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Sandia National Laboratories

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date: 6/11/2024

to: WIPP Records Center

from: Justin R. Kirkes
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6/11/24

subject: Milestone HYDRO 24-01: Progress Report that Documents CY23 Fluctuations in the WIPP Monitoring Well Network

1.0 Purpose

The Sandia National Laboratories (SNL) long-term, high-frequency monitoring program collects well pressure data in wells across the Culebra and Magenta Members of the Rustler Formation, the Bell Canyon Formation, and Dewey Lake Perched Anthropogenic wells (PAW) across the Waste Isolation Pilot Plant (WIPP) facility. Programmatic groundwater level measurements focus primarily on the Culebra Member of the Rustler Formation, as it is the most transmissive and laterally extensive water-bearing stratigraphic unit in proximity to the WIPP repository. Therefore, the Culebra groundwater level fluctuations are the focus of this progress report.

The Culebra dolomite has been identified as the most likely transport pathway for potential future inadvertent human intrusion into the repository (Wagner and Hayes, 2019). Monitoring of Culebra groundwater chemical composition, change in flow, and monitoring well water levels are to be conducted both during the pre-closure and post-closure phases of the repository (DOE, 2003). The Dewey Lake, and Bell Canyon formations and the Magenta members are not currently monitored as Compliance Monitoring Parameters (COMPs) and do not have Performance Assessment (PA) flow models (Wagner and Hayes, 2019). The objective of this milestone report is to present and summarize the well pressure data collected in Culebra, Magenta, Bell Canyon, and PAWs for calendar year (CY) 2023.

2.0 Introduction

In CY2023, SNL recorded pressure data across wells in Culebra (36), Magenta (13), Bell Canyon (2), and PAWs (15). The transducers, which are generally installed at mid-formation depths, record water pressure at 15-minute intervals during routine monitoring. Pressure transducers provide a higher temporal resolution of the changes in the pressure head occurring in the wells than is provided by monthly water-level measurements alone.

For the purposes of this report, these pressure data are reported in equivalent feet of fresh water (1 psi = 2.309 ft H_2O) and the first yearly value is normalized to zero. The data were also corrected for

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WIPP: 4.4.2.3.1: TD: QA-L: NOTEBOOK: Equipment

barometric and earth-tide effects using nSIGHTS v.2.41a (nSIGHTS 2013) in accordance with SP 9-13 Rev 1 (Bowman 2021). Data for each well are plotted individually and are also plotted in groups based on similarly sourced pressure head changes. A reference map of the Culebra monitoring well locations is shown in Figure 1. For completeness, Figure 1 also shows the Magenta and Bell Canyon well locations. A reference map of the PAWs currently being monitored is shown in Figure 2.

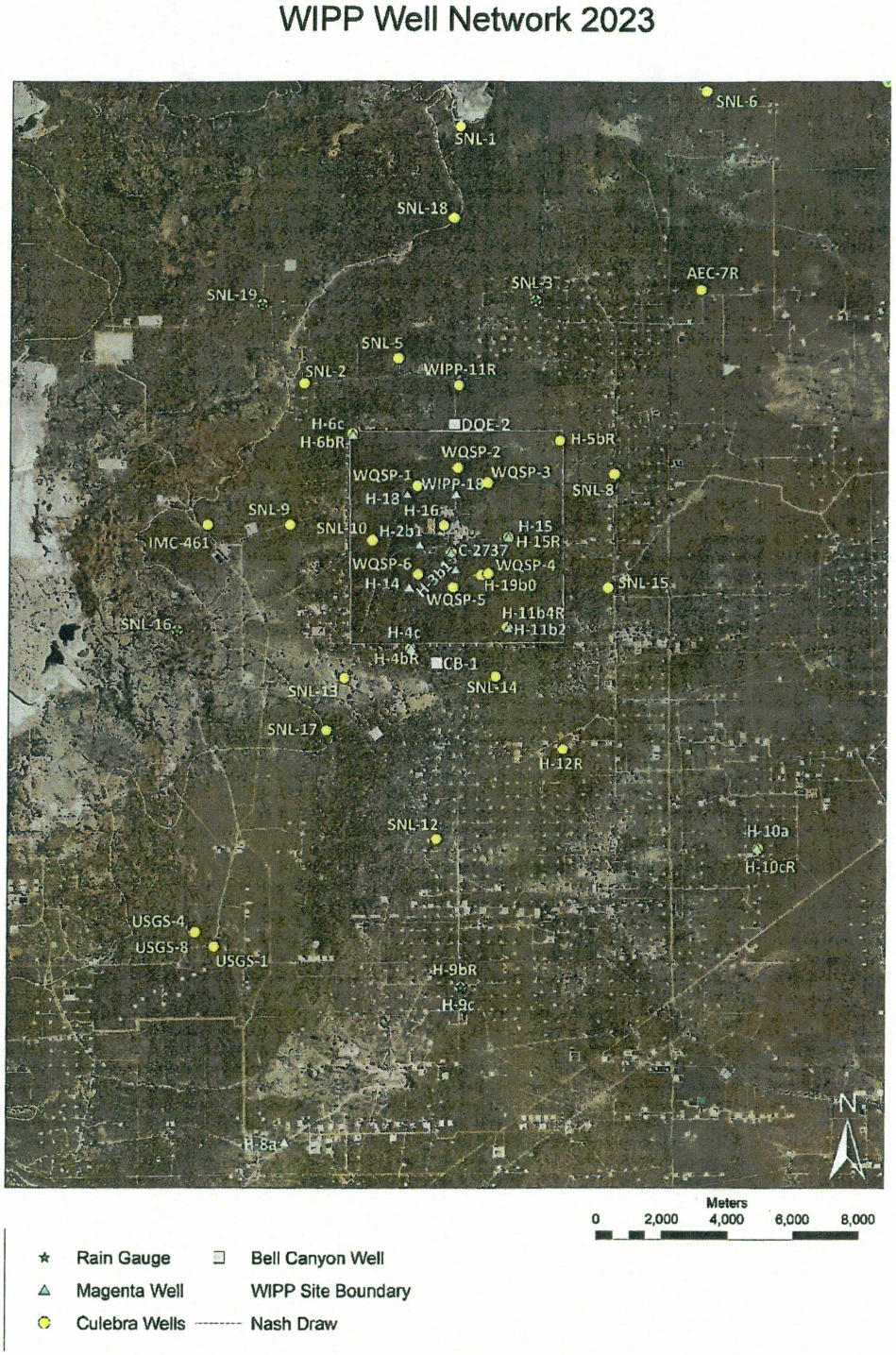

Figure 1. Locations of Culebra (yellow circles), Magenta (blue triangles), and Bell Canyon (grey squares) wells in the WIPP Groundwater Monitoring Network. Well C-2737 is a dual completion in both the Culebra and Magenta. The USGS wells are not monitored in the normal monthly monitoring run and are not included in any analysis in this document. The Land Withdrawal

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Boundary (LWB) is outlined in grey, and the approximate boundary of Nash Draw is outlined in a tan dashed line.

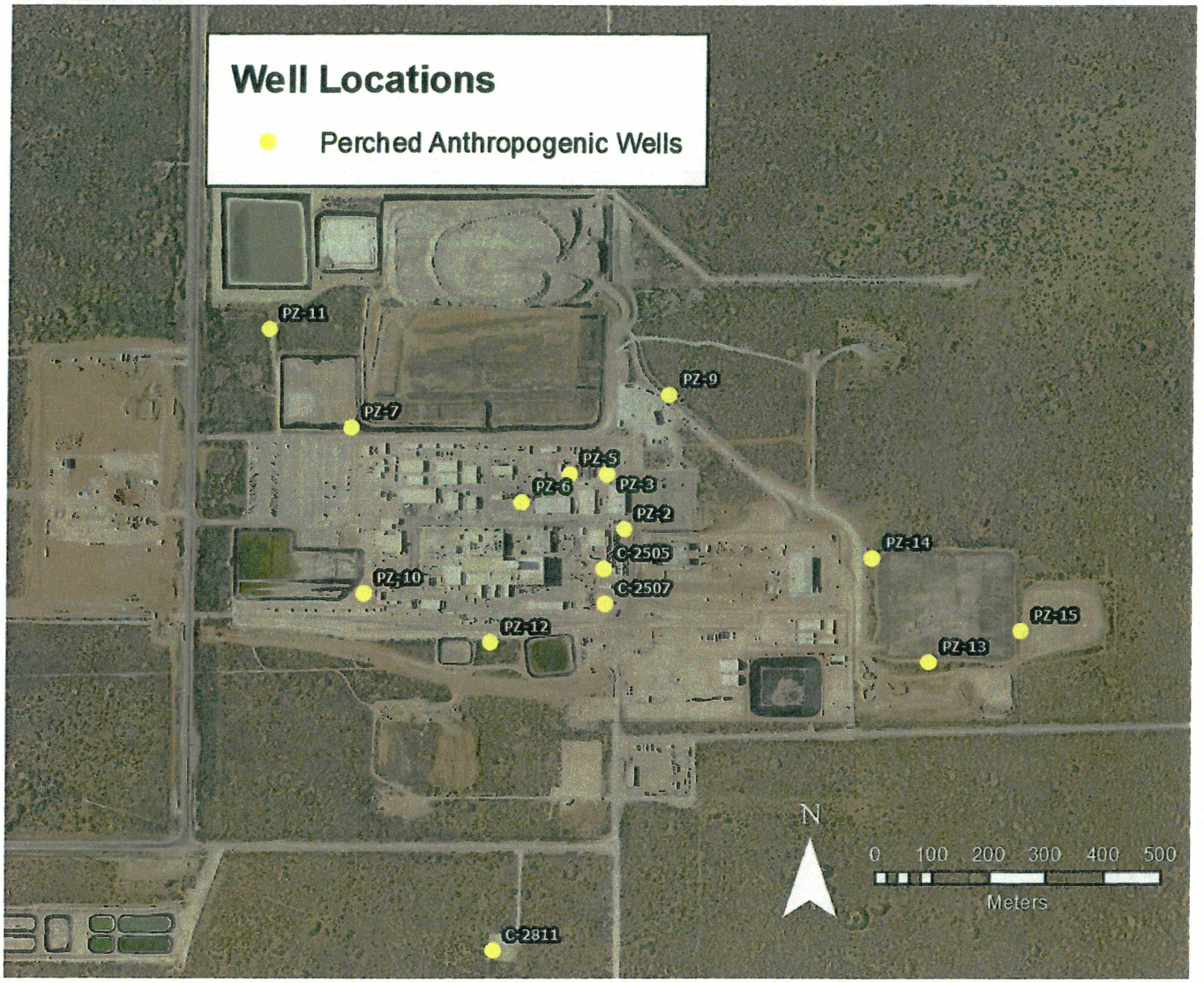

Figure 2. Locations of the Perched Anthropogenic wells (PAW) (yellow circles) in the WIPP Groundwater Monitoring Network.

Pressure head fluctuations for several wells include shifts, spikes, or incongruities. These fluctuations are due to various causes including adjustments to transducer depths, displacement of water during removal and replacement of transducers, transducer failures, cable stretch, or the operation of other equipment in the well. Small-scale instances of this type are not discussed in this report. Specific large-scale comments about breaks in the data or anomalous data are given on individual plots, as appropriate.

Table 1 contains a list of all monitored Culebra wells in CY2023, as shown in Figure 1, and an abbreviated description of the dominant influence(s) (the most prevalent cause(s) of pressure change) on each well's pressure head. A more precise description and broader context for each of the wells and the associated influences are provided in Section 3.0. Table 4 contains the delta pressure head (Δ) and net change of pressure head (both in feet of fresh water) for CY2023. Delta pressure head is calculated per well as the difference between the minimum and maximum recorded heads, and net change of pressure head is calculated as the difference between the first and last recorded head for CY2023. In circumstances where transducers were placed at different depths during CY2023 (i.e., SNL-6 in Figure 26), heads were adjusted to compensate for the artificial change in pressure value. This compensation

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was made by aligning the last head value preceding the transducer adjustment with the first head value after the transducer adjustment. These compensations are made solely for the calculations presented in Tables 4, 5, and 6.

Table 1. Culebra Wells with Pressure Transducer Data for CY2023

Well	Precipitation	Leakage	NWRA	Water Quality Sampling	Gravity Flow	Long-Term Recovery	Well	Precipitation	Leakage	NWRA	Water Quality Sampling	Gravity Flow	Long-Term Recovery
AEC-7R					X		SNL-8			X		X	
C-2737C	X	X					SNL-9	X			X	X	
H-4bR			X				SNL-10				X	X	
H-5bR			X		X		SNL-12			X			
H-6bR	X				X		SNL-13					X	
H-9bR			X		X		SNL-14	X		X		X	
H-10cR			X		X		SNL-15						X
H-11b4R	X		X				SNL-16	X		X			
H-12R			X				SNL-17A	X		X	X		
H-15R	X	X			X		SNL-18	X			X	X	
H-16		X					SNL-19	X			X		
H-19b0	X		X				WIPP-11R					X	
IMC-461	X		X				WQSP-1*				X		
SNL-1	X				X		WQSP-2				X		
SNL-2	X		X				WQSP-3				X		
SNL-3	X			X	X		WQSP-4				X		
SNL-5				X	X		WQSP-5				X		
SNL-6				X		X	WQSP-6				X		

NWRA = Non WIPP Related Anthropogenics

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Table 2. Magenta and **Bell Canyon** Wells with Pressure Transducer Data for CY2023

Well	Precipitation	Leakage	NWRA	Water Quality Sampling	Gravity Flow	Long-Term Recovery
C-2737M					X	
H-2b1					X	
H-3b1					X	
H-4c						
H-6c					X	
H-8a					X	
H-9c						
H-10a			X			
H-11b2			X			
H-14					X	
H-15					X	
H-18					X	
WIPP-18					X	
CB-1						X
DOE-2					X	

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Table 3. Perched Anthropogenic Wells with Pressure Transducer Data for CY2023

Well	Precipitation	Leakage	NWRA	Water Quality Sampling	Gravity Flow	Long-Term Recovery
C-2505				X		
C-2507				X		
C-2811				X		
PZ-2				X		
PZ-3				X		
PZ-5				X		
PZ-6				X		
PZ-7				X	X	
PZ-9				X		
PZ-10				X		
PZ-11				X	X	
PZ-12				X		
PZ-13				X		
PZ-14				X	X	
PZ-15				X	X	

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Table 4. Culebra Pressure Head Fluctuations

Well	Δ Hydraulic Head (ft fresh water)	Net Change (ft fresh water)	Well	Δ Hydraulic Head (ft fresh water)	Net Change (ft fresh water)
AEC-7R	1.43	1.25	SNL-8	7.57	1.18
C-2737C	20.43	-20.31	SNL-9	1.55	1.24
H-4bR	4.78	1.46	SNL-10	3.93	-3.30
H-5bR	2.72	-0.14	SNL-12	7.40	4.04
H-6bR	1.06	-0.25	SNL-13	1.49	0.75
H-9bR	20.63	15.04	SNL-14	6.44	1.75
H-10cR	1.12	10.11	SNL-15	7.54	7.11
H-11b4R	4.59	0.46	SNL-16	1.10	0.02
H-12R	1.58	0.48	SNL-17A	2.89	1.16
H-15R	4.74	-3.57	SNL-18	1.40	0.28
H-16	24.02	-22.96	SNL-19	2.02	1.51
H-19b0	8.79	-6.34	WIPP-11R	0.99	0.31
IMC-461	1.30	0.85	WQSP-1	1.59	-0.92
SNL-1	0.59	-0.06	WQSP-2	4.281	-0.36
SNL-2	2.10	1.82	WQSP-3	275.99	-3.41
SNL-3	0.78	0.14	WQSP-4	2.66	-2.43
SNL-5	1.10	0.53	WQSP-5	6.41	-6.29
*SNL-6	12.84	12.56	WQSP-6	12.58	-11.80

*Period(s) of data were adjusted for calculations due to artificial changes (changes in transducer depth)
All files associated with this analysis are stored on Sandia's Concurrent Versioning System in location: /cvs/CVSLIB/WIPP_EXTERNAL/SP913_CY23.

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Table 5. Magenta and **Bell Canyon** Pressure Head Fluctuations

Well	Δ Hydraulic Head (ft fresh water)	Net Change (ft fresh water)
C-2737M	9.70	-9.42
H-2b1	7.02	-6.36
H-3b1	5.61	-4.93
H-4c	1.31	1.67
H-6c	4.75	-4.32
H-8a	3.79	-1.59
H-9c	4.26	0.42
H-10a	3.96	0.62
H-11b2	10.88	1.79
H-14	1.46	-0.37
H-15	2.71	-2.30
H-18	5.66	-4.62
WIPP-18	3.42	-2.57
CB-1	**5.83**	**5.07**
DOE-2	**1.16**	**0.20**

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Table 6. Perched Anthropogenic Well Pressure Head Fluctuations

Well	Δ Hydraulic Head (ft fresh water)	Net Change (ft fresh water)
C-2505	0.56	0.31
C-2507	0.73	0.54
C-2811	0.50	0.01
PZ-2	0.80	0.75
PZ-3	0.87	0.58
PZ-5	0.83	0.56
PZ-6	0.77	0.67
PZ-7	0.63	-0.44
PZ-9	0.45	0.42
PZ-10	0.91	0.55
PZ-11	0.70	-0.56
PZ-12	0.60	0.49
PZ-13	0.30	0.21
PZ-14	0.78	-0.21
PZ-15	1.62	-0.60

3.0 Dominant Influences Affecting Wells

3.1 Anthropogenic Influences

The anthropogenic impacts on the WIPP monitoring wells include:
- WQSP water quality sampling: pumping for water quality sampling at WQSP wells,
- Well maintenance activities: including development, replacement, and pumping activities,
- Long-term recovery: recovery from past well development and/or nearby testing/purging/pumping that has been consistent for more than 12 months and uninterrupted in CY2023, and
- Non-WIPP related anthropogenic affects.

These human-driven impacts are discussed further in the following sections.

3.1.1 WQSP and PAW Water Quality Sampling

Sampling occurred between March and June 2023 for wells WQSP-1 through WQSP-6. Sampling occurred in April, and October 2023 for Perched Anthropogenic wells.

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3.1.2 Well Maintenance Activities

Well maintenance occurred between March and December 2023 for wells WQSP-1 through WQSP-6.

3.1.2 Long-Term Recovery

Wells SNL-6 and SNL-15 were drilled in areas where the Culebra contains halite cements, and the wells are still recovering from well-development activities that occurred before 2009 (DOE, 2019). The SNL-6 net recovery is 12.56 ft freshwater head (Figure 26), the SNL-15 net recovery is 7.11 ft freshwater head (Figure 33).

3.1.3 Culebra Non-WIPP-Related Anthropogenic (NWRA) Affects

Five wells in the Culebra and two wells in the Magenta that responded to NWRA affects in CY2023 are displayed in Figures 1 and 2 in Appendix 1. Graphically, the events are separated into those that are associated with a singular large-scale NWRA event that began in December 2023 and those that are independent of that singular event. In December, there was a negative pressure event near Culebra wells H-11b4R, SNL-12, H-4bR, and SNL-14 that lasted approximately two weeks followed by other NWRA events for the rest of the year. Well SNL-17A showed muted NWRA affects that follow the same trend. Magenta wells H-11b2 and H-9c had a negative pressure event in December 2023 that lasted approximately two weeks followed by other NWRA events the rest of the year. Two water wells presently located near this grouping of monitoring wells are the possible source of drawdown (NMOSE 2023). Well C-2258 (production) is located approximately 2 miles east of SNL-12 and it is owned by Devon Energy. Well C-2258 is the likely source of drawdown. The second well, BLM livestock well C-03351, is co-located on the same well pad as SNL-14, but as the drawdown is of greater magnitude at SNL-12, Well C-2258 is the more likely source of drawdown.

Well H-9bR was subject to the most prominent positive pressure events in July through September of 2023, which did not largely affect other wells. More than 20 oil and gas wells were drilled in the vicinity of H-9bR which are likely the cause of the NWRA experienced during this time. The remaining NWRA wells experience smaller, isolated effects.

3.1.4 Magenta Non-WIPP-Related Anthropogenic (NWRA) Affects

Two wells out of four in the Magenta that responded to NWRA affects in CY2023 are displayed in Figure 3 in Appendix 1. H-9c and H-11b2 both experienced a singular NWRA affect that started in December 2023 through the end of the year. H-8a and H-10a showed various smaller NWRA affects most likely due to heavy oil and gas exploration in the area South of NM 128. The PAWs experienced various anthropogenic affects from localized retention pond leakage.

3.1.4 Shaft Leakage Event

Three wells that responded to shaft leakage that began in January 2022 are displayed in Figure 5. Well H-16 showed a pressure head response of -22.96 ft fresh water and C-2737C showed a decline of 20.32 ft fresh water while well H-15R showed less of a response as they are farther away from the shaft.

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3.2 Natural Processes

The main natural processes that impact Culebra, Magenta, and Bell Canyon monitoring wells are precipitation events in Nash Draw and gravity-driven flow. We acknowledge that these processes also exist in our previously described anthropogenically affected wells in section 3.1.3; however, natural processes tend to be muted by anthropogenic events. The following sections discuss wells with responses dominated by natural processes.

3.2.1 General Water Level Change

In 2022, water levels in most wells (26) had a net negative head change, and most wells that had a positive net head change for the year still had declining water levels. Twenty-nine wells in the Culebra experienced net pressure head changes in 2023. The data show a decrease in average annual precipitation for 2023 (6.13 inches) compared to 2022 (9.07 inches). The average precipitation in 2022 was largely due to an absence of recorded rain at SNL-19 until mid-November of 2022. Cumulative change in head in the Culebra in 2022 (excluding test/developed wells and wells that were plugged and abandoned) was -50.12 ft while in 2023 cumulative head change was 7.29 ft in the Culebra, -31.98 ft in the Magenta, 5.27 ft in the Bell Canyon, and 3.88 ft in the PAWs.

3.2.2 Precipitation

Ten Culebra wells in the vicinity of Nash Draw show relatively immediate pressure head responses to precipitation events. Four wells (H-19b0, H-11b4R, H-15R, and SNL-14) located in an area near the repository showed immediate pressure head responses to precipitation events. Figures 7 and 8 correlates precipitation data collected from rain gauges on well pads, SNL-3, H-9bR, SNL-16, and SNL-19, to show pressure head responses to those precipitation events. The pressure head fluctuations for all ten wells mentioned (C-2737, H-6bR, IMC-461, SNL-1, SNL-2, SNL-3, SNL-9, SNL-16, SNL-17A, SNL-18, and SNL-19) are consistent with precipitation fluctuations seen in previous years (Bowman & Hayes, 2019 and 2020). Figure 8 shows five wells located in a high transmissivity zone located in the Southeastern corner of the LWB showed immediate responses to rain events recorded primarily at SNL-3. Magenta, and PAWs all showed muted responses to precipitation.

3.2.3 Gravity Flow

Sixteen Culebra wells experienced minimal pronounced pressure data affects from precipitation or anthropogenic events (AEC-7R, H-5bR, H-6bR, H-9bR, H-10cR, H-15R, WIPP-11R, SNL-1, SNL-3, SNL-5, SNL-8, SNL-9, SNL-10, SNL-13, SNL-14, SNL-18). AEC-7R and SNL-8 are located in areas of the Culebra with the largest distance from recharge, relatively low transmissivity, and other geologic factors that mute or prevent hydraulic responses observed in other wells. Wells AEC-7R, C-2737, H-6bR, SNL-1, SNL-2, SNL-3, SNL-9, were all slightly affected by rain events in the region. Wells AEC-7R, H-4bR, H-5bR, H-6bR, H-11b4R, H-12, IMC-461, SNL-1, SNL-2, SNL-3, SNL-5, SNL-8, SNL-9, SNL-13, SNL-14, SNL-16, SNL-17A, SNL-18, SNL-18 SNL-19, WIPP-11R, WQSP-1, and WQSP-2 all experienced net pressure head pressure changes that were less than +/- 2 ft of fresh water. Seven Magenta wells experienced net pressure head pressure losses of greater than 2 ft of fresh water. Six Magenta wells (H-4c, H-8a, H-9c, H-10a, H-11b2, H-14) experienced net pressure head pressure changes that were less than +/- 2 ft of fresh water. Bell Canyon well CB-1 experienced a net hydraulic pressure change of greater than 2 ft of fresh water. Fifteen PAWs experienced net pressure head pressure changes of less than +/- 2 ft of fresh water.

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4.0 Summary

Wells within the Culebra, Magenta, and Bell Canyon Groundwater Monitoring Networks are affected by both anthropogenic influences and natural processes. Wells within the perched anthropogenic system show very little water flow and are affected by leakage of local retention ponds in the area. The largest pressure head changes for CY2023 were in wells being developed and sampled, followed by those affected by the November NWRA event. Most wells that have been predominantly affected by natural processes in past years continue to behave consistent with previous years' precipitation responses. CY2023 was a dryer year than 2022 in regard to precipitation, the water levels in a majority of the observation wells are leveling out.

Many of the pressure responses described in this report that are important to our understanding of the Culebra in the WIPP vicinity would not have been identifiable using only monthly water level data. The monitoring of Culebra, Magenta, Bell Canyon, and Perched Anthropogenic wells using pressure transducers continues to enhance monthly water level measurements by recording high-resolution changes in pressure heads.

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Appendix 1

Appendix 1 contains both composite and individual graphs of pressure head data from Culebra monitoring wells. Gaps and/or inconsistencies that exist in the data are described in individual well graphs, and they were evaluated under NP 16-1, Rev 7, and addressed in a Corrective Action Requests (CARs) and Corrective Action Plans (CAPs), as needed.

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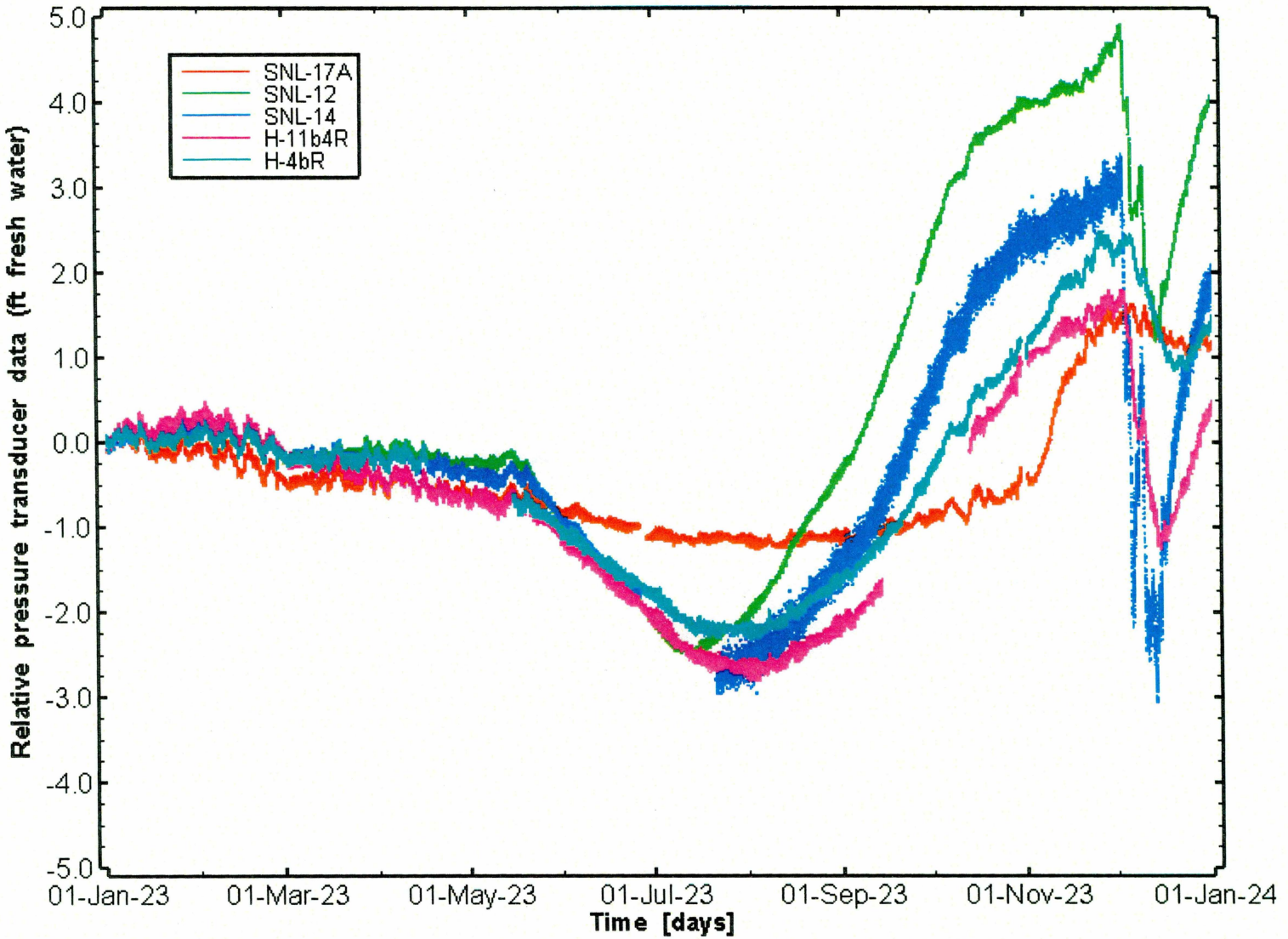

Figure 1.Five Culebra wells affected by NWRA beginning in late November 2023. Note: Data gap is identified in individual well graphs.

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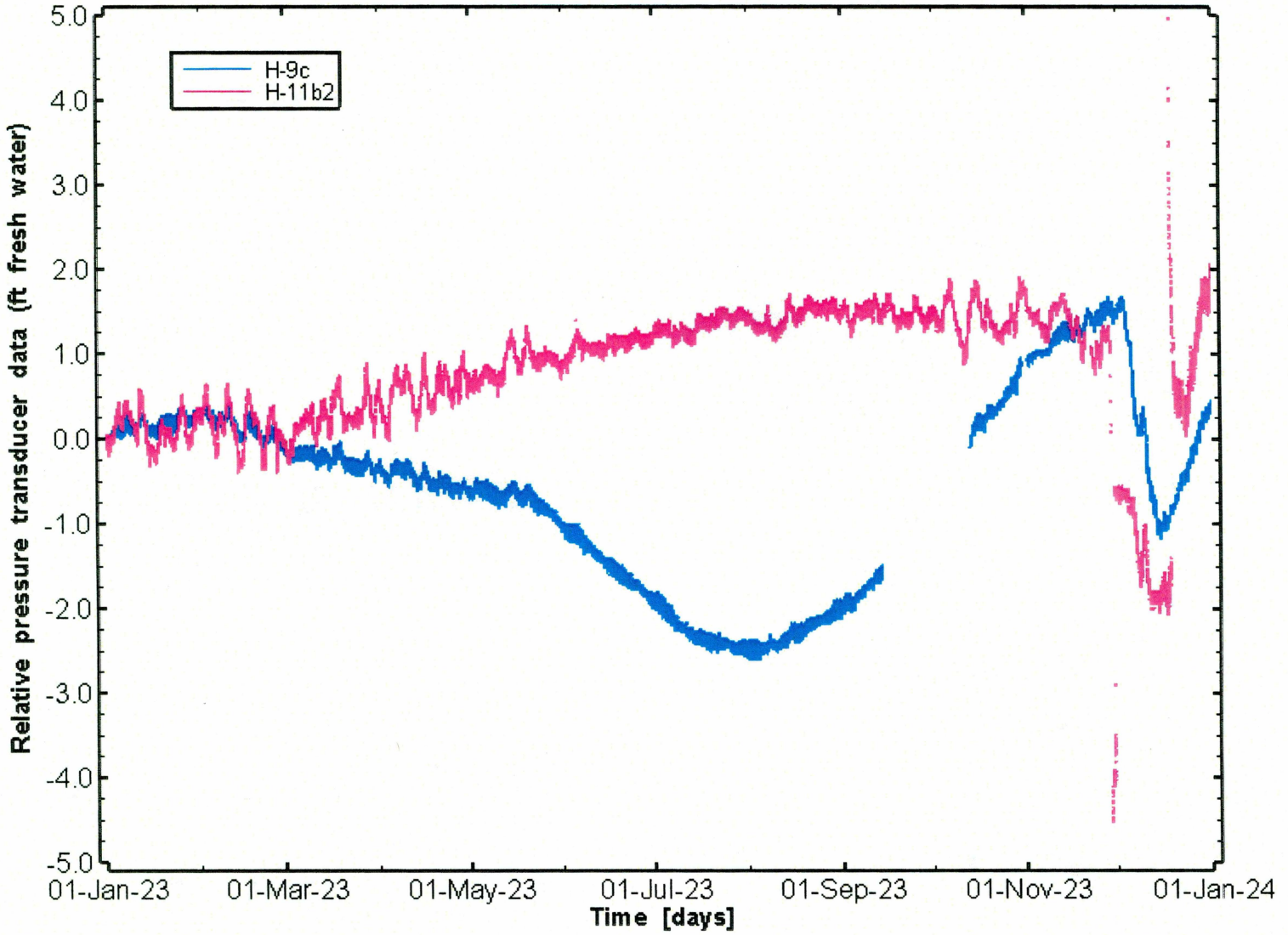

Figure 2. Two Magenta wells affected by a single NWRA event beginning in late November. Data gaps are identified in individual well graphs.

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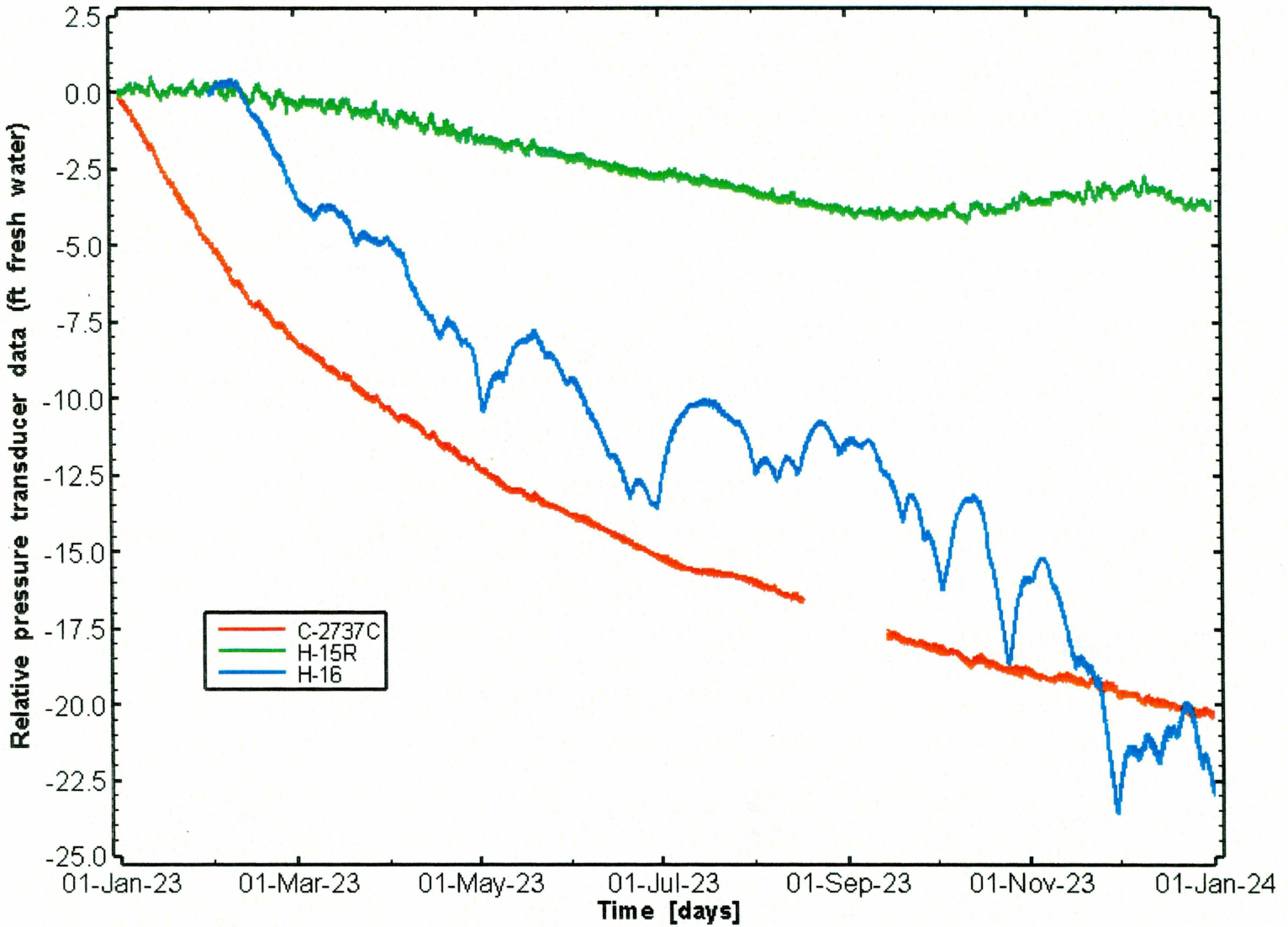

Figure 3. Three wells were affected by shaft leakage starting in early January 2022. Data gaps are identified in individual well graphs.

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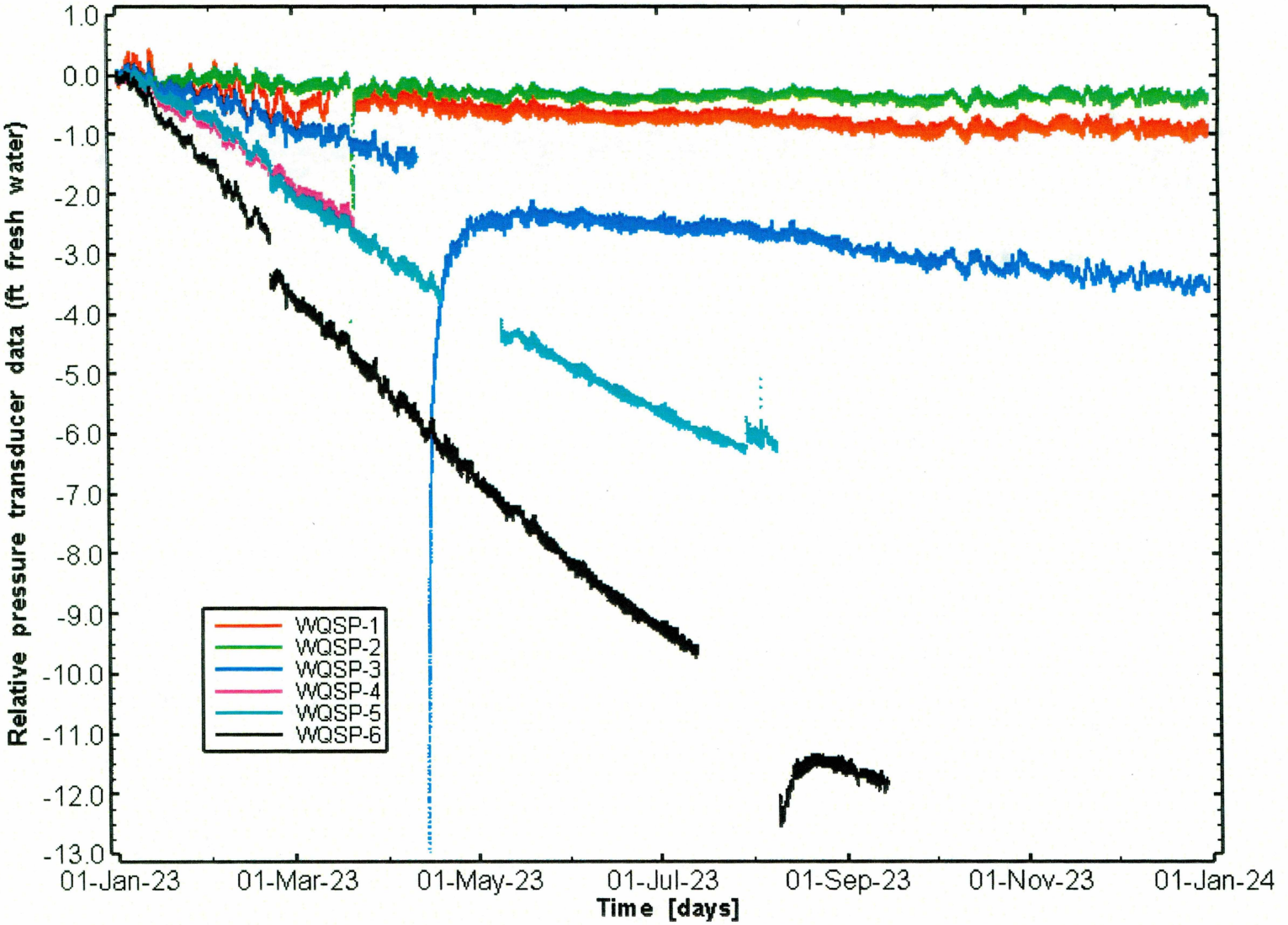

Figure 4. WQSP wells response. Data gaps are identified in individual well graphs.

