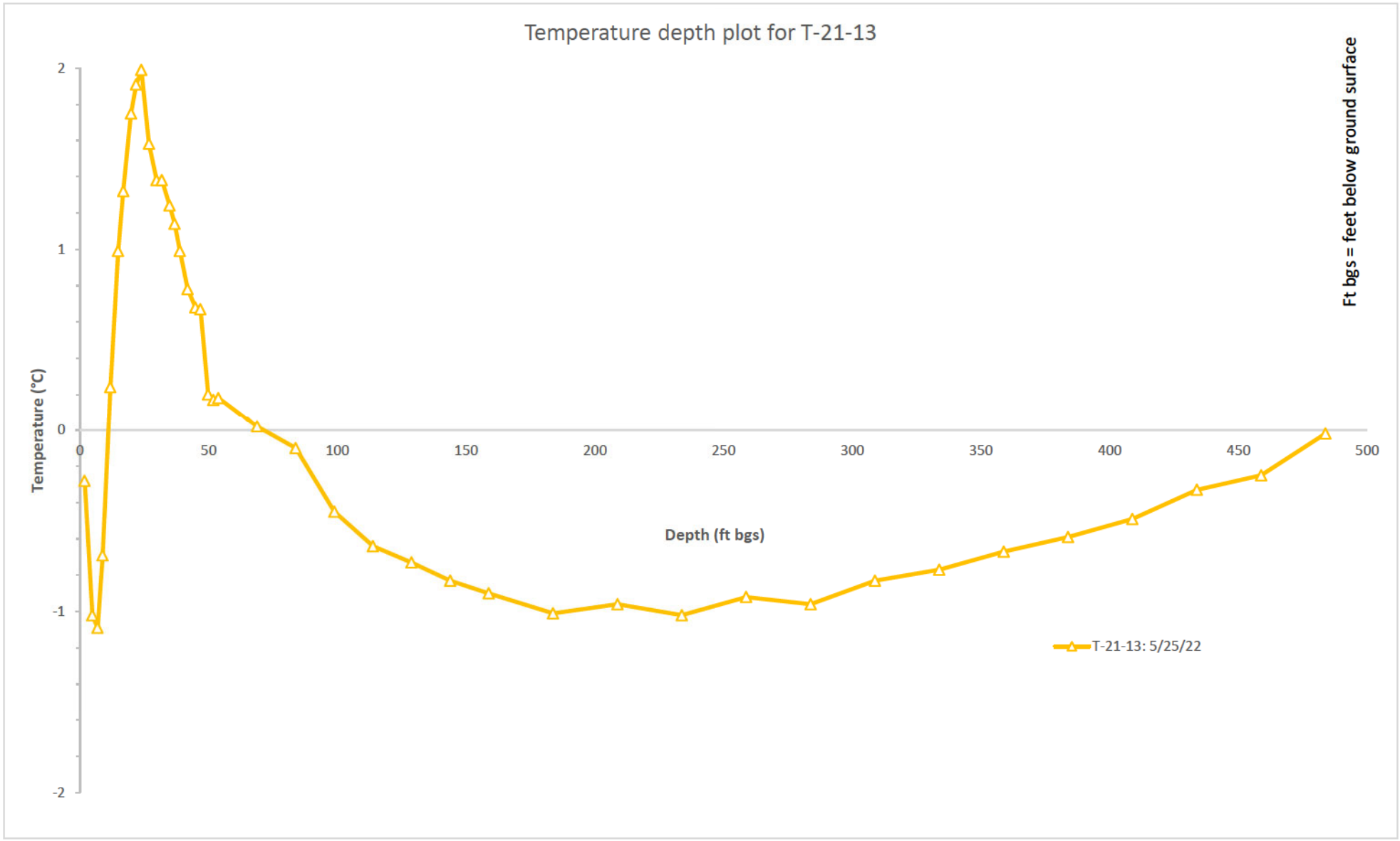
Thermistor T-96-13


Temperature Depth Plot for T-96-013, 2022
Temperature (°C)
6
5
4
3
2
1
0
-1
-2
-3
-4
0
50
100
150
200
250
300
350
400
450
500
Depth (ft bgs)
Legend (measurement date)
4/11/22
6/26/22
6/30/22
7/9/22
10/21/22
10/21/22
ft bgs = feet below ground surface


T-96-13, Mean Annual Ground Temperature (2022)
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft bgs)
3
2
1
0
-1
-2
-3
-4
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
475
500

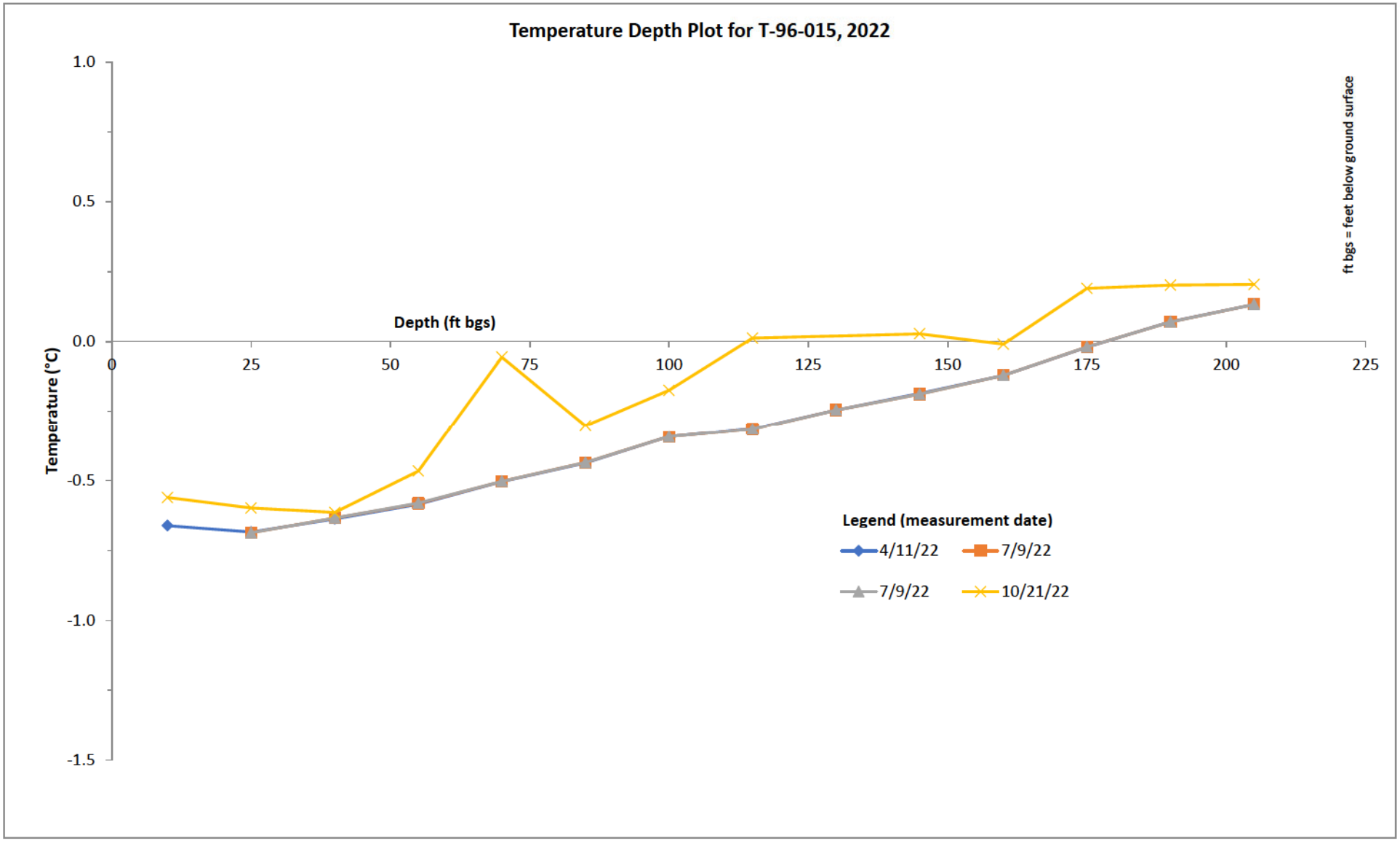

Temperature Depth Plot for T-96-013 (1996-2022)
Temperature (°C)
8
6
4
2
0
-2
-4
-6
-8
0
50
100
150
200
250
300
350
400
450
500
Depth (ft bgs)
ft bgs = feet below ground surface

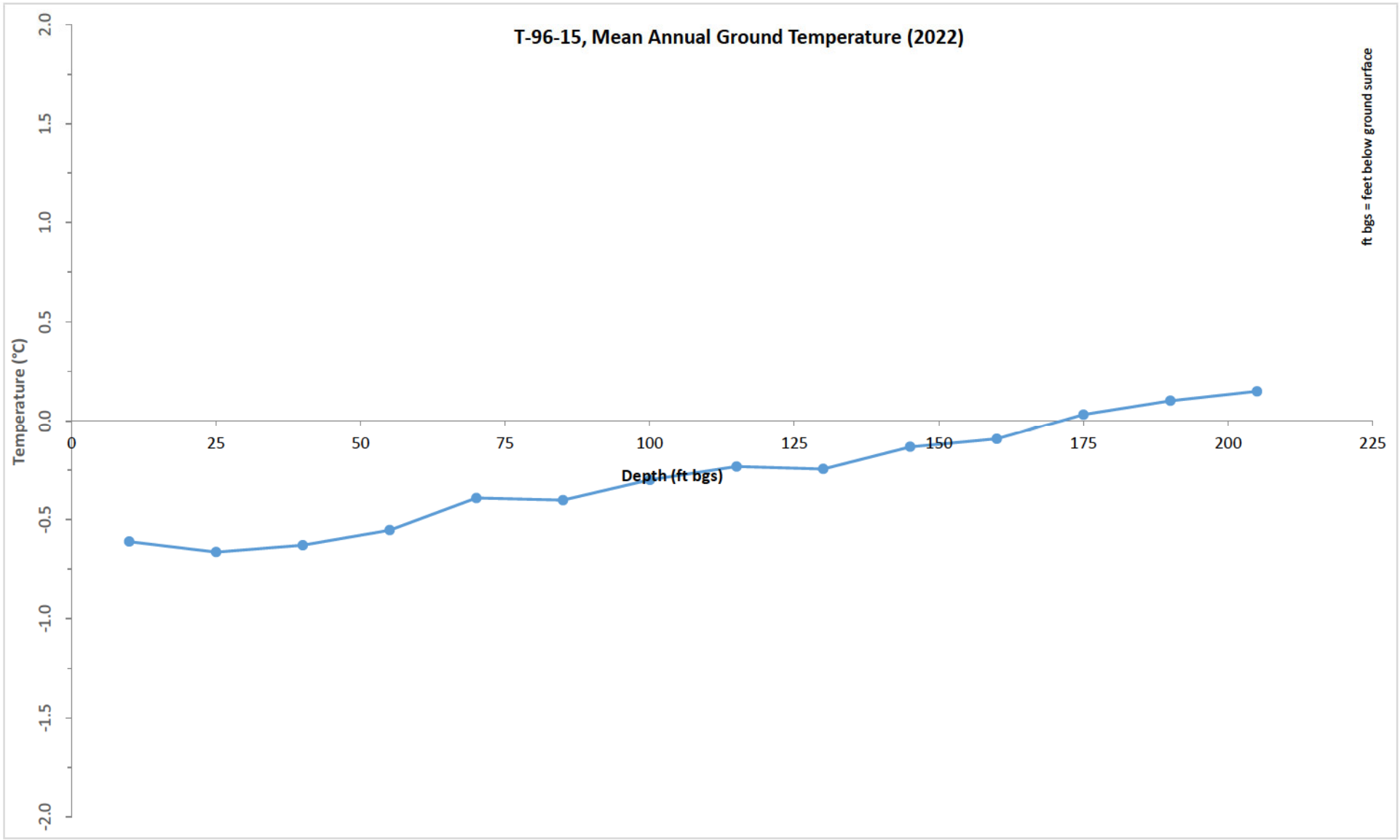
Thermistor T-21-13

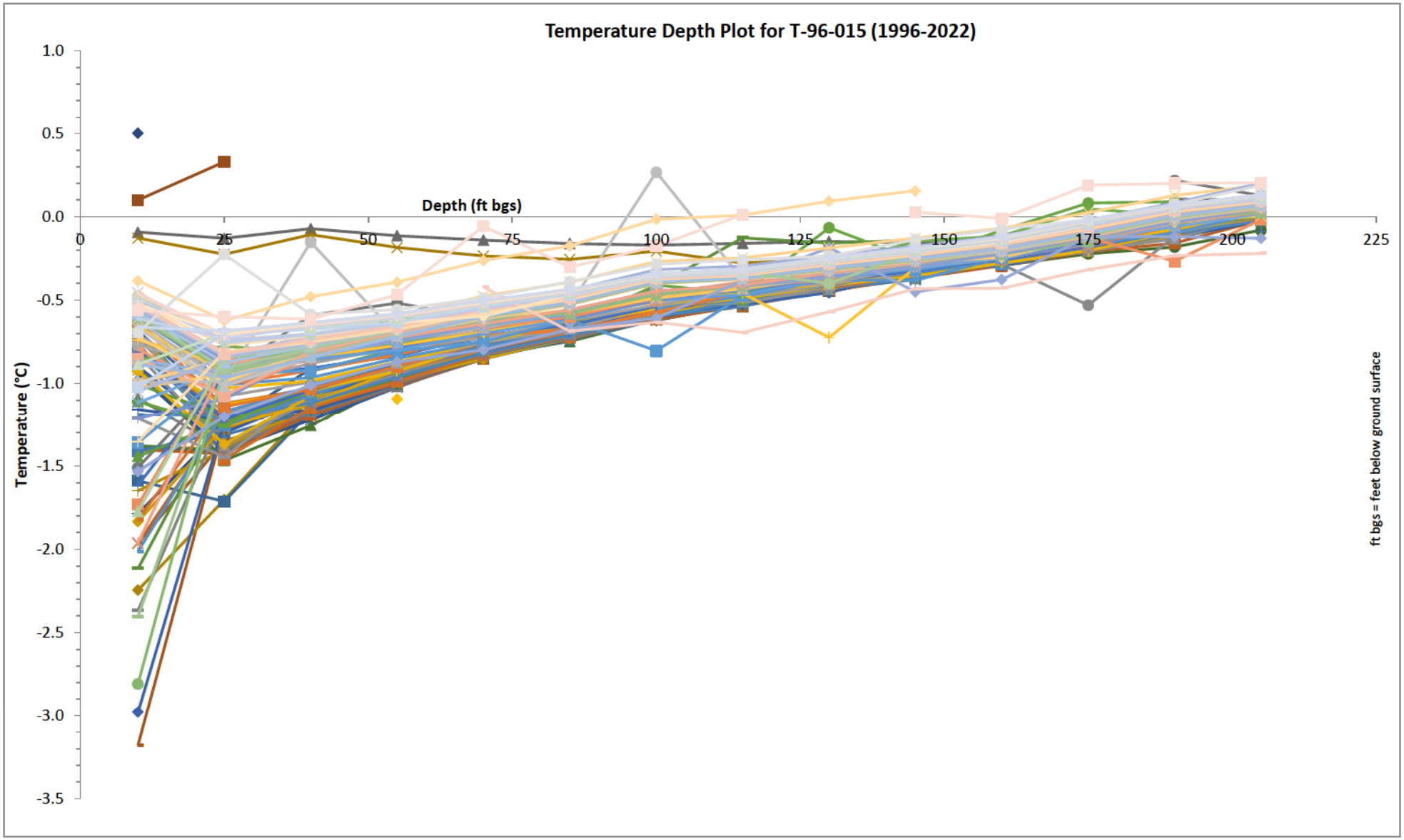


Note: Additional data exists on the datalogger for this instrument, however it could not be downloaded for use in this report and will be added to future reports.

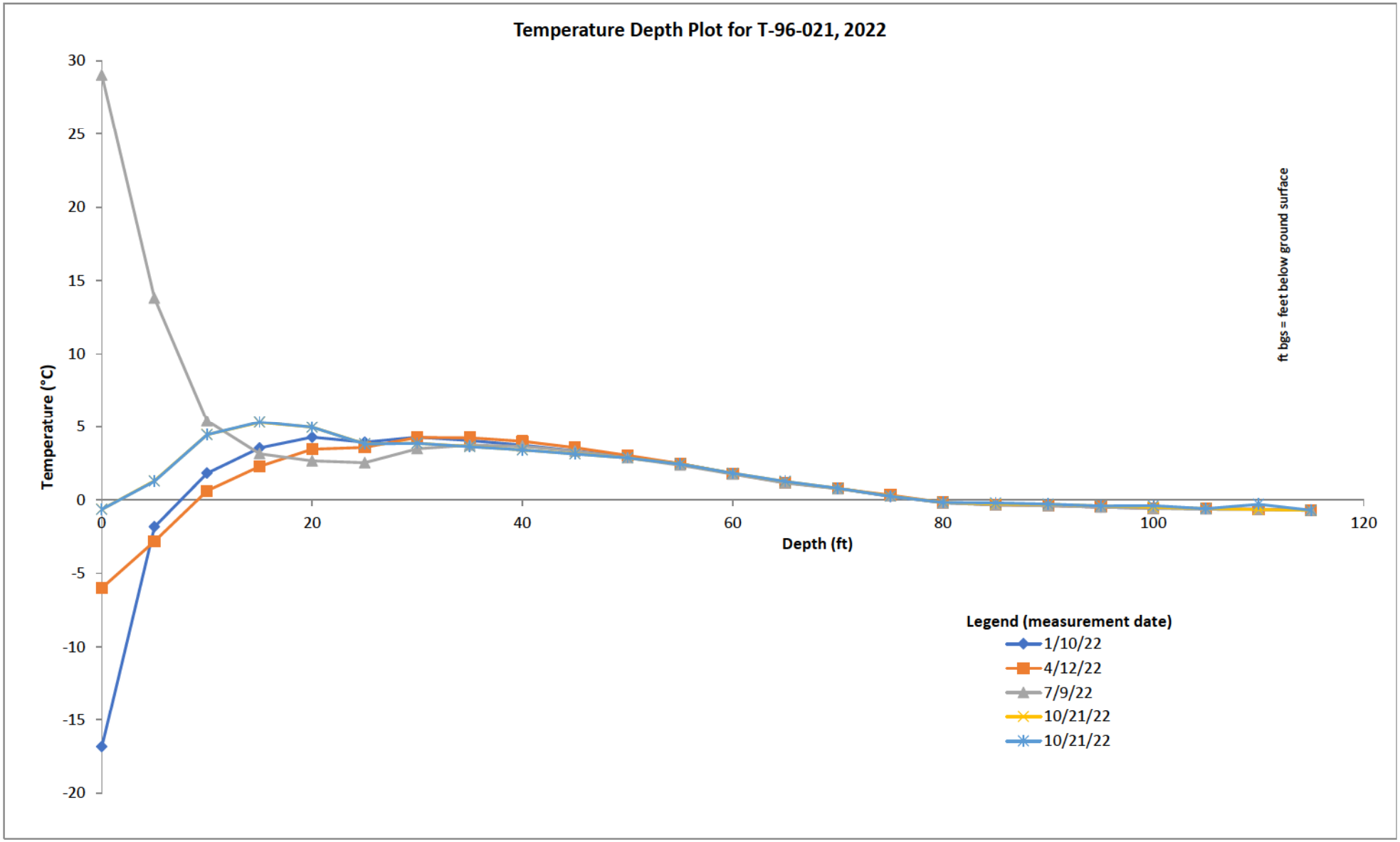
Thermistor T-96-15

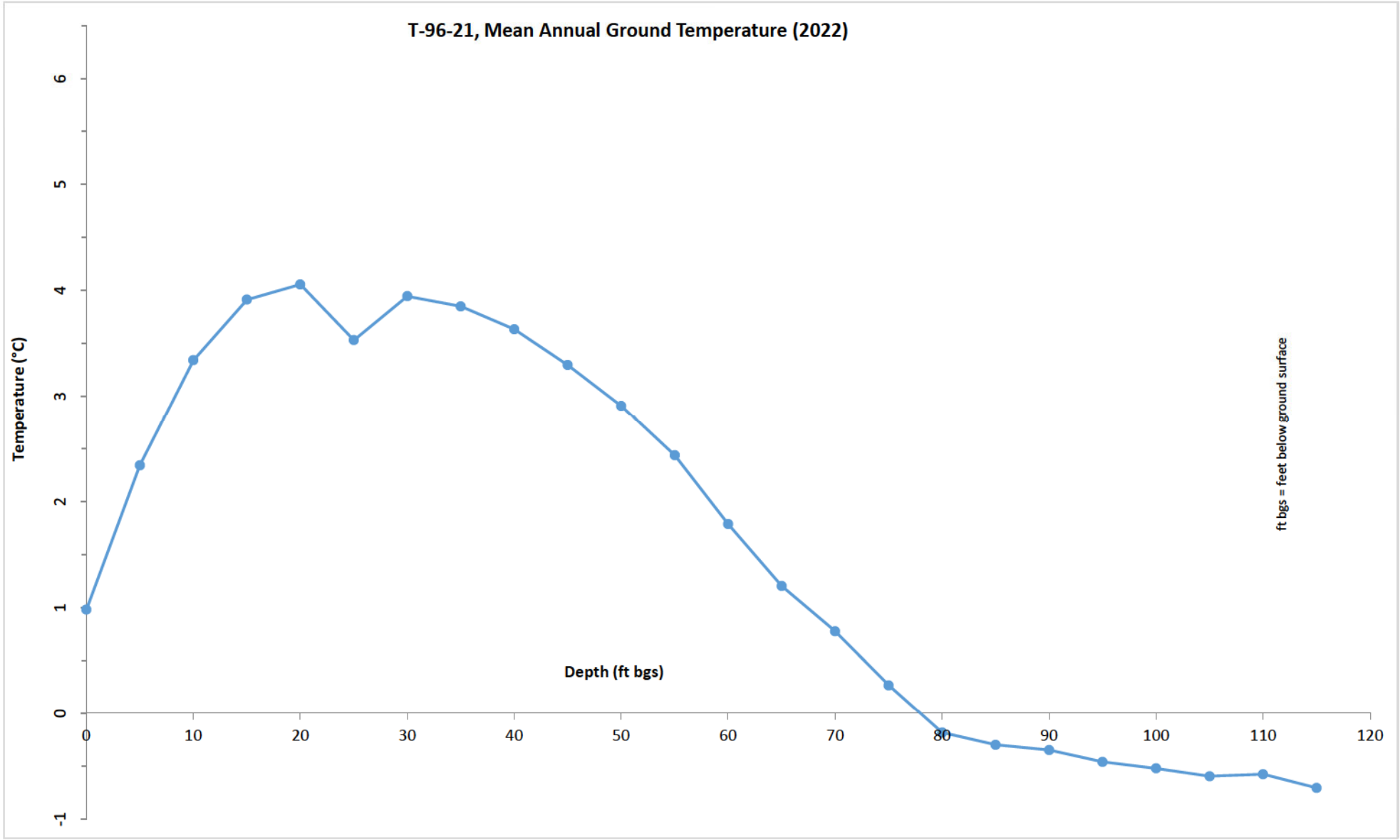

Temperature Depth Plot for T-96-015, 2022
1.0
0.5
0.0
-0.5
-1.0
-1.5
Temperature (°C)
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
ft bgs = feet below ground surface
Legend (measurement date)
4/11/22
7/9/22
7/9/22
10/21/22

