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March 2, 2018

Jeff KenKnight
USEPA Region 10
NPDES Compliance Unit, OCE-101
1200 Sixth Avenue
Seattle, WA 98101

Subject: **2017 Annual Data Report**
Long-Term Permafrost and Groundwater Monitoring Program
Red Dog Mine, Alaska

Dear Mr. KenKnight:

Teck Alaska Incorporated is pleased to present the 2017 Annual Data Report for the Long-Term Permafrost and Groundwater Monitoring Program for the Red Dog Mine. This Annual Report is being submitted pursuant to the Consent Decree between the U.S. Environmental Protection Agency (EPA) and Cominco Alaska, Inc. (now Teck Alaska, Incorporated) entered on November 25, 1997 (U.S. v. Cominco Alaska, Incorporated, Civil Action A97-267 CV, U.S. District Court for the District of Alaska). Appendix B of the Consent Decree describes the requirement for the Supplemental Environment Program (SEP) associated with performance of a groundwater study and the establishment of a long-term monitoring program. As described in Appendix B, the Long-Term Monitoring Program represents the culmination of the permafrost and groundwater study associated with the tailing impoundment at the Red Dog Mine.

The monitoring requirements of the 1997 consent decree are included by reference in the State of Alaska Waste Management Permit No. 2016DB0002 and associated Red Dog Mine, Waste Management, Reclamation and Closure Monitoring Plan. As you are aware, efforts are underway with EPA to close the Consent Decree and transfer reporting and enforcement authority to the State of Alaska.

The 2017 Annual Data Report has been prepared in accordance with the Long-Term Permafrost and Groundwater Monitoring Plan (2001) and the Five-Year Permafrost and Groundwater Data Analysis Report (2012). All data collected from site thermistors and piezometers monitored as part of the Program are presented in the report. Please don't hesitate to contact Frank Bendrick at (907) 754-5138 if you have any questions or comments.

Sincerely,
Teck Alaska Incorporated

John Egan

John Egan
Acting General Manager
Red Dog Mine

Teck

Enclosure: via Teck Secure File Transfer Site – Red Dog Mine, Long-Term Permafrost and Groundwater Monitoring Program for the Tailing Impoundment; 2017 Annual Report (2017 Final Annual GW SEP Report.pdf)

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Red Dog Mine
Long-Term Permafrost and Groundwater Monitoring Program for the Tailing Impoundment
2017
Annual Report

March 2018

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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 on November 25, 1997 (US v. Cominco Alaska Incorporated, Civil Action A97-267CV). The Monitoring Program was developed to monitor and predict potential effects of the Tailings Impoundment on permafrost and groundwater in the areas of the tailings Main Dam, Overburden Stockpile, and background locations downgradient of the Tailings Impoundment within the Red Dog Creek and Bons Creek drainages. A specific contract deliverable is the submission of an annual report which includes a data collection summary, a quality assurance and quality control (QA/QC) summary, and a description of the status of the monitoring program.

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 and 2 illustrate the regional setting and layout of the mine and its support facilities. As illustrated on Figure 2, the mine consists of two open pits and support facilities. The open pits are used for the extraction of zinc and lead bearing ore. The support facilities include an ore milling and a concentration facility, an employee housing area, a construction camp, an asphalt paved runway, a power generation facility, and a tailings area. There are approximately 300 acres of waste rock piles and a tailings pond behind two earthen dams. The pond receives drainage from the open pit areas, natural surface run-off, and process waters from the milling operation.

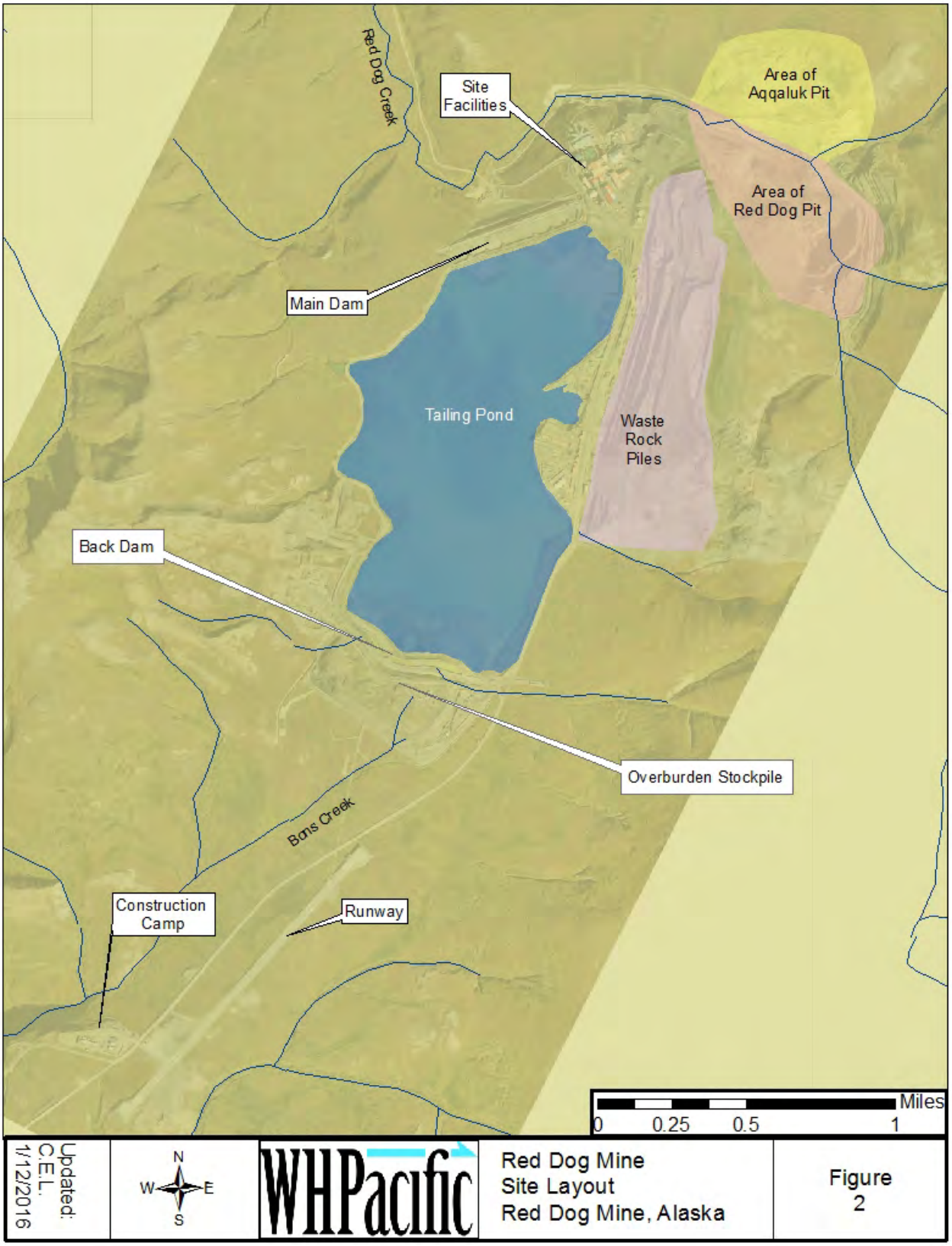
The tailings pond has the potential to affect both permafrost and groundwater in one or more adjacent drainages. To document this, a ground temperature/groundwater level monitoring program began in the mid-1990s as part of the Groundwater Monitoring Supplemental Environmental Project. Results from this project are documented in Water Management Consultants, Inc. (WMCI 2001) report and form the basis for the Long-Term Permafrost and Groundwater Monitoring Plan.

The key elements of the Monitoring Program are:

- The quarterly monitoring of fifteen thermistors at background sites, overburden stockpile, and main dam area;
- The quarterly monitoring of ten piezometers at background sites and main dam area;
- Data reduction, presentation, and management;
- Annual data reporting; and,
- Assessment of data trends on a five year basis.

Figure 1 Red Dog Mine and Vicinity

Figure 2 Red Dog Mine Site Layout



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2017 Data Collection

TAK emailed WHPacific the 2017 project thermistor and piezometer data for data reduction, presentation, and management. The raw data is presented in Appendix A.

Ground temperatures and water levels were monitored beneath the main dam and overburden stockpile for graphical comparison to the background sites.

Thermistor Data

WHPacific plotted the ground temperature measurements collected from the 15 thermistor monitoring locations. The Red Dog Mine thermistor monitoring locations are illustrated on Figure 3 (northern portion), Figure 4 (central portion), and Figure 5 (southern portion).

The ground temperature monitoring data is depicted using two types of graphical plots which are presented in Appendix B, and summarized below:

- Temperature trumpet plot of data for all years (separate color for each year); and
- Temperature trumpet plot of data for 2017.

For each graphic plot, the measurements are presented as auto range and scale limited. The auto range plots represents all measurements which have passed the database QA/QC process described in the Data Management section of this report. For visual clarity, scale limited plots only include data within a limited range and excludes most outliers.

Table 1 Summary of the 2017 Quarterly Thermistor Data Collection

Thermistors	Associated Figure	General Location	Sampling Dates			
			1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
T-96-015	Figure 3	Red Dog Creek	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-95-005	Figure 3	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-96-010	Figure 3	Dam Area	2/5/2017 2 of 24	4/23/2017 1 of 24	8/13/2017 4 of 24	11/26/2017 2 of 24
T-97-028	Figure 3	Dam Area	2/5/2017 2 of 24	4/23/2017 14 of 24	8/13/2017 13 of 24	11/26/2017 15 of 24
T-97-029	Figure 3	Dam Area	2/5/2017 4 of 24	4/23/2017 4 of 24	8/13/2017 6 of 24	11/26/2017 7 of 24
T-97-030	Figure 3	Dam Area	2/5/2017 13 of 24	4/23/2017 2 of 24	8/13/2017 2 of 24	11/26/2017 2 of 24
T-14-110	Figure 4	Tailing Impoundment	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-95-004	Figure 4	Dam area	2/5/2017 2 of 24	4/23/2017 2 of 24	8/13/2017 24 of 24	11/26/2017 23 of 24
T-05-061	Figure 4	Dam area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-95-008 #2	Figure 5	Overburden Stockpile	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-96-013	Figure 5	Overburden Stockpile	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-96-021	Figure 5	Overburden Stockpile	2/5/2017	4/23/2017	8/13/2017	11/26/2017
T-96-022	Figure 5	Overburden Stockpile	2/5/2017 2 of 24	4/23/2017 2 of 24	8/13/2017	11/26/2017 2 of 24
T-96-023	Figure 5	Overburden Stockpile	2/5/2017 8 of 24	4/23/2017 8 of 24	8/13/2017 8 of 24	11/26/2017 9 of 24
T-96-012	Figure 5	Bons Creek	2/5/2017	4/23/2017 1 of 24	8/13/2017	11/26/2017 1 of 24
T-96-012s	Figure 5	Bons Creek	2/5/2017	4/23/2017	8/13/2017	11/26/2017

Note: Dates listed for date of collection, second line, if present, indicates number of nodes out of total number of nodes that were missing. For example first quarter thermistor T-96-010, two of twenty four nodes had no results reported.

Figure 3 Red Dog Mine Long-Term Thermistor and Piezometer Monitoring Locations (Northern portion)

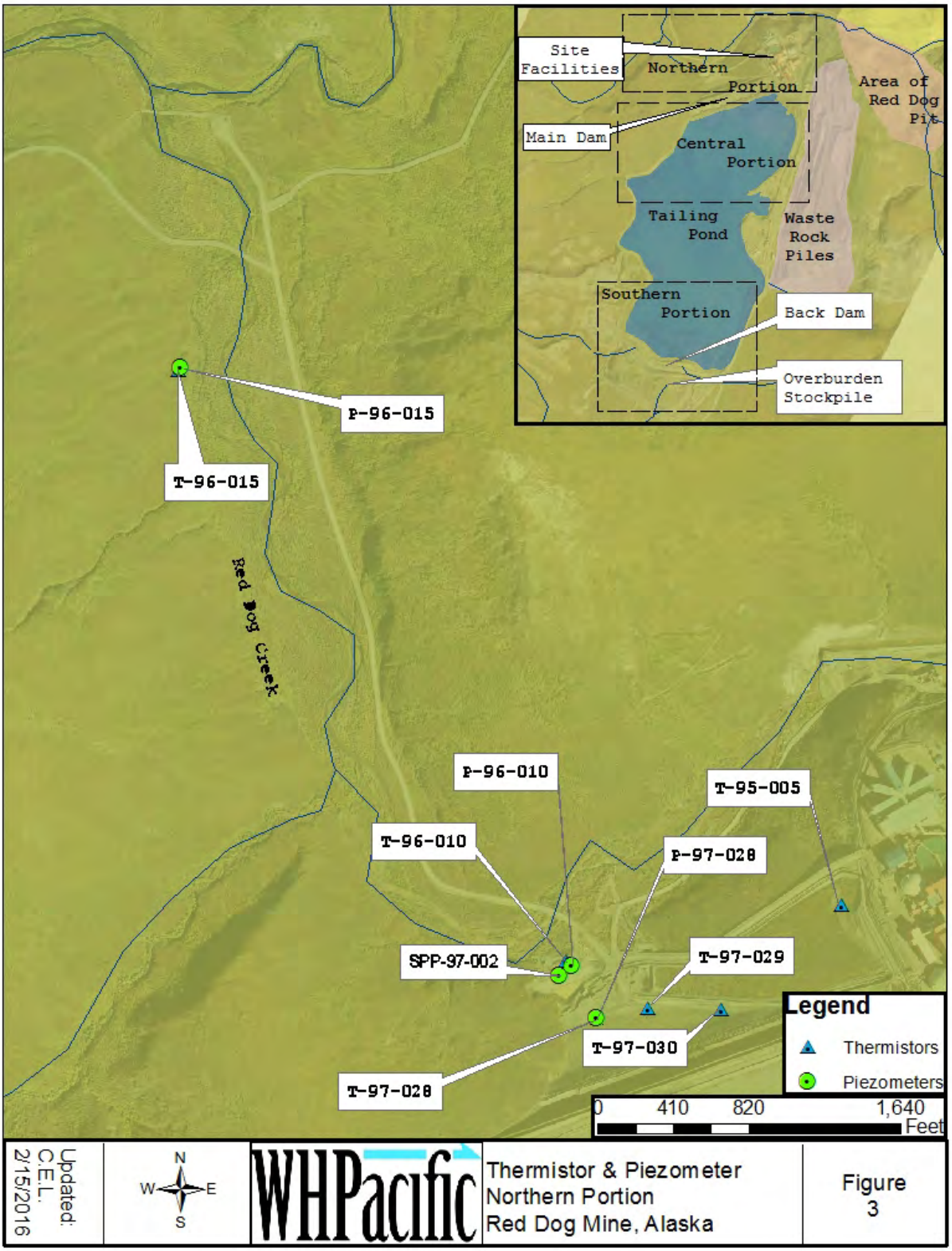


Figure 4 Red Dog Mine Long-Term Thermistor and Piezometer Monitoring Locations (Central portion)

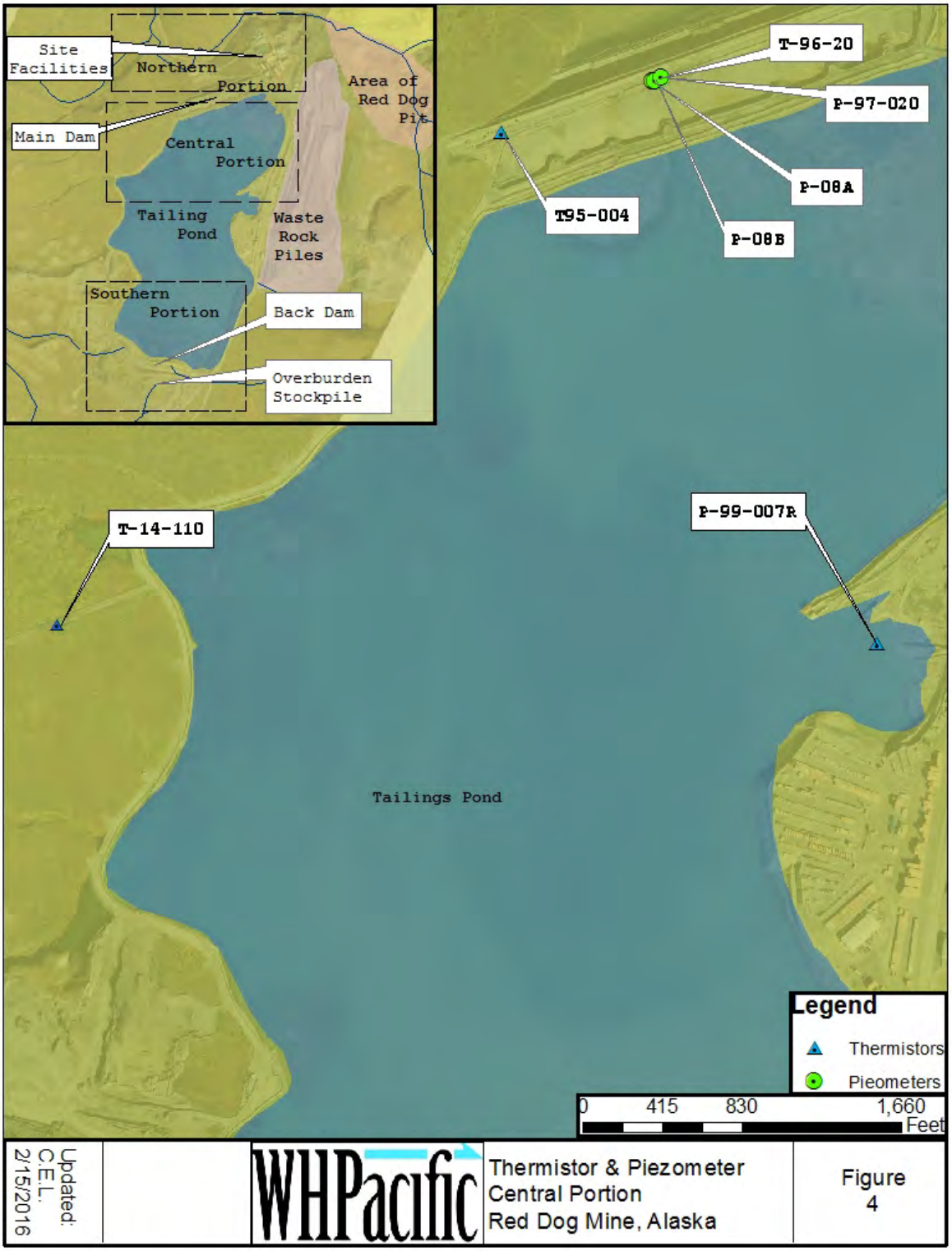
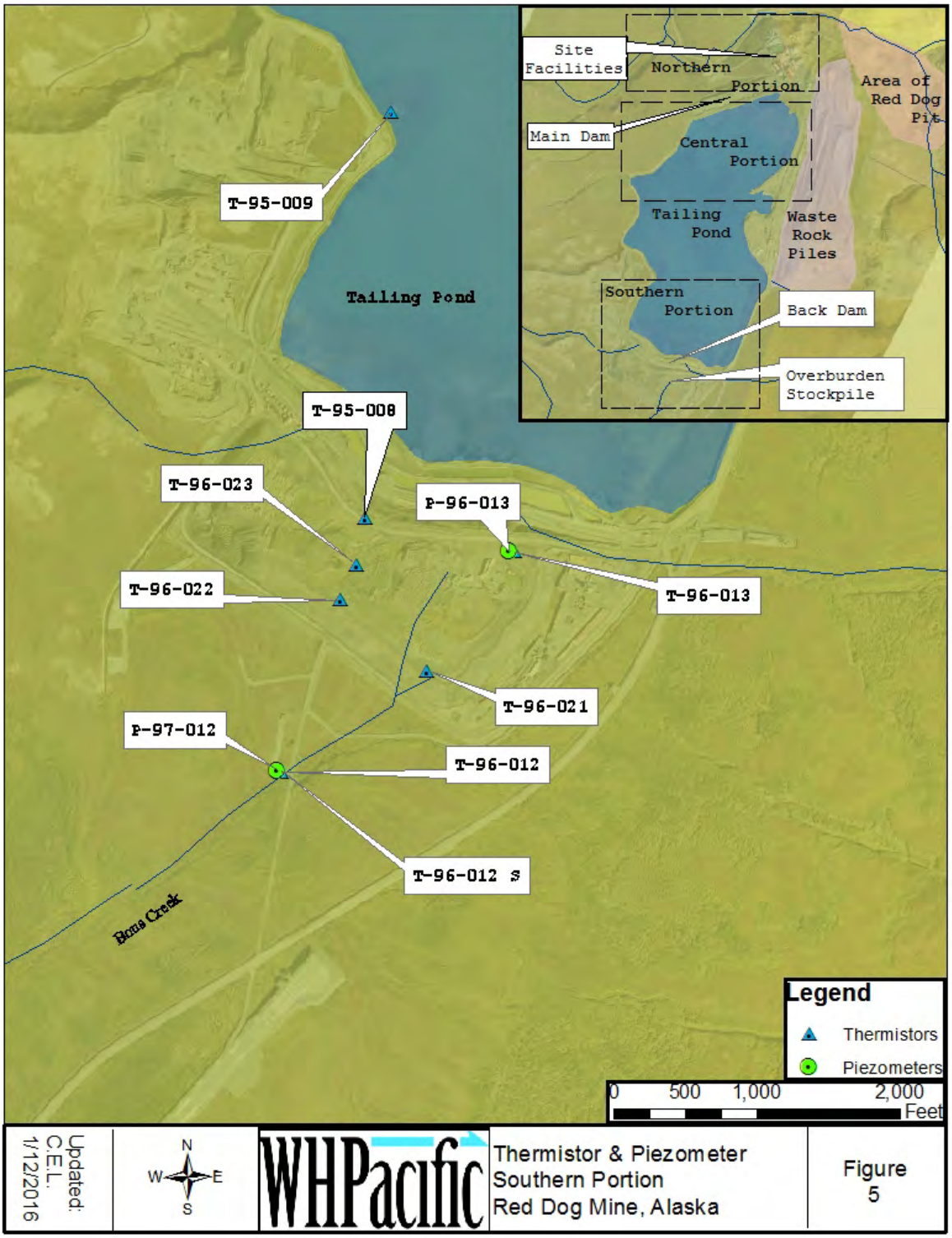


Figure 5 Red Dog Mine Long-Term Thermistor and Piezometer Monitoring Locations (Southern portion)



Piezometer Data

The Red Dog Mine piezometers are illustrated on Figure 3 (northern portion), Figure 4 (central portion), and Figure 5 (southern portion). The 2017 quarterly piezometer data was collected by TAK and submitted to WHPacific which prepared a graphical time series plots of groundwater elevation. This data is presented in Appendix C.

Table 2 Summary of the 2017 Quarterly Piezometer Data Collection

Piezometer	Associated Figure	General Location	Sampling Dates			
			1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
P-96-015	Figure 3	Red Dog Creek	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-96-010	Figure 3	Dam Area	-	4/23/2017	8/13/2017	11/26/2017
P-97-028	Figure 3	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
SPP-97-002	Figure 3	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-08A	Figure 4	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-08B	Figure 4	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-97-020	Figure 4	Dam Area	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-96-013	Figure 5	Overburden Stockpile	2/5/2017	4/23/2017	8/13/2017	11/26/2017
P-97-012	Figure 5	Bons Creek	2/5/2017	4/23/2017	8/13/2017	11/26/2017

Note:

- Hyphen (-) denotes data was not collected

Data Management

The 2017 thermistors and piezometers data collection was performed by TAK personnel in accordance with the Red Dog Mine Long Term Groundwater Monitoring Plan's standard operating procedure (WMCI 2001). This data was provided to WHPacific to update the TAK Red Dog Mine Database. Microsoft Access™ and Excel™ software were used to generate graphical plots of the data.

Data collected from the thermistor cables was measured in resistance as kilo-ohms (kohms) using a Dryden Instrumentation T5KMUK Automated Thermistor String Reader. The measured resistance values were converted to temperature 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. Data was reviewed for errors and omission, and then uploaded to the Red Dog Mine Database.

Ground temperature measurements that were not representative of true measurements (i.e., less than zero (0) kohms or greater than 300 kohms) were deleted before uploading to the Red Dog Mine Database. The deleted values are shaded red in the raw data table presented in Appendix A.

TAK provided WHPacific the piezometer's vibrating wire measurements and barometric pressure measurements collected on-site. The vibrating wire transducer measurements were converted to groundwater elevation using the calibration coefficients, site elevation, and barometric pressure. Calibration of the vibrating wire transducers was determined during installation. The 2017 data was reviewed for errors and omissions and then uploaded to the Red Dog Ming Database.

Summary of Data QA/QC and System OM

Starting in 2017 WHPacific developed and began using a "Quarterly Report Data Checklist", copies of which are included in Appendix D. The Checklist was developed to do a first order review of the data received from TAK. The completed checklists were transmitted to TAK to allow them to make corrections or if possible re-collect missing data. 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. QA/QC measurements for quarterly thermistors and piezometers data are attached in Appendix D.

Thermistor QA/QC

Duplicate measurements were collected from the Dryden Instrumentation T5KMUK data logger and the Dryden Switchbox Fluke multimeter system to ensure repeatability and concurrence with the automated data logger system. Variations in the thermistor measurements were also compared to previously collected data and trends. Thermistor QA/QC data is presented in Table 3.

Table 3 Summary of 2017, QA/QC Thermistors Data Collection

Quarter	Date	Thermistor	Multi-meter Start Time
1st Quarter	2/5/2017	T-96-013	1610 hours
2nd Quarter	4/23/2017	T-95-05	1535 hours
3rd Quarter	8/13/2017	T-96-022	1054 hours
4th Quarter	11/26/2017	T-96-023	1437 hours

Piezometer QA/QC

No piezometer QA/QC reports were received in 2017.

Thermistor System Maintenance

Thermistor measurements indicate that several are malfunctioning and require replacement. Replacement surface connectors have been ordered and are scheduled to be installed in 2018.

Piezometer System Maintenance

Vibrating wire transducers are functioning with few erroneous measurements collected from the sensors. Some of the piezometer wells have pneumatic packers installed in them to separate shallow from deep groundwater zones. It was noted in 2017, the pressure readings in some of these packers were very low so they were re-pressurized with nitrogen.

References

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

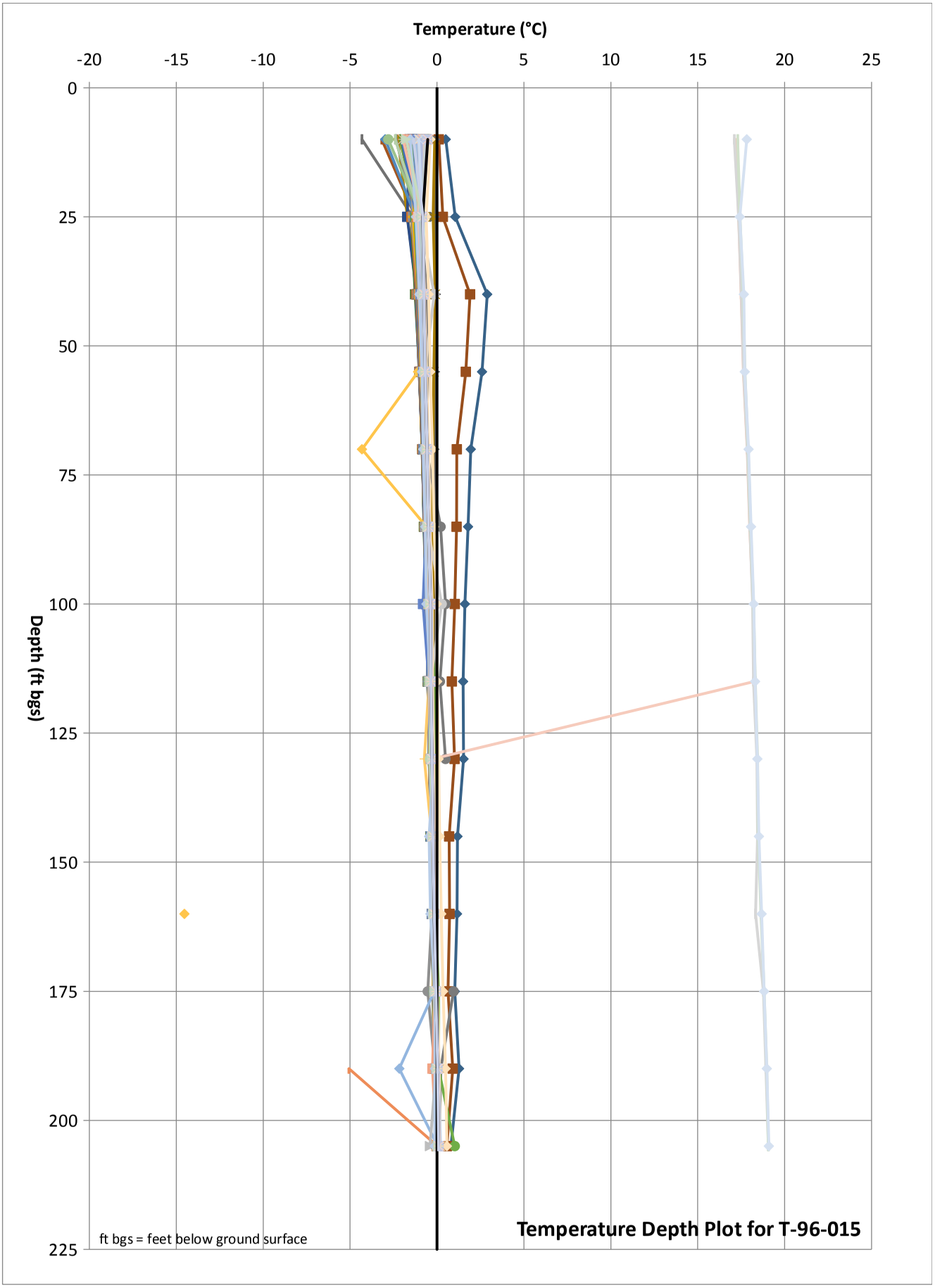
Appendix A
Raw Data

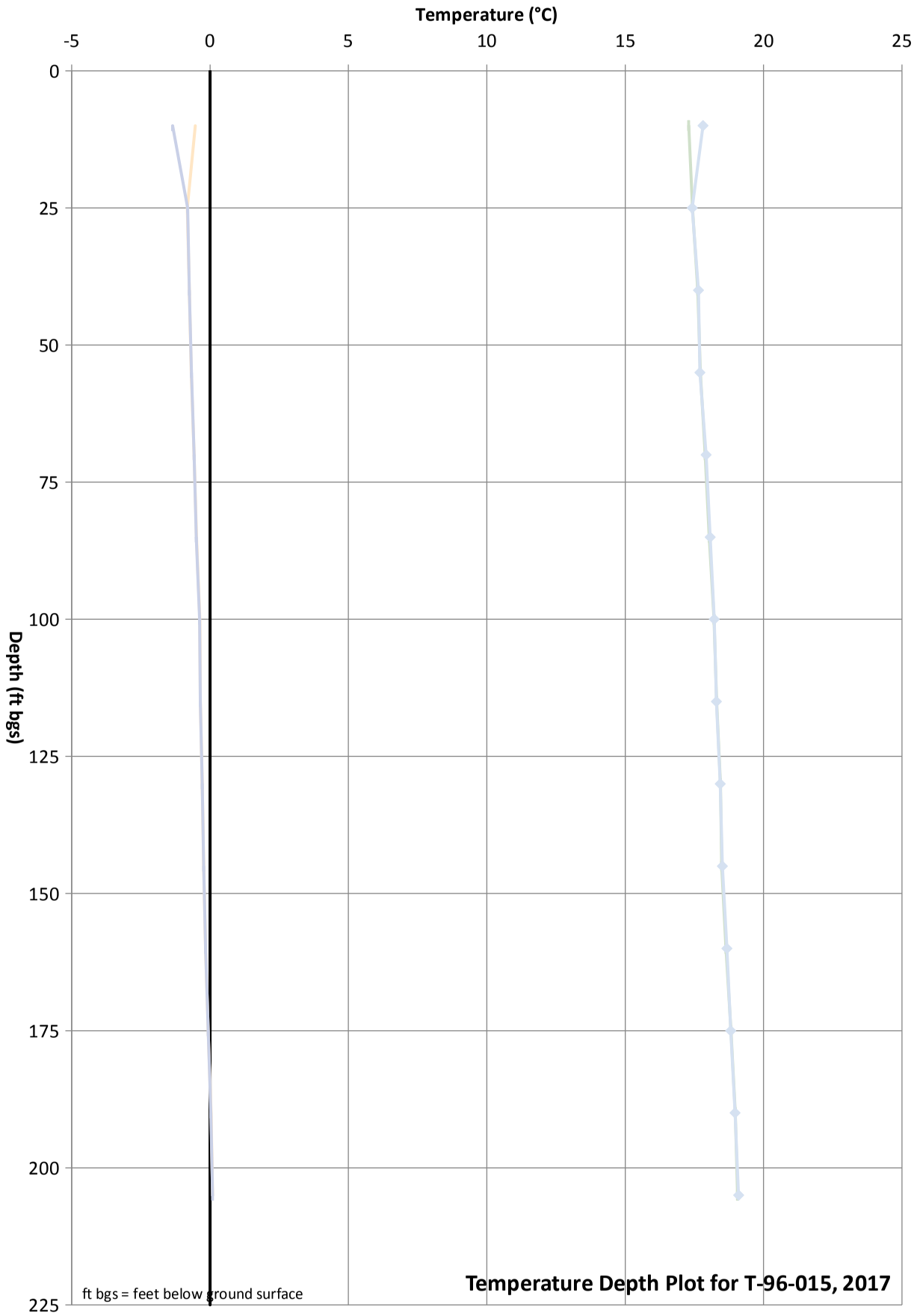
Raw Data Table (Thermistor)

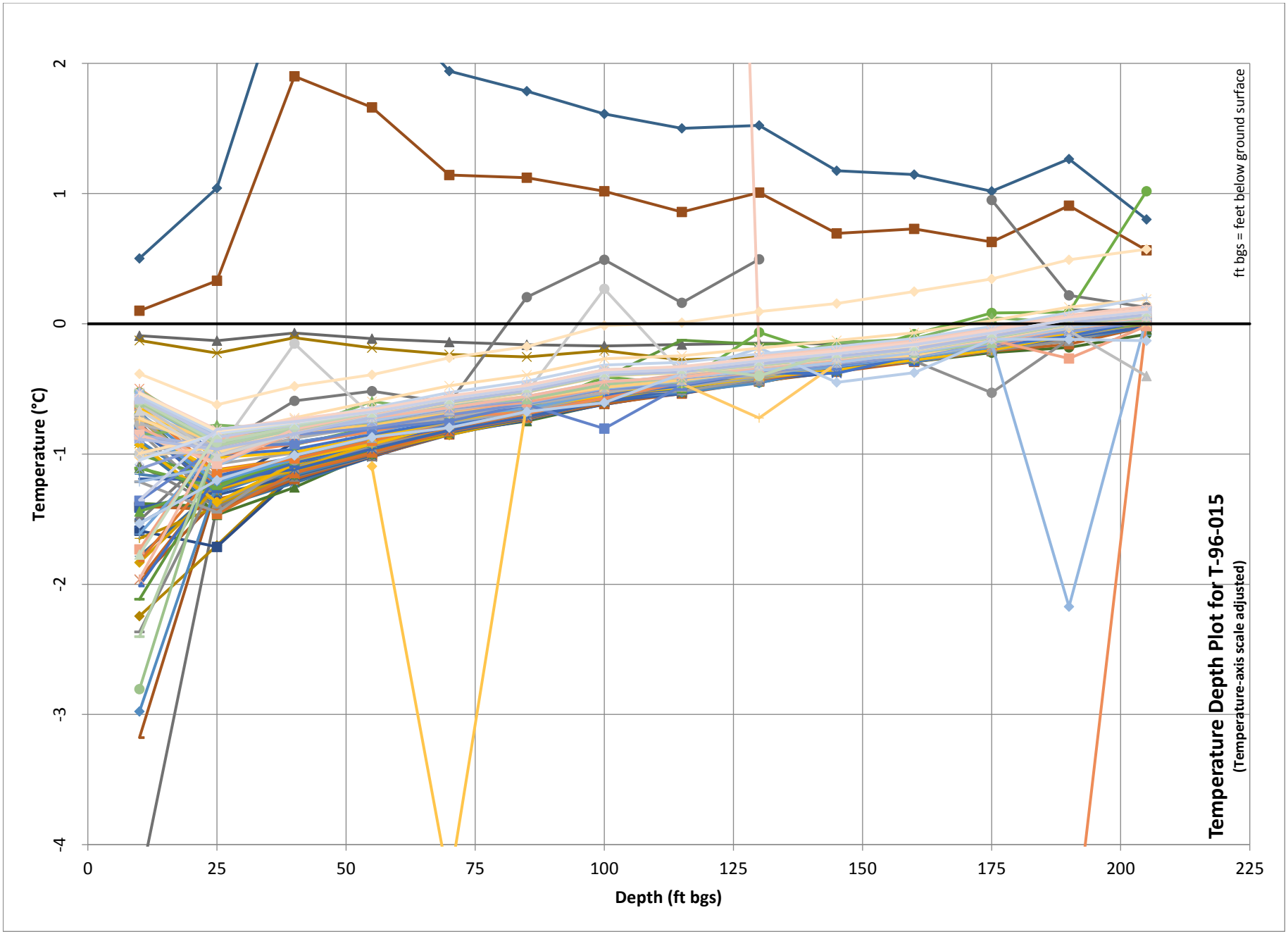
Site ID	Num Therm	Date/Time	pt-01	pt-02	pt-03	pt-04	pt-05	pt-06	pt-07	pt-08	pt-09	pt-10	pt-11	pt-12	pt-13	pt-14	pt-15	pt-16	pt-17	pt-18	pt-19	pt-20	pt-21	pt-22	pt-23	pt-24	pt-25	pt-26
T96-15	14	2/4/17 5:08 PM	16.78	17.00	16.96	16.94	16.83	16.74	16.68	16.60	16.55	16.54	16.44	16.37	16.31	16.26												
T96-15	14	4/23/17 4:17 PM	17.50	16.99	16.96	16.94	16.83	16.75	16.68	16.60	16.56	16.54	16.44	16.37	16.31	16.26												
T96-15	14	8/13/17 12:52 PM	7.06	7.01	6.96	6.95	6.88	6.83	6.79	6.74	6.70	6.70	6.64	6.59	6.55	6.52												
T96-15	14	11/25/17 1:16 PM	6.90	7.02	6.95	6.95	6.87	6.82	6.79	6.74	6.70	6.69	6.63	6.59	6.55	6.51												
T05-61	6	2/4/17 5:59 PM	14.45	14.83	15.78	16.64	16.85	17.22																				
T05-61	6	4/25/17 2:20 PM	6.39	6.36	6.64	6.87	7.02	7.18																				
T05-61	6	8/13/17 3:21 PM	8.00	6.04	5.62	5.55	5.54	5.61																				
T05-61	6	11/25/17 2:00 PM	-161.60	-161.60	-162.20	162.12	161.64	161.64																				
T05-61	6	11/25/17 2:01 PM	5.18	5.78	6.38	6.79	6.96	7.12																				
T95-5	24	2/4/17 6:19 PM	16.18	15.24	16.18	16.30	16.21	16.56	16.53	16.53	16.73	16.68	16.74	16.79	16.84	16.82	16.76	16.69	16.65	16.50	16.38	16.21	16.08	15.65	9999.90	9999.90		
T95-5	24	4/23/17 2:47 PM	6.78	6.46	6.59	6.75	6.79	6.87	16.84	16.87	16.88	16.90	16.91	16.86	16.84	16.82	16.76	16.69	16.65	16.50	16.38	16.20	16.08	15.90	24.92	-1131.00		
T95-5	24	8/14/17 8:20 AM	5.30	6.55	6.53	6.75	6.79	6.82	6.85	6.90	6.92	6.92	6.94	6.90	6.89	6.88	6.84	6.80	6.77	6.68	6.61	6.49	6.40	6.30	6.19	6.08		
T95-5	24	11/25/17 2:12 PM	5.98	6.09	6.59	6.74	6.78	6.86	6.88	6.91	6.91	6.92	6.94	6.90	6.88	6.87	6.83	6.81	6.77	6.68	6.60	6.48	6.41	6.29	6.19	6.08		
T96-10	24	2/4/17 4:36 PM	17.51	16.31	28.49	16.21	16.11	16.07	16.06	15.92	15.91	15.84	16.16	15.70	15.61	16.63	18.96	15.07	15.22	16.53	14.74	-13.78	14.62	14.53	9999.90	9999.90		
T96-10	24	4/23/17 3:57 PM	19.20	16.29	28.66	16.15	16.07	16.03	16.02	15.88	15.88	15.81	16.17	15.68	15.58	16.62	19.04	15.04	15.08	16.29	5.61	-5.35	5.49	5.53	2039.20	15.03		
T96-10	24	8/13/17 1:26 PM	5.37	6.59	14.33	6.46	6.41	6.40	6.38	6.29	6.29	6.24	6.51	6.17	6.11	-5.63	-7.53	5.58	5.85	6.78	5.61	-5.35	5.49	5.54	12.06	-124.70		
T96-10	24	11/28/17 8:32 AM	15.77	16.35	29.39	16.13	16.03	16.00	15.93	15.77	12.30	15.80	16.19	15.62	15.45	16.57	19.38	15.04	15.21	16.58	14.73	-13.76	14.64	14.52	25.34	-822.90		
T97-28	24	2/4/17 3:42 PM	12.41	12.85	12.82	12.92	13.24	13.49	13.51	13.55	13.58	13.63	13.72	13.93	14.21	14.31	14.43	14.59	14.80	14.81	14.96	14.98	15.06	-2003.00	9999.90	9999.90		
T97-28	24	4/23/17 3:07 PM	14.12	-10.28	-10.82	-10.93	-11.08	-11.86	14.61	14.20	-11.33	-12.86	-13.31	14.61	-17.05	15.85	14.99	-23.99	-11.43	15.33	15.25	-10.85	-14.15	15.27	-14.05	-14.34		
T97-28	24	8/13/17 1:44 PM	5.38	-4.44	-3.01	-4.10	-3.37	-2.64	5.46	5.29	-3.47	-4.85	-4.94	5.74	-9.35	-5.96	5.90	-12.42	-3.38	5.93	5.94	-4.17	5.84	6.07	5.85	7.74		
T97-28	24	11/28/17 8:39 AM	4.94	-4.92	5.34	-4.95	-4.31	-3.76	-2.28	-4.04	5.22	-5.01	-5.12	5.76	-9.16	6.48	5.91	5.98	-3.41	6.01	5.94	-3.53	-2.18	-4.98	-2.43	-5.30		
T97-29	24	2/4/17 3:36 PM	13.12	13.66	14.43	14.97	15.30	15.60	15.74	15.81	15.89	15.83	16.04	-14.97	16.18	16.17	16.16	16.12	16.02	15.31	15.94	-14.49	14.67	15.57	9999.90	9999.90		
T97-29	24	4/23/17 3:41 PM	4.50	4.71	5.28	5.66	5.77	6.01	6.14	6.19	6.27	6.29	6.37	-5.53	6.46	6.46	6.45	6.43	6.31	6.11	6.17	-5.06	5.91	5.97	15.19	-20.43		
T97-29	24	8/13/17 1:41 PM	4.94	4.97	5.25	5.47	5.60	7.54	6.03	6.12	6.19	6.24	6.35	-5.50	13.50	-17.30	8.79	-9.87	13.43	6.70	8.01	-5.71	-11.28	6.19	-7.10	10.56		
T97-29	24	11/28/17 8:36 AM	4.84	4.94	5.21	5.42	5.56	7.24	5.96	6.07	6.16	6.22	6.32	-5.57	6.43	6.48	9.92	6.43	-12.11	-9.56	9.61	-6.57	-8.35	9.68	-5.98	-5.54		
T97-30	24	2/4/17 10:49 AM	13.88	-10.81	-13.22	-10.75	-10.87	-12.98	14.61	14.09	-11.08	-12.65	-13.10	14.66	-16.92	15.77	14.94	-23.76	-11.38	15.33	15.24	-11.29	14.48	15.28	9999.90	9999.90		
T97-30	24	4/23/17 3:33 PM	13.54	14.19	14.17	14.05	13.92	13.81	13.76	13.80	13.83	13.89	14.00	14.22	14.48	14.58	14.74	14.89	15.09	15.10	15.22	15.27	15.37	-2794.00	7.09	7.12		
T97-30	24	8/13/17 1:39 PM	4.67	4.77	4.84	4.89	5.00	5.02	4.98	4.99	4.99	5.03	5.09	5.24	5.40	5.35	5.46	5.63	5.78	5.80	5.87	5.87	5.96	-152.30	-150.70	5.92		
T97-30	24	11/25/17 2:18 PM	4.77	4.74	4.72	4.81	4.84	4.90	4.95	5.00	5.02	5.04	5.10	5.25	5.40	5.46	5.57	5.67	5.78	5.79	5.87	5.89	5.95	-152.80	-151.20	5.92		
T95-8 #2	24	2/4/17 8:12 PM	9.23	6.84	6.90	6.96	6.95	6.96	6.95	6.95	7.00	7.00	7.00	6.99	7.00	7.04	7.01	7.04	7.04	7.03	7.05	7.07	7.05	7.07	9999.90	9999.90		
T95-8 #2	24	4/23/17 10:46 AM	9.22	7.03	6.89	6.96	6.96	6.97	6.96	6.95	7.00	7.00	7.01	6.99	7.00	7.04	7.01	7.04	7.04	7.04	7.05	7.06	7.06	7.06	6.71	6.61		
T95-8 #2	24	7/4/17 12:03 PM	4.60	6.96	6.91	6.95	6.95	6.97	6.95	6.94	16.99	16.99	17.01	16.98	17.00	17.06	17.01	17.05	17.06	17.05	17.07	17.10	17.09	17.09	17.15	17.18		
T95-8 #2	24	11/25/17 11:58 AM	16.41	16.78	16.82	16.92	16.91	16.93	16.89	16.88	16.94	16.94	16.88	16.85	16.74	16.80	16.62	16.64	16.49	16.48	17.04	17.07	17.04	17.04	17.05	17.07		
T96-13	24	2/4/17 8:29 PM	8.44	6.38	6.09	6.73	6.84	6.91	7.04	6.99	7.05	7.08	7.12	7.14	7.77	7.75	7.48	7.13	7.14	7.03	7.98	6.91	6.86	6.78	9999.90	9999.90		
T96-13	24	4/23/17 10:35 AM	3.30	7.76	8.62	8.12	7.44	7.29	7.77	8.09	8.20	8.04	7.77	7.53	7.27	6.99	6.77	6.64	6.56	6.49	6.40	6.35	6.27	6.20	16.91	16.98		
T96-13	24	8/13/17 9:10 AM	3.44	7.12	6.23	6.72	6.83	6.91	7.04	6.98	7.04	7.07	7.12	7.15	7.83	7.82	7.49	7.12	7.15	7.03	8.03	6.91	6.85	6.78	6.72	6.60		
T96-13	24	11/25/17 11:27 AM	15.29	16.23	15.78	16.57	16.75	16.86	17.09	16.98	17.08	17.12	17.19	17.23	18.38	18.38	16.99	17.20	17.23	17.05	18.70	16.86	16.77	16.65	16.55	16.39		
T96-21	24	2/4/17 7:41 PM	22.46	20.50	16.98	14.80	13.82	13.89	13.55	13.70	13.90	14.21	14.46	14.84	15.25	15.68	15.89	16.17	16.50	16.62	16.68	16.78	16.83	16.87	9999.90	9999.90		
T96-21	24	4/24/17 1:22 PM	3.48	7.72	7.10	6.08	5.36	5.23	13.26	13.23	13.75	14.03	14.37	14.76	15.16	14.64	15.85	16.16	16.51	16.63	16.69	16.79	16.84	16.88	9999.90	9999.90		
T96-21	24	7/4/17 11:34 AM	-0.13	1.67	3.30	4.64	5.31	5.62	5.21	5.08	5.06	5.19	5.36	5.59	5.83	6.10	6.25	6.44	6.68	6.76	6.80	6.86	6.89	6.92	6.94	6.98		
T96-21	24	11/25/17 11:36 AM	33.32	16.56	13.91	13.05	12.94	13.43	13.36	13.59	13.77	14.00	14.20	14.54	14.97	15.40	15.67	15.99	16.38	16.47	16.29	16.73	16.84	16.88	16.92	16.99		
T96-22	24	2/4/17 7:45 PM	24.80	19.80	9999.90	14.81	14.17	14.20	14.65	15.18	15.74	16.15	16.52	16.71	16.77	16.83	9999.90	16.94	17.06	17.02	17.08	17.11	17.12	17.19	9999.90	9999.90		
T96-22	24	4/24/17 1:25 PM	13.21	18.59	9999.90	15.61	14.87	14.69	14.94	15.26	15.73	16.12	16.49	16.71	16.77	16.83	9999.90	16.94	17.06	17.02	17.08	17.10	17.12	17.19	-6.72	7.17		
T96-22	24	7/4/17 11:40 AM	-0.01	2.08	160.75	5.59	5.90	5.84	5.81	5.82	6.04	6.20	6.61	6.81	6.85	6.89	161.70	6.96	7.02	7.01	7.03	7.06	7.06	7.11	5.36	7.15		
T96-22	24	11/25/17 11:38 AM	33.29	16.98	9999.90	14.13	14.11	14.51	15.02	15.42	15.85	16.14	16.44	16.69	16.75	16.81	9999.90	16.92	17.03	16.99	17.06	17.08	17.09	17.17	14.33	17.25		
T96-22	24	11/25/17 11:39 AM	33.31	16.98	9999.90	14.13	14.11	14.51	15.02	15.42	15.84	16.14	16.44	16.69	16.75	16.81	9999.90	16.92	17.03	16.99	17.06	17.08	17.09	17.17	14.32	17.25		
T96-23	24	2/4/17 8:14 PM	161.62	161.62	7.36	6.42	6.12	6.23	6.29	6.45	-4.46	-5.92	6.70	6.86	6.88	6.94	-6.25	-5.67	-6.20	-6.50	7.07	7.09	6.96	-5.89	9999.90	9999.90		
T96-23	24	4/24/17 1:26 PM	161.40	161.40	7.21	6.67	6.48	6.45	6.46	6.60	-4.40	-5.93	6.73	6.86	6.87	6.94	-6.06	-5.59	-6.10	-6.48	7.07	7.10	6.96	-5.79	6.37	6.28		
T96-23	24	7/4/17 11:45 AM	161.54	161.70	1.27	2.12	5.19	5.66	5.70	6.03	-4.23	-5.44	6.44	6.85	6.88	6.93	-5.98	-5.45	-5.50	-6.23	7.06	7.09	6.92	-5.59	-6.71	7.18		
T96-23	24	11/25/17 11:41 AM	9999.90	9999.90	16.09	14.81	15.01	15.20	15.32	15.68	-13.15	-14.50	16.31	16.24	16.84	16.84	-15.17	-14.39	-14.72	16.24	17.11	17.15	16.65	-14.36	-16.24	17.27		
T96-12	24	2/4/17 8:44 PM	6.75	6.87	7.01	7.08	7.13	7.14	7.16	7.18	7.17	7.16	7.17	7.12	7.05	7.05	6.97	6.93	6.88	6.79	6.70	6.61	161.63	6.46	9999.90	9999.90		
T96-12	24	4/23/17 10:23 AM	17.54	16.73	16.98	17.07	17.15	17.19	17.21	17.24	17.22	17.19	17.22	17.13	17.03	17.04	16.91	16.84	16.77	16.63	16.50	16.34	9999.90	16.11	9999.90	9999.90		
T96-12	24	8/13/17 8:40 AM	2.75	3.22	2.92	3.50	4.13	6.25	6.83	6.89	6.88	6.93	6.93	6.92	6.90	6.89	6.90	6.92	6.95	6.97	6.97	6.98	6.99	7.02	7.01	7.01		
T96-12	24	11/25/17 12:03 PM	10.51	10.72	10.79	10.92	10.96	11.13	11.11	11.20	11.16	11.08	11.25	11.11	10.98	11.09	11.00	10.87	10.73	10.70	10.64	10.29	436.17	11.60	11.67	11.49		
T96-12	24	2/4/17 8:45 PM	12.45	11.89	12.38	10.45	8.90	7.31	6.65	6.67	6.71	6.79	6.81	6.84	6.85	6.85	6.88	6.91	6.95	6.97	6.97	6.98	7.01	7.04	9999.90	9999.90		
T96-12s	24	4/23/17 10:24 AM	15.00	17.80	18.67	18.44	18.63	18.03	17.34	16.83	16.67	16.71	16.73	16.74	16.77	16.77	16.81	16.85	16.91	16.95	16.95	16.98	17.01	17.06	15.85	15.54		
T96-12s	24	8/13/17 8:41 AM	6.76	6.93	6.99	7.06	7.11	7.14	7.15	7.18	7.16	7.15	7.16	7.11	7.05	7.05	6.97	6.93	6.88	6.80	6.70	6.61	161.48	6.45	6.36	6.28		
T96-12s	24	11/25/17 12:04 PM	31.86	32.59	24.47	15.01	12.53	12.11	12.19	12.23	12.13	12.18	12.29	12.52	13.11	13.22	13.34	13.45	12.95	12.96	12.94	12.96	12.76	12.70	12.84	12.83		
T95-4	24	2/4/17 6:43 PM	13.98	15.03	15.64	16.02	16.26	-5795.00	16.64	16.82	17.05	16.89	17.07	17.11	17.14	17.08	17.03	16.96	16.81	16.74	16.57	16.45	16.15	9999.90		9999.90		
T95-4	24	4/25/17 2:17 PM	14.77	15.00	15.44	15.72	6.46	-88.48	6.43	6.71	6.55	6.83	6.91	6.76	6.98	6.80	6.89	6.76	6.85	6.80	6.63	6.38	6.34	-154.00	9999.90	9999.90		
T95-4	24	8/13/17 3:45 PM	-1.92	-1.37	-7.04	-7.43	-7.00	-12.05	-8.33	-8.56	-7.05	-7.61	-7.42	-8.24	-7.93	-7.39	-7.58	-7.21	-6.68	-7.45	-6.65	-7.76	-7.15	-13.57	-7.57	-8.62		
T95-4	24	11/28/17 8:47 AM	13.47	-10.78	-9.39	-8.40	-7.62	-14.37	-10.12	-8.65	-7.12	-7.35	-7.05	-7.74	-7.47	-11.89	-13.83	-11.99	-3.63	-5.08	-9999.00	-9.23	-7.43	-13.02	-7.04	-8.13		