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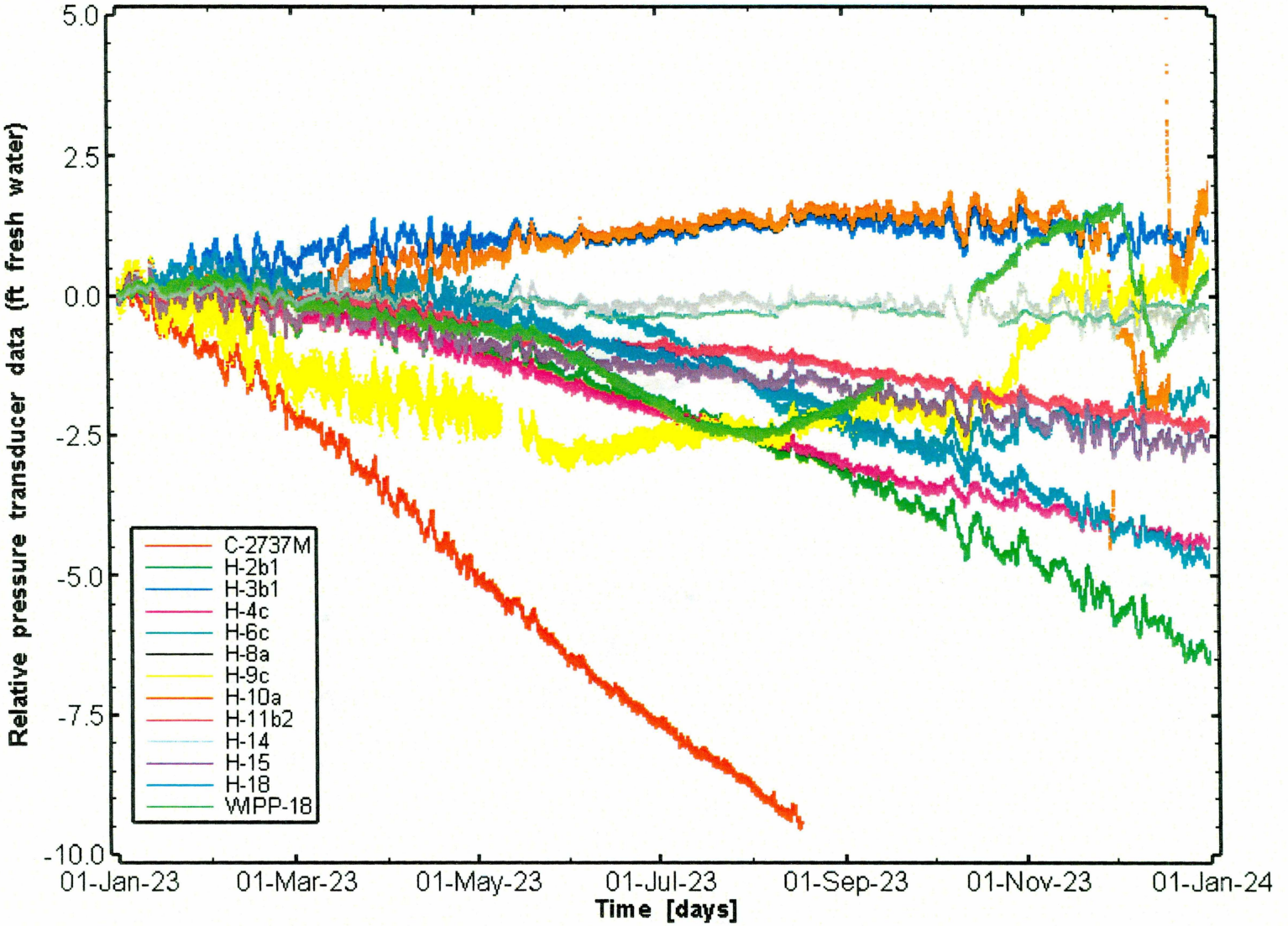

Figure 5. Magenta monitored well pressure head response. Data gaps are identified in individual well graphs.

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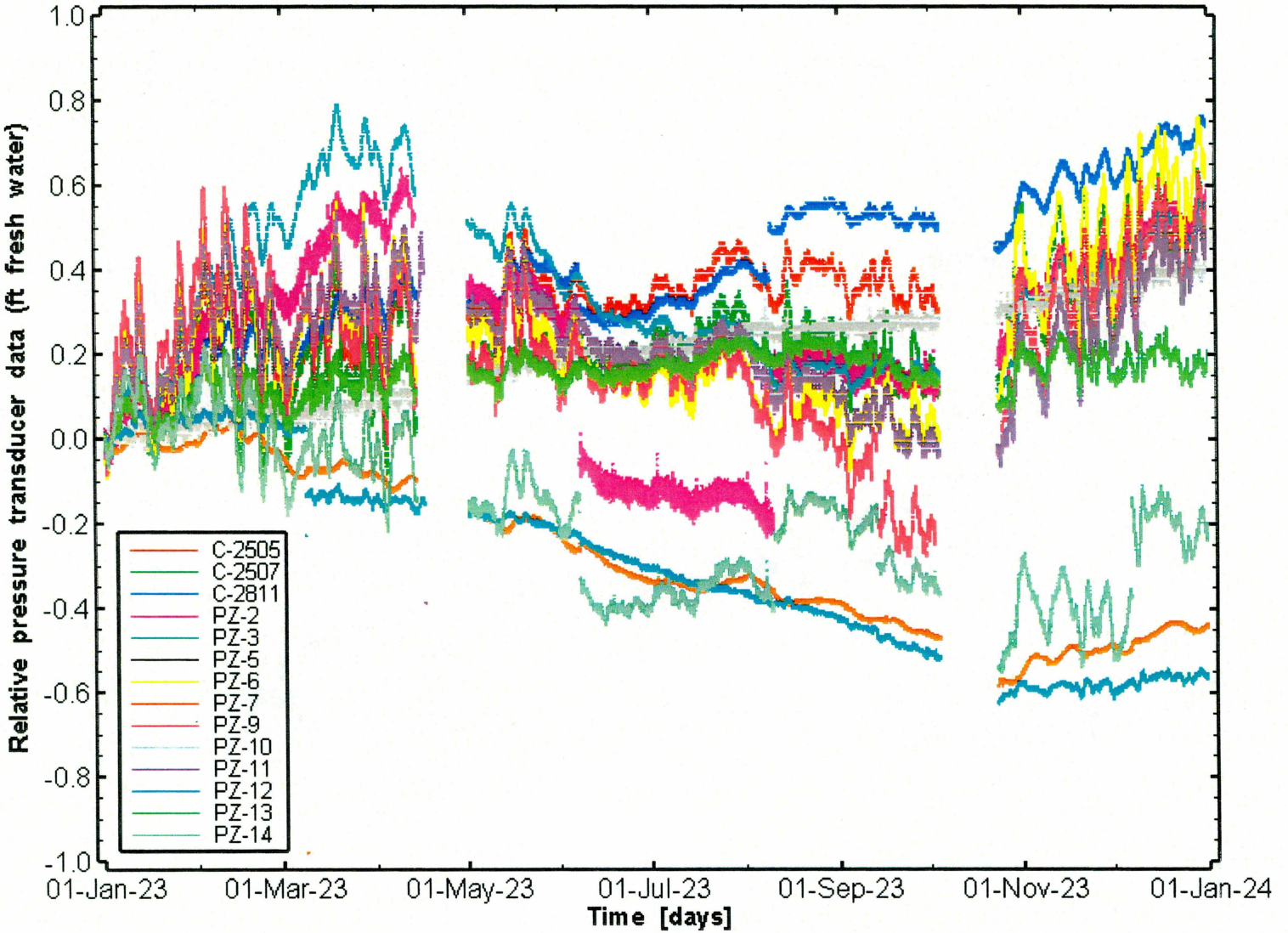

Figure 6. Perched Anthropogenic Wells (PAWs) monitored pressure head response. Data gaps are identified in individual well graphs.

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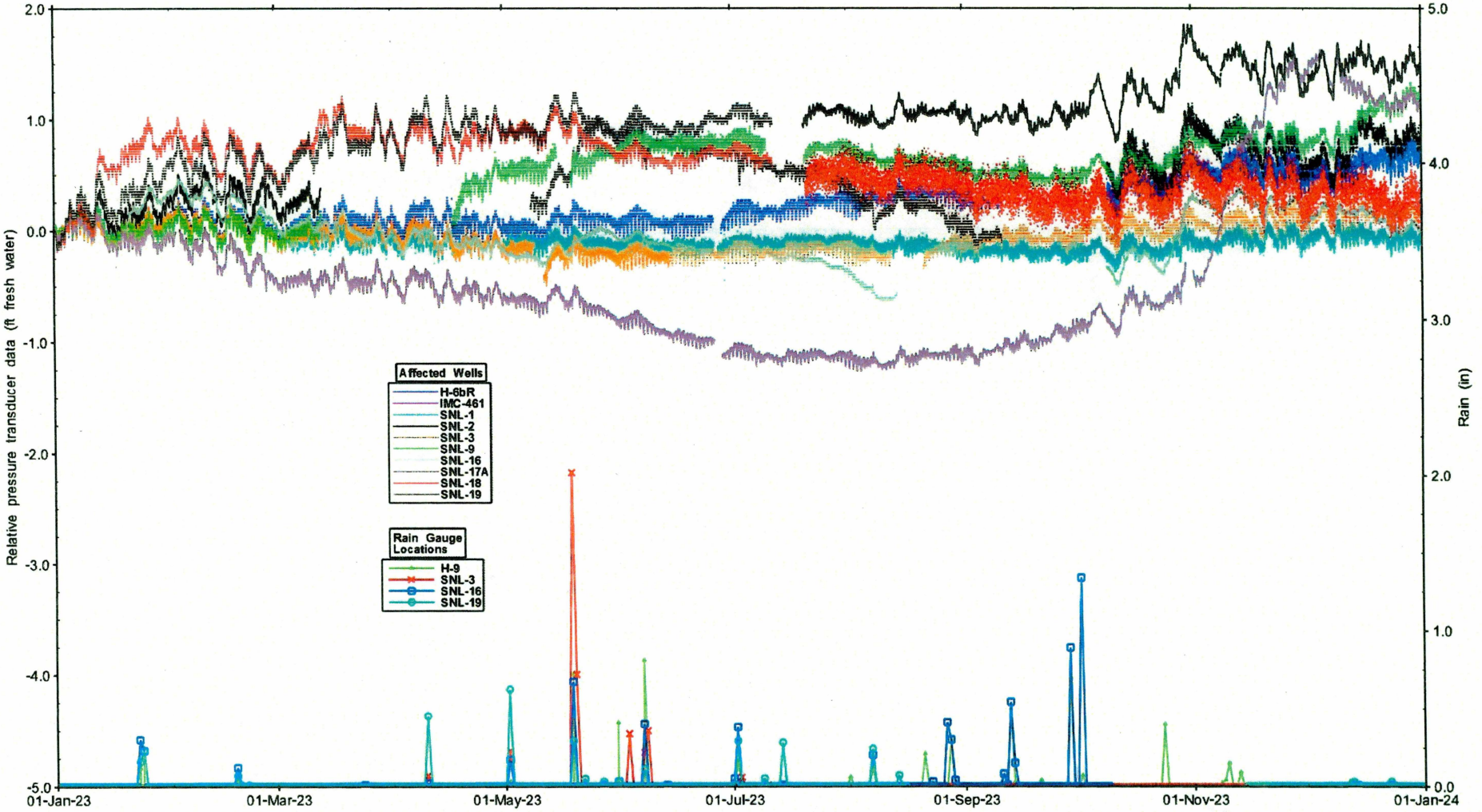

Figure 7. Nash Draw precipitation events. Data gaps are identified in individual well graphs.

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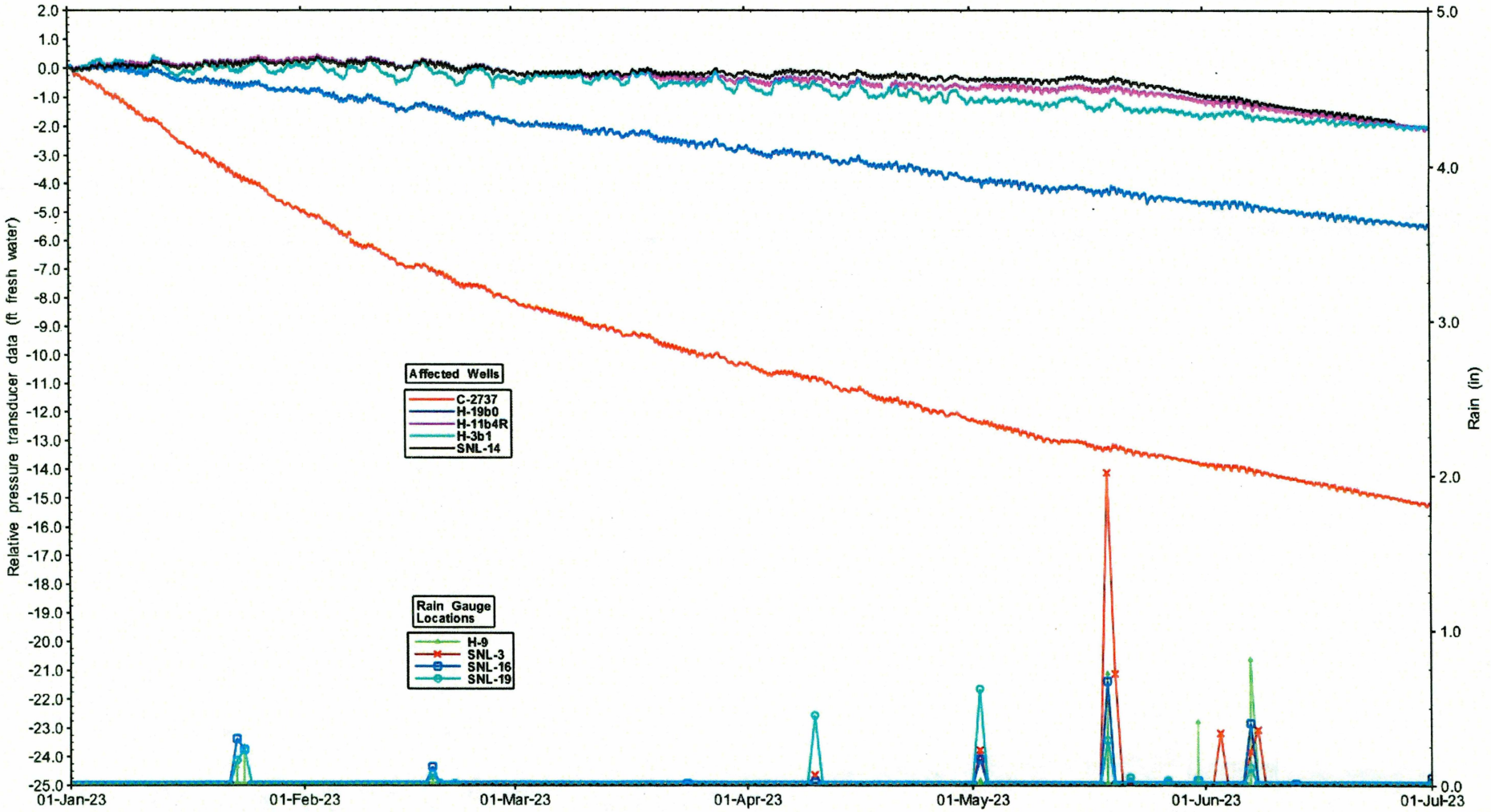

Figure 8. High transmissivity zone precipitation events. Data gaps are identified in individual well graphs.

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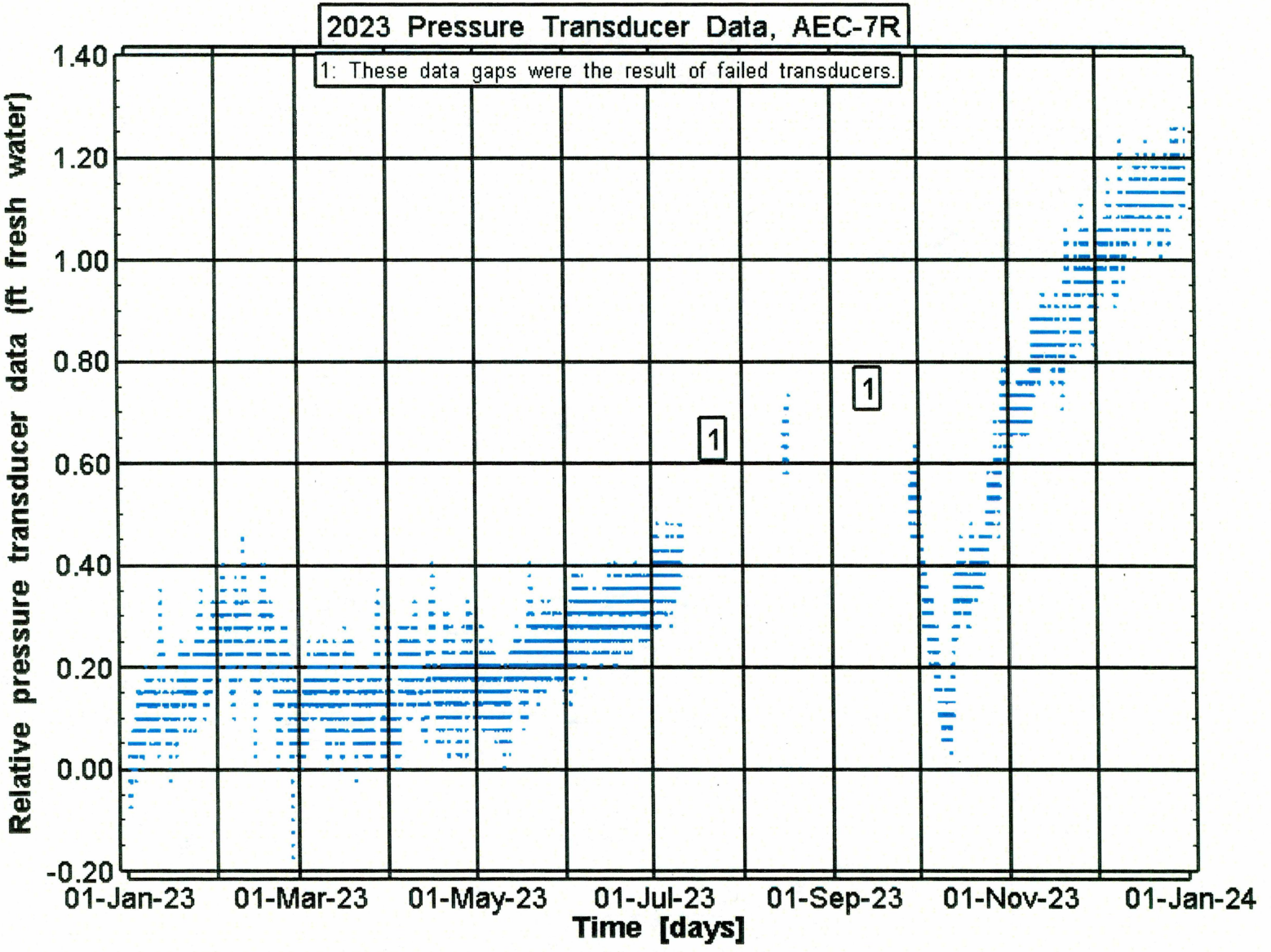

Figure 9. Well AEC-7R experienced a net change in pressure head of 1.25 ft fresh water in 2023.

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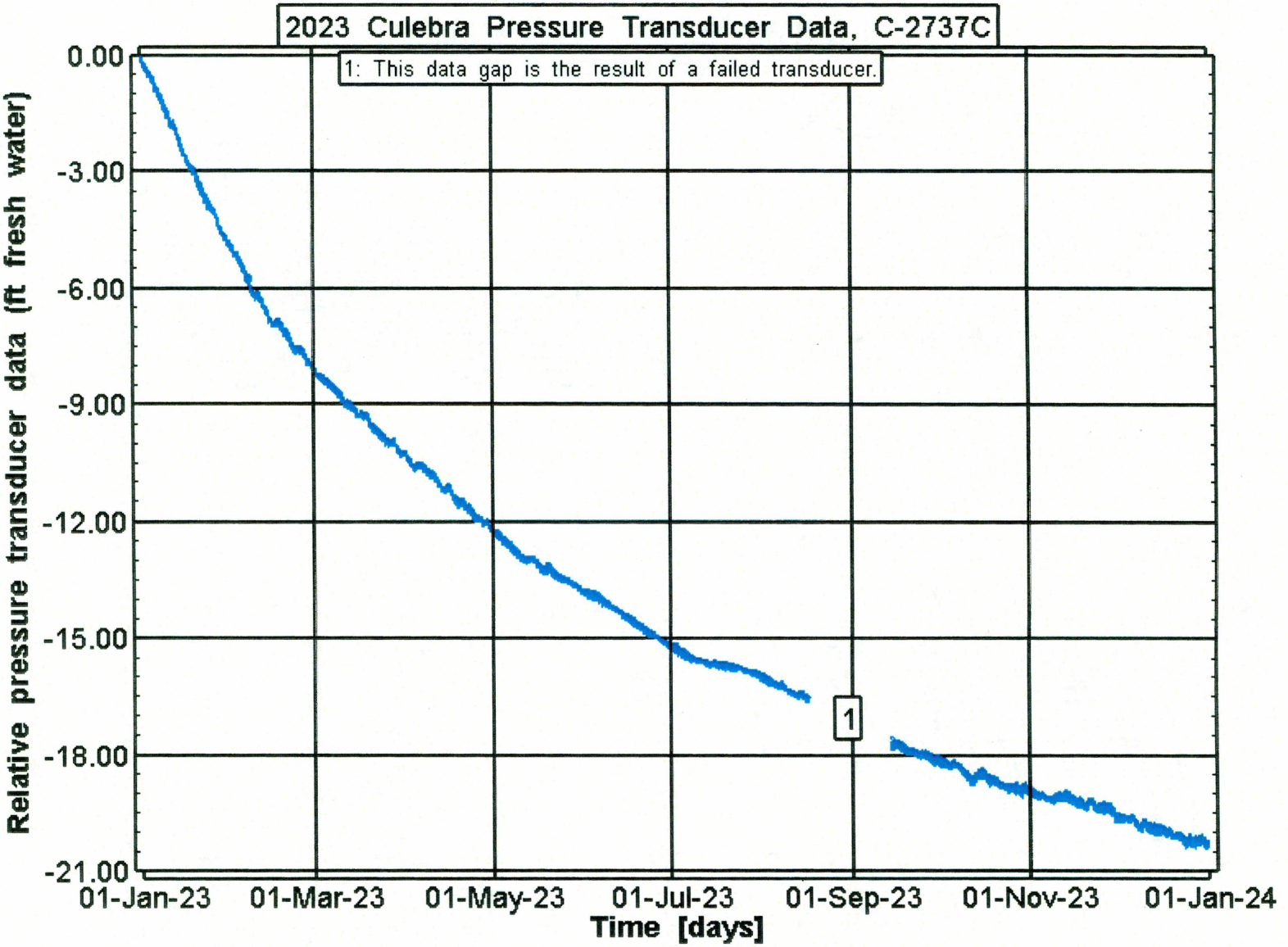

Figure 10. Well C-2737C experienced a net change in pressure head of -20.32 ft fresh water in 2023. This well was affected by shaft leakage.

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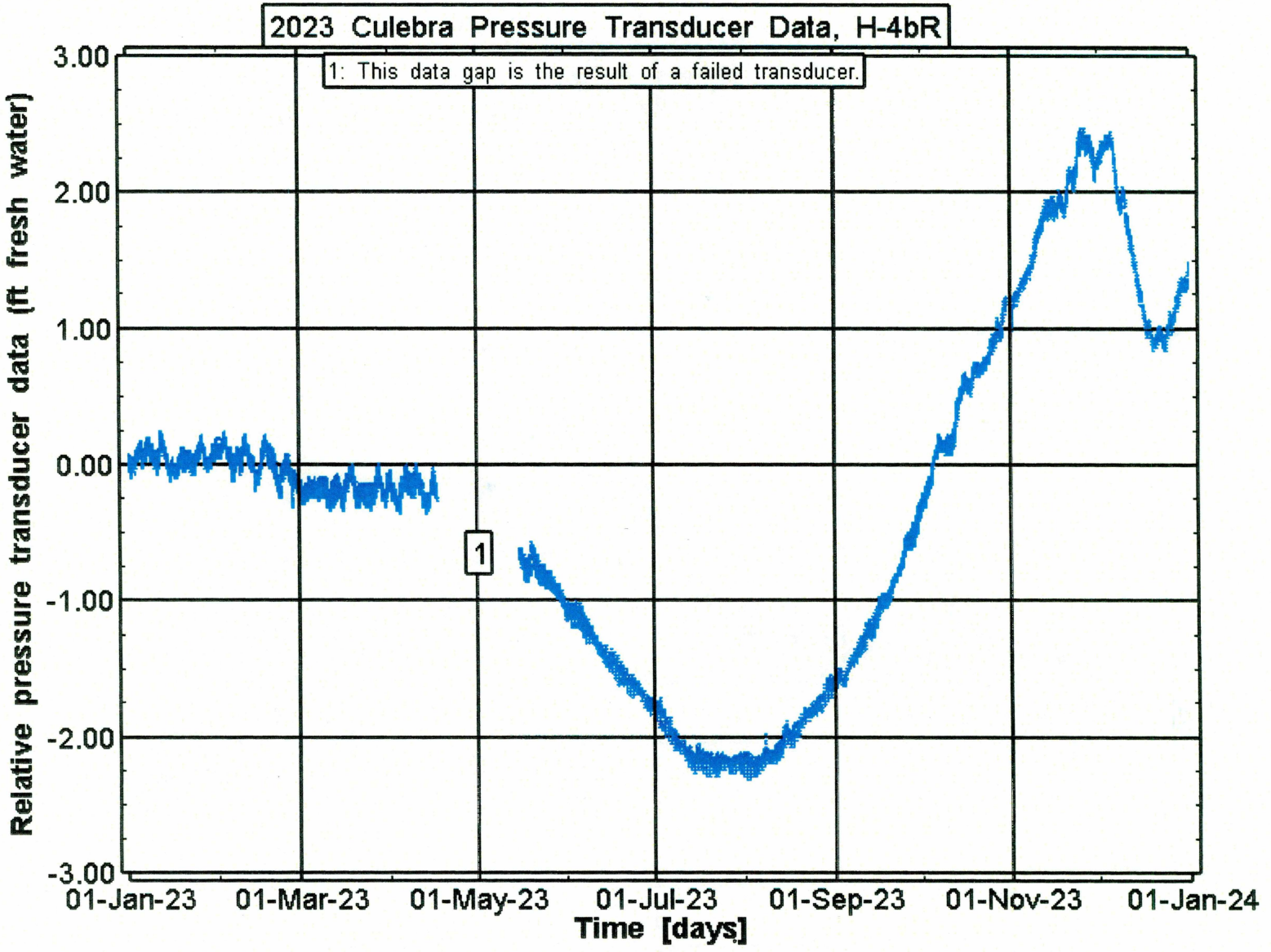

Figure 11. Well H-4bR experienced a net change in pressure head of 1.46 ft fresh water in 2023. This well was affected by NWRA.

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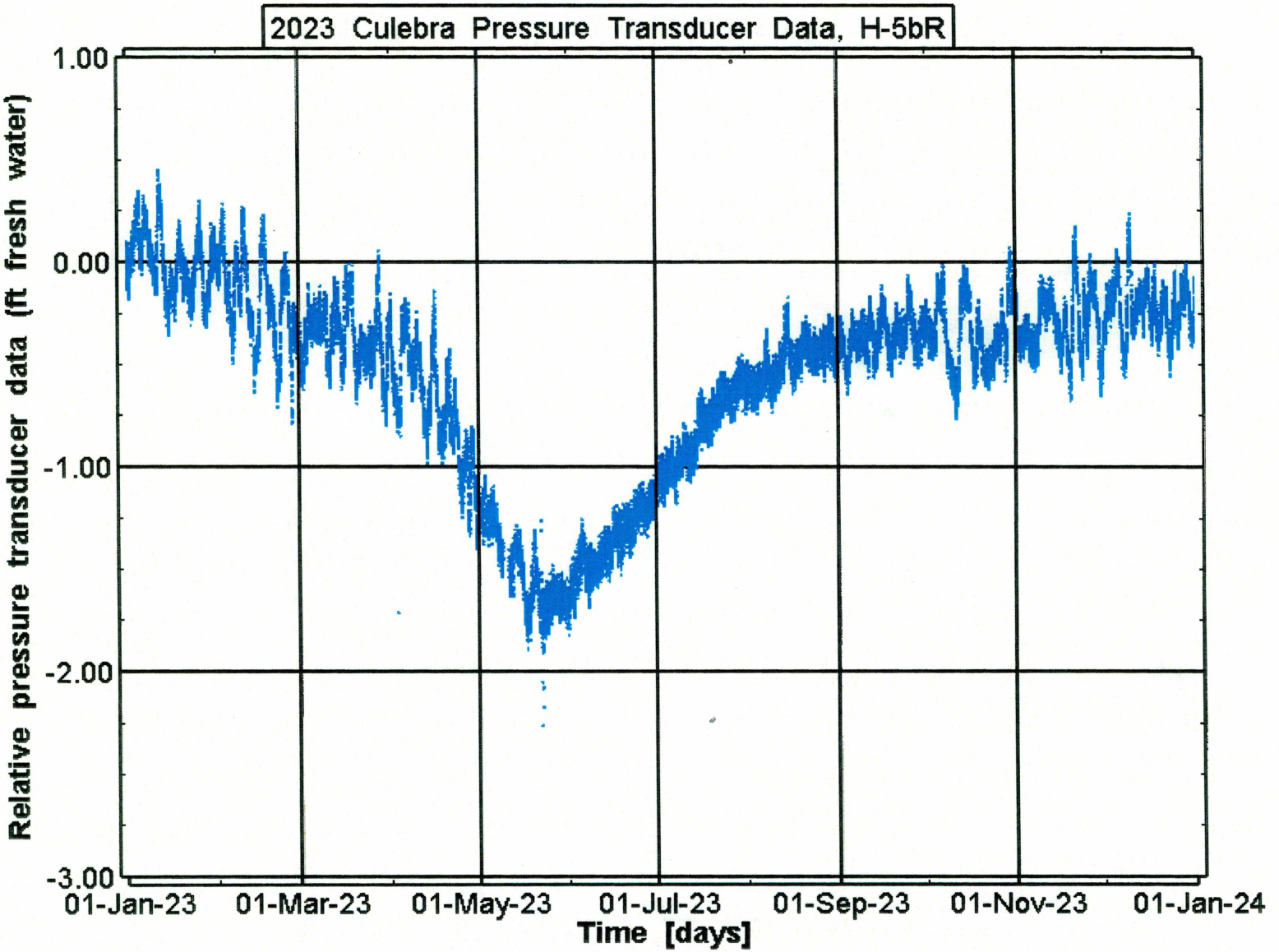

Figure 12. Well H-5bR experienced a net change in pressure head of -0.14 ft fresh water in 2023. This well has been subject to hydrologic purges and a slug test.

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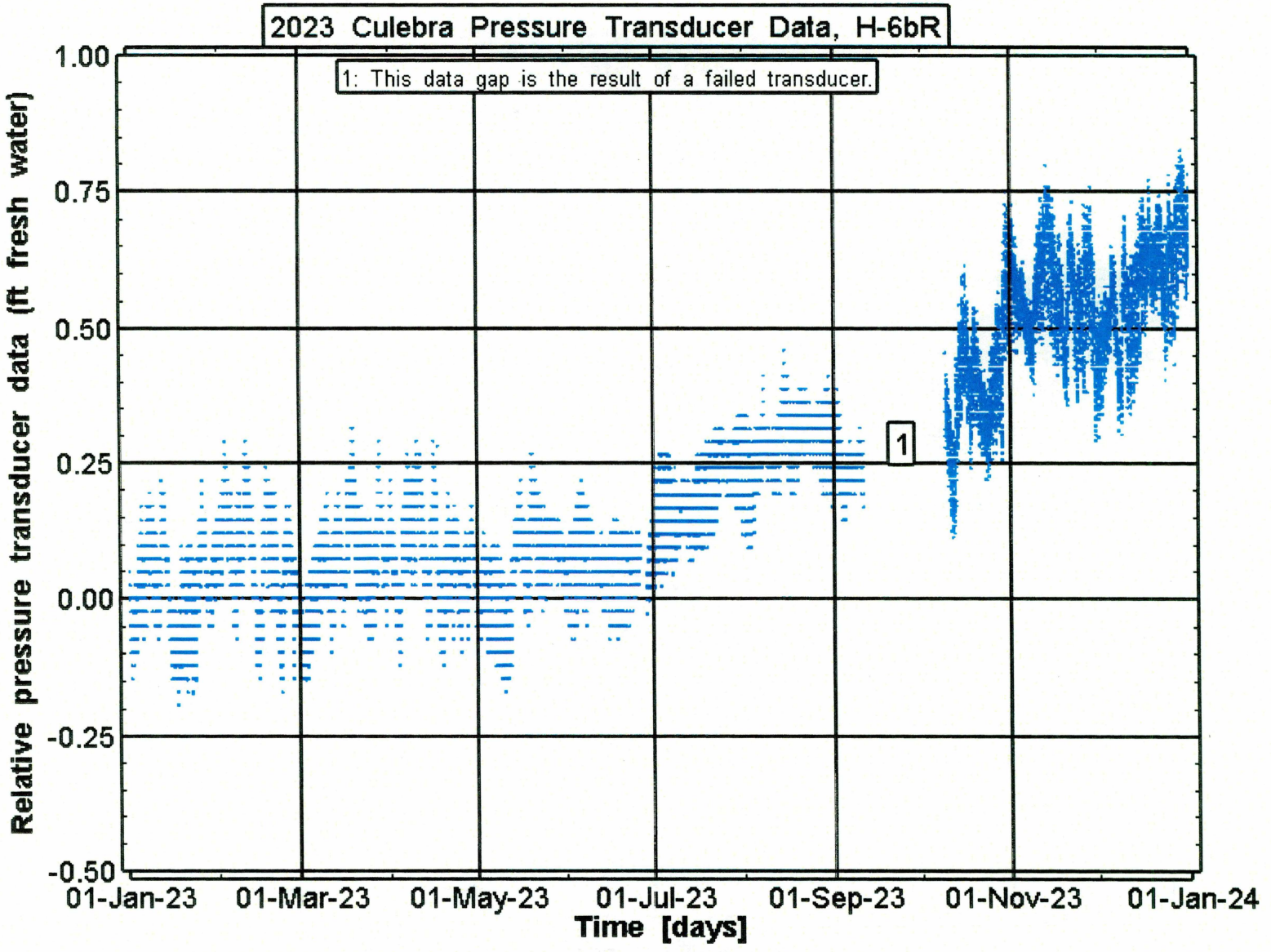

Figure 13. Well H-6bR experienced a net change in pressure head of 0.72 ft fresh water in 2023.

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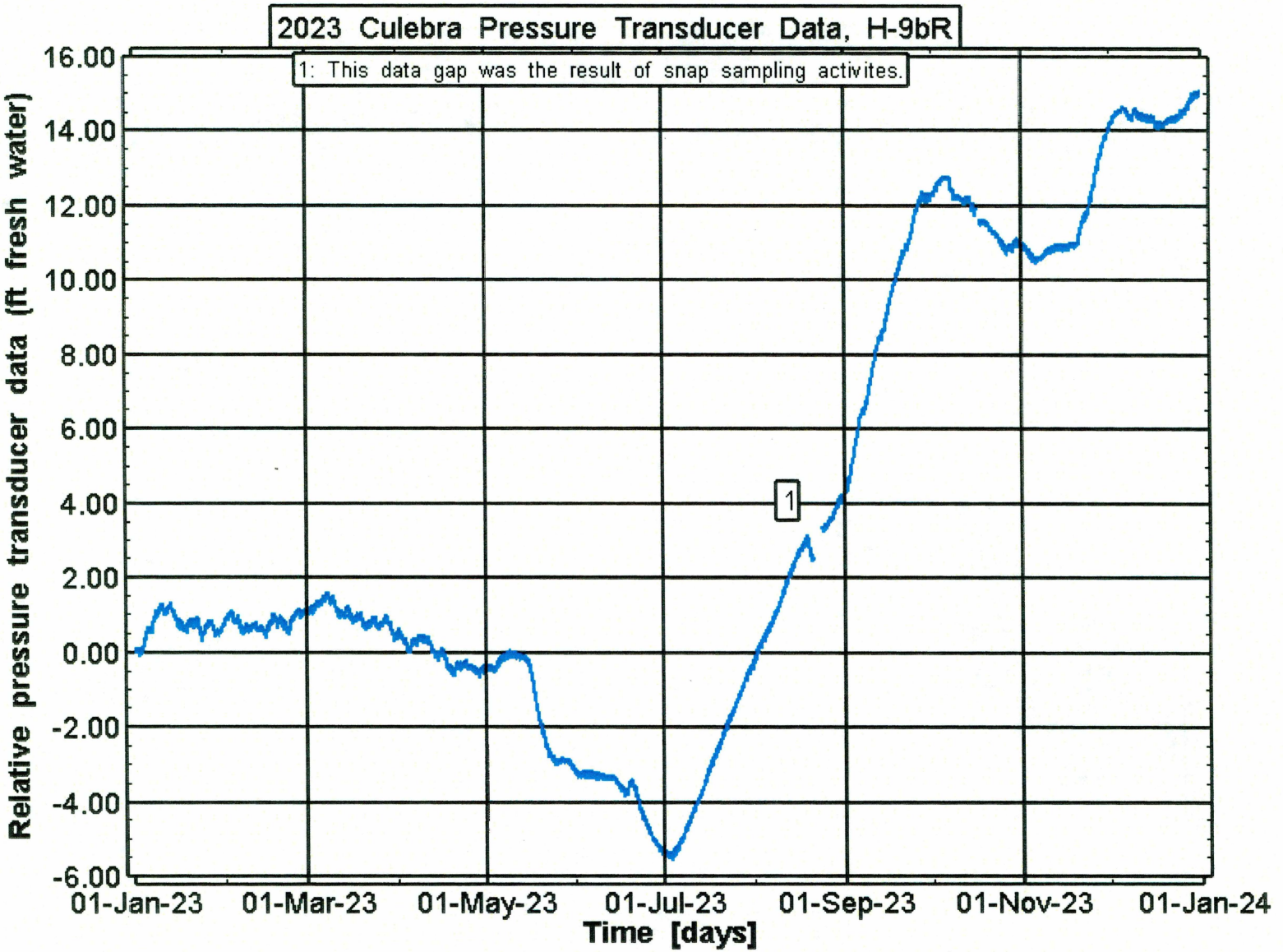

Figure 14. Well H-9bR experienced a net change in pressure head of 15.04 ft fresh water in 2023.