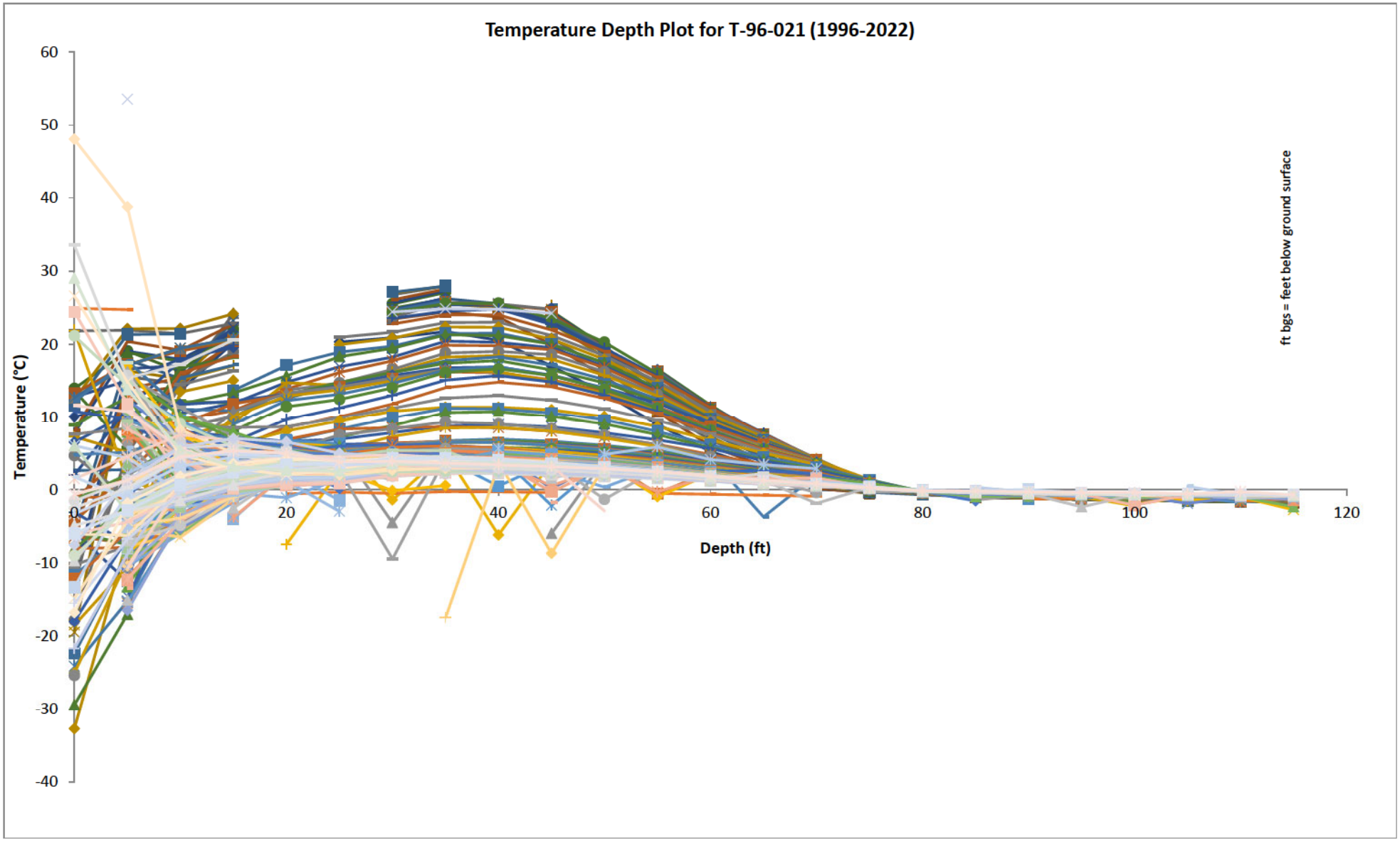

T-96-15, Mean Annual Ground Temperature (2022)
Temperature (°C)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
25
50
75
100
125
150
175
200
225
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-015 (1996-2022)
Temperature (°C)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
ft bgs = feet below ground surface

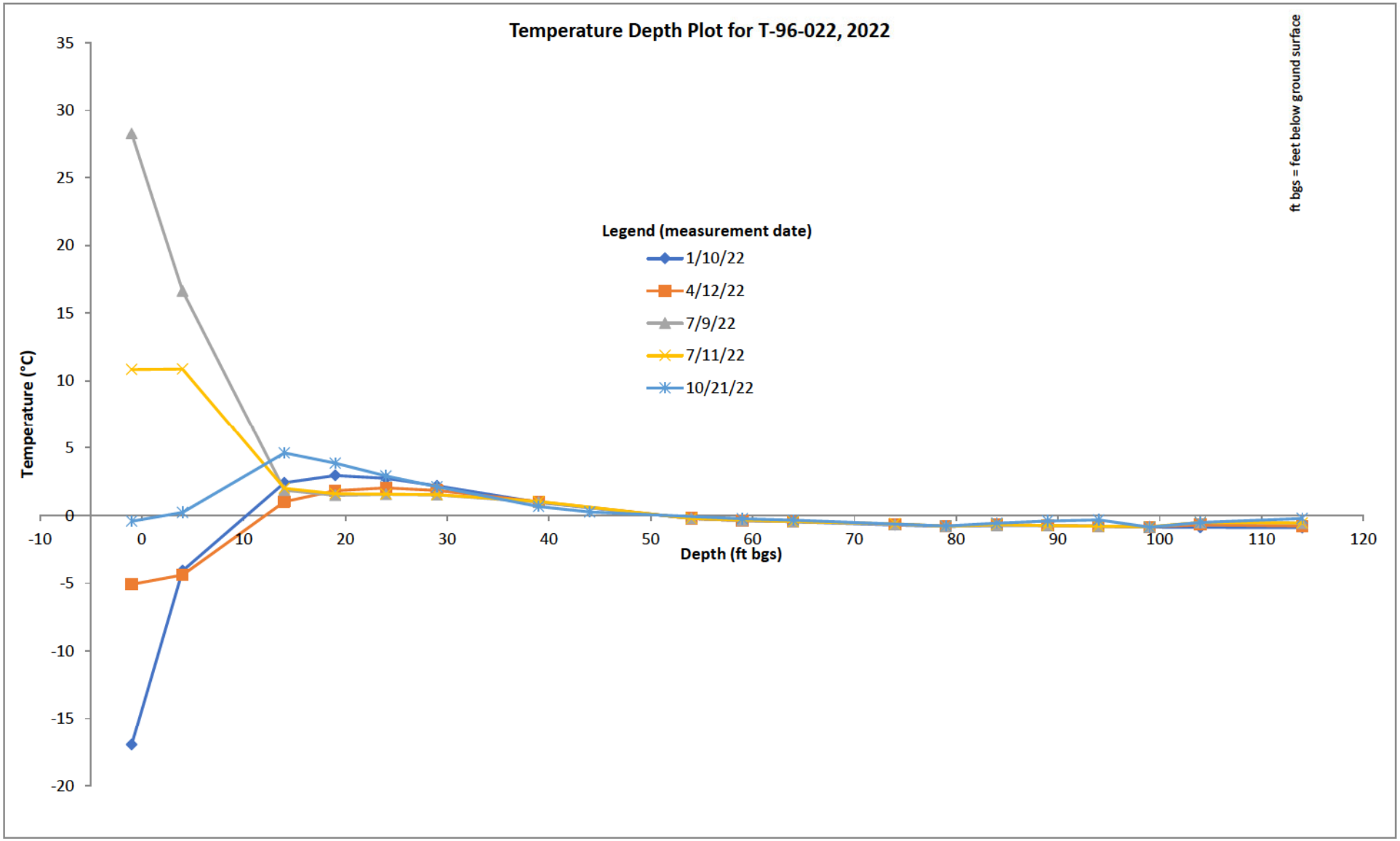
Thermistor T-96-21

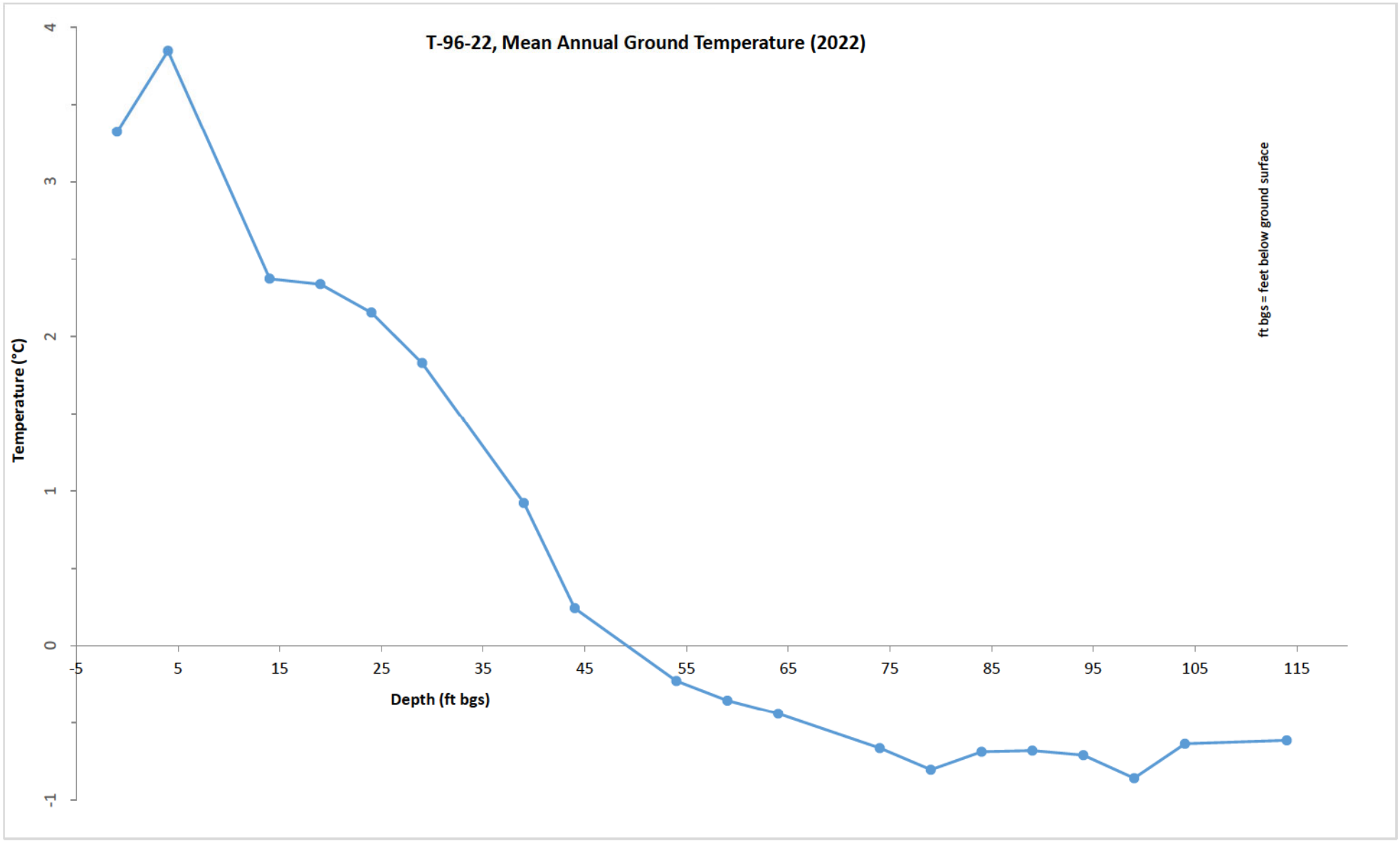

Temperature Depth Plot for T-96-021, 2022
Temperature (°C)
30
25
20
15
10
5
0
-5
-10
-15
-20
0
20
40
60
80
100
120
Depth (ft)
ft bgs = feet below ground surface
Legend (measurement date)
1/10/22
4/12/22
7/9/22
10/21/22
10/21/22

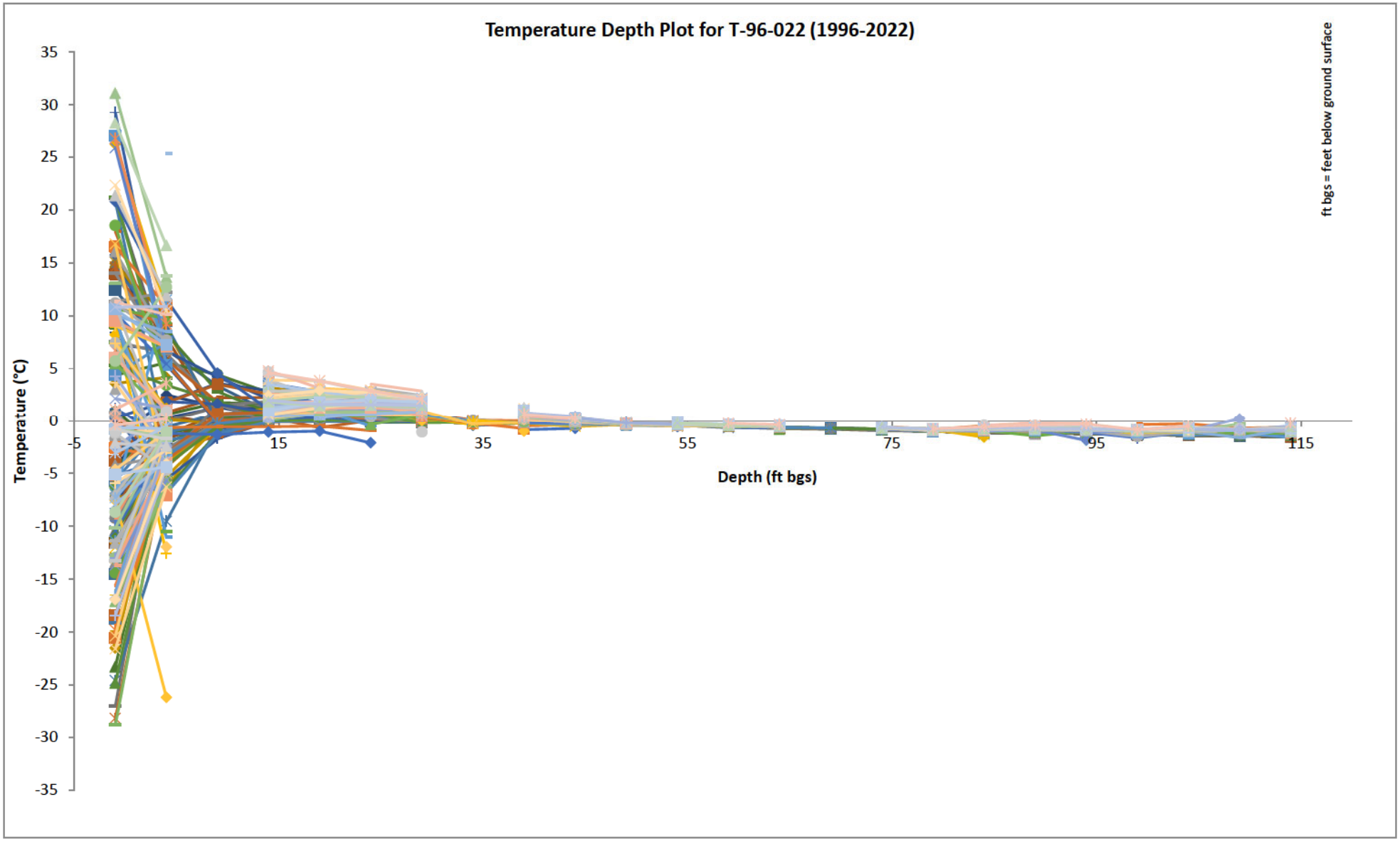

T-96-21, Mean Annual Ground Temperature (2022)
Temperature (°C)
6
5
4
3
2
1
0
-1
0
10
20
30
40
50
60
70
80
90
100
110
120
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-021 (1996-2022)
Temperature (°C)
60
50
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
Depth (ft)
ft bgs = feet below ground surface

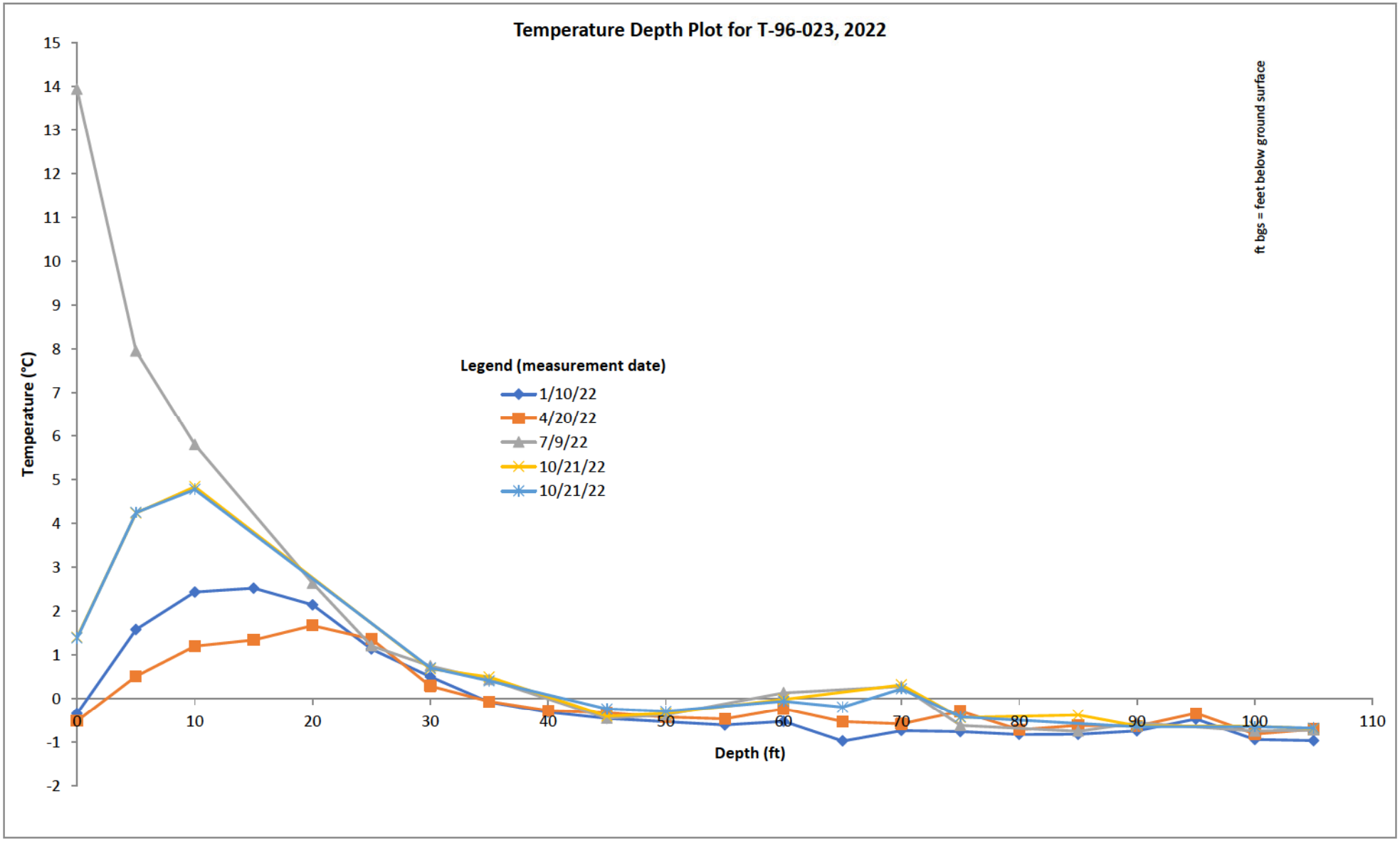
Thermistor T-96-22

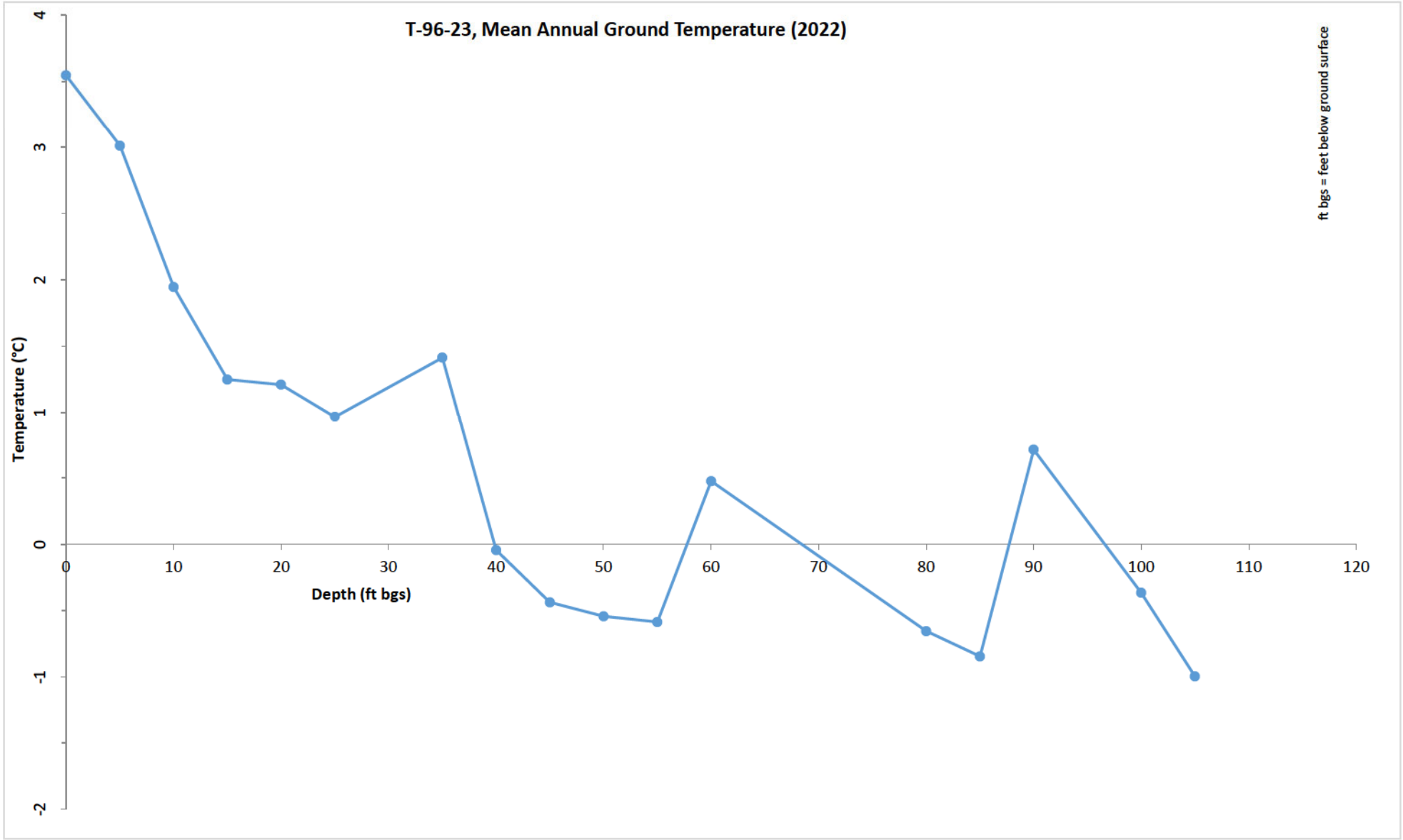

Temperature Depth Plot for T-96-022, 2022
ft bgs = feet below ground surface
Legend (measurement date)
1/10/22
4/12/22
7/9/22
7/11/22
10/21/22
Temperature (°C)
Depth (ft bgs)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120