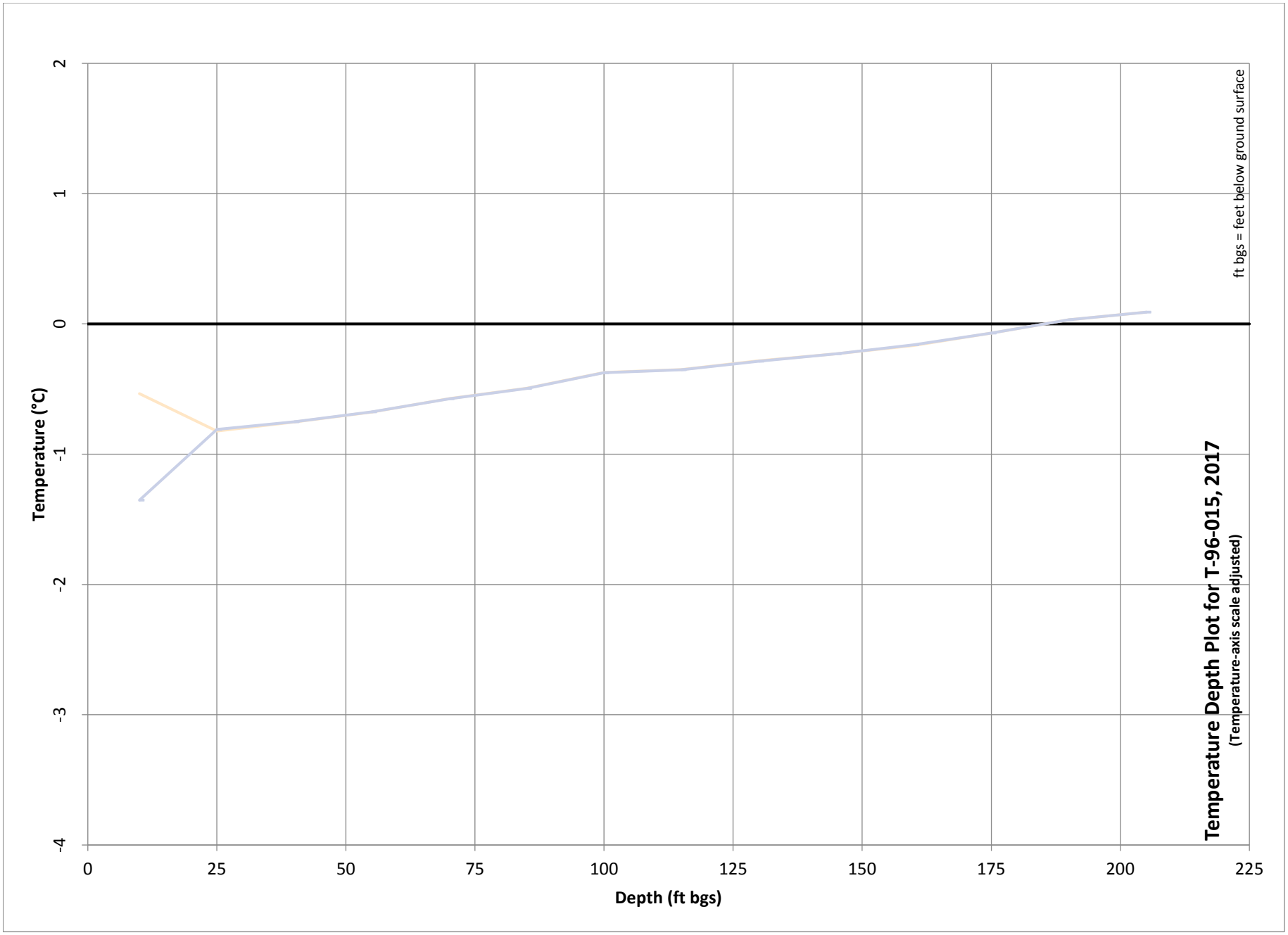
Note:
Num of Therms = total number of thermistors at each site
Date/Time = mm-dd-yy hh:mm
Measurements are shown in kohms
Red highlighted data represent measurements that are outside of database criteria and omitted from the database.

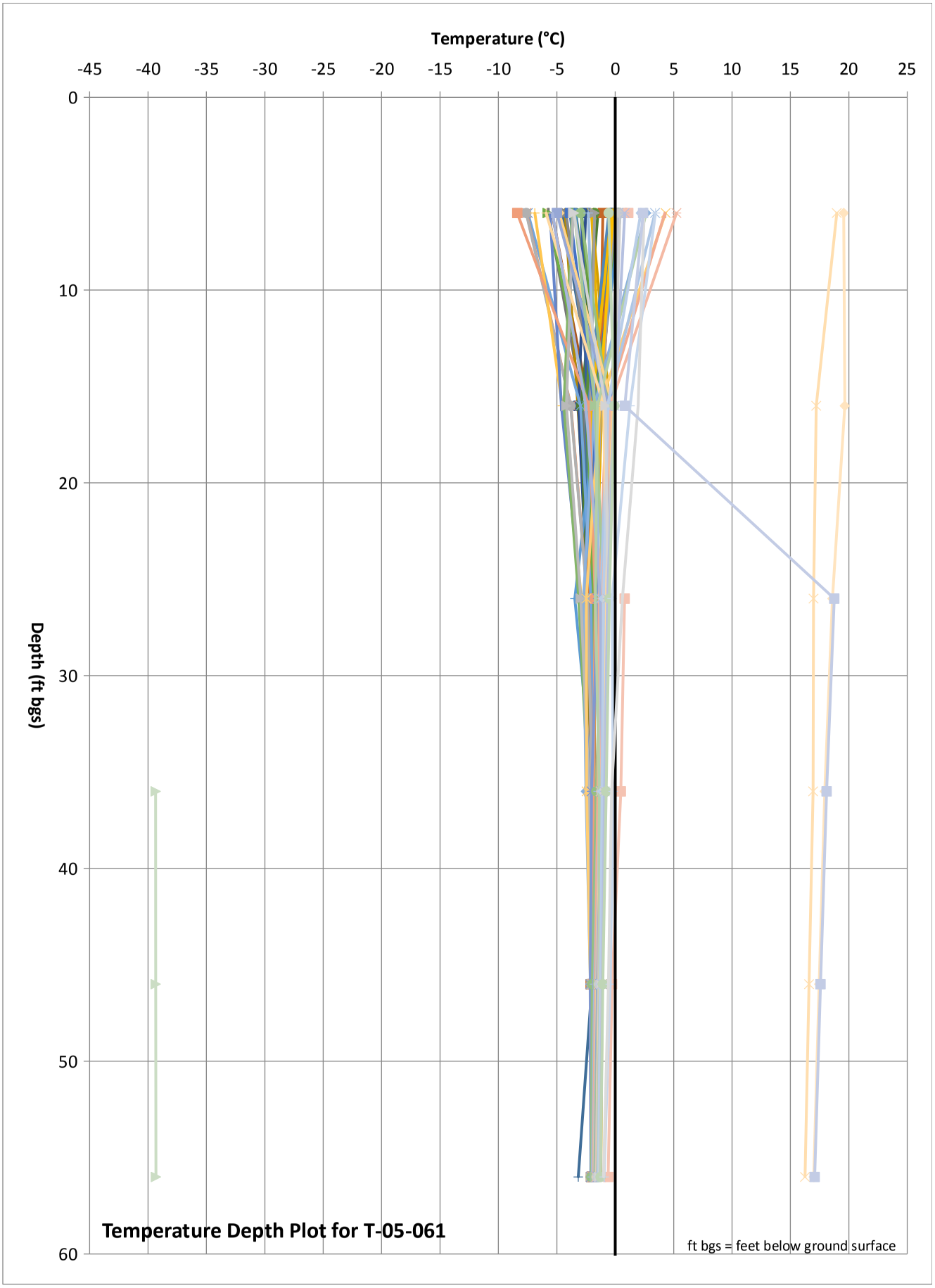
Appendix B
Thermistor Plots

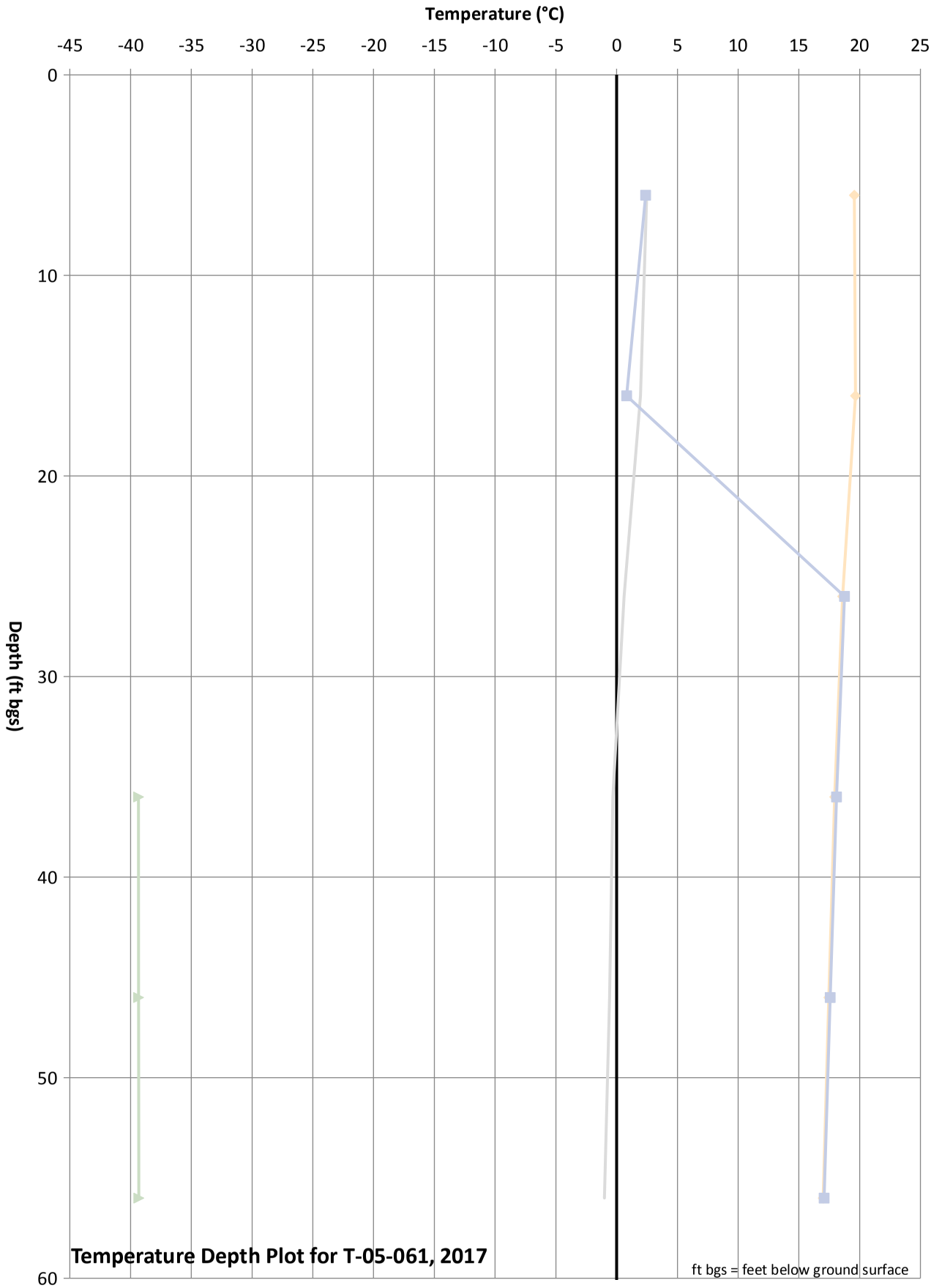

Temperature (°C)
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
ft bgs = feet below ground surface
Temperature Depth Plot for T-96-015

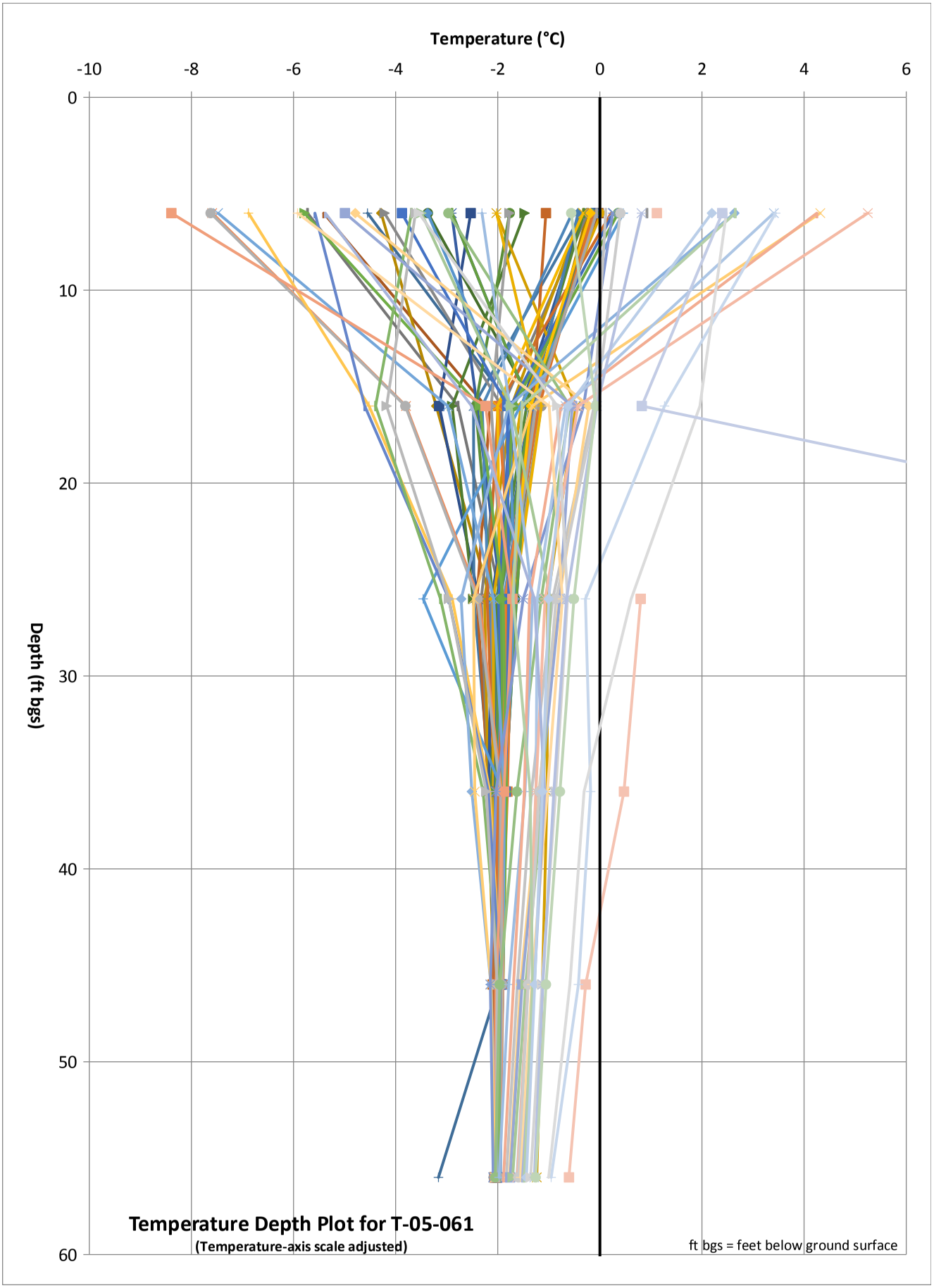

Temperature (°C)
-5
0
5
10
15
20
25
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
ft bgs = feet below ground surface
Temperature Depth Plot for T-96-015, 2017

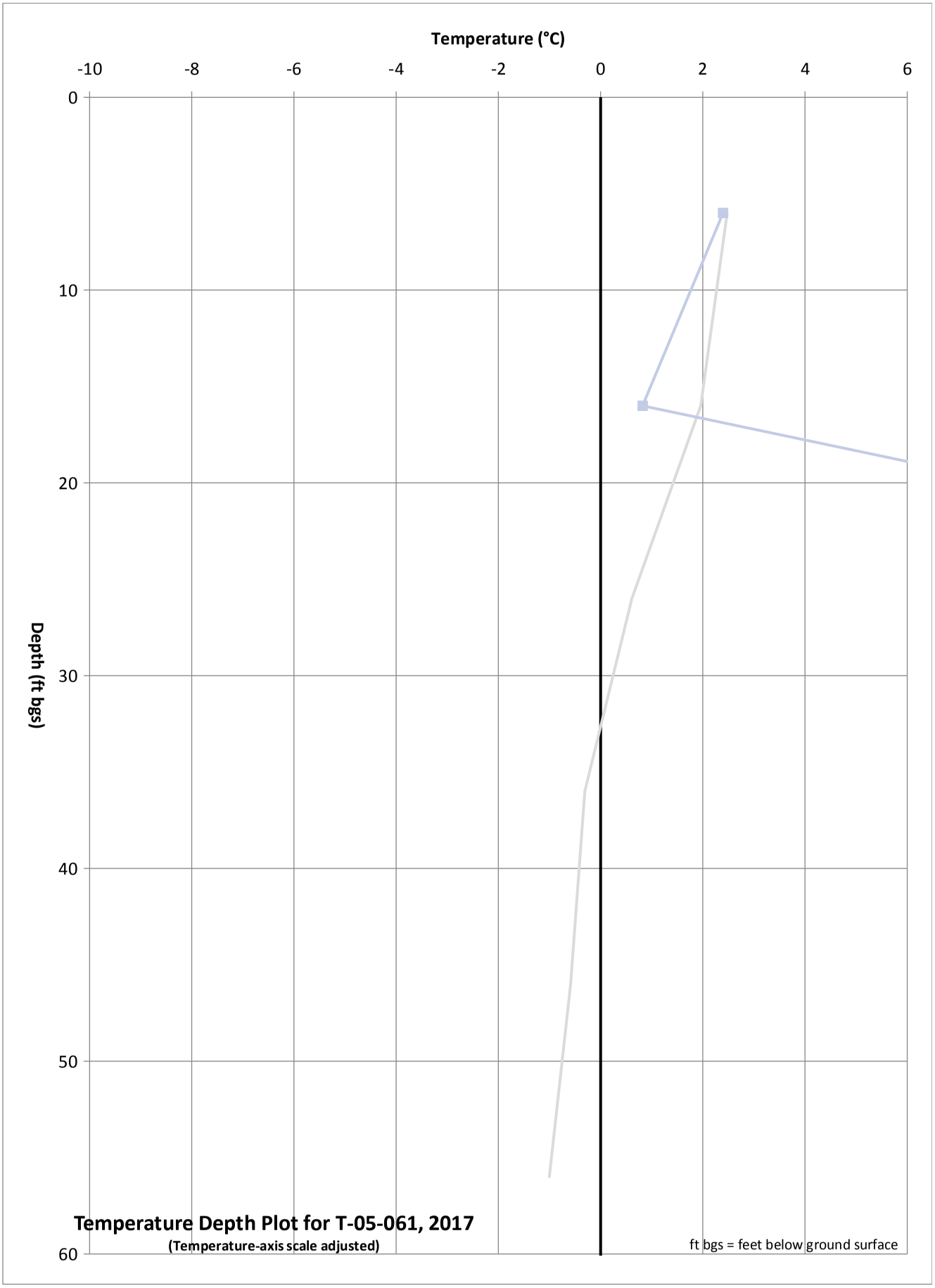

Temperature Depth Plot for T-96-015
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface
Temperature (°C)
2
1
0
-1
-2
-3
-4
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225

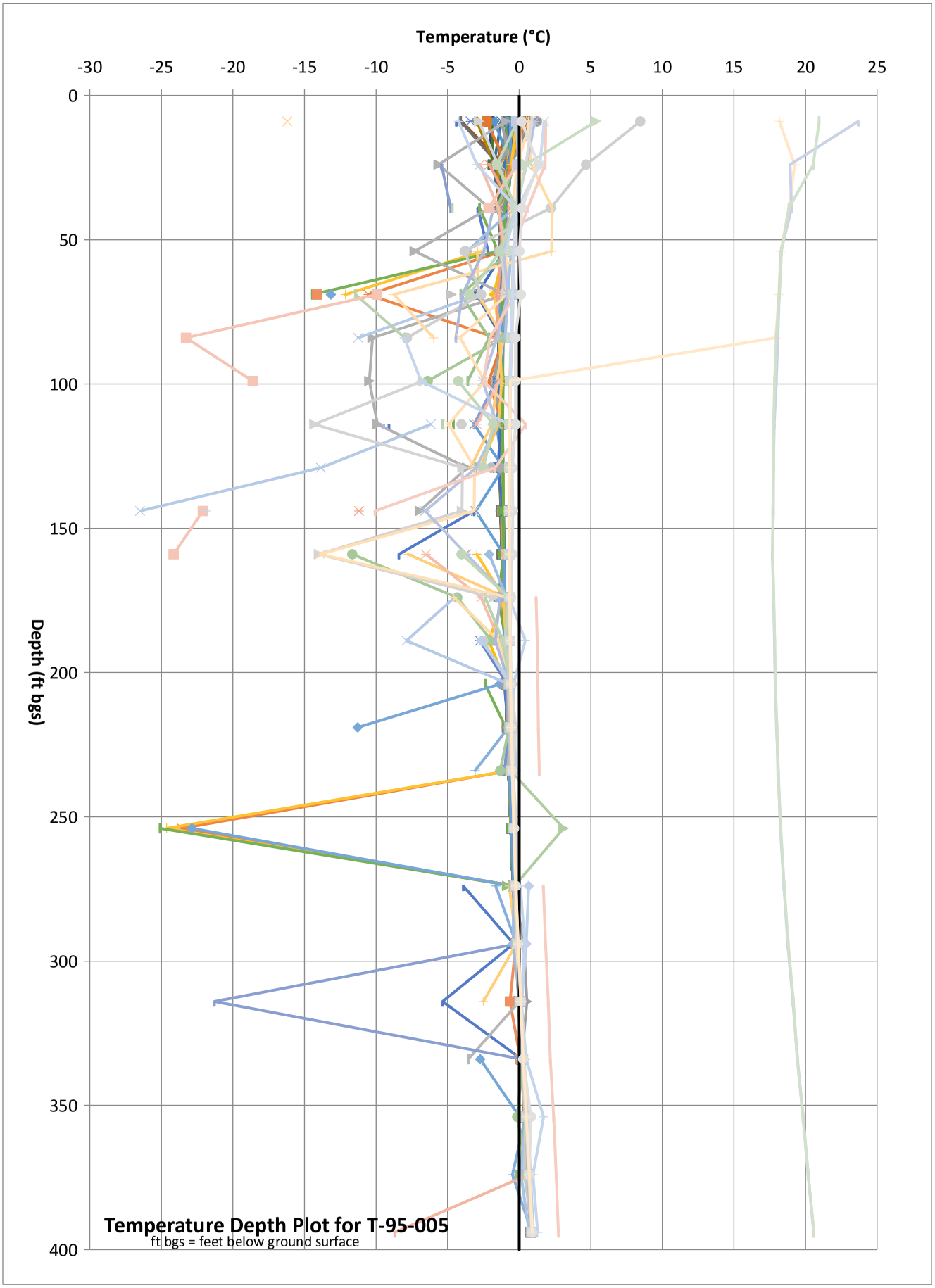

Temperature Depth Plot for T-96-015, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface
Temperature (°C)
2
1
0
-1
-2
-3
-4
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225

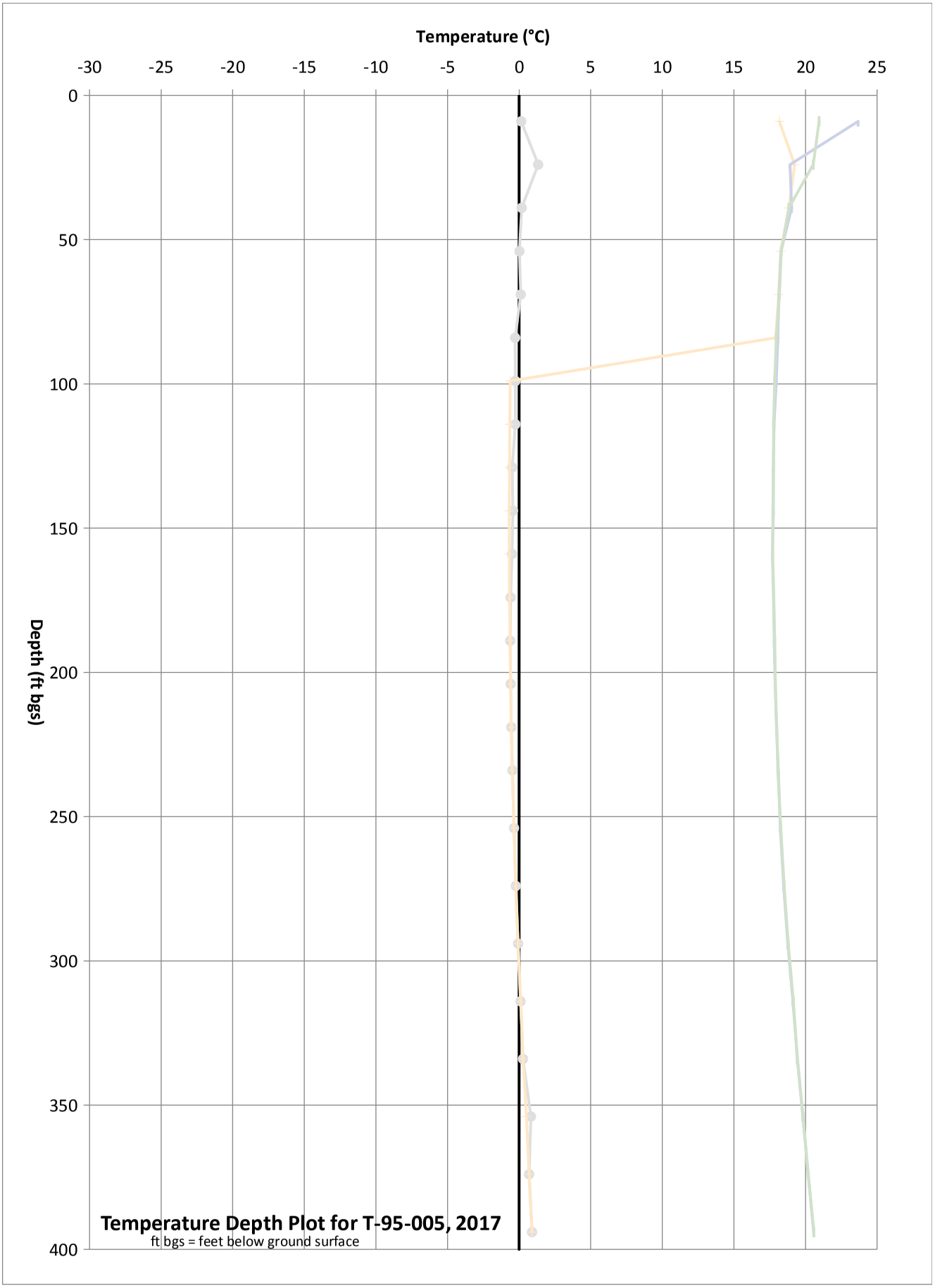

Temperature (°C)
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
10
20
30
40
50
60
Temperature Depth Plot for T-05-061
ft bgs = feet below ground surface

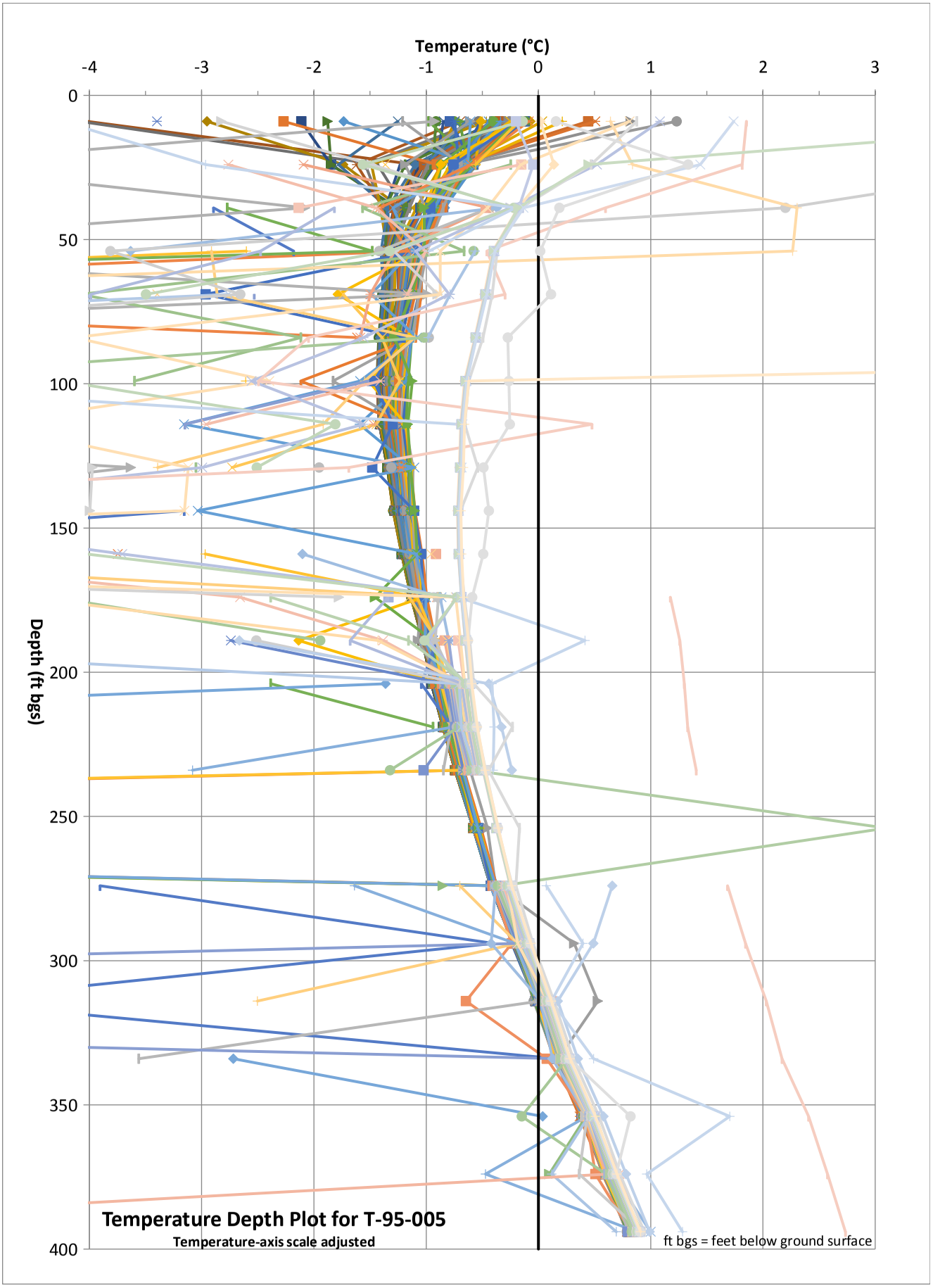

Temperature (°C)
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
10
20
30
40
50
60
Temperature Depth Plot for T-05-061, 2017
ft bgs = feet below ground surface

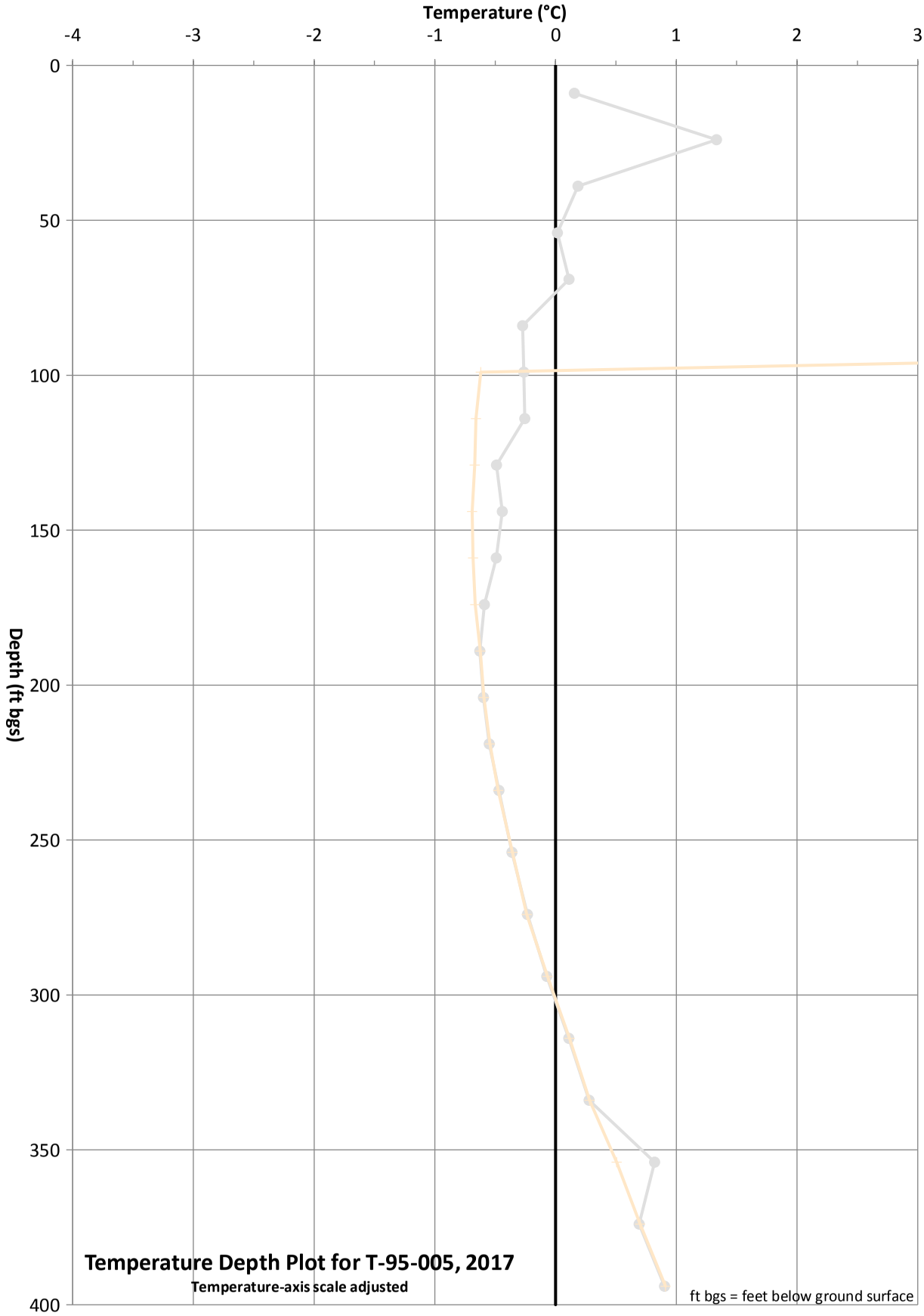

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
0
10
20
30
40
50
60
Depth (ft bgs)
Temperature Depth Plot for T-05-061
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

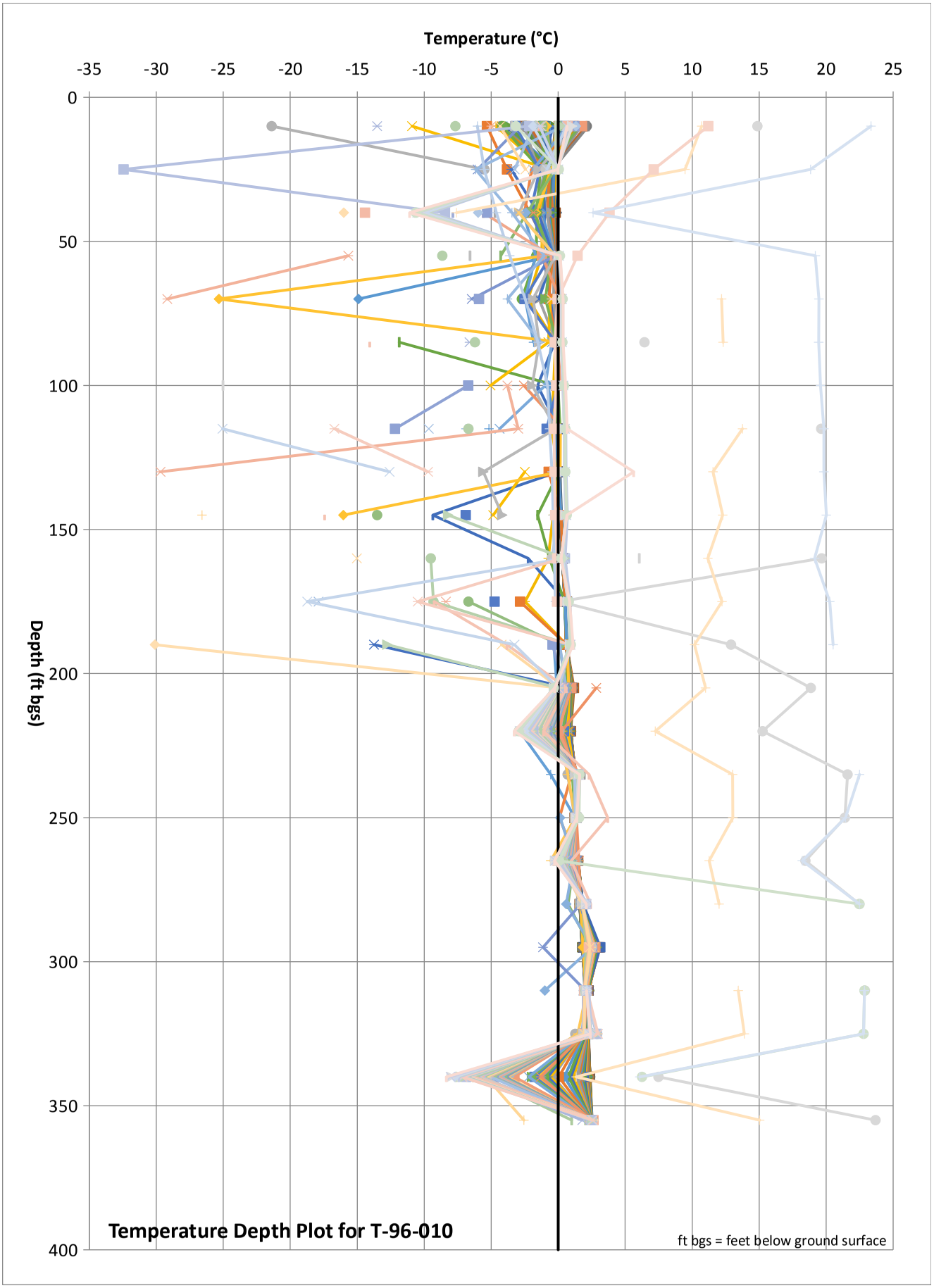

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
0
10
20
30
40
50
60
Depth (ft bgs)
Temperature Depth Plot for T-05-061, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

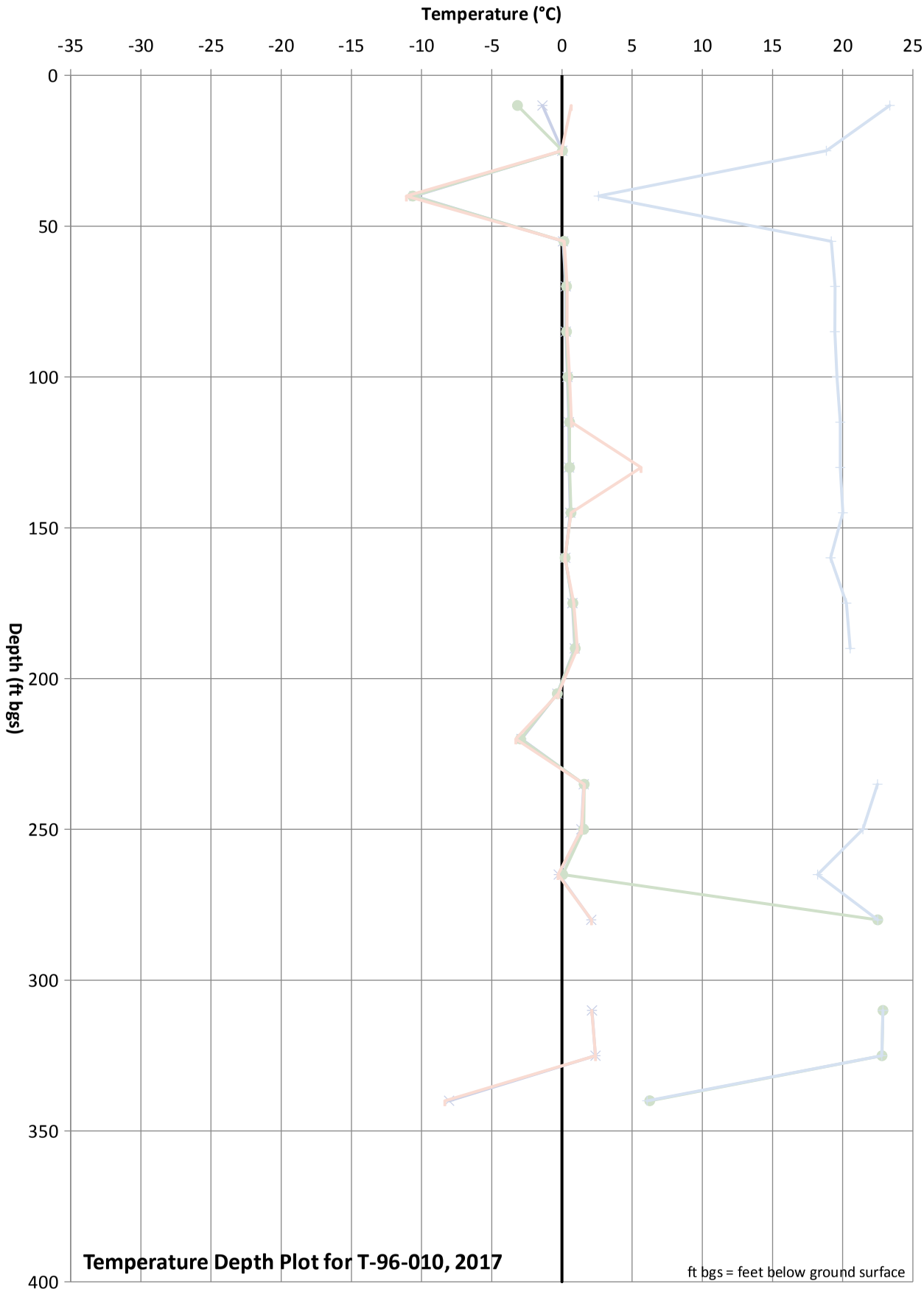

Temperature (°C)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-95-005
ft bgs = feet below ground surface