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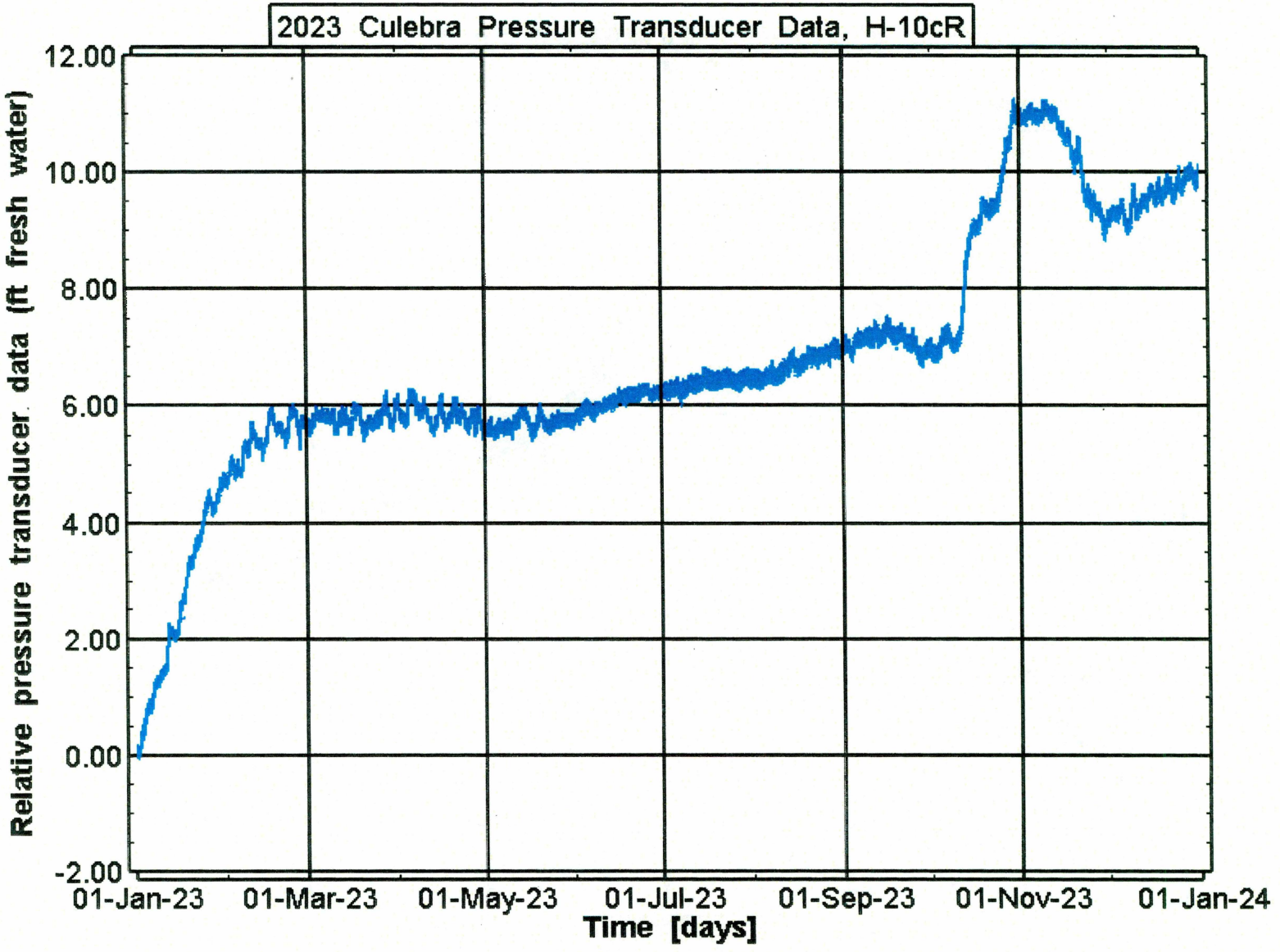

Figure 15. Well H-10cR experienced a net change in pressure head of 10.12 ft fresh water in 2023.

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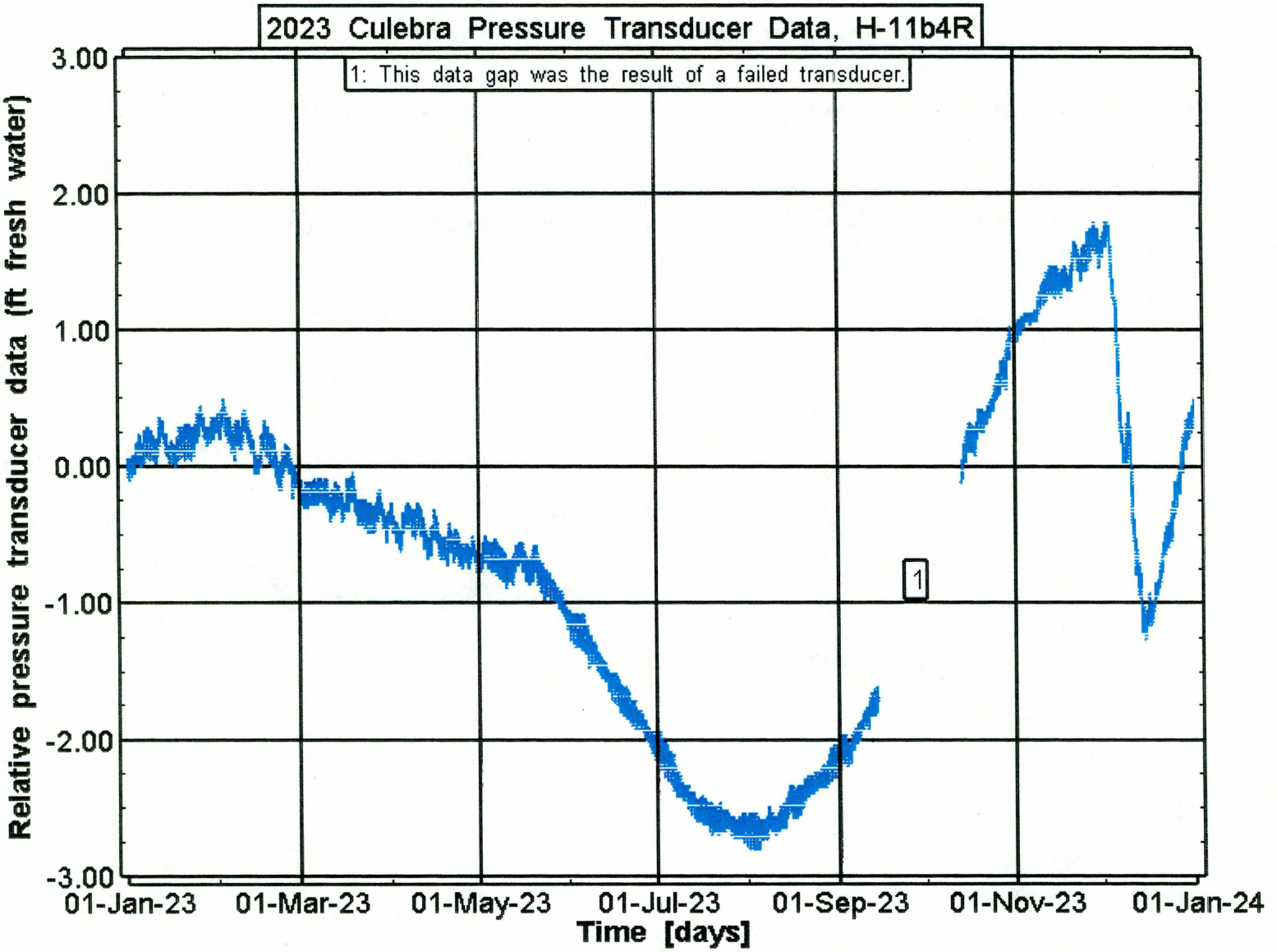

Figure 16. Well H-11b4R experienced a net change in pressure head of 0.46 ft fresh water in 2023. This well was affected by NWRA.

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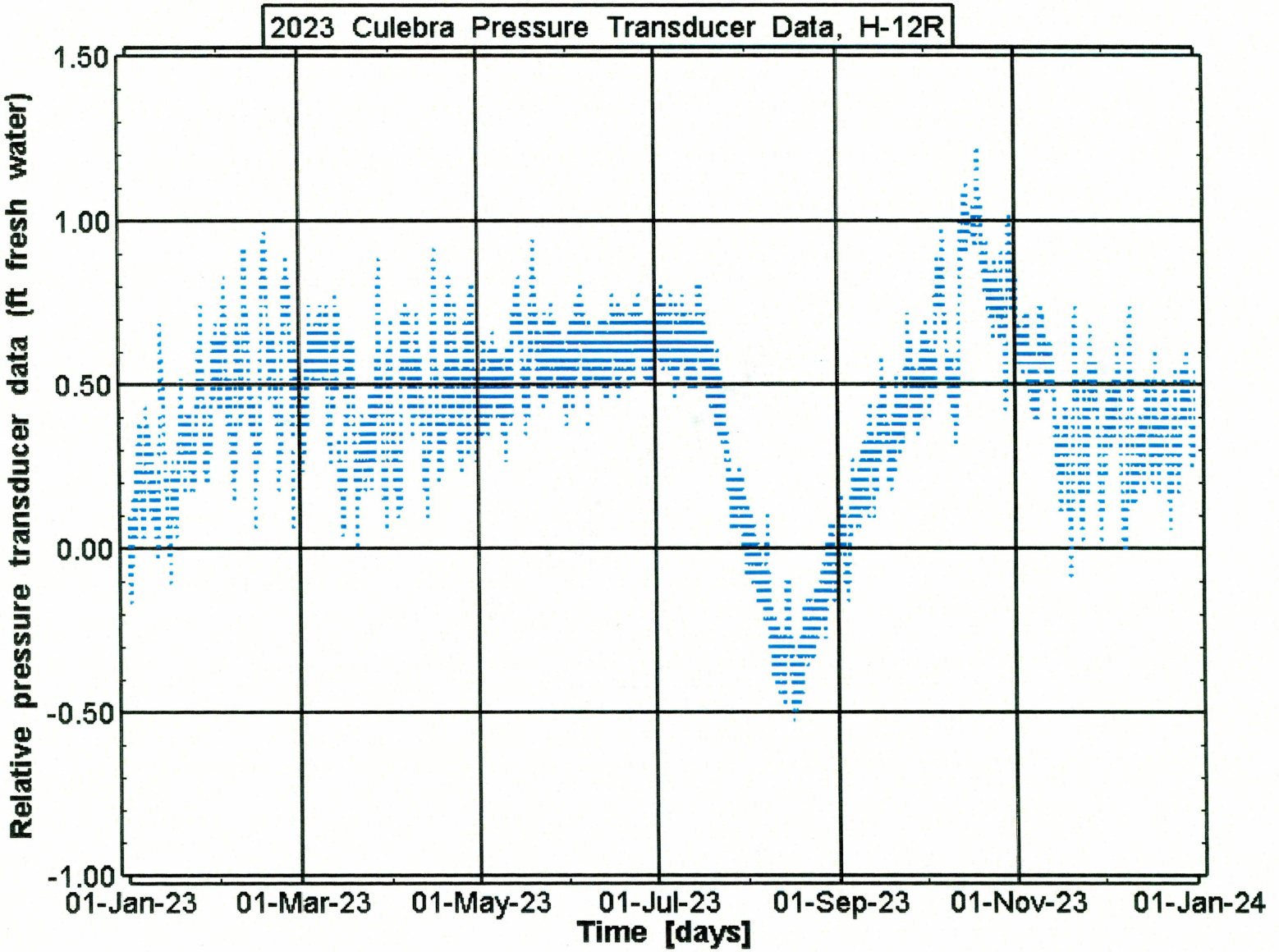

Figure 17. Well H-12R experienced a net change in pressure head of 0.48 ft fresh water in 2023. This well was affected by NWRA.

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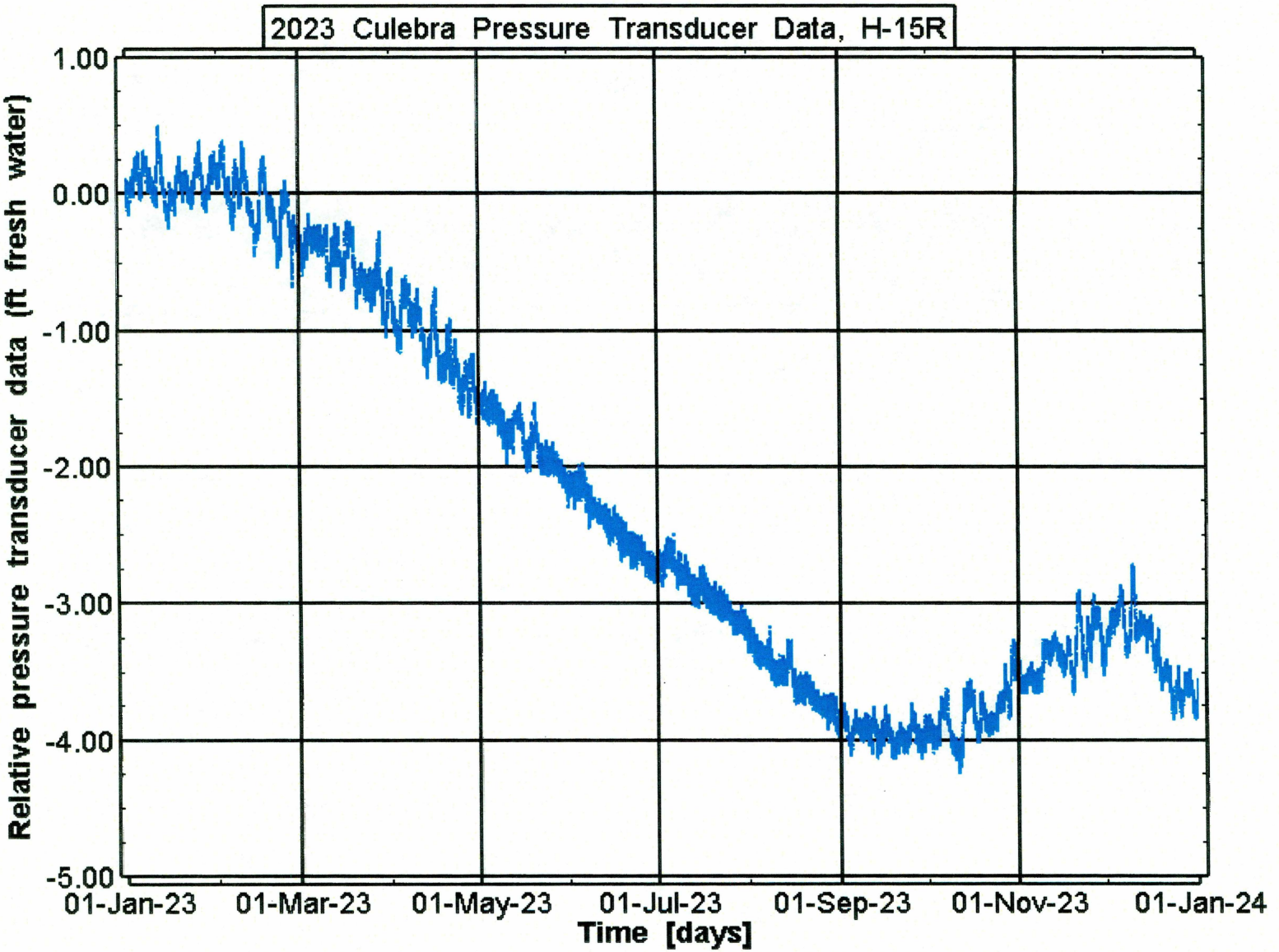

Figure 18. Well H-15R experienced a net change in pressure head of -3.57 ft fresh water in 2023.

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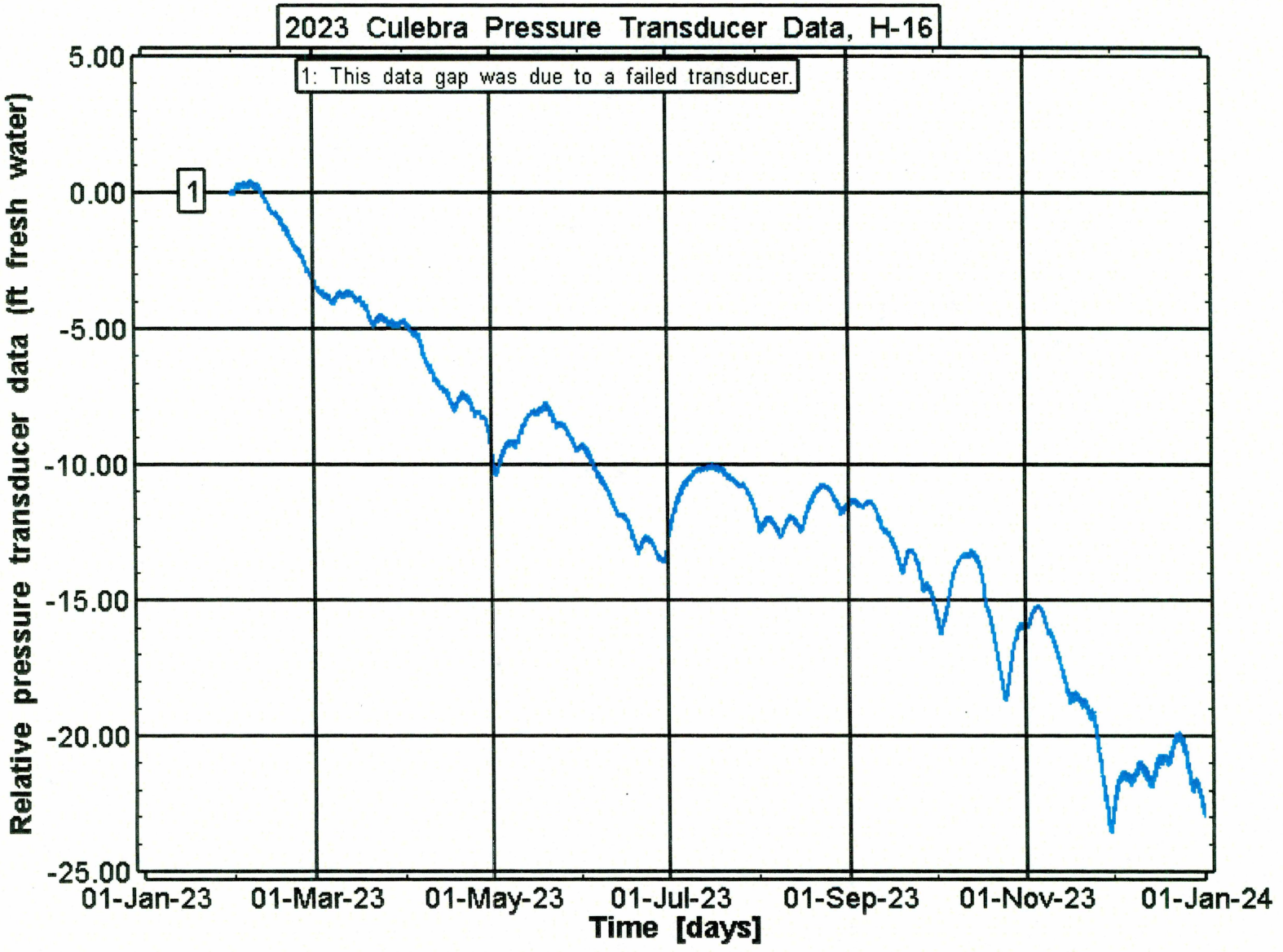

Figure 19. H-16 experienced a net change in pressure head of -22.96 ft fresh water in 2023. This well was affected by shaft leakage.

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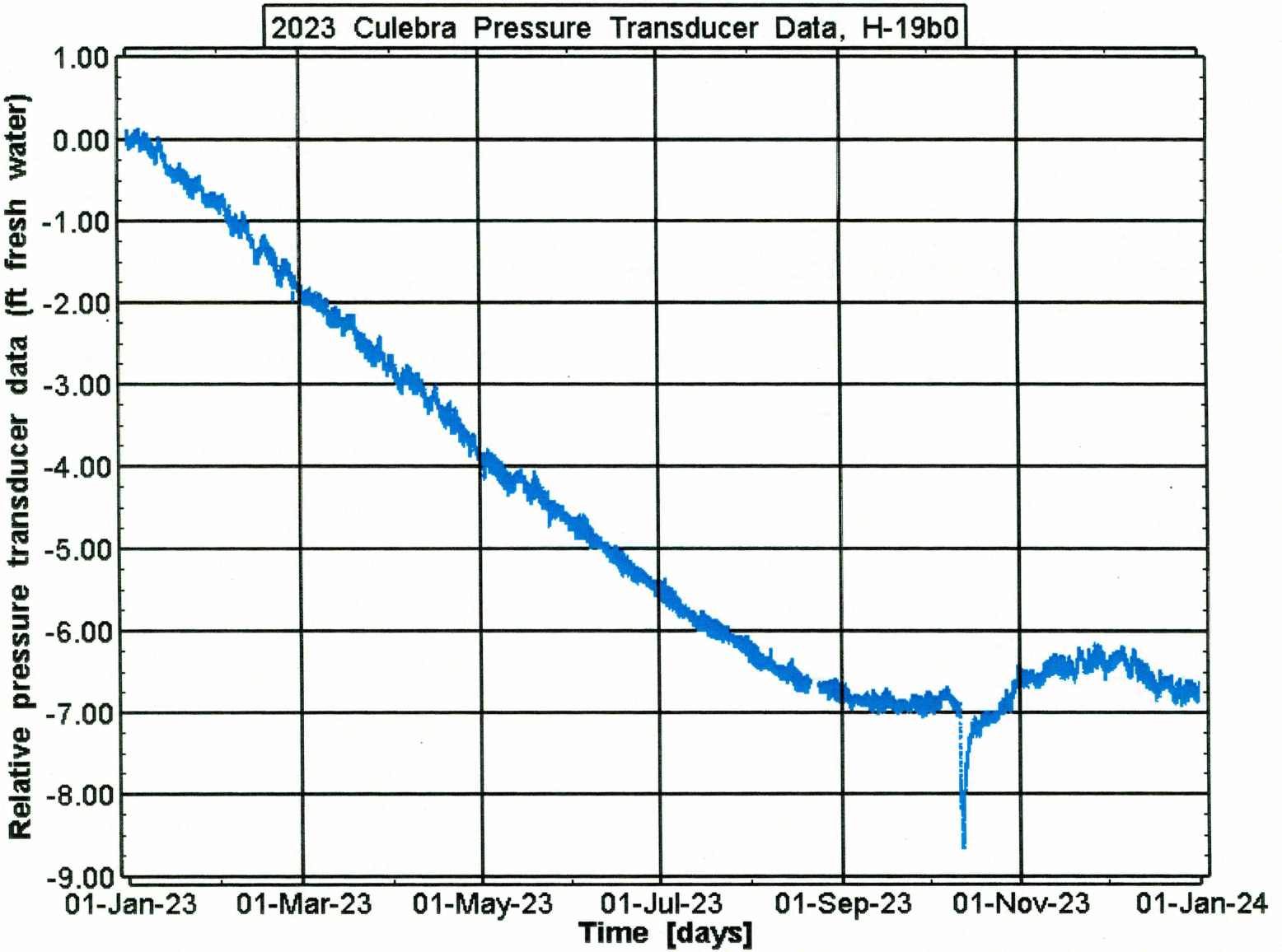

Figure 20. Well H-19b0 experienced a net change in pressure head of -6.64 ft fresh water in 2023. This well was affected by NWRA.

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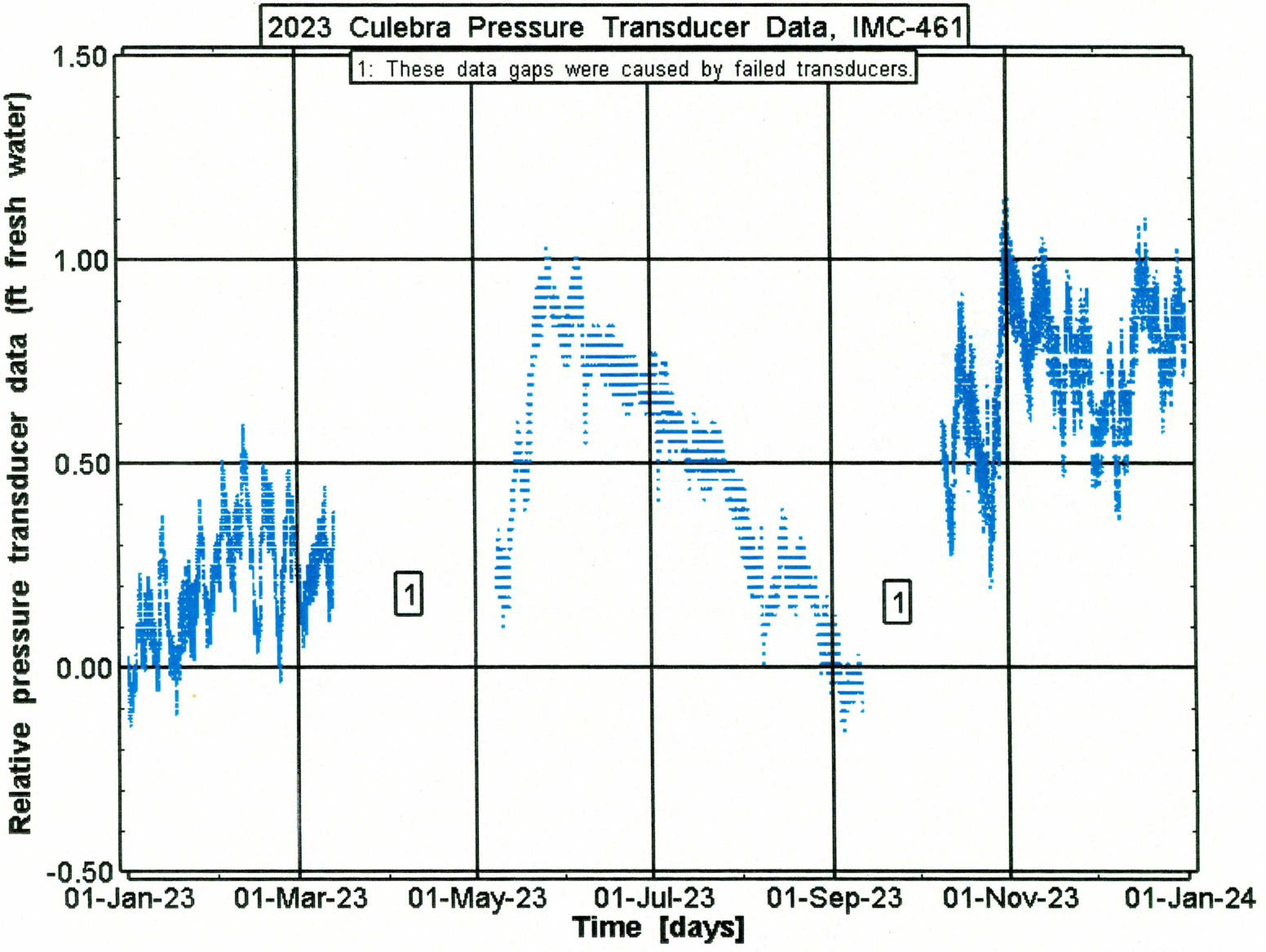

Figure 21. Well IMC-461 experienced a net change in pressure head of 0.85 ft fresh water in 2023. This well was affected by NWRA.

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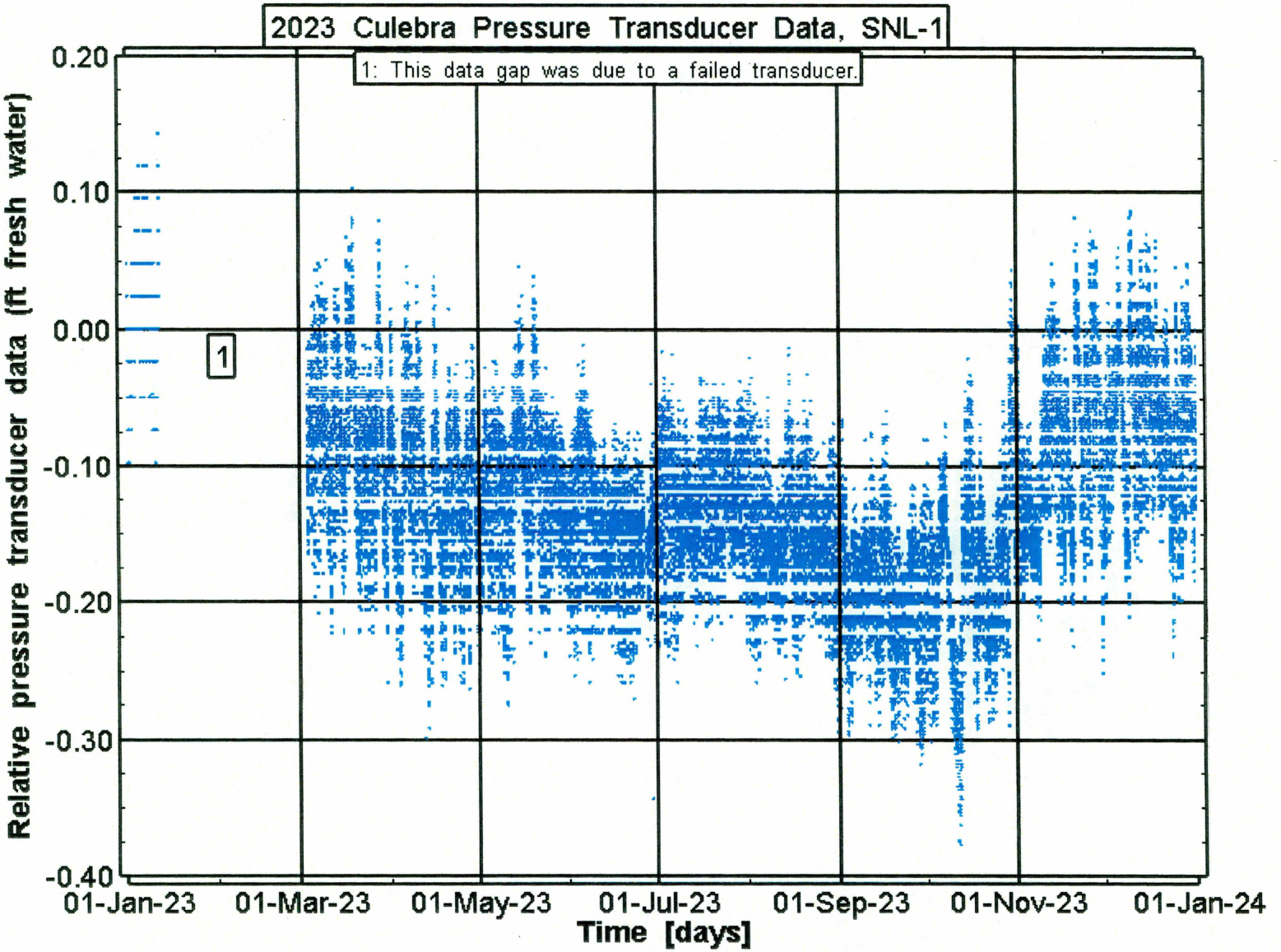

Figure 22. Well SNL-1 experienced a net change in pressure head of -0.06 ft fresh water in 2023.

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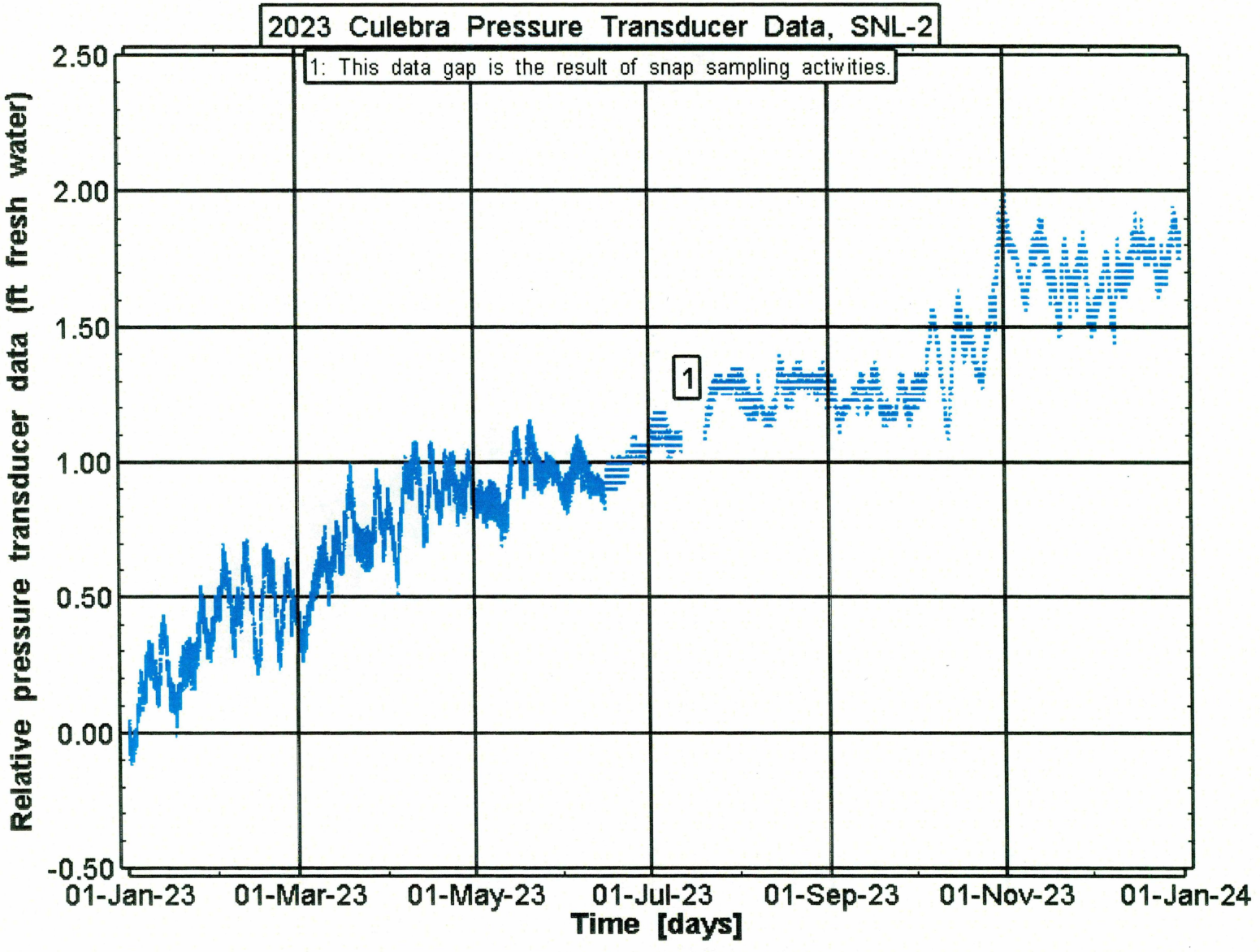

Figure 23. Well SNL-2 experienced a net change in pressure head of 1.82 ft fresh water in 2023.

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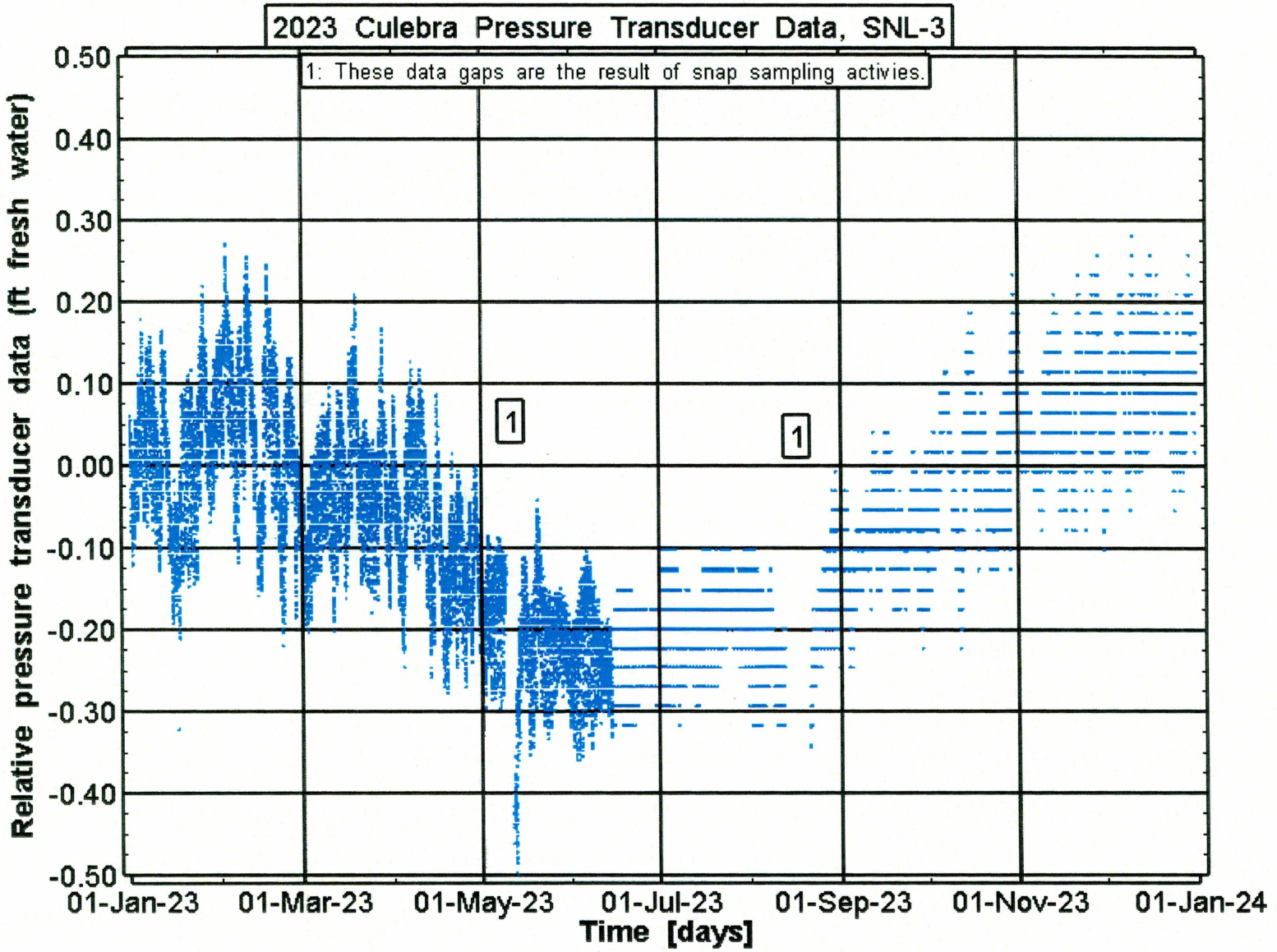

Figure 24. Well SNL-3 experienced a net change in pressure head of 0.14 ft fresh water in 2023.