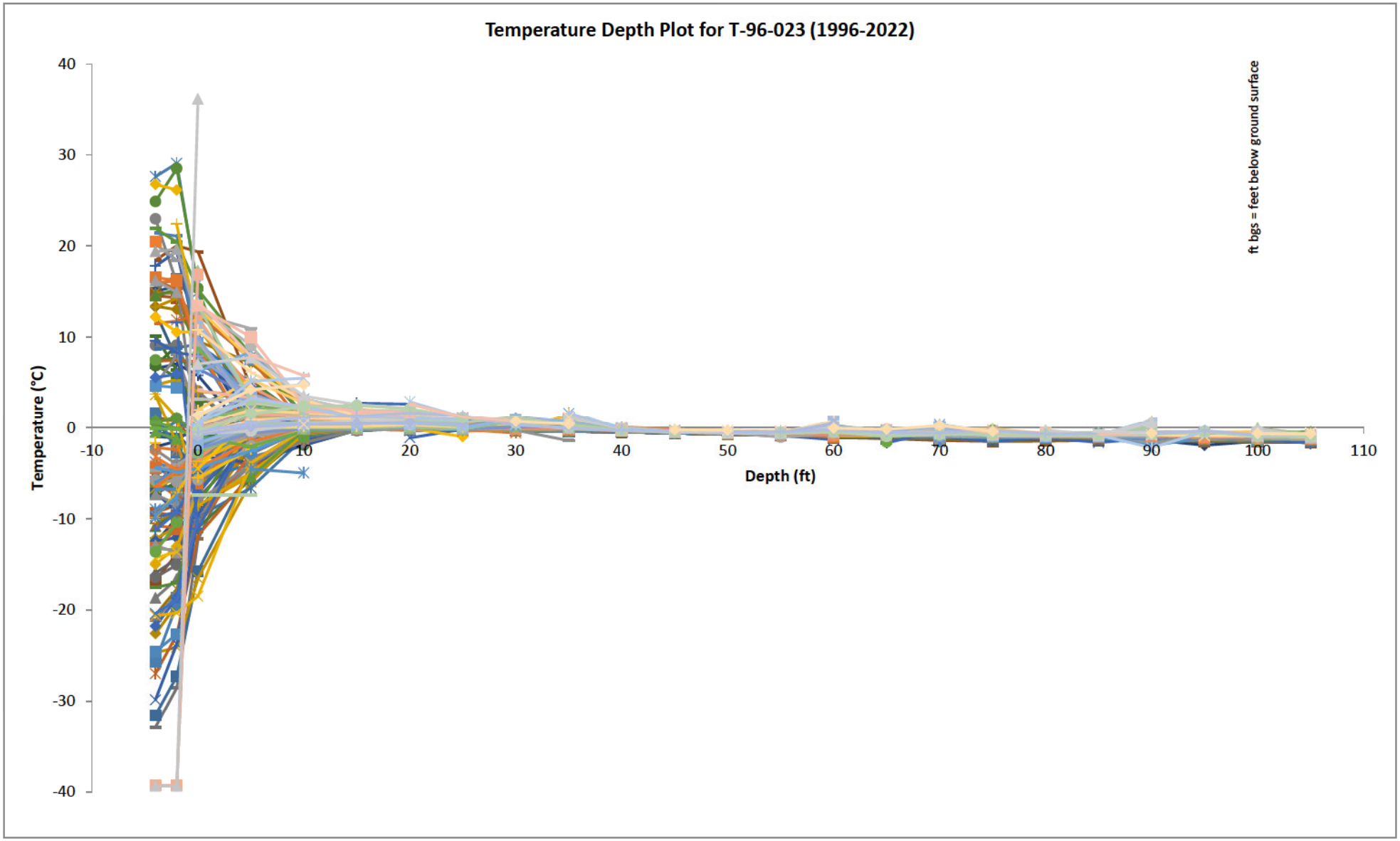

T-96-22, Mean Annual Ground Temperature (2022)
Temperature (°C)
4
3
2
1
0
-1
-5
5
15
25
35
45
55
65
75
85
95
105
115
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-022 (1996-2022)
Temperature (°C)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-5
15
35
55
75
95
115
Depth (ft bgs)
ft bgs = feet below ground surface

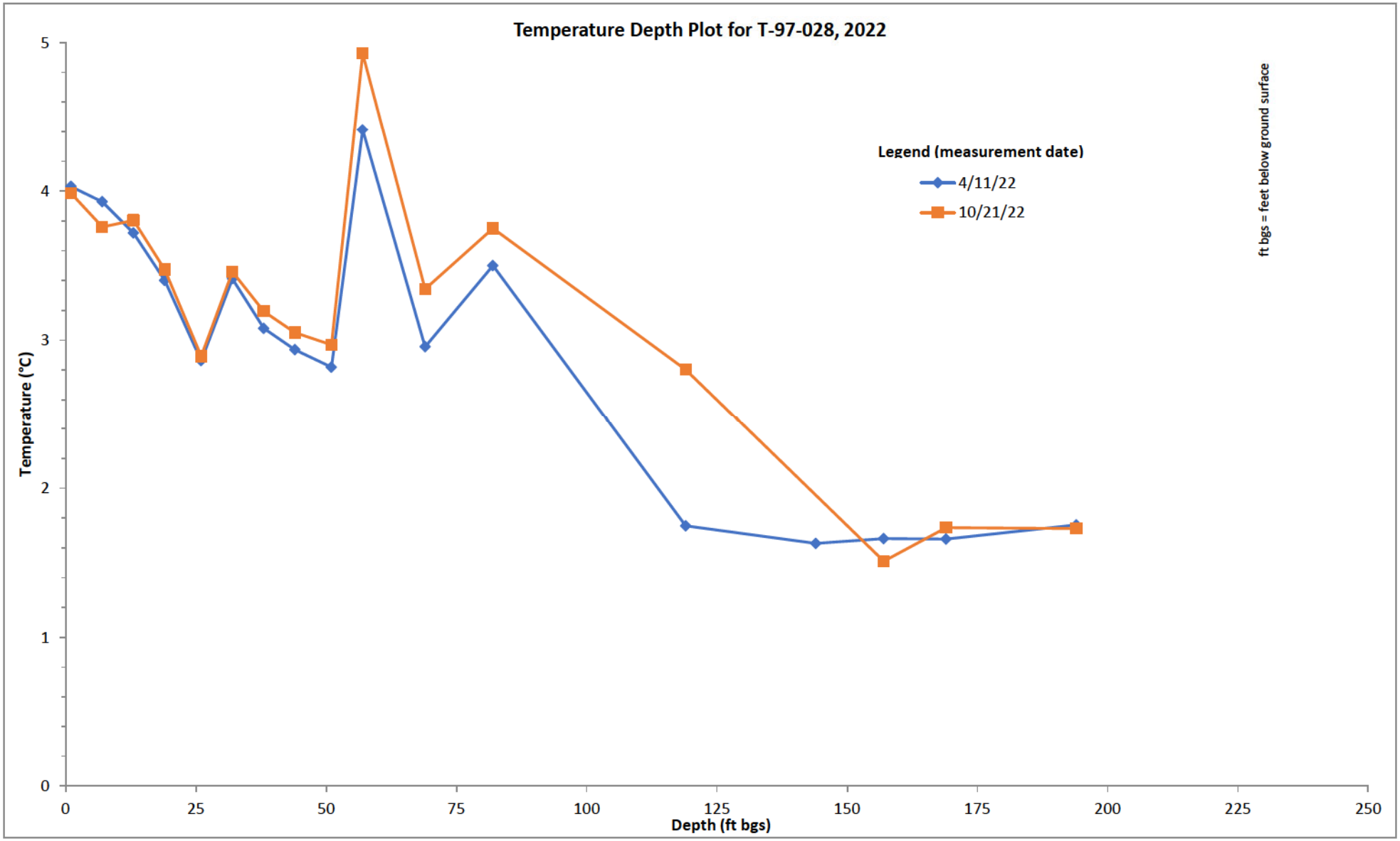
Thermistor T-96-23

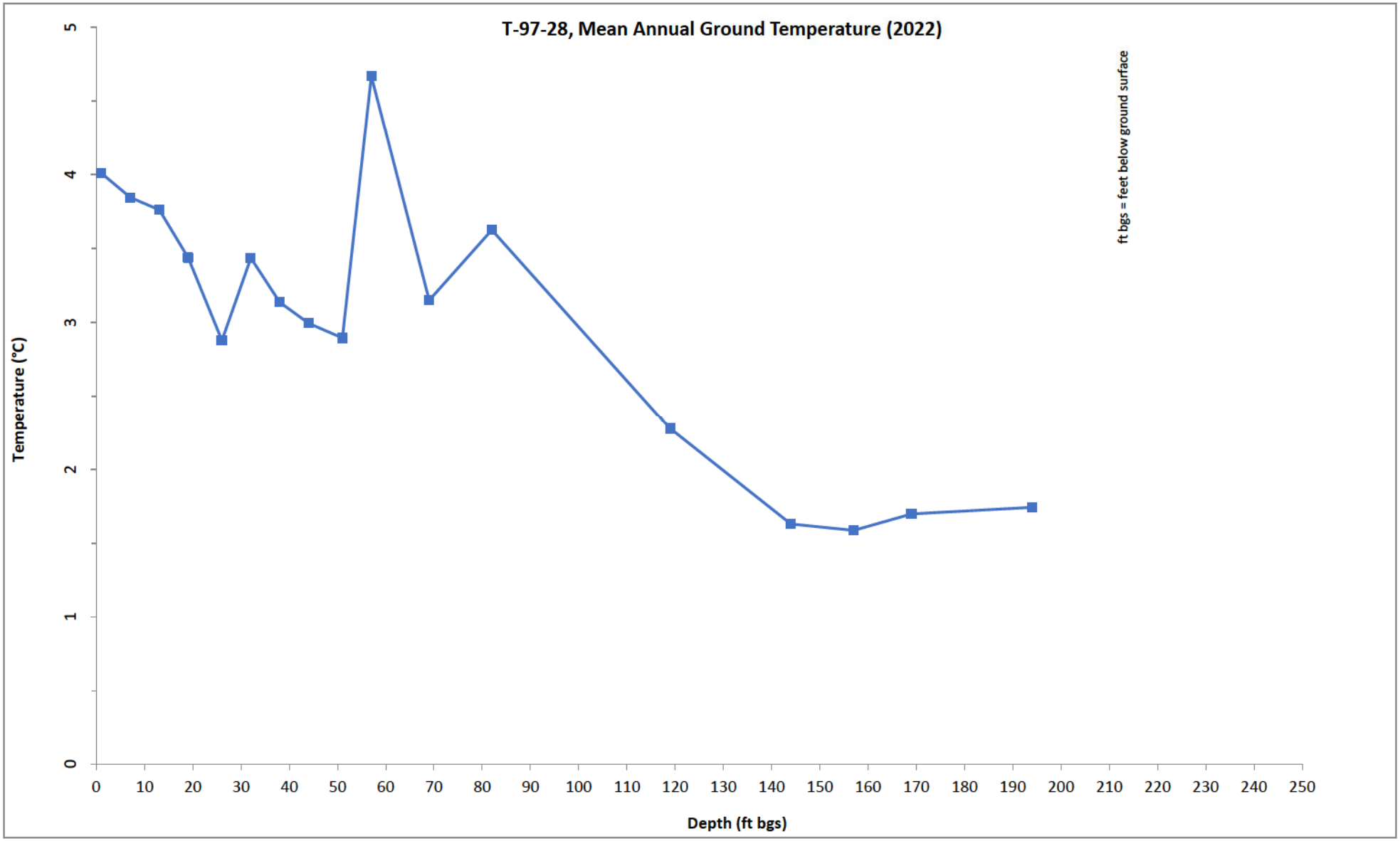

Temperature Depth Plot for T-96-023, 2022
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft)
Legend (measurement date)
1/10/22
4/20/22
7/9/22
10/21/22
10/21/22
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
0
10
20
30
40
50
60
70
80
90
100
110

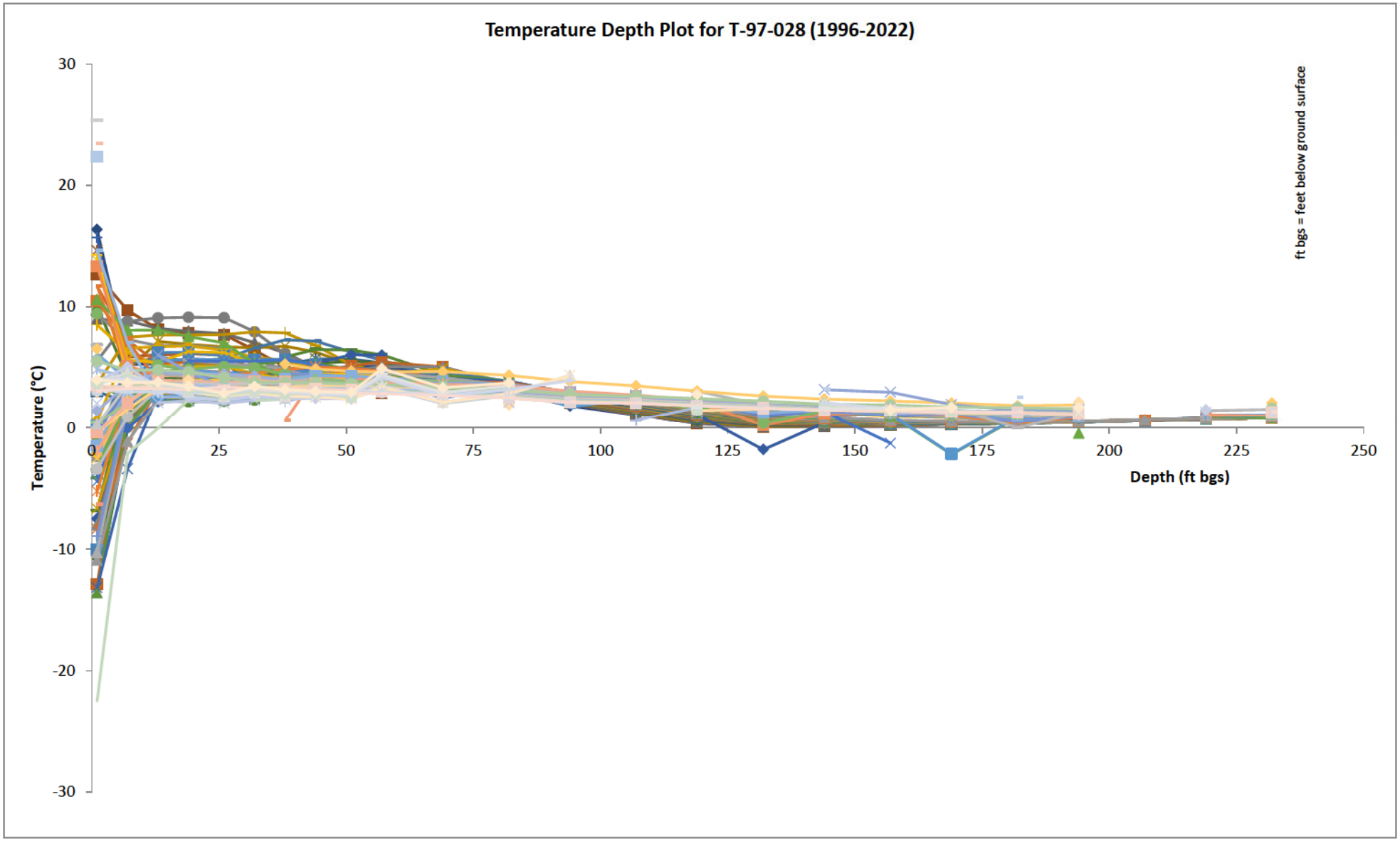

T-96-23, Mean Annual Ground Temperature (2022)
Temperature (°C)
4
3
2
1
0
-1
-2
0
10
20
30
40
50
60
70
80
90
100
110
120
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-96-023 (1996-2022)
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft)
40
30
20
10
0
-10
-20
-30
-40
-10
0
10
20
30
40
50
60
70
80
90
100
110

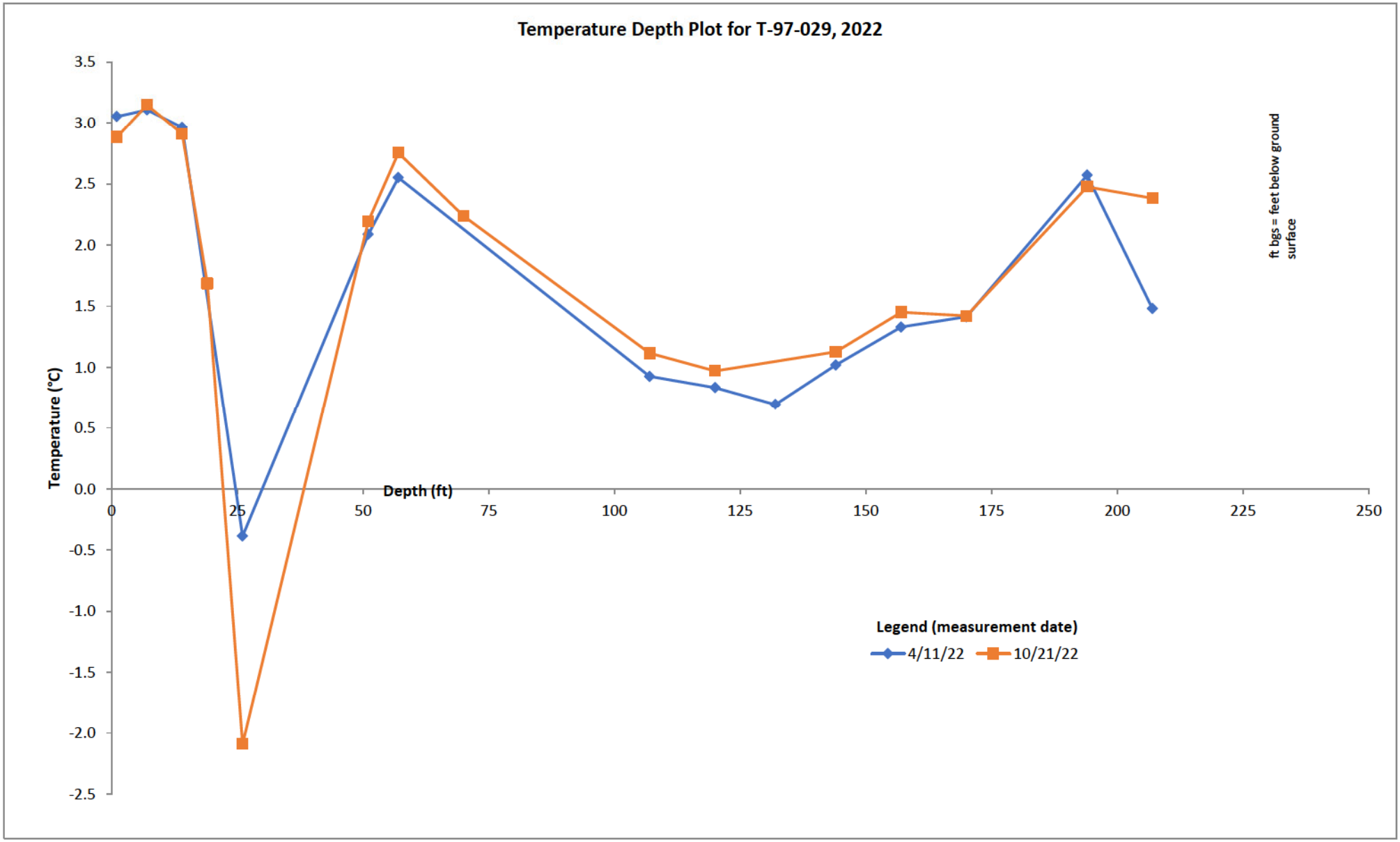
Thermistor T-97-28

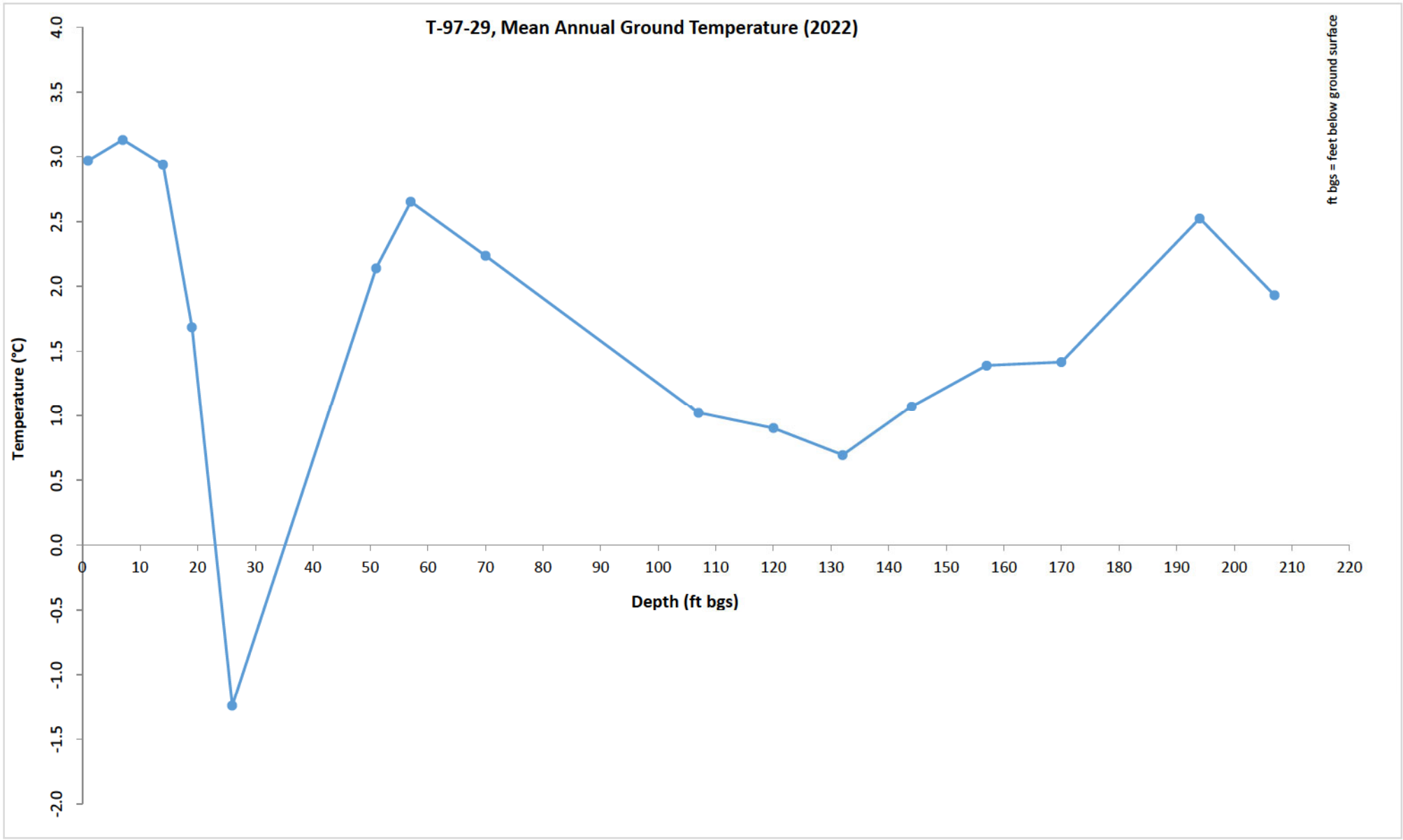

Temperature Depth Plot for T-97-028, 2022
Legend (measurement date)
4/11/22
10/21/22
ft bgs = feet below ground surface
Temperature (°C)
Depth (ft bgs)
0
1
2
3
4
5
0
25
50
75
100
125
150
175
200
225
250