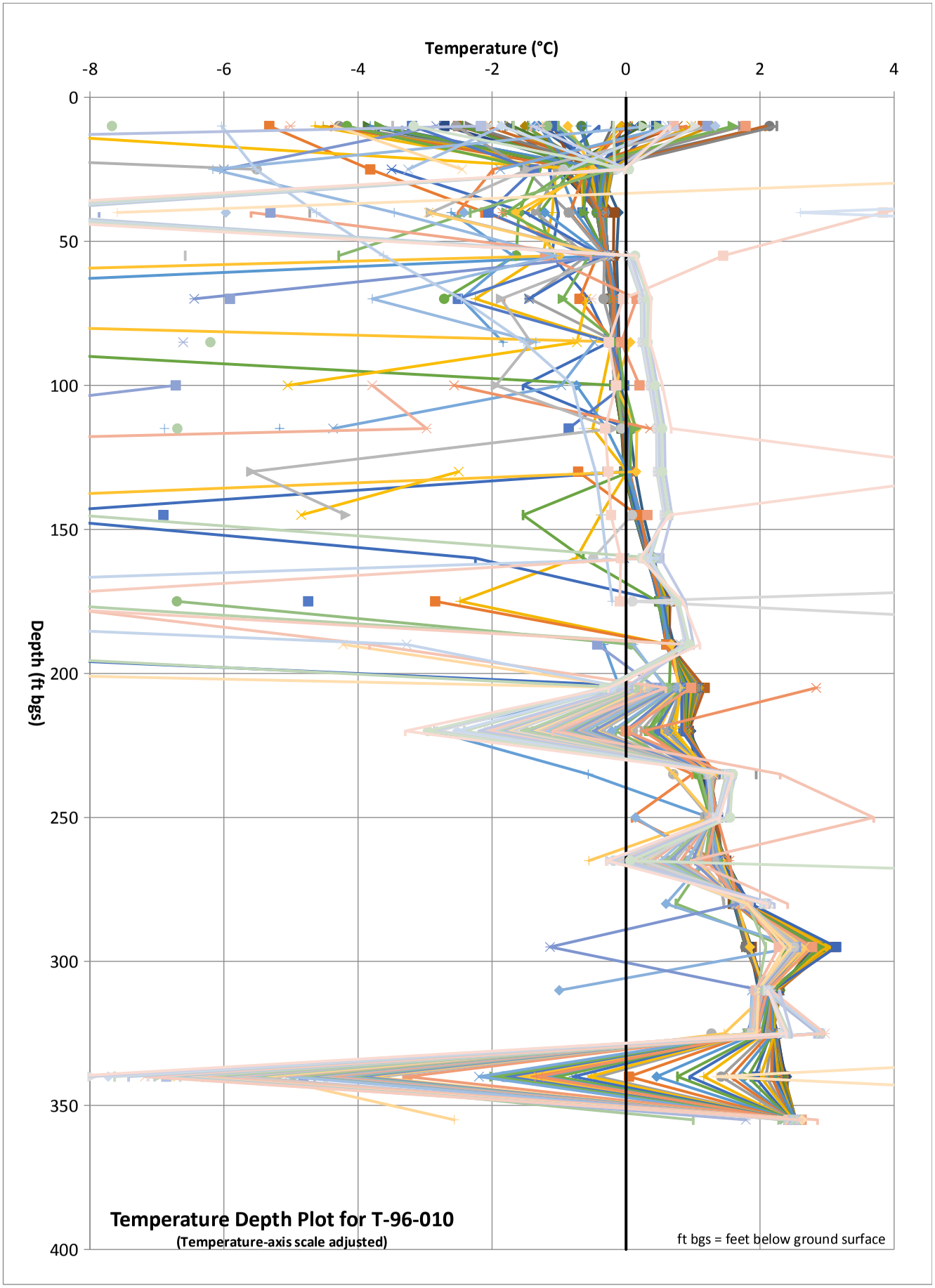

Temperature (°C)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-95-005, 2017
ft bgs = feet below ground surface

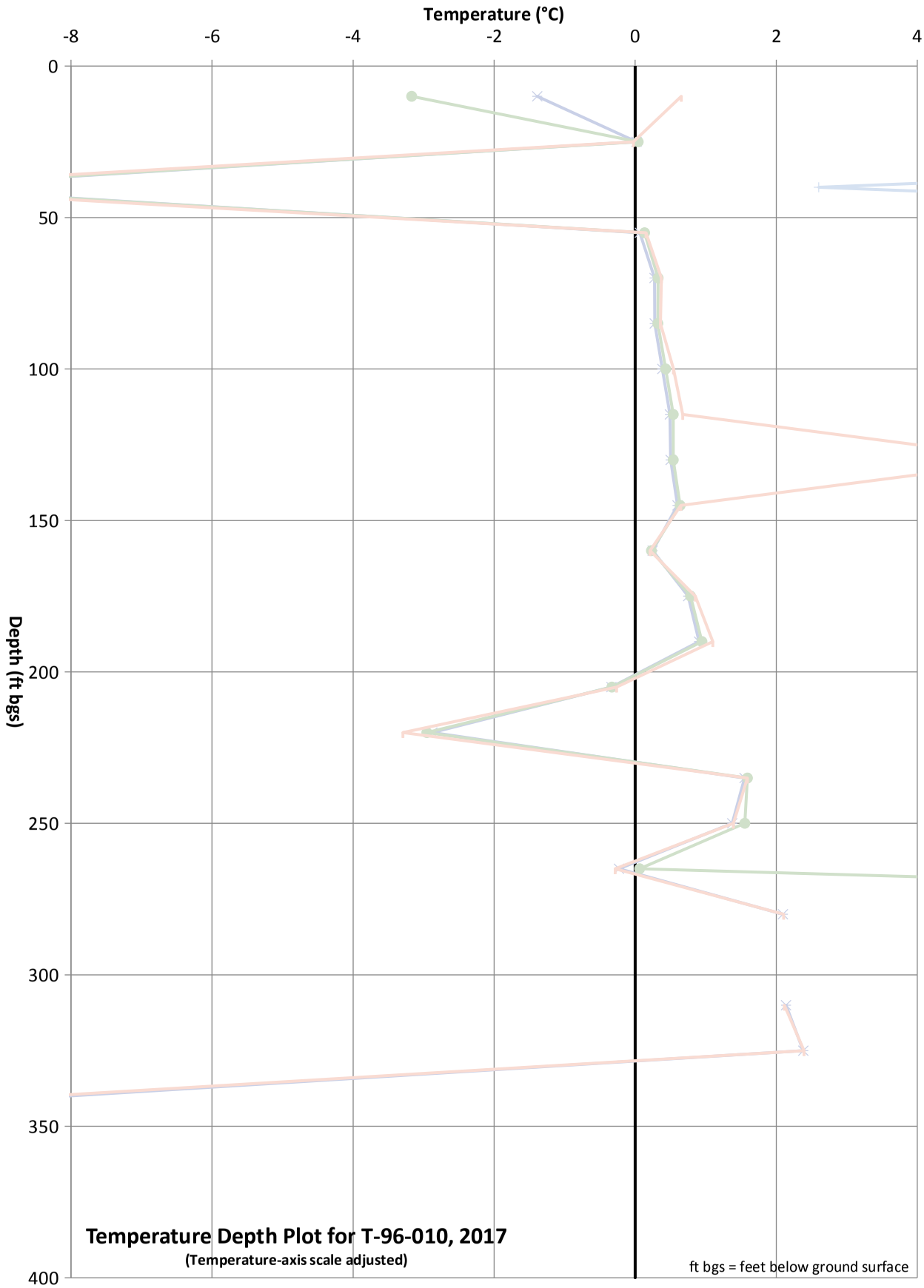

Temperature (°C)
-4
-3
-2
-1
0
1
2
3
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-95-005
Temperature-axis scale adjusted
ft bgs = feet below ground surface

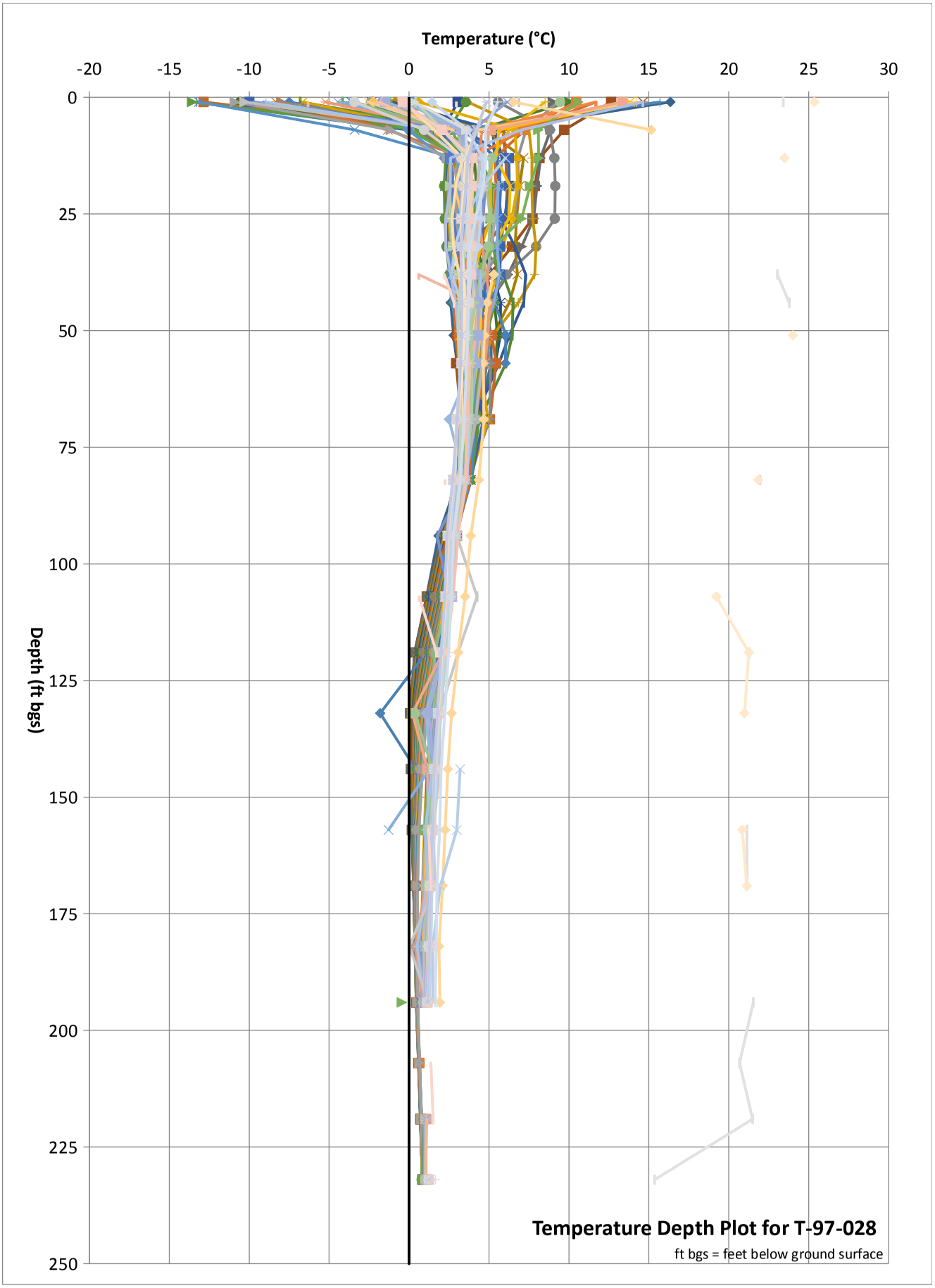

Temperature (°C)
-4
-3
-2
-1
0
1
2
3
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-95-005, 2017
Temperature-axis scale adjusted
ft bgs = feet below ground surface

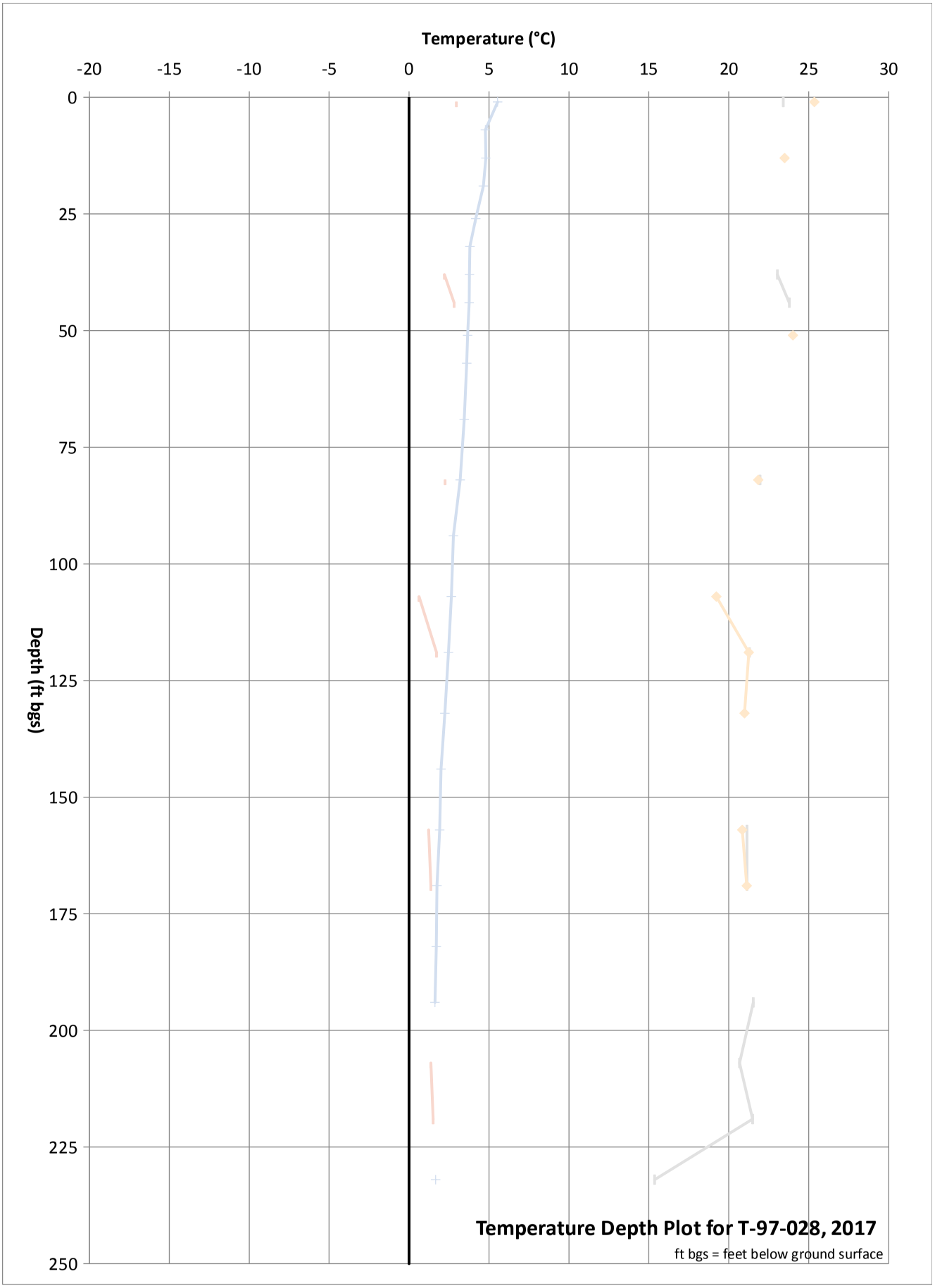

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-96-010
ft bgs = feet below ground surface

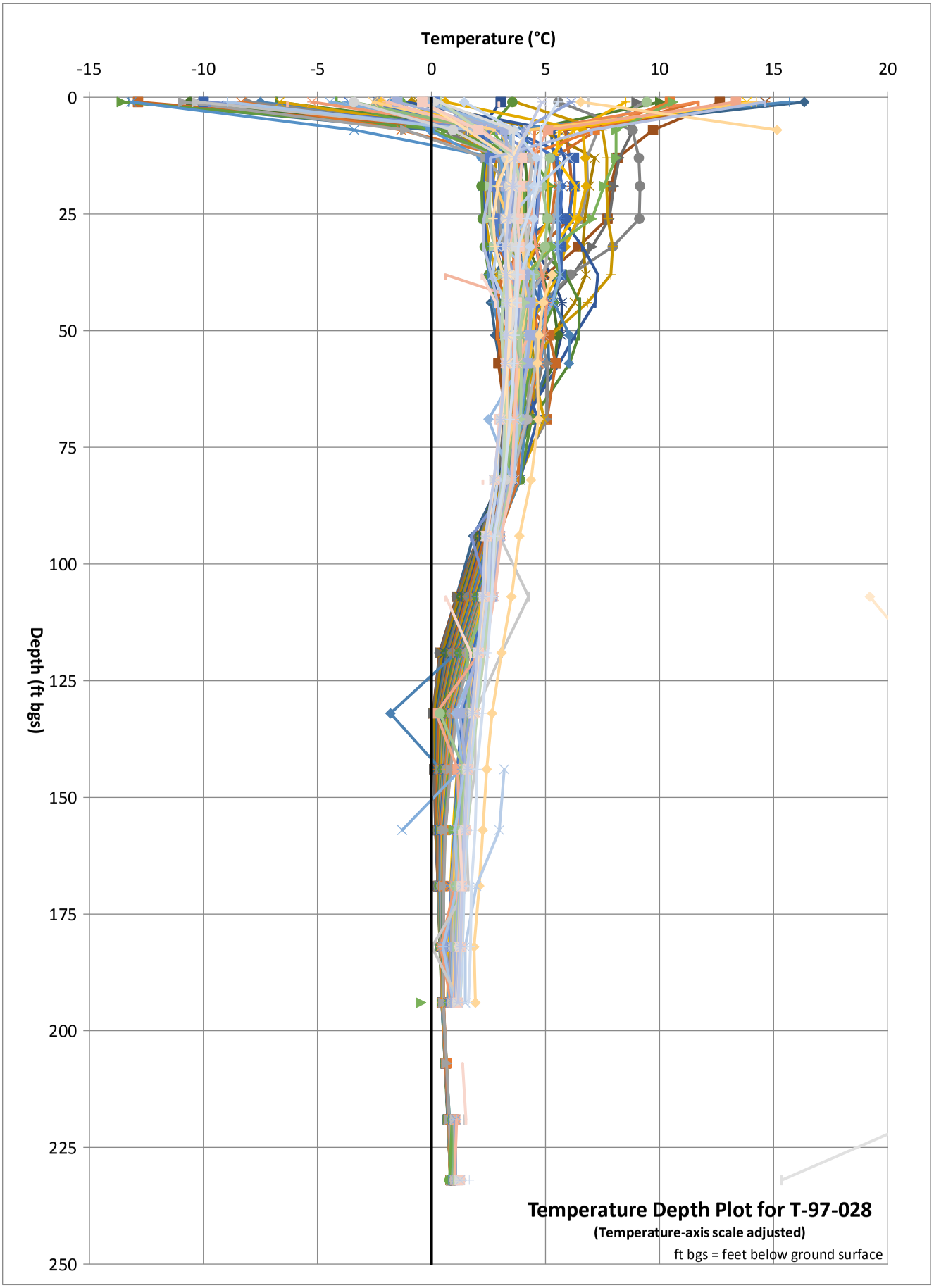

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-96-010, 2017
ft bgs = feet below ground surface

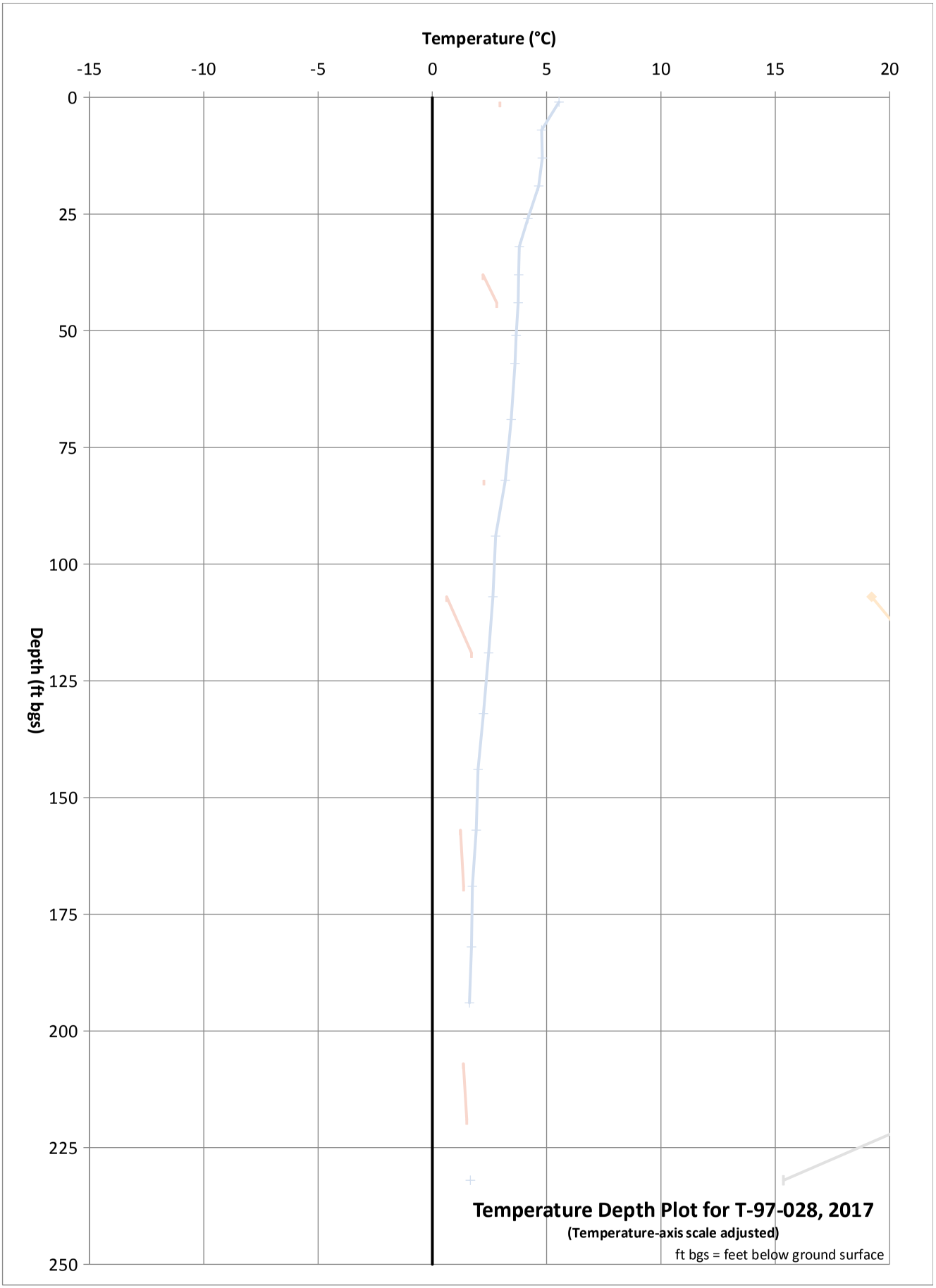

Temperature (°C)
-8
-6
-4
-2
0
2
4
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-96-010
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

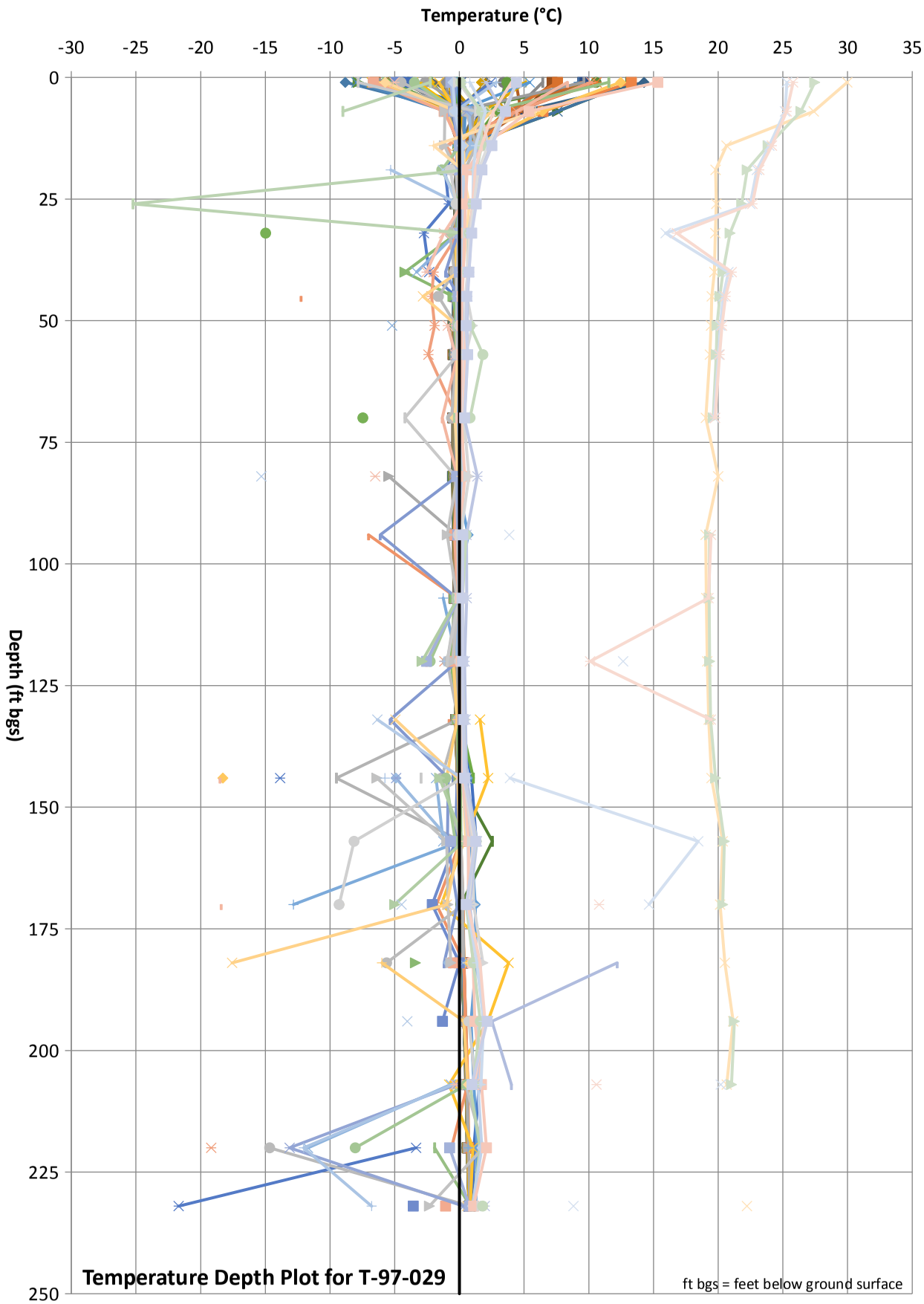

Temperature (°C)
-8
-6
-4
-2
0
2
4
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-96-010, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

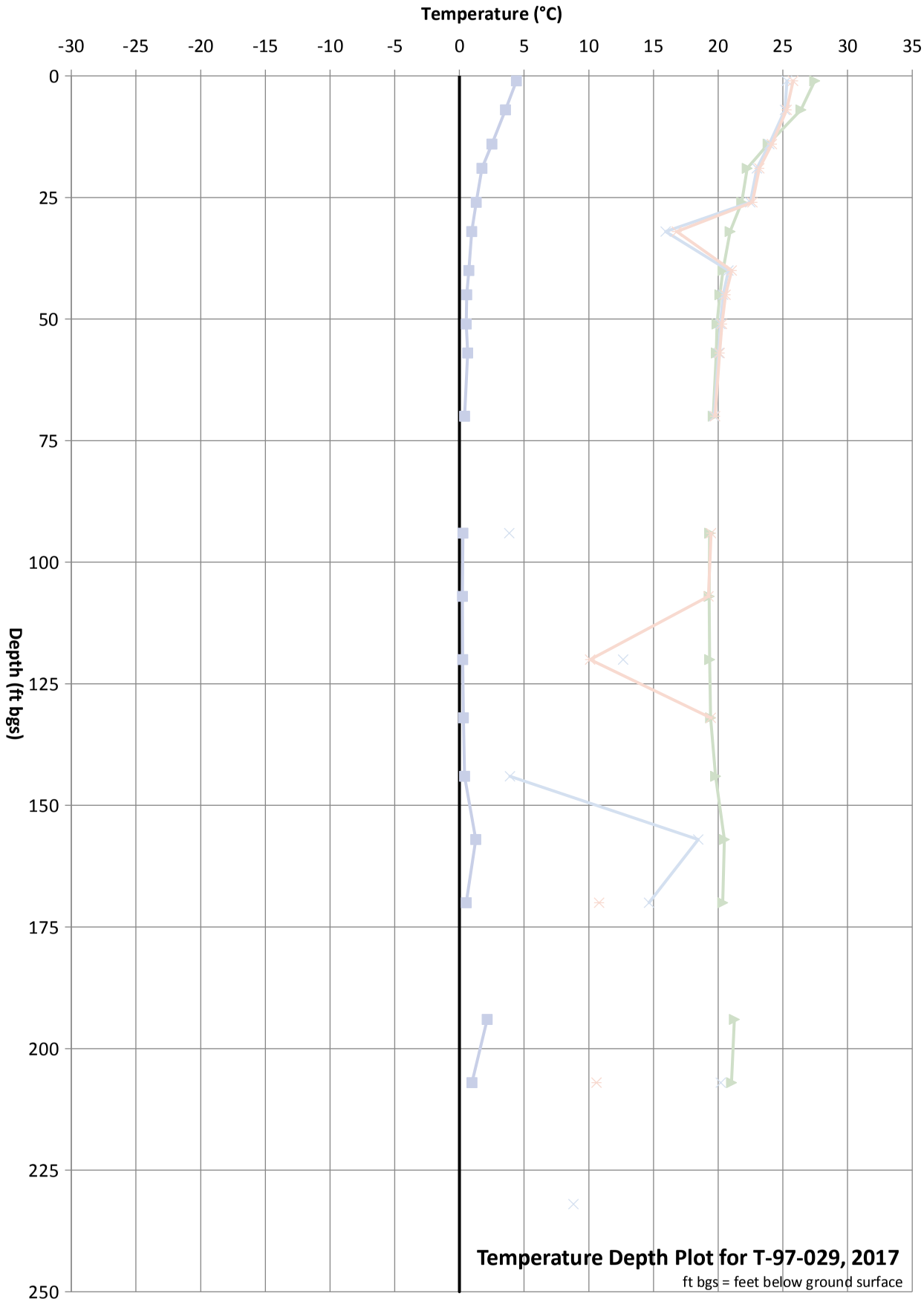

Temperature (°C)
-20
-15
-10
-5
0
5
10
15
20
25
30
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-028
ft bgs = feet below ground surface

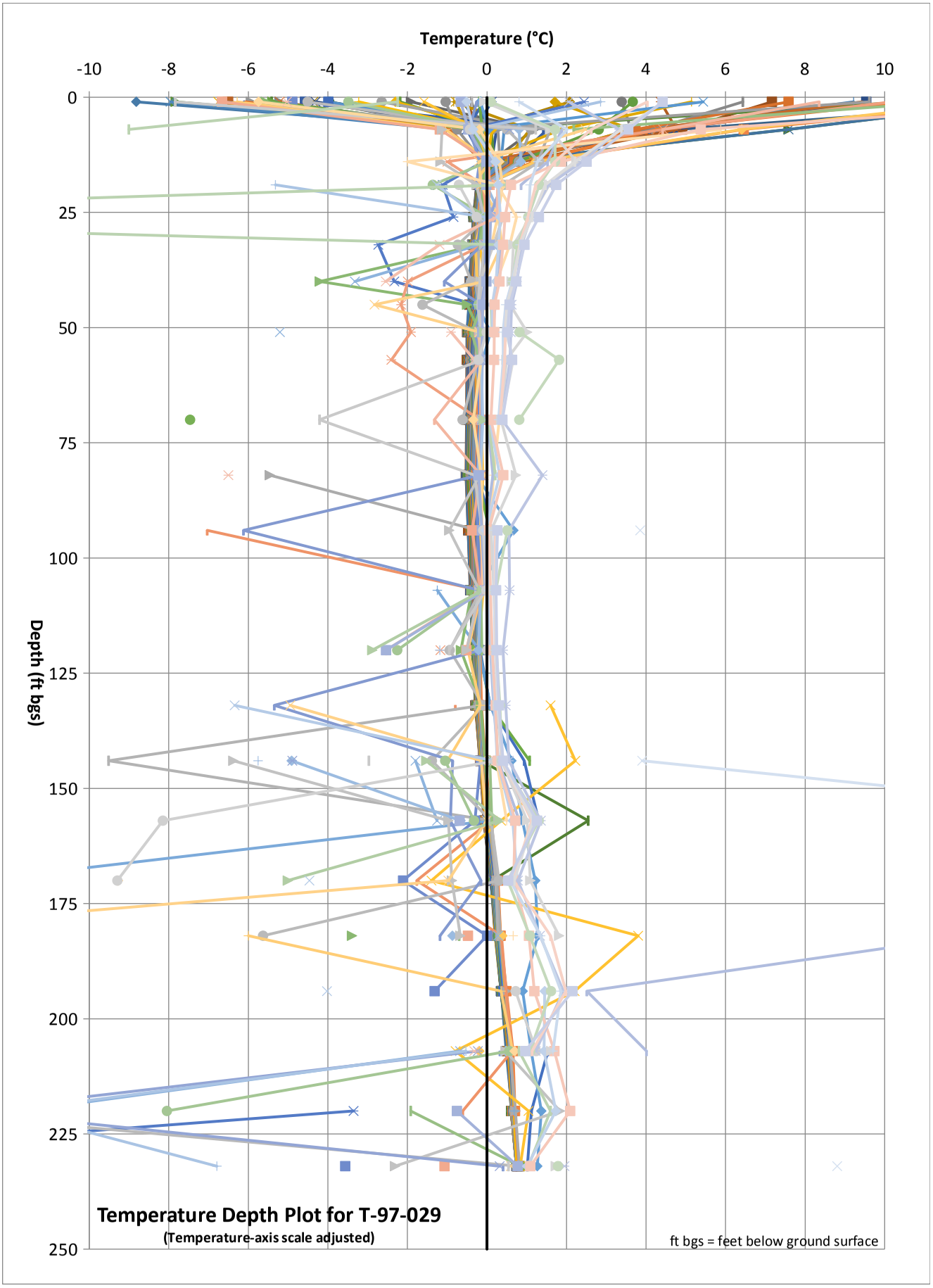

Temperature (°C)
-20
-15
-10
-5
0
5
10
15
20
25
30
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-028, 2017
ft bgs = feet below ground surface

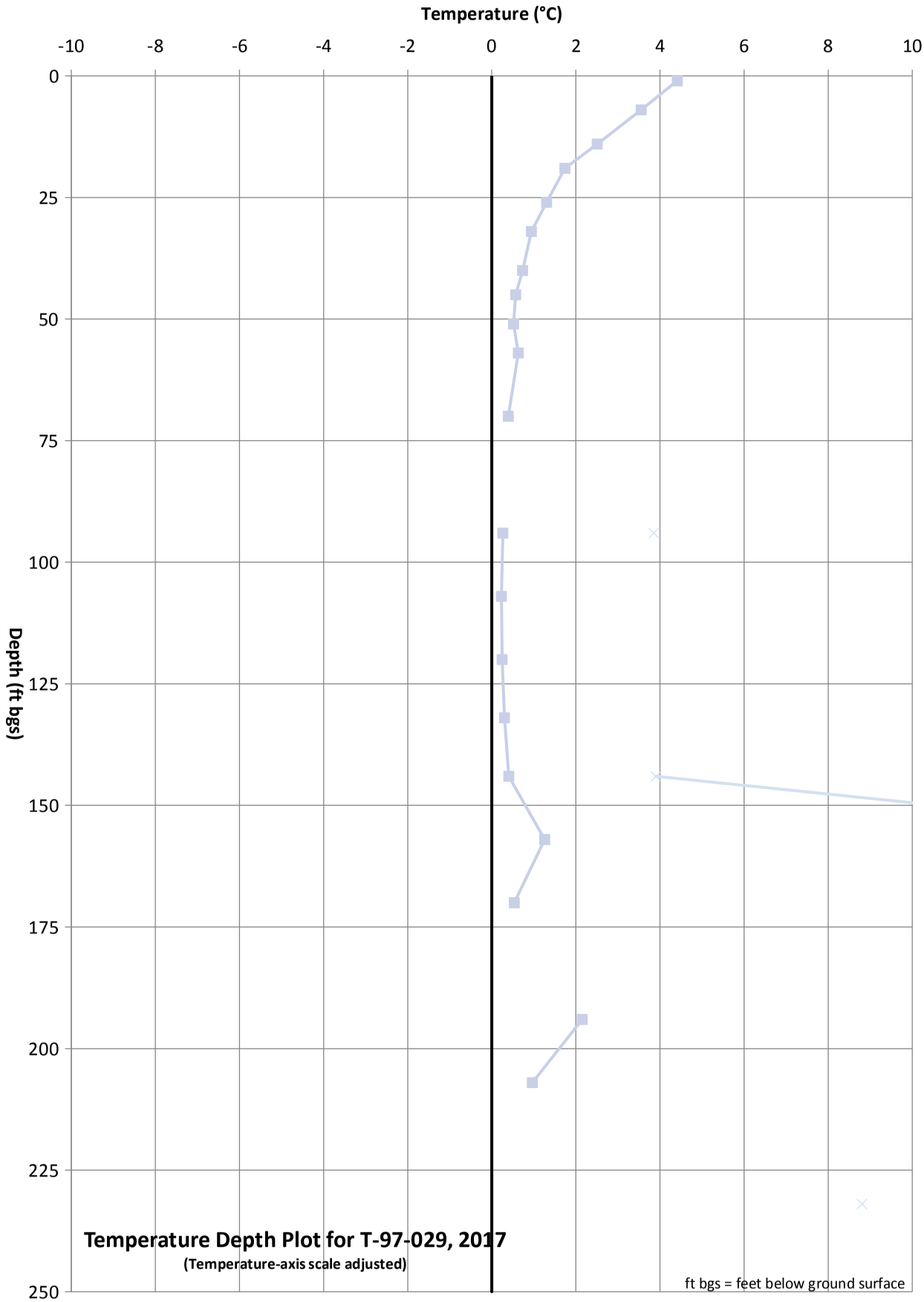

Temperature (°C)
-15
-10
-5
0
5
10
15
20
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-028
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

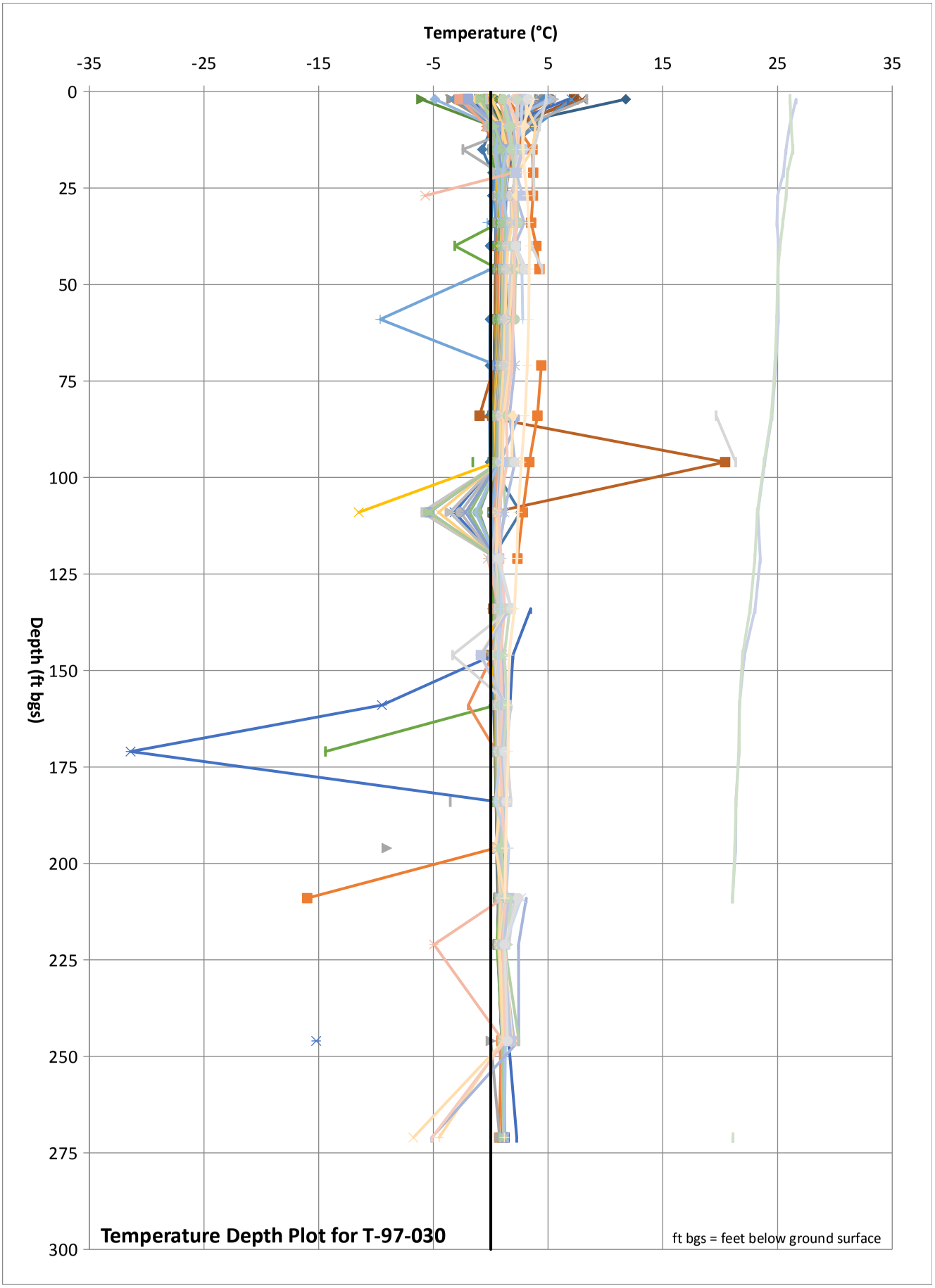

Temperature (°C)
-15
-10
-5
0
5
10
15
20
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-028, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

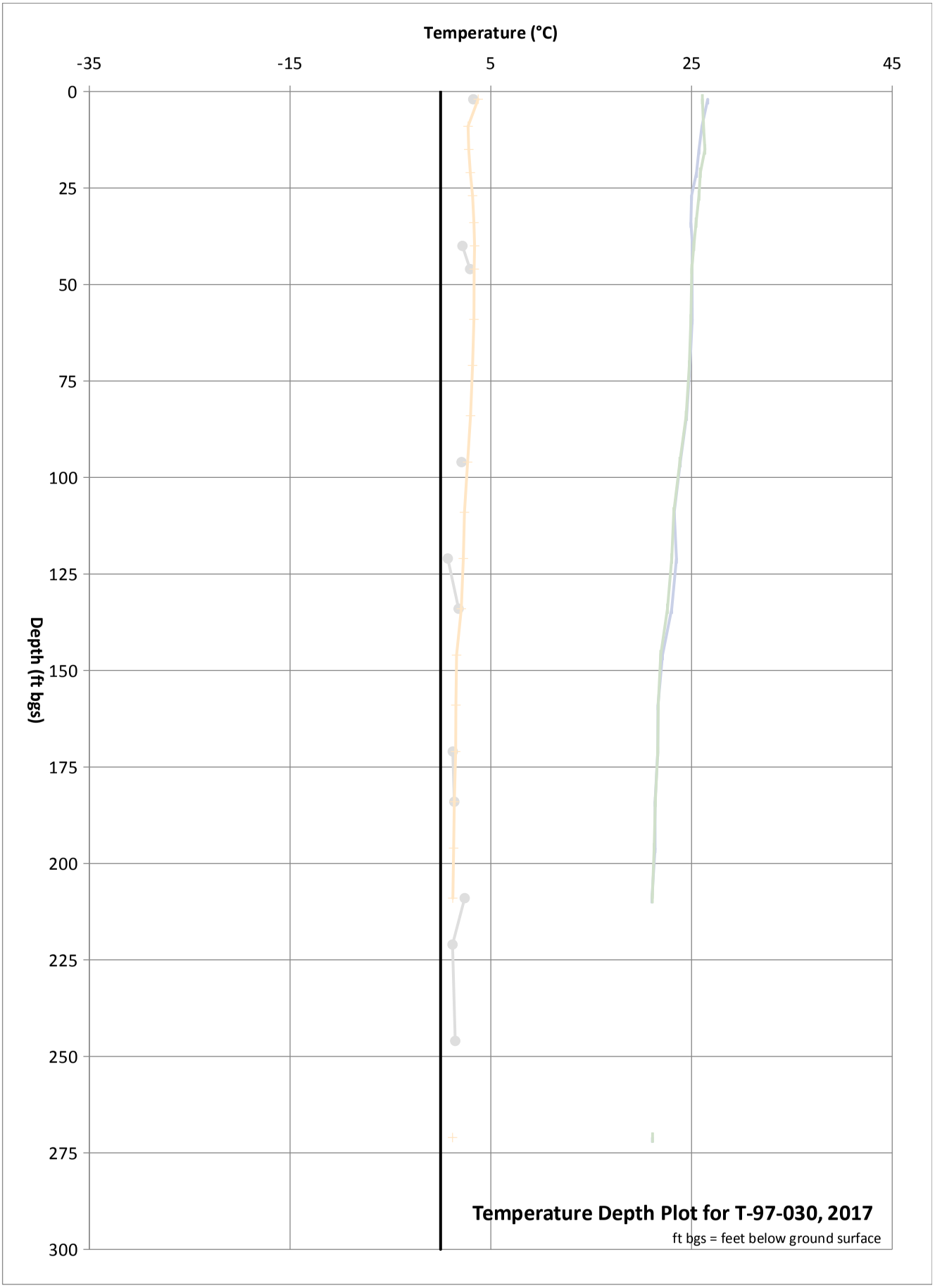

Temperature (°C)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-029
ft bgs = feet below ground surface

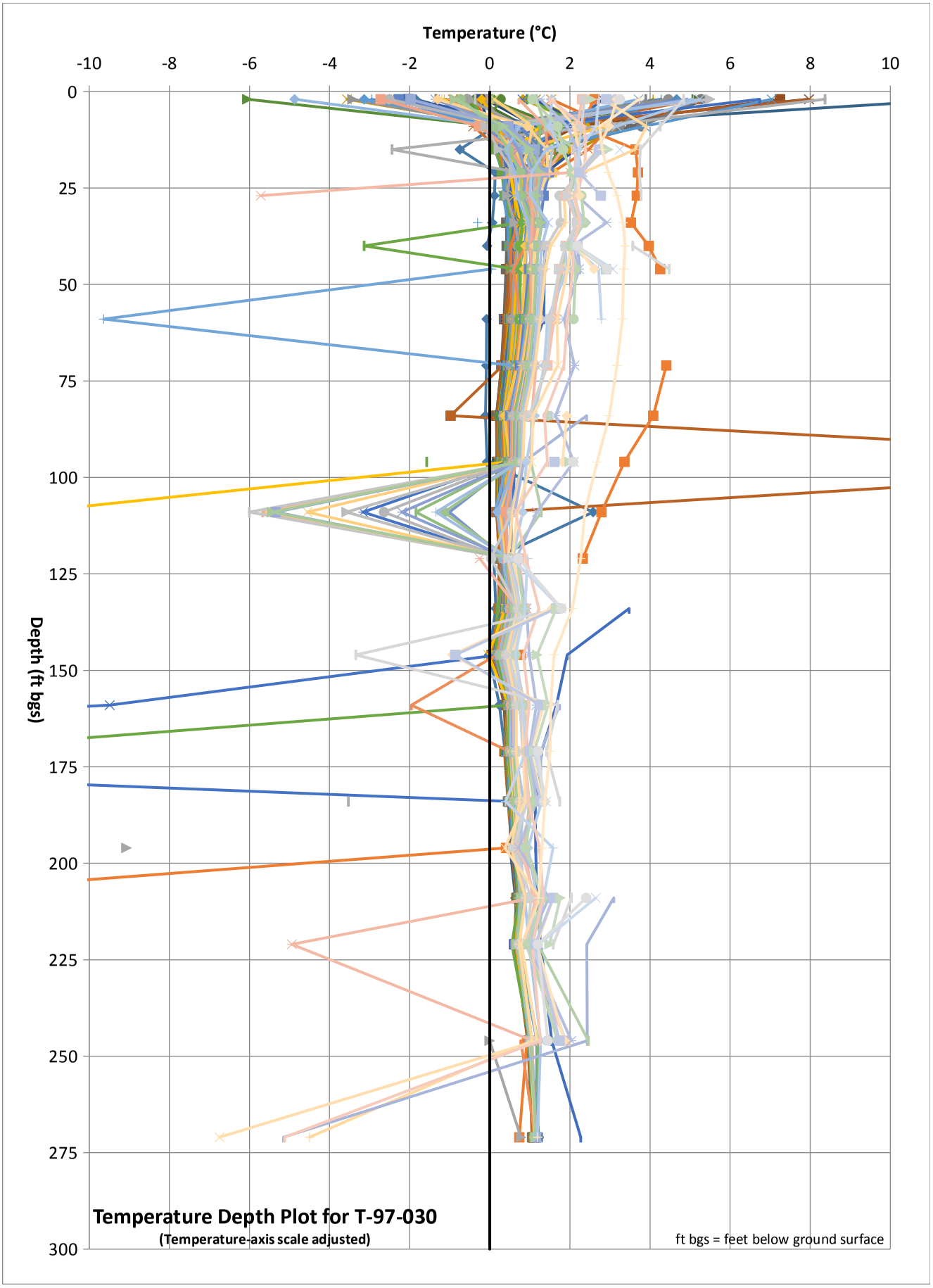

Temperature (°C)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-029, 2017
ft bgs = feet below ground surface