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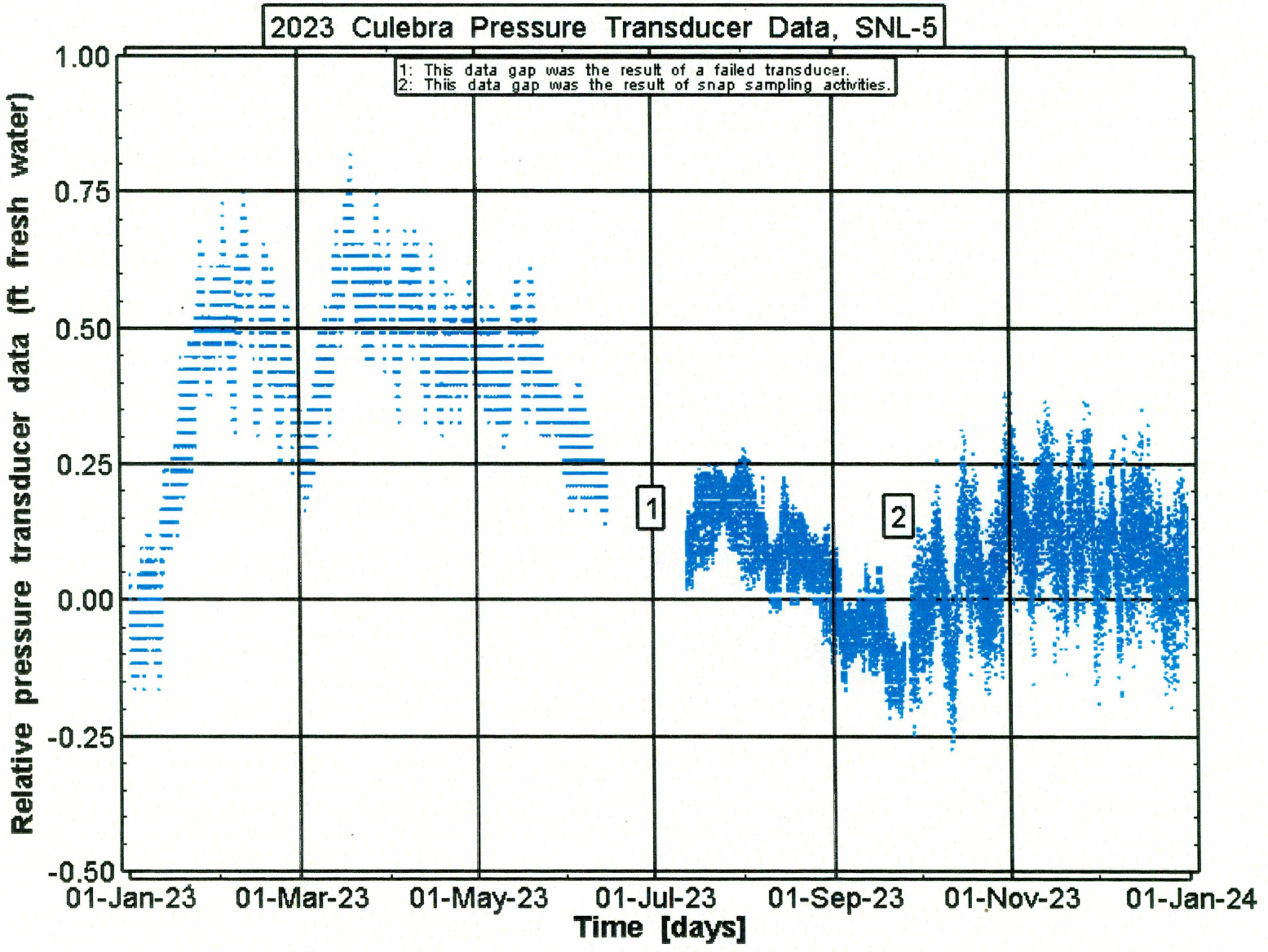

Figure 25. Well SNL-5 experienced a net change in pressure head of 0.05 ft fresh water in 2023.

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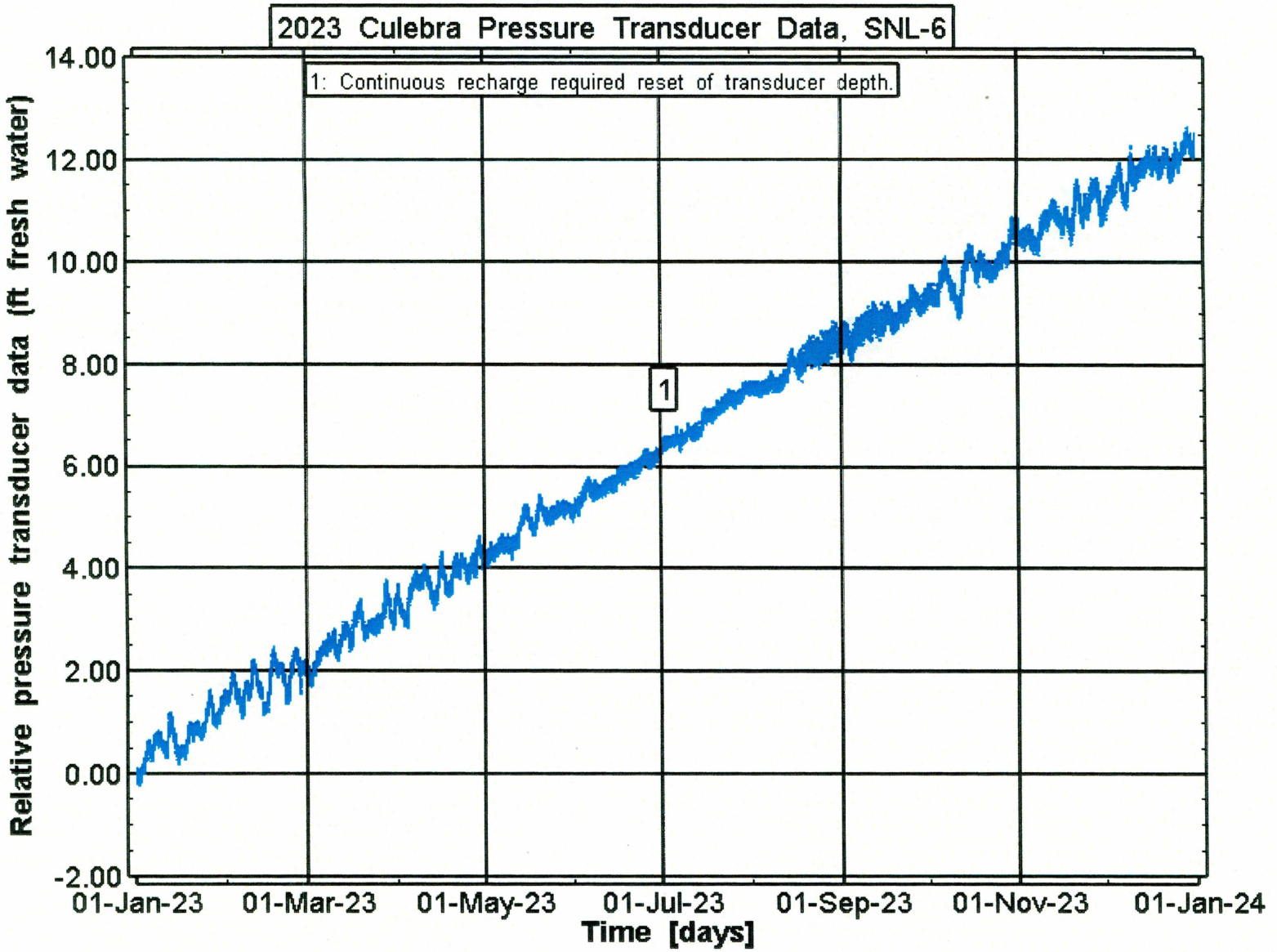

Figure 26. Well SNL-6 experienced a net change in pressure head of 12.56 ft fresh water in 2023. The well is in long-term recovery from well development.

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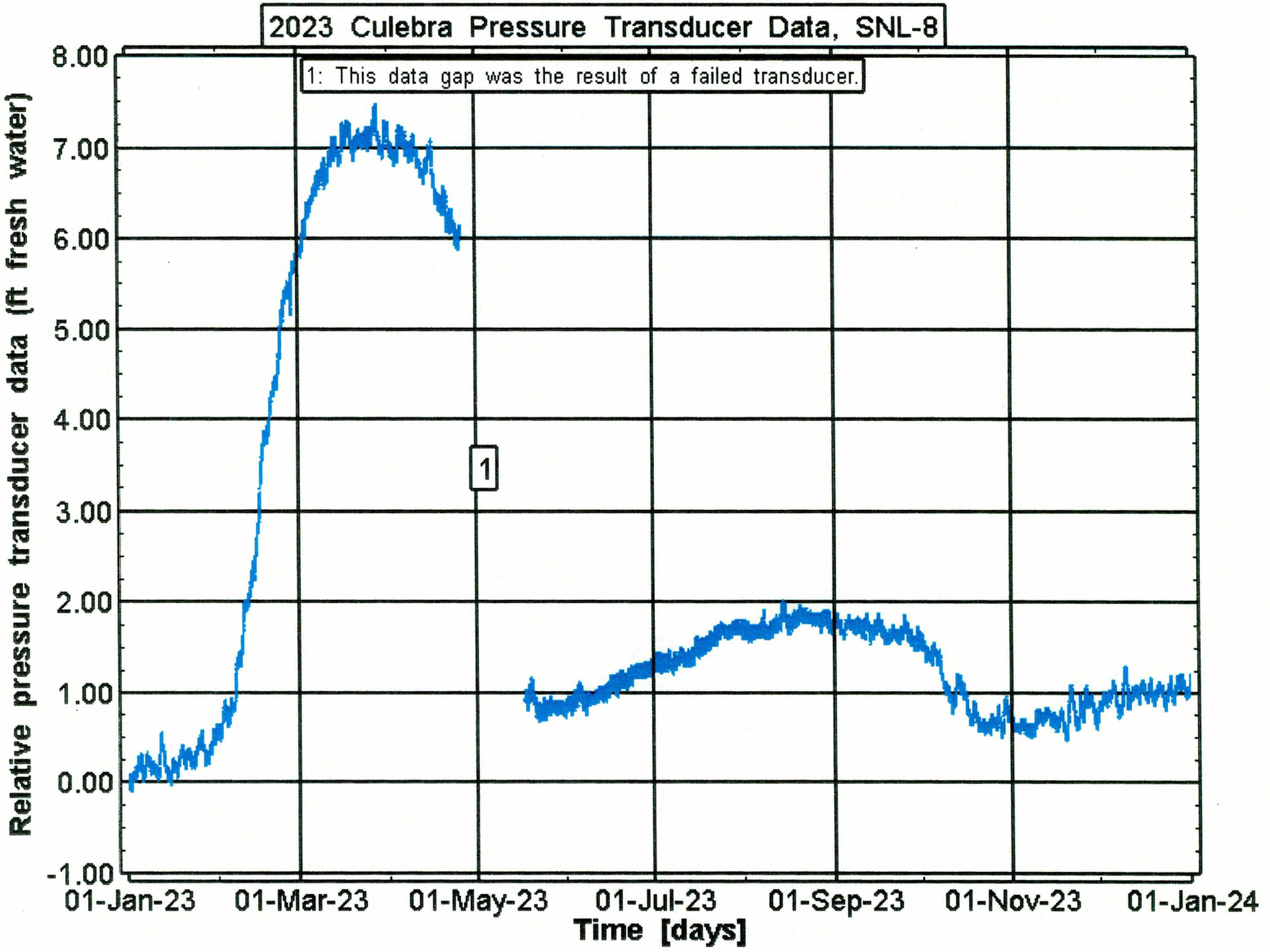

Figure 27. Well SNL-8 experienced a net change in pressure head of 1.18 ft fresh water in 2023. This well was affected by NWRA.

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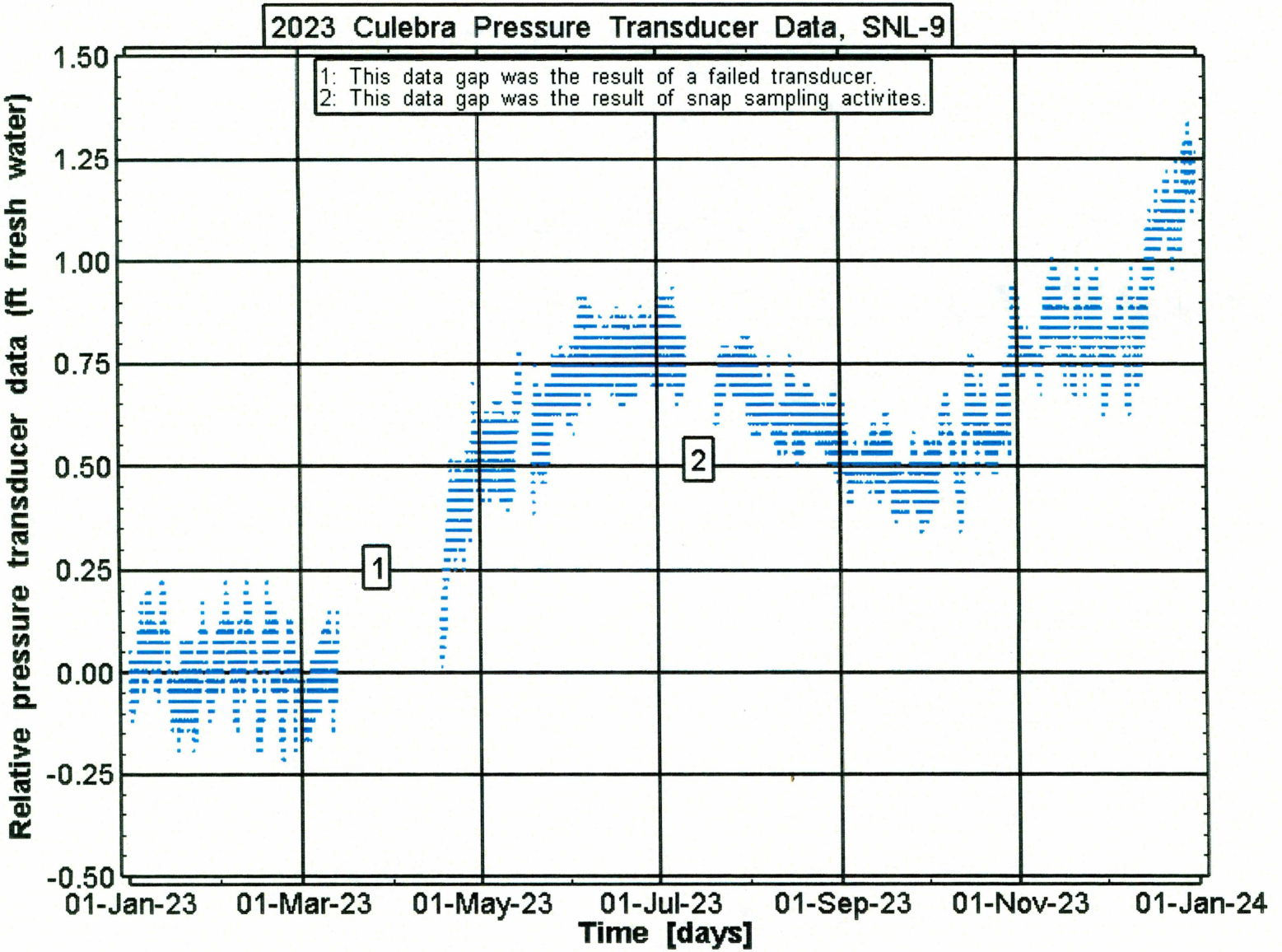

Figure 28. Well SNL-9 experienced a net change in pressure head of 1.24 ft fresh water in 2023.

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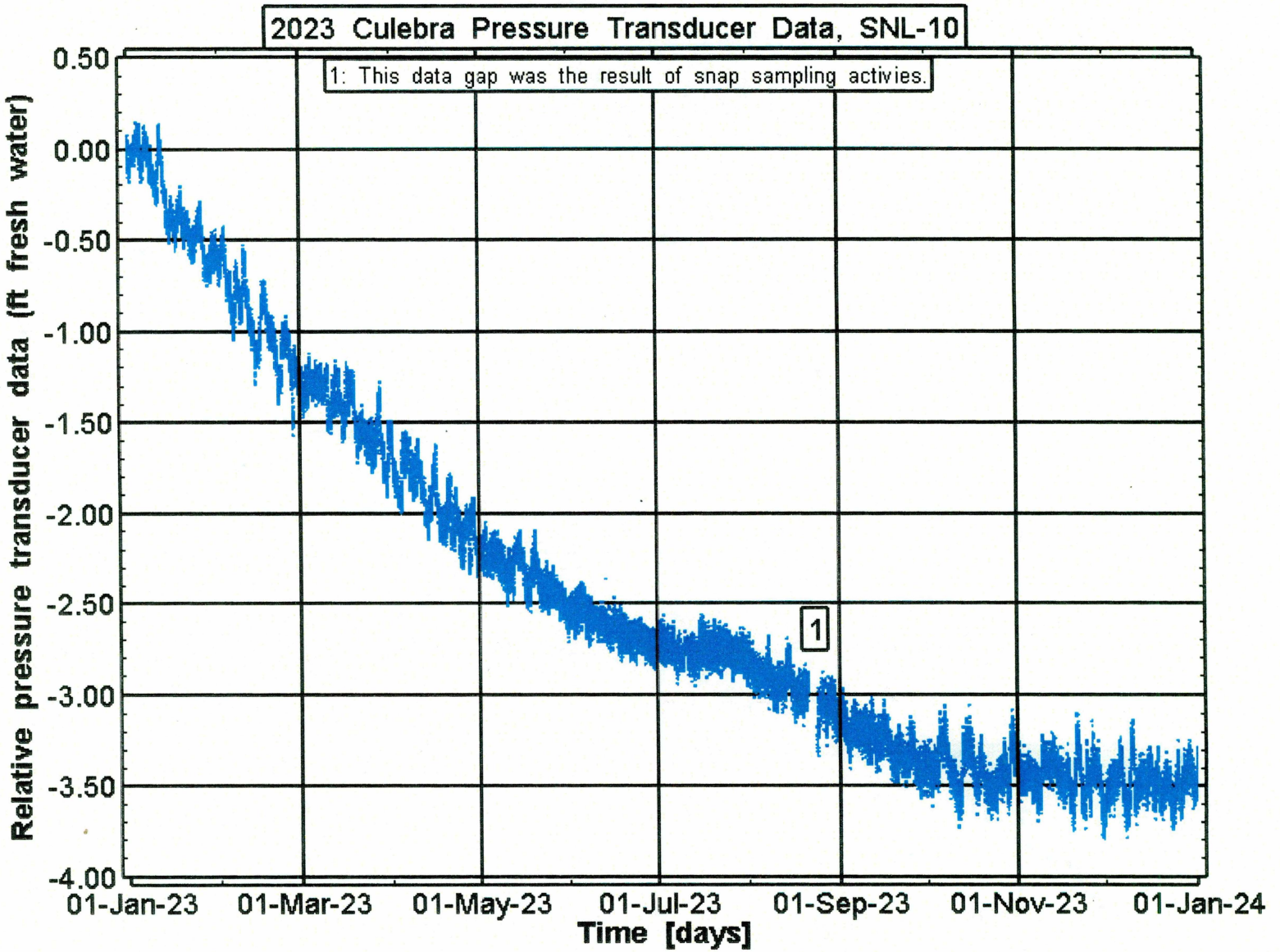

Figure 29. Well SNL-10 experienced a net change in pressure head of -3.30 ft fresh water in 2023.

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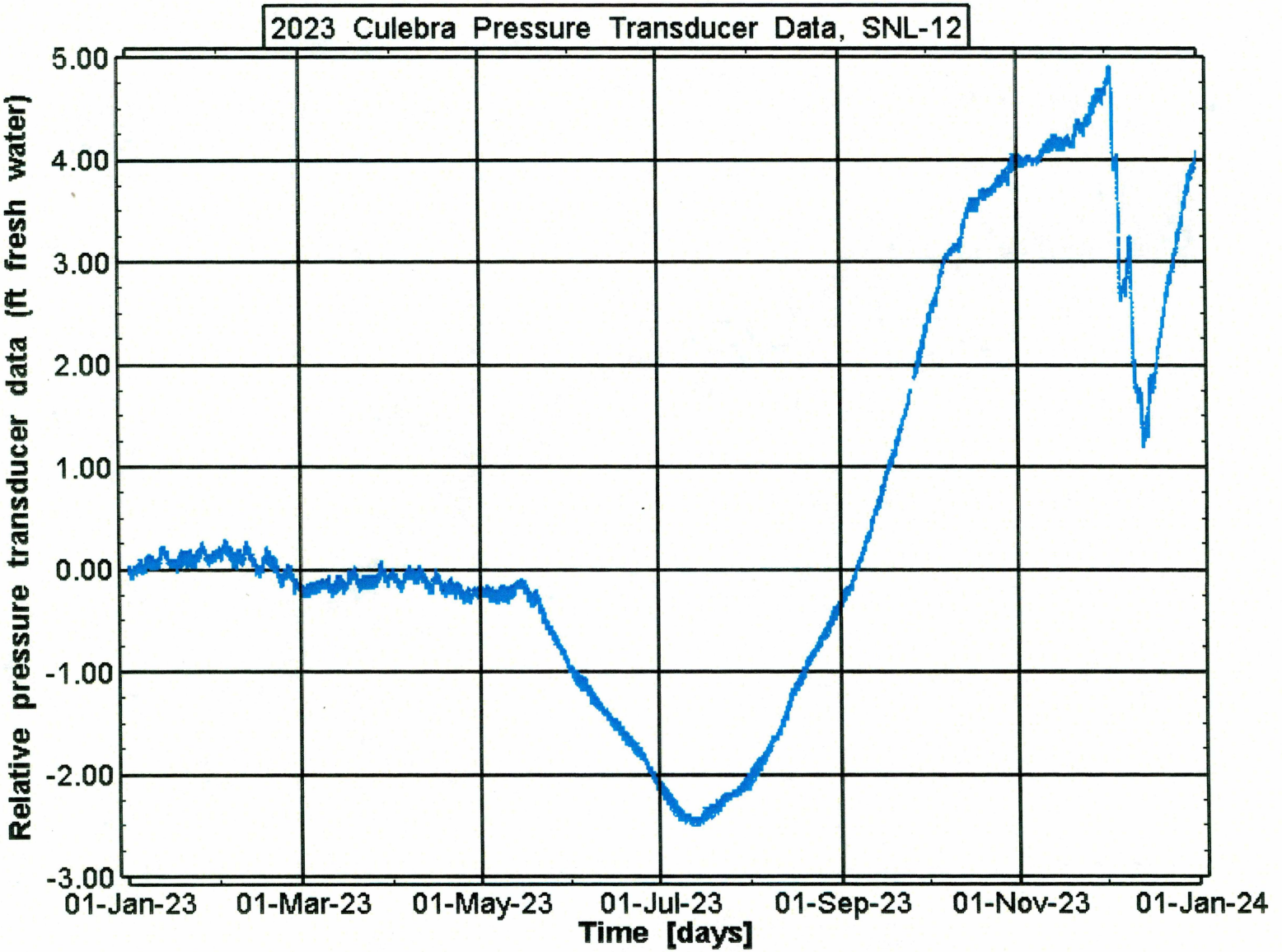

Figure 30. Well SNL-12 experienced a net change in pressure head of 4.04 ft fresh water in 2023. This well was affected by NWRA.

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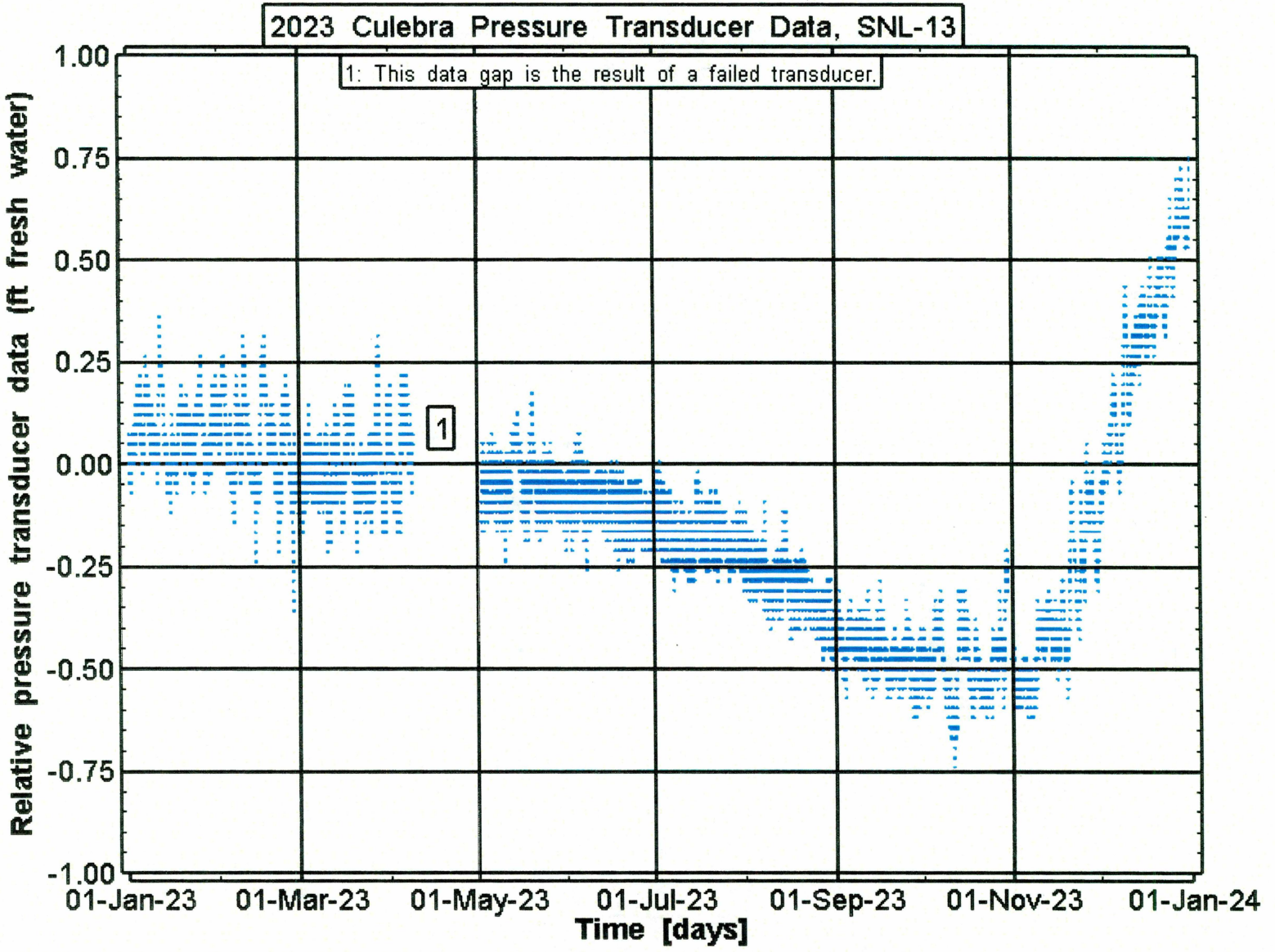

Figure 31. Well SNL-13 experienced a net change in pressure head of 0.75 ft fresh water in 2023.

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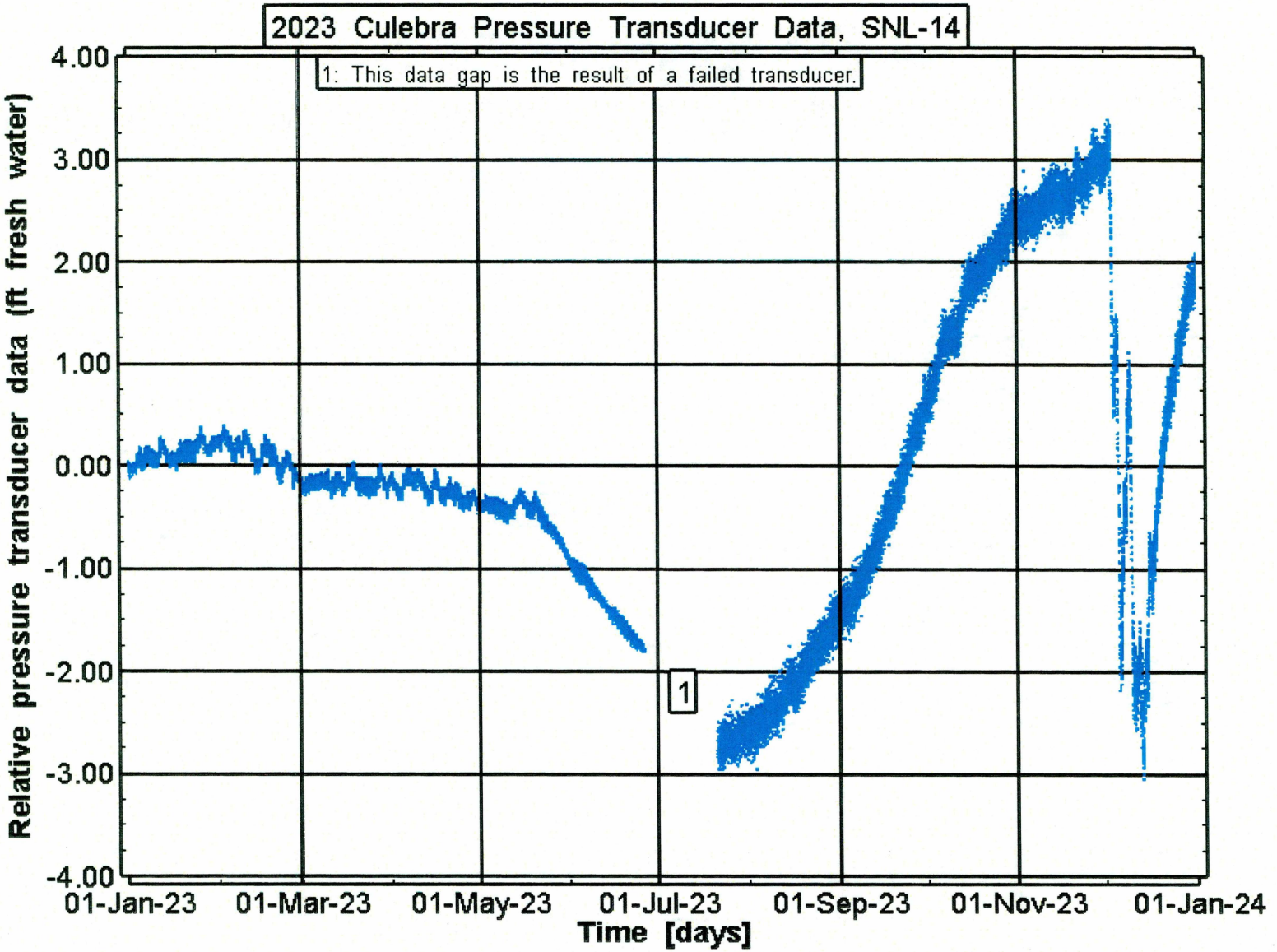

Figure 32. Well SNL-14 experienced a net change in pressure head of 1.75 ft fresh water in 2023. This well was affected by NWRA.

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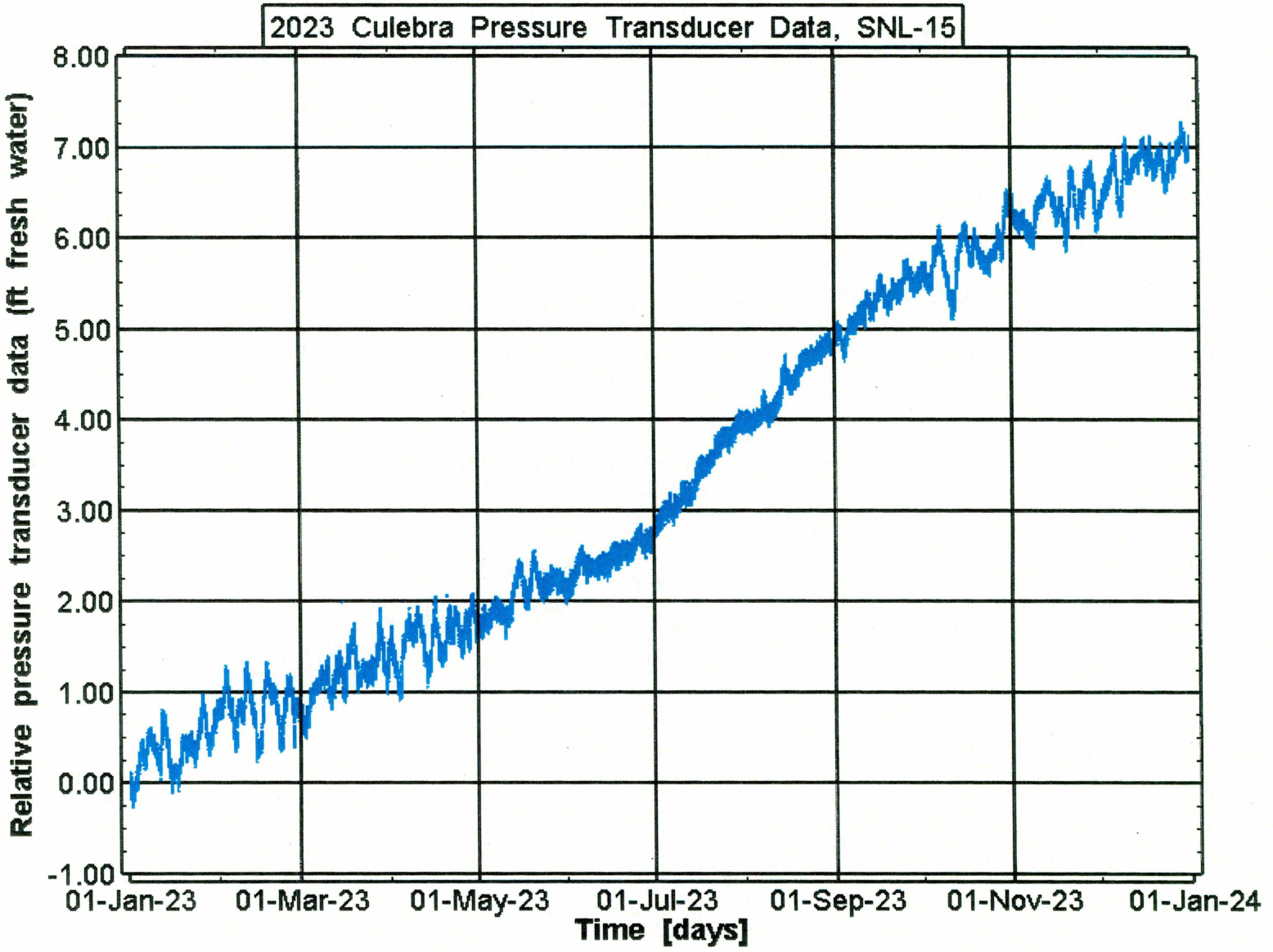

Figure 33. Well SNL-15 experienced a net change in pressure head of 7.11 ft fresh water in 2023. The well is in long-term recovery from well development.

Information Only

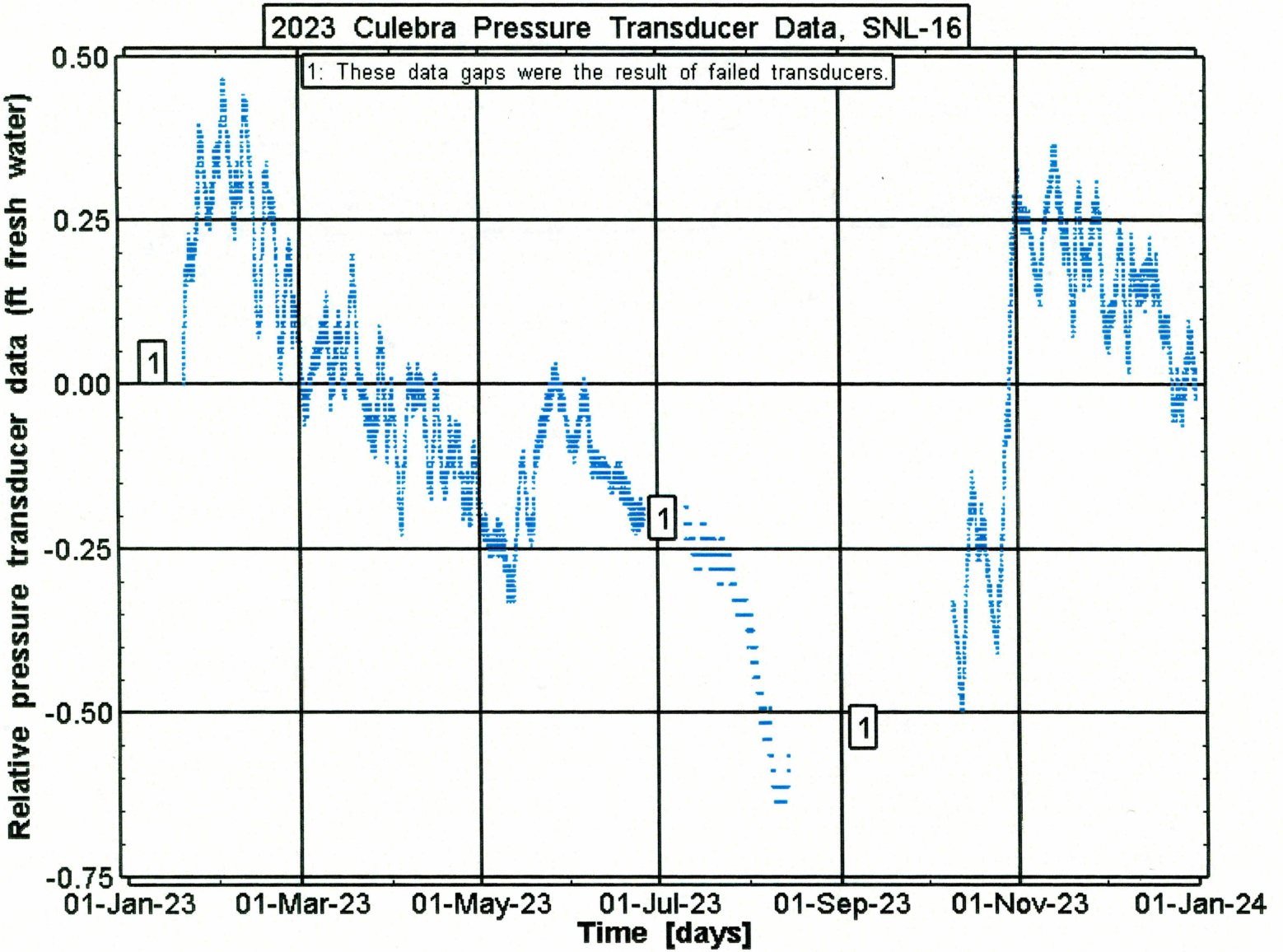

Figure 34. Well SNL-16 experienced a net change in pressure head of 0.02 ft fresh water in 2023. This well was affected by NWRA.