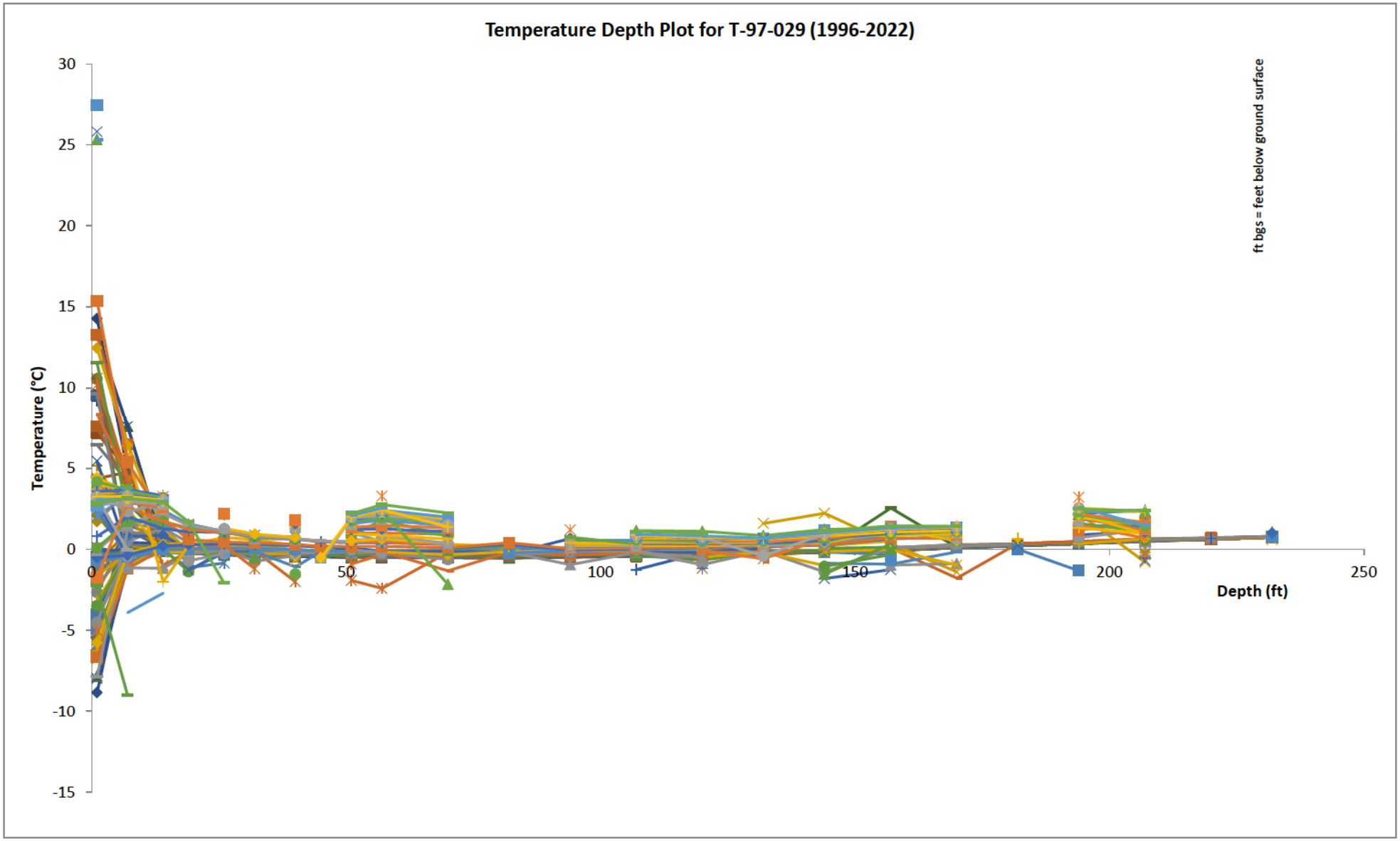

T-97-28, Mean Annual Ground Temperature (2022)
ft bgs = feet below ground surface
Temperature (°C)
0
1
2
3
4
5
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250


Temperature Depth Plot for T-97-028 (1996-2022)
Temperature (°C)
30
20
10
0
-10
-20
-30
0
25
50
75
100
125
150
175
200
225
250
Depth (ft bgs)
ft bgs = feet below ground surface

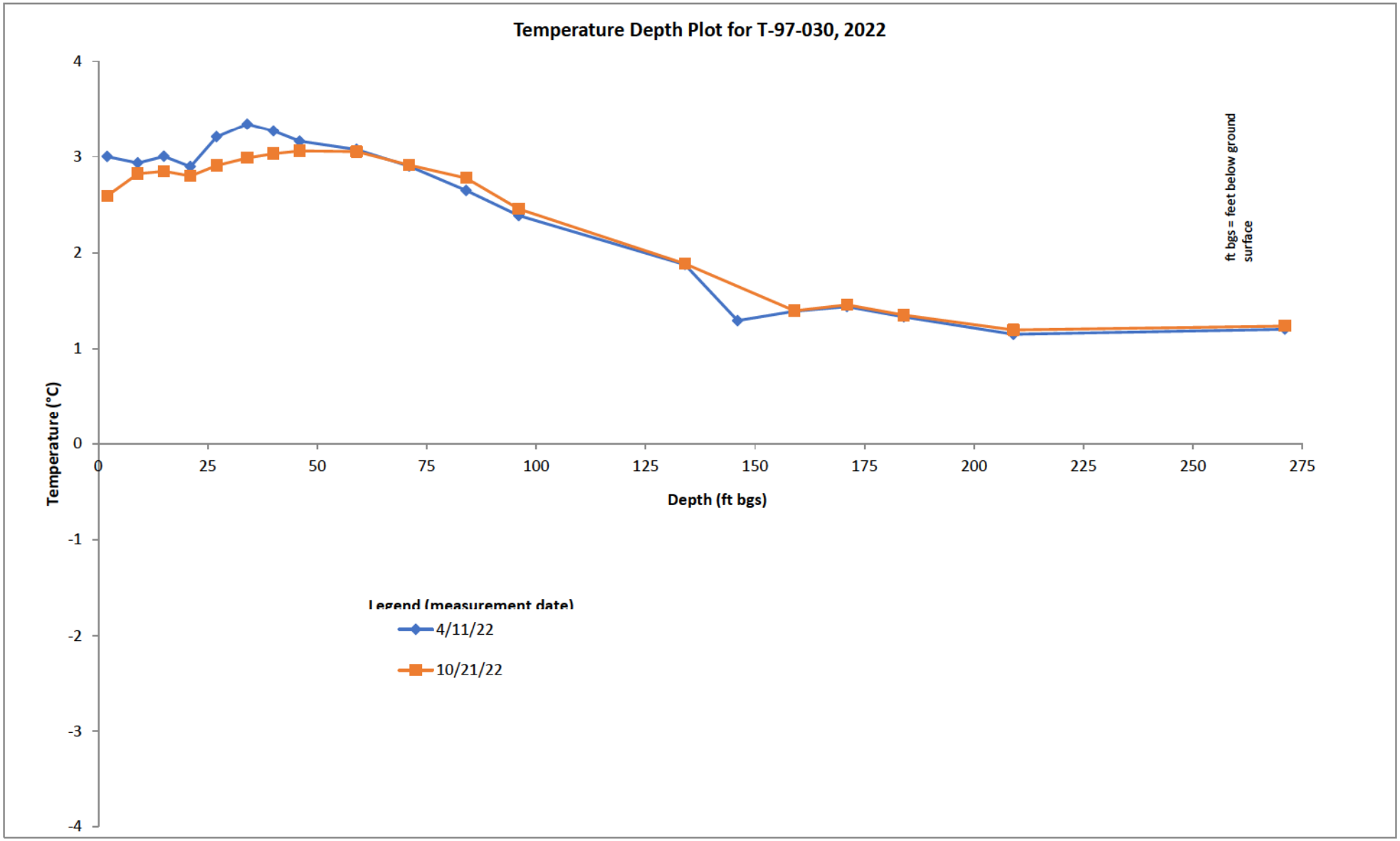
Thermistor T-97-29

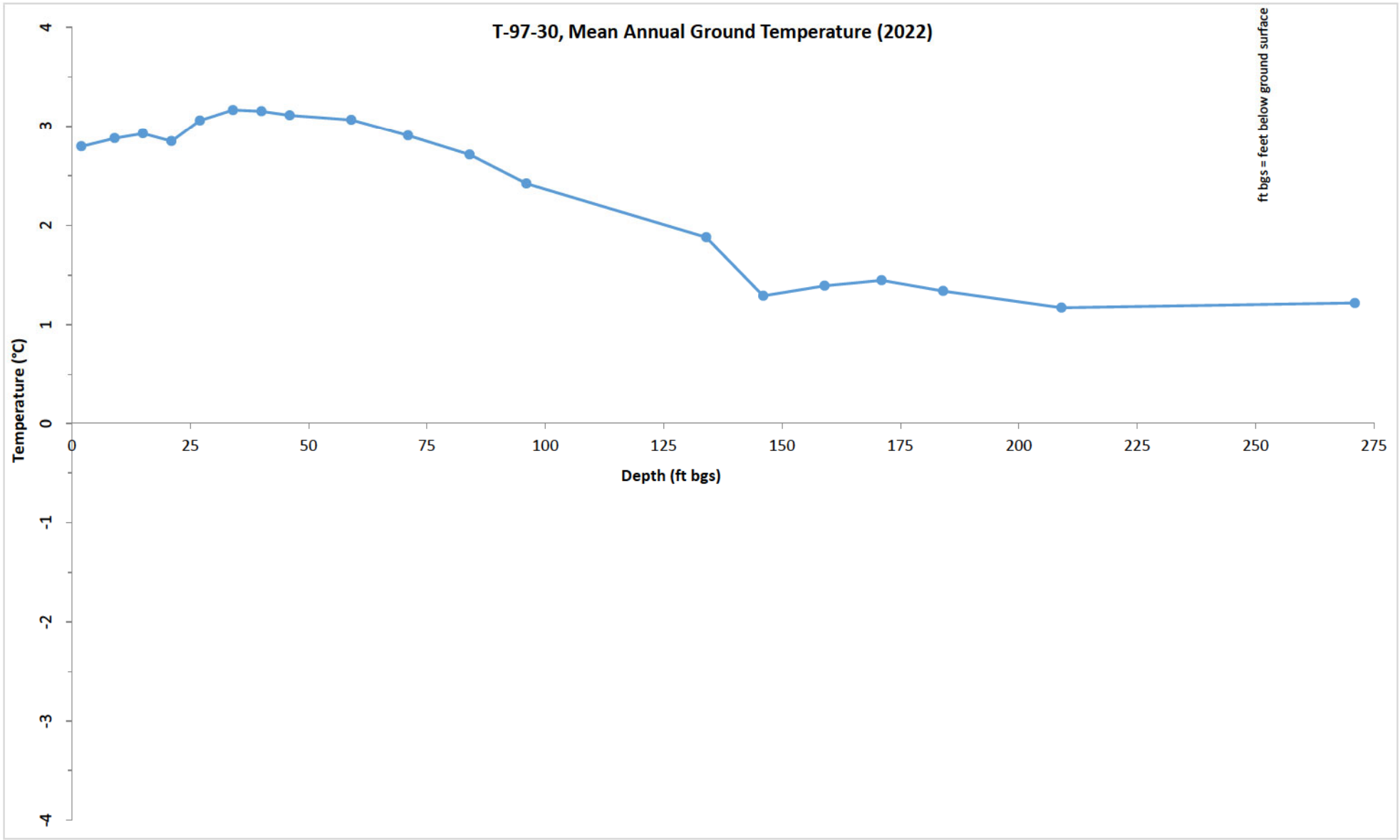

Temperature Depth Plot for T-97-029, 2022
Temperature (°C)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
Depth (ft)
0
25
50
75
100
125
150
175
200
225
250
ft bgs = feet below ground surface
Legend (measurement date)
4/11/22
10/21/22

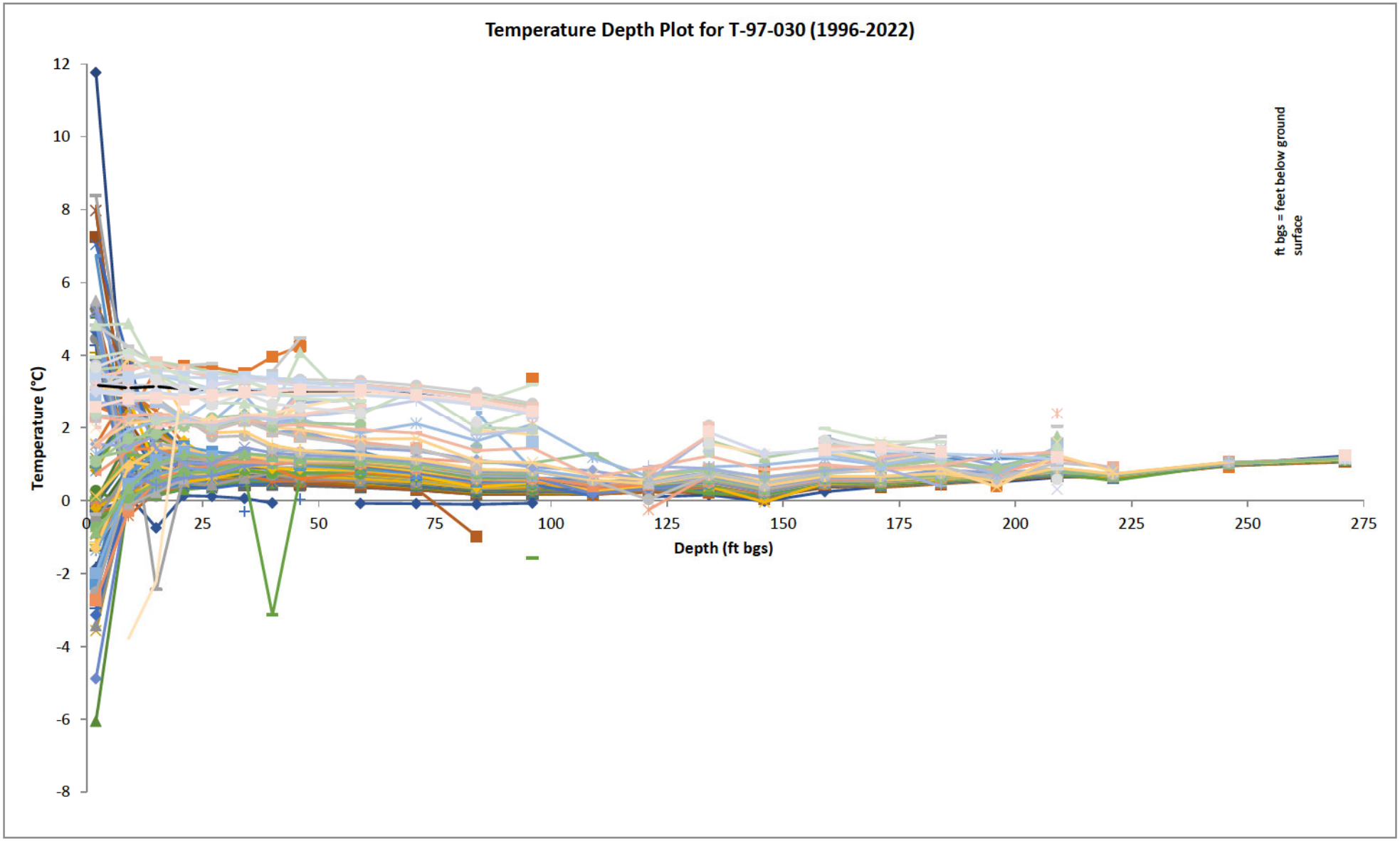

T-97-29, Mean Annual Ground Temperature (2022)
Temperature (°C)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
Depth (ft bgs)
ft bgs = feet below ground surface


Temperature Depth Plot for T-97-029 (1996-2022)
ft bgs = feet below ground surface
Temperature (°C)
30
25
20
15
10
5
0
-5
-10
-15
0
50
100
150
200
250
Depth (ft)

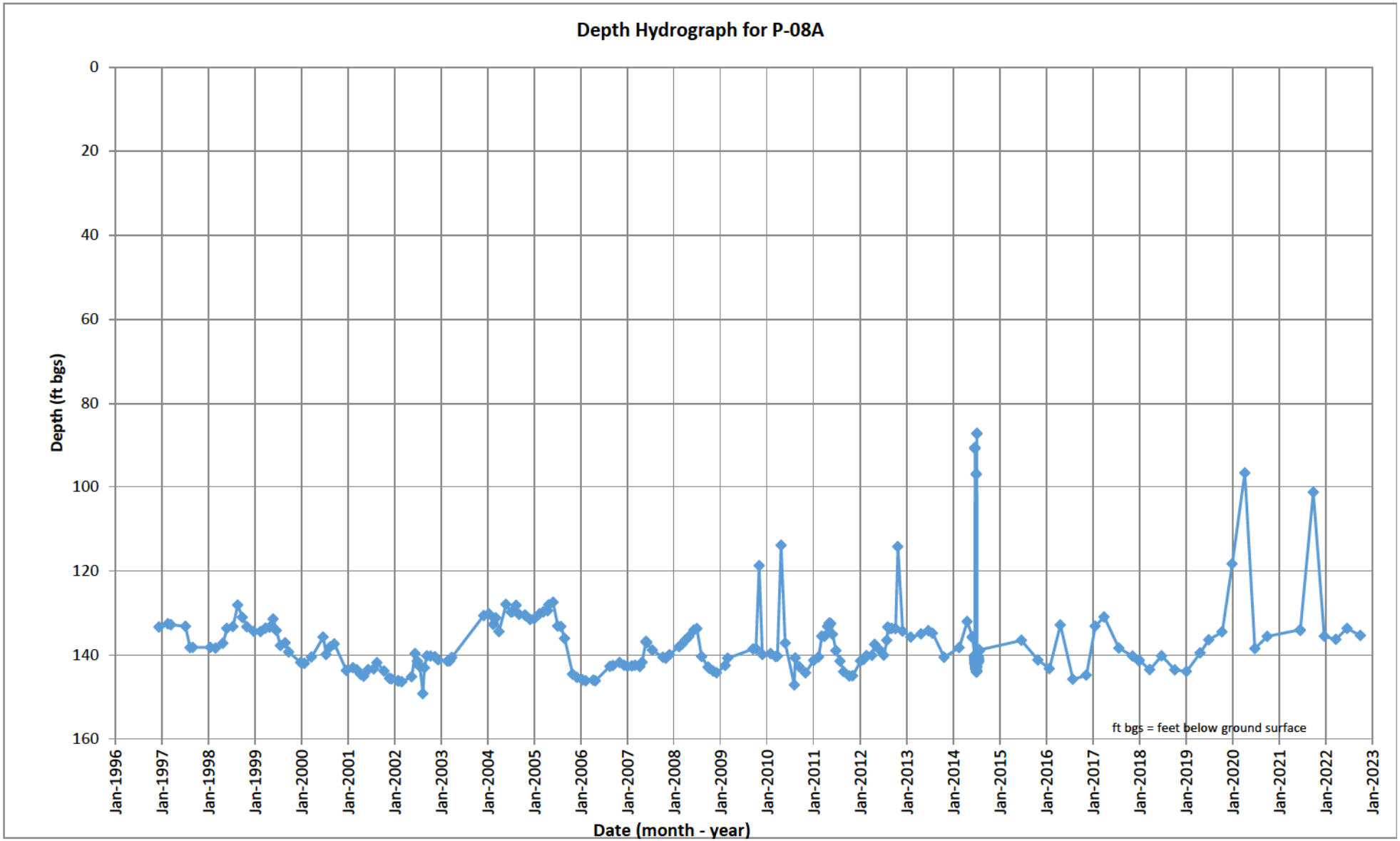
Thermistor T-97-30

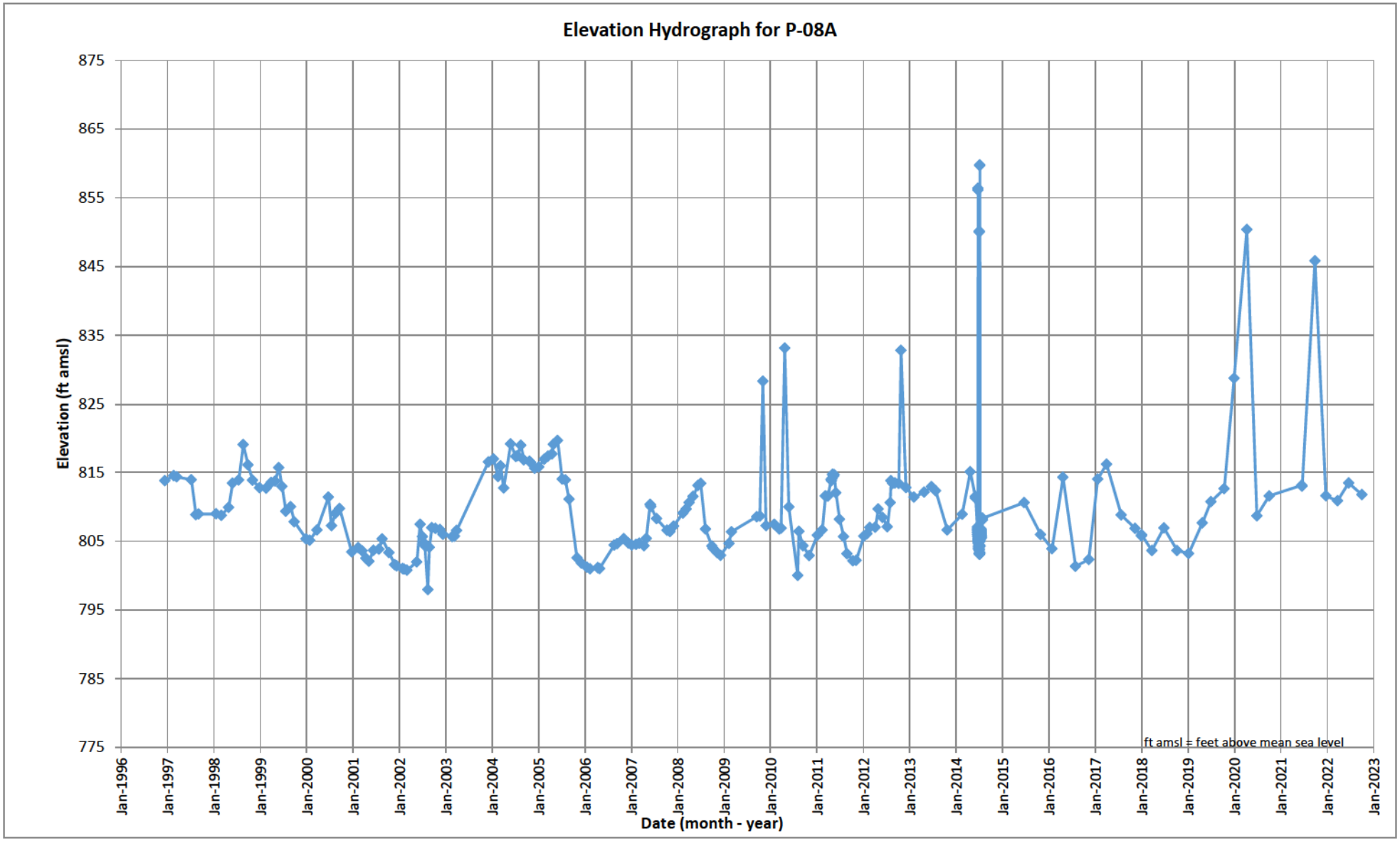

Temperature Depth Plot for T-97-030, 2022
Temperature (°C)
Depth (ft bgs)
ft bgs = feet below ground surface
Legend (measurement date)
4/11/22
10/21/22
4
3
2
1
0
-1
-2
-3
-4
0
25
50
75
100
125
150
175
200
225
250
275