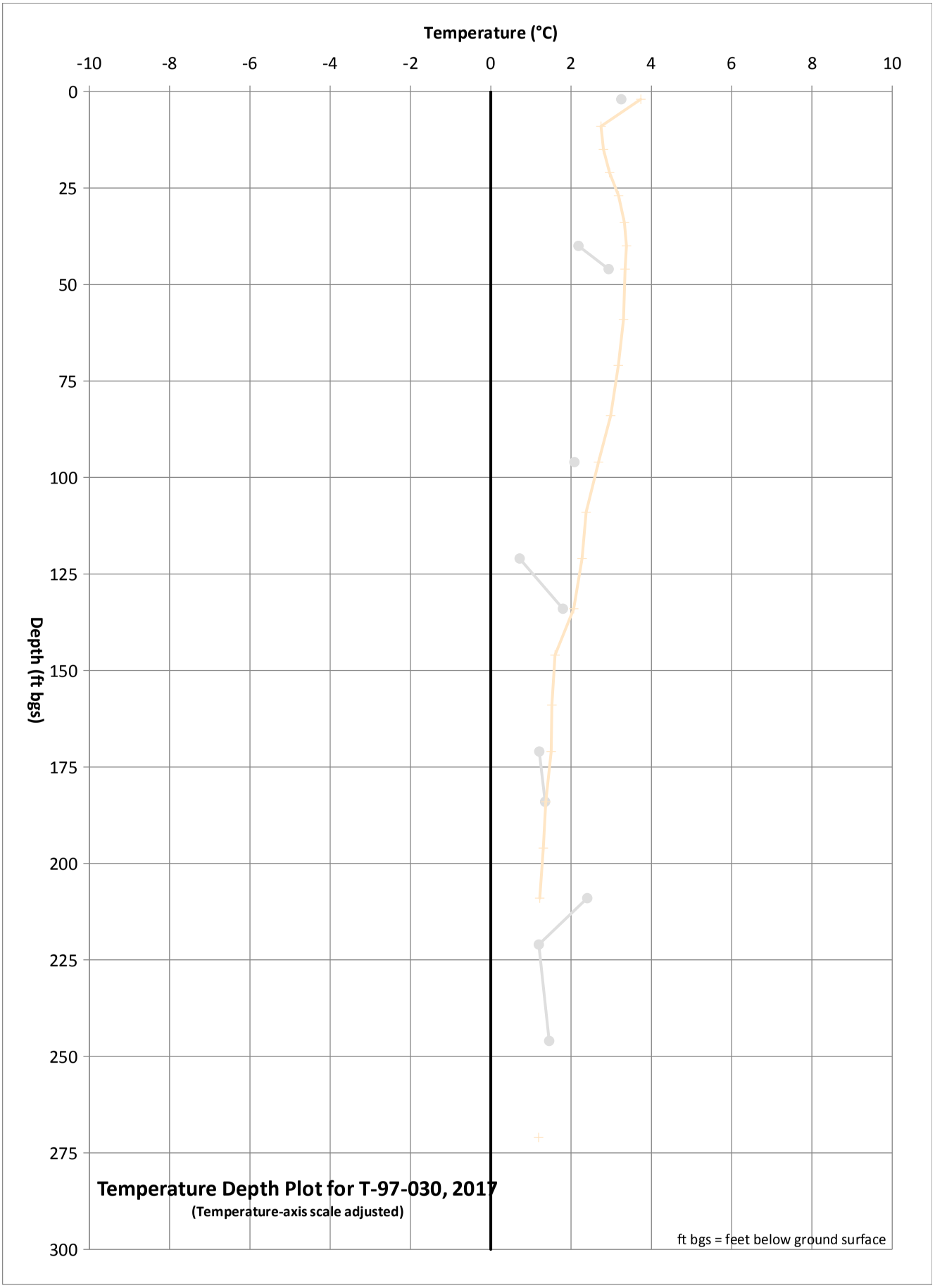

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-029
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

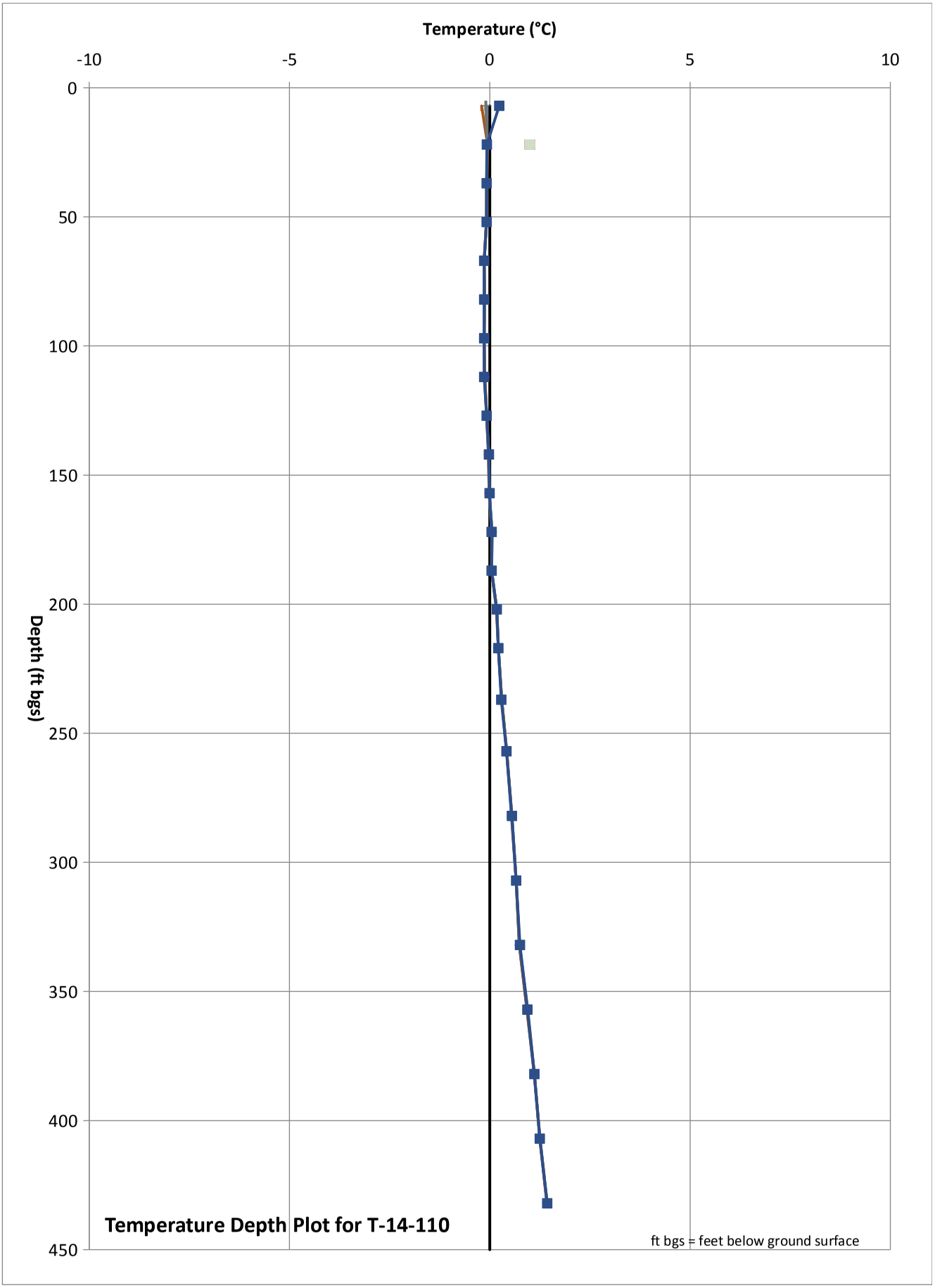

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
Temperature Depth Plot for T-97-029, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

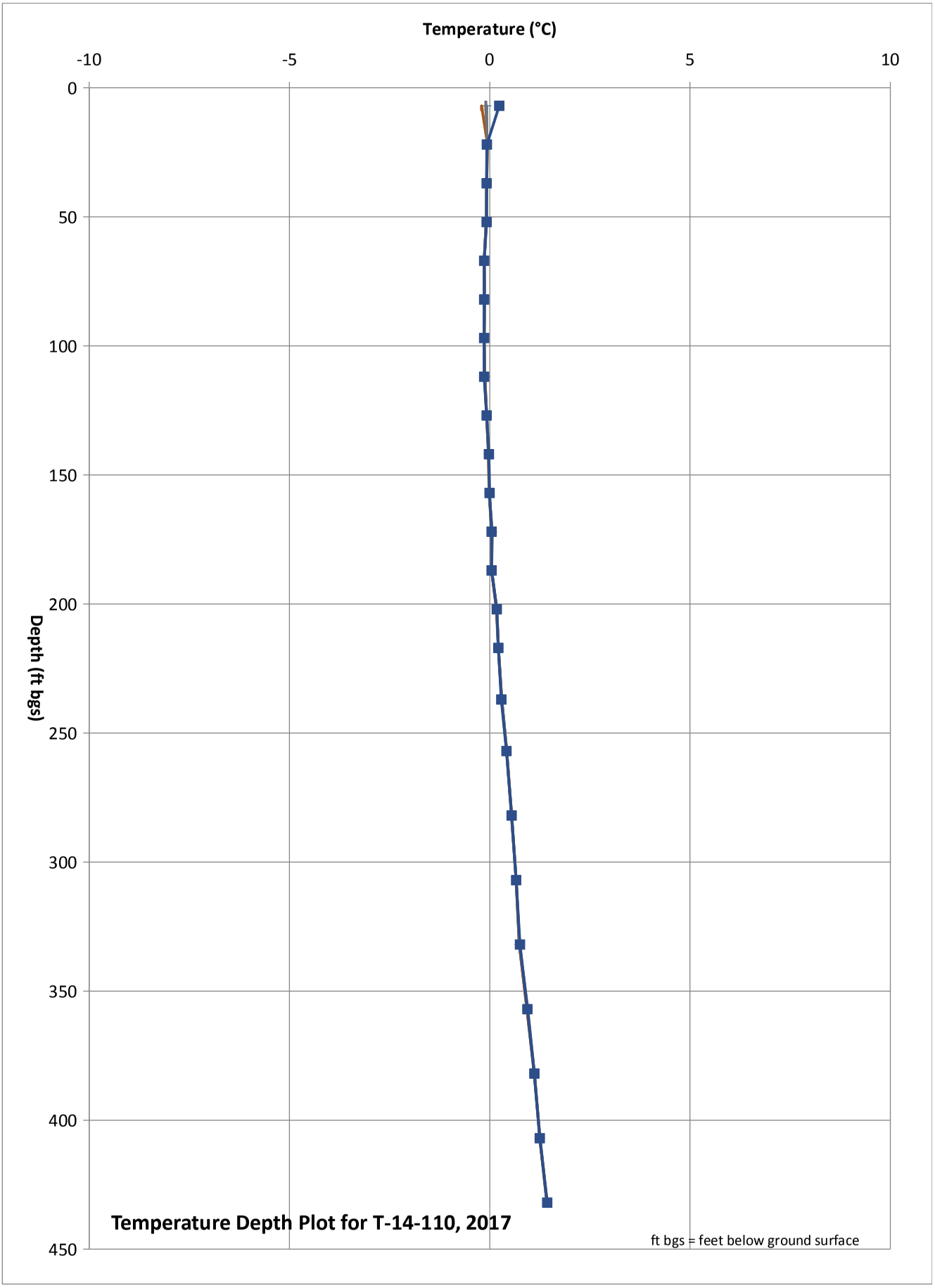

Temperature (°C)
-35
-25
-15
-5
5
15
25
35
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
275
300
Temperature Depth Plot for T-97-030
ft bgs = feet below ground surface

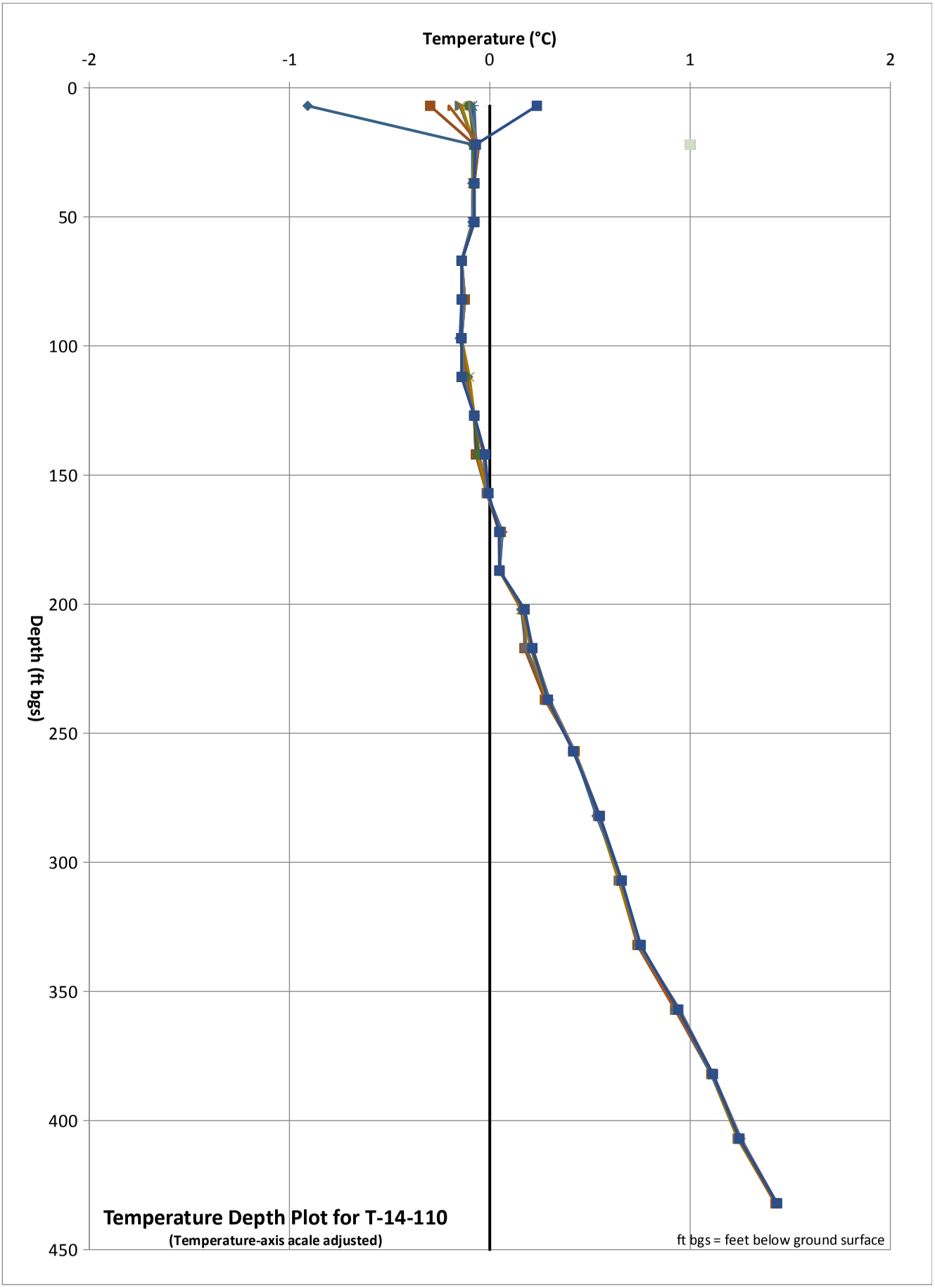

Temperature (°C)
-35
-15
5
25
45
0
25
50
75
100
125
150
175
200
225
250
275
300
Depth (ft bgs)
Temperature Depth Plot for T-97-030, 2017
ft bgs = feet below ground surface

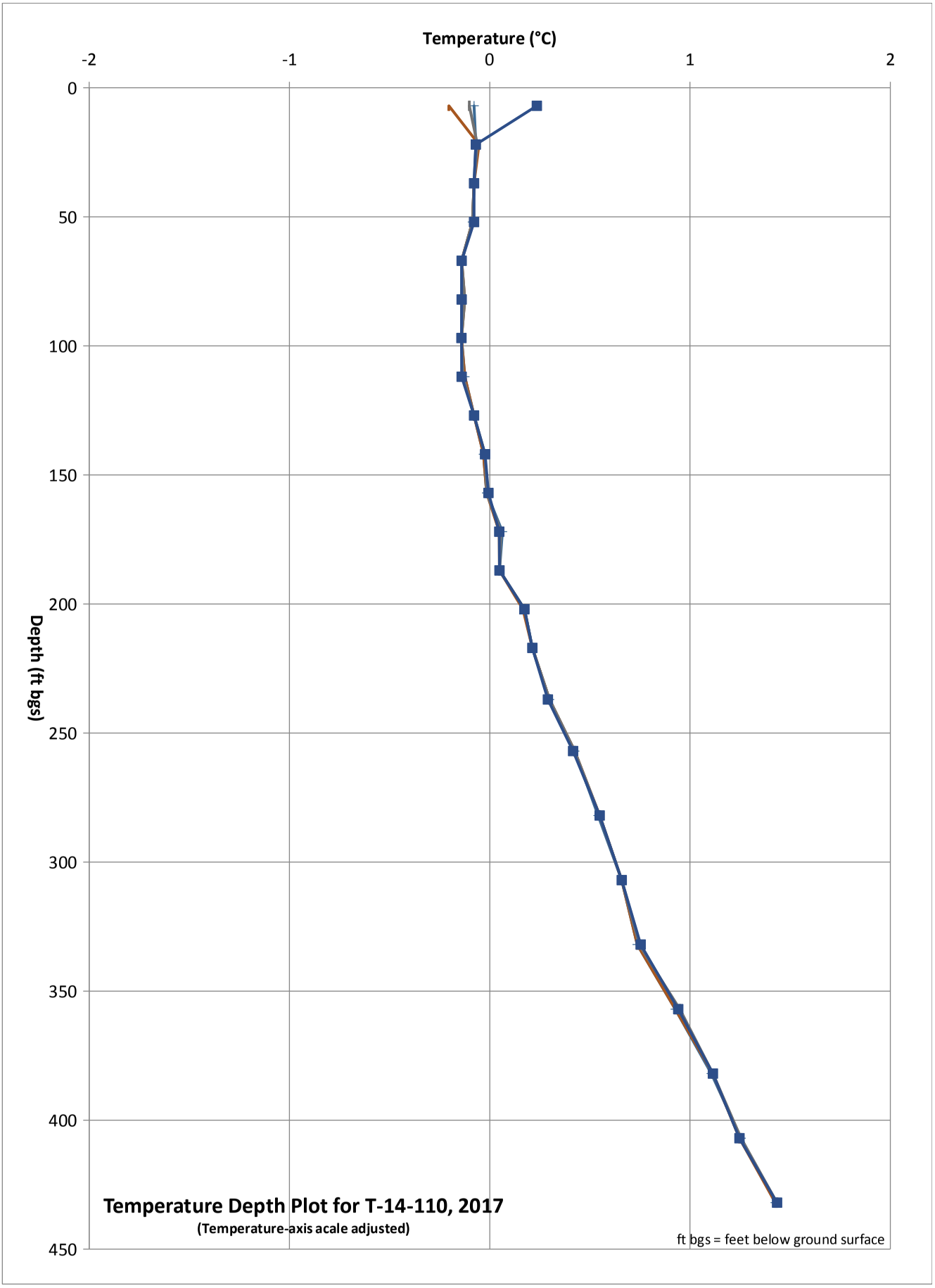

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
275
300
Temperature Depth Plot for T-97-030
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

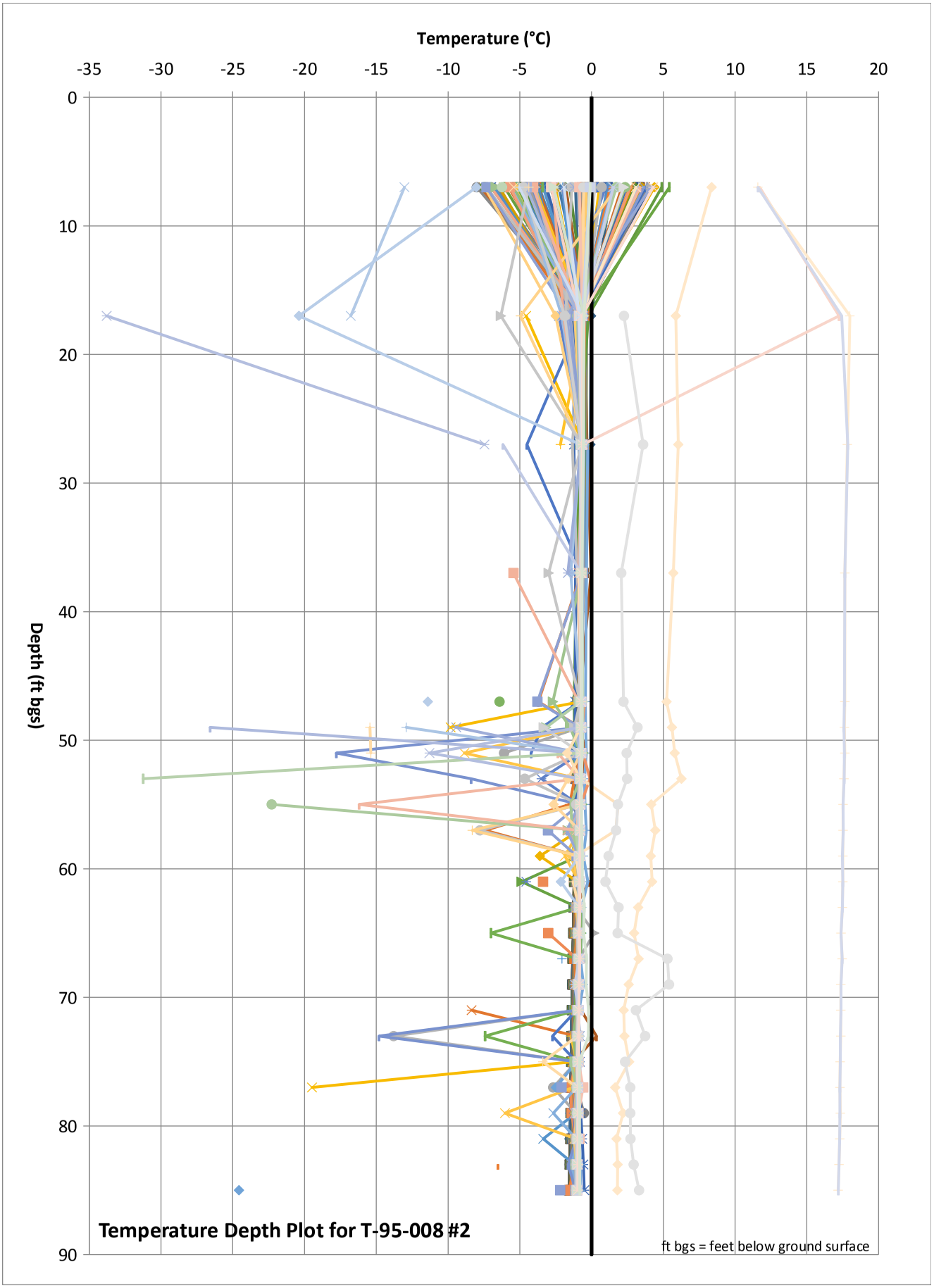

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
25
50
75
100
125
150
175
200
225
250
275
300
Temperature Depth Plot for T-97-030, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

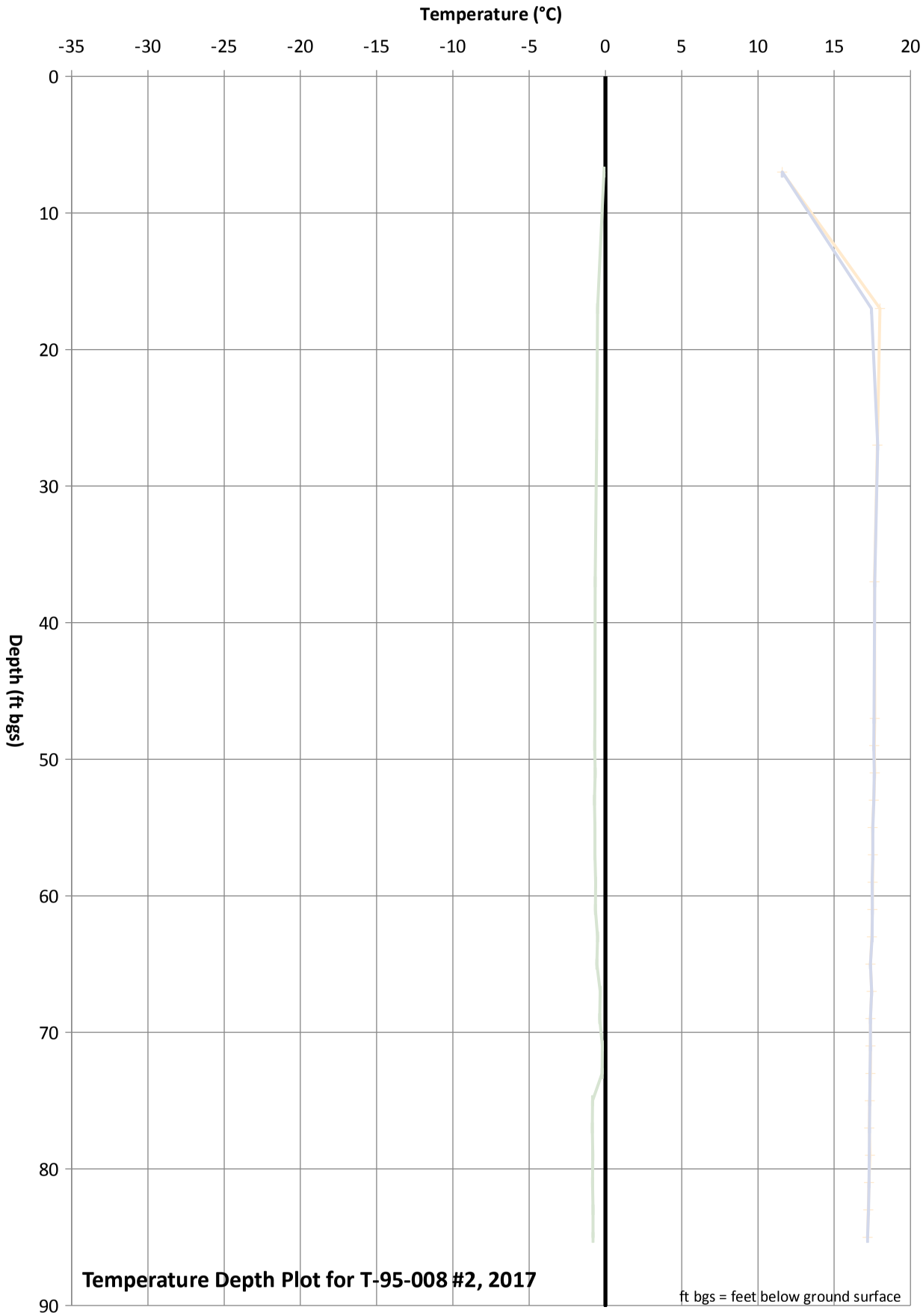

Temperature (°C)
-10
-5
0
5
10
0
50
100
150
200
250
300
350
400
450
Depth (ft bgs)
Temperature Depth Plot for T-14-110
ft bgs = feet below ground surface

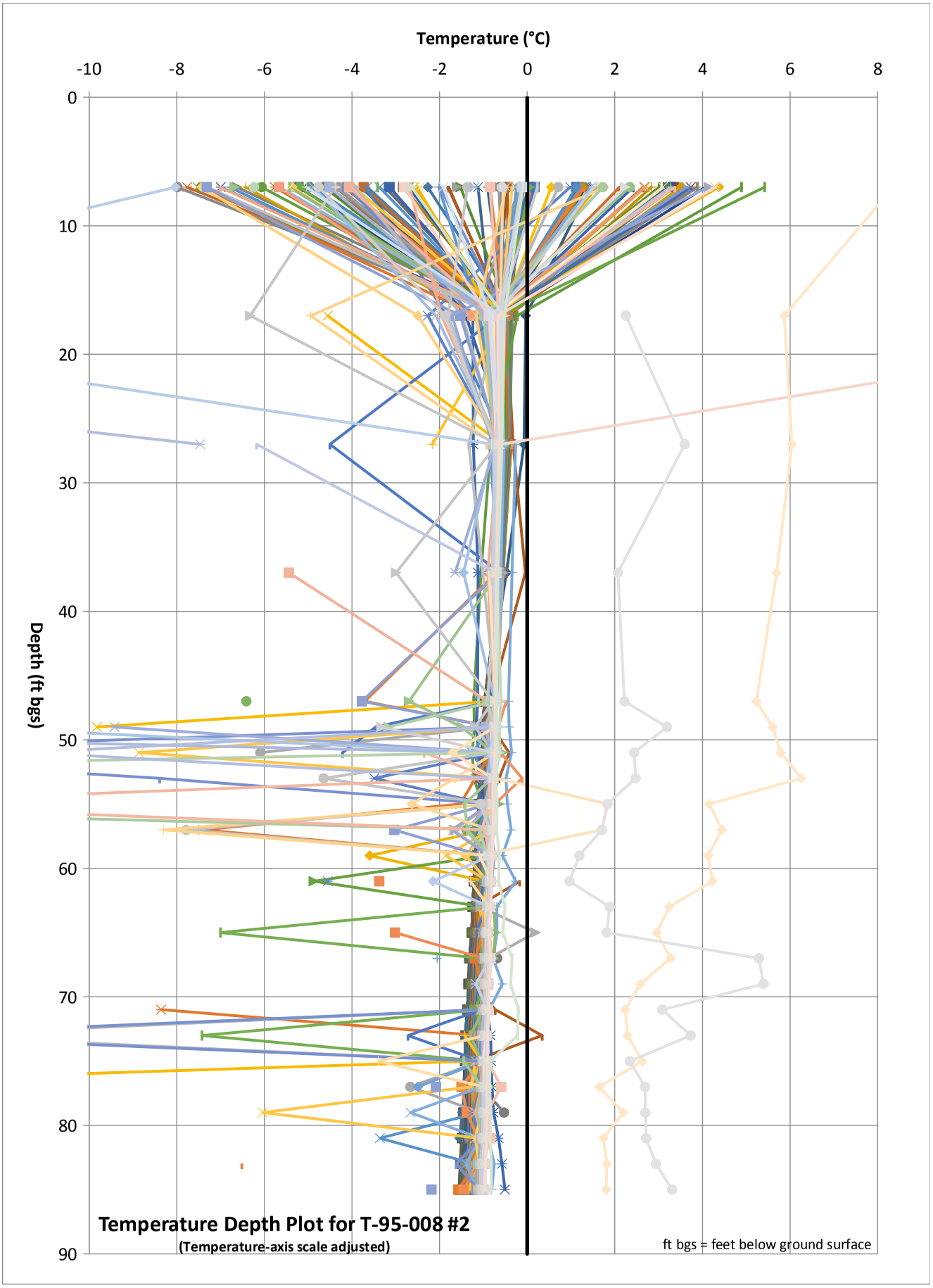

Temperature (°C)
-10
-5
0
5
10
0
50
100
150
200
250
300
350
400
450
Depth (ft bgs)
Temperature Depth Plot for T-14-110, 2017
ft bgs = feet below ground surface

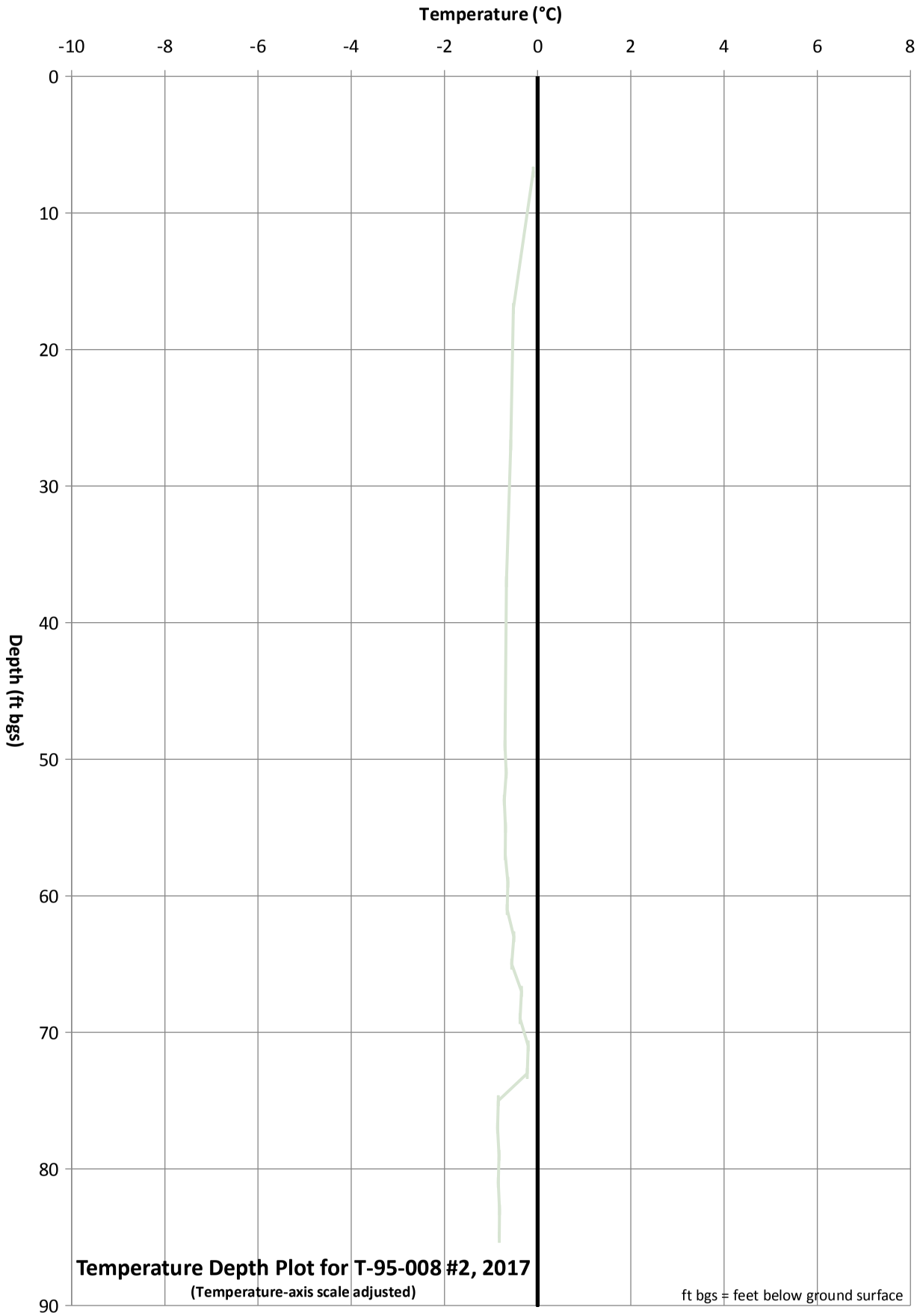

Temperature (°C)
-2
-1
0
1
2
0
50
100
150
200
250
300
350
400
450
Depth (ft bgs)
Temperature Depth Plot for T-14-110
(Temperature-axis acale adjusted)
ft bgs = feet below ground surface

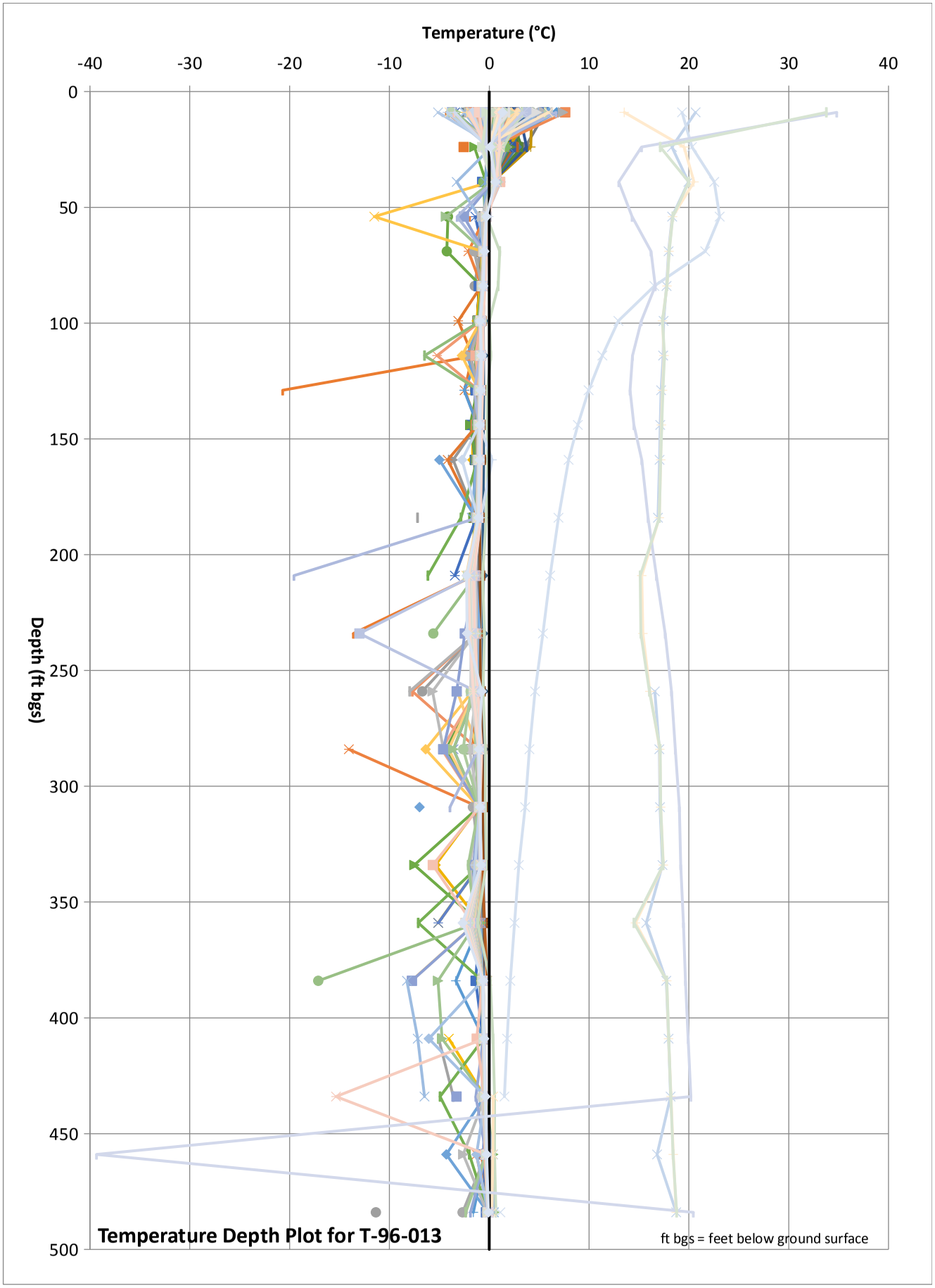

Temperature (°C)
-2
-1
0
1
2
0
50
100
150
200
250
300
350
400
450
Depth (ft bgs)
Temperature Depth Plot for T-14-110, 2017
(Temperature-axis acale adjusted)
ft bgs = feet below ground surface

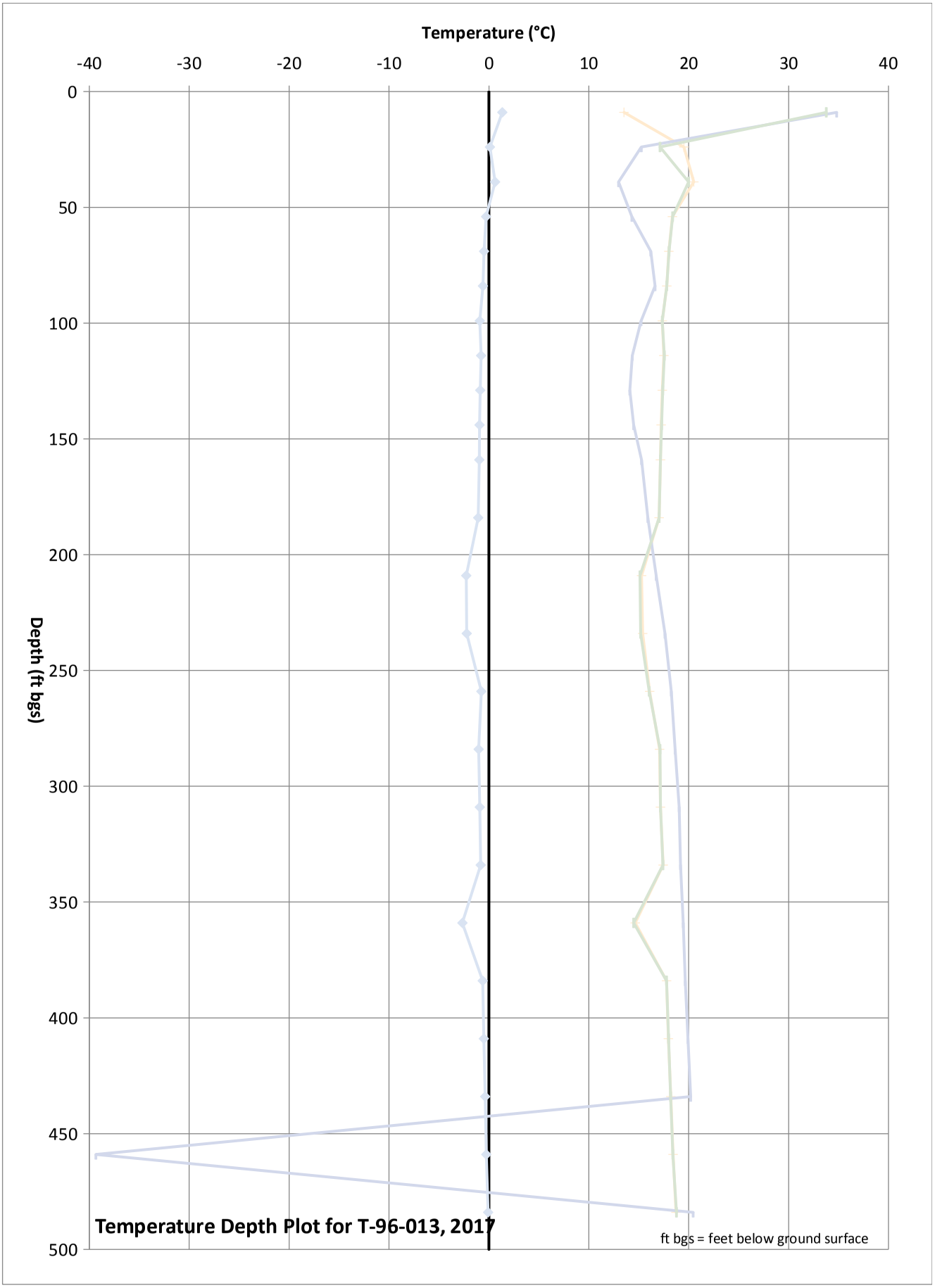

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
Temperature Depth Plot for T-95-008 #2
ft bgs = feet below ground surface

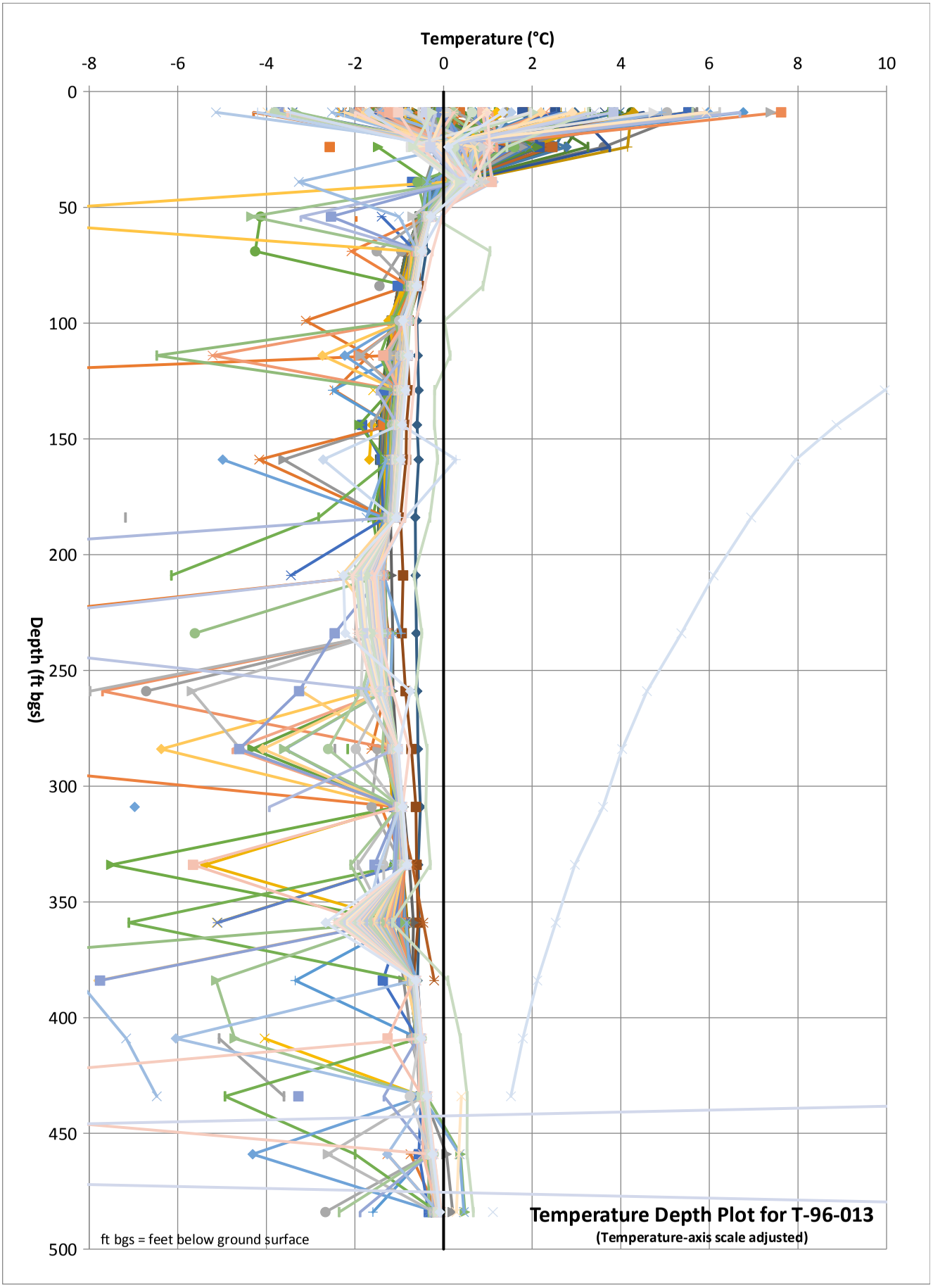

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
Temperature Depth Plot for T-95-008 #2, 2017
ft bgs = feet below ground surface

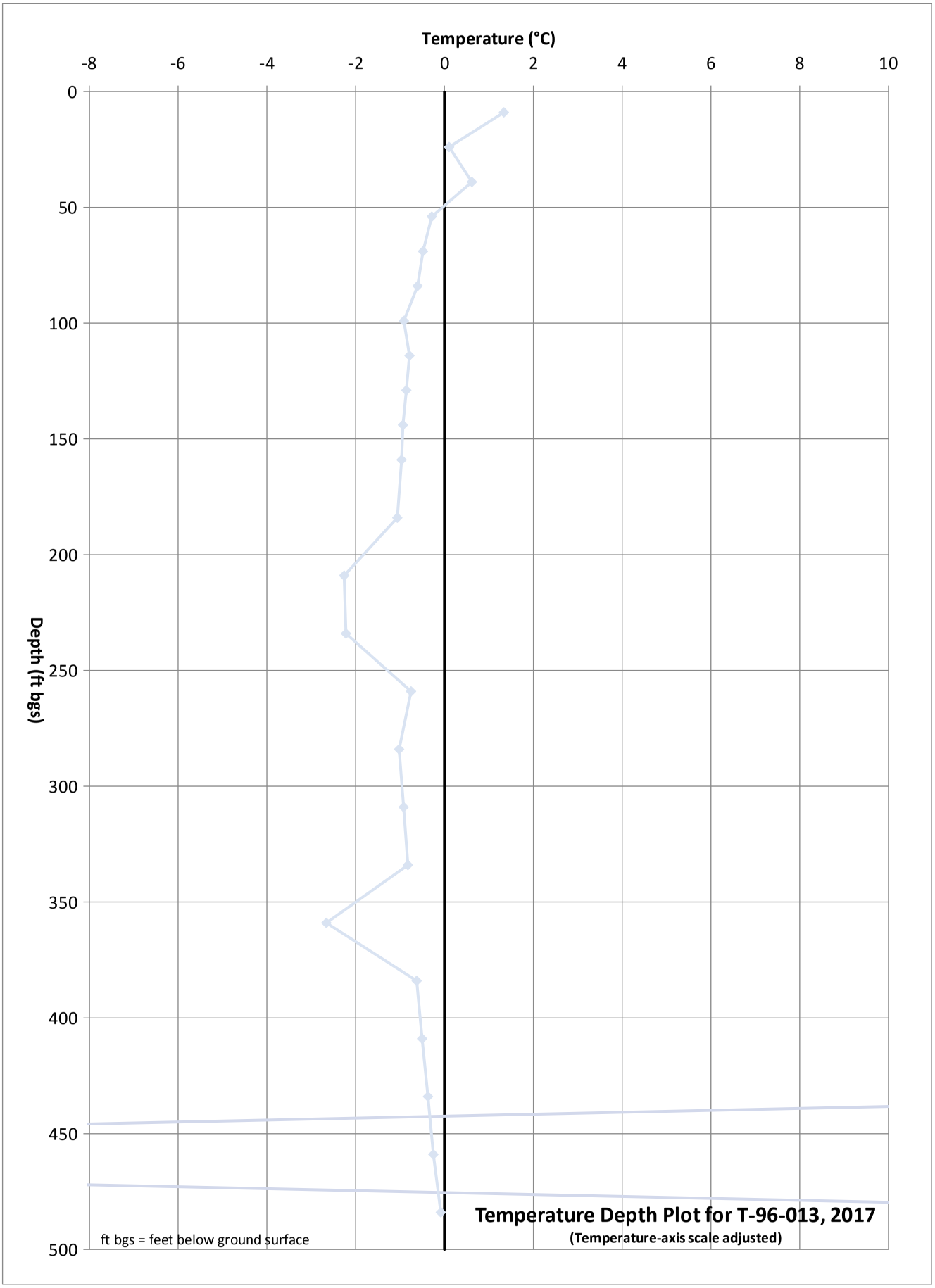

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
Temperature Depth Plot for T-95-008 #2
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