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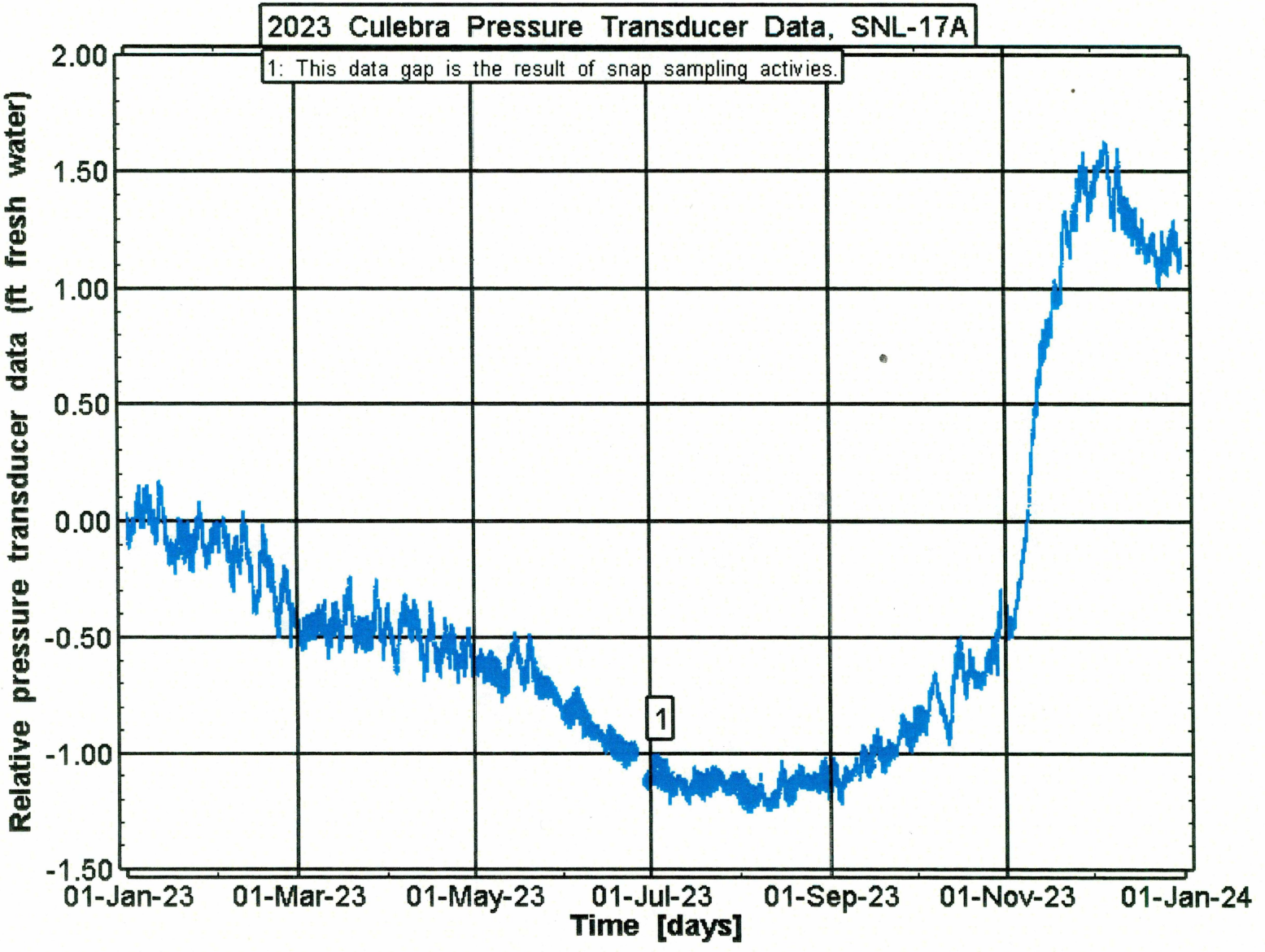

Figure 35. Well SNL-17A experienced a net change in pressure head of 1.16 ft fresh water in 2023. This well was affected by NWRA.

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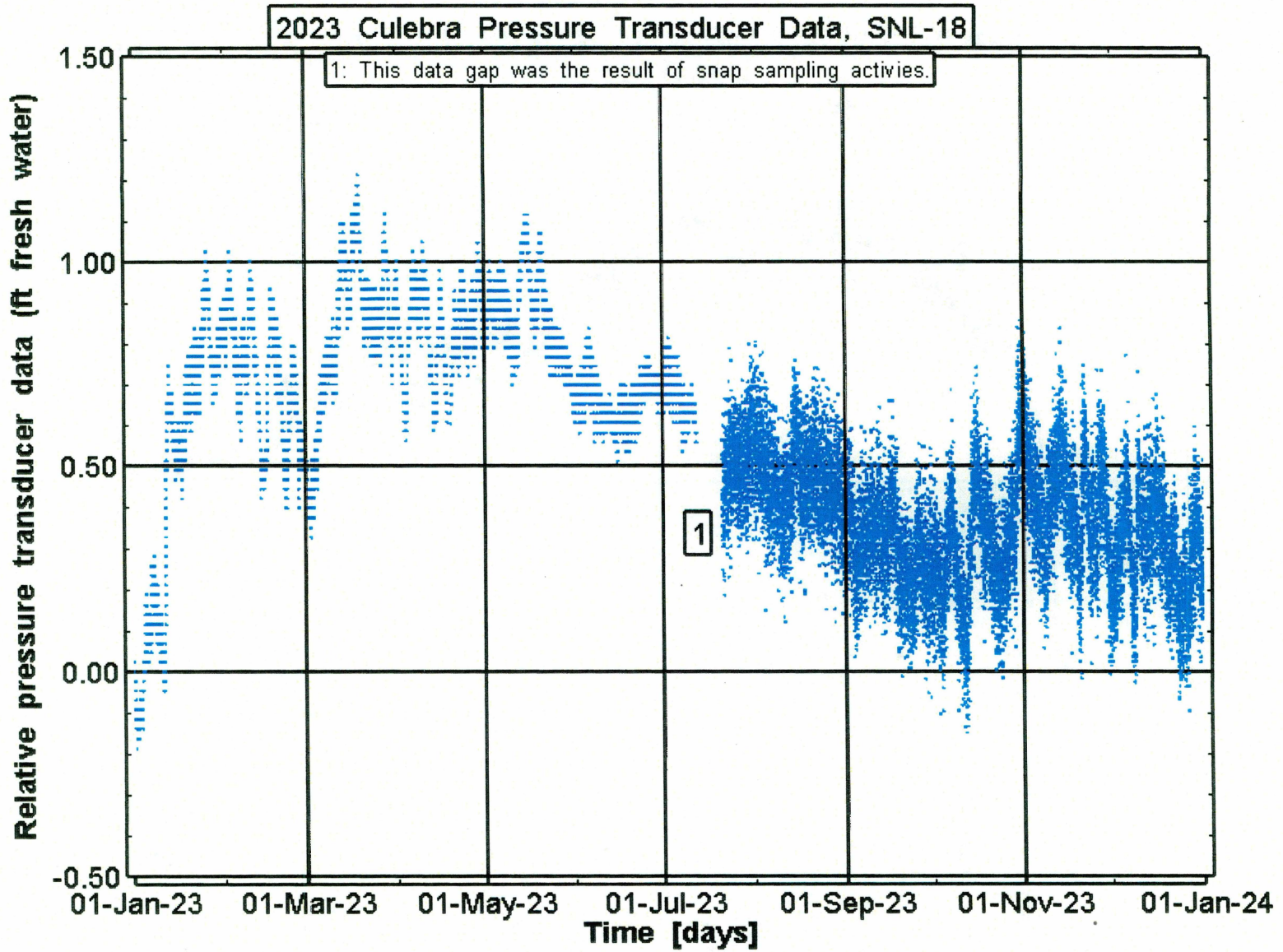

Figure 36. Well SNL-18 experienced a net change in pressure head of 0.28 ft fresh water in 2023.

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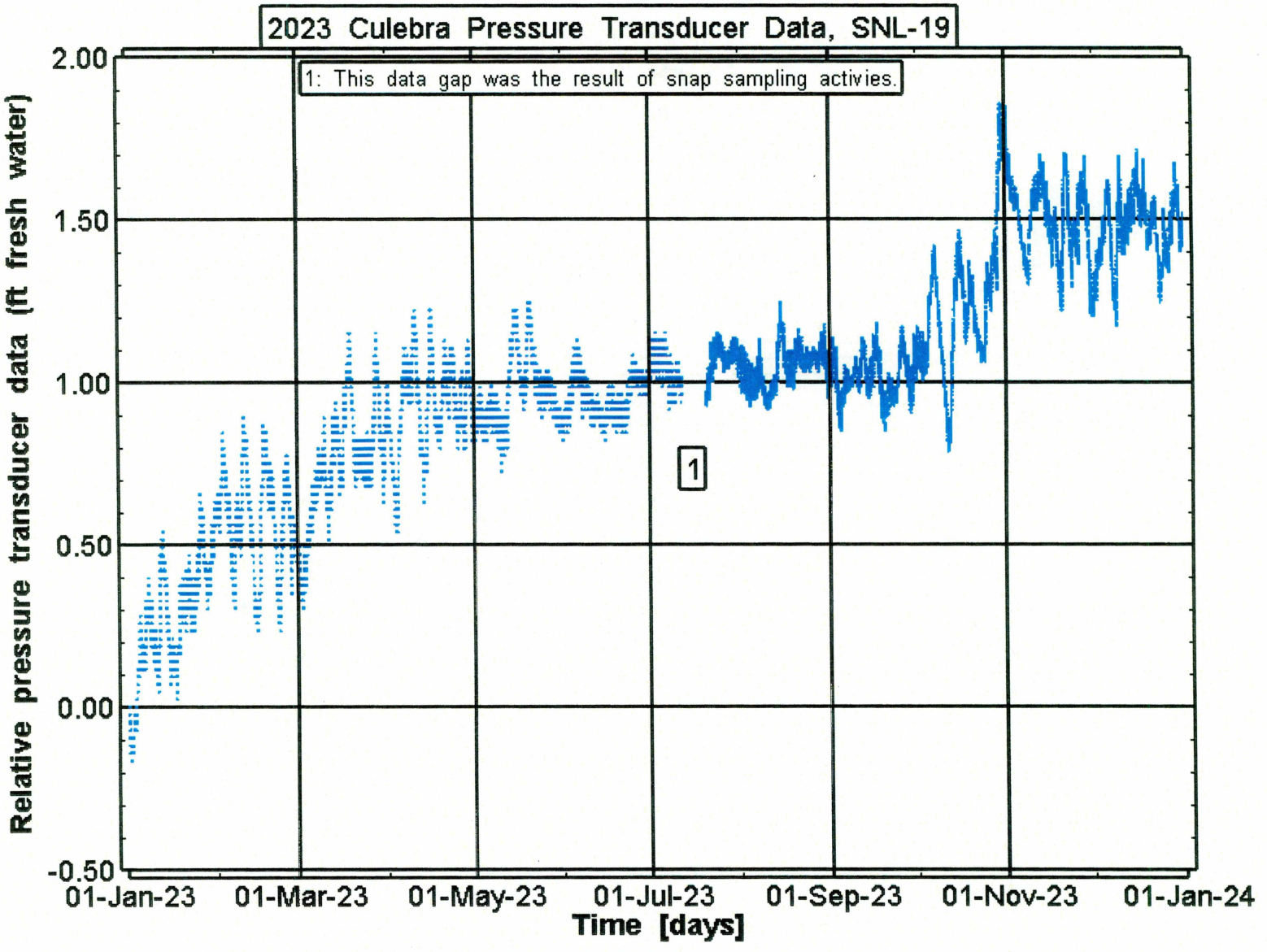

Figure 37. Well SNL-19 experienced a net change in pressure head of 1.51 ft fresh water in 2023.

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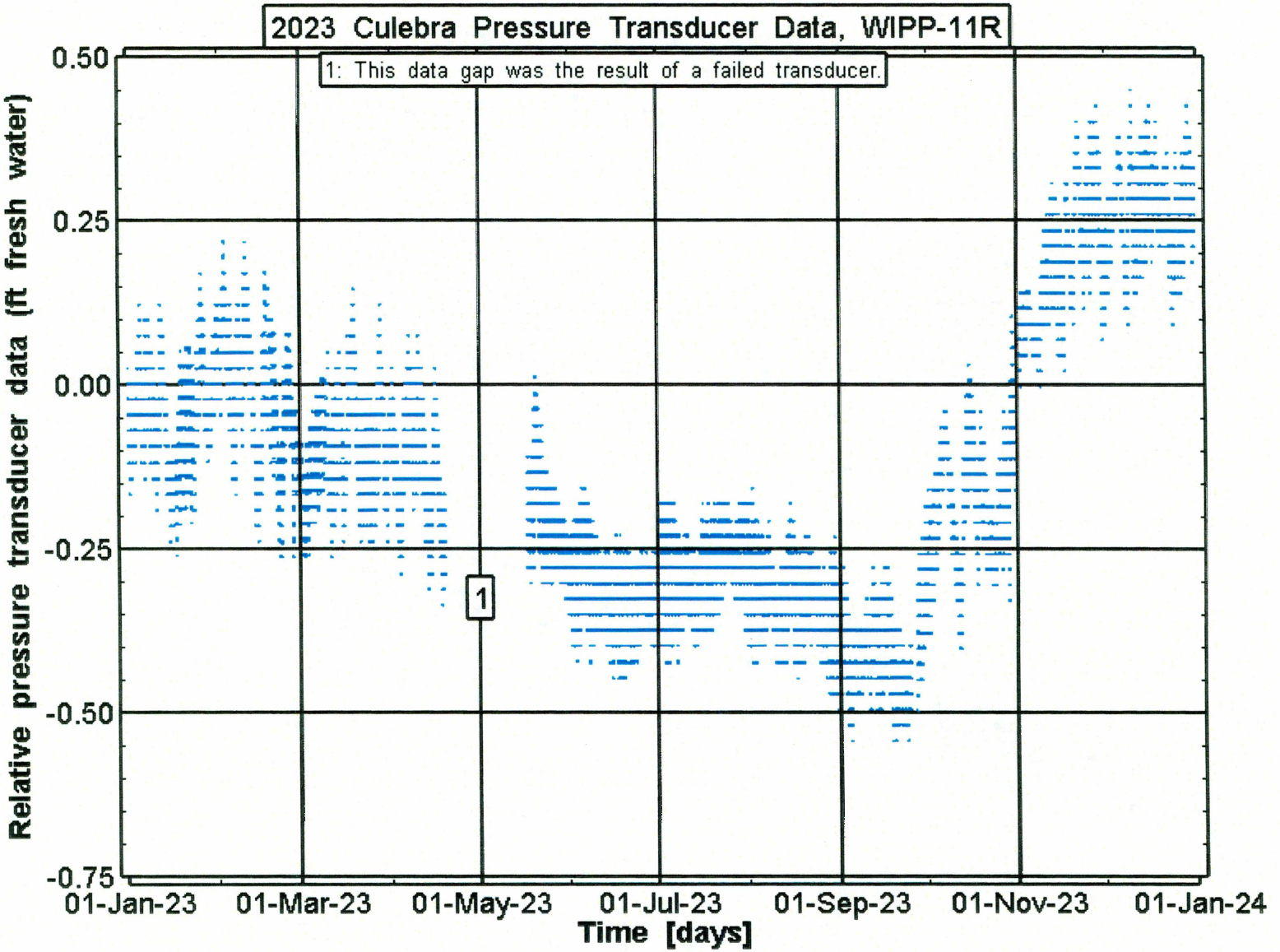

Figure 38. Well WIPP-11R experienced a net change in pressure head of 0.31 ft fresh water in 2023.

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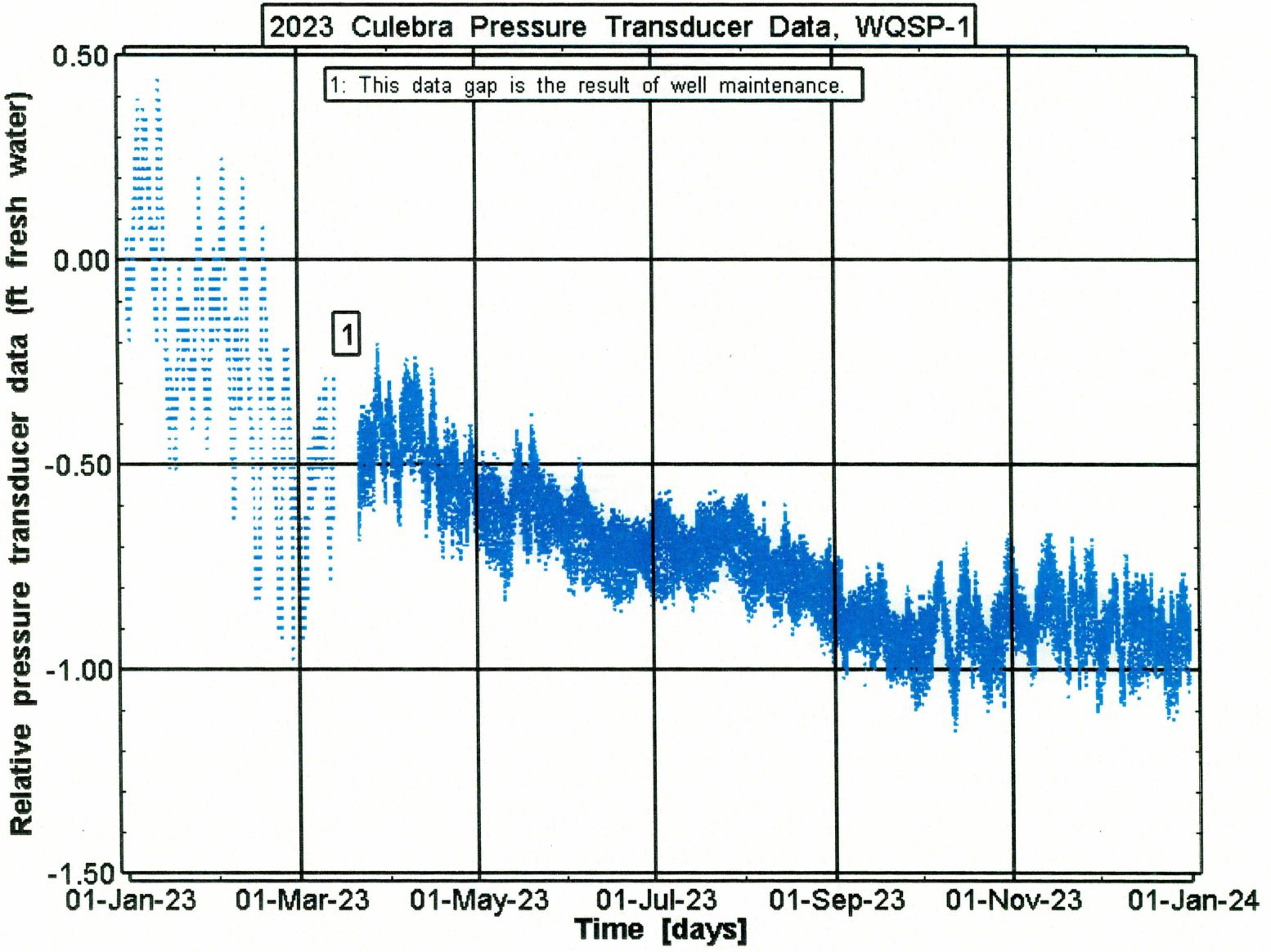

Figure 39. Well WQSP-1 experienced a net change in pressure head of -0.92 ft fresh water in 2023.

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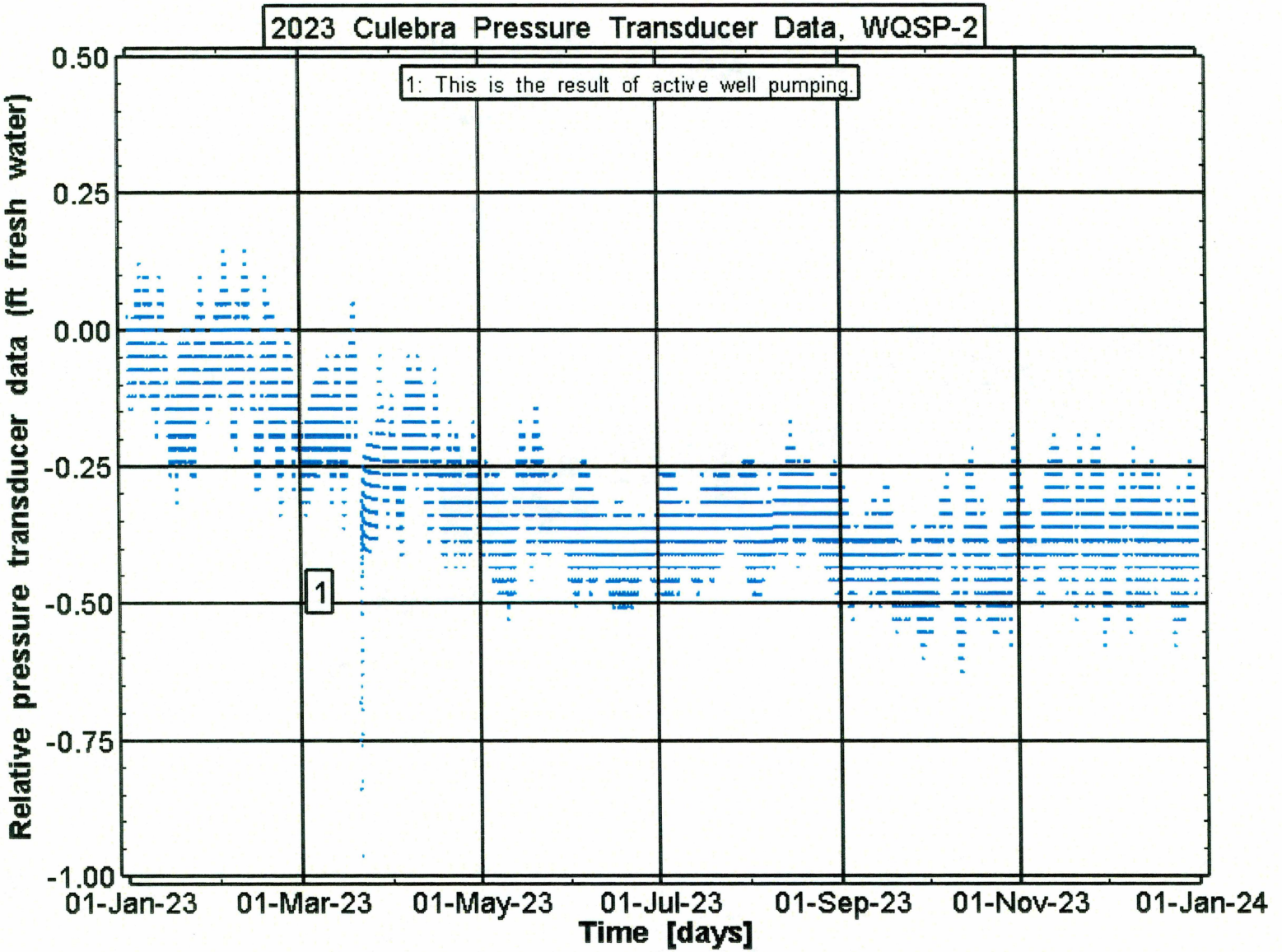

Figure 40. Well WQSP-2 experienced a net change in pressure head of -0.36 ft fresh water in 2023.

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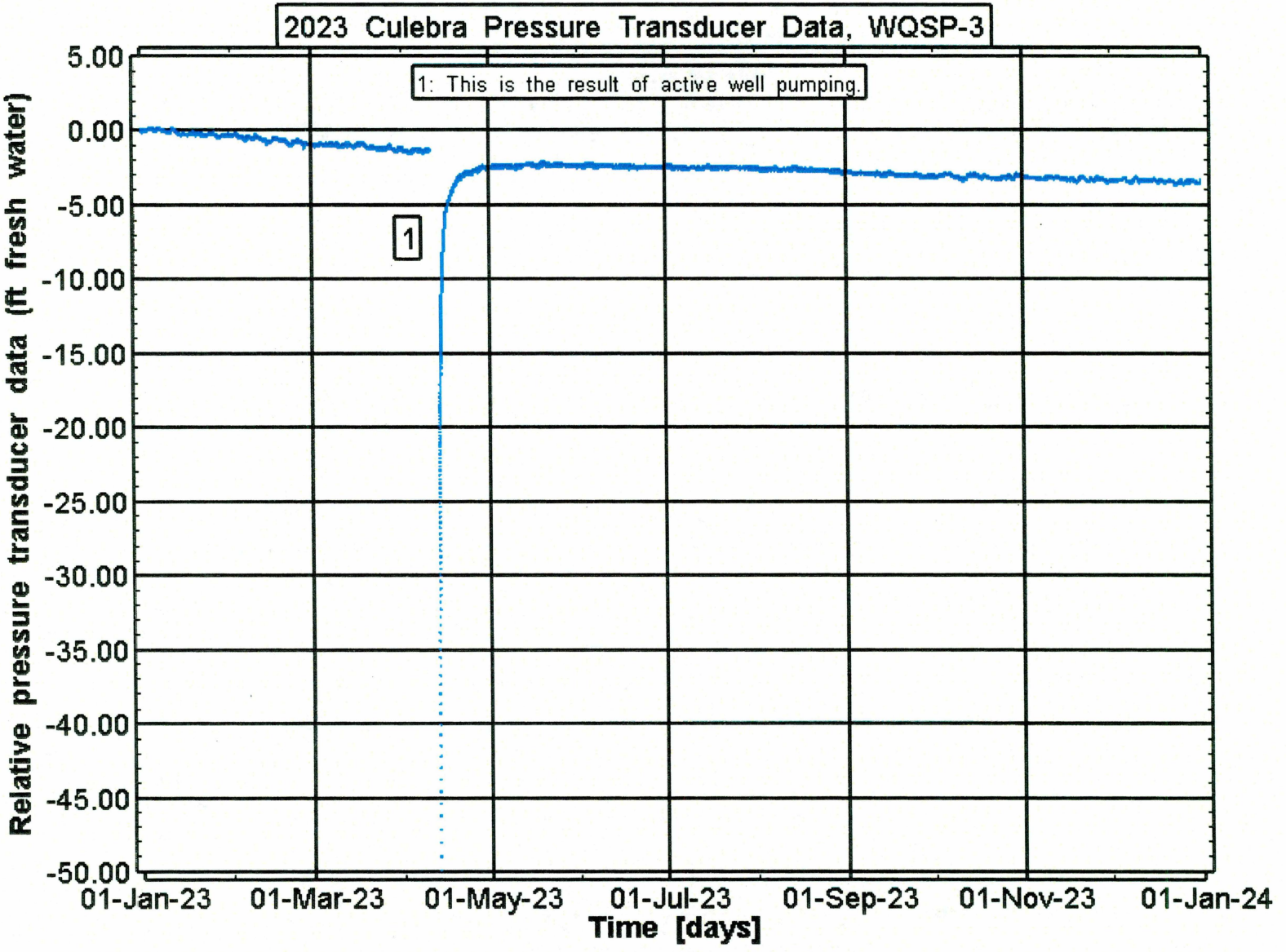

Figure 41. Well WQSP-3 experienced a net change in pressure head of -3.41 ft fresh water in 2023.

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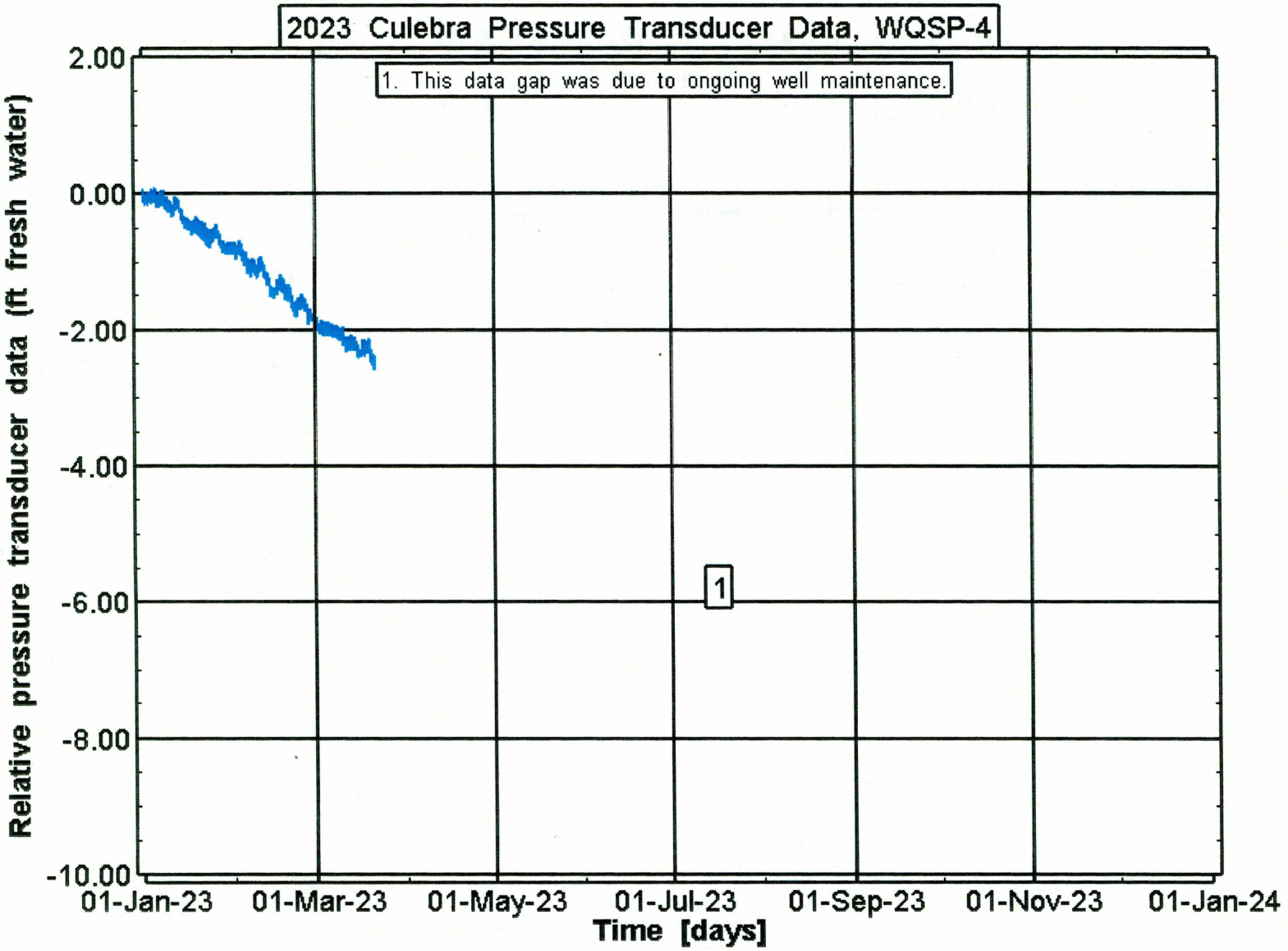

Figure 42. Well WQSP-4 experienced a net change in pressure head of -2.43 ft fresh water in 2023.

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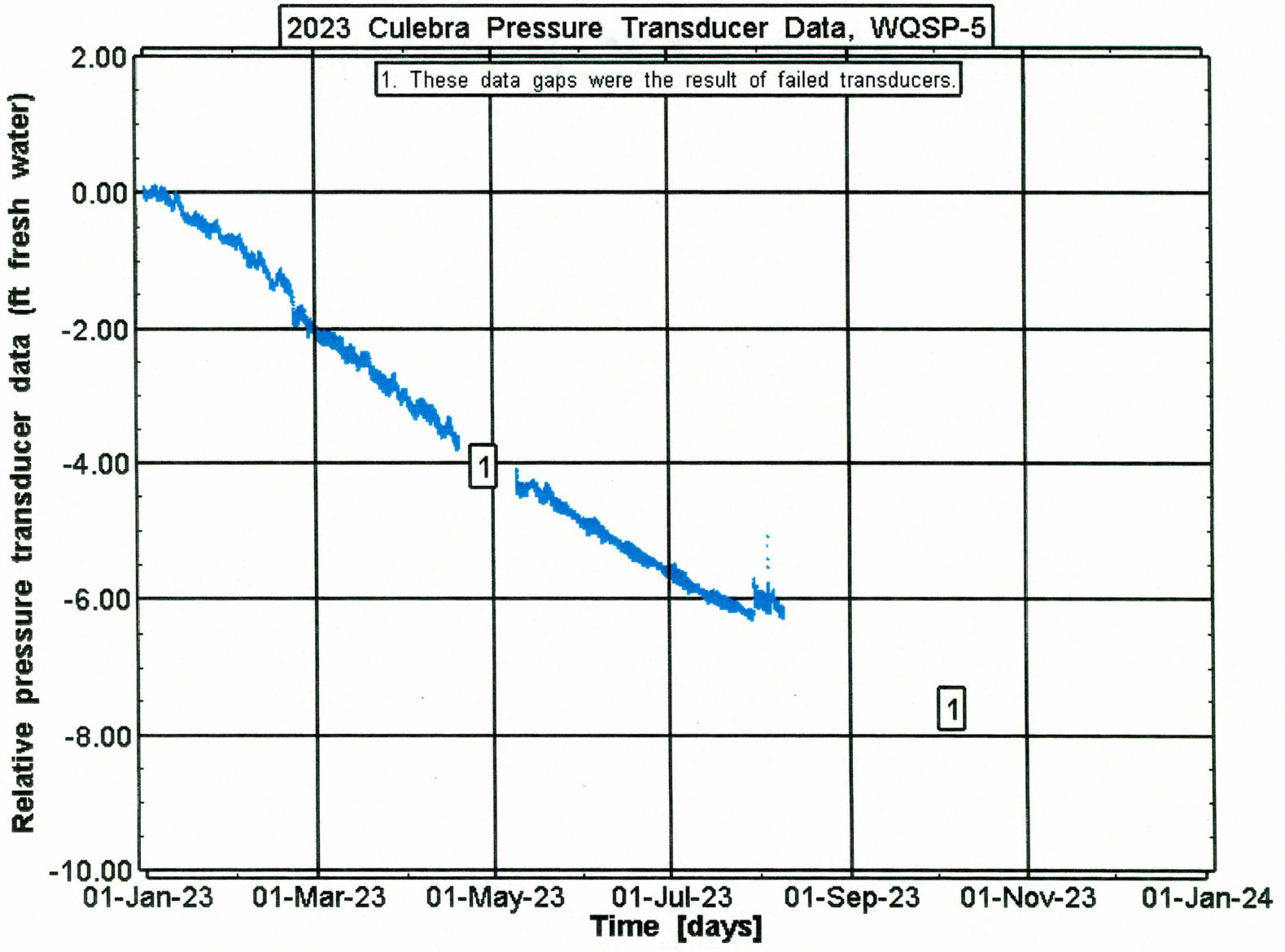

Figure 43. Well WQSP-5 experienced a net change in pressure head of -6.29 ft fresh water in 2023.

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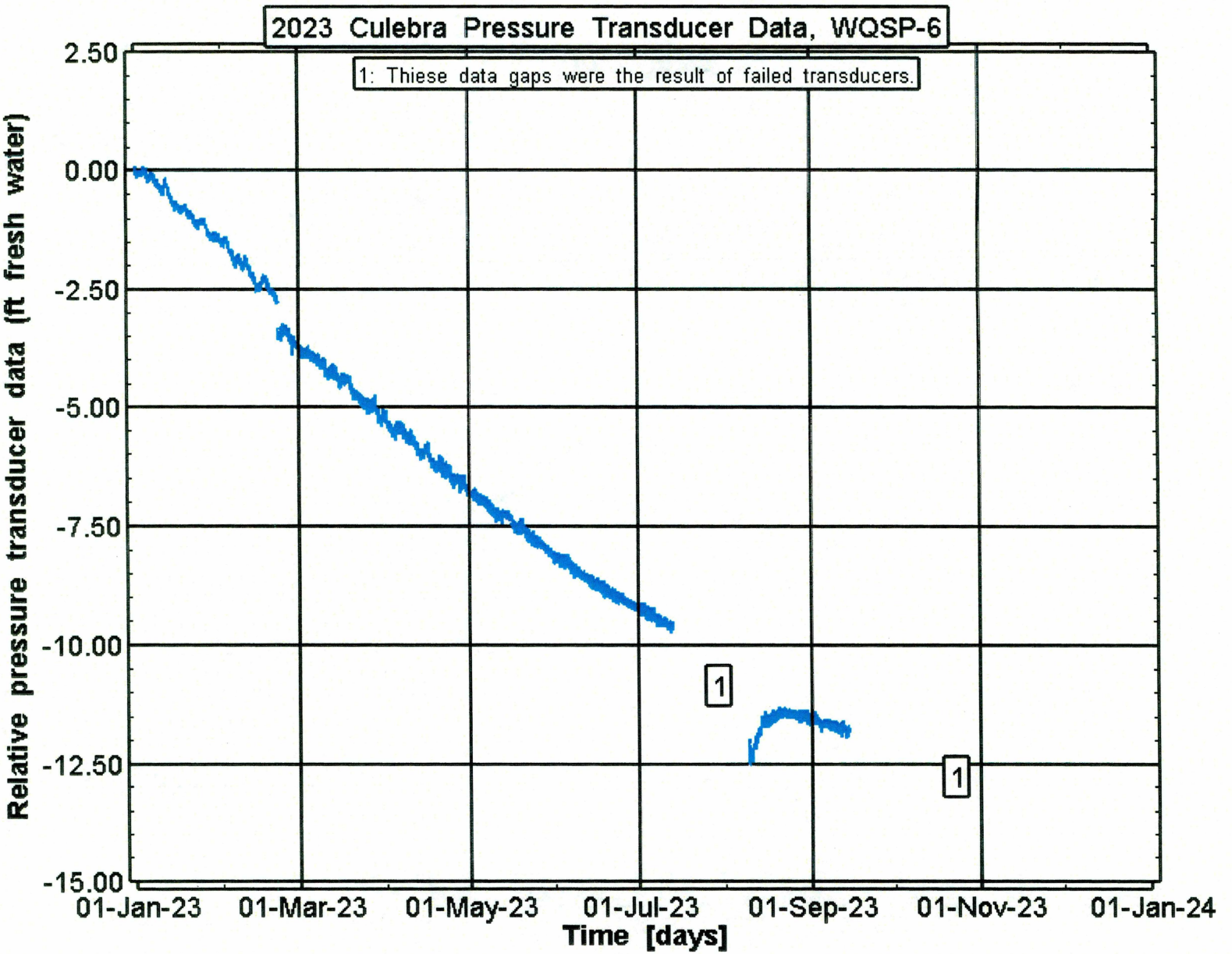

Figure 44. Well WQSP-6 experienced a net change in pressure head of -11.80 ft fresh water in 2023.