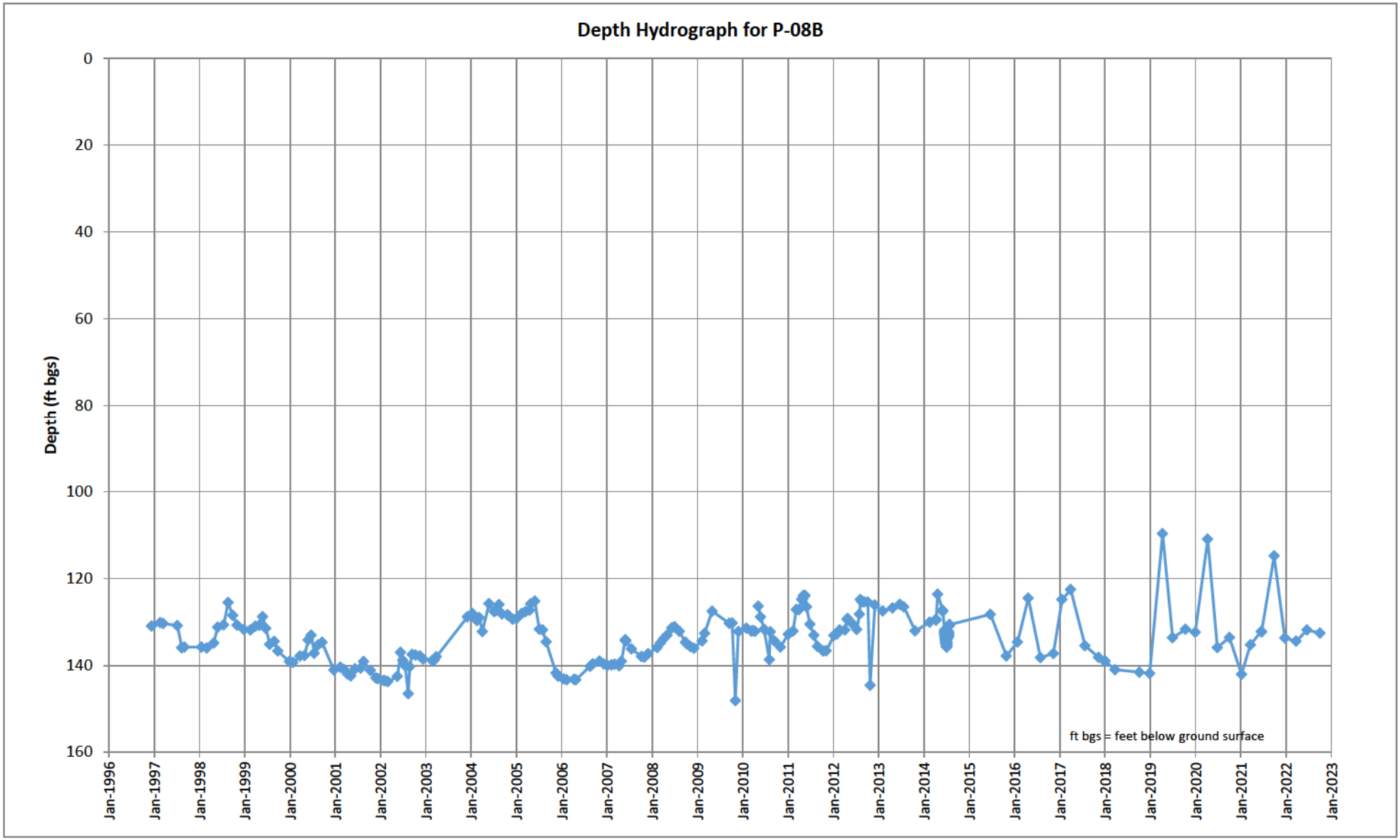

T-97-30, Mean Annual Ground Temperature (2022)
ft bgs = feet below ground surface
Temperature (°C)
4
3
2
1
0
-1
-2
-3
-4
0
25
50
75
100
125
150
175
200
225
250
275
Depth (ft bgs)

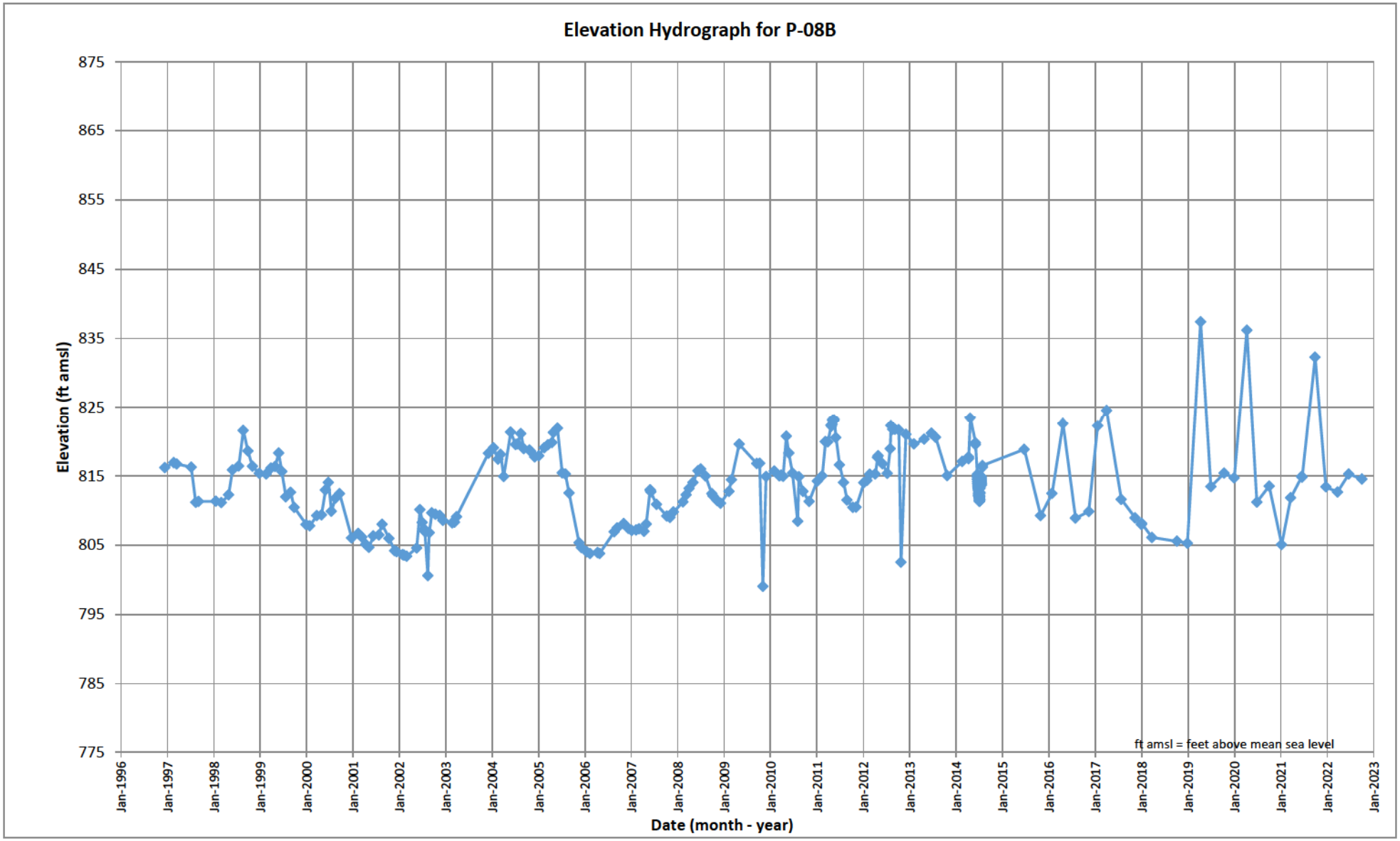

Temperature Depth Plot for T-97-030 (1996-2022)
Temperature (°C)
12
10
8
6
4
2
0
-2
-4
-6
-8
0
25
50
75
100
125
150
175
200
225
250
275
Depth (ft bgs)
ft bgs = feet below ground surface

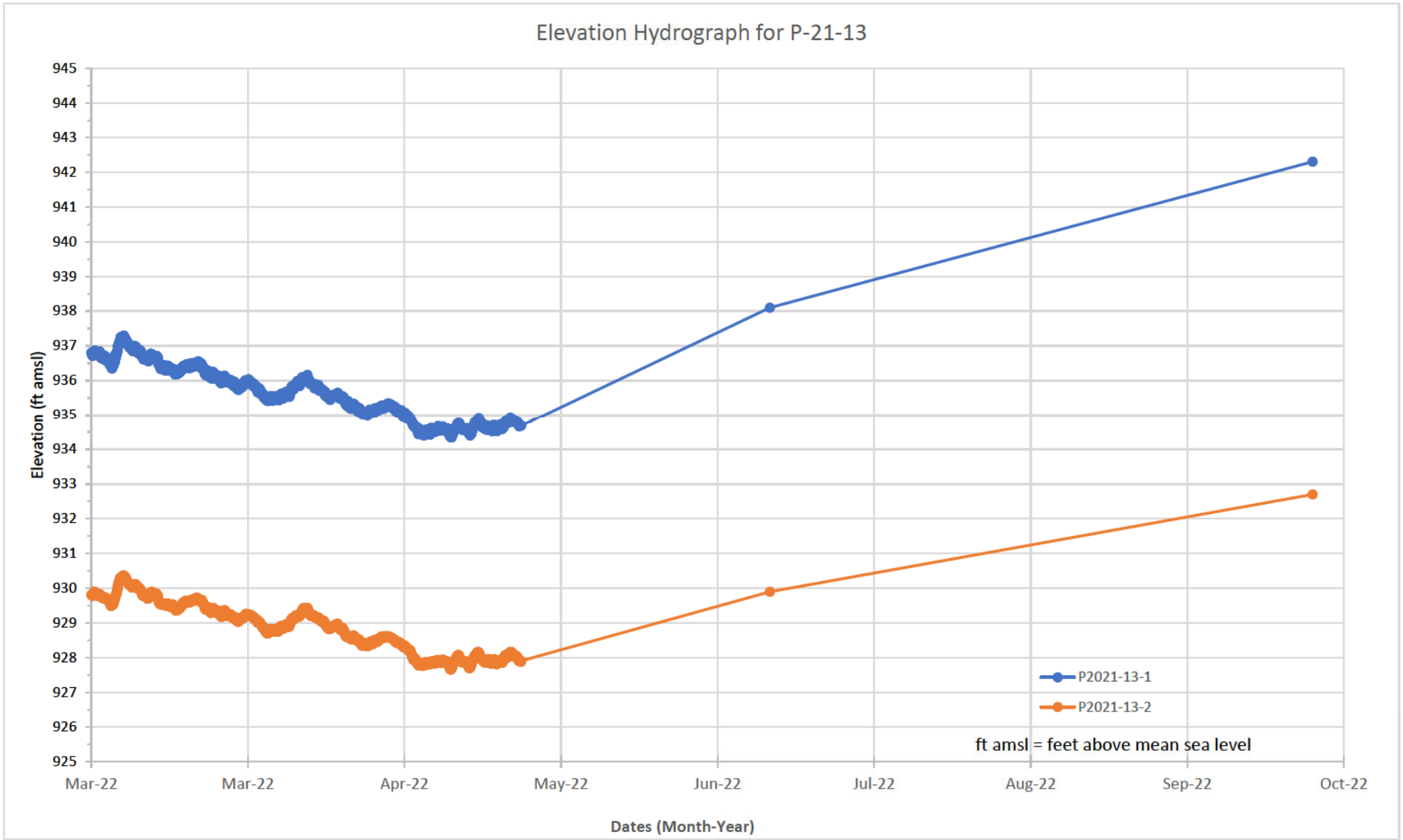
Appendix E
Piezometer Plots

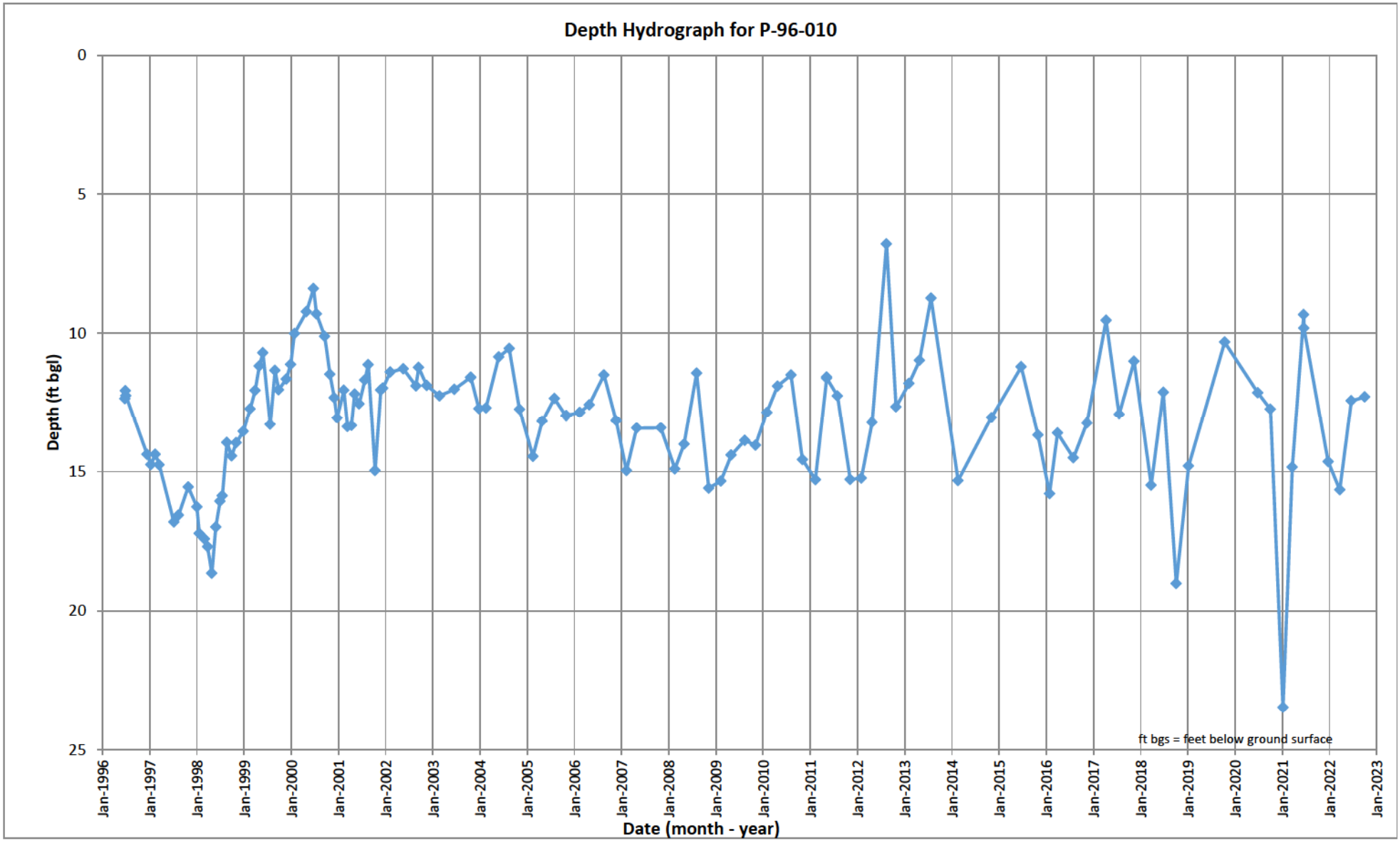

Depth Hydrograph for P-08A
Depth (ft bgs)
0
20
40
60
80
100
120
140
160
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft bgs = feet below ground surface

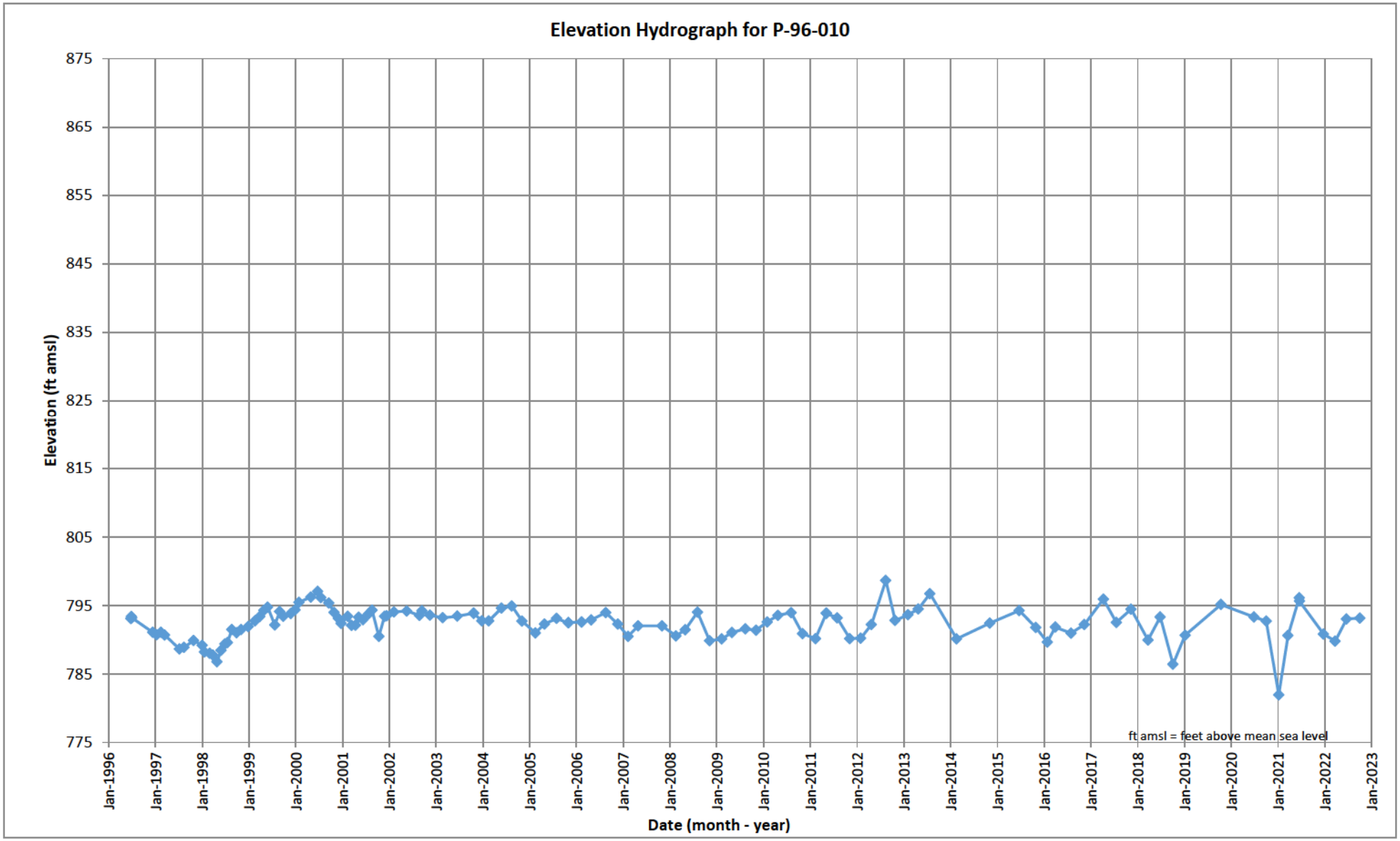

Elevation Hydrograph for P-08A
Elevation (ft amsl)
875
865
855
845
835
825
815
805
795
785
775
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level


Depth Hydrograph for P-08B
Depth (ft bgs)
0
20
40
60
80
100
120
140
160
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
ft bgs = feet below ground surface

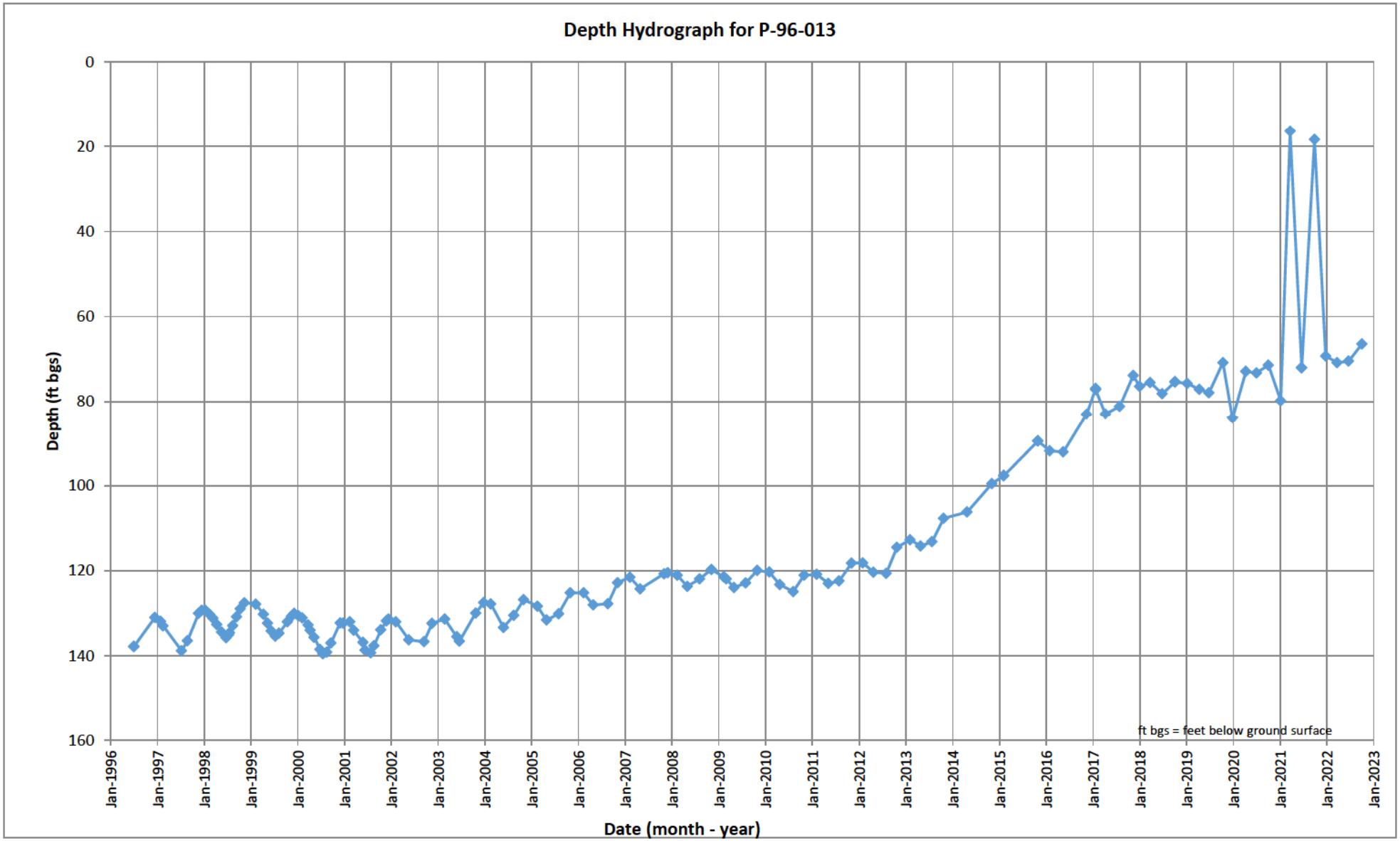

Elevation Hydrograph for P-08B
Elevation (ft amsl)
875
865
855
845
835
825
815
805
795
785
775
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level


Elevation Hydrograph for P-21-13
945
944
943
942
941
940
939
938
937
936
935
934
933
932
931
930
929
928
927
926
925
Elevation (ft amsl)
Mar-22
Mar-22
Apr-22
May-22
Jun-22
Jul-22
Aug-22
Sep-22
Oct-22
Dates (Month-Year)
P2021-13-1
P2021-13-2
ft amsl = feet above mean sea level