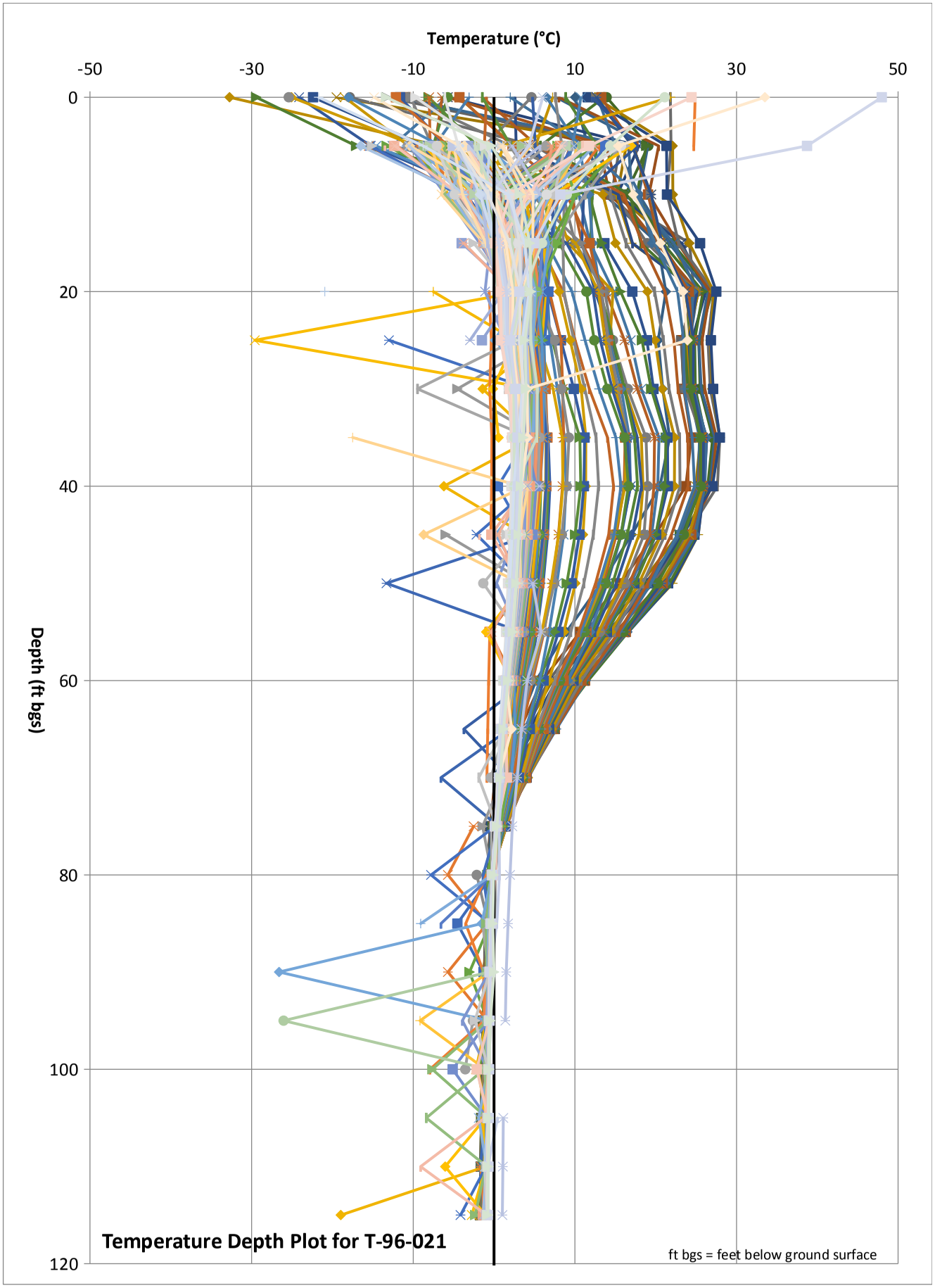

Temperature (°C)
-10
-8
-6
-4
-2
0
2
4
6
8
0
10
20
30
40
50
60
70
80
90
Depth (ft bgs)
Temperature Depth Plot for T-95-008 #2, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

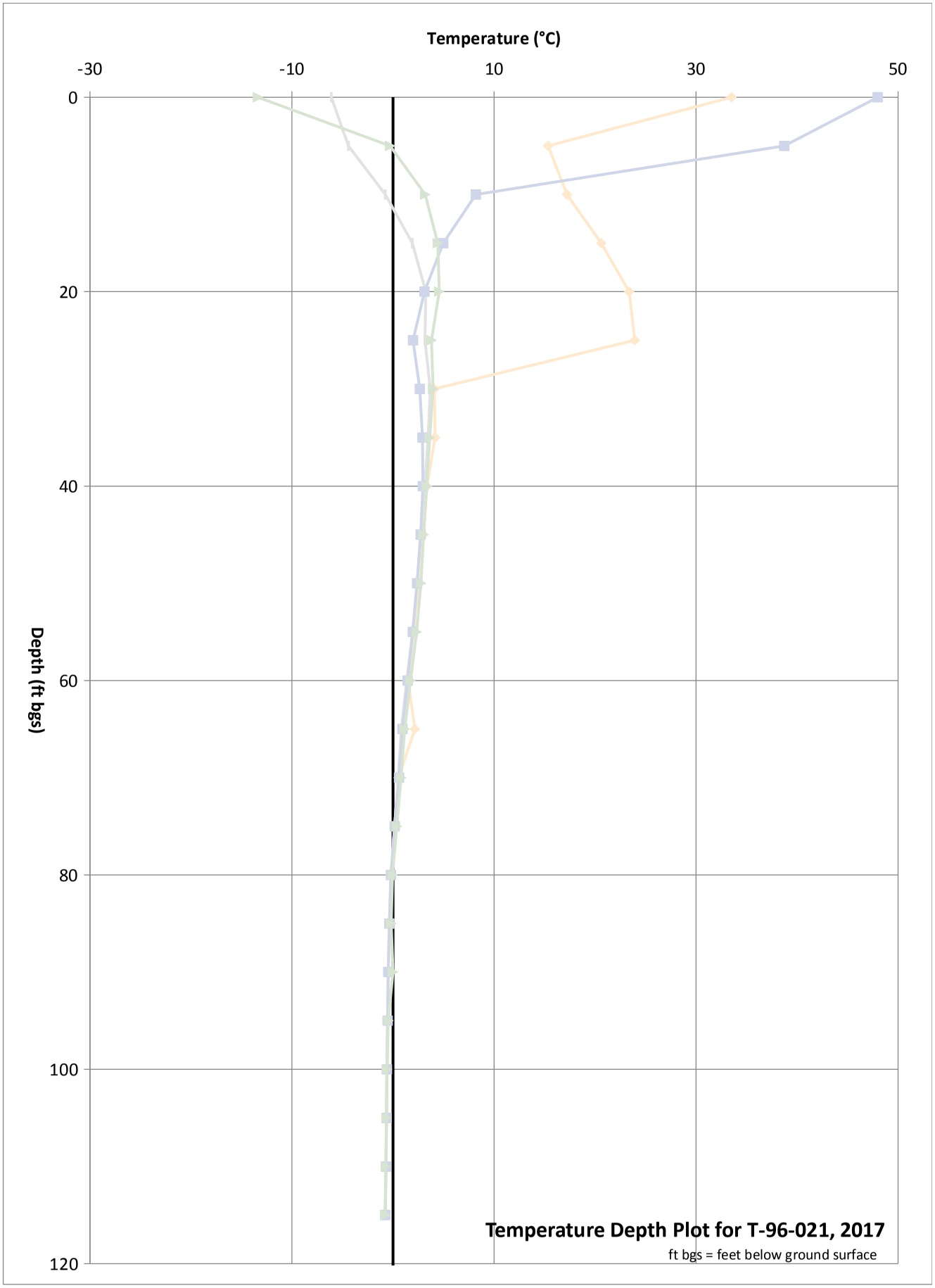

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
Temperature Depth Plot for T-96-013
ft bgs = feet below ground surface

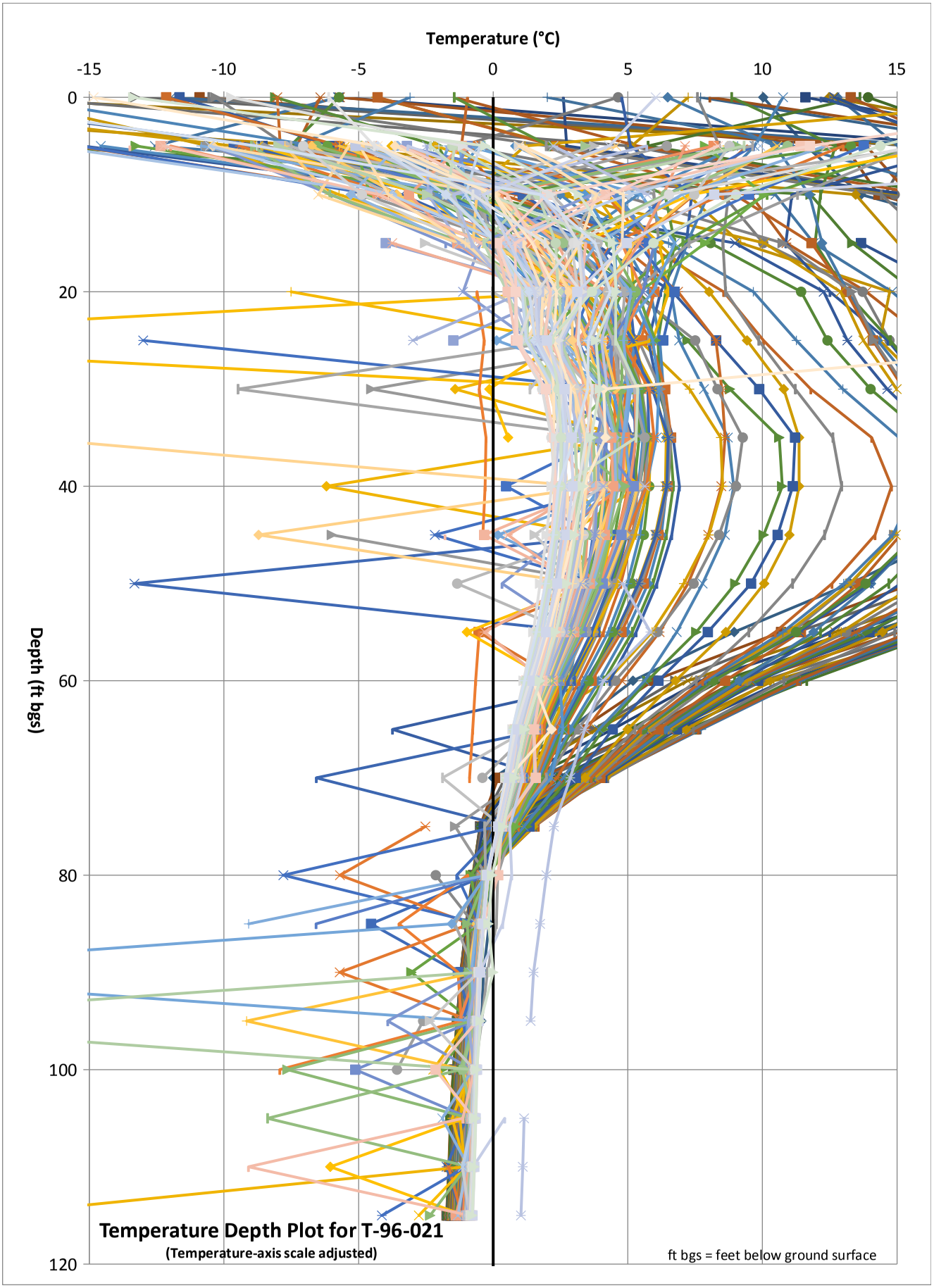

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
Temperature Depth Plot for T-96-013, 2017
ft bgs = feet below ground surface

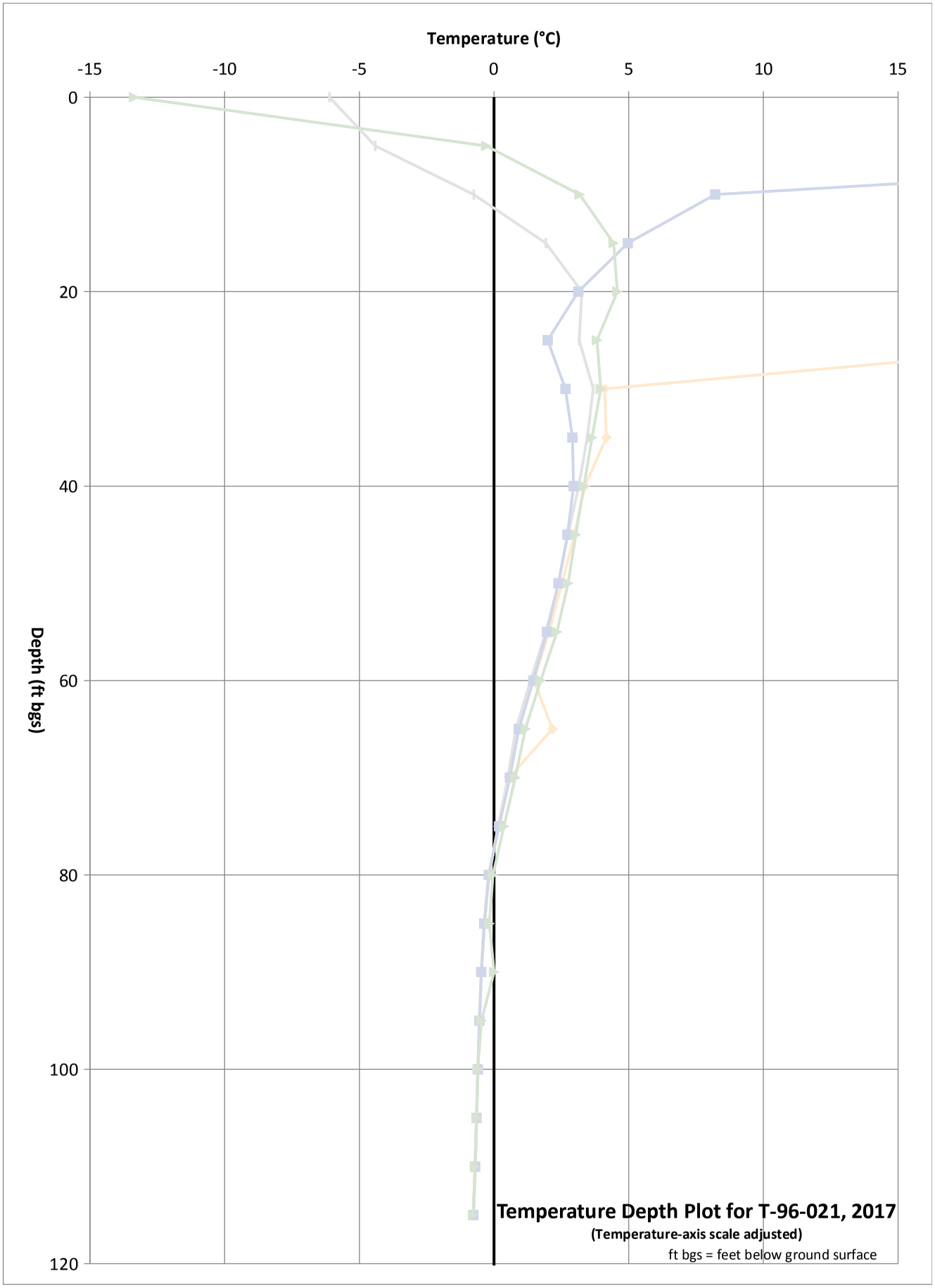

Temperature (°C)
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
ft bgs = feet below ground surface
Temperature Depth Plot for T-96-013
(Temperature-axis scale adjusted)

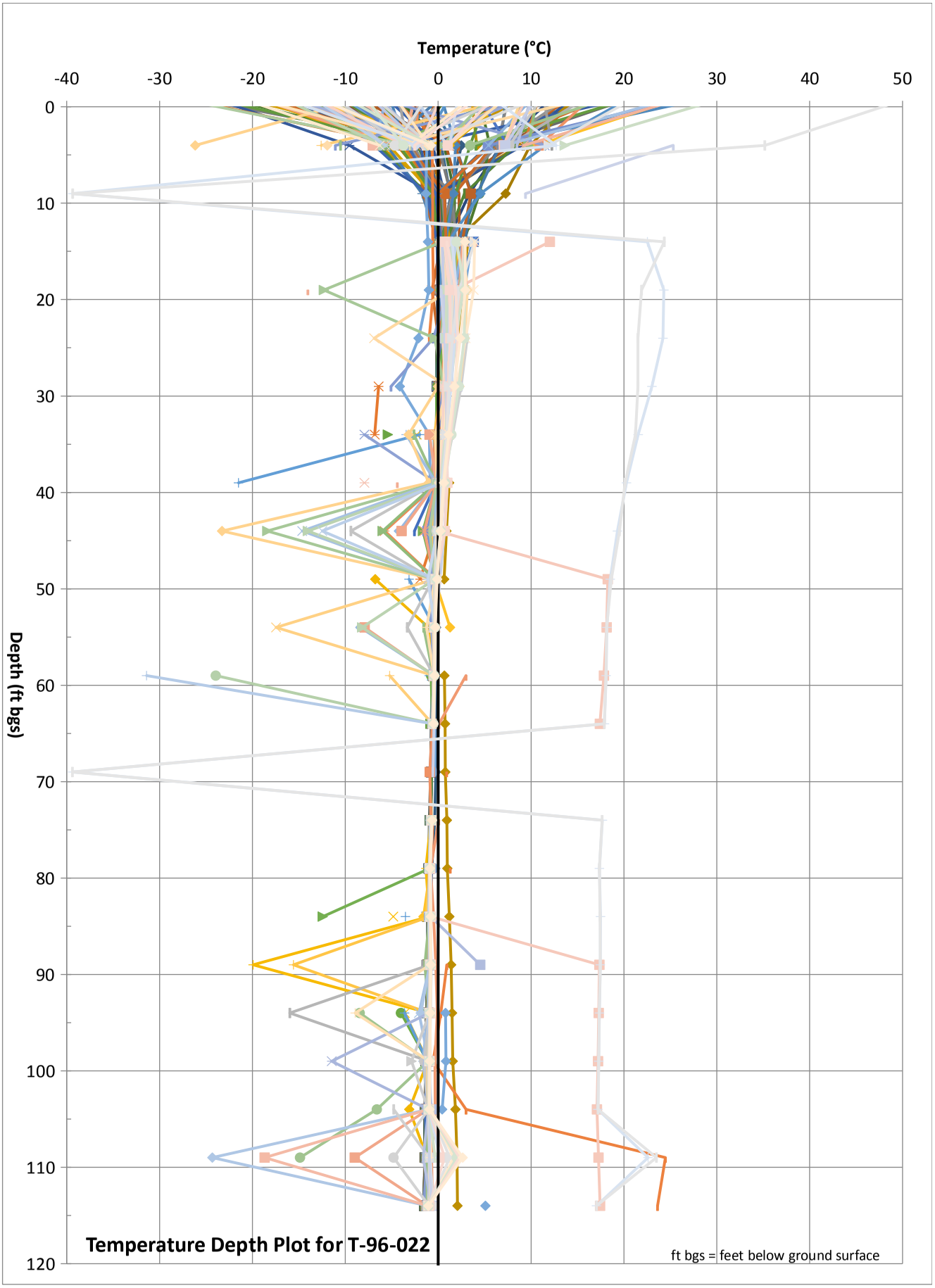

Temperature (°C)
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
ft bgs = feet below ground surface
Temperature Depth Plot for T-96-013, 2017
(Temperature-axis scale adjusted)

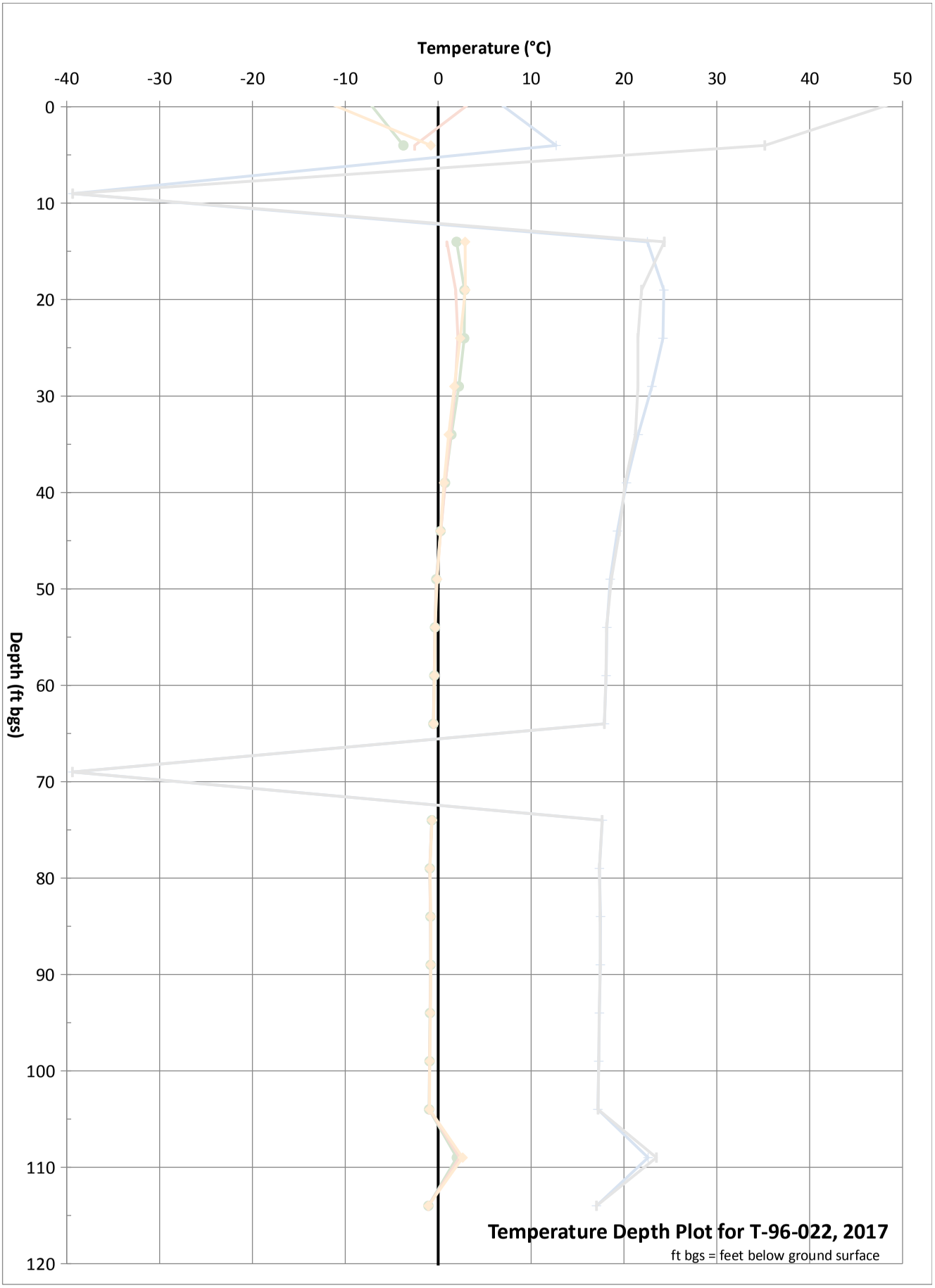

Temperature (°C)
-50
-30
-10
10
30
50
0
20
40
60
80
100
120
Depth (ft bgs)
Temperature Depth Plot for T-96-021
ft bgs = feet below ground surface

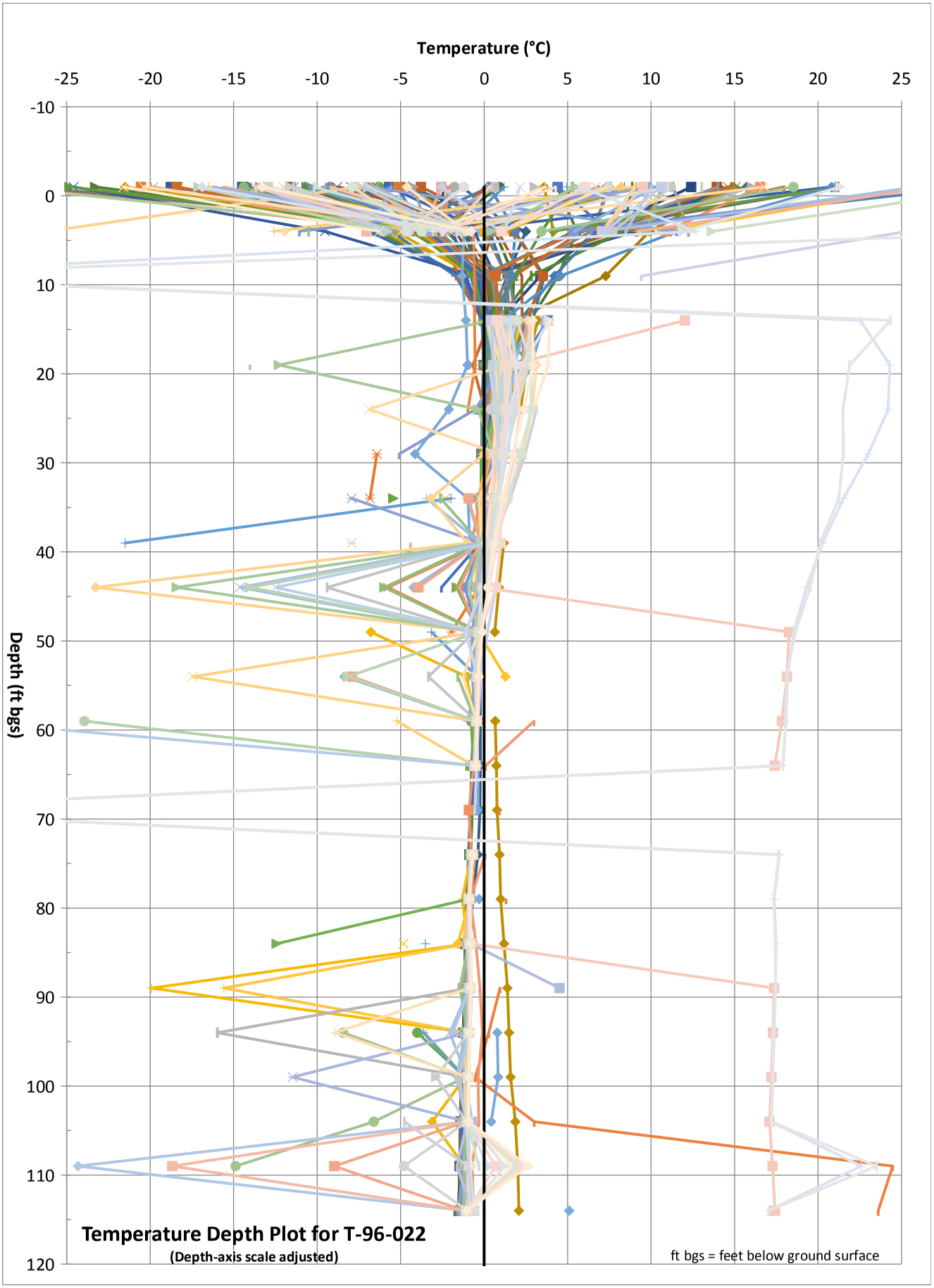

Temperature (°C)
-30
-10
10
30
50
0
20
40
60
80
100
120
Depth (ft bgs)
Temperature Depth Plot for T-96-021, 2017
ft bgs = feet below ground surface

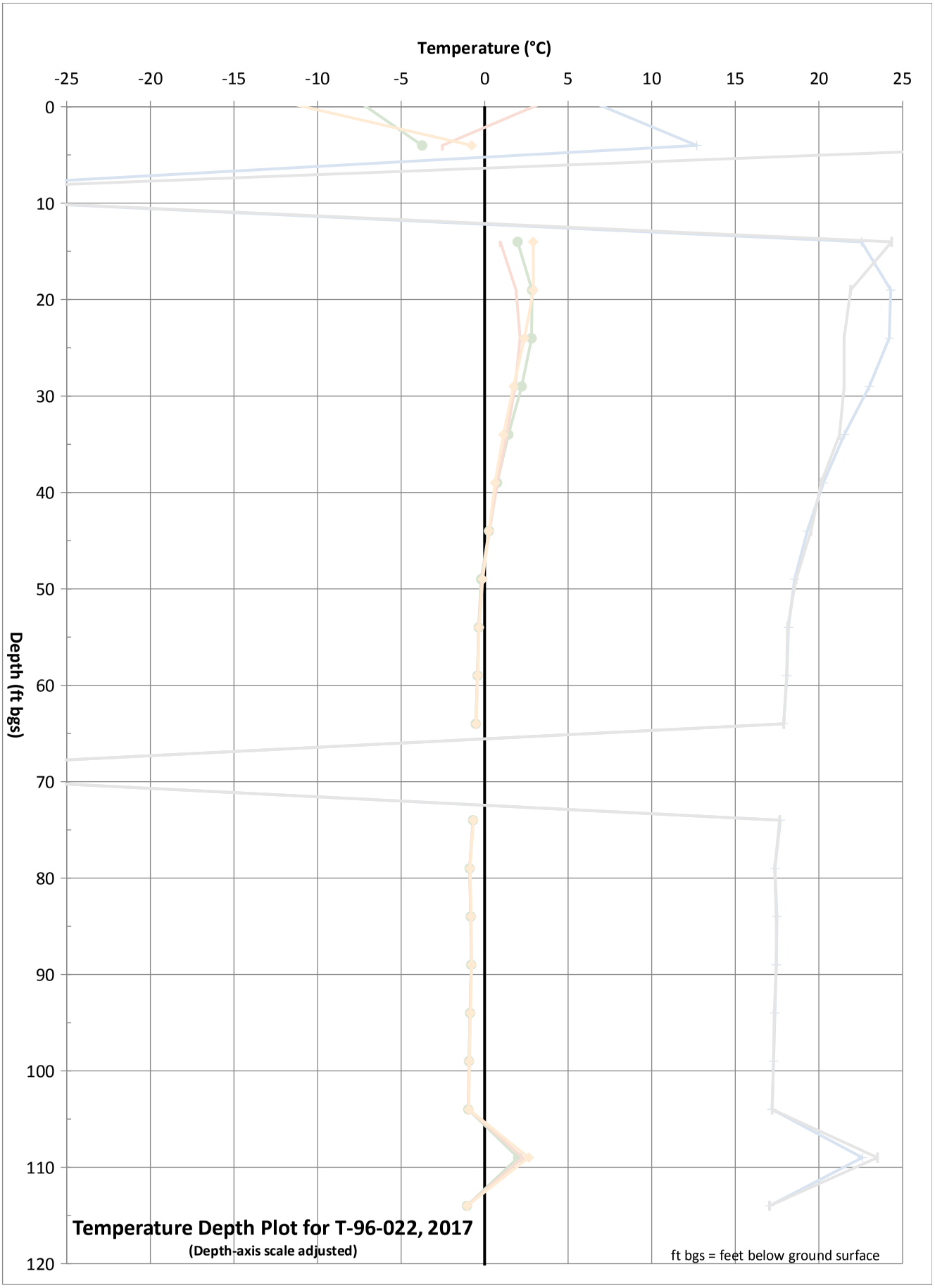

Temperature (°C)
-15
-10
-5
0
5
10
15
0
20
40
60
80
100
120
Depth (ft bgs)
Temperature Depth Plot for T-96-021
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

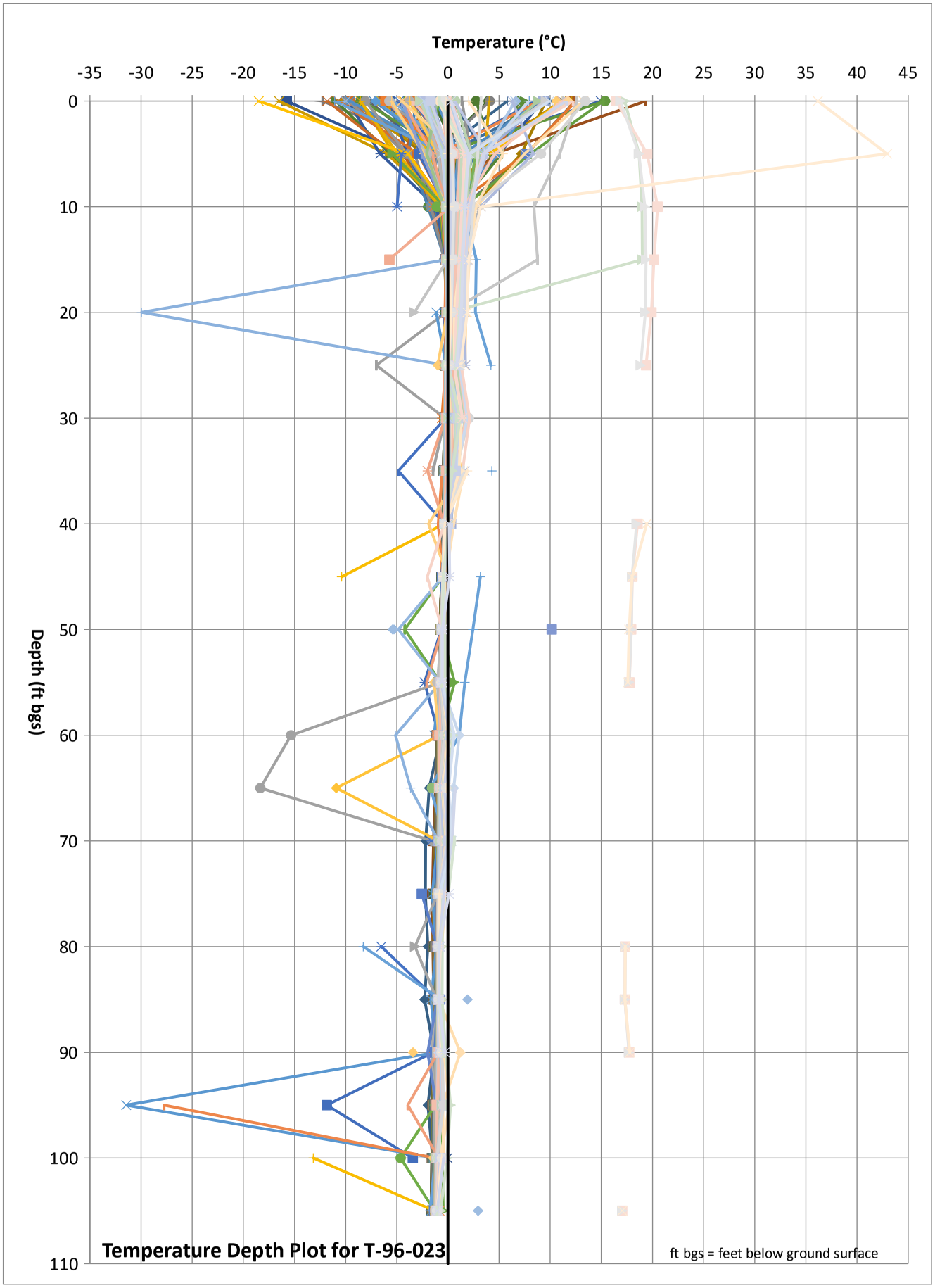

Temperature (°C)
-15
-10
-5
0
5
10
15
0
20
40
60
80
100
120
Depth (ft bgs)
Temperature Depth Plot for T-96-021, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

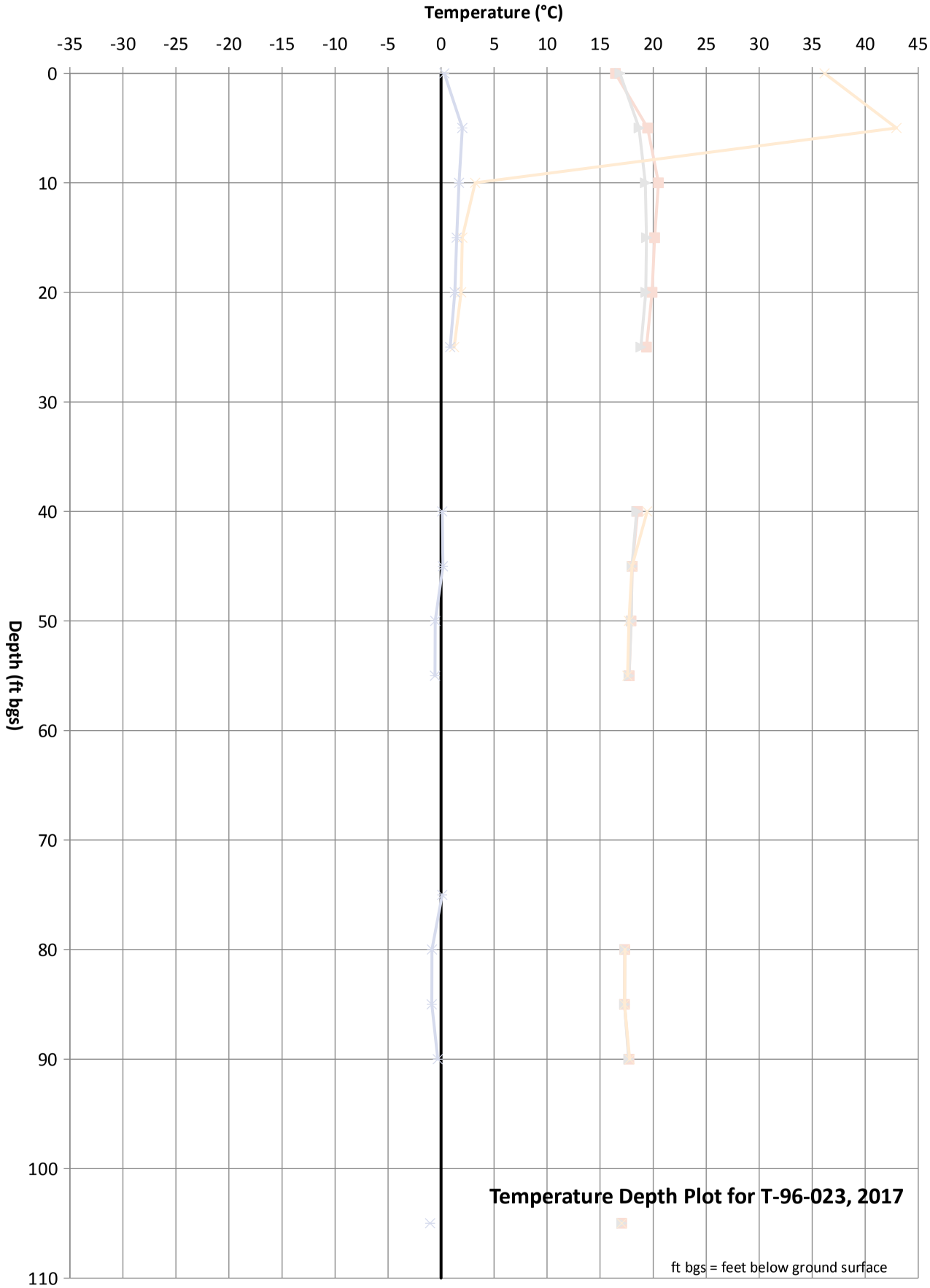

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
50
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature Depth Plot for T-96-022
ft bgs = feet below ground surface

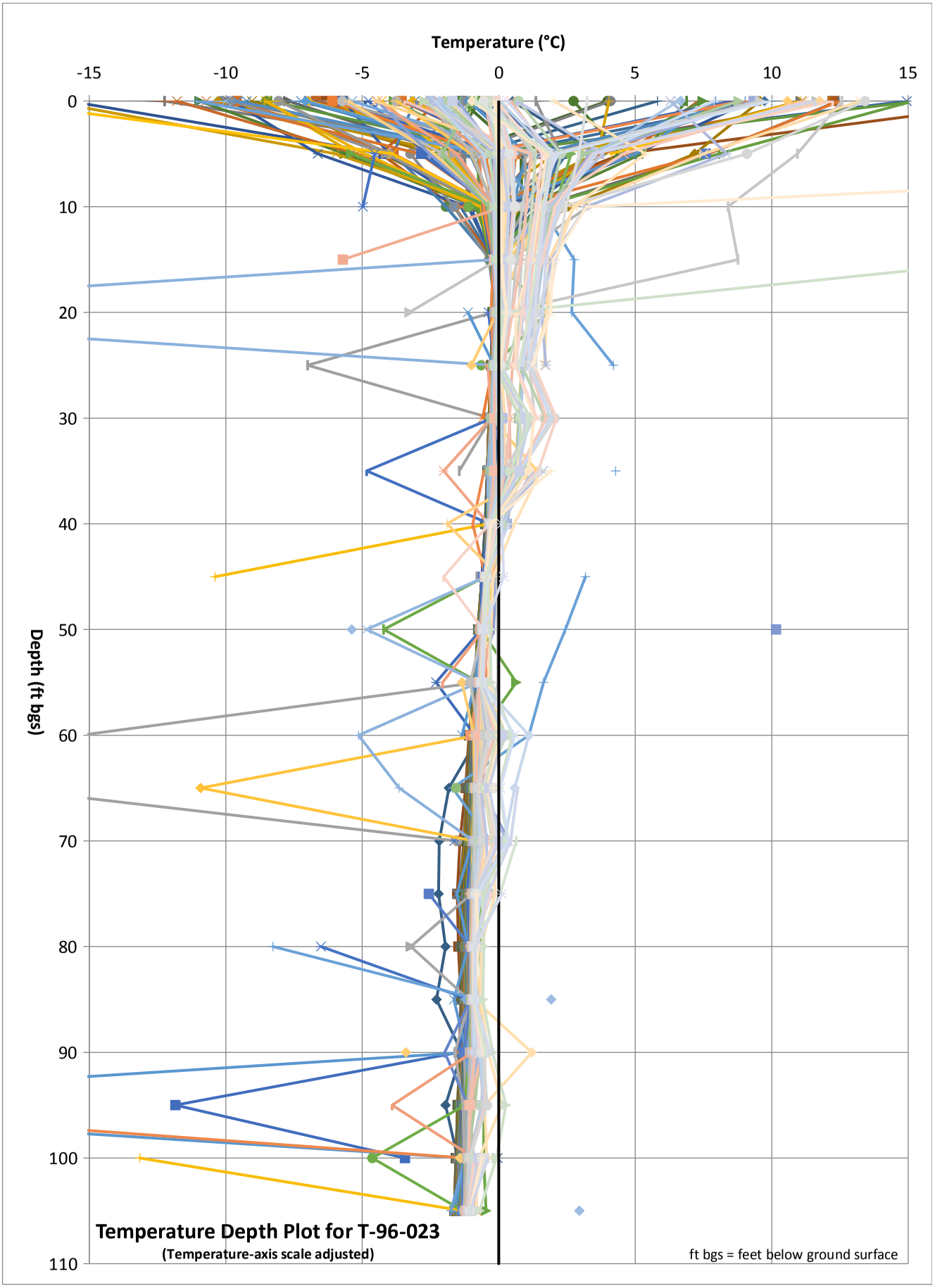

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
50
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature Depth Plot for T-96-022, 2017
ft bgs = feet below ground surface

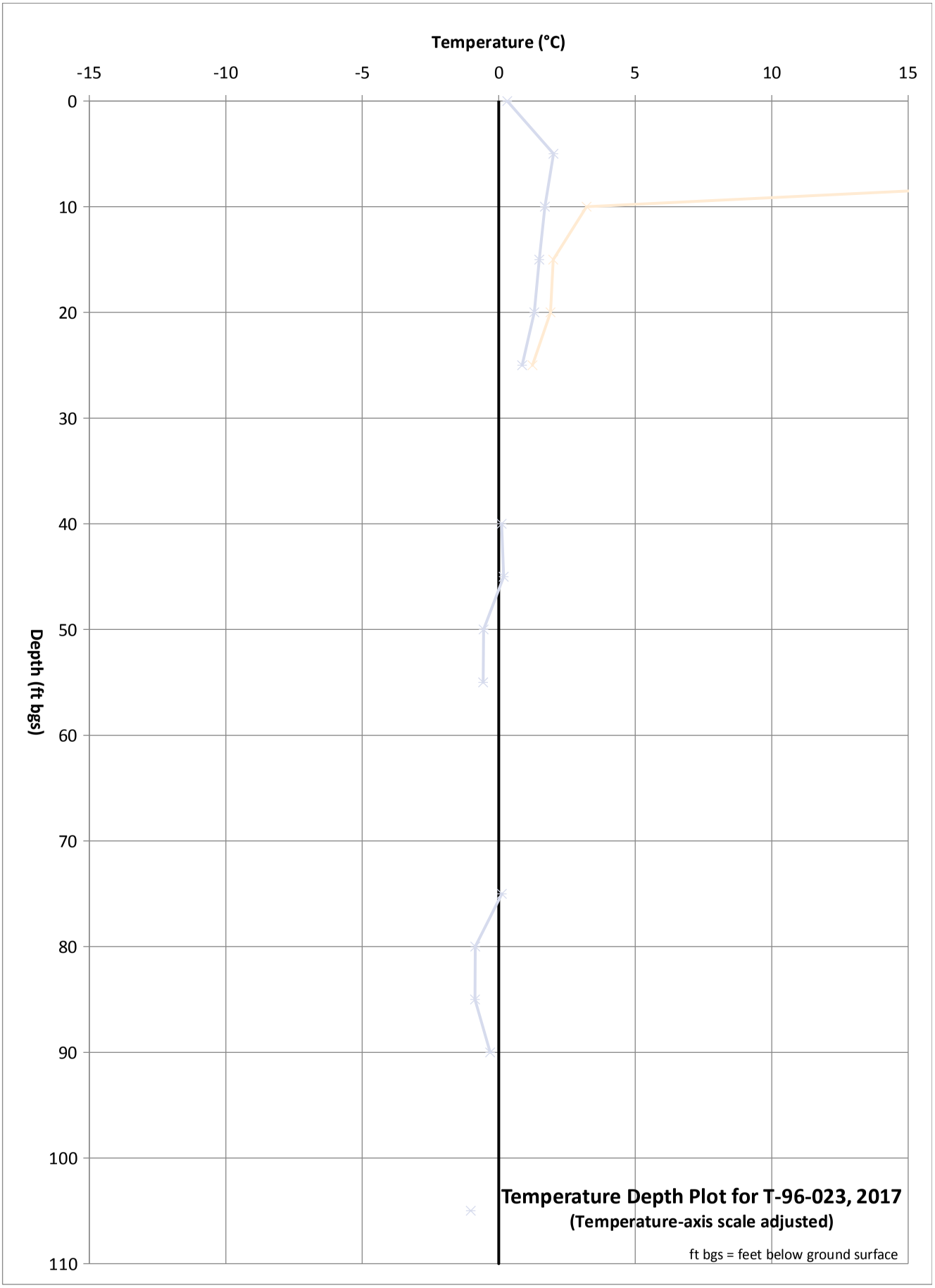

Temperature (°C)
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature Depth Plot for T-96-022
(Depth-axis scale adjusted)
ft bgs = feet below ground surface

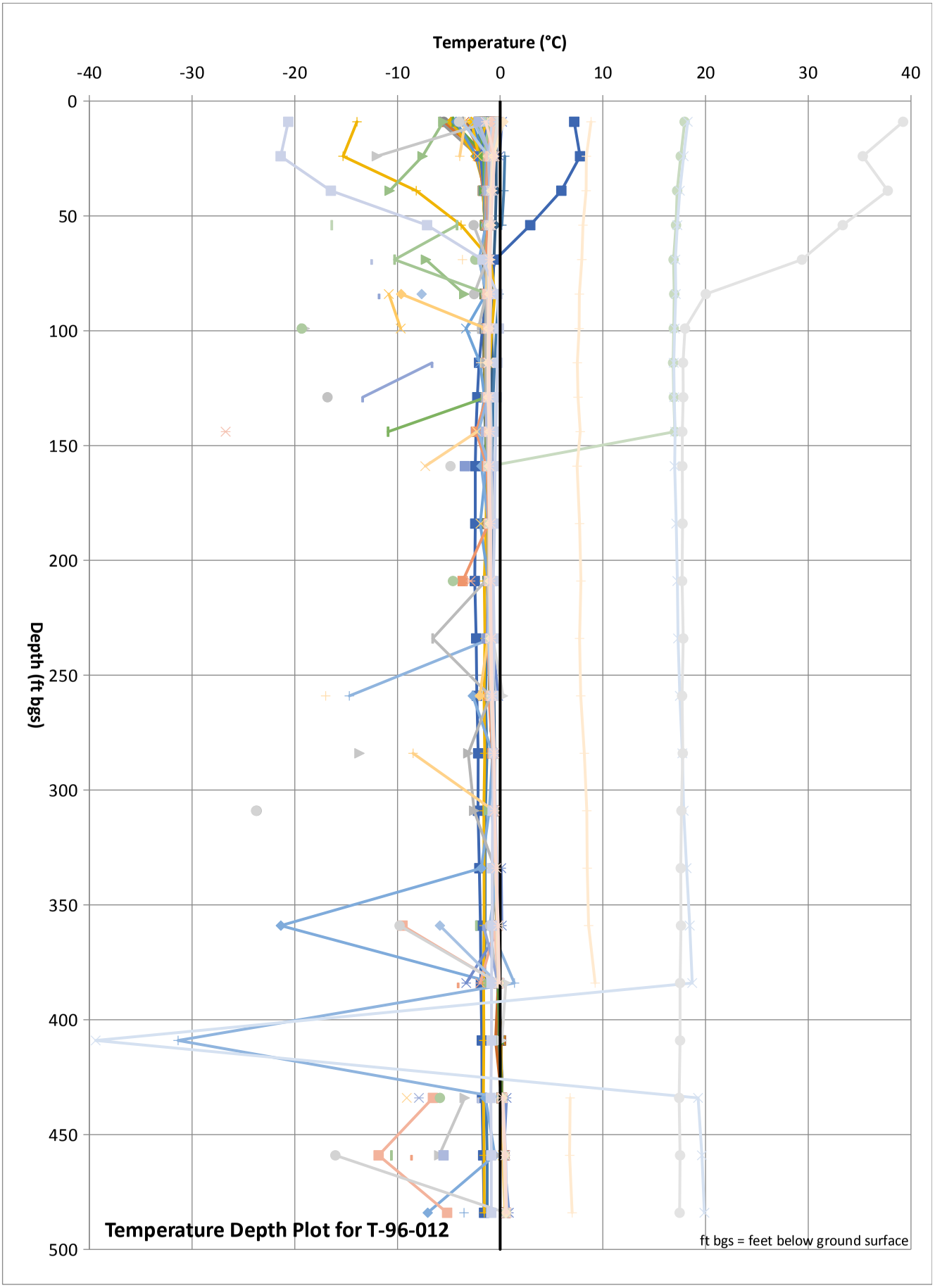

Temperature (°C)
-25
-20
-15
-10
-5
0
5
10
15
20
25
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature Depth Plot for T-96-022, 2017
(Depth-axis scale adjusted)
ft bgs = feet below ground surface