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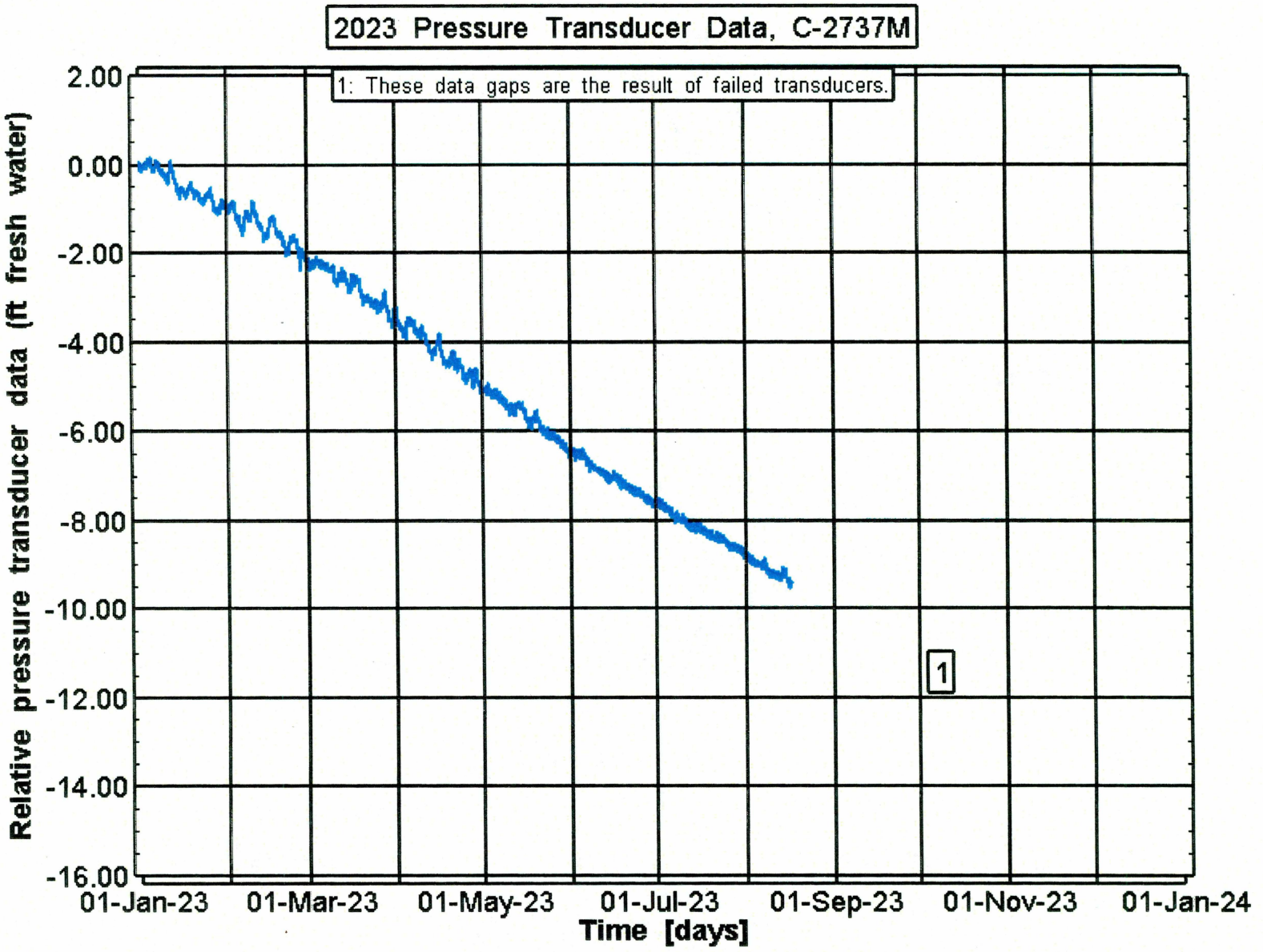

Figure 45. Well C-2737M experienced a net pressure head of -9.42 ft fresh water in 2023.

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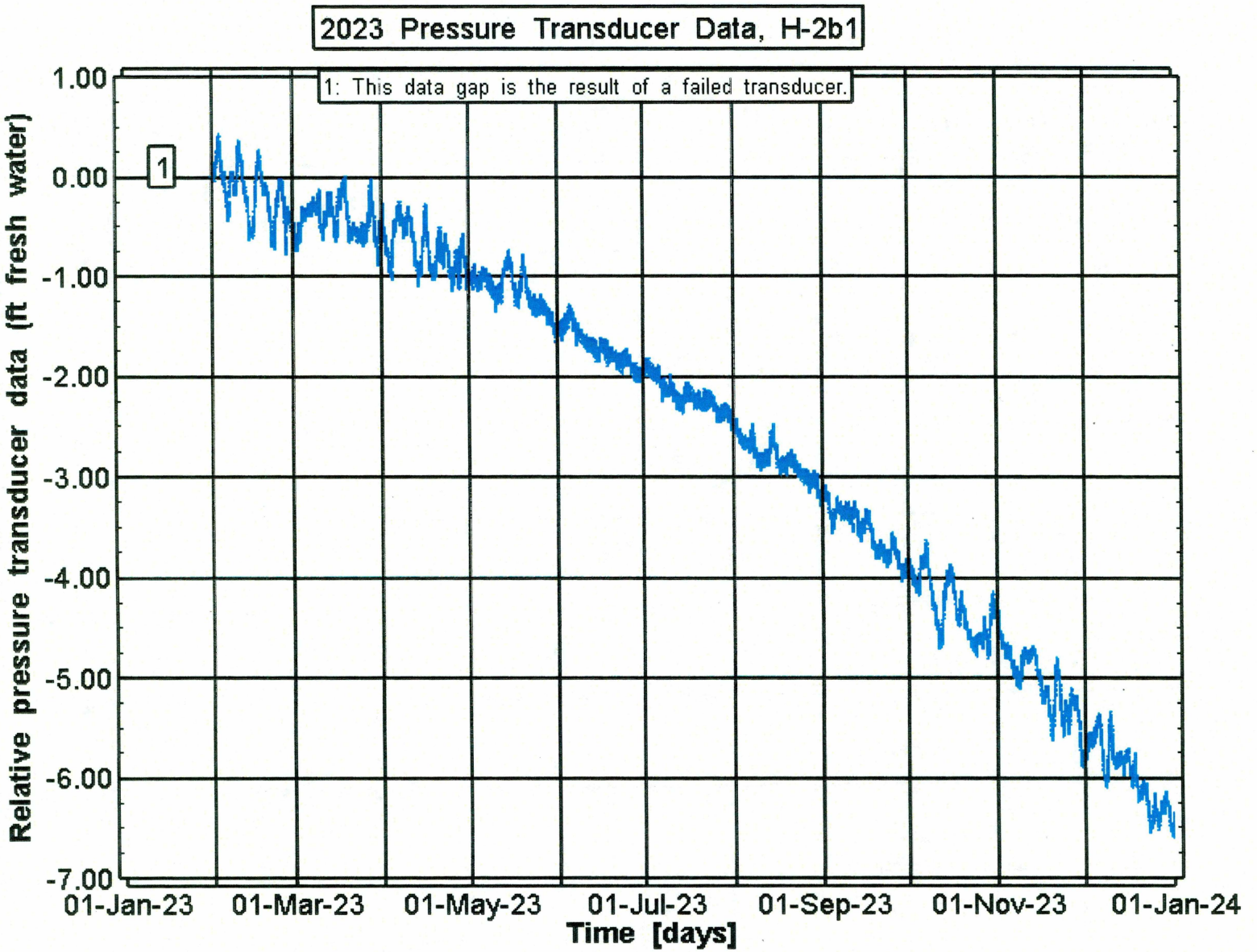

Figure 46. Well H-2b1 experienced a net pressure head of -6.36 ft fresh water in 2023.

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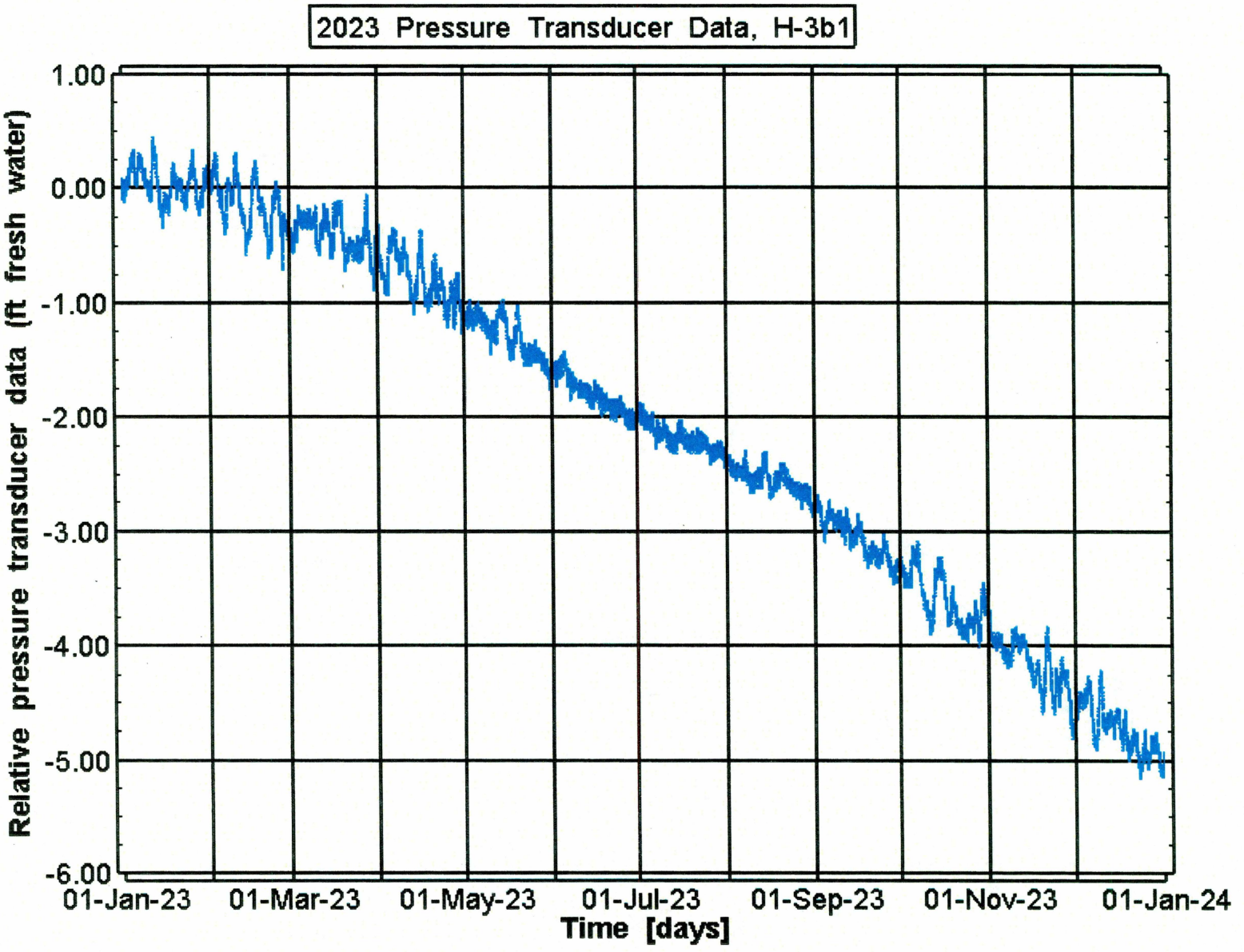

Figure 47. Well H-3b1 experienced a net pressure head of -4.93 ft fresh water in 2023.

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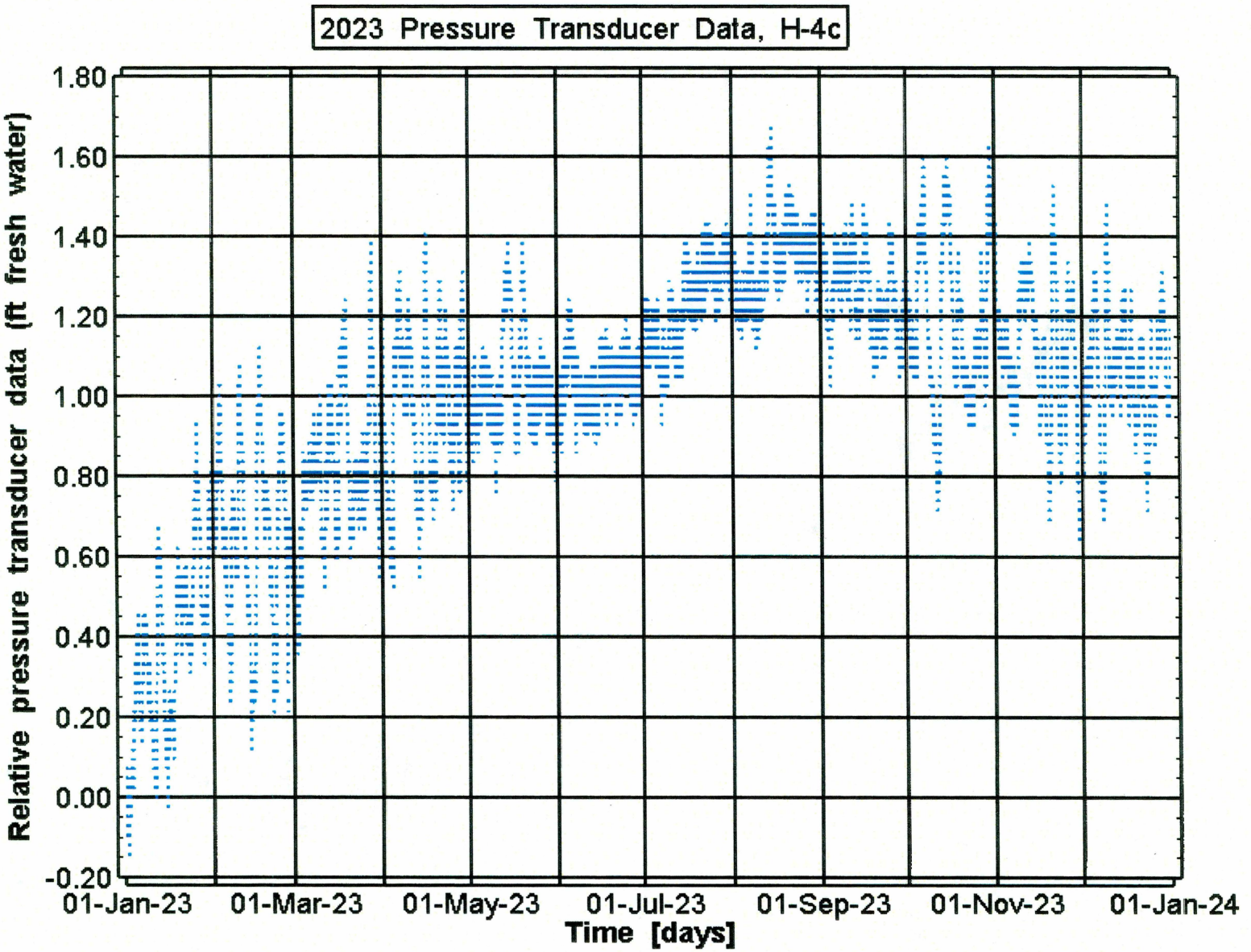

Figure 48. Well H-4c experienced a net pressure head of 1.67 ft fresh water in 2023.

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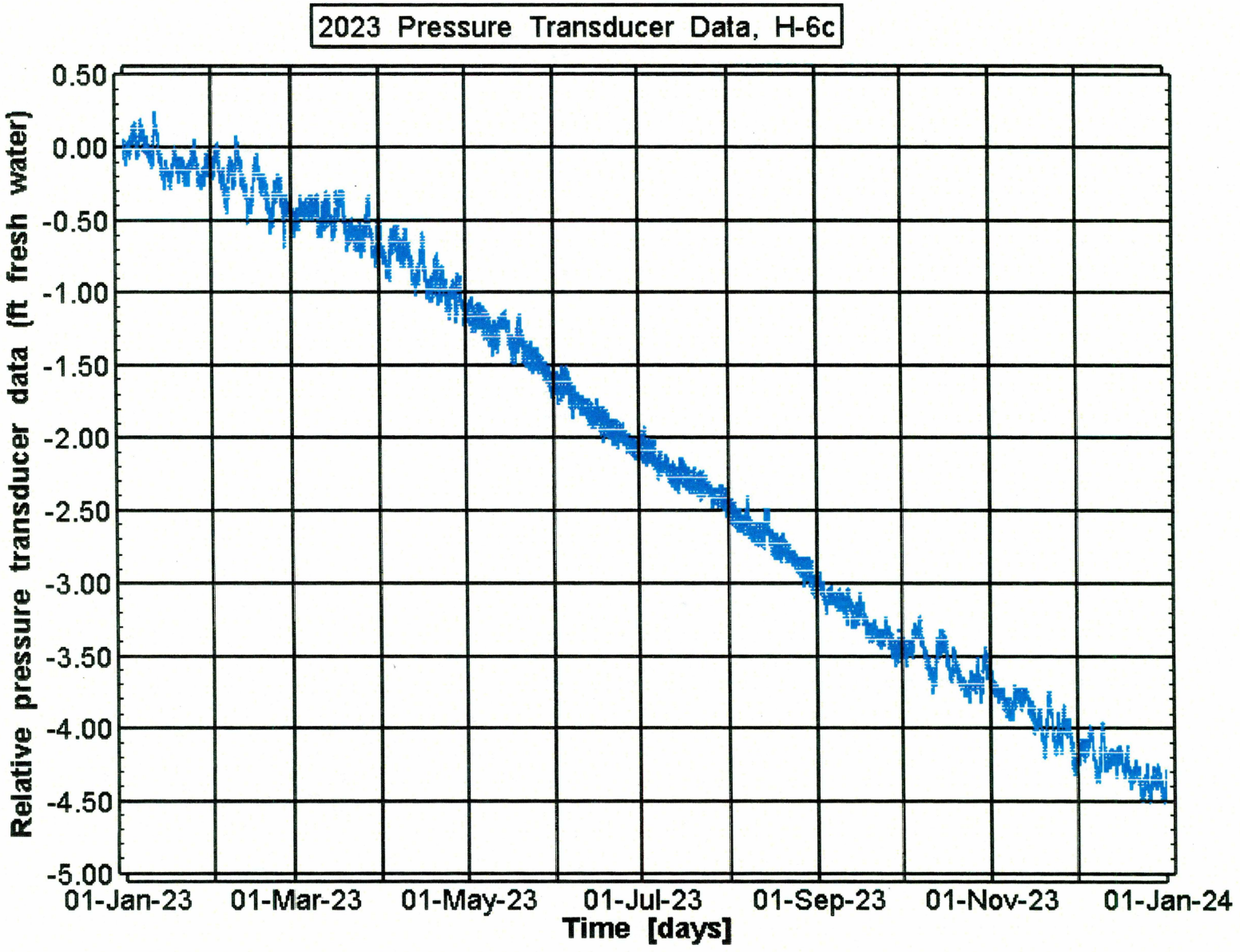

Figure 49. Well H-6c experienced a net pressure head of -4.32 ft fresh water in 2023.

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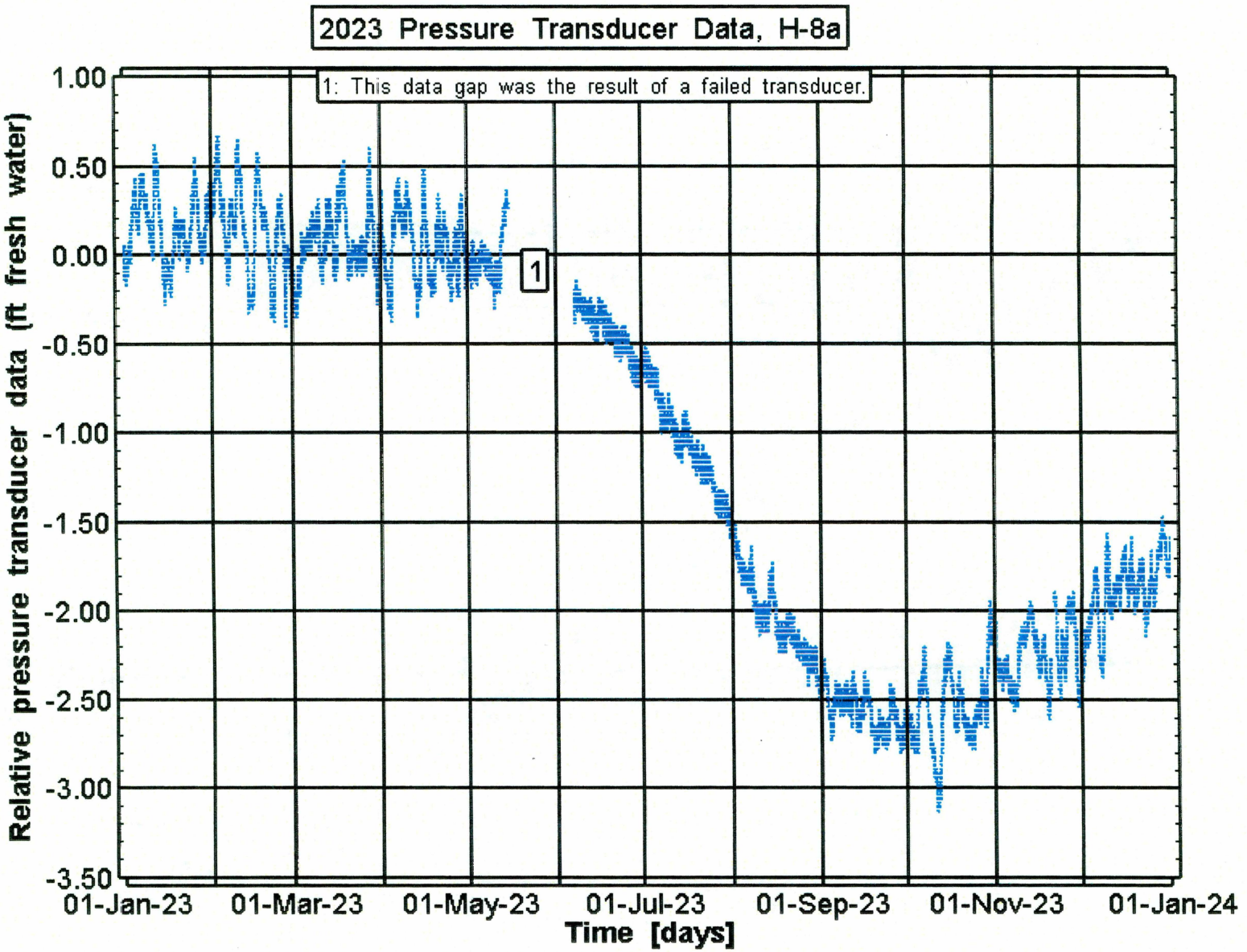

Figure 50. Well H-8a experienced a net pressure head of -1.59 ft fresh water in 2023.

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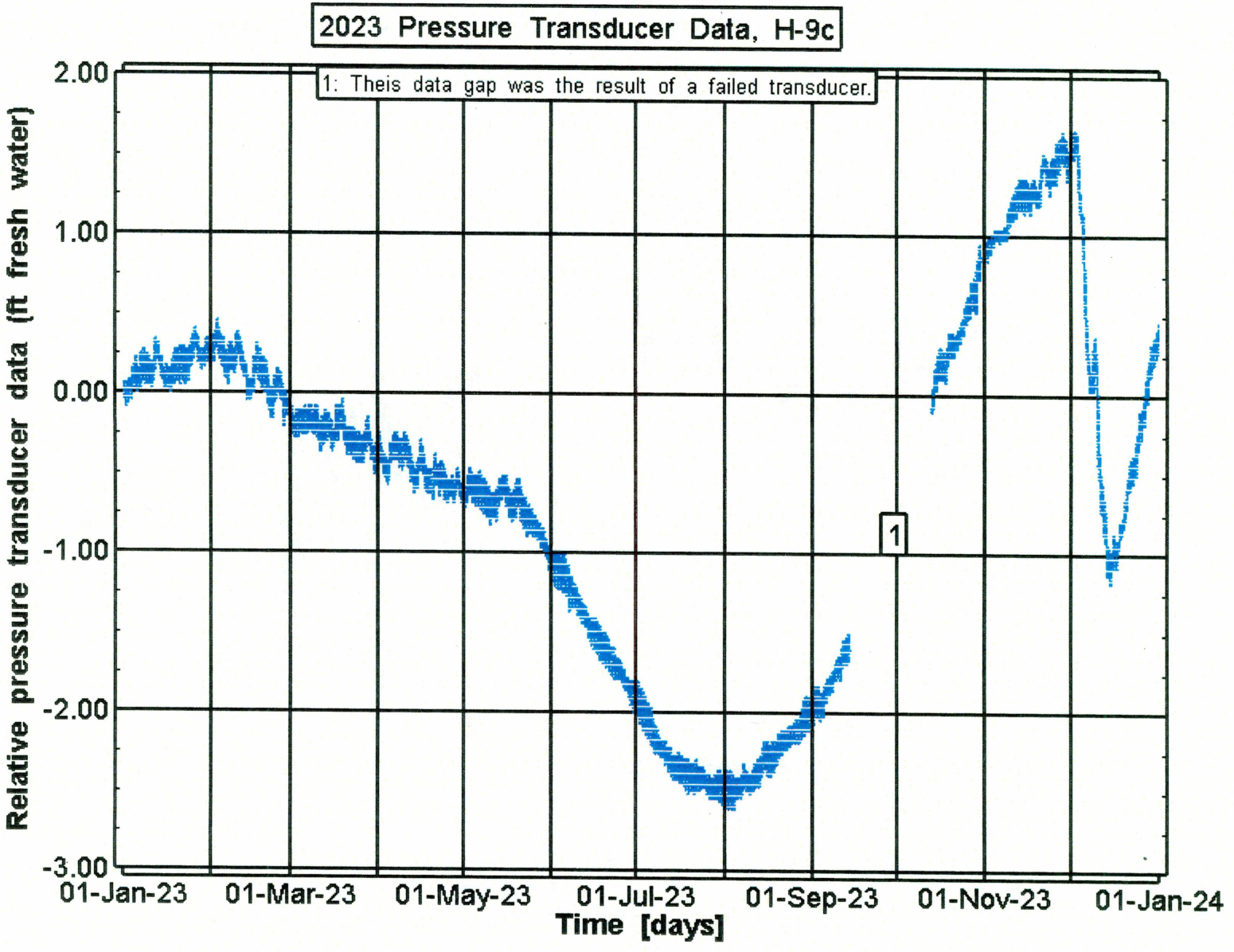

Figure 51. Well H-9c experienced a net pressure head of 0.42 ft fresh water in 2023. This well was affected by NWRA.

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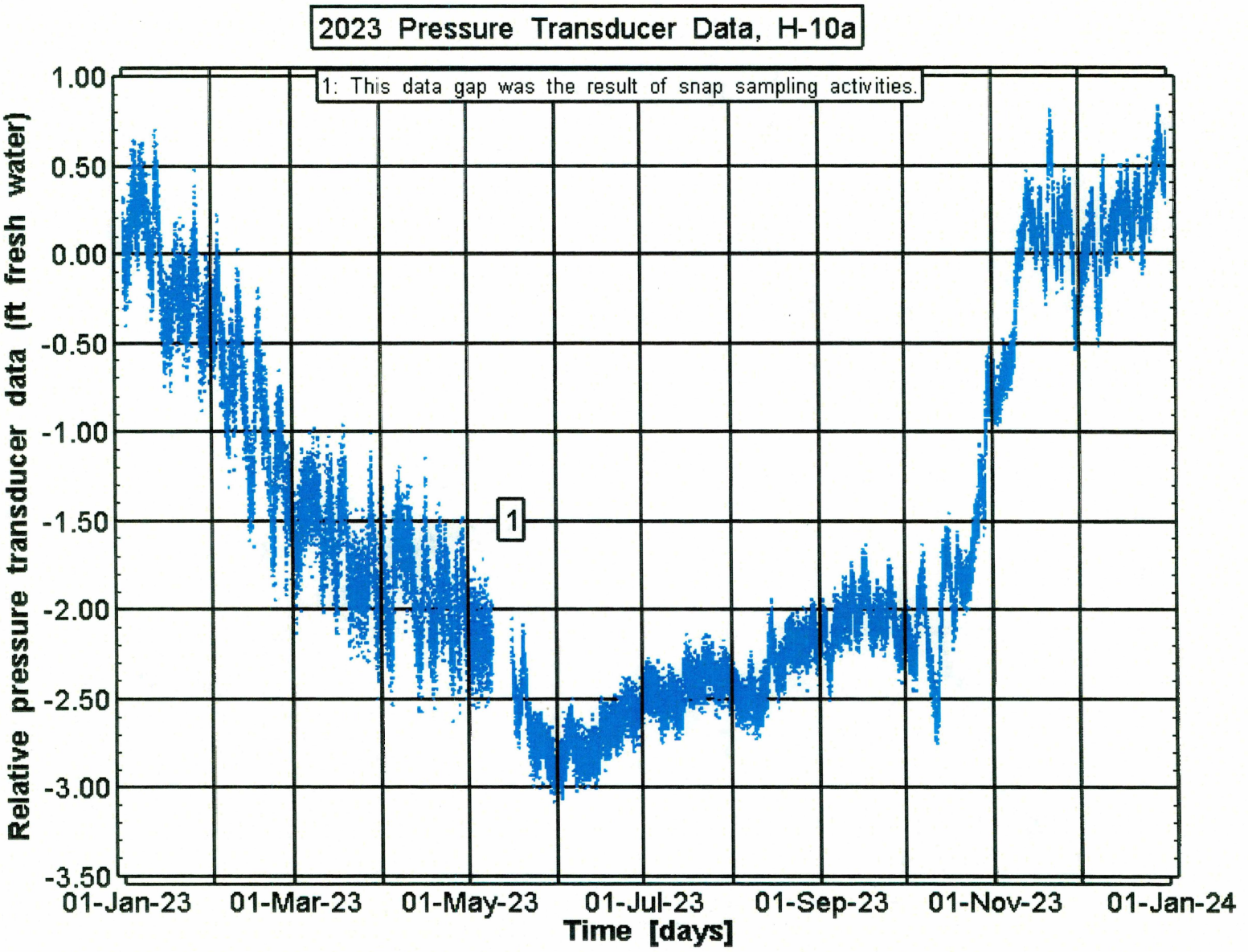

Figure 52. Well H-10a experienced a net pressure head of 0.62 ft fresh water in 2023.

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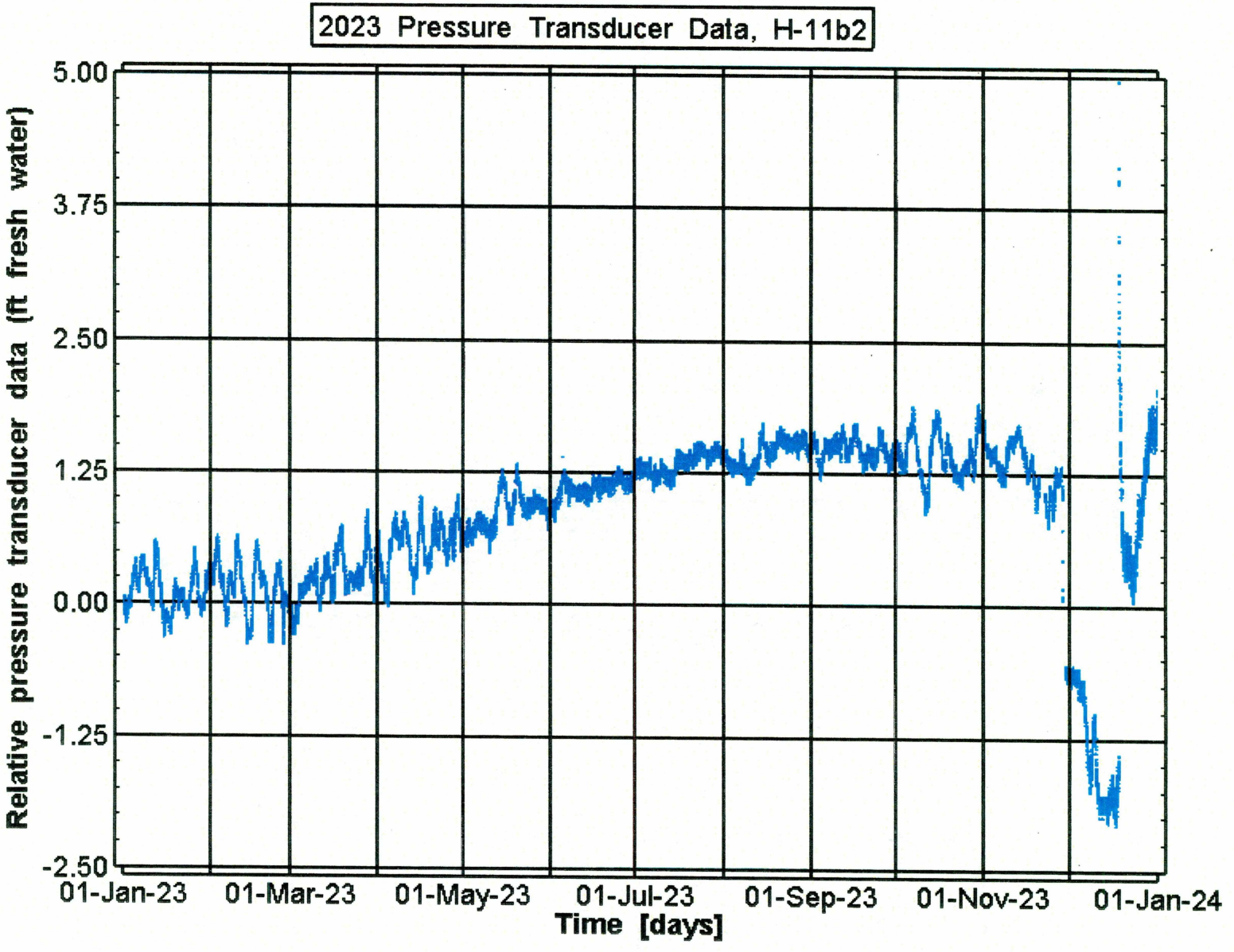

Figure 53. Well H-11b2 experienced a net pressure head of 1.79 ft fresh water in 2023. This well was affected by NWRA.

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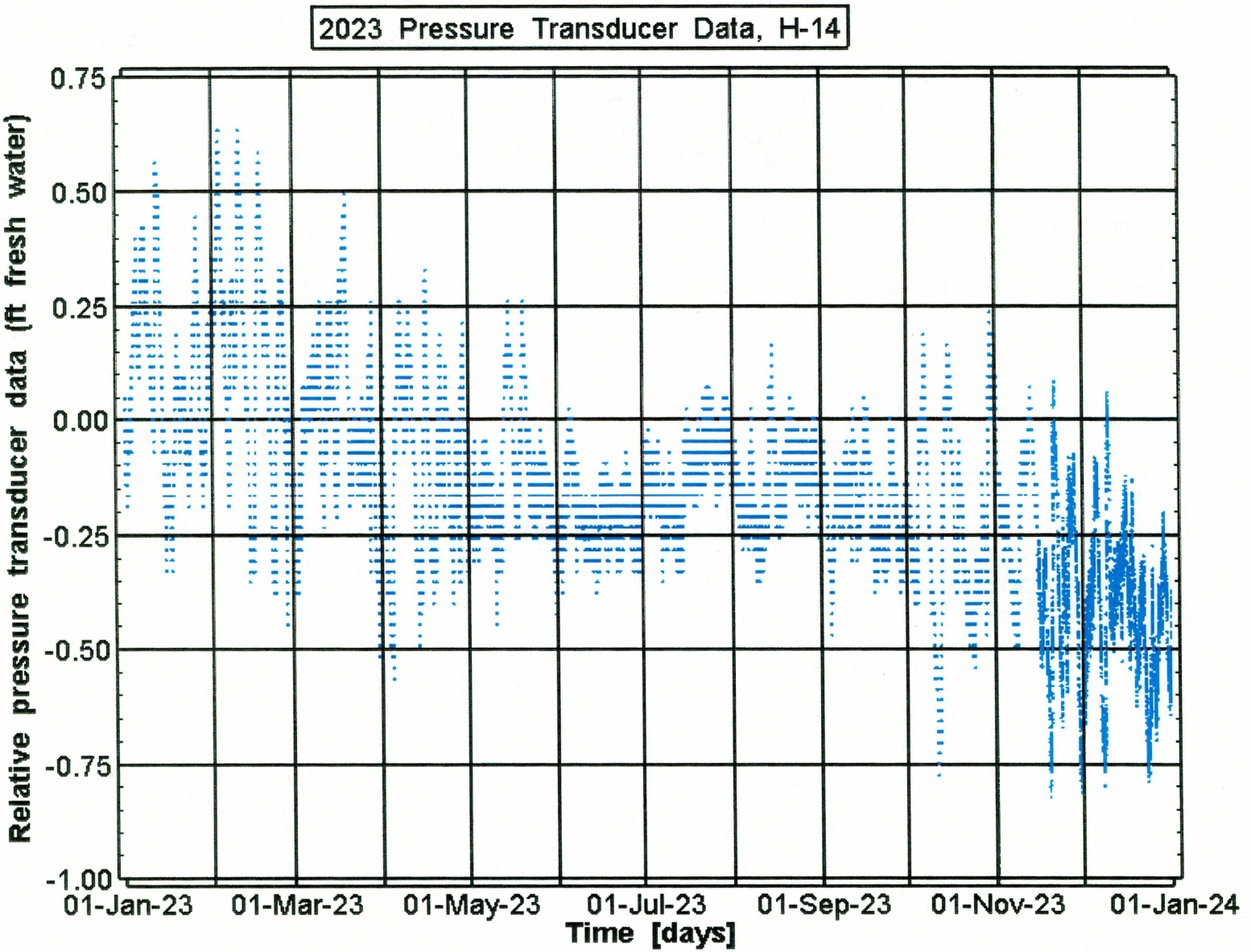

Figure 54. Well H-14 experienced a net pressure head of -0.37 ft fresh water in 2023.