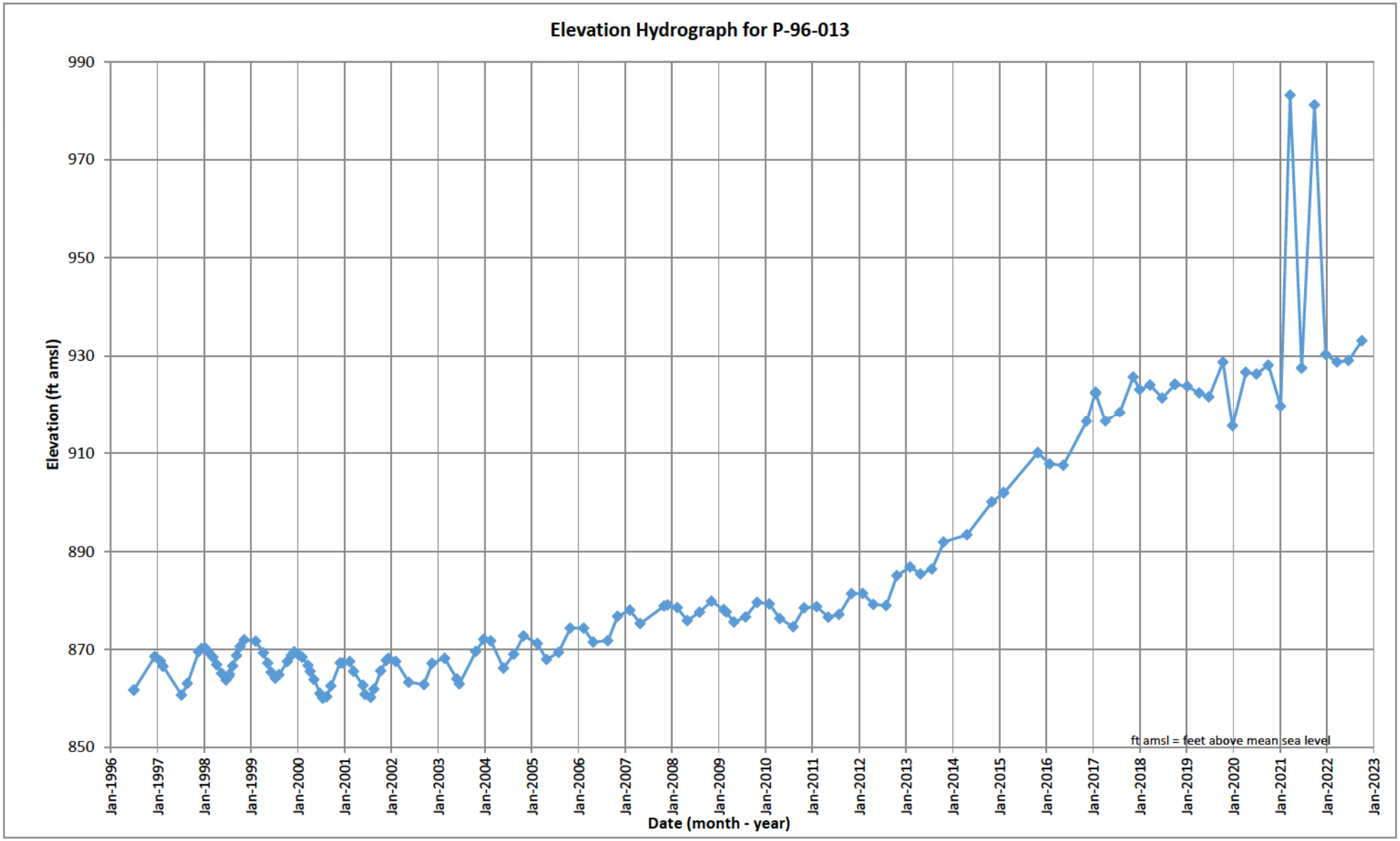

Depth Hydrograph for P-96-010
Depth (ft bgl)
0
5
10
15
20
25
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft bgs = feet below ground surface

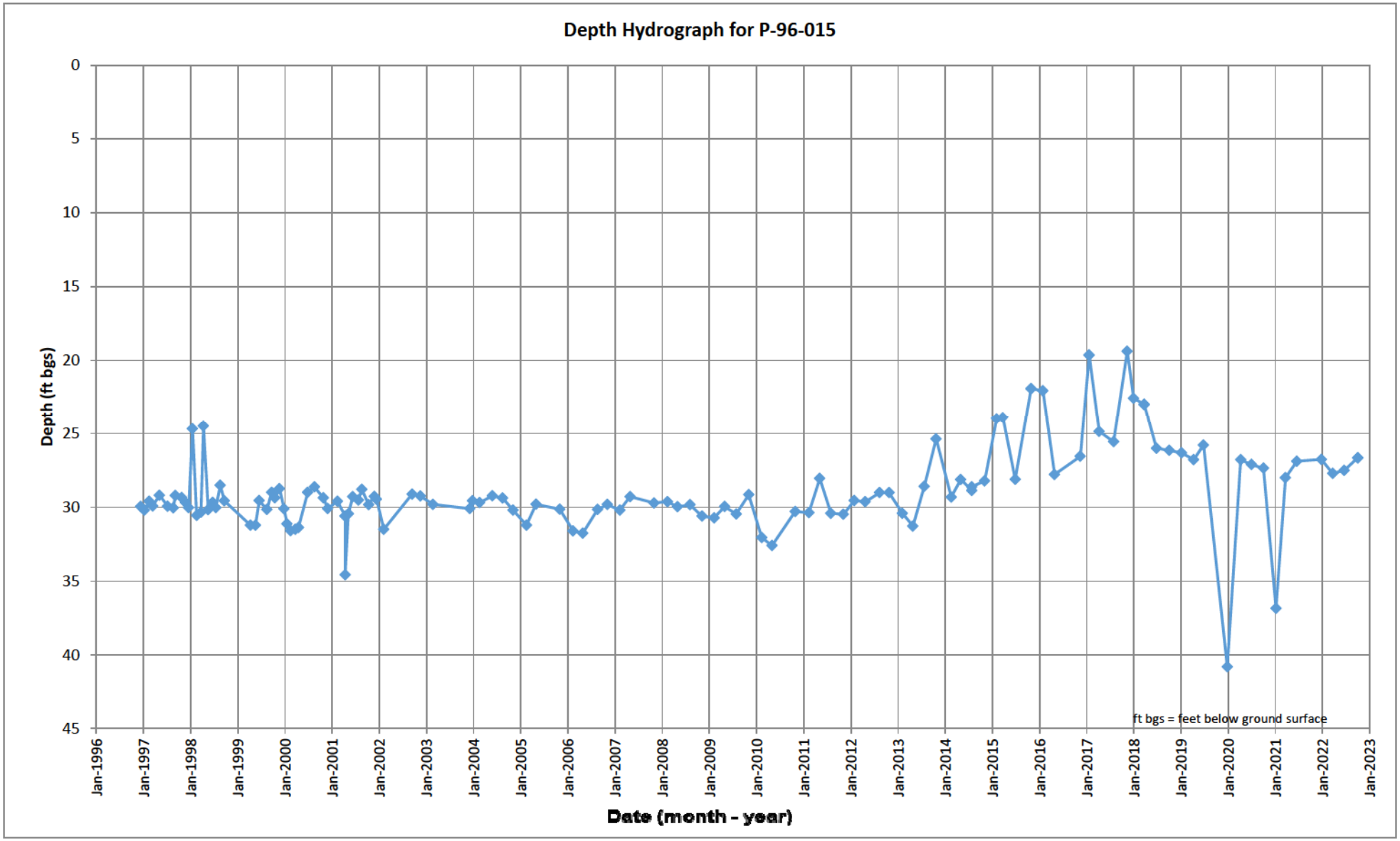

Elevation Hydrograph for P-96-010
875
865
855
845
835
825
815
805
795
785
775
Elevation (ft amsl)
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level

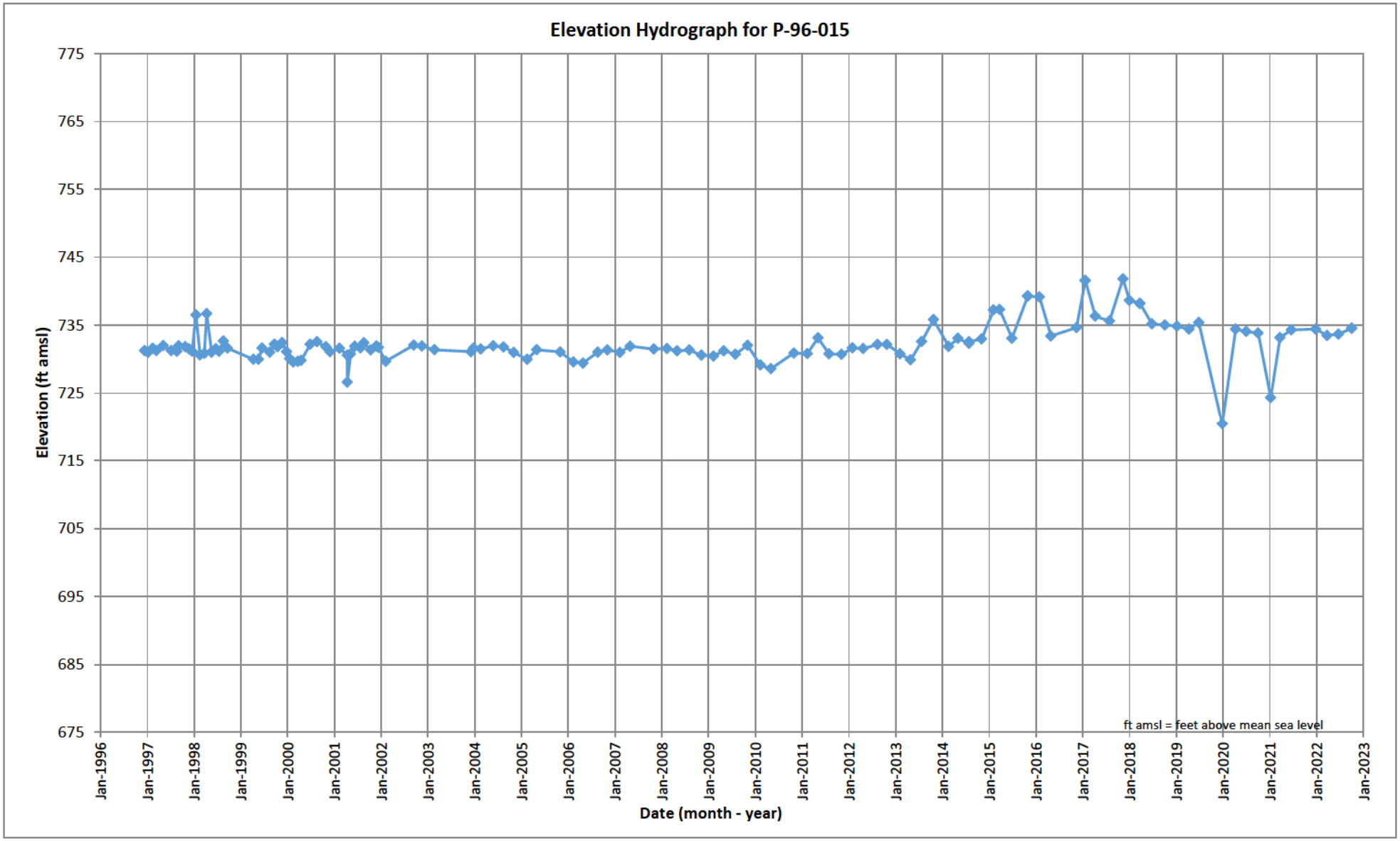
Note: this instrument is replaced by P-21-13

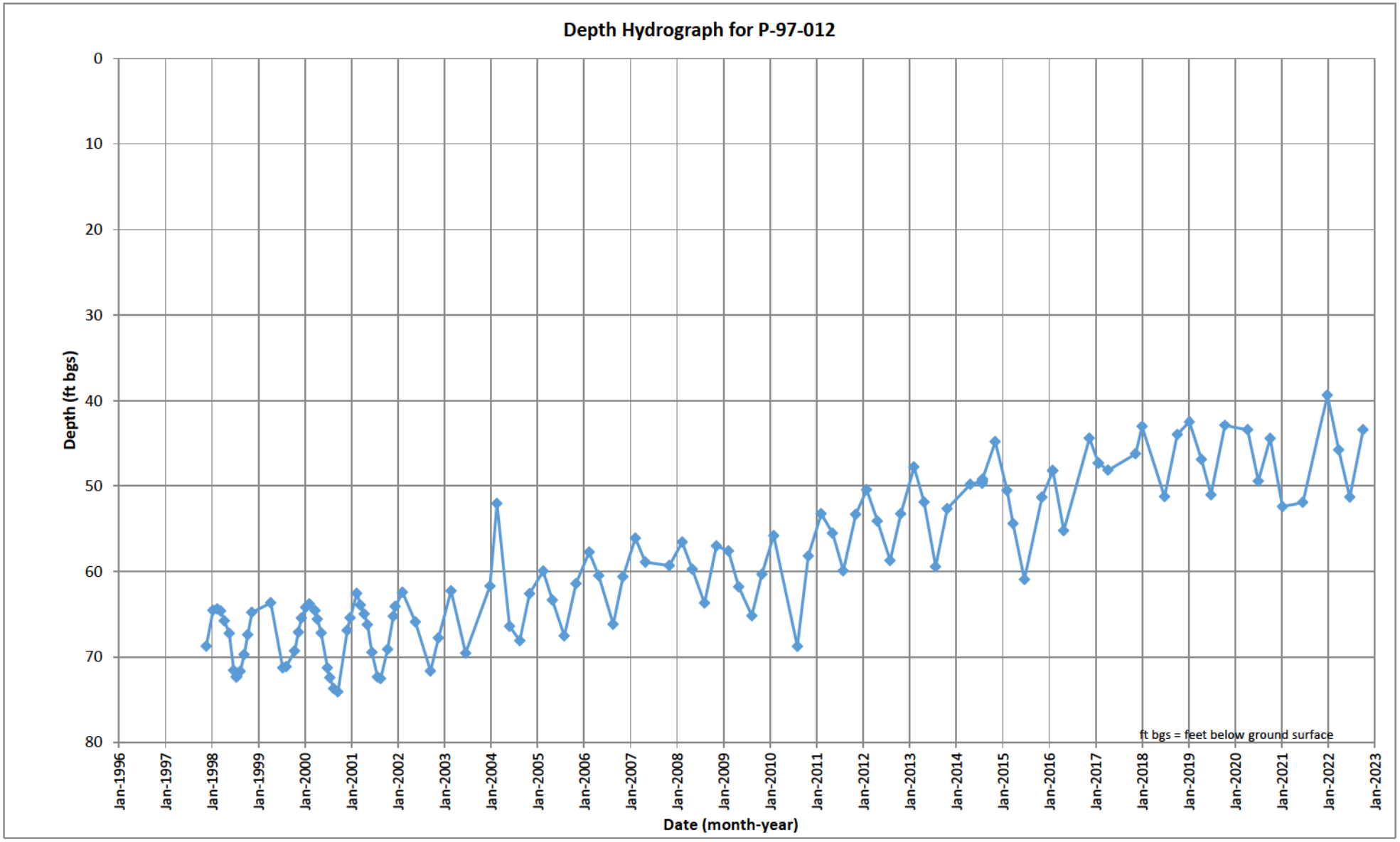


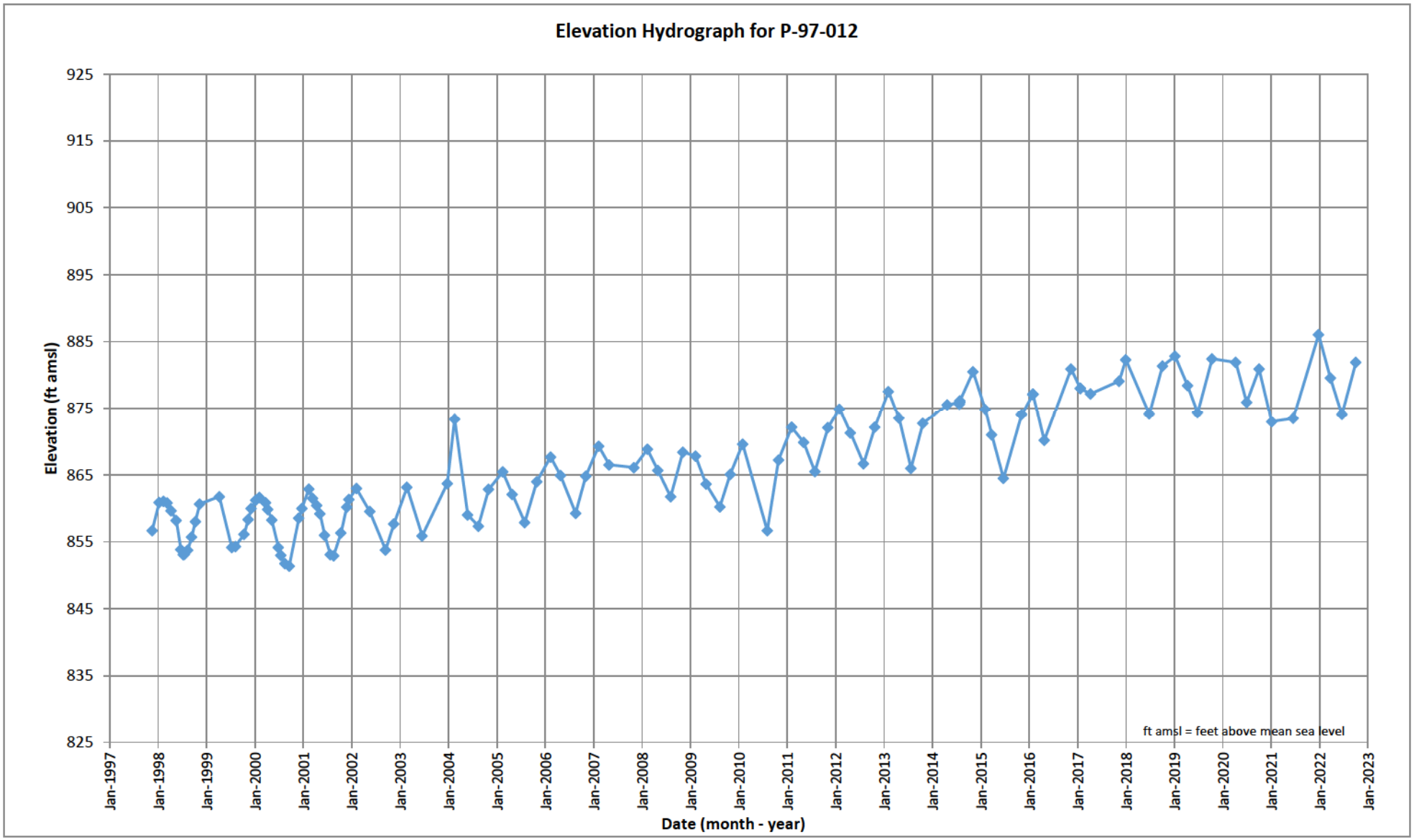
Note: this instrument is replaced by P-21-13

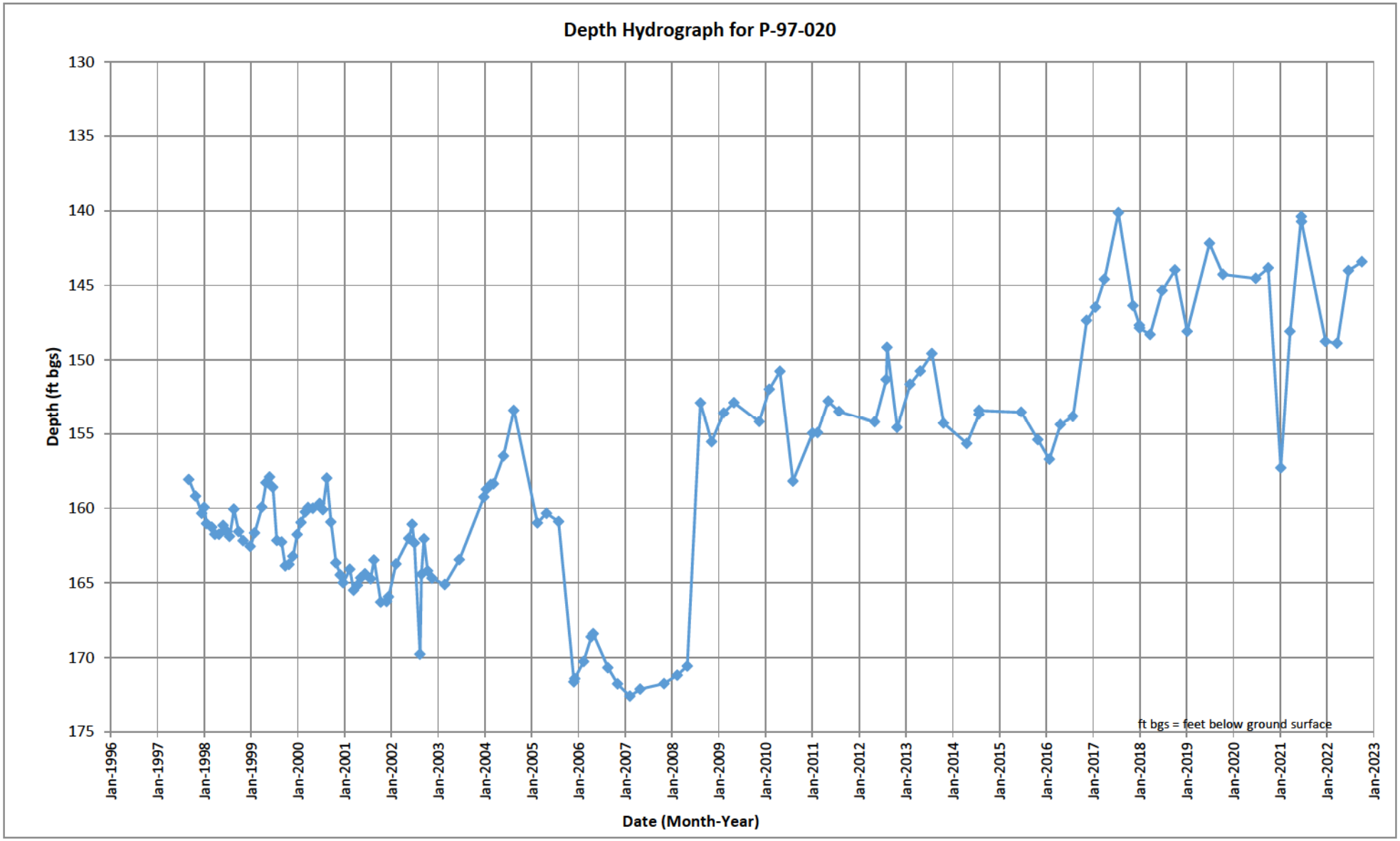


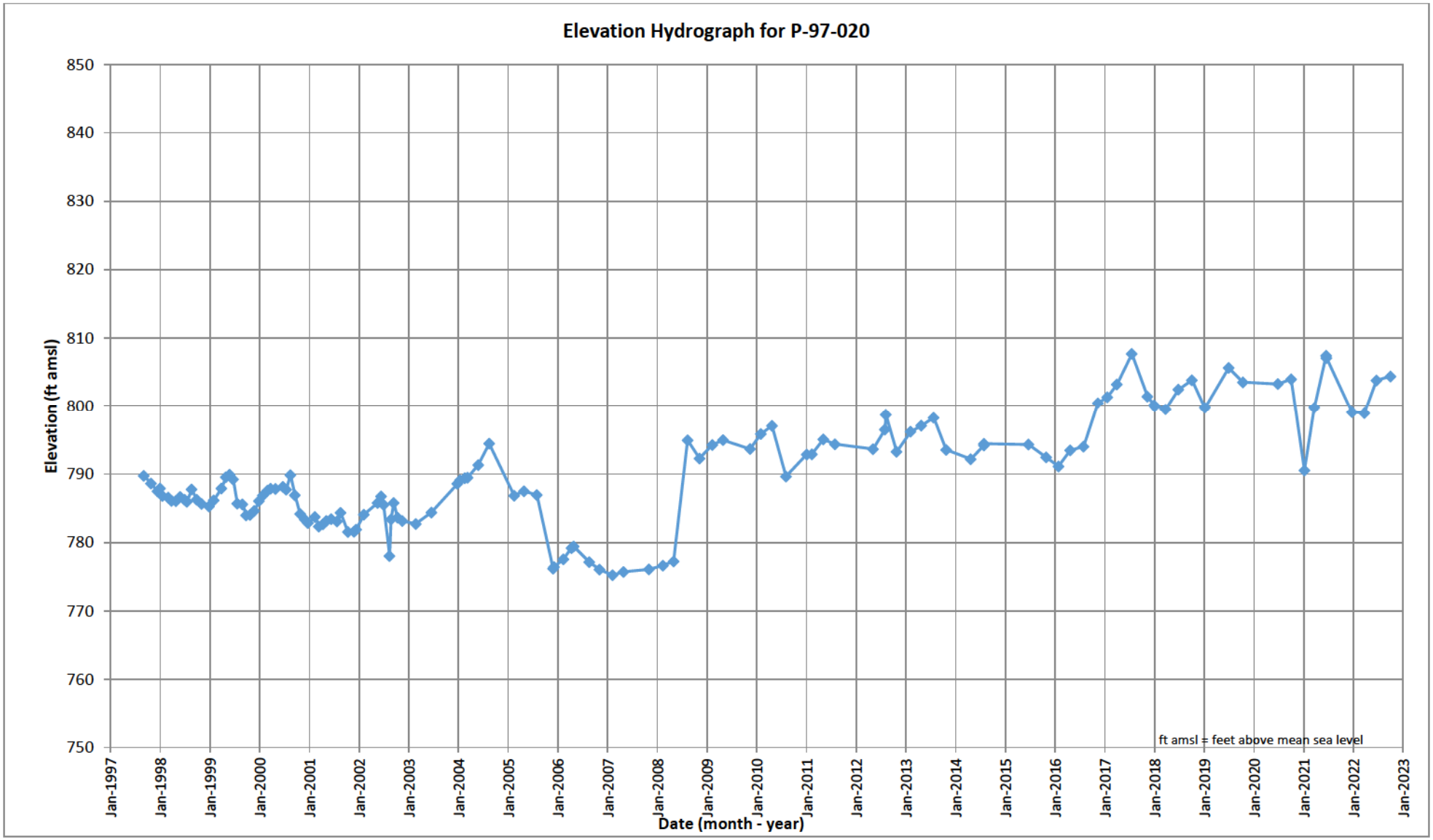

Depth Hydrograph for P-96-015
Depth (ft bgs)
0
5
10
15
20
25
30
35
40
45
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft bgs = feet below ground surface