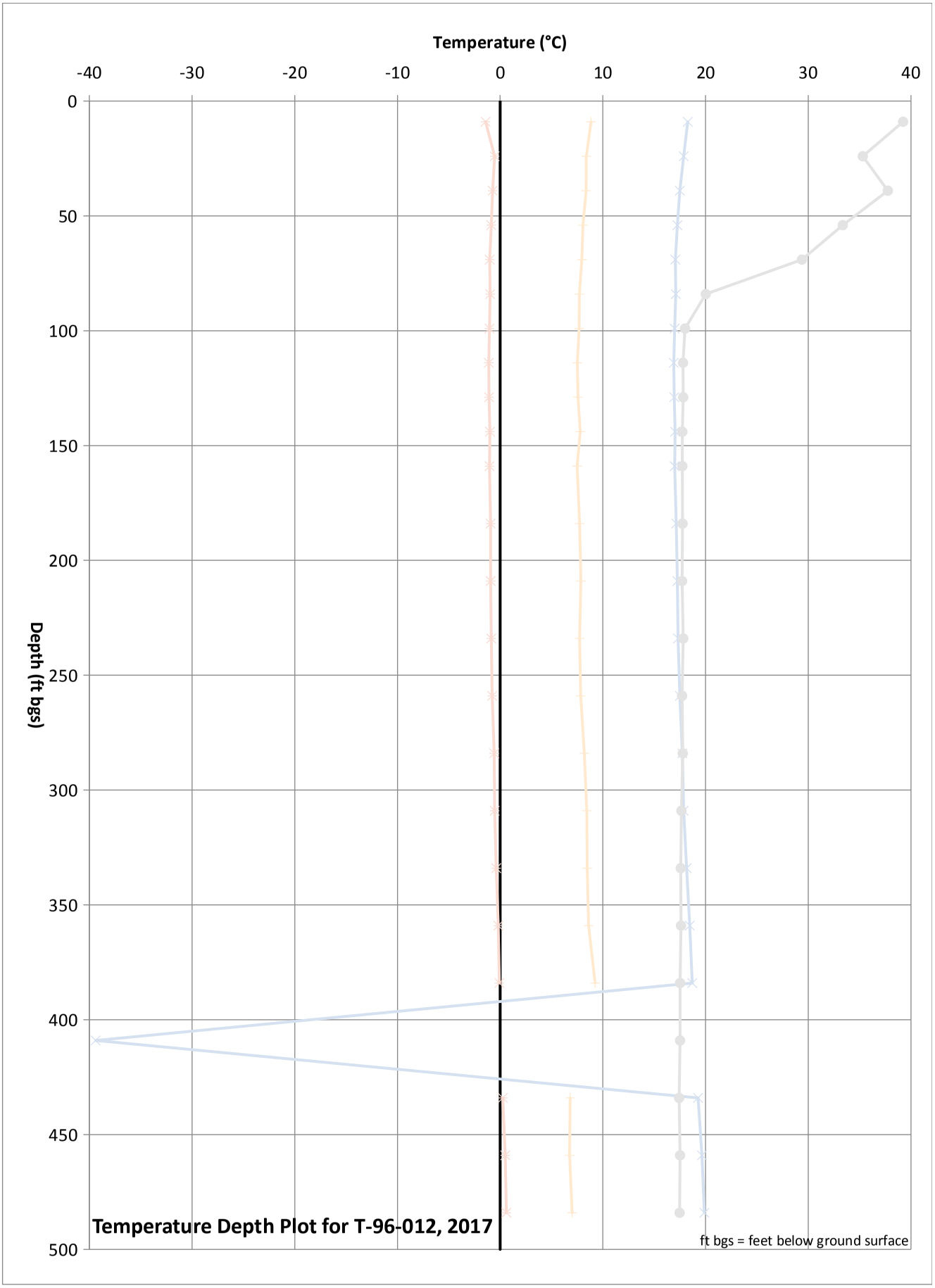

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
Temperature Depth Plot for T-96-023
ft bgs = feet below ground surface

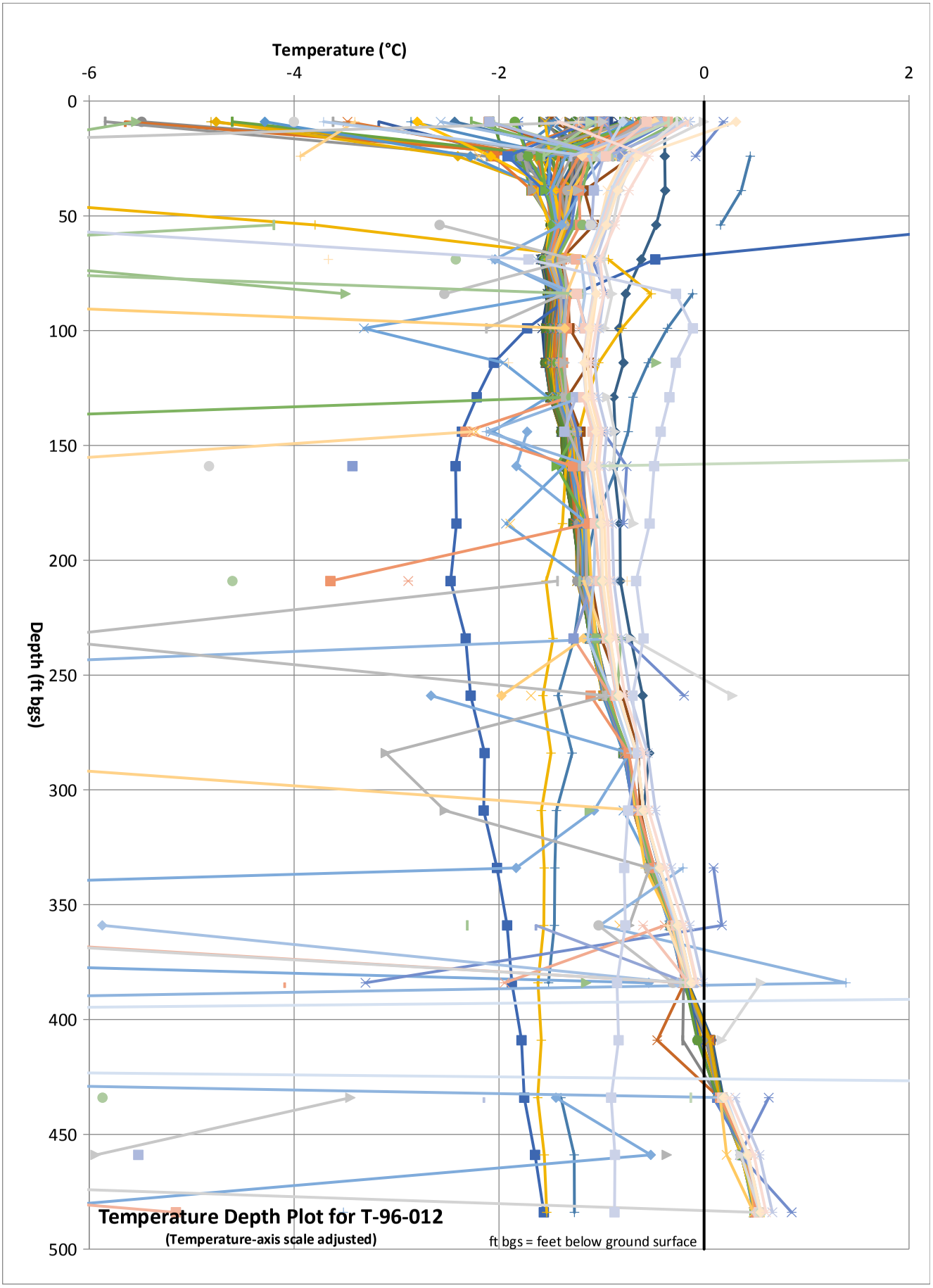

Temperature (°C)
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
Temperature Depth Plot for T-96-023, 2017
ft bgs = feet below ground surface

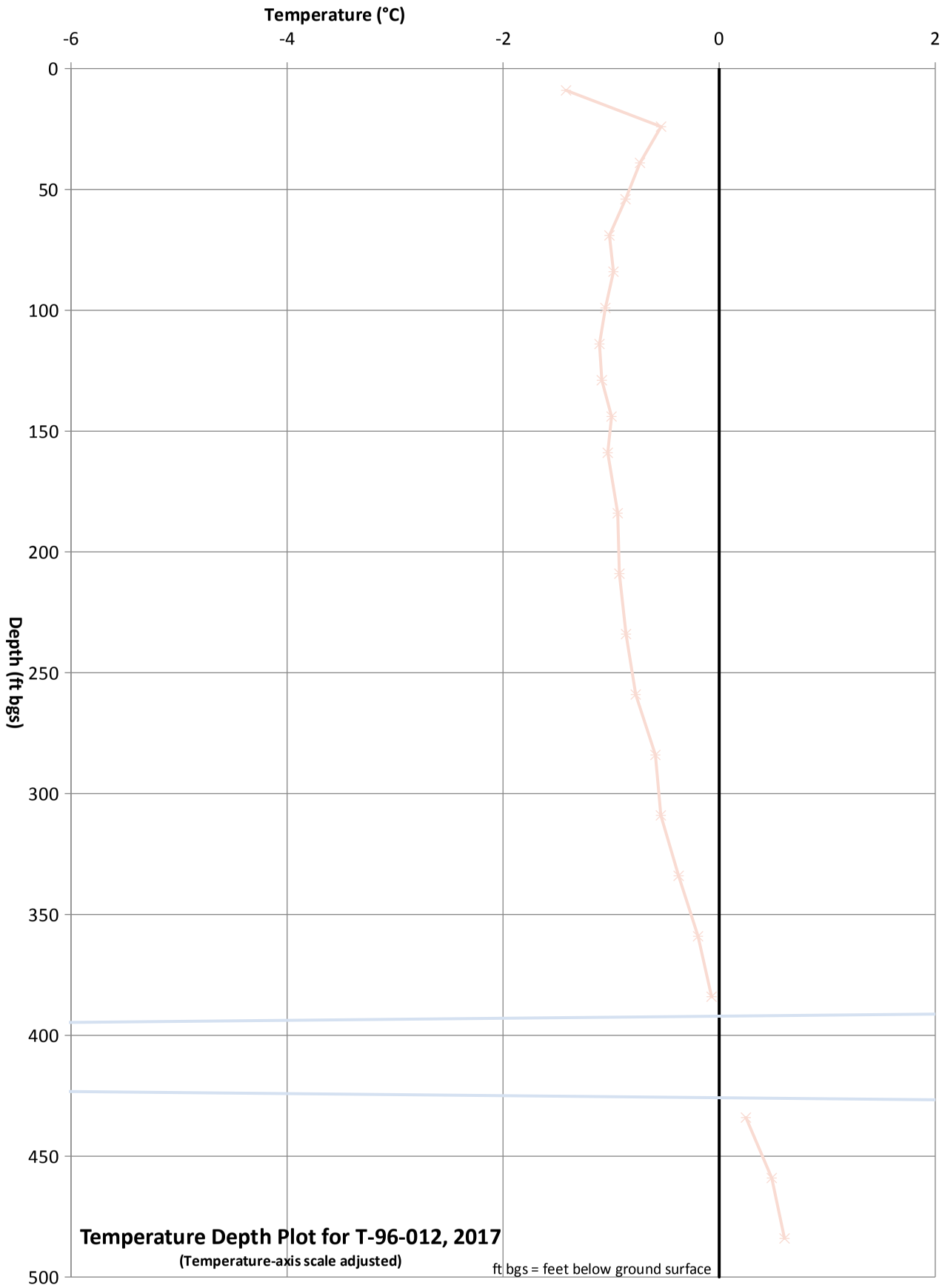

Temperature (°C)
-15
-10
-5
0
5
10
15
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
Temperature Depth Plot for T-96-023
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

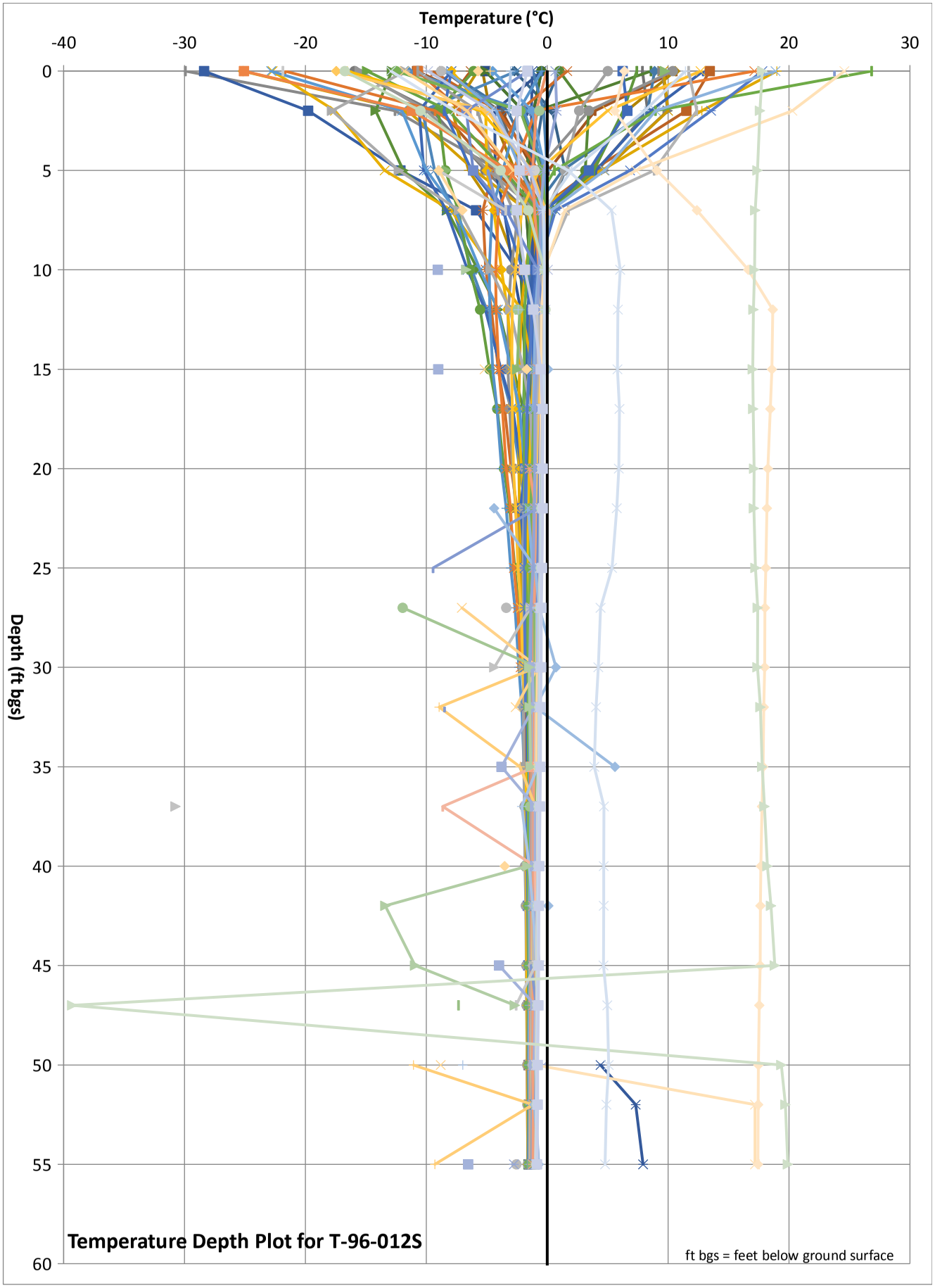

Temperature (°C)
-15
-10
-5
0
5
10
15
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
90
100
110
Temperature Depth Plot for T-96-023, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

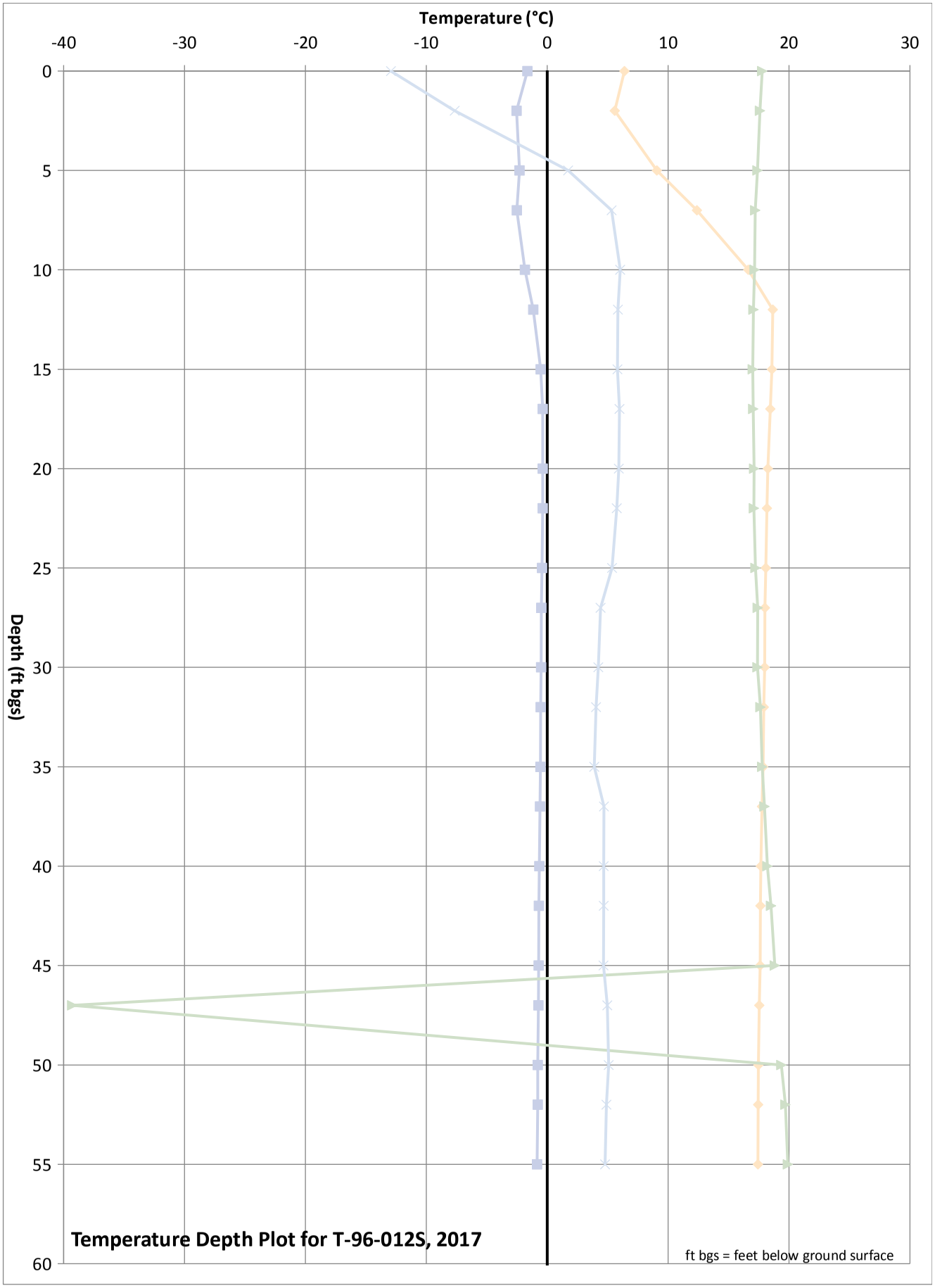

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
Temperature Depth Plot for T-96-012
ft bgs = feet below ground surface

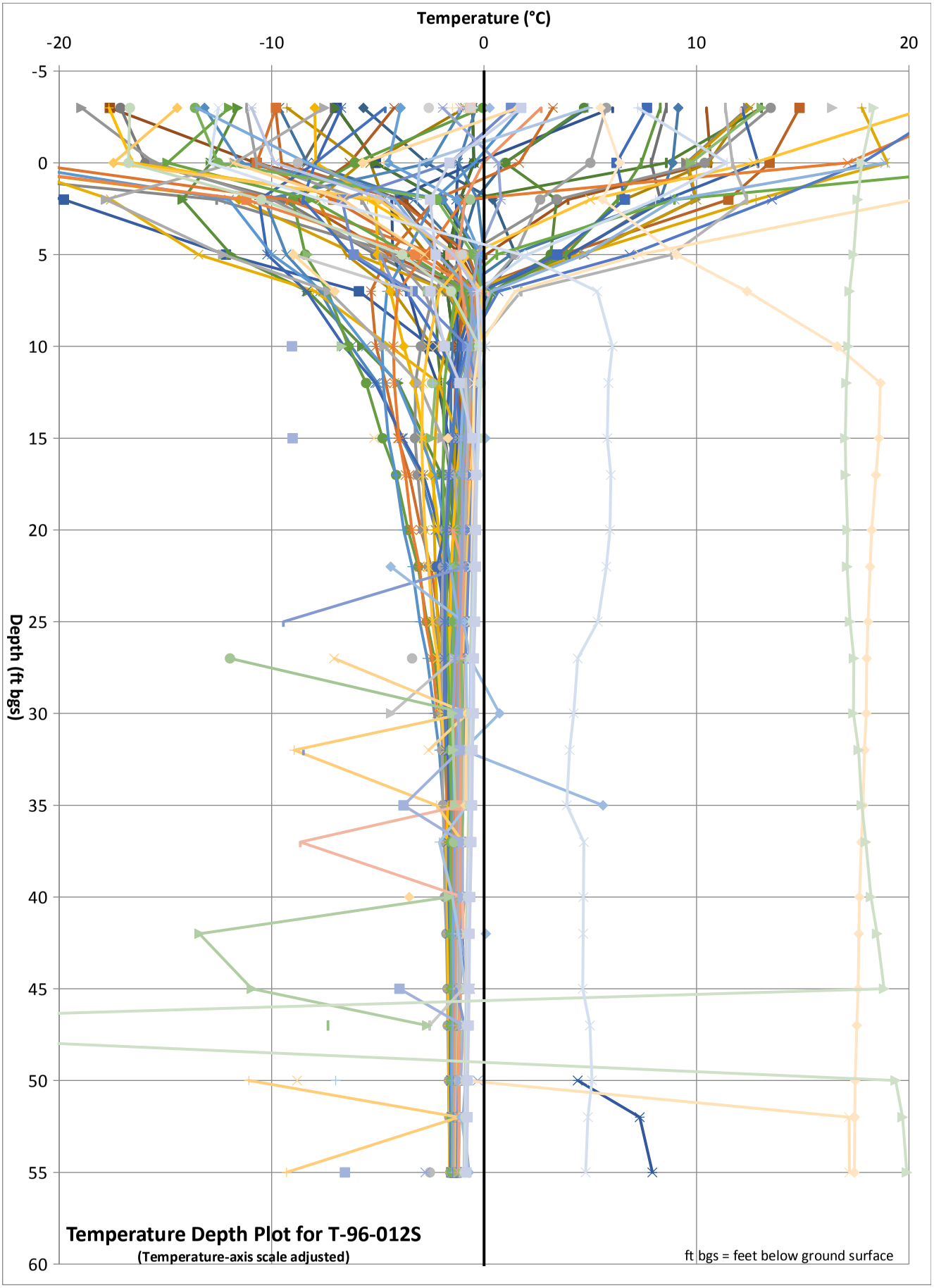

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
40
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
450
500
Temperature Depth Plot for T-96-012, 2017
ft bgs = feet below ground surface

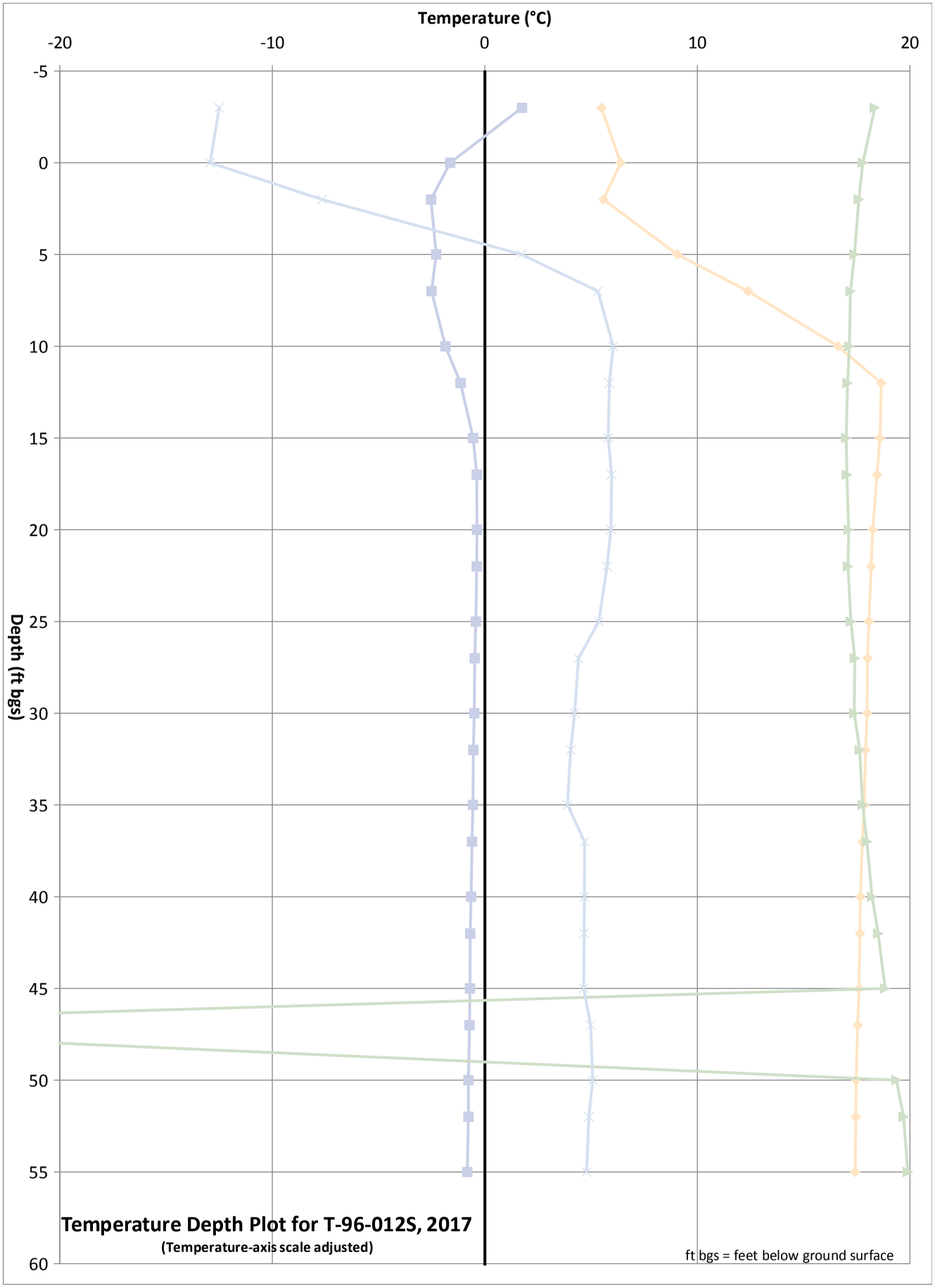

Temperature (°C)
-6
-4
-2
0
2
0
50
100
150
200
250
300
350
400
450
500
Depth (ft bgs)
Temperature Depth Plot for T-96-012
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

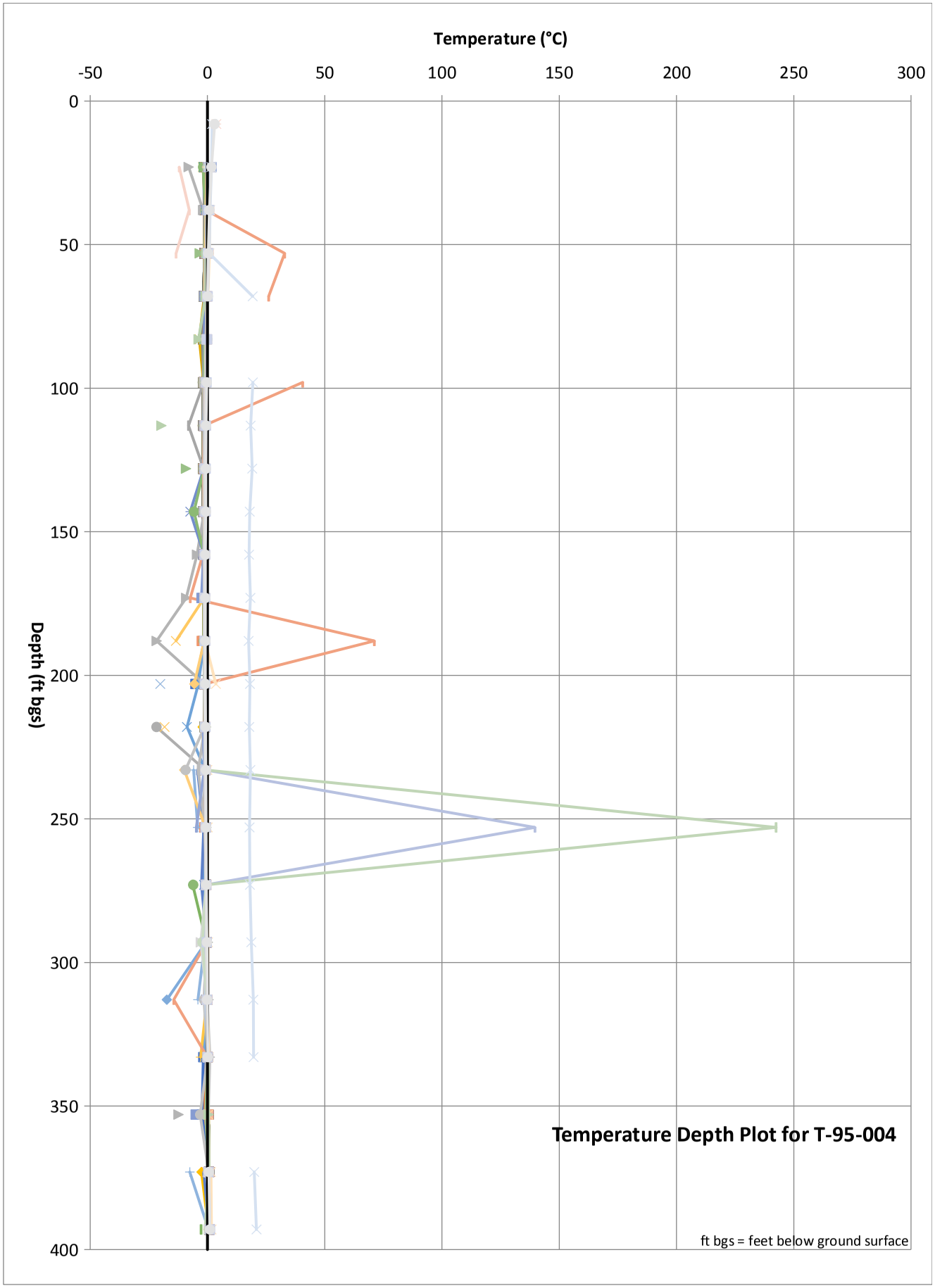

Temperature (°C)
-6
-4
-2
0
2
0
50
100
150
200
250
300
350
400
450
500
Depth (ft bgs)
Temperature Depth Plot for T-96-012, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

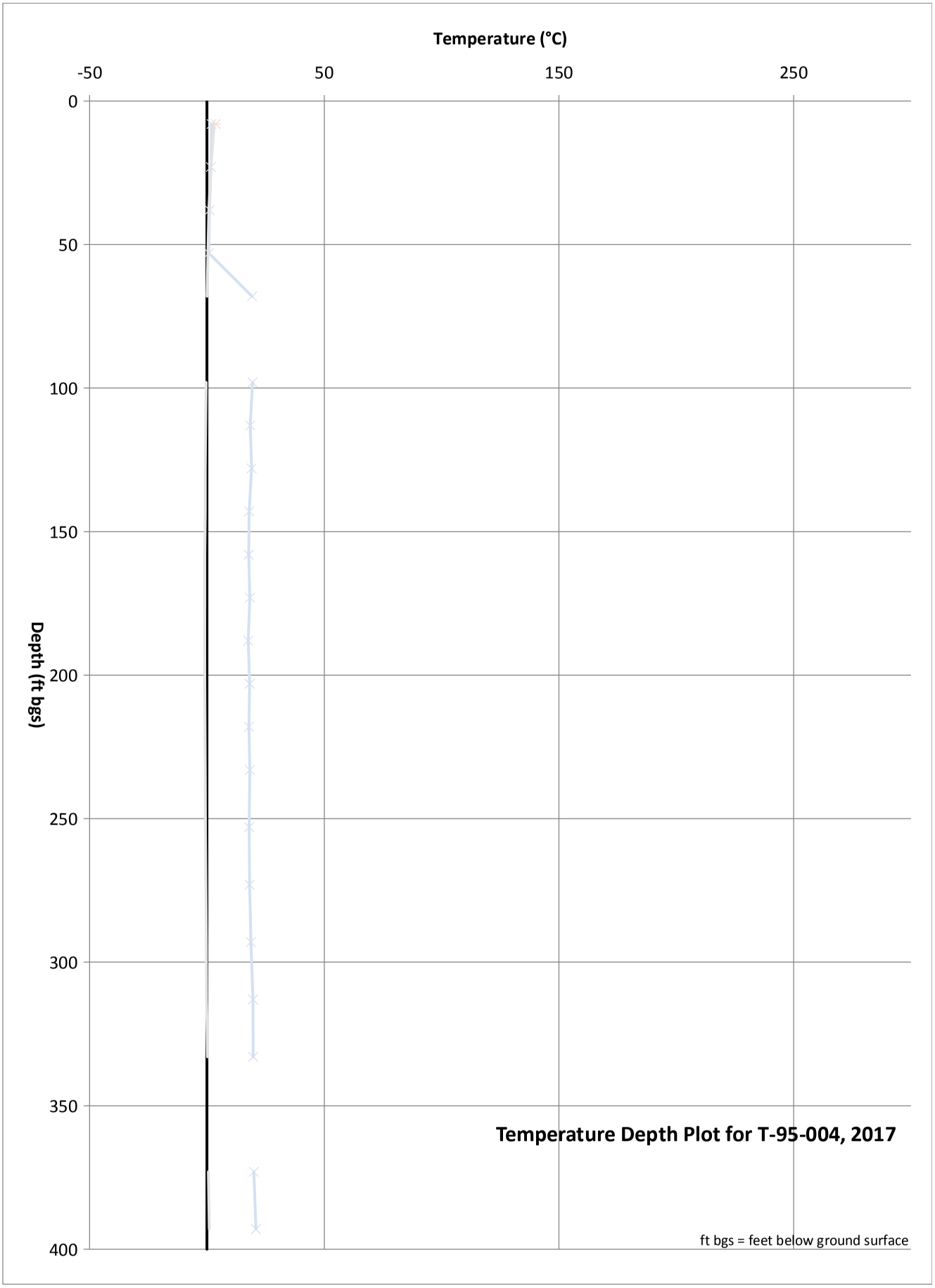

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
Depth (ft bgs)
0
5
10
15
20
25
30
35
40
45
50
55
60
Temperature Depth Plot for T-96-012S
ft bgs = feet below ground surface

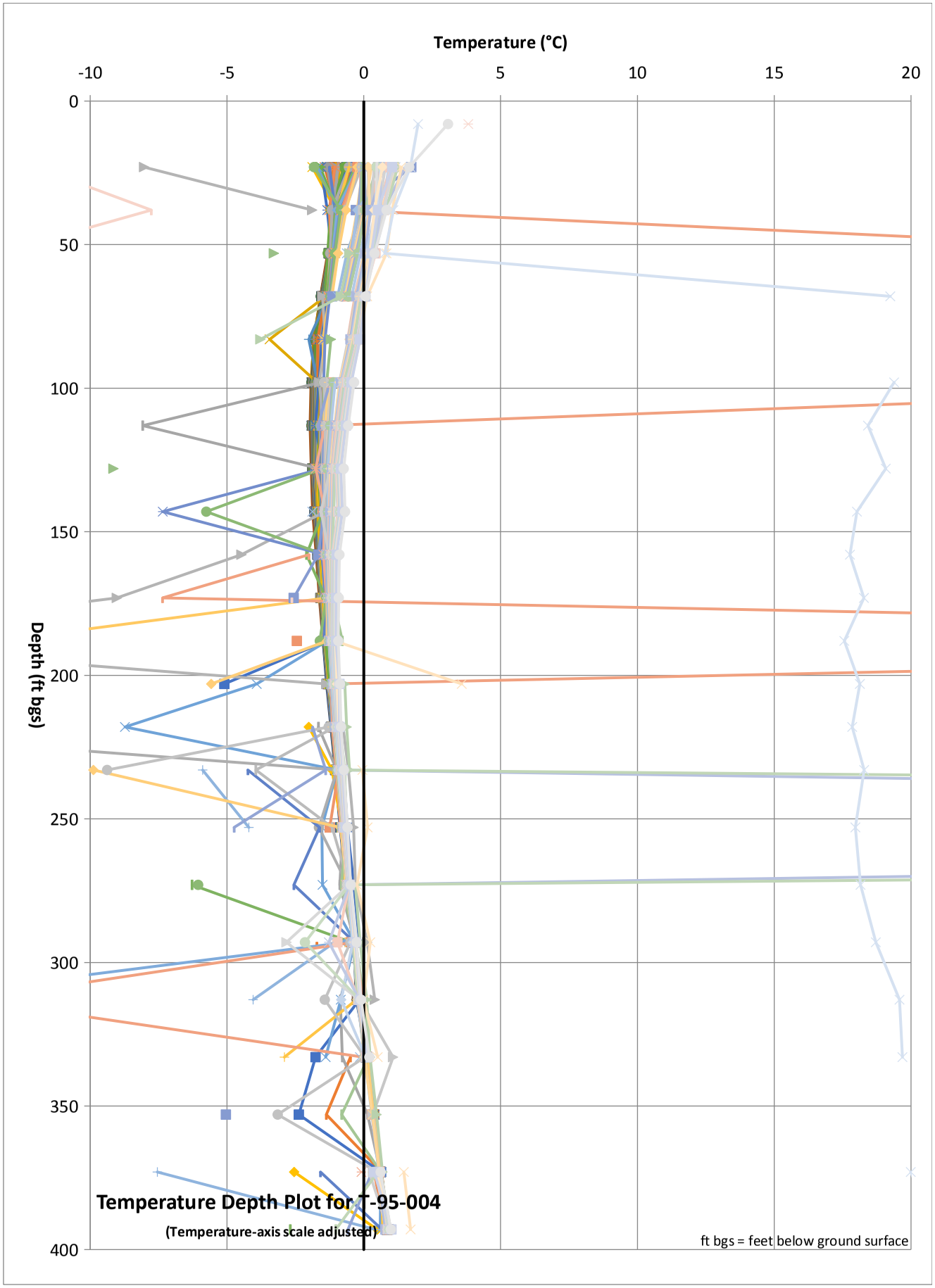

Temperature (°C)
-40
-30
-20
-10
0
10
20
30
Depth (ft bgs)
0
5
10
15
20
25
30
35
40
45
50
55
60
Temperature Depth Plot for T-96-012S, 2017
ft bgs = feet below ground surface

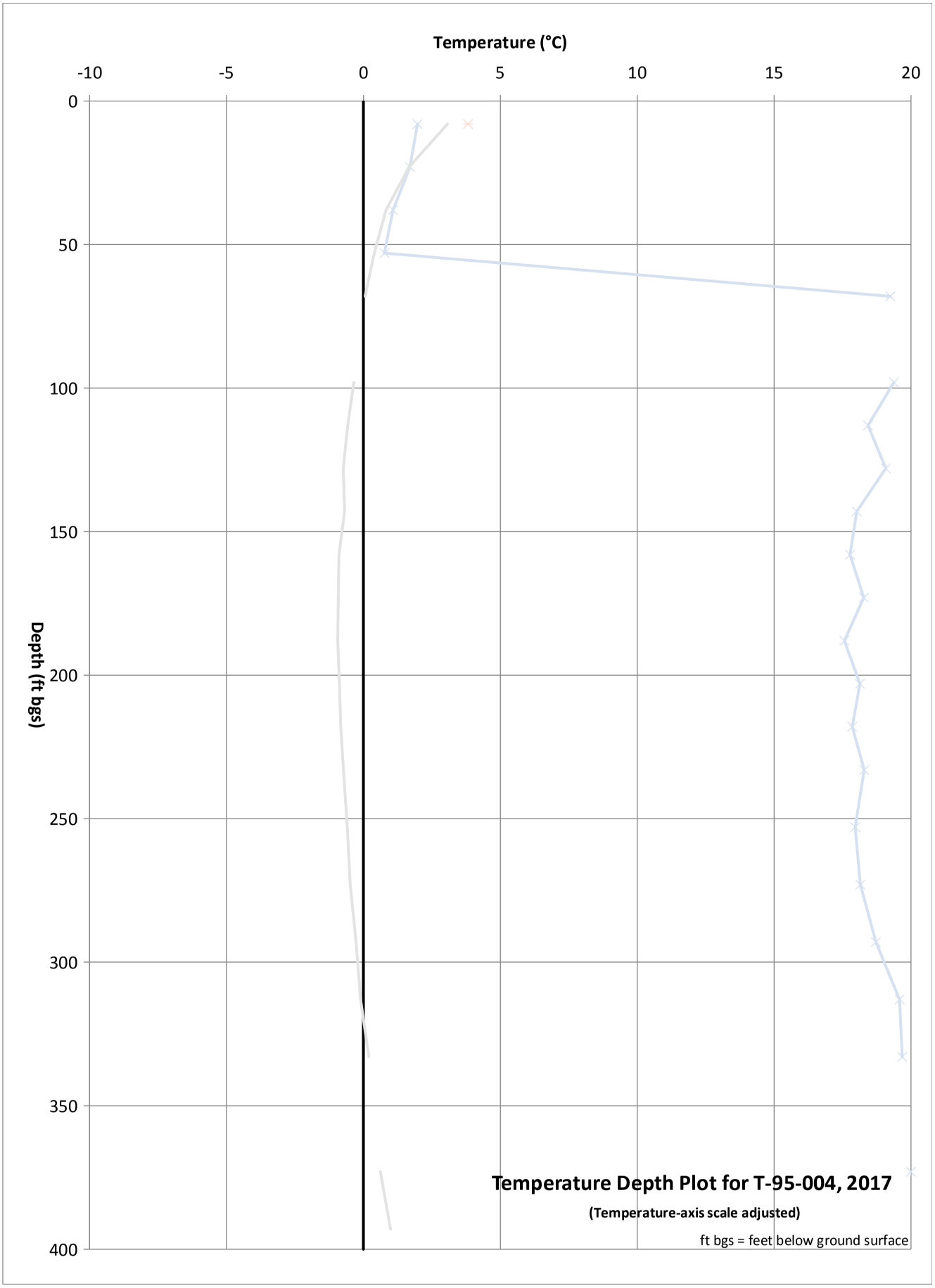

Temperature (°C)
-20
-10
0
10
20
Depth (ft bgs)
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Temperature Depth Plot for T-96-012S
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface


Temperature (°C)
-20
-10
0
10
20
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Depth (ft bgs)
Temperature Depth Plot for T-96-012S, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

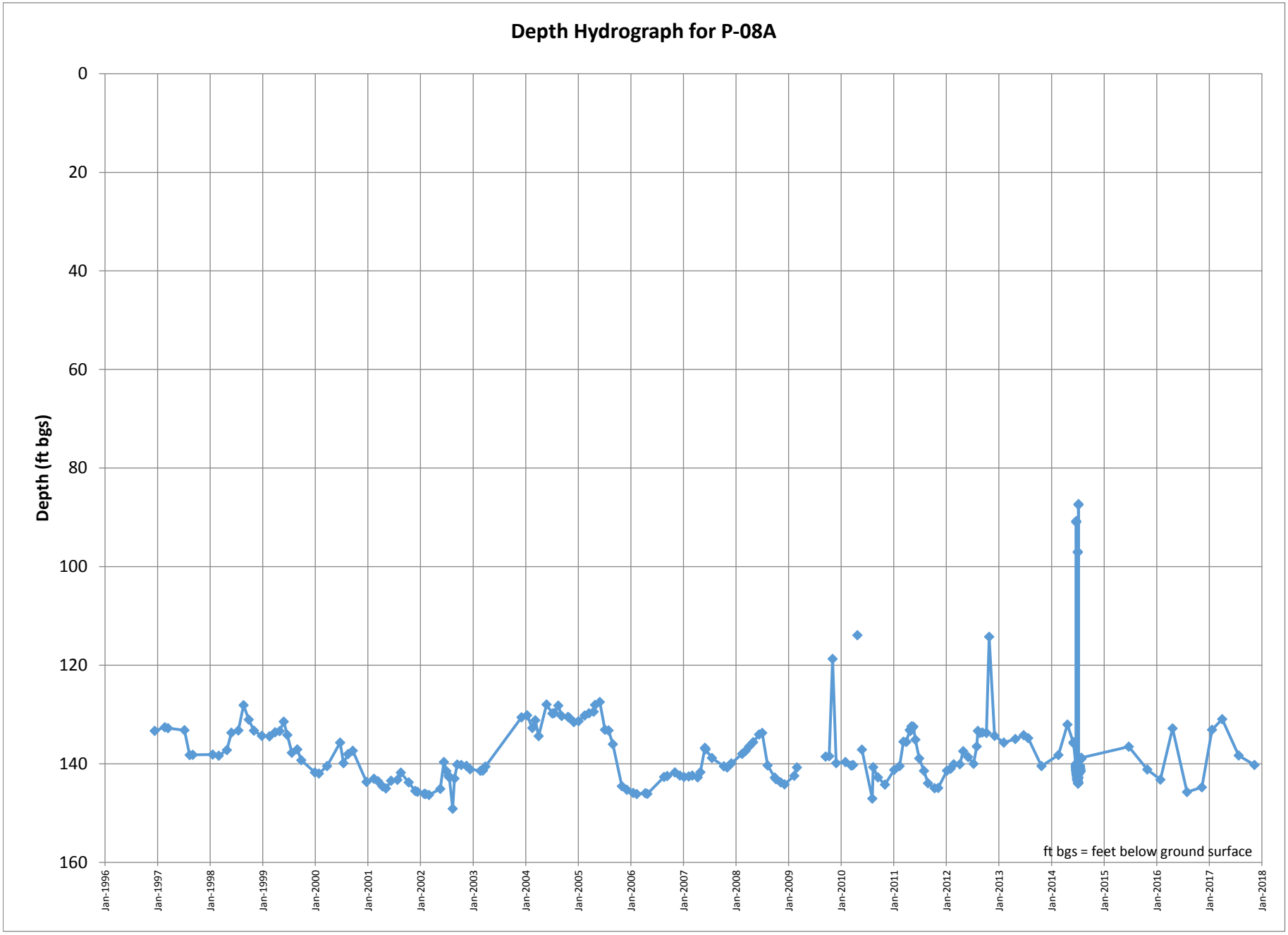

Temperature (°C)
-50
0
50
100
150
200
250
300
Depth (ft bgs)
0
50
100
150
200
250
300
350
400
Temperature Depth Plot for T-95-004
ft bgs = feet below ground surface