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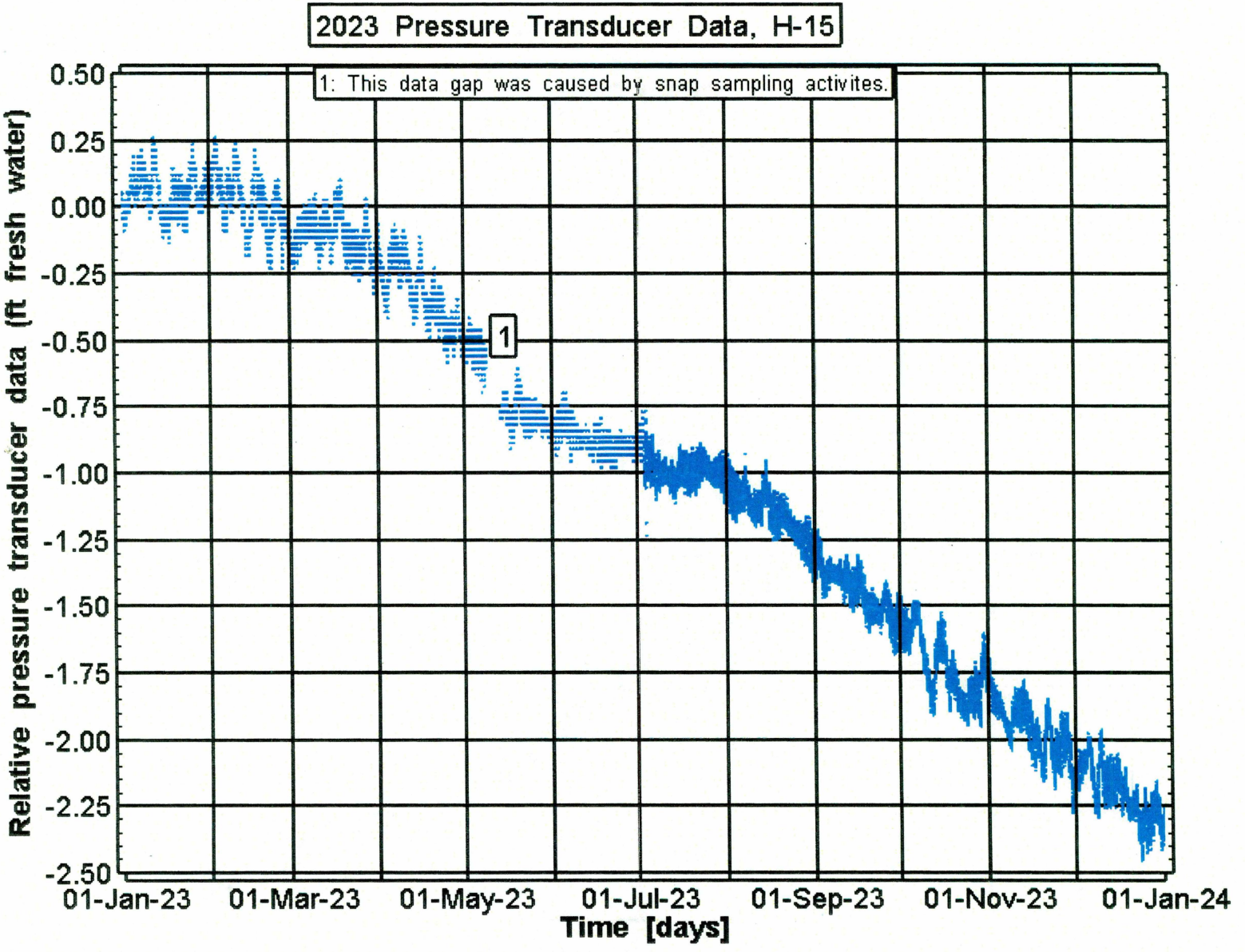

Figure 55. Well H-15 experienced a net pressure head of -2.30 ft fresh water in 2023.

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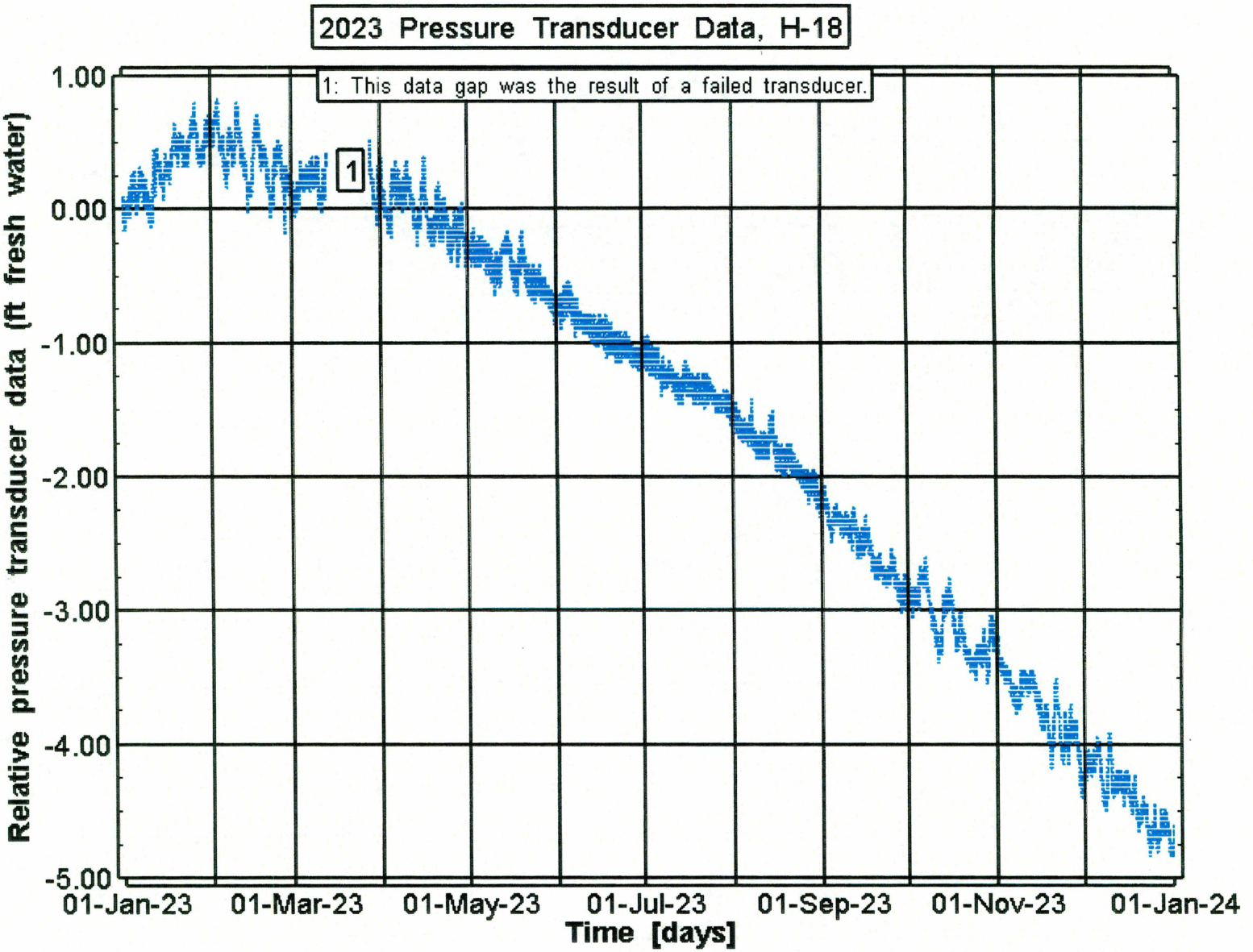

Figure 56. Well H-18 experienced a net pressure head of -4.62 ft fresh water in 2023.

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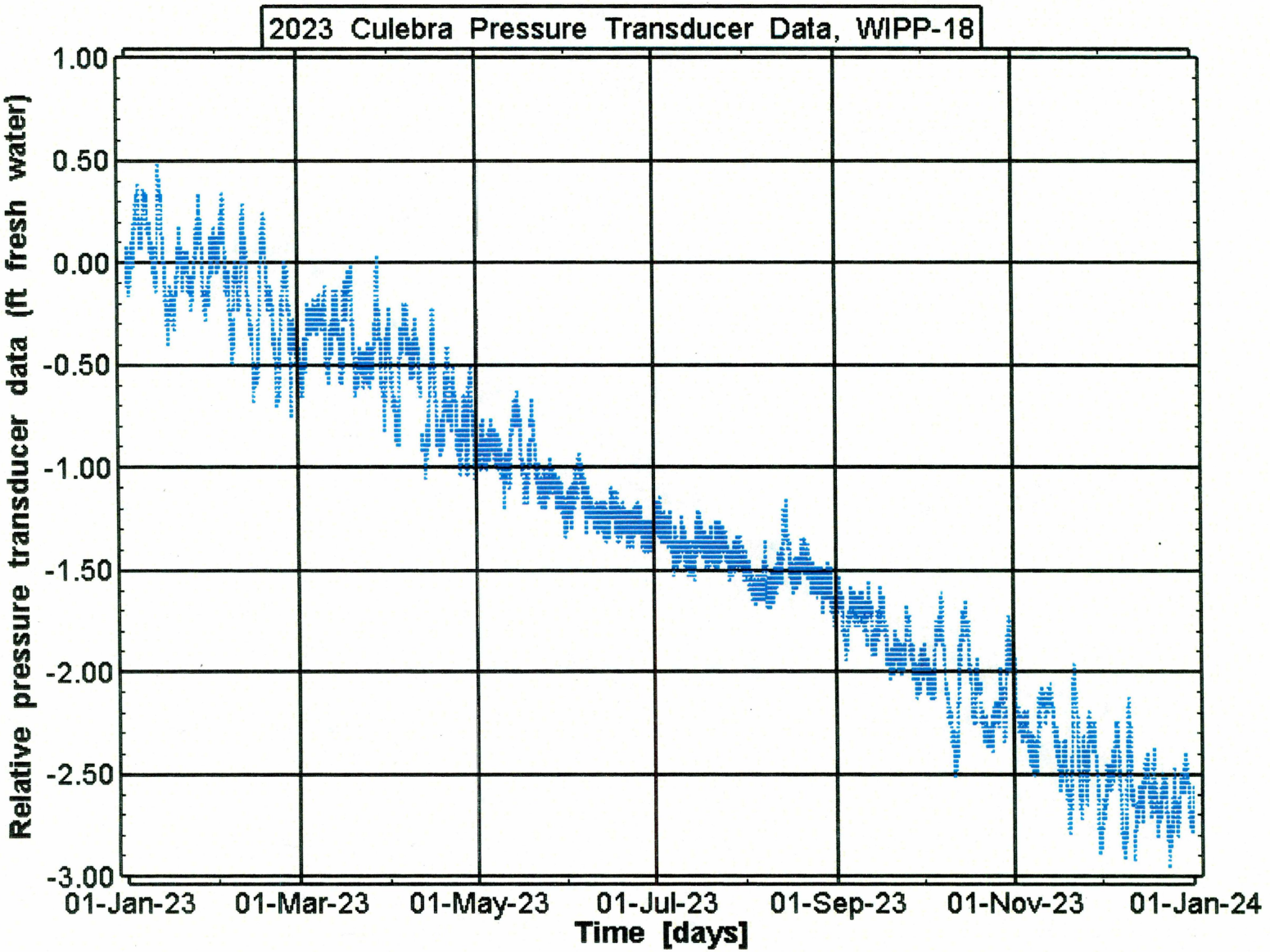

Figure 57. Well WIPP-18 experienced a net pressure head of -2.57 ft fresh water in 2023.

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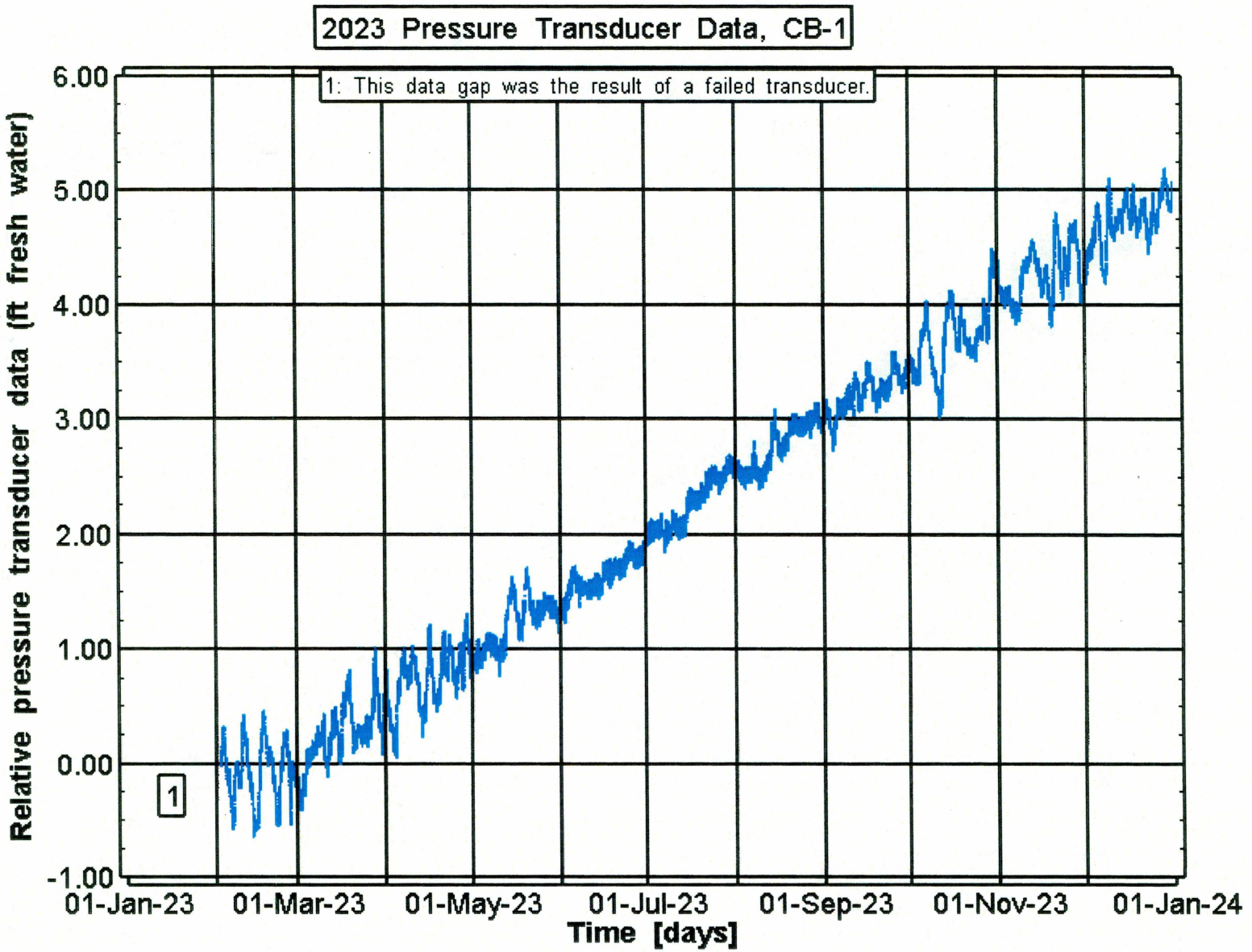

Figure 58. Well CB-1 experienced a net pressure head of 5.07 ft fresh water in 2023.

Information Only

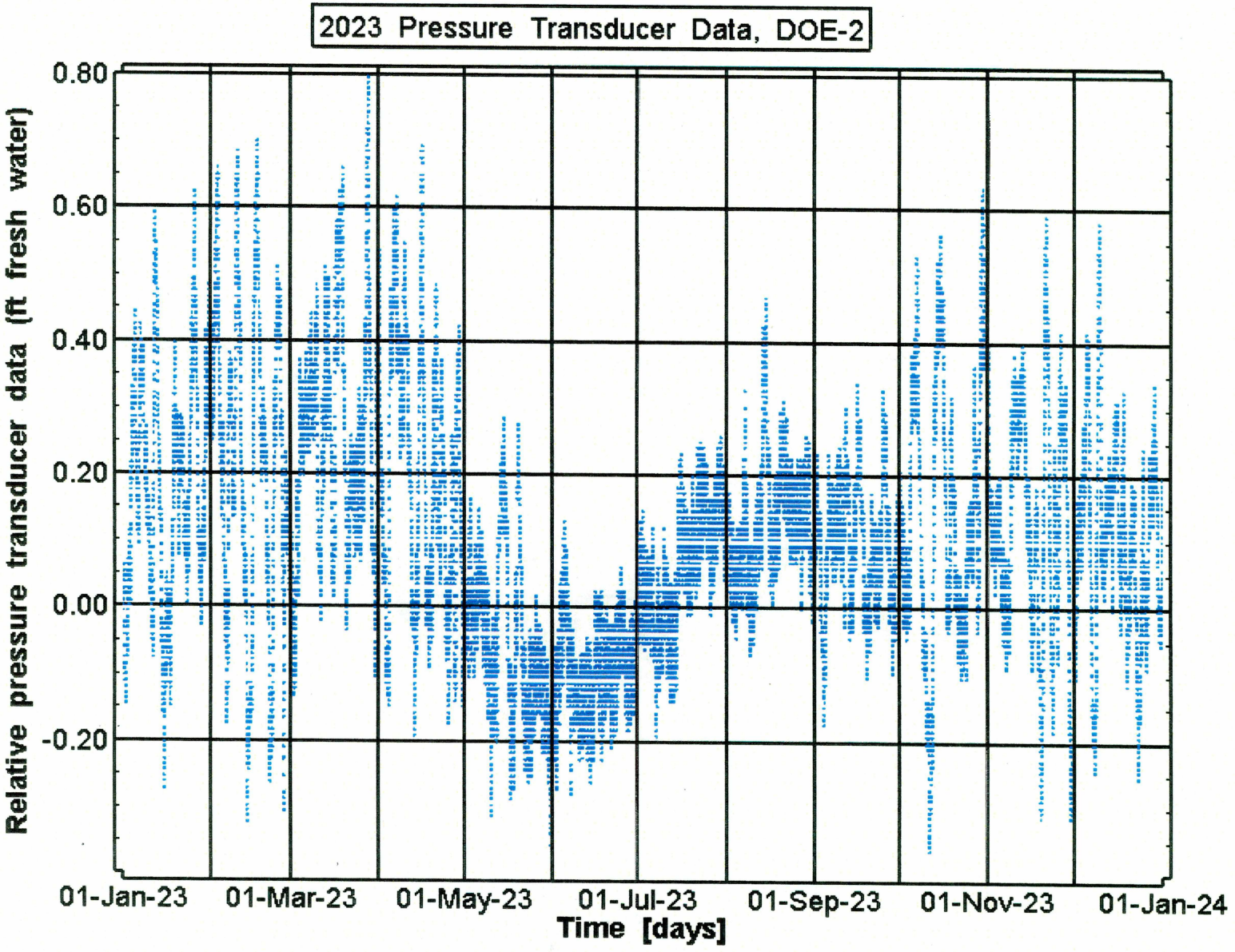

Figure 59. Well DOE-2 experienced a net pressure head of 0.20 ft fresh water in 2023.

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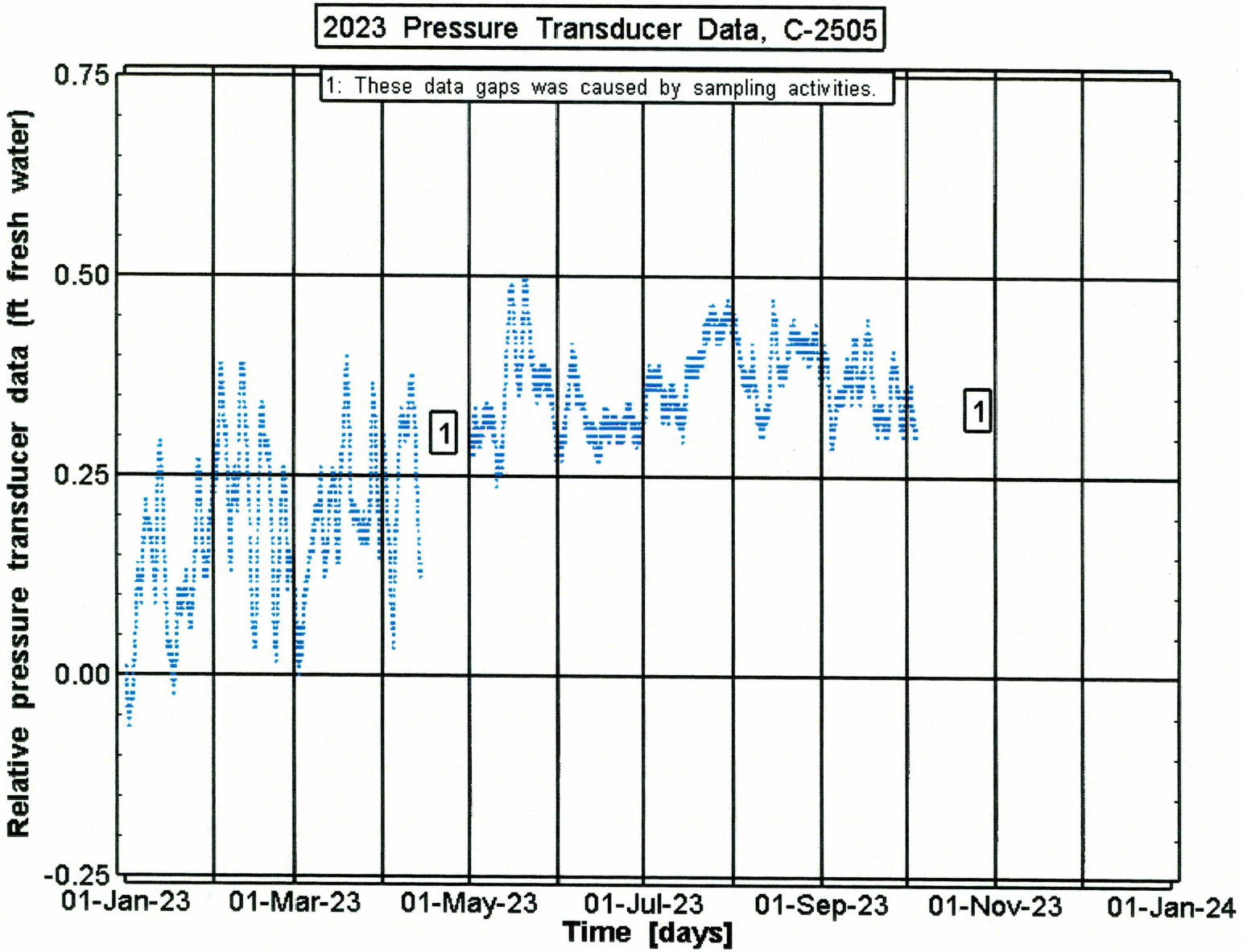

Figure 60. Well C-2505 experienced a net pressure head of 0.31 ft fresh water in 2023.

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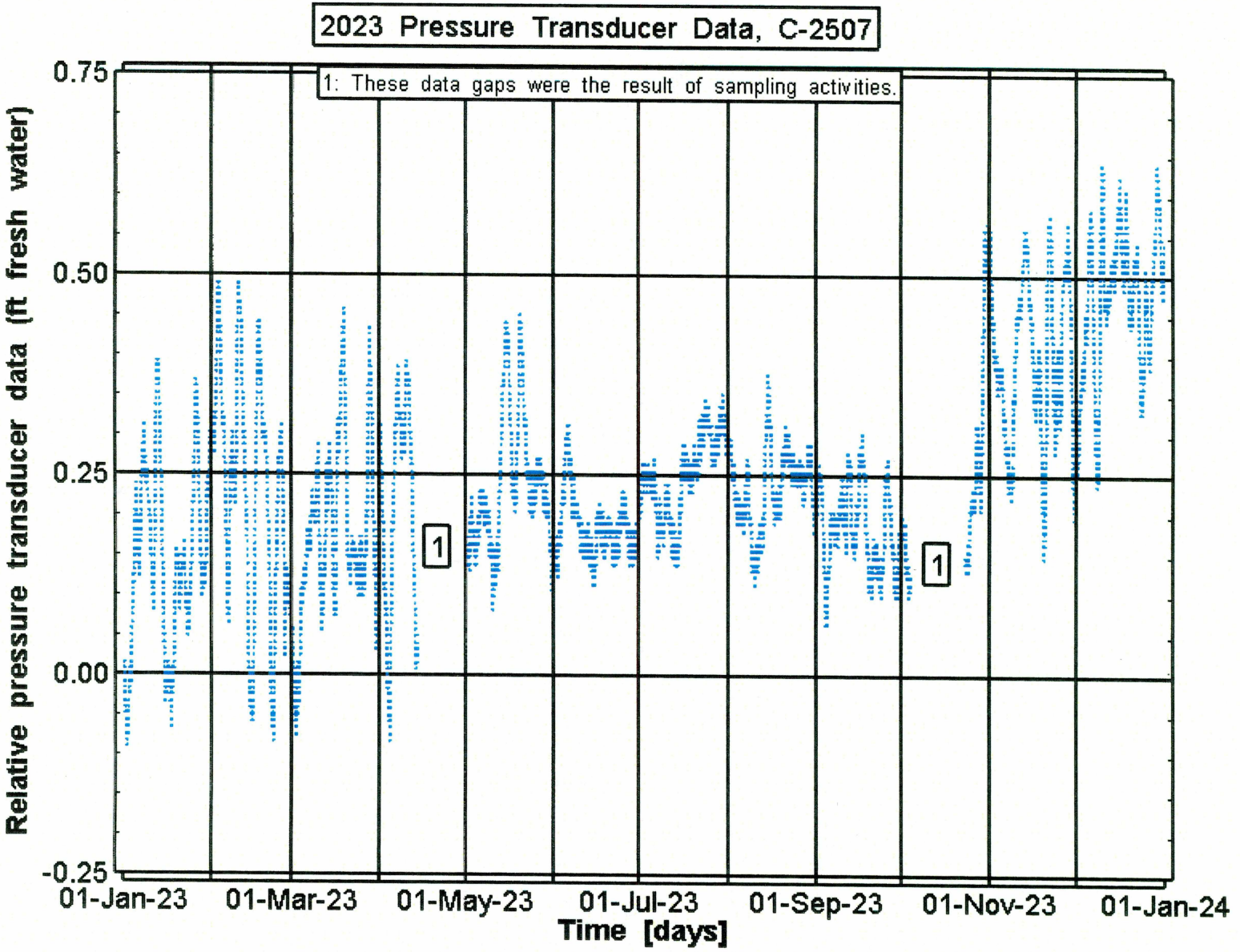

Figure 61. Well C-2507 experienced a net pressure head of 0.54 ft fresh water in 2023.

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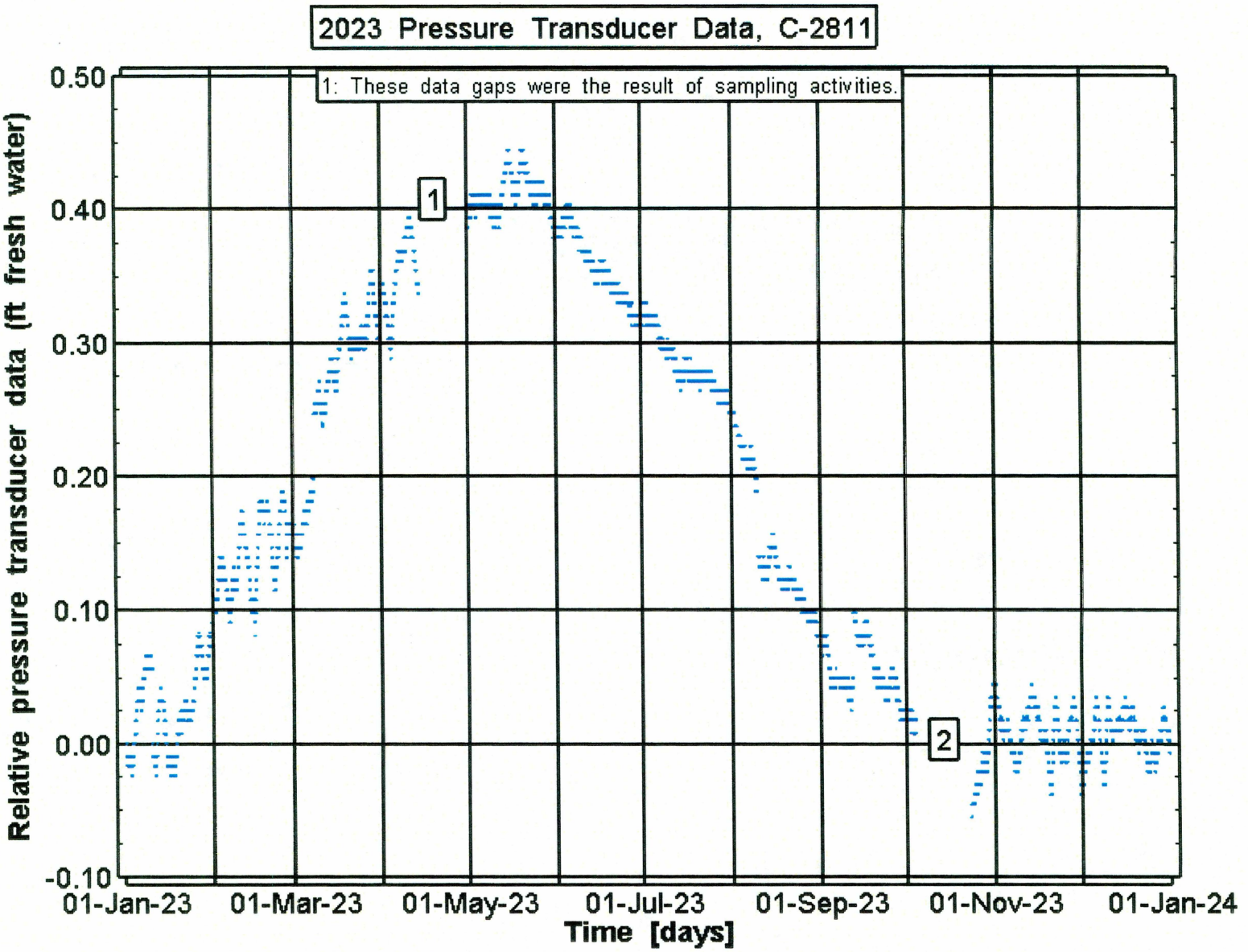

Figure 62. Well C-2811 experienced a net pressure head of 0.01 ft fresh water in 2023.

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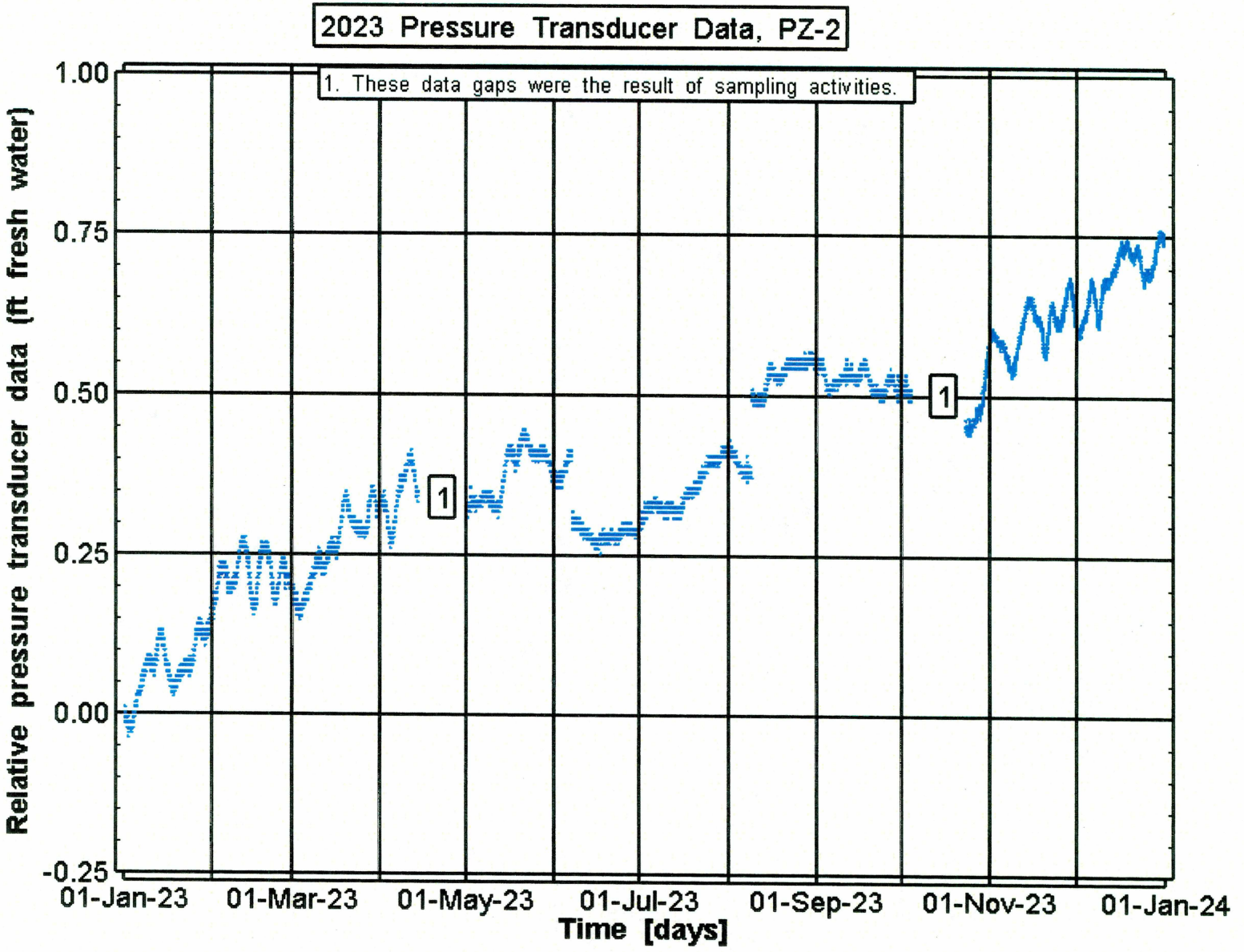

Figure 63. Well PZ-2 experienced a net pressure head of 0.75 ft fresh water in 2023.

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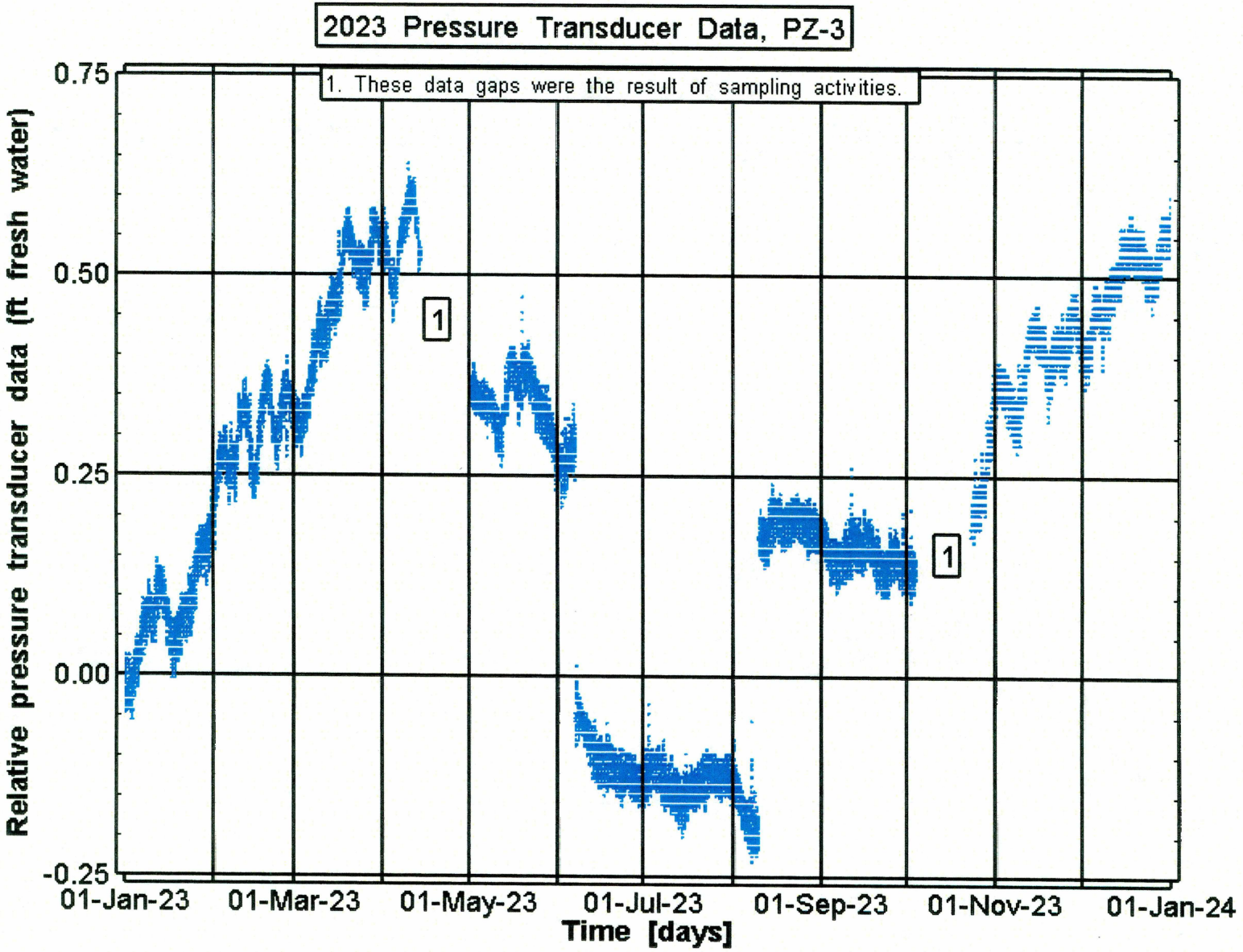

Figure 64. Well PZ-3 experienced a net pressure head of 0.58 ft fresh water in 2023.