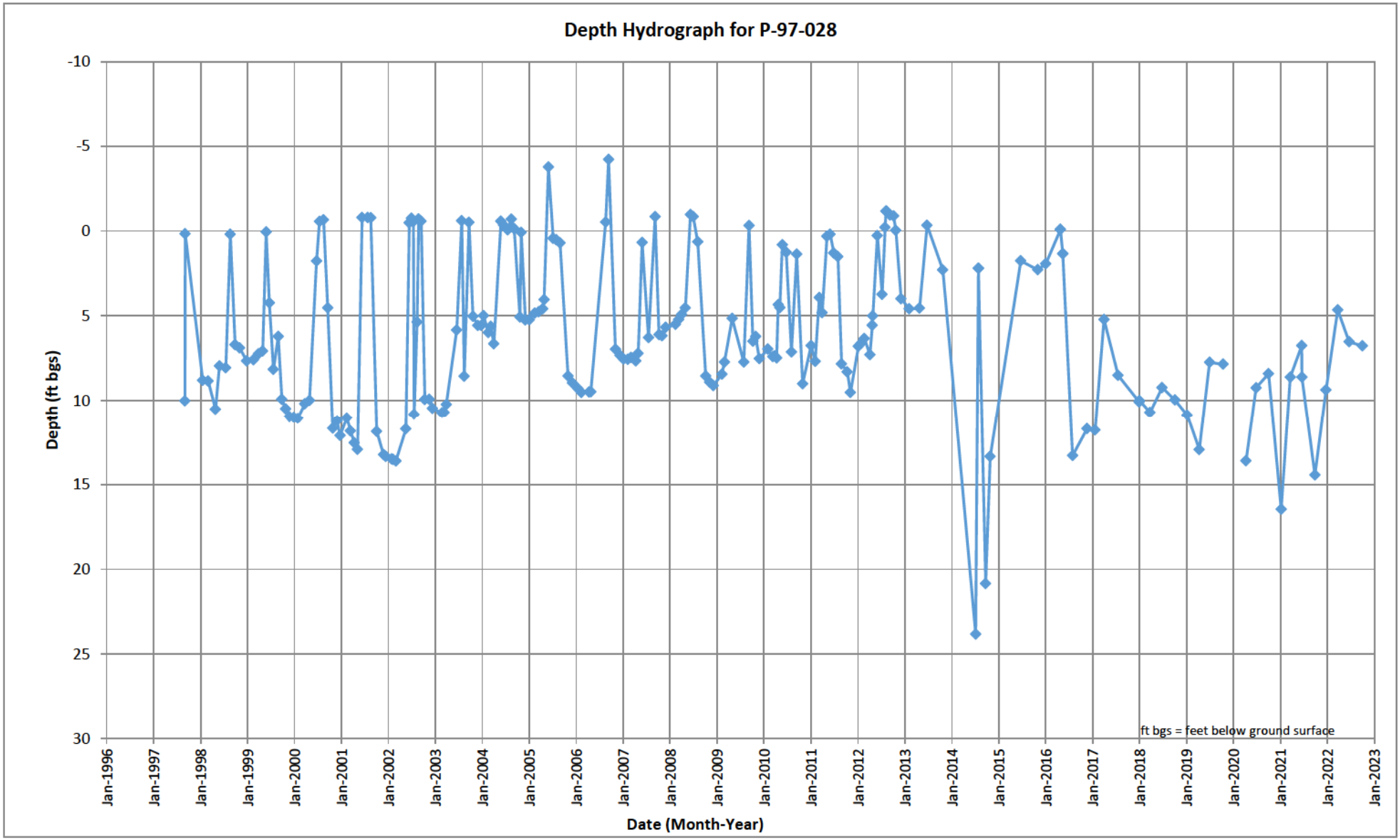

Elevation Hydrograph for P-96-015
775
765
755
745
735
725
715
705
695
685
675
Elevation (ft amsl)
ft amsl = feet above mean sea level
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)

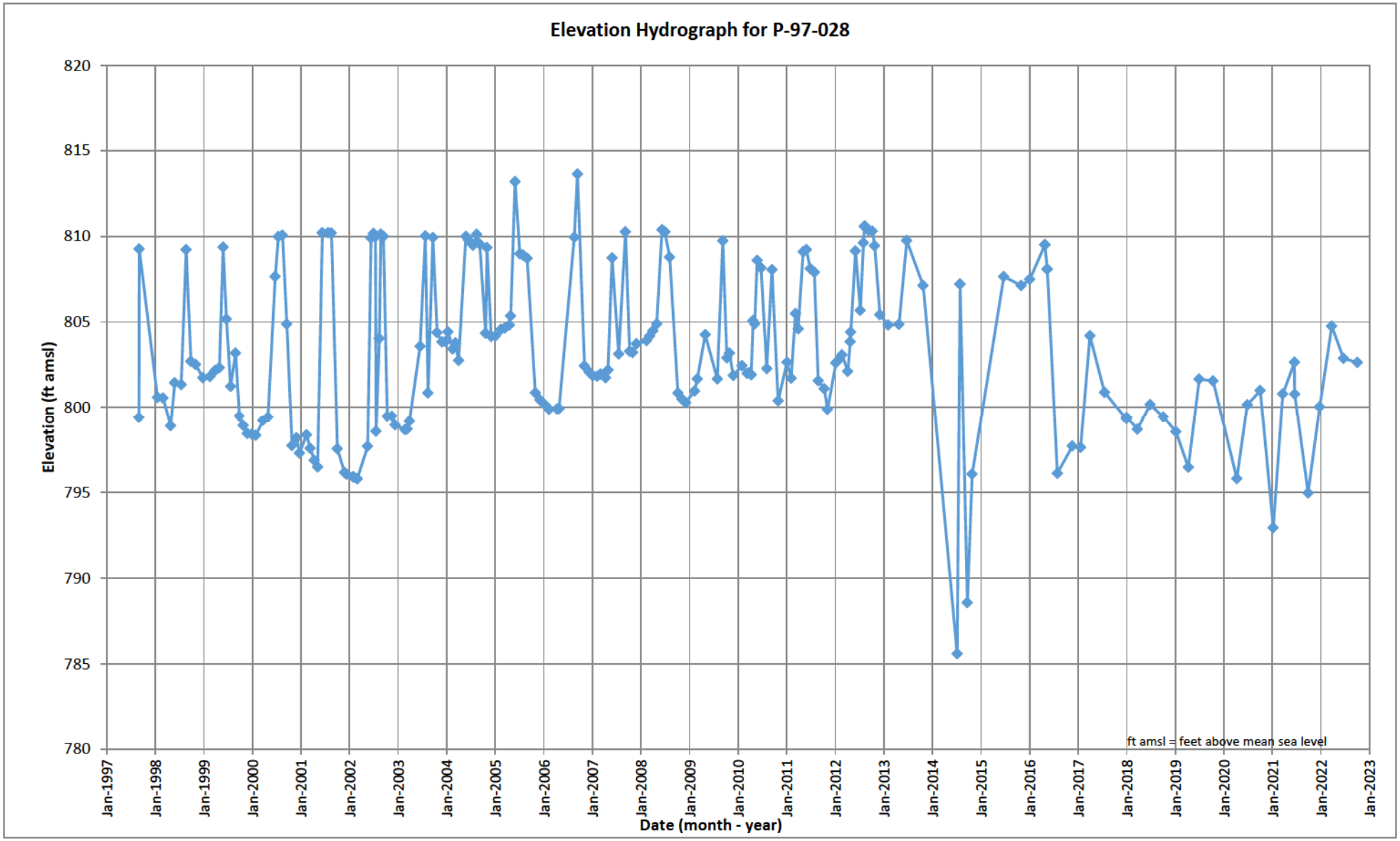

Depth Hydrograph for P-97-012
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month-year)
ft bgs = feet below ground surface

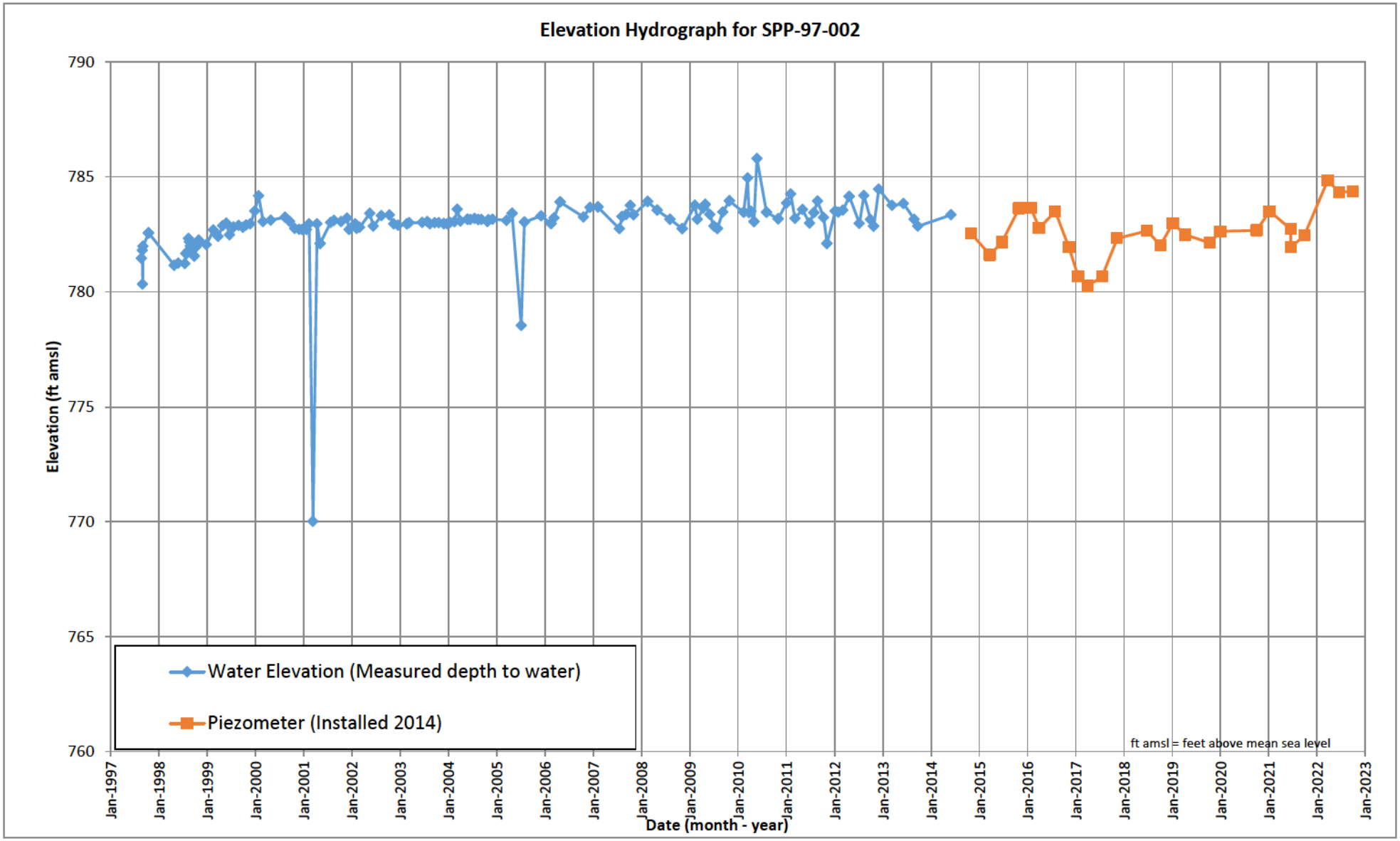

Elevation Hydrograph for P-97-012
925
915
905
895
885
875
865
855
845
835
825
Elevation (ft amsl)
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level

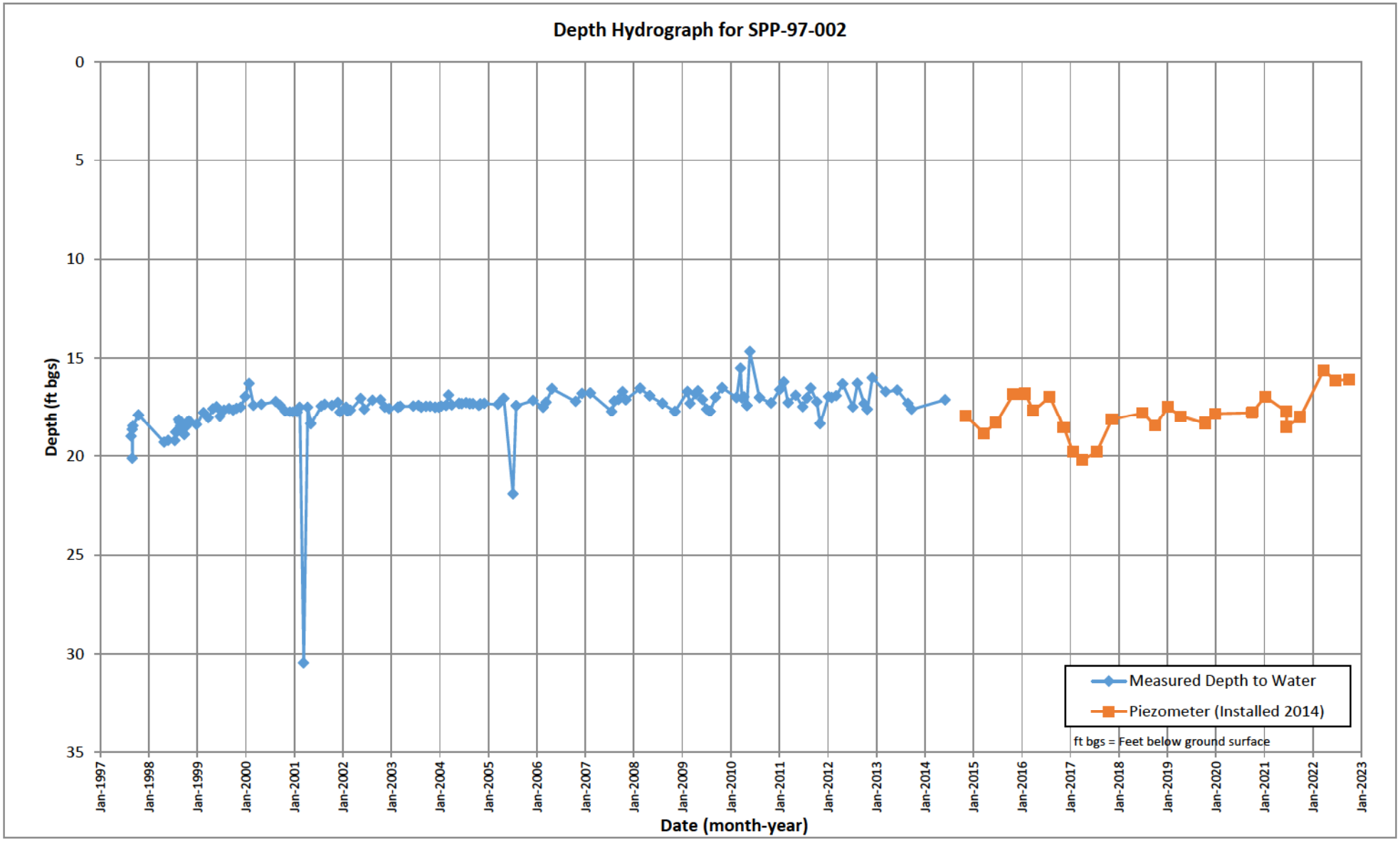

Depth Hydrograph for P-97-020
Depth (ft bgs)
130
135
140
145
150
155
160
165
170
175
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (Month-Year)
ft bgs = feet below ground surface


Elevation Hydrograph for P-97-020
Elevation (ft amsl)
850
840
830
820
810
800
790
780
770
760
750
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level


Depth Hydrograph for P-97-028
Depth (ft bgs)
-10
-5
0
5
10
15
20
25
30
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (Month-Year)
ft bgs = feet below ground surface


Elevation Hydrograph for P-97-028
820
815
810
805
800
795
790
785
780
Elevation (ft amsl)
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
ft amsl = feet above mean sea level


Elevation Hydrograph for SPP-97-002
790
785
780
775
770
765
760
Elevation (ft amsl)
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month - year)
Water Elevation (Measured depth to water)
Piezometer (Installed 2014)
ft amsl = feet above mean sea level


Depth Hydrograph for SPP-97-002
Depth (ft bgs)
0
5
10
15
20
25
30
35
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Date (month-year)
Measured Depth to Water
Piezometer (Installed 2014)
ft bgs = Feet below ground surface

Appendix F
QA/QC Data and Field Forms

1st Quarter 2020

KUNA QUARTERLY REPORT DATA CHECKLIST **Quarter** Q1 2022 **Date** 2/16/2022

For Teck/RedDog Long-Term Groundwater and Permafrost Monitoring

Checklist Items

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 2/1/2022
- ☐ **YES / NO** Data received for 16 Thermistors
- ☐ **YES / NO** Data received for 9 Piezometers
- ☐ **YES / NO** QA/QC Forms received for both Thermistors and Piezos
- ☐ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:
- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:
  See notes in table on specific data values/readings.
- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Comments/Notes:

- The barometric readings are in the correct format! Great! Thank you.
- T-95-004 is noted on the fieldsheet but no data is included from RDM.
- T-96-010 is missing. It was noted on the field sheet in Q4 of 2021 "On hold. Need to resplice connection. New construction."
- The Piezometer data was only given on the field sheet. Normally it is given in a separate word document with the specific temperature at each piezometer location.

Thermistor Data

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	1 error reading
T-05-061	Y	3 error readingS
T-95-005	Y	1 error reading
T-96-010	N	No reading provided. Comment included in fieldsheet from RDM.
T-97-028	Y	1 error reading
T-97-029	Y	15 error readings
T-97-030	Y	10 error reading
T-14-110	Y	Readings received. Uploaded to database.
T-95-008 #2 (manually add "#2")	Y	1 negative readings
T-96-013	Y	4 error readings
T-96-021	Y	
T-96-022	Y	3 error readings
T-96-023	Y	3 error readings
T-96-012	Y	3 error readings
T-96-012s	Y	1 error reading
T-95-004	N	No reading provided. Fieldsheets notes a reading, but no data included in submittal.

Piezometer Data

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	
P-08A	Y	
P-08B	Y	
P-96-010	Y	
P-97-020	Y	
P-97-028	Y	
SPP-97-002	Y	
P-96-013	Y	
P-97-012	Y	
Barometer	Y	

Quarterly Thermistor QA / QC

Location: T 96-12 Date: 1-31-22

Technician: DJS / DLJ Start Time: 1616 Stop Time: 1618

Node Test	Ohms	Comments
1	16.33	
2	16.78	
3	16.73	
4	16.92	
5	16.99	
6	17.07	
7	17.10	
8	17.15	
9	17.20	
10	17.20	
11	17.17	
12	17.23	
13	0	
14	0	
15	17.07	
16	16.94	
17	16.88	
18	16.81	
19	16.69	
20	16.55	
21	16.40	
22	0	
23	16.14	
24	16.01	
Test	15.90	
	16.33	

Node Test	Temperature
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
Test	

Read these locations on noted month.

Month	Location
Feb-17	T 95-04
May-17	T 96-21
Aug-17	T96-22
Nov-17	T 96-23
Feb-18	T 96-12
May-18	T 95-15
Aug-18	T 96-05
Nov-18	T 96-10
Feb-19	T 97-28
May-19	T 97-29
Aug-19	T 97-30
Nov-19	T 95-8
Feb-20	T 96-13
May-20	T 96-21
Aug-20	T 96-22

Make a comment if reading jumps around and takes a long time to stabilize.

QA / QC readings to be done on 5% of SEP required thermistors - see above schedule.

Record test readings before and after other readings.

CR850 & multimeter readings are to be taken within 5 minutes of each other.

Teck

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
Dennis J. Shebbon Tristen Pattee	392	19977	1/10/2022	6.90F, -11.8°F windchill, 52% RH, 5.3mph WS, Clear Skies

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T-95-008	Overburden	Yellow box Thermistor	24		1/10/22	
25	*P-96-013	Overburden	Geokon Piezometer	3	PSI Reading:	1/29/22	6558.5 m/m @ 0.3°C
29	*T-96-013	Overburden	Yellow box Thermistor	24		~~1/10/22~~	~~QC~~ Wire sliced. No connection
30	T-96-013S	Overburden	Yellow box Thermistor	24		1/10/22	
31	*T-96-021	Overburden	Yellow box Thermistor	24		1/10/22	
32	*T-96-022	Overburden	Yellow box Thermistor	24		1/10/22	
33	*T-96-023	Overburden	Yellow box Thermistor	24		1/10/22	
24	*P-97-012	Blast Road	Geokon Piezometer	Row 1	PSI Reading:	1/10/22	6171.3 m/m @ 0.2°C
27	*T-96-012	Blast Road	Yellow box Thermistor	24		1/10/22	QC check
28	*T-96-012S	Blast Road	Yellow box Thermistor	24		1/10/22	
1	*T-14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T-95-005	By sandfilter	Yellow box Thermistor	24		1/20/22	
127	*T-05-061	TDAM (end)	Yellow box Thermistor	6		1/20/22	
75	*T-97-028	Buttress	Yellow box Thermistor	24		1/20/22	
76	*T-97-029	Buttress	Yellow box Thermistor	24		1/20/22	
77	*T-97-030	Buttress	Yellow box Thermistor	24		1/20/22	
71	*T-96-010	Seepage Dam	Yellow box Thermistor	24		~~1/20/22~~	No Connector on New Cable Extension
	*P-96-010	Seepage Dam	Read PSI Only		PSI Reading: ~~1/29/22~~	~~1/20/22~~	Reading taken from Pi via T+W
23	*P-96-015	Lower RDC	Geokon Piezometer	4	PSI Reading:	1/20/22	7531.8 m/m @ 0.6°C
44	*T-96-015	Lower RDC	Yellow box Thermistor	14	3	1/20/22	
	P-97-12	Write-in QAQC Piezometer #	Geokon Piezometer	2	Duplicate reading within 5 minutes of first Piezo reading for QAQC		6172.1 m/m @ 0.2°C

Additional Comments: T-96-10 reading will have to wait until a connector is installed on cable. Cable was extended last fall.