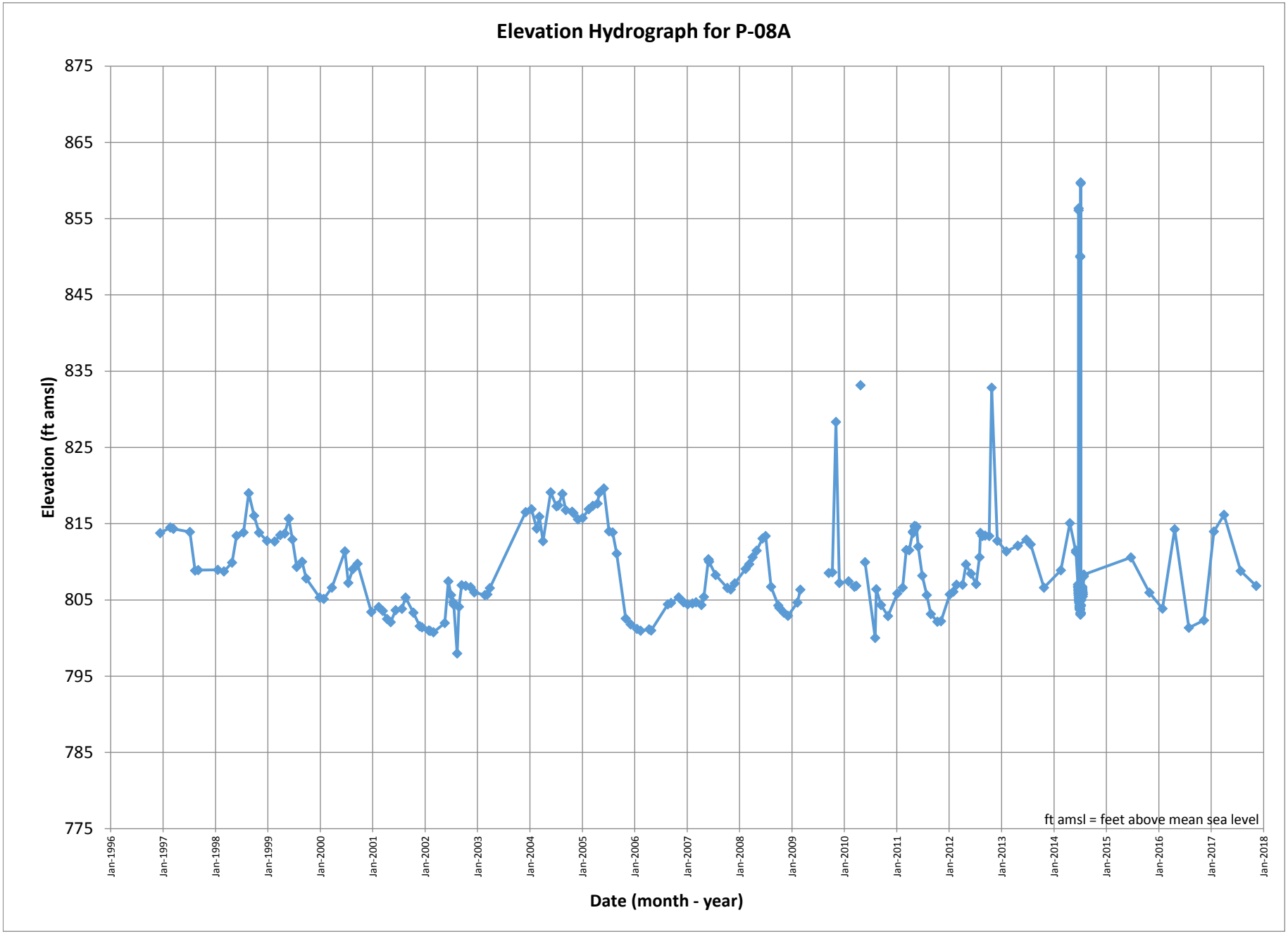

Temperature (°C)
-50
50
150
250
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-95-004, 2017
ft bgs = feet below ground surface

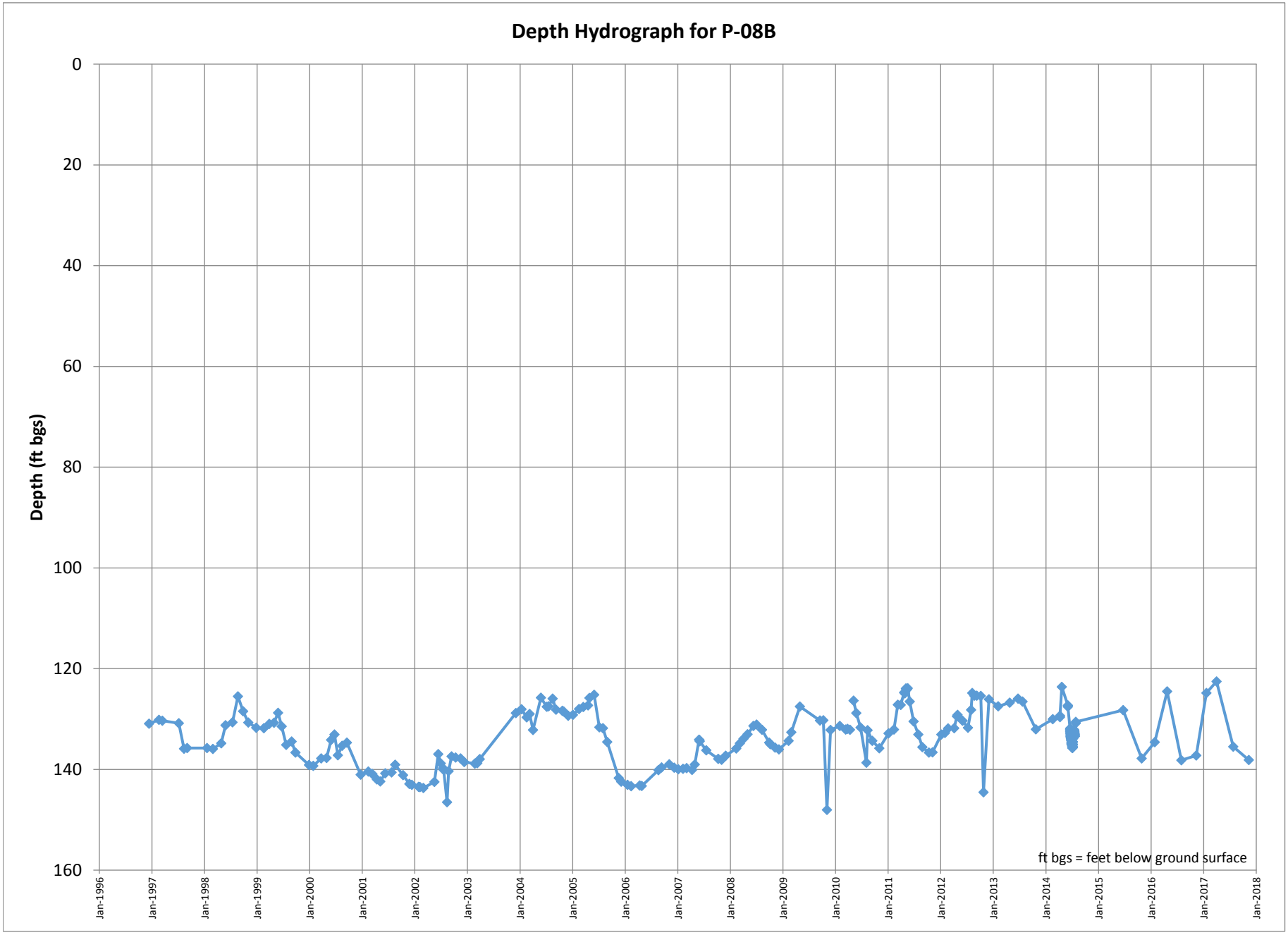

Temperature (°C)
-10
-5
0
5
10
15
20
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-95-004
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

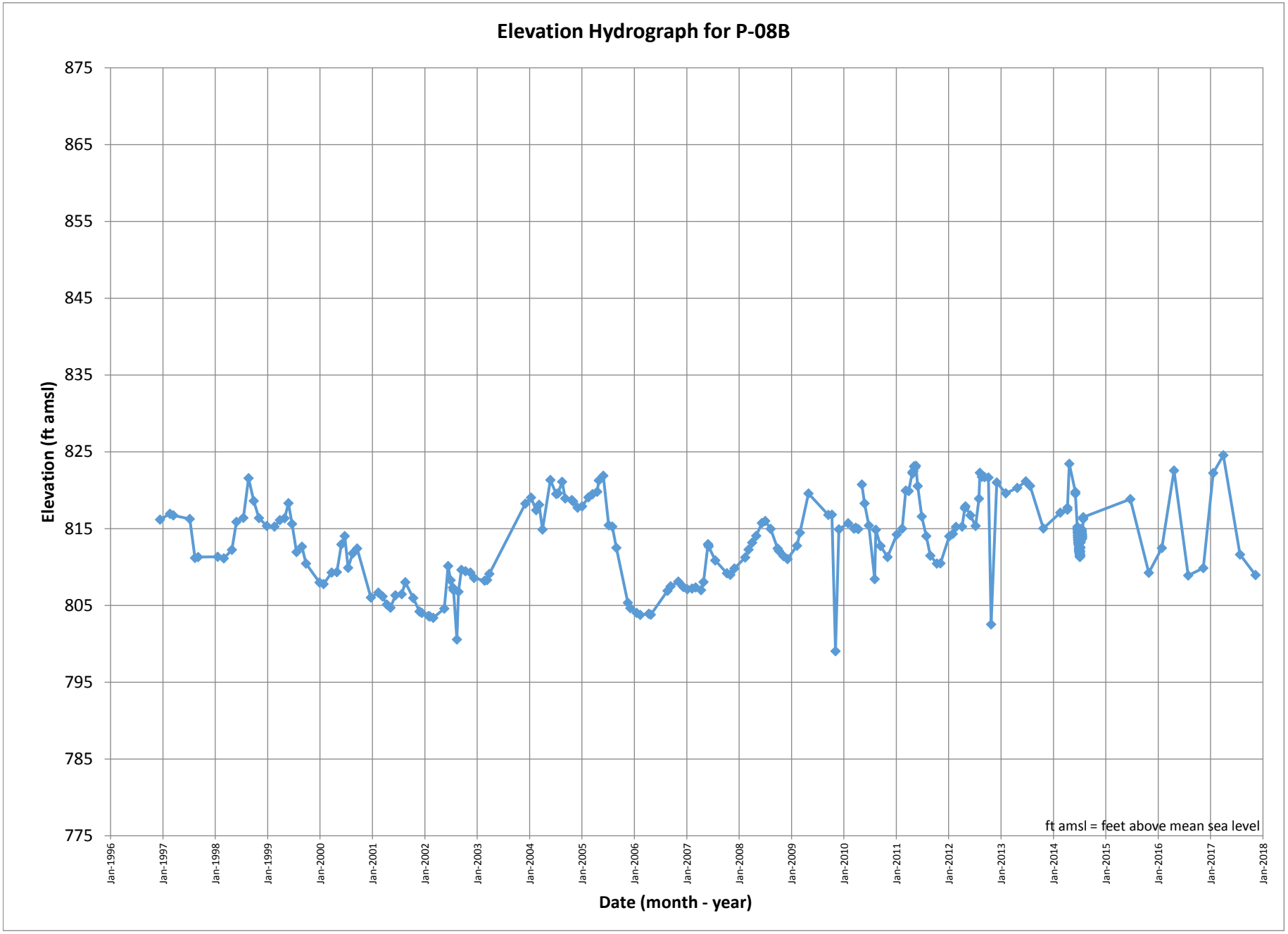

Temperature (°C)
-10
-5
0
5
10
15
20
0
50
100
150
200
250
300
350
400
Depth (ft bgs)
Temperature Depth Plot for T-95-004, 2017
(Temperature-axis scale adjusted)
ft bgs = feet below ground surface

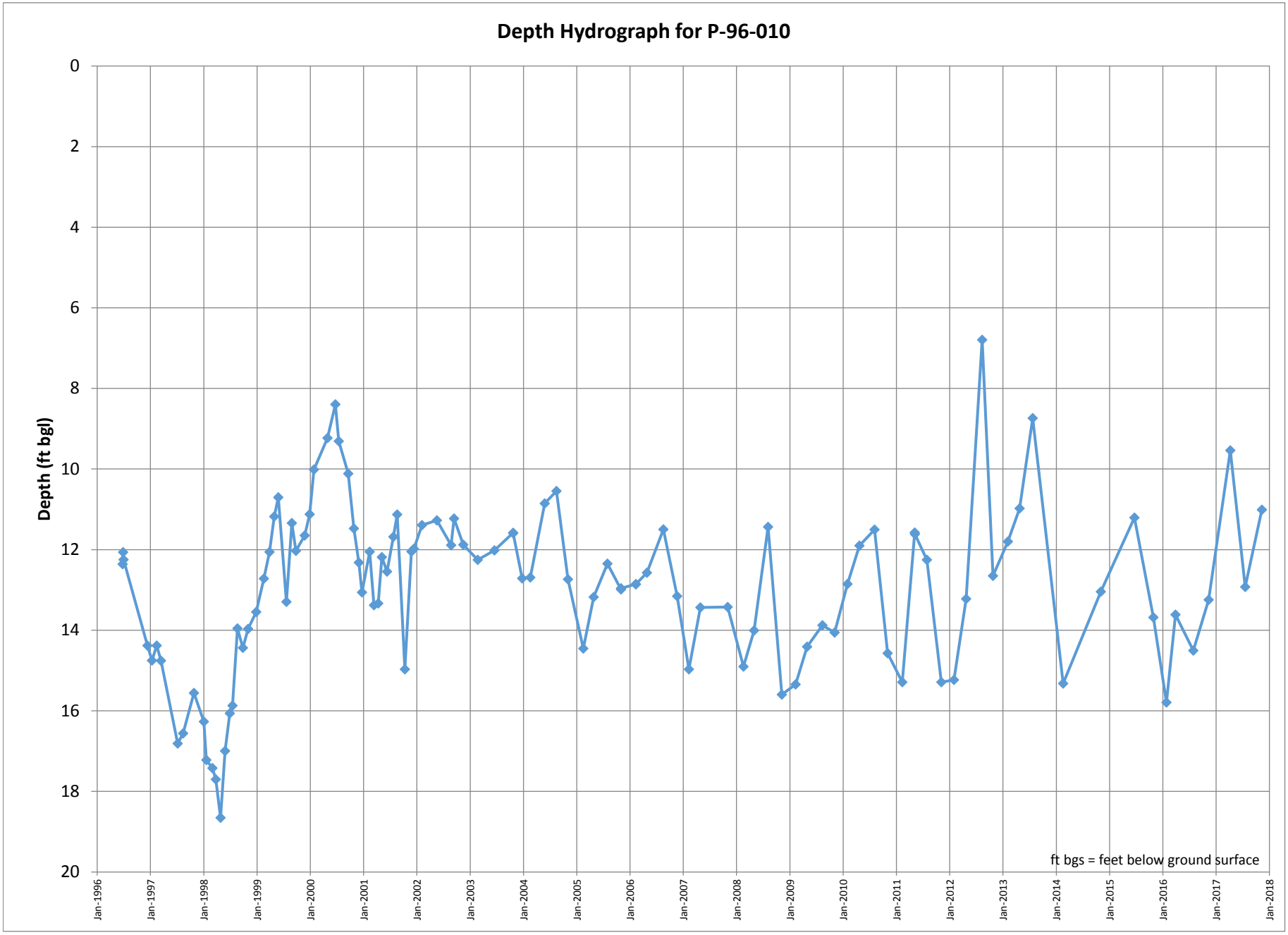
Appendix C
Piezometer Plots

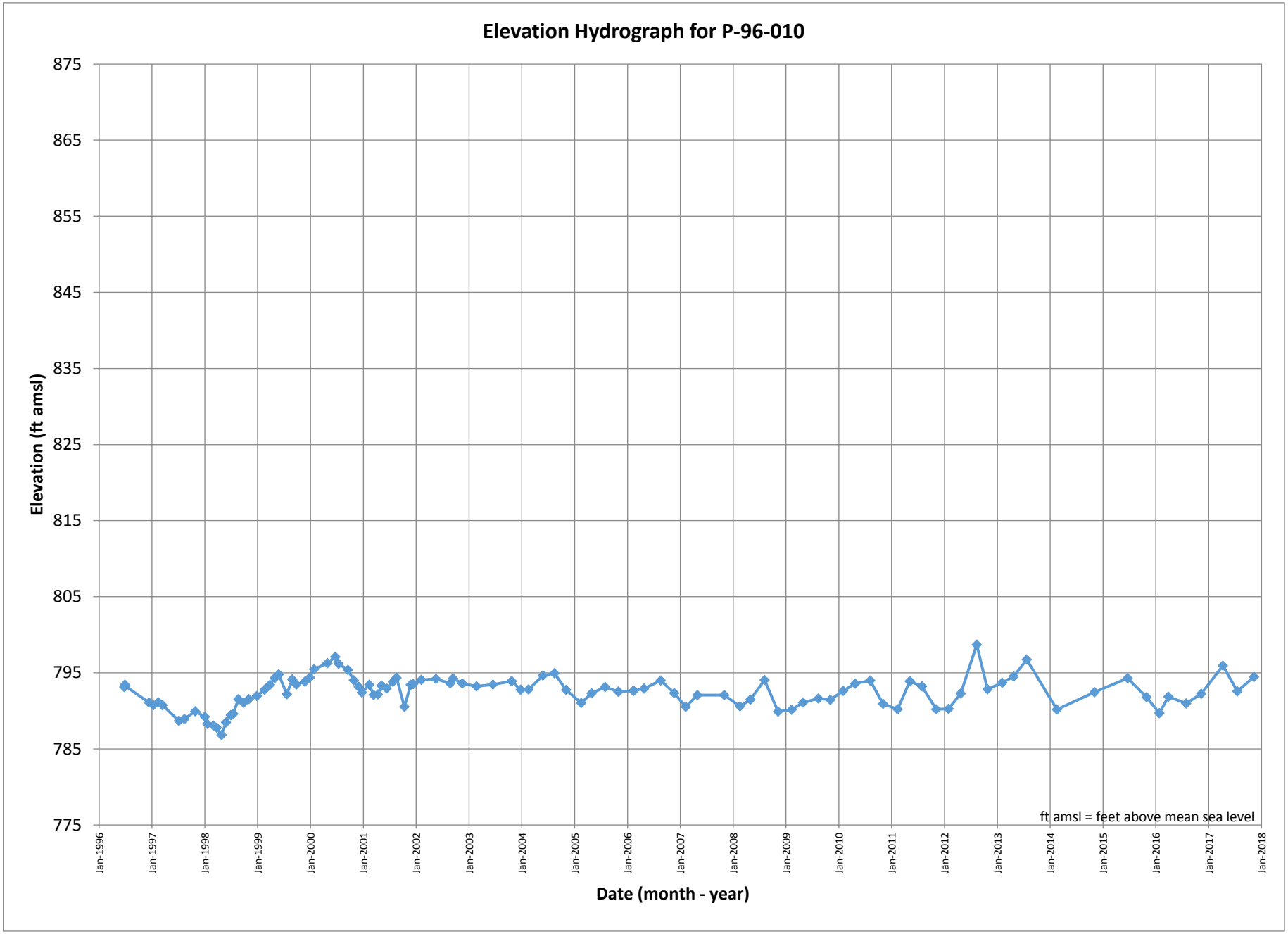

Depth Hydrograph for P-08A
Depth (ft bgs)
0
20
40
60
80
100
120
140
160
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = feet below ground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

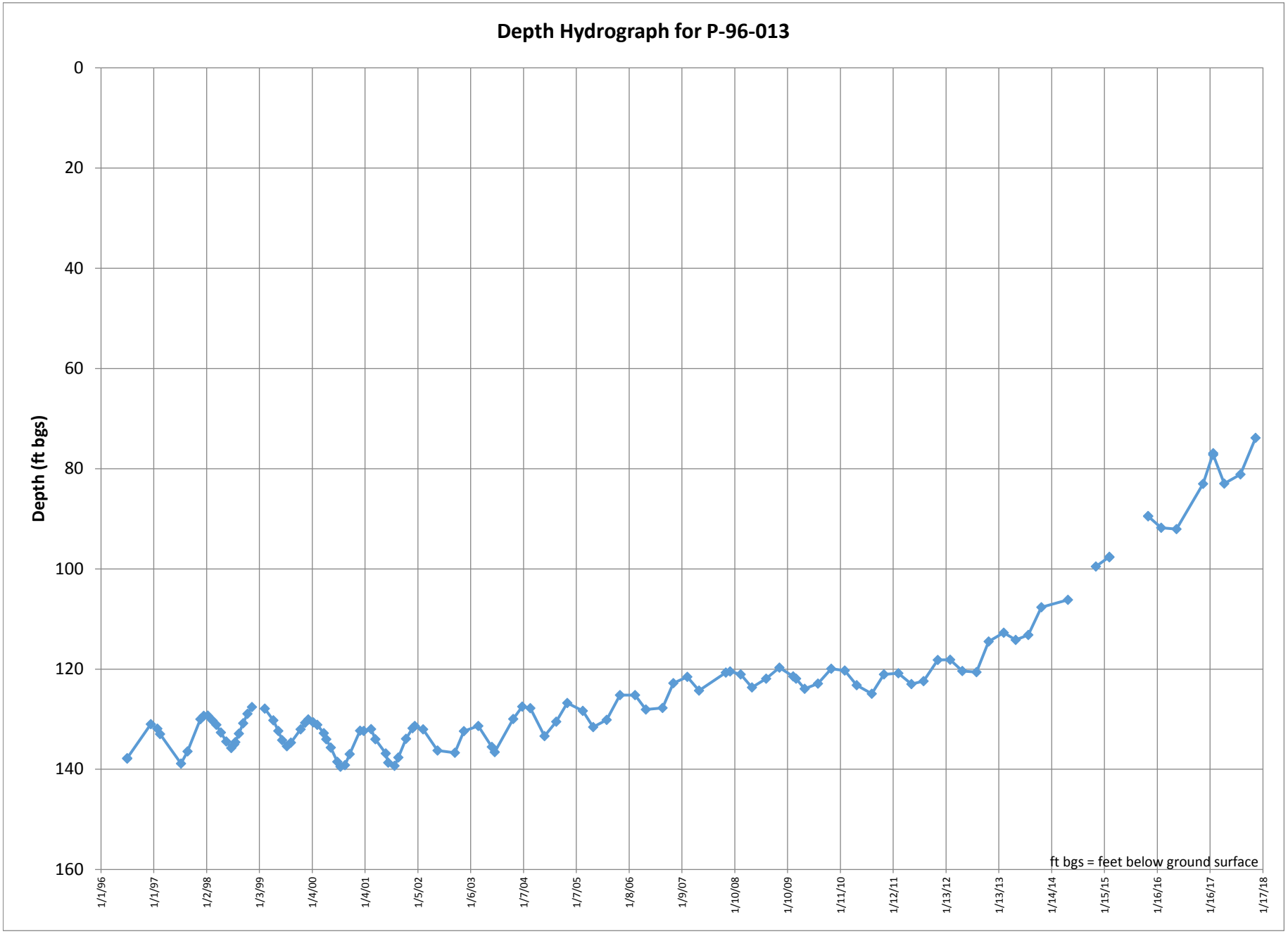

Elevation Hydrograph for P-08A
Elevation (ft amsl)
875
865
855
845
835
825
815
805
795
785
775
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018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

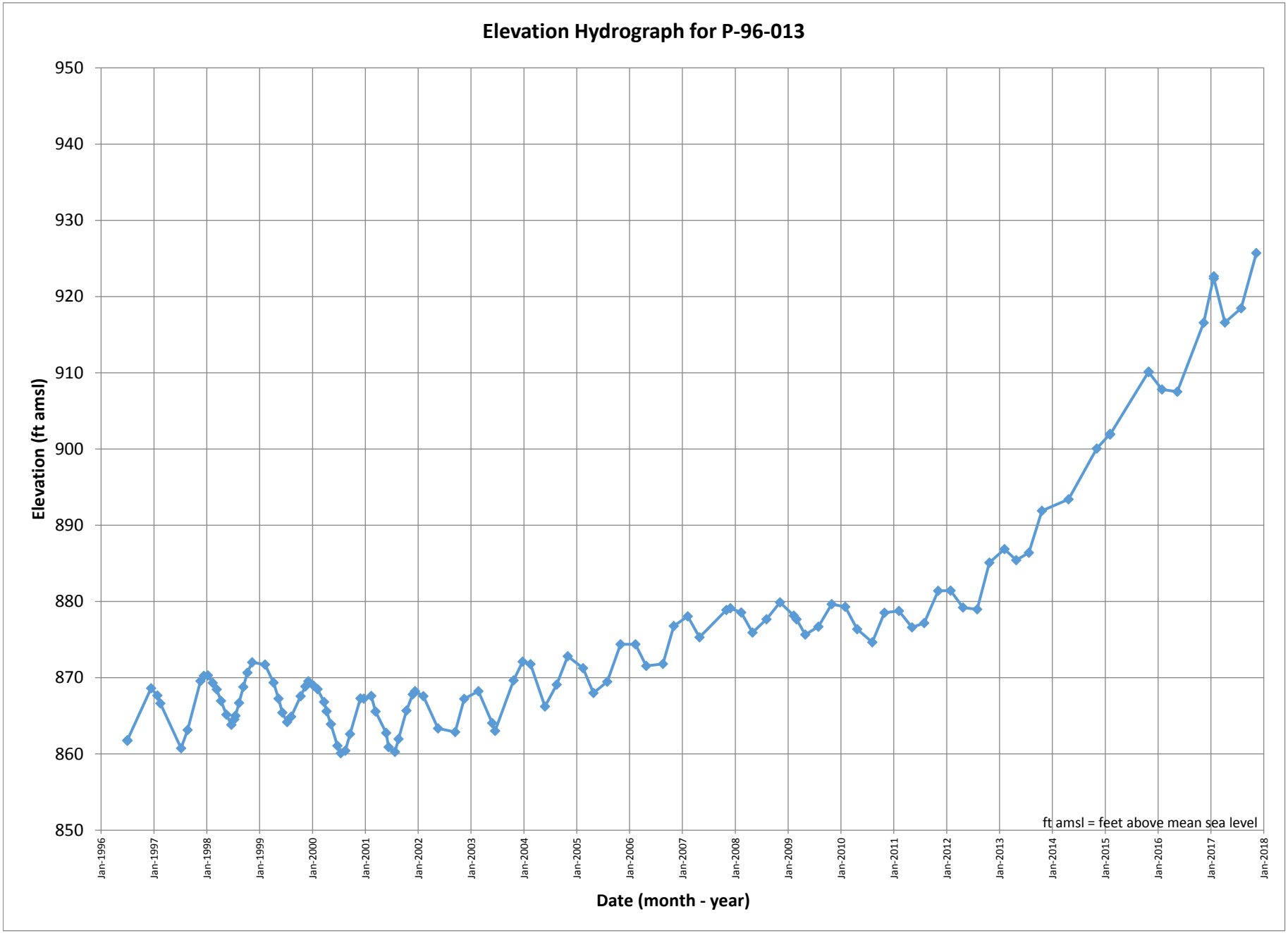

Depth Hydrograph for P-08B
Depth (ft bgs)
0
20
40
60
80
100
120
140
160
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = feet below ground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

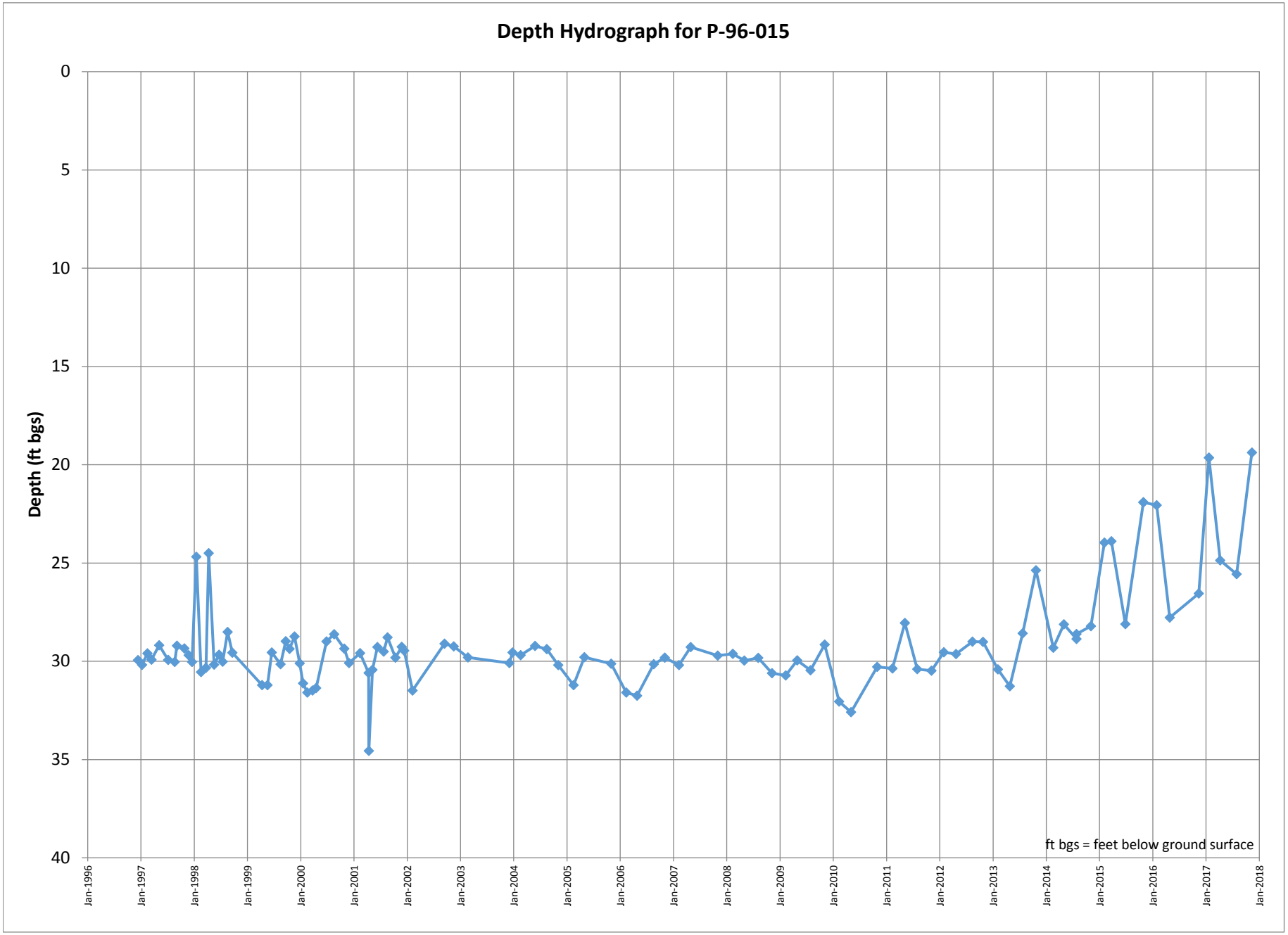

Elevation Hydrograph for P-08B
875
865
855
845
835
825
815
805
795
785
775
Elevation (ft amsl)
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018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

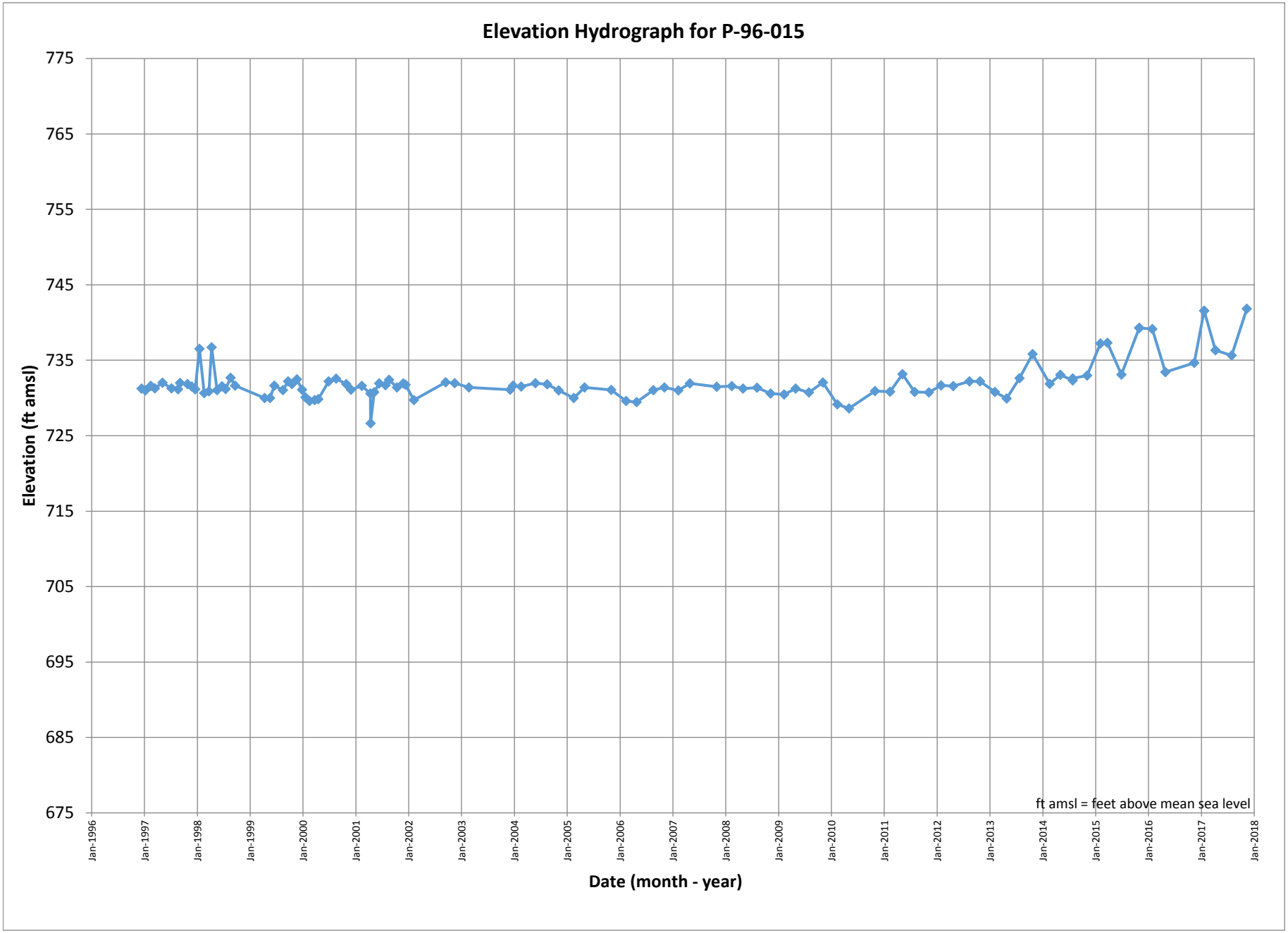

Depth Hydrograph for P-96-010
Depth (ft bgl)
0
2
4
6
8
10
12
14
16
18
20
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = feet below ground surface

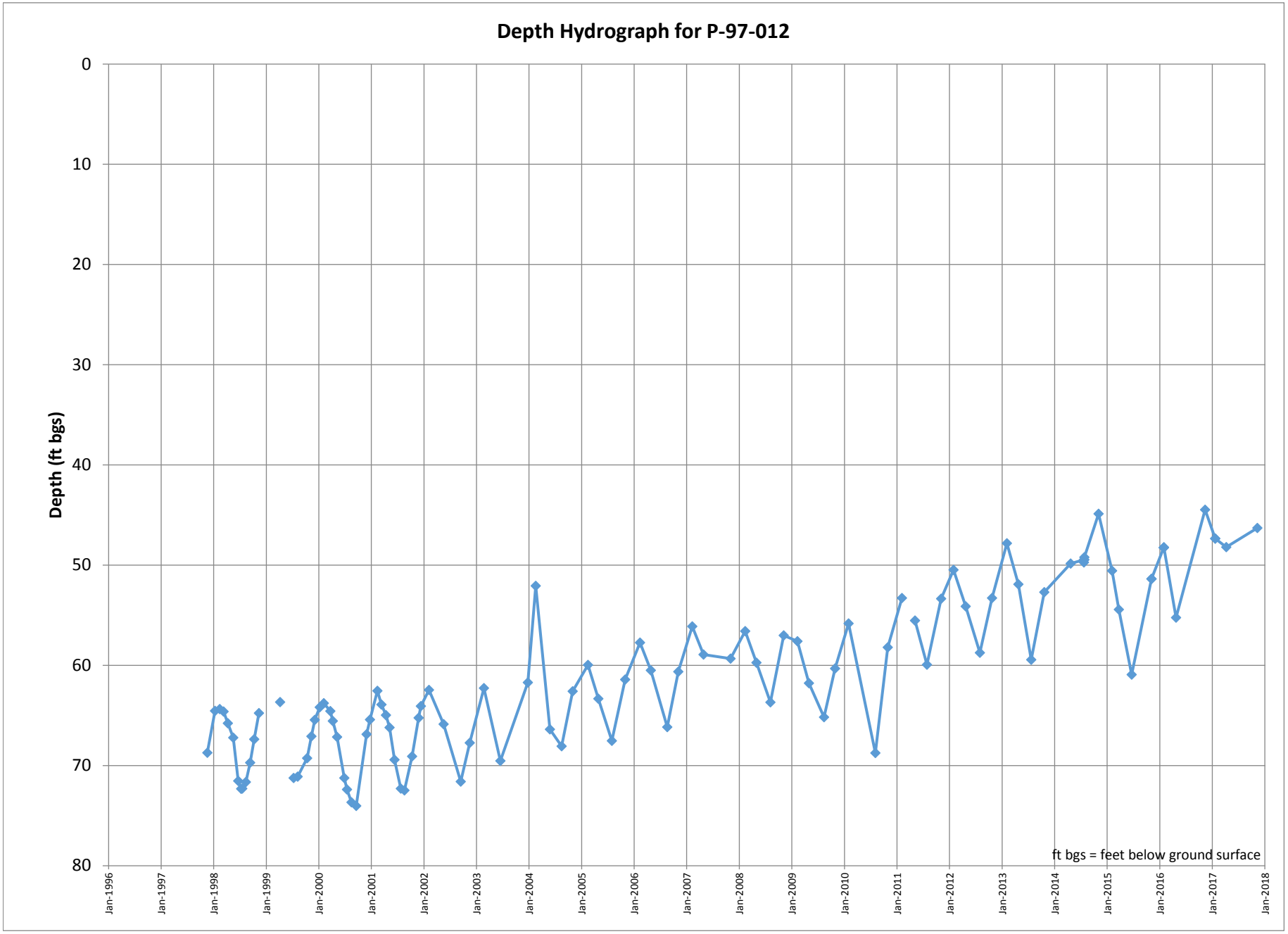

Elevation Hydrograph for P-96-010
875
865
855
845
835
825
815
805
795
785
775
Elevation (ft amsl)
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018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

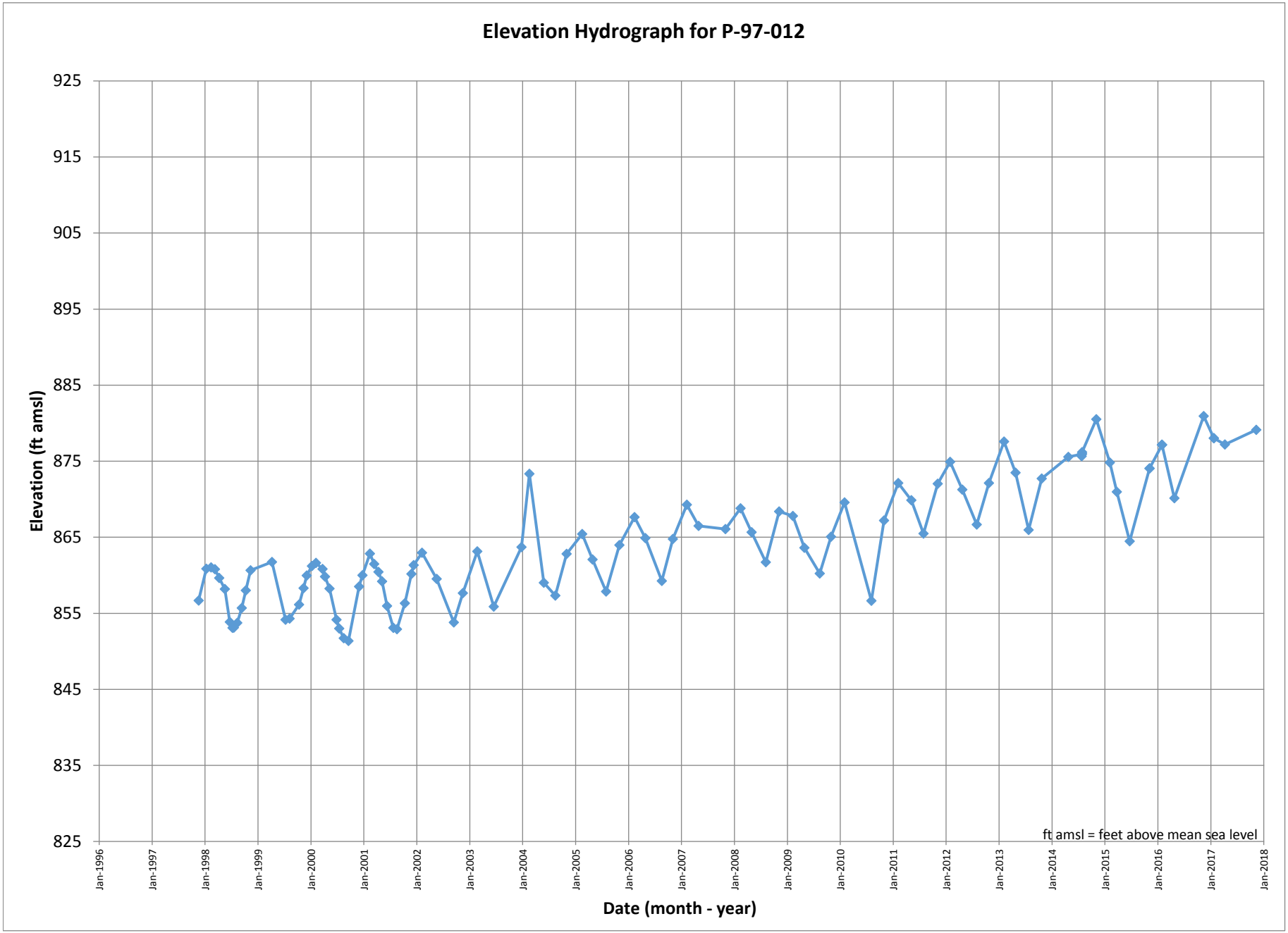

Depth Hydrograph for P-96-013
Depth (ft bgs)
0
20
40
60
80
100
120
140
160
1/1/96
1/1/97
1/2/98
1/3/99
1/4/00
1/4/01
1/5/02
1/6/03
1/7/04
1/7/05
1/8/06
1/9/07
1/10/08
1/10/09
1/11/10
1/12/11
1/13/12
1/13/13
1/14/14
1/15/15
1/16/16
1/16/17
1/17/18
ft bgs = feet below ground surface

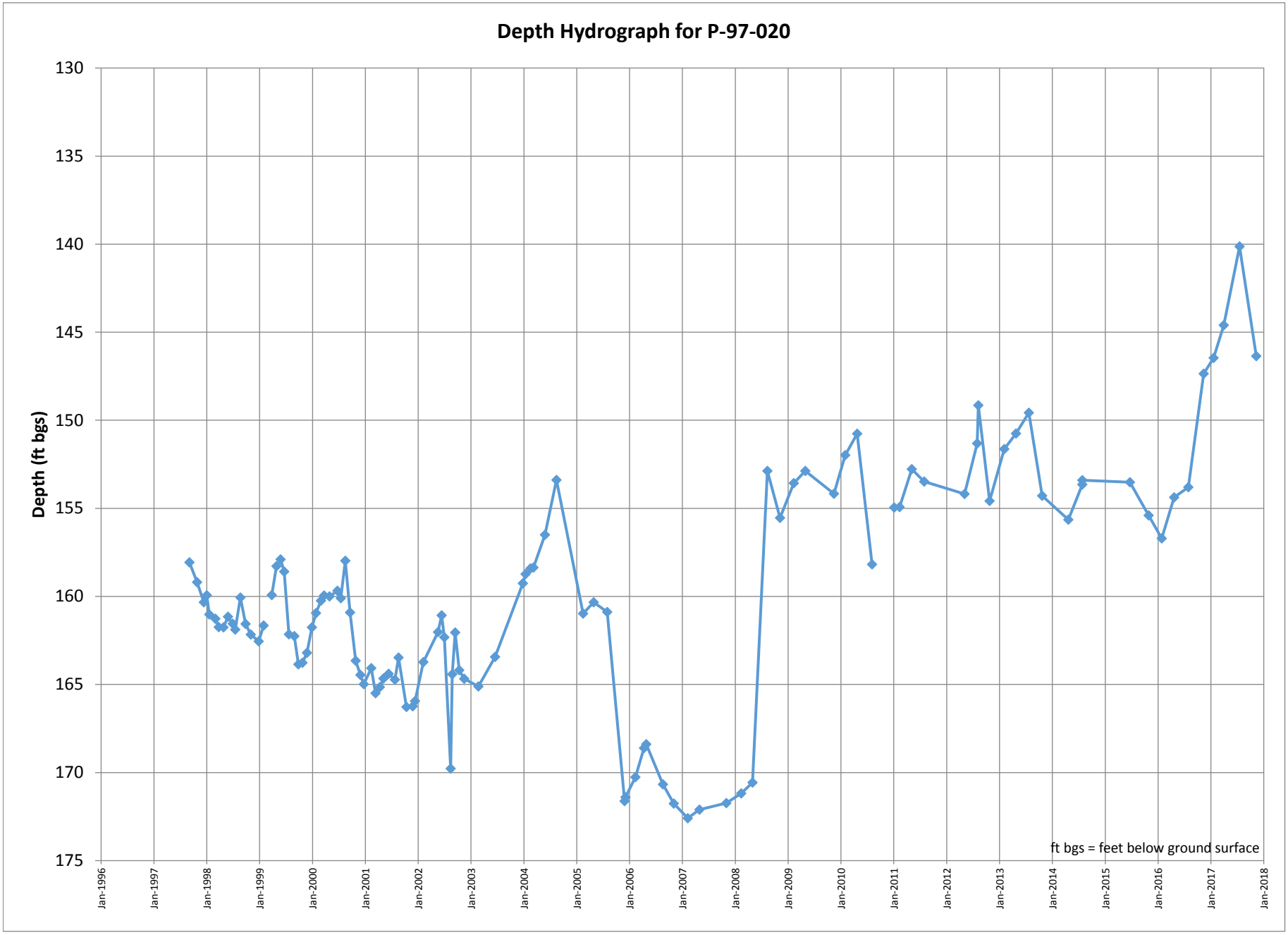

Elevation Hydrograph for P-96-013
Elevation (ft amsl)
950
940
930
920
910
900
890
880
870
860
850
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Date (month - year)
ft amsl = feet above mean sea level

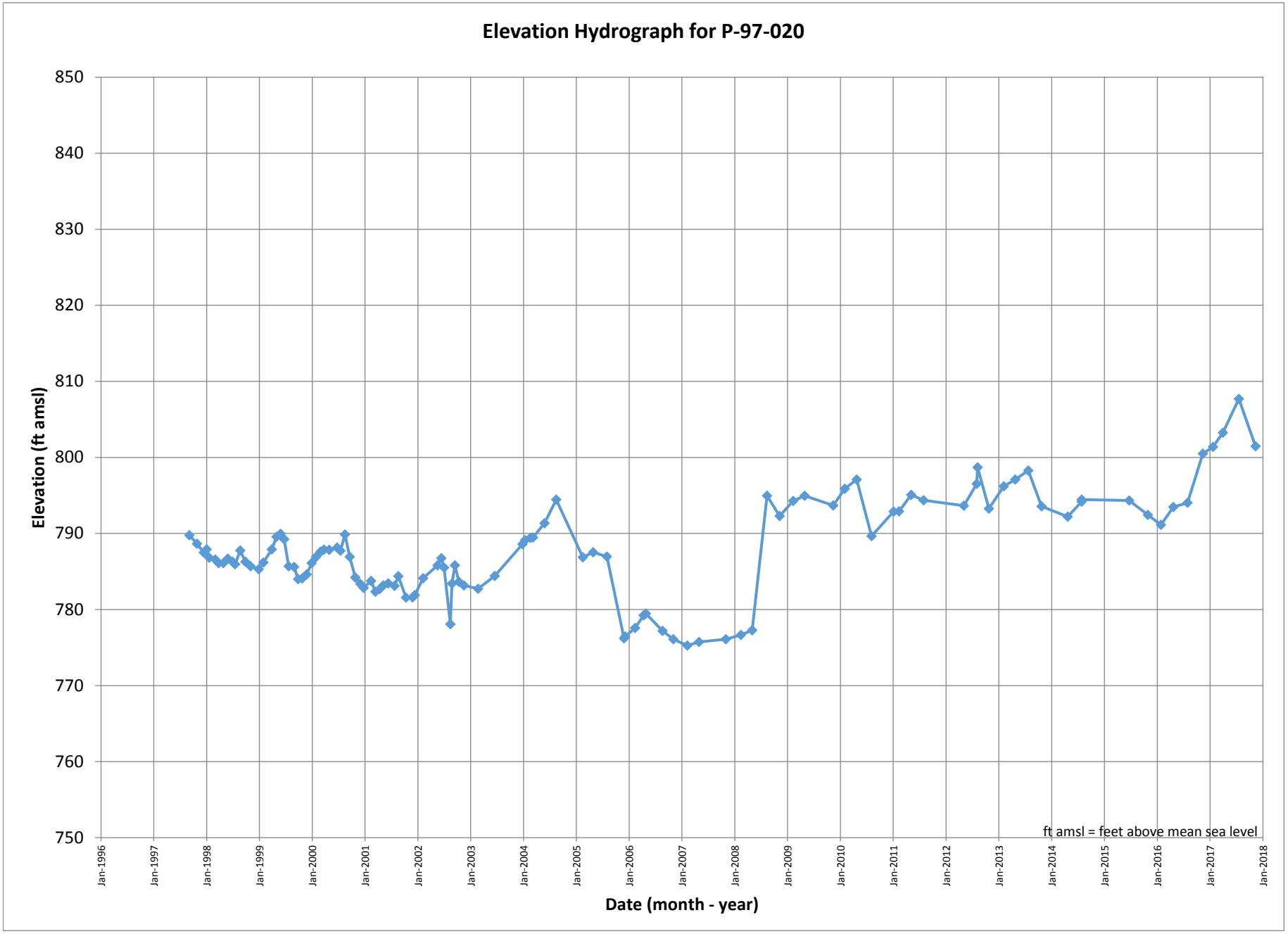

Depth Hydrograph for P-96-015
Depth (ft bgs)
0
5
10
15
20
25
30
35
40
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = feet below ground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