T-95-04 is Not listed on the sheet but read on 1/29/22

Request Piezo data from T&W for Piezometer's P-97-028, P-96-010, SPP 97-002, P-08A, P-08B, P-97-020, Barometer (Baro needed for each day of data collection

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

Teck

2nd Quarter 2020

KUNA QUARTERLY REPORT DATA CHECKLIST **Quarter** Q2 2022 **Date** 4/20/2022

For Teck/RedDog Long-Term Groundwater and Permafrost Monitoring

Checklist Items

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 4/20/2022
- ☐ **YES / NO** Data received for 16 Thermistors
- ☐ **YES / NO** Data received for 9 Piezometers
- ☐ **YES / NO** QA/QC Forms received for both Thermistors and Piezos
- ☐ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:
- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:
  See notes in table on specific data values/readings.
- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Comments/Notes:

- The barometric readings are in the correct format! Great! Thank you.
- See comments below for missing thermistor string data. All are noted in the QA/QC forms submitted by Teck.

Thermistor Data

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	1 error reading
T-05-061	N	Buried under snow.
T-95-005	Y	1 error reading
T-96-010	N	Connector needs to be spliced.
T-97-028	Y	6 error readings
T-97-029	Y	8 error readings
T-97-030	Y	Readings received. Uploaded to database.
T-14-110	Y	Readings received. Uploaded to database.
T-95-008 #2 (manually add "#2")	Y	Readings received. Uploaded to database.
T-96-013	Y	1 error readings
T-96-021	Y	Readings received. Uploaded to database.
T-96-022	Y	5 error readings
T-96-023	N	Buried under snow
T-96-012	Y	4 error readings
T-96-012s	Y	1 error reading
T-95-004	N	Buried under snow.

Piezometer Data

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	
P-08A	Y	
P-08B	Y	
P-96-010	Y	
P-97-020	Y	
P-97-028	Y	
SPP-97-002	Y	
P-96-013	Y	
P-97-012	Y	
Barometer	Y	

Quarterly Thermistor QA / QC

Location: T-96-15 Date: 4/11/21

Technician: TDP Start Time: 1626 Stop Time: 1631

Node	Ohms	Comments
Test		
1	16.91	
2	16.91	
3	16.88	
4	16.89	
5	16.80	
6	16.72	
7	16.72	
8	16.60	
9	16.55	
10	16.53	
11	16.43	
12	16.36	
13	16.24	
14	16.25	
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
Test		

Node	Temperature
Test	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
Test	

Read these locations on noted quarter.

Month	Location
Q1-2021	T 97-28
Q2-2021	T 96-21
Q3-2021	T96-22
Q4-2021	T 96-23
Q1-2022	T 96-12
Q2-2022	T 95-15
Q3-2022	T 96-05
Q4-2022	T 96-10
Q1-2023	T 97-28
Q2-2023	T 97-29
Q3-2023	T 97-30
Q4-2023	T 95-8
Q1-2024	T 96-13
Q2-2024	T 96-21
Q3-2024	T 96-22
Q4-2024	T 95-04

Make a comment if reading jumps around and takes a long time to stabilize.
QA / QC readings to be done on 5% of SEP required thermistors - see above schedule.
Record test readings before and after other readings.
CR850 & multimeter readings are to be taken within 5 minutes of each other.

Teck

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date: / General Weather:
Trevor Phillips	19977	392	4/11/22 -4.17°C, 94.4% RH, mostly sunny, 6.61 mph, NE wind 4/12/22 -4.447°C, 75.18% RH, mostly cloudy, 8.00 mph E wind

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T95-08	Overburden	Yellow box Thermistor	24	3	4/12/22	
25	*P96-13	Overburden	Geokon Piezometer		PSI Reading: 6562.9	4/11/22	0.3°C
29	*T96-13	Overburden	Yellow box Thermistor	24	3	4/11/22	
30	T96-13S	Overburden	Yellow box Thermistor	24	—	—	cord cut, no connector
31	*T96-21	Overburden	Yellow box Thermistor	24	3	4/12/22	
32	*T96-22	Overburden	Yellow box Thermistor	24	3	4/12/22	
33	*T96-23	Overburden	Yellow box Thermistor	24	—	—	Buried under snow
24	*P97-12	Blast Road	Geokon Piezometer		PSI Reading: 6206.4	4/12/22	0.2°C
27	*T96-12	Blast Road	Yellow box Thermistor	24	3	4/12/22	
28	*T96-12S	Blast Road	Yellow box Thermistor	24	3	4/12/22	
1	*T14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T95-05	By sandfilter	Yellow box Thermistor	24	3	~~4/11/22~~ 4/11/22	
127	*T05-61	TDAM (end)	Yellow box Thermistor	6	—	—	Buried under snow
69	~~*T95-04~~	~~TDAM (end)~~	~~Yellow box Thermistor~~	~~24~~	—		~~Buried under snow~~
75	*T97-28	Buttress	Yellow box Thermistor	24	3	4/11/22	Bent cord
76	*T97-29	Buttress	Yellow box Thermistor	24	3	4/11/22	
77	*T97-30	Buttress	Yellow box Thermistor	24	3	4/11/22	
71	*T96-10	Seepage Dam	Yellow box Thermistor	24	—	—	connecter needs to be spliced to cord
	*P96-10	Seepage Dam	Read PSI Only	—	PSI Reading:	—	
23	*P96-15	Lower RDC	Geokon Piezometer		PSI Reading: ~~6562.4~~ TDP	4/11/22	~~0.3°C~~ TDP 7532.4 @ 0.6°C
44	*T96-15	Lower RDC	Yellow box Thermistor	14	0	4/11/22	
	~~P-96-15~~ TDP P-96-15	Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		7532.6 @ 0.6°C

Additional Comments:

Request Piezo data from T&W for Piezometer's P-97-28, P-96-10, SPP 97-2, P-08B, P-97-20, Barometer (Baro needed for each day of data collection)

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
Trevor Phillips Shelby Sampson		19977	4/20/22	41.54°F, 0-3 mph N windy, clear

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T95-08	Overburden	Yellow box Thermistor	24			
25	*P96-13	Overburden	Geokon Piezometer		PSI Reading:		
29	*T96-13	Overburden	Yellow box Thermistor	24			
30	T96-13S	Overburden	Yellow box Thermistor	24			TDP
31	*T96-21	Overburden	Yellow box Thermistor	24			
32	*T96-22	Overburden	Yellow box Thermistor	24			
33	*T96-23	Overburden	Yellow box Thermistor	24	3	4/21/22	
24	*P97-12	Blast Road	Geokon Piezometer		PSI Reading:		
27	*T96-12	Blast Road	Yellow box Thermistor	24			
28	*T96-12S	Blast Road	Yellow box Thermistor	24			TDP
1	*T14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T95-05	By sandfilter	Yellow box Thermistor	24			
127	*T05-61	TDAM (end)	Yellow box Thermistor	6	3	4/21/22	
69	*T95-04	TDAM (end)	Yellow box Thermistor	24	—	—	Not accessible
75	*T97-28	Buttress	Yellow box Thermistor	24			
76	*T97-29	Buttress	Yellow box Thermistor	24			
77	*T97-30	Buttress	Yellow box Thermistor	24			
71	*T96-10	Seepage Dam	Yellow box Thermistor	24			TDP
23	*P96-15	Lower RDC	Geokon Piezometer		PSI Reading:		
44	*T96-15	Lower RDC	Yellow box Thermistor	14			
		Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		

Additional Comments: Barometer ~~down~~ down due to malfunction from 4/13/22 to 4/25/22. Barometer reading on 4/26/22: 4762.519 @ 11.09°C

Request Piezo data from T&W for Piezometer's P-97-28, P-96-10, SPP 97-2, P-08B, P-97-20, Barometer (Baro needed for each day of data collection)

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
Trevor Phillips	19977	392	4/11/22	-4.17°C, 94.4% RH, mostly sunny, 6.61 mph, NE wind
			4/12/22	-4.447°C, 75.18% RH, mostly cloudy, 8.00 mph E wind

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T95-08	Overburden	Yellow box Thermistor	24	3	4/12/22	
25	*P96-13	Overburden	Geokon Piezometer		PSI Reading: 6562.9	4/11/22	0.3°C
29	*T96-13S	Overburden	Yellow box Thermistor	24	3	4/11/22	
30	T96-13~~S~~ TDP	Overburden	Yellow box Thermistor	24	—	—	cord cut, no connector
31	*T96-21	Overburden	Yellow box Thermistor	24	3	4/12/22	
32	*T96-22	Overburden	Yellow box Thermistor	24	3	4/12/22	
33	*T96-23	Overburden	Yellow box Thermistor	24	—	—	Buried under snow
24	*P97-12	Blast Road	Geokon Piezometer		PSI Reading: 6206.4	4/12/22	0.2°C
27	*T96-12	Blast Road	Yellow box Thermistor	24	3	4/12/22	
28	*T96-12S	Blast Road	Yellow box Thermistor	24	3	4/12/22	
1	*T14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T95-05	By sandfilter	Yellow box Thermistor	24	3	4/11/22 ~~4/11/22~~ TDP	
127	*T05-61	TDAM (end)	Yellow box Thermistor	6	—	—	Buried under snow
69	~~*T95-04~~	~~TDAM (end)~~	~~Yellow box Thermistor~~	~~24~~	—	—	Buried under snow
75	*T97-28	Buttress	Yellow box Thermistor	24	3	4/11/22	Bent cord
76	*T97-29	Buttress	Yellow box Thermistor	24	3	4/11/22	
77	*T97-30	Buttress	Yellow box Thermistor	24	3	4/11/22	
71	*T96-10	Seepage Dam	Yellow box Thermistor	24	—	—	connecter needs to be spliced to cord
	*P96-10	Seepage Dam	Read PSI Only	--	PSI Reading:	—	
23	*P96-15	Lower RDC	Geokon Piezometer		PSI Reading: ~~6562.4~~	4/11/22	~~0.3°C~~ TDP 7532.4 @ 0.6°C
44	*T96-15	Lower RDC	Yellow box Thermistor	14	0	4/11/22	
	~~P-96-15~~ TDP P-96-15	Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		7532.6 @ 0.6°C

Additional Comments:

Request Piezo data from T&W for Piezometer's P-97-28, P-96-10, SPP 97-2, P-08B, P-97-20, Barometer (Baro needed for each day of data collection)

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

3rd Quarter 2020

KUNA QUARTERLY REPORT DATA CHECKLIST **Quarter** Q3 2022 **Date** 7/29/2022

For Teck/RedDog Long-Term Groundwater and Permafrost Monitoring

Checklist Items

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 7/22/2022
- ☐ **YES / NO** Data received for 16 Thermistors
- ☐ **YES / NO** Data received for 9 Piezometers
- ☐ **YES / NO** QA/QC Forms received for both Thermistors and Piezos
- ☐ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:
- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:
  See notes in table on specific data values/readings.
- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Comments/Notes:

- The barometric readings are in the correct format! Great! Thank you.
- See comments below for missing thermistor string data. All are noted in the QA/QC forms submitted by Teck.

Thermistor Data

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	1 error reading
T-05-061	Y	4 error readings
T-95-005	Y	5 error readings
T-96-010	N	Will read later this quarter (from Teck)
T-97-028	N	All readings were errors.
T-97-029	Y	8 error readings
T-97-030	Y	Readings received. Uploaded to database.
T-14-110	Y	Readings received. Uploaded to database.
T-95-008 #2 (manually add "#2")	Y	1 error reading
T-96-013	Y	1 error readings
T-96-021	Y	Readings received. Uploaded to database.
T-96-022	Y	5 error readings
T-96-023	Y	3 error readings
T-96-012	Y	2 error readings
T-96-012s	Y	1 error reading
T-95-004	N	No reading given

Piezometer Data

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	
P-08A	Y	
P-08B	Y	
P-96-010	Y	
P-97-020	Y	
P-97-028	Y	
SPP-97-002	Y	
P-96-013	Y	
P-97-012	Y	
Barometer	Y	

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
James Mills/Shelby Simpson Shad Cormack	392	1977	7/9/2022	Mostly Clear, light winds and 65°F

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T-95-008	Overburden	Yellow box Thermistor	24	0	7-9-22	
25	*P-96-013	Overburden	Geokon Piezometer		PSI Reading: 260	1522	Row 256, column 27
29	*T-96-013	Overburden	Yellow box Thermistor	24			
31	*T-96-021	Overburden	Yellow box Thermistor	24			No negatives after pigtail removed
32	*T-96-022	Overburden	Yellow box Thermistor	24	3		Same Errors as Historical
33	*T-96-023	Overburden	Yellow box Thermistor	24	3		Same Errors as Historical. Pipe has fallen Over
24	*P-97-012	Blast Road	Geokon Piezometer	0	PSI Reading: No PSI given		QAQC done on row 256 collum 25 and row 256 collum 26
27	*T-96-012	Blast Road	Yellow box Thermistor	24	3		Read 3 times after cleaning.
28	*T-96-012S	Blast Road	Yellow box Thermistor	24	3		Read & Cleaned before [illegible]
1	*T-14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T-95-005	By sandfilter	Yellow box Thermistor	24	3		
127	*T-05-061	TDAM (end)	Yellow box Thermistor	6		7/9/22	
75	*T-97-028	Buttress	Yellow box Thermistor	24			
76	*T-97-029	Buttress	Yellow box Thermistor	24			
77	*T-97-030	Buttress	Yellow box Thermistor	24			
71	*T-96-010	Seepage Dam	Yellow box Thermistor	24			Will Read later this quarter. Per DJS
23	*P-96-015	Lower RDC	Geokon Piezometer		PSI Reading: 0	7/9/22	Col: 256, Row 26
44	*T-96-015	Lower RDC	Yellow box Thermistor	14	3	7/9/22	
		Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		

Additional Comments: NA

Request Piezo data from T&W for Piezometer's P-97-028, P-96-010, SPP 97-002, P-08A, P-08B, P-97-020, Barometer (Baro needed for each day of data collection

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

Quarterly Thermistor QA / QC

Technician(s): JWM/SLS/SRL Date: 7/9/2022

Location: P95-05 Start Time: 1704 Stop Time: 1707

Node	Ohms	Comments
Test	16.34	
1	14.15	
2	15.84	little d
3	16.00	
4	16.35	
5	16.53	
6	16.68	
7	16.74	
8	16.40	
9	16.80	
10	16.52	
11	16.85	
12	16.60	
13	16.75	
14	16.78	
15	16.72	
16	16.67	
17	16.64	
18	OL	
19	16.38	
20	16.20	
21	16.04	
22	15.90	
23	15.75	
24	15.58	
Test	16.34	

Node	Temperature
Test	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
Test	

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Month
Q1-2021
Q2-2021
Q3-2021
Q4-2021
Q1-2022
Q2-2022
Q3-2022
Q4-2022
Q1-2023
Q2-2023
Q3-2023
Q4-2023
Q1-2024
Q2-2024
Q3-2024
Q4-2024

Make a comment if reading jumps around and takes a long time to stabilize.
QA / QC readings to be done on 5% of SEP required thermistors - see above schedule.
Record test readings before and after other readings.
CR850 & multimeter readings are to be taken within 5 minutes of each other.

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
JWM/SLS/SRC		1977	7/11/2022	Offand on Rain & light winds. 65°F

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T-95-008	Overburden	Yellow box Thermistor	24			
25	*P-96-013	Overburden	Geokon Piezometer		PSI Reading:		
29	*T-96-013	Overburden	Yellow box Thermistor	24			
30	T-96-013S	Overburden	Yellow box Thermistor	24			
31	*T-96-021	Overburden	Yellow box Thermistor	24			
* 32	*T-96-022	Overburden	Yellow box Thermistor	24	3		Ignore 1st Reading. QAQC done
33	*T-96-023	Overburden	Yellow box Thermistor	24			
24	*P-97-012	Blast Road	Geokon Piezometer		PSI Reading:		
* 27	*T-96-012	Blast Road	Yellow box Thermistor	24	3		QAQC Done
28	*T-96-012S	Blast Road	Yellow box Thermistor	24			
1	*T-14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T-95-005	By sandfilter	Yellow box Thermistor	24			
* 127	*T-05-061	TDAM (end)	Yellow box Thermistor	6			
75	*T-97-028	Buttress	Yellow box Thermistor	24			
76	*T-97-029	Buttress	Yellow box Thermistor	24			
77	*T-97-030	Buttress	Yellow box Thermistor	24			
71	*T-96-010	Seepage Dam	Yellow box Thermistor	24			
	*P-96-010	Seepage Dam	Read PSI Only		PSI Reading:		
23	*P-96-015	Lower RDC	Geokon Piezometer		PSI Reading:		
44	*T-96-015	Lower RDC	Yellow box Thermistor	14			
		Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		

Additional Comments: Read T-96-22 & T96-12 w/a QAQC Check. Could not access T5-61 due to dam construction

Request Piezo data from T&W for Piezometer's P-97-028, P-96-010, SPP 97-002, P-08A, P-08B, P-97-020, Barometer (Baro needed for each day of data collection

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

Quarterly Thermistor QAQC Schedule: **2023** Q1=T97-28, Q2=T97-29, Q3=97-30, Q4=T95-08; **2024** Q1=T96-13, Q2=T96-21, Q3=T96-22, Q4=T96-05

*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor

Quarterly Thermistor QA / QC

Technician(s): QS/SRC/JWM Date: 7/11/22

Location: T96-12 Start Time: 1648 Stop Time: 1653

Node Test	Ohms	Comments
1	16.34	
2	15.85	
3	16.64	
4	16.85	
5	16.92	
6	17.04	
7	17.09	
8	17.13	
9	17.2	
10	17.16	
11	16.95	number bouncing
12	17.06	number bouncing?
13	6.71	
14	OL	
15	17.07	
16	16.79	
17	16.66	
18	16.74	
19	16.54	
20	16.32	Bouncing
21	16.25	
22	1.06	Bouncing
23	15.83	Bouncing
24	15.54	Bouncing
Test	15.88	
	16.34	

Node Test	Temperature
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
Test	

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Month
Q1-2021
Q2-2021
Q3-2021
Q4-2021
Q1-2022
Q2-2022
Q3-2022
Q4-2022
Q1-2023
Q2-2023
Q3-2023
Q4-2023
Q1-2024
Q2-2024
Q3-2024
Q4-2024

Make a comment if reading jumps around and takes a long time to stabilize.
QA / QC readings to be done on 5% of SEP required thermistors - see above schedule.
Record test readings before and after other readings.
CR850 & multimeter readings are to be taken within 5 minutes of each other.

Quarterly Thermistor QA / QC

Technician(s): JWM/SLS/SRC Date: 7/1/22

Location: T-96-22 Start Time: 1629 Stop Time: 1633

Node	Ohms	Comments
Test	16.34	
1	9.56	
2	9.58	
3	7.17	Jumpy
4	14.85	
5	15.19	
6	15.15	
7	15.21	
8	16.64	Jumpy
9	15.59	
10	15.93	
11	16.30	
12	16.65	
13	16.76	
14	16.82	
15	9.57	
16	16.92	
17	17.07	
18	16.97	
19	17.06	
20	17.04	
21	17.05	
22	16.84	
23	16.89	
24	17.01	
Test	16.34	

Node	Temperature
Test	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
Test	

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Month
Q1-2021
Q2-2021
Q3-2021
Q4-2021
Q1-2022
Q2-2022
Q3-2022
Q4-2022
Q1-2023
Q2-2023
Q3-2023
Q4-2023
Q1-2024
Q2-2024
Q3-2024
Q4-2024

Make a comment if reading jumps around and takes a long time to stabilize.
QA / QC readings to be done on 5% of SEP required thermistors - see above schedule.
Record test readings before and after other readings.
CR850 & multimeter readings are to be taken within 5 minutes of each other.

Teck

4th Quarter 2020

KUNA QUARTERLY REPORT DATA CHECKLIST **Quarter** Q4 2022 **Date** 10/26/2022

For Teck/RedDog Long-Term Groundwater and Permafrost Monitoring

Checklist Items

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 10/20/2022
- ☐ **YES / NO** Data received for 16 Thermistors
- ☐ **YES / NO** Data received for 9 Piezometers
- ☐ **YES / NO** QA/QC Forms received for both Thermistors and Piezos
- ☐ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:
  See notes in table on specific data values/readings.
- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:
  See notes in table on specific data values/readings.
- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?
  Because Q4 QAQC Thermistor is T-96-010 and it was noted that it needs repair, there was no attached QAQC thermistor field note report.

Comments/Notes:

- See comments below for missing thermistor string data. All are noted in the QA/QC forms submitted by Teck.

Thermistor Data

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	Readings received. Uploaded to database.
T-05-061	N	T5-61 is buried under gravel as I could not find the cone that was used to hold the wire. The dam was raised more since July. Readings were given but most were errors
T-95-005	Y	2 error readings
T-96-010	N	T96-10 needs repair as it does not have any connector. Looks like a splice was being done but it was never finished. So the data will be collected once repairs are made.
T-97-028	Y	6 error readings
T-97-029	Y	3 error readings
T-97-030	Y	3 error readings
T-14-110	Y	Readings received. Uploaded to database.
T-95-008 #2 (manually add "#2")	Y	1 error reading
T-96-013	Y	3 error readings
T-96-021	Y	Readings received. Uploaded to database.
T-96-022	Y	5 error readings
T-96-023	Y	2 error readings
T-96-012	Y	5 error readings
T-96-012s	Y	2 error reading
T-95-004	N	No reading given

Piezometer Data

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	
P-08A	Y	
P-08B	Y	
P-96-010	Y	
P-97-020	Y	
P-97-028	Y	
SPP-97-002	Y	
P-96-013	Y	
P-97-012	Y	
Barometer	Y	

Quarterly Thermistor/Piezometer Fieldsheet

Technician(s):	Geokon ID #:	Thermrdr ID #:	Date:	General Weather:
James Mills	392	19977	10/21/2022	Cloudy, snow showers, light & variable winds & 27°F

Col. # Row	Well	Location	Collection Method Instrument	Nodes	Piezo PSI or Therm Error Code	Date	Comments
26	*T-95-008	Overburden	Yellow box Thermistor	24	3	10/21/22	
25	*P-96-013	Overburden	Geokon Piezometer		PSI Reading: 250		
29	*T-96-013	Overburden	Yellow box Thermistor	24	3		
31	*T-96-021	Overburden	Yellow box Thermistor	24	3		
32	*T-96-022	Overburden	Yellow box Thermistor	24	3		
33	*T-96-023	Overburden	Yellow box Thermistor	24	3		
24	*P-97-012	Blast Road	Geokon Piezometer		PSI Reading: NA		No PSI Gauge
27	*T-96-012	Blast Road	Yellow box Thermistor	24	3		
28	*T-96-012S	Blast Road	Yellow box Thermistor	24	3		
1	*T-14-110	W. Tails Pond	Beaded Stream Datalogger	24	Collect Data via Internet		
70	*T-95-005	By sandfilter	Yellow box Thermistor	24	3		
127	*T-05-061	TDAM (end)	Yellow box Thermistor	6	NA		Buried under Gravel
75	*T-97-028	Buttress	Yellow box Thermistor	24	3		
76	*T-97-029	Buttress	Yellow box Thermistor	24	3		
77	*T-97-030	Buttress	Yellow box Thermistor	24	3		
71	*T-96-010	Seepage Dam	Yellow box Thermistor	24	NA		Not wired to connector end
23	*P-96-015	Lower RDC	Geokon Piezometer		PSI Reading: NA		No PSI Gauge
44	*T-96-015	Lower RDC	Yellow box Thermistor	14	3		
	P-96-15	Write-in QAQC Piezometer #	Geokon Piezometer		Duplicate reading within 5 minutes of first Piezo reading for QAQC		

Additional Comments:

Request Piezo data from T&W for Piezometer's P-97-028, P-96-010, SPP 97-002, P-08A, P-08B, P-97-020, Barometer (Baro needed for each day of data collectior

Quarterly Thermistor QAQC Schedule: **2021** Q1=T97-28, Q2=T96-21, Q3=T96-22, Q4=T96-23; **2022** Q1=T96-12, Q2=T95-15, Q3=T96-05, Q4=T96-10;

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*SEP Thermistor. QAQC: Datalogger & Manual Switchbox w/Ohmmeter readings to be taken within 5 min. of each other

Remember to print QAQC form for Thermistor