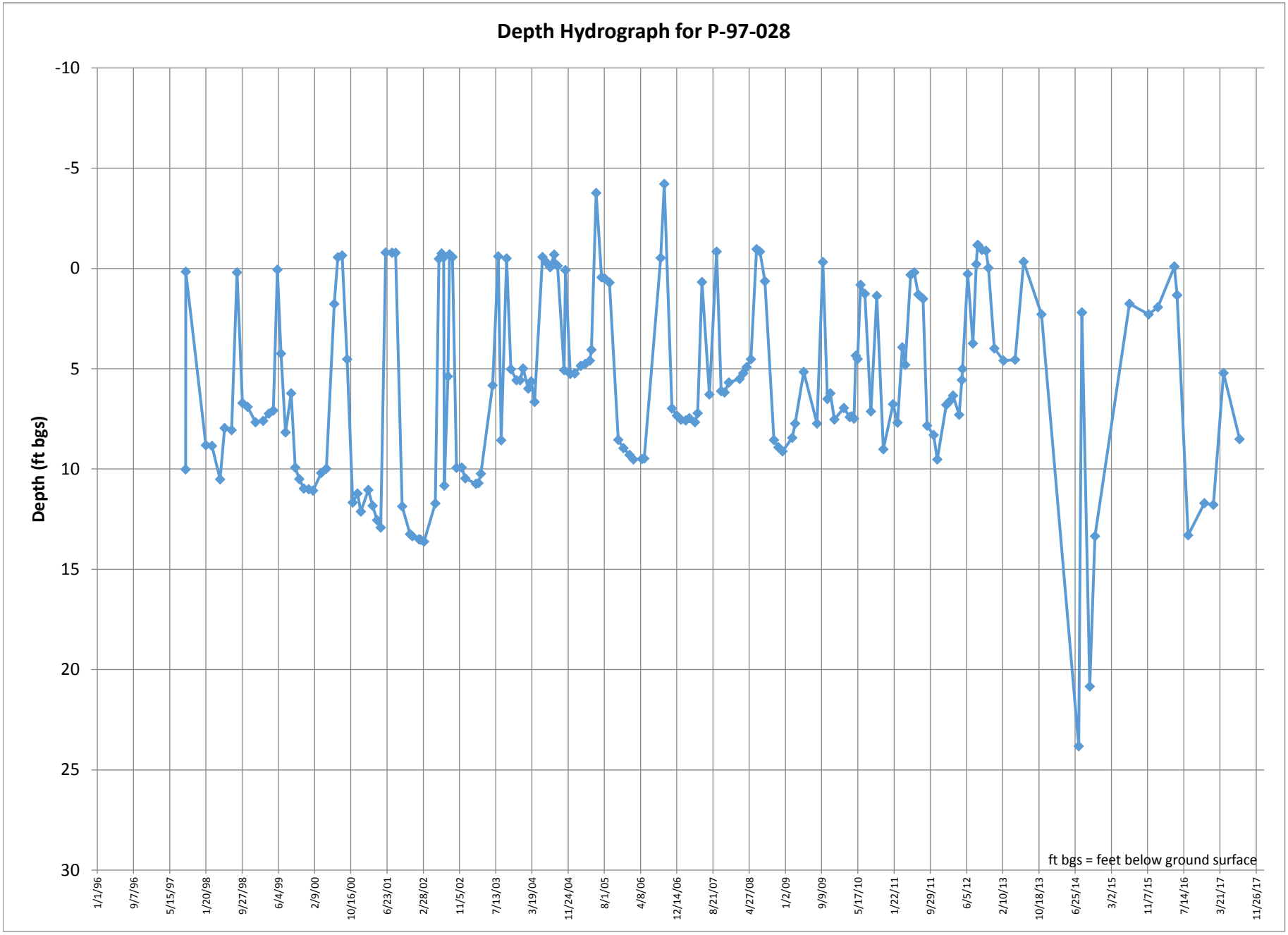

Elevation Hydrograph for P-96-015
775
765
755
745
735
725
715
705
695
685
675
Elevation (ft amsl)
ft amsl = feet above mean sea level
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014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

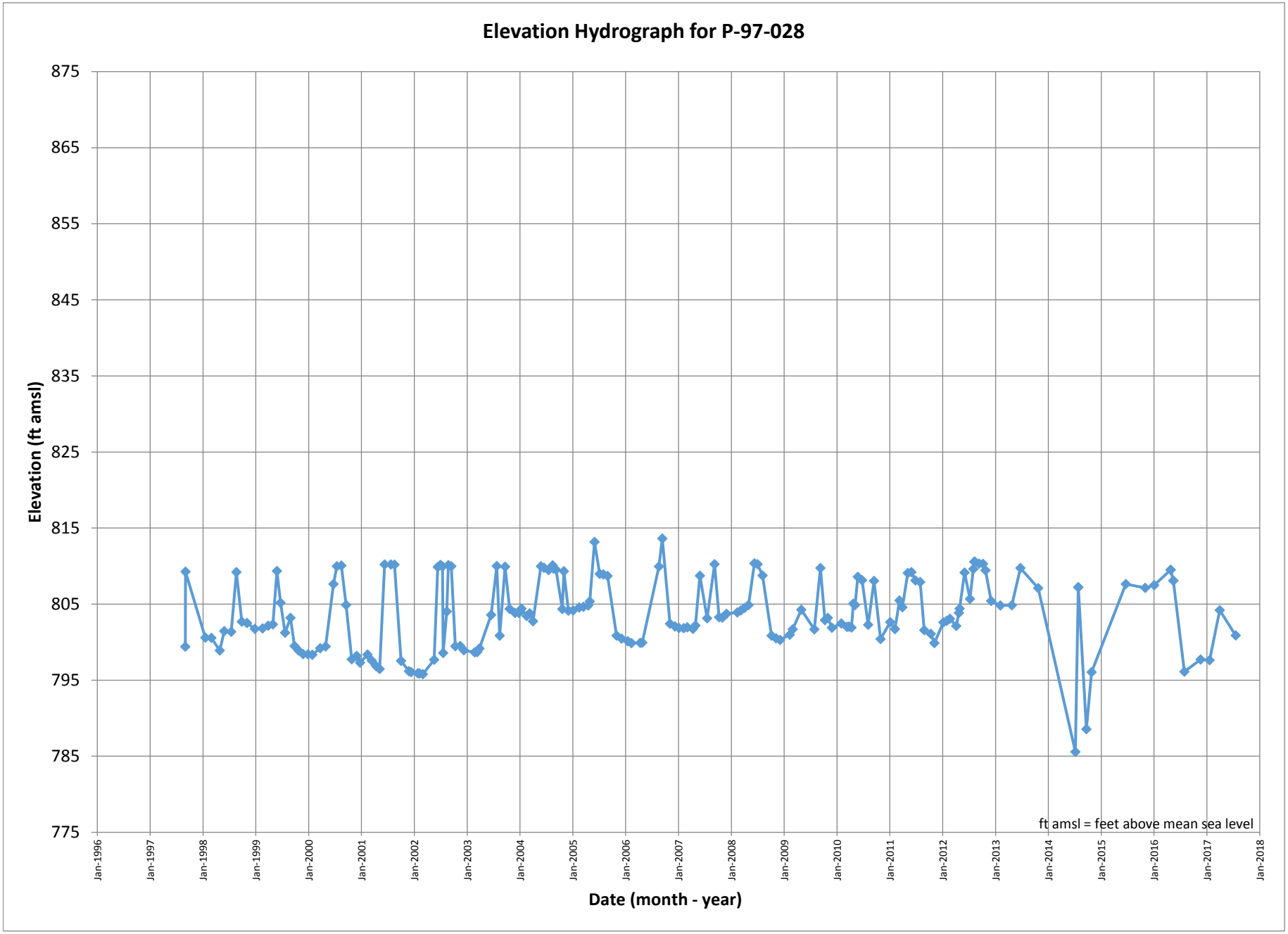

Depth Hydrograph for P-97-012
Depth (ft bgs)
0
10
20
30
40
50
60
70
80
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = feet below ground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

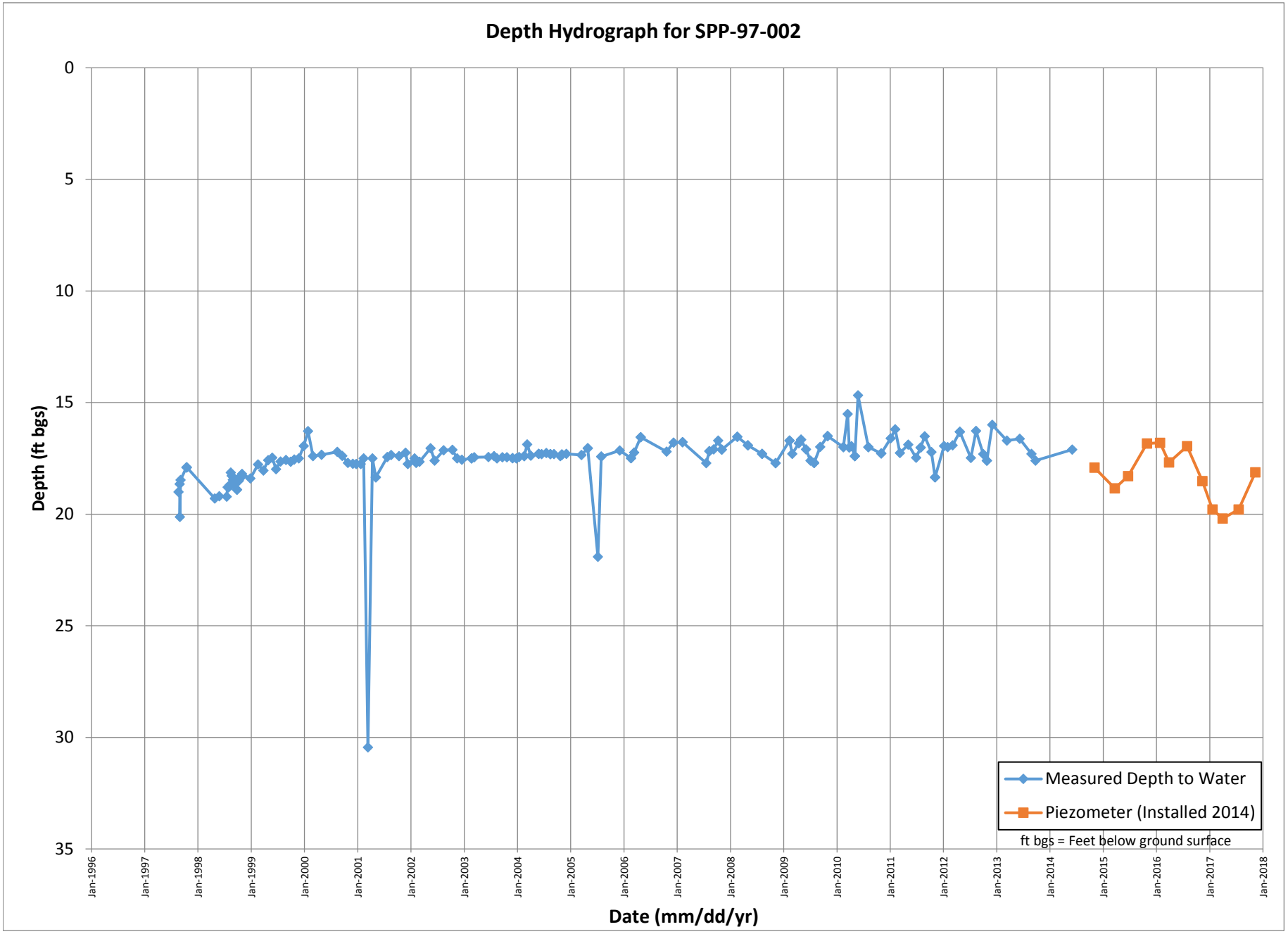

Elevation Hydrograph for P-97-012
Elevation (ft amsl)
925
915
905
895
885
875
865
855
845
835
825
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Date (month - year)
ft amsl = feet above mean sea level

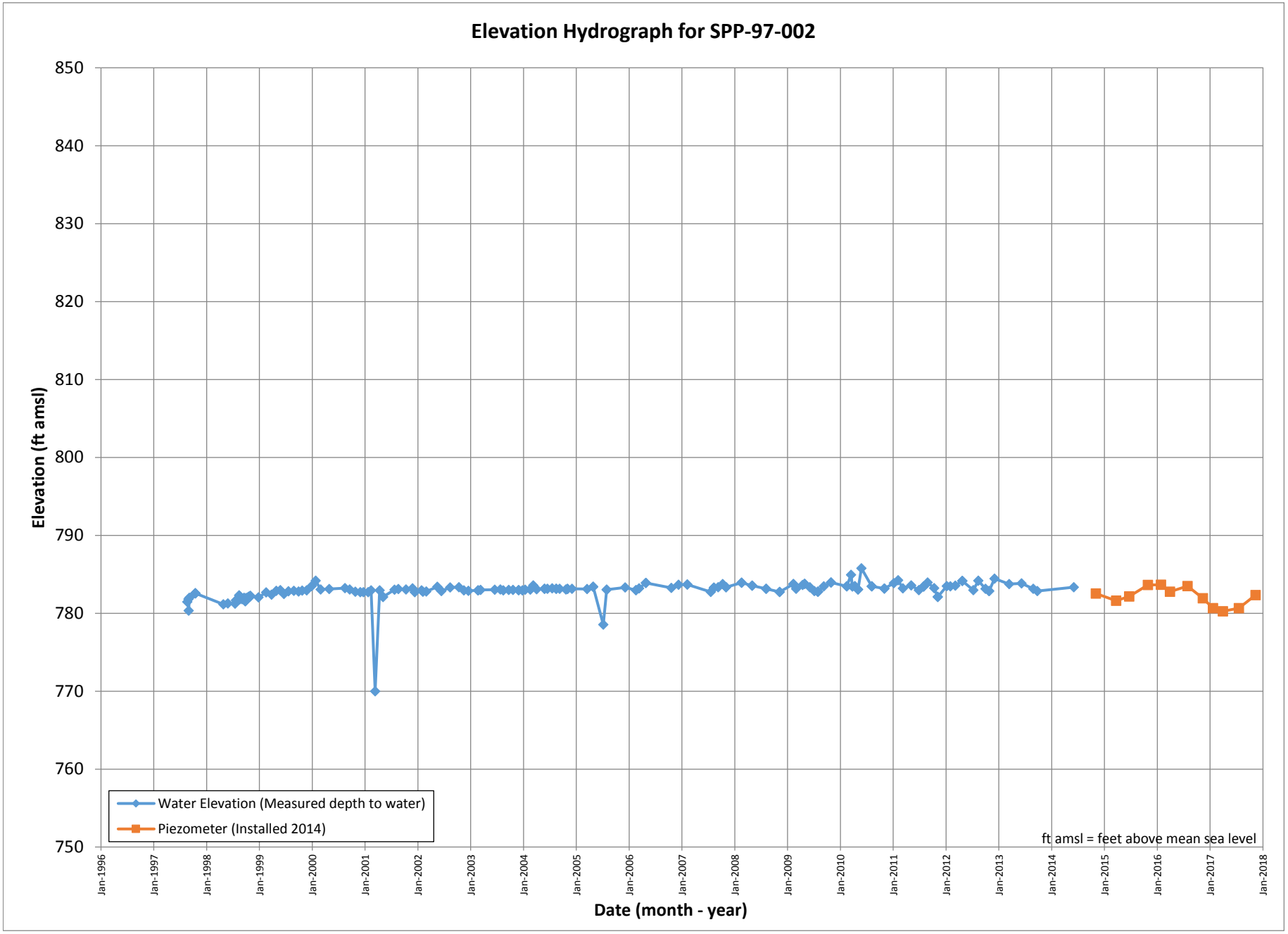

Depth Hydrograph for P-97-020
Depth (ft bgs)
130
135
140
145
150
155
160
165
170
175
Jan-1996
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
ft bgs = 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-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
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
1/1/96
9/7/96
5/15/97
1/20/98
9/27/98
6/4/99
2/9/00
10/16/00
6/23/01
2/28/02
11/5/02
7/13/03
3/19/04
11/24/04
8/1/05
4/8/06
12/14/06
8/21/07
4/27/08
1/2/09
9/9/09
5/17/10
1/22/11
9/29/11
6/5/12
2/10/13
10/18/13
6/25/14
3/2/15
11/7/15
7/14/16
3/21/17
11/26/17
ft bgs = feet below ground surface


Elevation Hydrograph for P-97-028
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
Date (month - year)
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-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
Date (mm/dd/yr)
Measured Depth to Water
Piezometer (Installed 2014)
ft bgs = Feet below ground surface


Elevation Hydrograph for SPP-97-002
Elevation (ft amsl)
850
840
830
820
810
800
790
780
770
760
750
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
Date (month - year)
Water Elevation (Measured depth to water)
Piezometer (Installed 2014)
ft amsl = feet above mean sea level

Appendix D
Quality Control / Quality Assurance

Quarterly Thermistor QA / QC

Location: T-96-13 Date: 2-5-17

Technician: NMS DJS Start Time: 16:10 Stop Time: 16:13

Node	Ohms	Comments	Node	Temperature
Test	16.95		Test	
1	19.33		1	
2	16.08		2	
3	15.63		3	
4	16.60		4	
5	16.79		5	
6	16.90		6	
7	17.10		7	
8	17.01		8	
9	17.12		9	
10	17.16		10	
11	17.24		11	
12	17.27		12	
13	18.27		13	
14	18.21		14	
15	17.79		15	
16	17.25		16	
17	17.27		17	
18	17.08		18	
19	18.60		19	
20	16.90		20	
21	16.81		21	
22	16.70		22	
23	16.59		23	
24	16.42		24	
Test	16.35		Test	

Read these locations on noted month.

Month	Location
Feb-14	T 95-04
May-14	T 96-21
Aug-14	T96-22
Nov-14	T 96-23
Feb-15	T 96-12
May-15	T 95-15
Aug-15	T 96-05
Nov-15	T 96-10
Feb-16	T 97-28
May-16	T 97-29
Aug-16	T 97-30
Nov-16	T 95-8
Feb-17 *	T 96-13
May-17	T 96-21
Aug-17	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 Thermister & Piezometer

Row:

Technician: JMB DJS

Well	Location	Col. Row #Ports	Collection Method Instrument	(Nodes) Time	Date
Backdam Piezo	Backdam	16	Nautiz Geokon logger		2-5-17
T15-135	Backdam	1	Archer Beadad Stream		2-5-17
T15-136	Backdam	1	Archer Beaded Stream		2-5-17
T15-138	Backdam	1	Archer Beaded Stream		2-5-17
T15-139	Backdam	1	Archer Beaded Stream		2-5-17
T15-140	Backdam	1	Archer Beaded Stream		2-5-17
T15-141	Backdam	1	Archer Beaded Stream		2-5-17
T15-143	Backdam	1	Archer Beaded Stream		2-5-17
T15-144	Backdam	1	Archer Beaded Stream		2-5-17
T12-106	Backdam	1	Archer Beaded Stream		2-5-17
T12-107	Backdam	1	Archer Beaded Stream		2-5-17
T12-108	Backdam	1	Archer Beadad Stream		2-5-17
T12-109	Backdam	1	Archer Beaded Stream		2-5-17
*T95-08	Over Burden	26	Yellow box Thermister	(24)	2-5-17
*P96-13	Over Burden	25	Geokon Piezometer		2-5-17
*T96-13	Over Burden	29	Yellow box Thermister	(24)	2-5-17
T96-13S	Over Burden	30	Yellow box Thermister	(24)	2-5-17
*T96-21	Over Burden	31	Yellow box Thermister	(24)	2-5-17
*T96-22	Over Burden	32	Yellow box Thermister	(24)	2-5-17
*T96-23	Over Burden	33	Yellow box Thermister	(24)	2-5-17
T96-24	Over Burden	34	Yellow box Thermister	(24)	2-5-17
*P97-12	Blast Road	24	Geokon Piezometer		2-5-17
*T96-12	Blast Road	27	Yellow box Thermister	(24)	2-5-17
*T96-12S	Blast Road	28	Yellow box Thermister	(24)	2-5-17
T98-33	Cold Storage	12	Yellow box Thermister	(10)	2-5-17
T98-34	Cold Storage	13	Yellow box Thermister	(11)	2-5-17
T98-35	Cold Storage	14	Yellow box Thermister	(11)	2-5-17
T11-91	ARD Toe	145	Yellow box Thermister	(12)	2-5-17
T11-92	ARD Toe	146	Yellow box Thermister	(11)	2-6-17
T11-93	ARD Toe	147	Yellow box Thermister	(9)	2-6-17
T11-94	ARD Toe	148	Yellow box Thermister	(12)	2-6-17
T11-95	ARD Toe	149	Yellow box Thermister	(12) Buried	
P05-67	By "3 Way"	1	Nautiz Geokon logger		2-5-17
T05-67	By "3 Way"	133	Yellow box Thermister	(8)	2-5-17
WingWall	Power House	4	Nautiz Geokon logger		2-4-17

Well	Location	Col. Row #Ports	Collection Method Instrument	(Nodes) Time	Date
P16-148AB	Powerhouse	2	Nautiz Geokon logger		
P16-149AB	S. of Powerhouse	2	Nautiz Geokon logger		
P16-150	S. of Powerhouse	1	Nautiz Geokon logger		
P05-63	Zn Thickener	1	Nautiz Geokon logger		2-4-17
T05-63	Zn Thickener	129	Yellow box Thermister	(8)	2-4-17
T05-64	By CSB	130	Yellow box Thermister	(7)	2-4-17
T05-66	South of CSB	132	Yellow box Thermister	(8)	
*T95-05	By sandfilter	70	Yellow box Thermister	(24)	2-5-17
*T05-61	TDAM (end)	127	Yellow box Thermister	(6)	2-5-17
*T95-04	TDAM (end)	69	Yellow box Thermister	(24)	2-5-17
*T14-110	W. Tails Pond	1	Archer Beaded Stream	(24)	2-5-17
Piglet & 12A	TDAM	4	Nautiz Geokon logger		2-5-17
TailingsCPT	TDAM	16	Nautiz Geokon logger		2-5-17
P14-134	TDAM	1	Nautiz Geokon logger		2-5-17
P06-74	TDAM	1	Nautiz Geokon logger		2-5-17
The Hog	TDAM	4	Nautiz Geokon logger		2-5-17
Warthog	TDAM	16	Nautiz Geokon logger		2-4-17
*SS-16 prt	TDAM	16	Nautiz Geokon logger		2-5-17
P16-151AB	TDAM Slope	1	Nautiz Geokon logger	Buried	
P14-131	TDAM Slope	1	Nautiz Geokon logger		2-4-17
P05-62 LB	Buttress	1	Nautiz Geokon logger		2-4-17
P14-132 LB	Buttress	1	Nautiz Geokon logger		2-4-17
P05-69 LB	Buttress	1	Nautiz Geokon logger	8 arrays	2-4-17
*T97-28	Buttress	76	Yellow box Thermister	(24)	2-4-17
*T97-29	Buttress	77	Yellow box Thermister	(24)	2-4-17
*T97-30	Buttress	78	Yellow box Thermister	(24)	2-4-17
*P96-10	Seepage Dam	1	Nautiz Geokon logger		2-4-17
*T96-10	Seepage Dam	71	Yellow box Thermister	(24)	2-4-17
TDAM T7	Seepage Dam	65	Yellow box Thermister		2-4-17
*SPP97-2	Seepage Dam	1	Nautiz Geokon logger		2-4-17
*P96-15	Lower RDC	23	Geokon Piezometer	17:10	2-4-17
*T96-15	Lower RDC	44	Yellow box Thermister	(14) 17:10	2-4-17
DODO	By OF_001	1	Nautiz Geokon logger		2-4-17
P16-147	By OF_001	1	Nautiz Geokon logger	LB	2-4-17
RDD Piezo	RDC Dam	16	Nautiz Geokon logger	LB	2-4-17

Comments: P97-30 2-4-17, 10A 2-4-17

~~P16-151AB~~

~~T05-65~~ Piezo Nest

*SEP Piezometer. QC: Duplicate Reading with Geokon to be taken within 5 min. of each other, Quarterly.

*SEP Thermister. QC: CR850 & Multimeter readings to be taken within 5 min. of each other, Quarterly.

WHP QUARTERLY REPORT DATA CHECKLIST **Quarter** Q1 **Date** 4/24/2017

For Teck/Red Dog Long term Groundwater and Permafrost monitoring

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 02/08/2017
- ☐ **YES / NO** Data received for 16 Thermistors
- ☐ **YES / NO** Data received for 9 Piezometers
- ☐ **YES / NO** QA/QC Forms received for both Thermistors and Piezometers No Piezometer QA/QC
- ☐ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:

  7 thermistors had issues with at least 2 nodes
- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:

  Readings for P-96-10 were 0.0
- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Additional Comments: _____

Checklist Completed by: NB

QUARTER Q1 **DATE** 4/24/2017

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	
T-05-061	Y	
T-95-005	Y	
T-96-010	Y	Two (of 24) nodes reported resistance readings < 0
T-97-028	Y	Two (of 24) nodes had problematic readings
T-97-029	Y	Four (of 24) nodes had resistance readings < 0
T-97-030	Y	Thirteen (of 24) nodes had resistance readings < 0
T-14-110	Y	
T-95-008 #2 (manually add "#2")	Y	
T-96-013	Y	
T-96-021	Y	
T-96-022	Y	No data from two (of 24) nodes.
T-96-023	Y	Eight (of 24) nodes had resistance readings < 0
T-96-012	Y	
T-96-012s	Y	
T-95-004	Y	Two (of 24) nodes had problematic readings

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	Two readings reported
P-08A	Y	
P-08B	Y	
P-96-010	**N**	Piezo and temp readings both reported as 0.0
P-97-020	Y	
P-97-028	Y	
SPP-97-002	Y	
P-96-013	Y	Four readings reported
P-97-012	Y	Two readings reported

Quarterly Thermister & Piezometer

Row:

Technician: Nicole Shellabarger

Well	Location	Col. Row #Ports	Collection Method Instrument	(Nodes)	Time	Date
Backdam Piezo	Backdam	16	Nautiz Geokon logger			4-23-17
T15-135	Backdam	1	Archer Beaded Stream			
T15-136	Backdam	1	Archer Beaded Stream			
T15-138	Backdam	1	Archer Beaded Stream			
T15-139	Backdam	1	Archer Beaded Stream			
T15-140	Backdam	1	Archer Beaded Stream			
T15-141	Backdam	1	Archer Beaded Stream			
T15-143	Backdam	1	Archer Beaded Stream			
T15-144	Backdam	1	Archer Beaded Stream			
T12-106	Backdam	1	Archer Beaded Stream			4-24-17
T12-107	Backdam	1	Archer Beaded Stream			4-24-17
T12-108	Backdam	1	Archer Beaded Stream			4-24-17
T12-109	Backdam	1	Archer Beaded Stream			4-24-17
*T95-08	Over Burden	26	Yellow box Thermister	(24)		4-23-17
*P96-13	Over Burden	25	Geokon Piezometer			4-23-17
*T96-13	Over Burden	29	Yellow box Thermister	(24)		4-23-17
T96-13S	Over Burden	30	Yellow box Thermister	(24)		4-23-17
*T96-21	Over Burden	31	Yellow box Thermister	(24)		4-24-17
*T96-22	Over Burden	32	Yellow box Thermister	(24)		4-24-17
*T96-23	Over Burden	33	Yellow box Thermister	(24)		4-24-17
T96-24	Over Burden	34	Yellow box Thermister	(24)		4-24-17
*P97-12	Blast Road	24	Geokon Piezometer			4-23-17
*T96-12	Blast Road	27	Yellow box Thermister	(24)		4-23-17
*T96-12S	Blast Road	28	Yellow box Thermister	(24)		4-23-17
T98-33	Cold Storage	12	Yellow box Thermister	(10)	13:40	4-23
T98-34	Cold Storage	13	Yellow box Thermister	(11)	13:43	4-23
T98-35	Cold Storage	14	Yellow box Thermister	(11)	13:48	4-23
T11-91	ARD Toe	145	Yellow box Thermister	(12)	14:26	4-23-17
T11-92	ARD Toe	146	Yellow box Thermister	(11)	14:23	4-23-17
T11-93	ARD Toe	147	Yellow box Thermister	(9)	14:14	4-23-17
T11-94	ARD Toe	148	Yellow box Thermister	(12)	13:58	4-23-17
T11-95	ARD Toe	149	Yellow box Thermister	(12)	14:08	4-23-17
P05-67	By "3 Way"	1	Nautiz Geokon logger		14:30	4-23-17
T05-67	By "3 Way"	133	Yellow box Thermister	(8)	14:30	4-23-17
WingWall	Power House	4	Nautiz Geokon logger			

Well	Location	Col. Row #Ports	Collection Method Instrument	(Nodes)	Time	Date
P16-148AB	Powerhouse	2	Nautiz Geokon logger		15:24	4-23-17
P16-149AB	S. of Powerhouse	2	Nautiz Geokon logger		15:35	4-23-17
P16-150	S. of Powerhouse	1	Nautiz Geokon logger		15:40	4-23-17
P05-63	Zn Thickener	1	Nautiz Geokon logger		15:11	4-23-17
T05-63	Zn Thickener	129	Yellow box Thermister	(8)	15:11	4-23-17
T05-64	By CSB	130	Yellow box Thermister	(7)	15:08	4-23-17
T05-66	South of CSB	132	Yellow box Thermister	(8)	15:06	4-23-17
*T95-05	By sandfilter	70	Yellow box Thermister	(24)	15:33	4-23-17
*T05-61	TDAM (end)	127	Yellow box Thermister	(6)	15:05	4-23-17
*T95-04	TDAM (end)	69	Yellow box Thermister	(24)	15:00	4-23-17
*T14-110	W. Tails Pond	1	Archer Beaded Stream	(24)		
Piglet & 12A	TDAM	4	Nautiz Geokon logger		14:44	4-25-17
TailingsCPT	TDAM	16	Nautiz Geokon logger			4-25-17
P14-134	TDAM	1	Nautiz Geokon logger			4-25-17
P06-74	TDAM	1	Nautiz Geokon logger			4-25-17
The Hog	TDAM	4	Nautiz Geokon logger			4-25-17
Warthog	TDAM	16	Nautiz Geokon logger			4-25-17
*SS-16 prt	TDAM	16	Nautiz Geokon logger			4-25-17
P16-151AB	TDAM Slope	1	Nautiz Geokon logger		16:10	4-23-17
P14-131	TDAM Slope	1	Nautiz Geokon logger			4-23-17
P05-62	Buttress	1	Nautiz Geokon logger		16:20	4-23-17
P14-132	Buttress	1	Nautiz Geokon logger		16:24	4-23-17
P05-69	Buttress	1	Nautiz Geokon logger		16:02	4-23-17
*T97-28	Buttress	76	Yellow box Thermister	(24)	15:58	4-23-17
*T97-29	Buttress	77	Yellow box Thermister	(24)	16:26	4-23-17
*T97-30	Buttress	78	Yellow box Thermister	(24)	16:20	4-23-17
*P96-10	Seepage Dam	1	Nautiz Geokon logger		[illegible]	4-23-17
*T96-10	Seepage Dam	71	Yellow box Thermister	(24)		4-23-17
TDAM T7	Seepage Dam	65	Yellow box Thermister			4-23-17
*SPP97-2	Seepage Dam	1	Nautiz Geokon logger			4-23-17
*P96-15	Lower RDC	23	Geokon Piezometer		17:00	4-23-17
*T96-15	Lower RDC	44	Yellow box Thermister	(14)	17:00	4-23-17
DODO	By OF_001	1	Nautiz Geokon logger		17:23	4-23-17
P16-147	By OF_001	1	Nautiz Geokon logger			4-23-17
RDD Piezo	RDC Dam	16	Nautiz Geokon logger			4-23-17

Comments:

ADD TDAM TOE, OLD Archer Dead

*SEP Piezometer. QC: Duplicate Reading with Geokon to be taken within 5 min. of each other, Quarterly.

*SEP Thermister. QC: CR850 & Multimeter readings to be taken within 5 min. of each other, Quarterly.

Quarterly Thermistor QA / QC

Location T95-05 Date:___ 4/23/2017

Technician:_____ NMS Start Tim 15:35 Stop Tim 15:42

Node	Ohms	Comments	Node	Temperature
Test	16.34		Test	
1	16.69		1	
2	16.19		2	
3	16.41		3	
4	16.64		4	
5	16.71		5	
6	16.82		6	
7	16.87		7	
8	16.92		8	
9	16.92		9	
10	19.93		10	
11	19.94		11	
12	16.89		12	
13	16.87		13	
14	16.85		14	
15	16.79		15	
16	16.72		16	
17	16.68		17	
18	16.55		18	
19	16.42		19	
20	16.23		20	
21	16.12		21	
22	15.93		22	
23	15.78		23	
24	15.6		24	
Test	16.34		Test	

Read these locations on noted month.

Month	Location
Feb-14	T 95-04
May-14	T 96-21
Aug-14	T96-22
Nov-14	T 96-23
Feb-15	T 96-12
May-15	T 95-15
Aug-15	T 96-05
Nov-15	T 96-10
Feb-16	T 97-28
May-16	T 97-29
Aug-16	T 97-30
Nov-16	T 95-8
Feb-17	T 96-13
May-17	T 96-21
Aug-17	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

WHP QUARTERLY REPORT DATA CHECKLIST **Quarter** **Q2 2017** **Date** 20 June, 2017

For Teck/RedDog Longterm Groundwater and Permafrost monitoring

☒ **YES / NO** Quarterly data received from Teck. Date received: 12 June, 2017

☒ **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: No Piezometer QA/QC

☒ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:

No data reported for T-14-110, noted by NS from Teck

☒ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:

Data received for all Piezometers, no Piezo QA/QC received

☒ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Additional Comments:

Did not receive a copy of the Field Form for Q2 2017

QUARTER Q2 2017 **DATE** 20 June, 2017

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	
T-05-061	Y	
T-95-005	Y	
T-96-010	Y	Error at 1 of 24 nodes
T-97-028	Y	Error at 14 of 24 nodes
T-97-029	Y	Error at 4 of 24 nodes
T-97-030	Y	Error at 2 of 24 nodes
T-14-110	**N**	Data not recieved. Per Teck data was downloaded, but not sent.
T-95-008 #2 (manually add "#2")	Y	
T-96-013	Y	
T-96-021	Y	
T-96-022	Y	Error at 2 of 24 nodes
T-96-023	Y	Error at 8 of 24 nodes
T-96-012	Y	Error at 1 of 24 nodes
T-96-012s	Y	
T-95-004	Y	Error at 2 of 24 nodes

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	

8-13-17

Quarterly Thermister & Piezometer

Row:

Technician: WMS KGS JWM

Well	Location	Col. Row #Ports	Collection Method instrument	(Nodes)	Time	Date
Backdam Piezo	Backdam	16	Nautiz Geokon logger		11:25	8-13-17
T15-135	Backdam	1	Archer Beaded Stream		11:40	8-14-17
T15-136	Backdam	1	Archer Beaded Stream		11:03	
T15-138	Backdam	1	Archer Beaded Stream		11:10	
T15-139	Backdam	1	Archer Beaded Stream		11:15	
T15-140	Backdam	1	Archer Beaded Stream		11:18	
T15-141	Backdam	1	Archer Beaded Stream		11:23	
T15-143	Backdam	1	Archer Beaded Stream		11:31	
T15-144	Backdam	1	Archer Beaded Stream		11:55	
T12-106	Backdam	1	Archer Beaded Stream		11:20	8-13-17
T12-107	Backdam	1	Archer Beaded Stream		11:31	8-13-17
T12-108	Backdam	1	Archer Beaded Stream		11:33	8-13-17
T12-109	Backdam	1	Archer Beaded Stream		11:12	8-13-17
*T95-08	Over Burden	26	Yellow box Thermister	(24)	11:32	8-13-17
*P96-13	Over Burden	25	Geokon Piezometer		10:36	8-13-17
*T96-13	Over Burden	29	Yellow box Thermister	(24)	10:35	
T96-13S	Over Burden	30	Yellow box Thermister	(24)	10:37	
*T96-21	Over Burden	31	Yellow box Thermister	(24)	10:44	
*T96-22	Over Burden	32	Yellow box Thermister	(24)		8-13-17
*T96-23	Over Burden	33	Yellow box Thermister	(24)		8-13-17
T96-24	Over Burden	34	Yellow box Thermister	(24)	11:03	8-13-17
*P97-12	Blast Road	24	Geokon Piezometer		10:12	8-13-17
*T96-12	Blast Road	27	Yellow box Thermister	(24)	10:05	8-13-17
*T96-12S	Blast Road	28	Yellow box Thermister	(24)	10:06	8-13-17
T98-33	Cold Storage	12	Yellow box Thermister	(10)	13:26	
T98-34	Cold Storage	13	Yellow box Thermister	(11)	13:31	
T98-35	Cold Storage	14	Yellow box Thermister	(11)	13:35	
T11-91	ARD Toe	145	Yellow box Thermister	(12)	~~13:46~~ 13:55	8-13-17
T11-92	ARD Toe	146	Yellow box Thermister	(11)	~~13:40~~ 13:54	8-13-17
T11-93	ARD Toe	147	Yellow box Thermister	(9)	13:44	8-13-17
T11-94	ARD Toe	148	Yellow box Thermister	(12)	13:43	8-13-17
T11-95	ARD Toe	149	Yellow box Thermister	(12)	13:38	8-13-17
P05-67	By "3 Way"	1	Nautiz Geokon logger		~~13:14~~ 10:00	8-13-17
T05-67	By "3 Way"	133	Yellow box Thermister	(8)	13:59	8-13-17
WingWall	Power House	4	Nautiz Geokon logger		10:00	8-14-17

Well	Location	Col. Row #Ports	Collection Method instrument	(Nodes)	Time	Date
P16-148AB	~~Behind Power~~ Powerhouse	2	Nautiz Geokon logger		Unreachable Condition	
P16-149AB	S. of Powerhouse	2	Nautiz Geokon logger		10:09	8-14-17
P16-150	S. of Powerhouse	1	Nautiz Geokon logger		10:34	8-13-17
P05-63	Zn Thickener	1	Nautiz Geokon logger		10:53	
T05-63	Zn Thickener	129	Yellow box Thermister	(8)	10:50	
T05-64	By CSB	130	Yellow box Thermister	(7)	09:55	8-14-17
T05-66	South of CSB	132	Yellow box Thermister	(8)	10:39	8-13-17
*T95-05	By sandfilter	70	Yellow box Thermister	(24)	09:49	8-14-17
*T05-61	TDAM (end)	127	Yellow box Thermister	(6)	09:42	8-14-17
*T95-04	TDAM (end)	69	Yellow box Thermister	(24)	17:13	8-13-17
*T14-110	W. Tails Pond	1	Archer Beaded Stream	(24)	11:42	8-13-17
Piglet & 124	~~TDAM~~ Kansan	4	Nautiz Geokon logger			
TailingsCPT	TDAM	16	Nautiz Geokon logger		Done Already	
~~P14-134~~ Liverpool	TDAM	1	Nautiz Geokon logger			
P06-74	TDAM	1	Nautiz Geokon logger			
~~[illegible]~~	TDAM	4	Nautiz Geokon logger			
Warthog	TDAM	16	Nautiz Geokon logger		Done Already	
~~[illegible]~~	TDAM	16	Nautiz Geokon logger			
~~P16-15[illegible]~~	TDAM Slope	1	Nautiz Geokon logger			
~~P[illegible]~~	TDAM Slope	1	Nautiz Geokon logger			
~~P05-[illegible]~~	Buttress	1	Nautiz Geokon logger			
~~P14-142~~	Buttress	1	Nautiz Geokon logger			
~~P05-69~~	Buttress	1	Nautiz Geokon logger			
*T97-28	Buttress	76	Yellow box Thermister	(24)	15:10	8-13-17
*T97-29	Buttress	77	Yellow box Thermister	(24)	15:06	8-13-17
*T97-30	Buttress	78	Yellow box Thermister	(24)	15:05	8-13-17
*P96-10	Seepage Dam	1	Nautiz Geokon logger		15:00	8-13-17
*T96-10	Seepage Dam	71	Yellow box Thermister	(24)	15:00	
TDAM T7	Seepage Dam	65	Yellow box Thermister		15:00	
*SPP97-2	Seepage Dam	1	Nautiz Geokon logger		15:00	
*P96-15	Lower RDC	23	Geokon Piezometer		14:20	8-13-17
*T96-15	Lower RDC	44	Yellow box Thermister	(14)	14:20	8-13-17
DODO	By OF_001	1	Nautiz Geokon logger		14:35	8-13-17
P16-147	By OF_001	1	Nautiz Geokon logger		14:40	8-13-17
RDD Piezo	RDC Dam	16	Nautiz Geokon logger		14:45	8-13-17

Comments: Ptarmigan 14:35

*SEP Piezometer. QC: Duplicate Reading with Geokon to be taken within 5 min. of each other, Quarterly.

*SEP Thermister. QC: CR850 & Multimeter readings to be taken within 5 min. of each other, Quarterly.

Quarterly Thermistor QA / QC

Location: T96-22 Date: 8-13-17

Technician: JWM Start Time: 10:54 Stop Time: 10:59

Node	Ohms	Comments
Test	16.34	
1	9.06	
2	11.29	
3	OL	
4	14.17	
5	15.06	
6	15.22	
7	15.24	
8	15.33	
9	15.79	
10	OL	
11	16.47	
12	16.75	
13	16.81	
14	16.87	
15	OL	
16	16.96	
17	17.10	
18	17.03	
19	17.10	
20	17.12	
21	17.14	
22	17.21	
23	14.58	
24	17.31	
Test	16.35	

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 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

WHP QUARTERLY REPORT DATA CHECKLIST **Quarter** **Q3 2017** **Date** 6 Sept, 2017

For Teck/RedDog Longterm Groundwater and Permafrost monitoring

☒ **YES / NO** Quarterly data received from Teck. Date received: 6 Sept, 2017

☒ **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: No Piezometer QA/QC

☒ **YES / NO** Is data complete for all Thermistors? If "No" make note of data gaps:

T-95-04 data had error (below 0) readings for all 24 thermistors.

☒ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:

Data received for all Piezometers, no Piezo QA/QC received.

☒ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Additional Comments: _____

QUARTER Q3 2017 **DATE** 6 Sept, 2017

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	
T-05-061	Y	
T-95-005	Y	
T-96-010	Y	Error at 4 of 24 nodes
T-97-028	Y	Error at 13 of 24 nodes
T-97-029	Y	Error at 6 of 24 nodes
T-97-030	Y	Error at 2 of 24 nodes
T-14-110	Y	
T-95-008 #2 (manually add "#2")	Y	
T-96-013	Y	
T-96-021	Y	
T-96-022	Y	
T-96-023	Y	Error at 8 of 24 nodes
T-96-012	Y	
T-96-012s	Y	
T-95-004	Y	Error at ALL 24 of 24 nodes (All readings below 0)

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	Pressure reading received, error in temperature value

DJSheldon/JWMills

Quarterly Thermister & Piezometer

Row: Thermrdr: Date: 11-26-17

	Well	Location	Collection Method Instrument	Nodes	Date	Piezo PSI Therm Error	Comments
16	Backdam Piezo	Backdam	Nautiz Geokon logger		11-26-17		
26	*T95-08	Over Burden	Yellow box Thermister	24	11-26-17		
25	*P96-13	Over Burden	Geokon Piezometer				Damage to Cable sheath
29	*T96-13	Over Burden	Yellow box Thermister	24			14:25
30	T96-13S	Over Burden	Yellow box Thermister	24			14:22
31	*T96-21	Over Burden	Yellow box Thermister	24			14:23
32	*T96-22	Over Burden	Yellow box Thermister	24			14:28, No Cap for thermo connector
33	*T96-23	Over Burden	Yellow box Thermister	24			14:30, no cap for thermo connector, damage to cable sheath
34	T96-24	Over Burden	Yellow box Thermister	24			14:33, No Cap on connector QA/QC
24	*P97-12	Blast Road	Geokon Piezometer		11-26-17		Damage to Cable sheath
27	*T96-12	Blast Road	Yellow box Thermister	24			
28	*T96-12S	Blast Road	Yellow box Thermister	24			
12	T98-33	Cold Storage	Yellow box Thermister	10			Could not find Thermistor
13	T98-34	Cold Storage	Yellow box Thermister	11	11-29-17		Exposed Wires, Broken
14	T98-35	Cold Storage	Yellow box Thermister	11			Exposed + Broken Wires
145	T11-91	ARD Toe	Yellow box Thermister	12			
146	T11-92	ARD Toe	Yellow box Thermister	11			
147	T11-93	ARD Toe	Yellow box Thermister	9			
148	T11-94	ARD Toe	Yellow box Thermister	12			~~Exposed + Broken Wires~~ DJS
149	T11-95	ARD Toe	Yellow box Thermister	12			~~" " "~~ " DJS
1	P05-67	By "3 Way"	Nautiz Geokon logger		11-26-17		
133	T05-67	By "3 Way"	Yellow box Thermister	8	11-29-17		
4	WingWall	Power House	Nautiz Geokon logger				
1	P16-150	S. of Powerhouse	Nautiz Geokon logger				
1	P05-63	Zn Thickener	Nautiz Geokon logger		11-26-17		
129	T05-63	Zn Thickener	Yellow box Thermister	8	11-29-17		
130	T05-64	By CSB	Yellow box Thermister	7			
132	T05-66	South of CSB	Yellow box Thermister	8			
70	*T95-05	By sandfilter	Yellow box Thermister	24	11-26-17		
127	*T05-61	TDAM (end)	Yellow box Thermister	6	11-26-17		
69	*T95-04	TDAM (end)	Yellow box Thermister	24	11-29-17		Mostly Negative Readings
1	*T14-110	W. Tails Pond	Archer Beadeu Stream	24	11-26-17		
76	*T97-28	Buttress	Yellow box Thermister	24	11-29-17		
77	*T97-29	Buttress	Yellow box Thermister	24	11-29-17		
78	*T97-30	Buttress	Yellow box Thermister	24	11-26-17		
1	*P96-10	Seepage Dam	Nautiz Geokon logger		11-26-17		
71	*T96-10	Seepage Dam	Yellow box Thermister	24	11-29-17		
65	TDAM T7	Seepage Dam	Yellow box Thermister		11-29-17		
1	*SPP97-2	Seepage Dam	Nautiz Geokon logger		11-26-17		
23	*P96-15	Lower RDC	Geokon Piezometer		11-26-17		
44	*T96-15	Lower RDC	Yellow box Thermister	14	11-26-17		
1	P16-147	By OF_001	Nautiz Geokon logger				Logger in Ice
16	RDD Piezo	RDC Dam	Nautiz Geokon logger		11-26-17		

*SEP Thermister. QC: CR850 Multimeter readings to be taken within 5 min. of each other, Quarterly.

*SEP Piezometer. QC: Duplicate Reading with Geokon to be taken within 5 min. of eac

Quarterly Thermistor QA / QC

Location: P 96-23 Date: 11/26/17

Technician: Dwn/DVS Start Time: 1437 Stop Time: 1442

Node	Ohms	Comments	Node	Temperature
Test	16.35		Test	
1	open		1	
2	17.31		2	
3	17.24		3	
4	~~16~~ 17.05		4	
5	17.20		5	
6	16.91		6	
7	17.15		7	
8	17.08		8	
9	17.08		9	
10	16.95		10	
11	16.92		11	
12	16.88		12	
13	16.86		13	
14	16.34		14	
15	16.41		15	
16	15.8		16	
17	15.83		17	
18	15.72		18	
19	15.44		19	
20	15.52		20	
21	15.05		21	
22	14.88		22	
23	16.05		23	
24	open		24	
Test	16.35		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

WHP QUARTERLY REPORT DATA CHECKLIST **Quarter** Q4 **Date** 20 Dec 2017

For Teck/RedDog Longterm Groundwater and Permafrost monitoring

- ☐ **YES / NO** Quarterly data received from Teck. Date received: 13 December, 2017
- ☐ **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:

  Significant data gaps at 4 thermistors

- ☐ **YES / NO** Is data complete for all Piezometers? If "No" make note of data gaps:

  Need barometric pressure readings for day(s)/time of piezometer readings.

- ☐ **YES / NO** Field Notes for the Quarter. Are data gaps/irregularities addressed?

Additional Comments: No field notes received for Q4.

QUARTER Q4 DATE 20 Dec 2017

Thermistor	Data Received? Y / N	Comments
T-96-015	Y	
T-05-061	Y	
T-95-005	Y	
T-96-010	Y	Error at 2 of 24 nodes
T-97-028	Y	Errors (negative readings) at 15 of 24 nodes
T-97-029	Y	Errors (negative readings) at 7 of 24 nodes
T-97-030	Y	Errors at 2 of 24 nodes
T-14-110	Y	
T-95-008 #2 (manually add "#2")	Y	
T-96-013	Y	
T-96-021	Y	
T-96-022	Y	No reading at 2 of 24 nodes
T-96-023	Y	Errors at 9 of 24 nodes
T-96-012	Y	Error at 1 of 24 nodes
T-96-012s	Y	
T-95-004	Y	Error at 23 of 24 nodes

Piezometer	Data Received? Y / N	Comments
P-96-015	Y	BAROMETER READINGS??
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	