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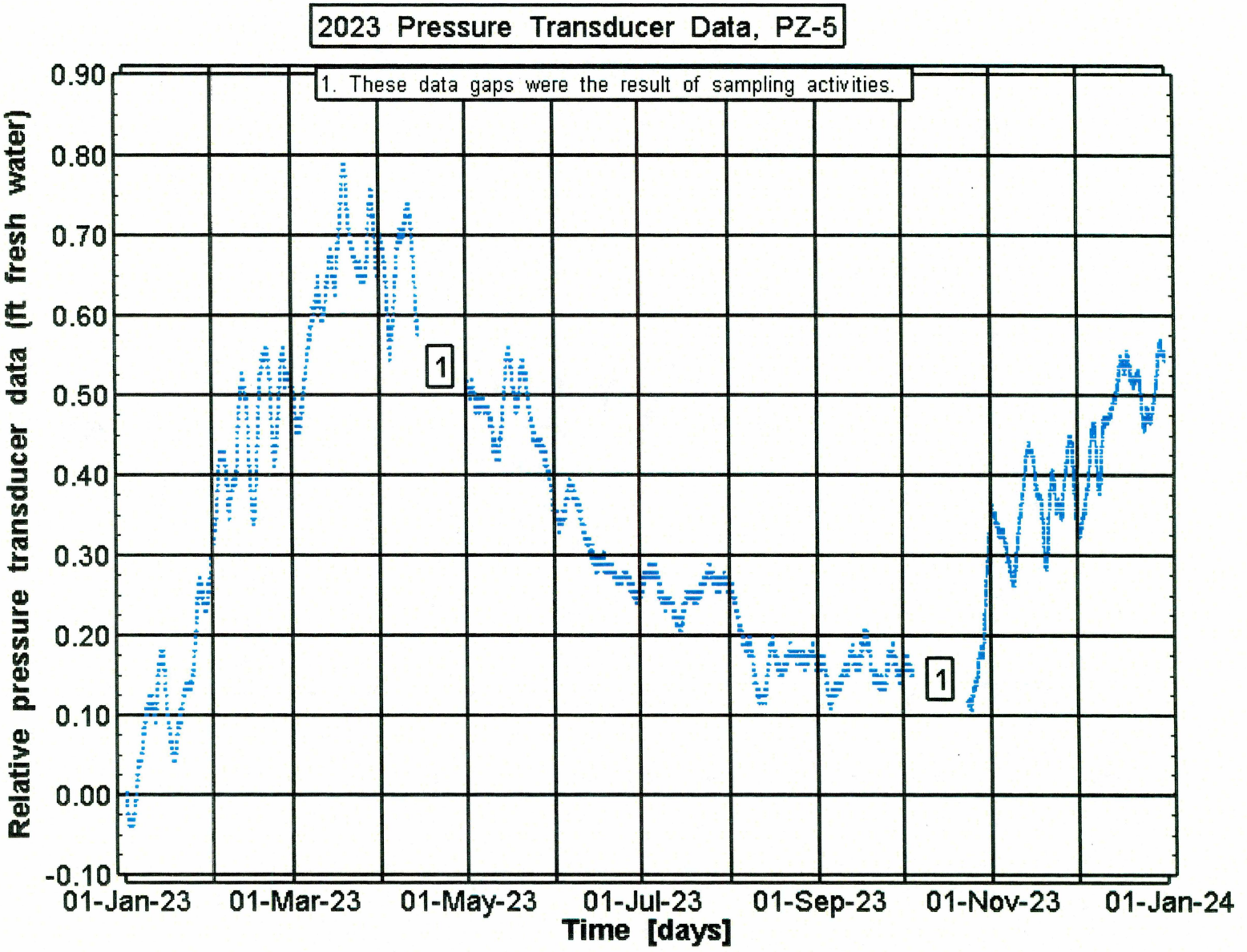

Figure 65. Well PZ-5 experienced a net pressure head of 0.56 ft fresh water in 2023.

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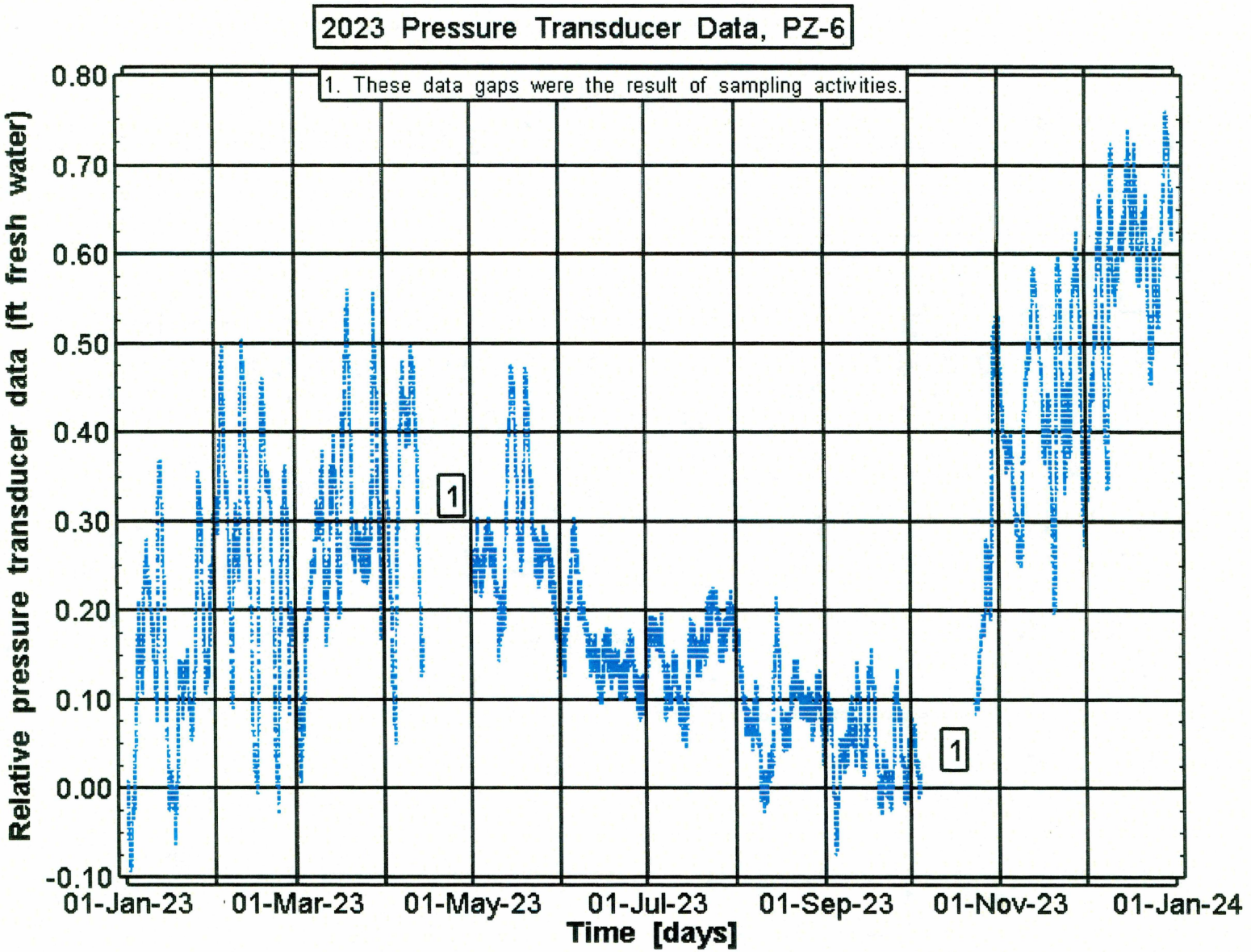

Figure 66. Well PZ-6 experienced a net pressure head of 0.67 ft fresh water in 2023.

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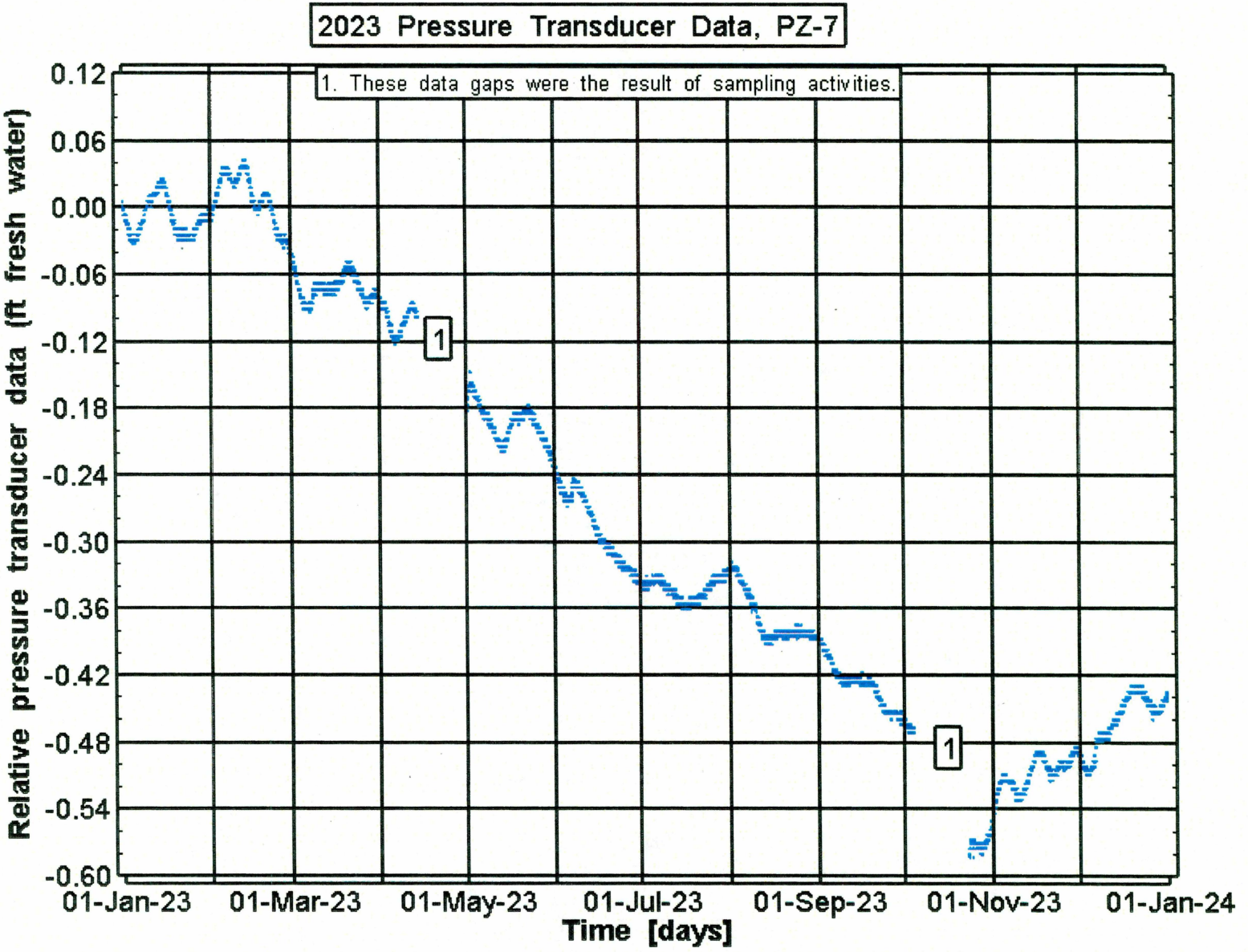

Figure 67. Well PZ-7 experienced a net pressure head of -0.44 ft fresh water in 2023.

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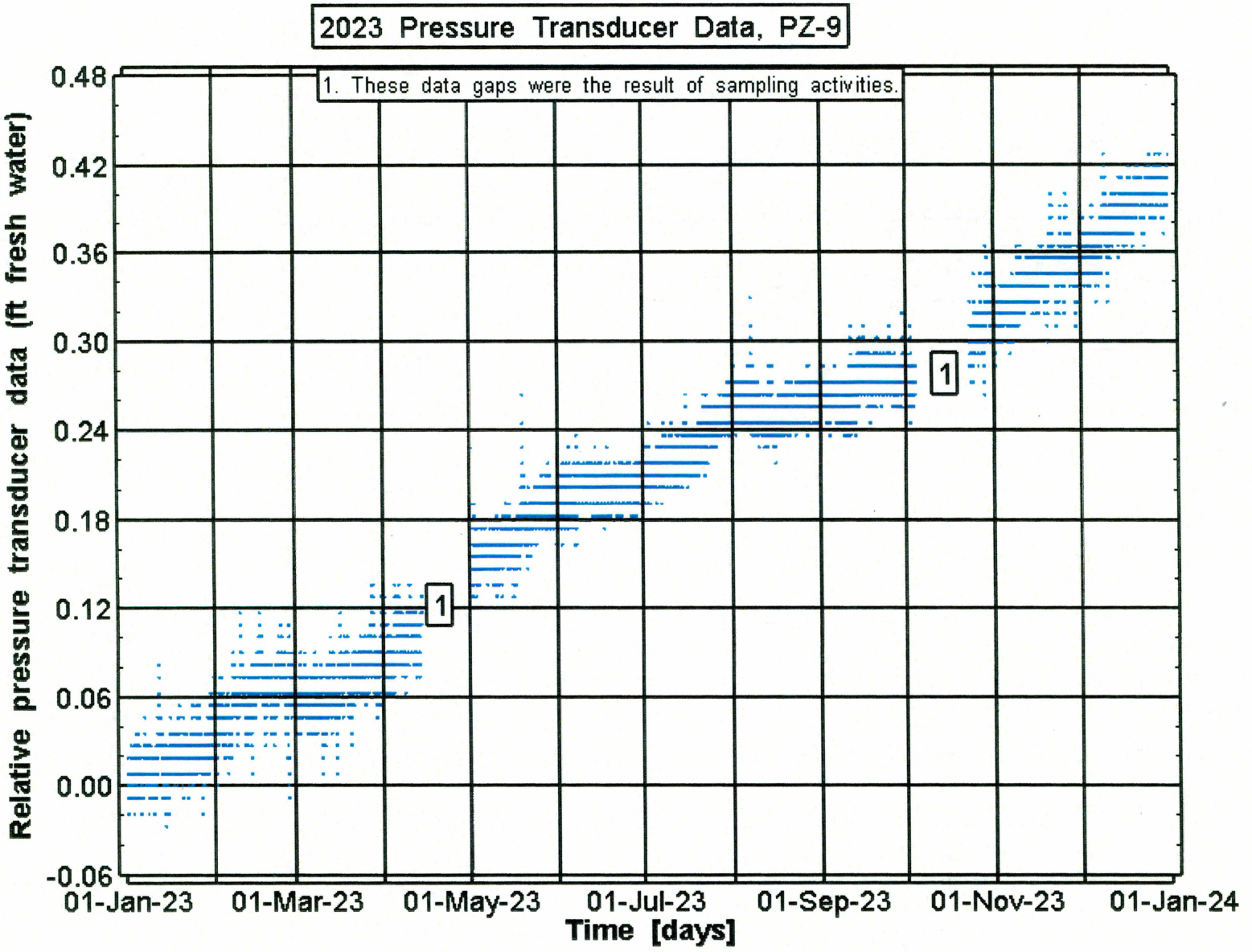

Figure 68. Well PZ-9 experienced a net pressure head of 0.42 ft fresh water in 2023.

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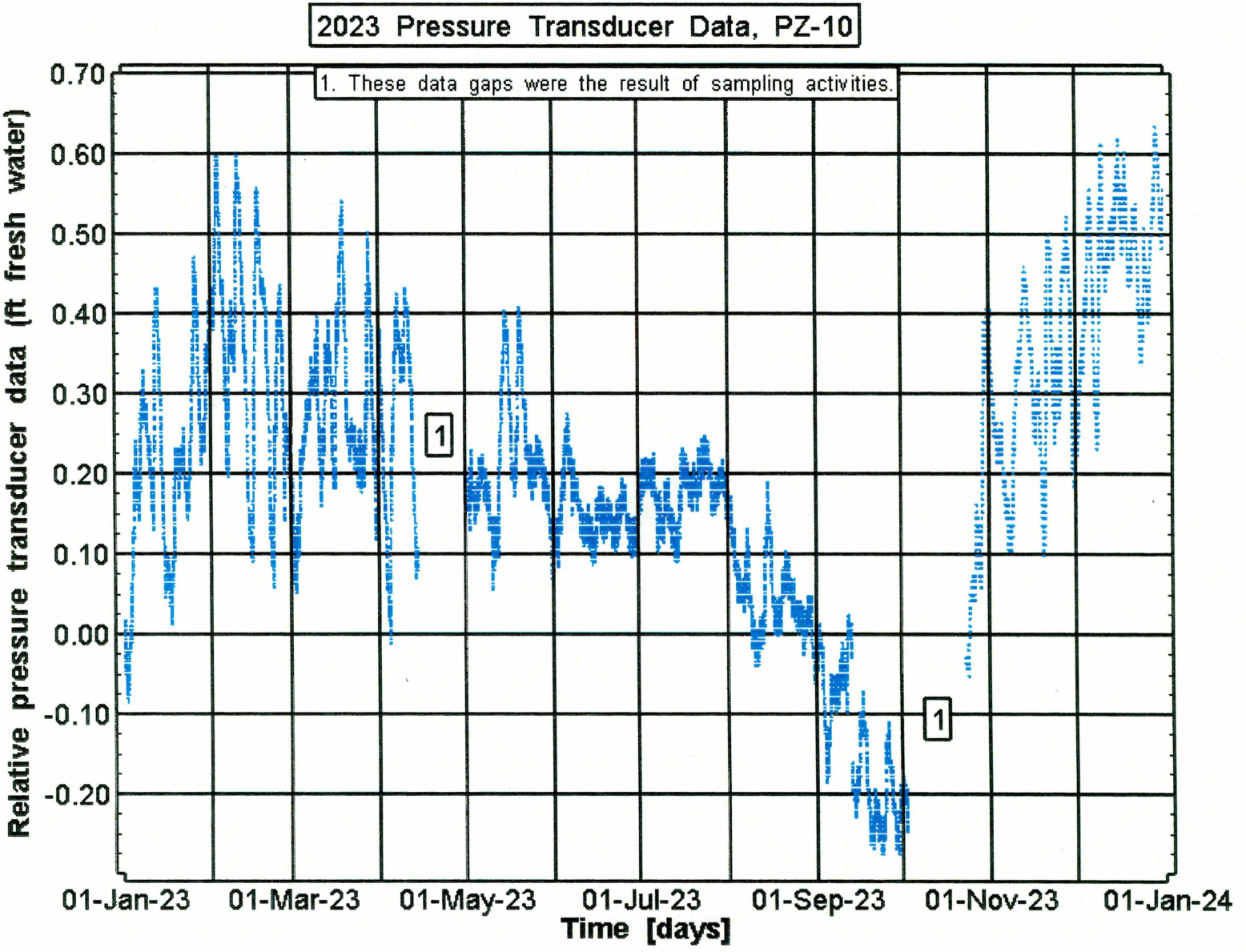

Figure 69. Well PZ-10 experienced a net pressure head of 0.56 ft fresh water in 2023.

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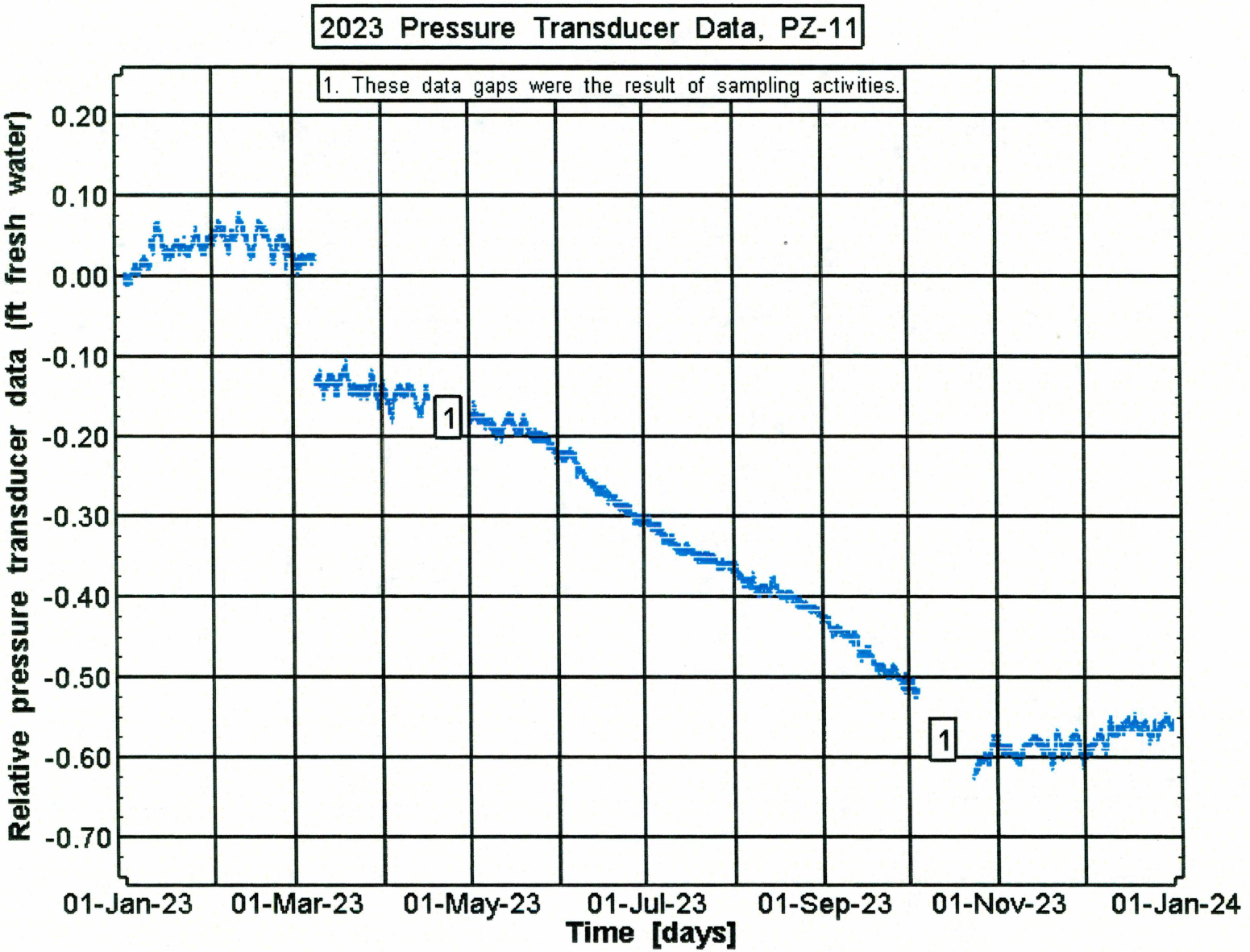

Figure 70. Well PZ-11 experienced a net pressure head of -0.55 ft fresh water in 2023.

Information Only

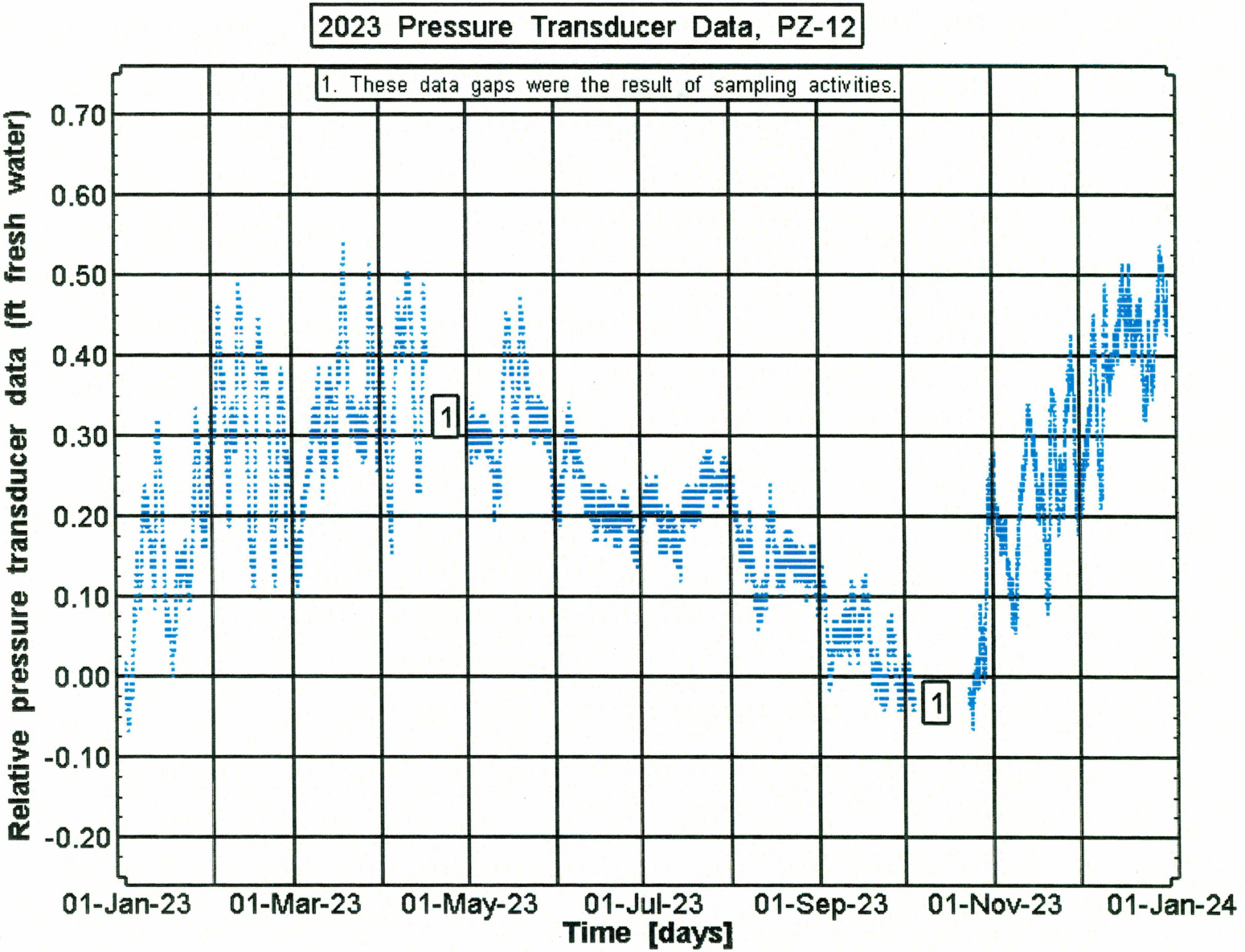

Figure 71. Well PZ-13 experienced a net pressure head of 0.49 ft fresh water in 2023.

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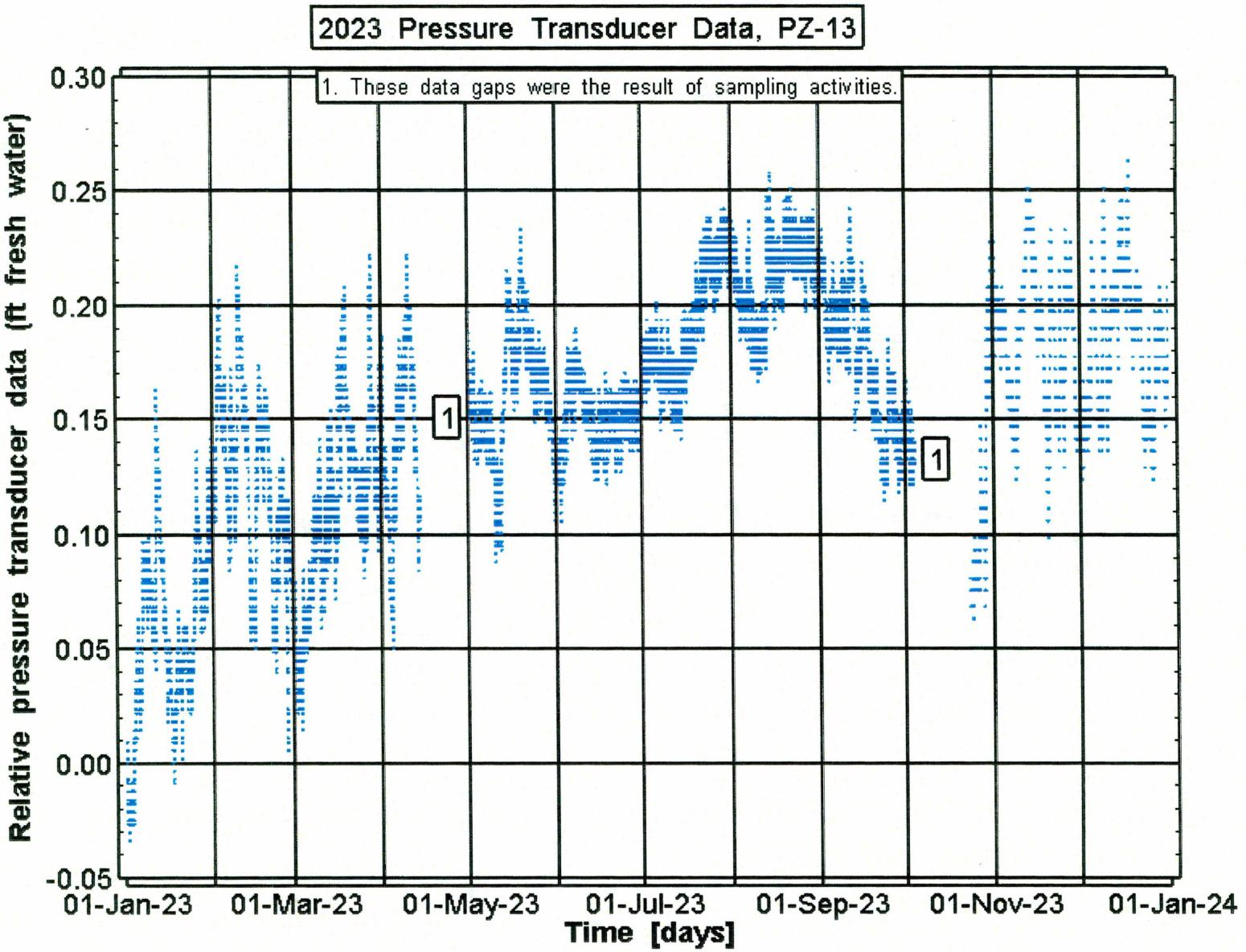

Figure 72. Well PZ-13 experienced a net pressure head of 0.21 ft fresh water in 2023.

Information Only

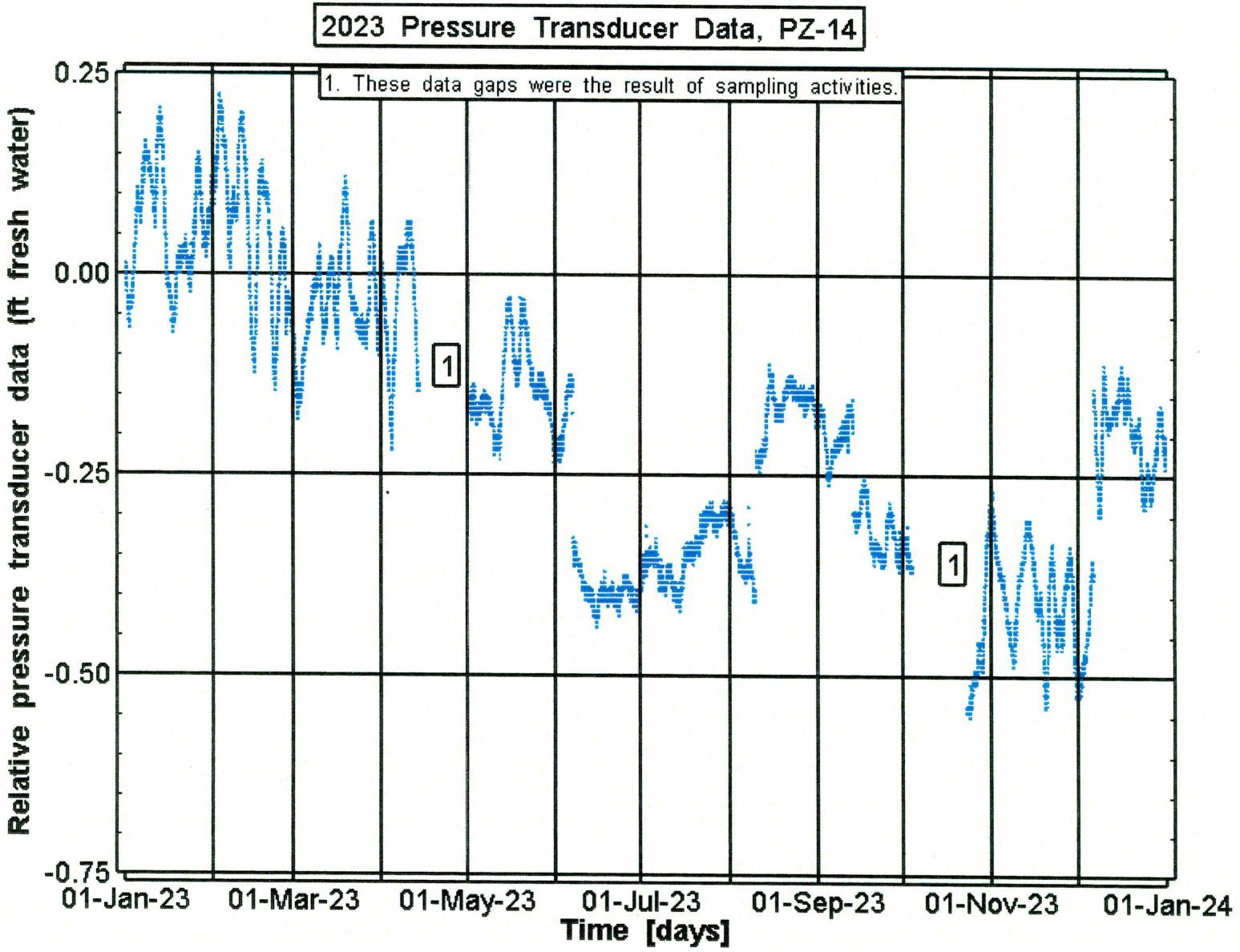

Figure 73. Well PZ-14 experienced a net pressure head of -0.21 ft fresh water in 2023.

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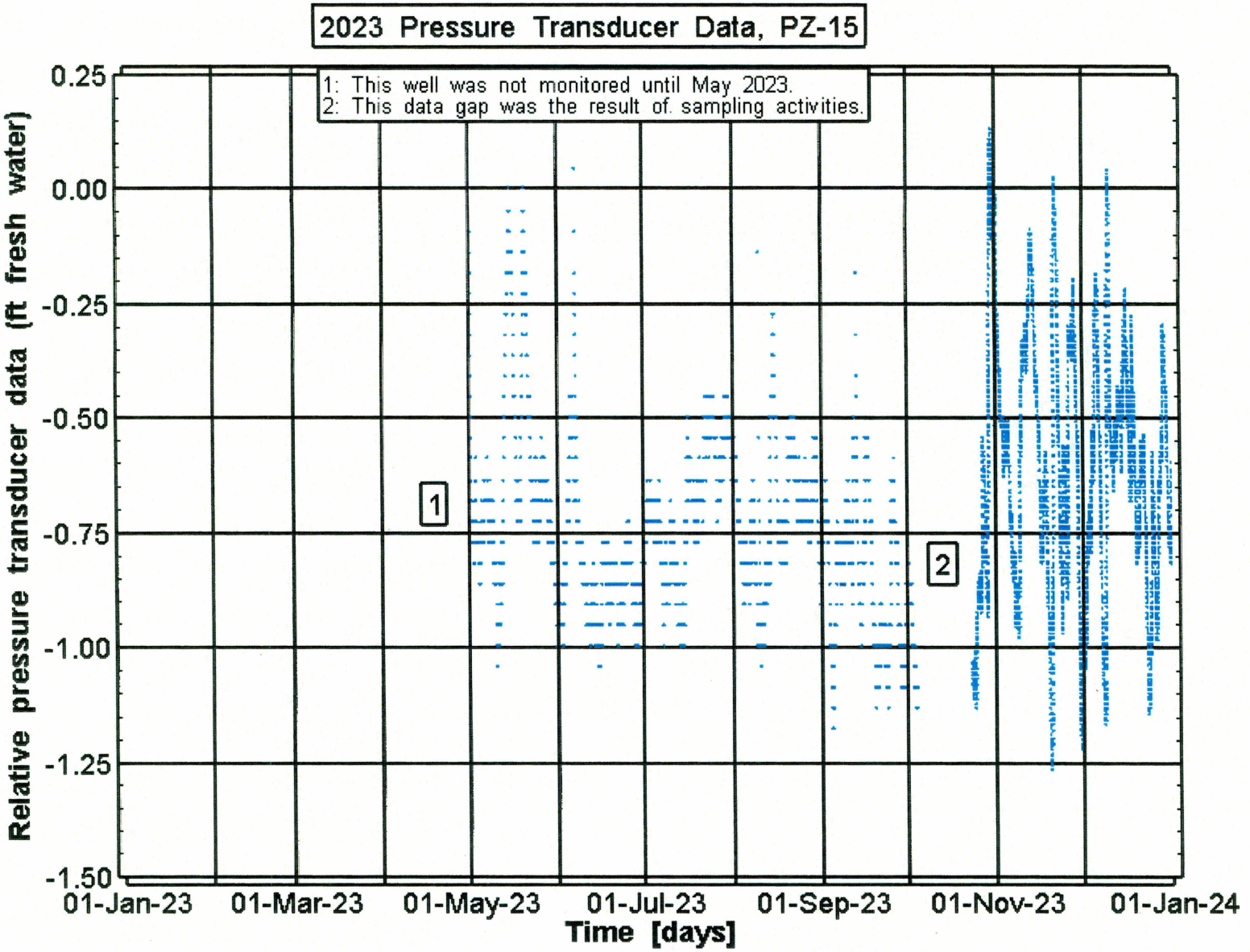

Figure 74. Well PZ-15 experienced a net pressure head of 0.60 ft fresh water in 2023.

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Internal Distribution

MS-1395	D.O. Bowman	Org. 8882
MS-1395	L. Kirkes	Org. 8882
MS-1395	J. Kirkes	Org. 8882
MS-1395	P. Johnson	Org. 8882
MS-1395	O. Reyna	Org. 8882
MS-1395	O. Lofton	Org. 8882
MS-1395	R. Keith	Org. 8880
MS-1395	C. Miller	Org. 8882

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Pre Water Quality Calibration for 05/21/2024 - 05/22/2024 Water Quality Sampling Activities
YSI Pro Plus Sonde S/N: 17D109296
Culebra Monitoring Wells: SNL-1, SNL-16, H-6bR, SNL-14

***** Calibrate: Conductivity		***** Calibrate: pH	
Date	05/21/24 MM/DD/YY	Date	05/21/24 MM/DD/YY
Time	07:22:15 24-hour	Time	07:19:16 24-hour
User ID:	GED	User ID:	GED
Probe ID	PH	Probe ID	PH
User Field #1:	GED	User Field #1:	GED
Method	Sp. Conductance	Buffer Value	7.000000 pH
Cal Value:	100.000000 SPC-mS/cm	Sensor Value:	-3.600000 pH mV
Sensor Value:	98.000000 SPC-mS/cm	Temperature	21.550013 °C
Temperature Ref.	25.000000 °C		
Temperature Comp.	1.910000 %/C	Buffer Value	10.000000 pH
TDS Constant	0.650000	Sensor Value:	-176.699997 pH mV
Temperature	21.600000 °C	Temperature	21.450006 °C
Cal Cell Constant:	5.042918		
Calibrate Status	Calibrated	Slope	58.395294 mV/pH
		Slope	98.774179 % of Ideal pH Value
		Calibrate Status	Calibrated

Post Conductivity Instrument Check:	Post pH Instrument Check:
Date: 05/23/2024	Date: 05/23/2024
Time: 10:16	Time: 10:06
User: GED	User: GED
Standard: 100 mS/cm	Standard: 7.00 pH
Reading: 100.6 mS/cm	Reading: 7.00 pH
Temperature: 21.5°C	Temperature: 21.3°C

Standards Used During The Calibration Check:	
Calibration Procedure:	
SP 12-38, Rev 0: "Calibration of Multi-Parameter Water Quality Measurement Instrumentation"	
pH Soultions:	
ph 7.00, Manufacturer: Ricca Chemical Co., Lot No. 1212838, Expiration Date 12-2024, Batch Date: 05/03/2024	
pH 10.00, Manufacturer: Ricca Chemical Co., Lot No. 1304P74, Expiration Date: 10-2024, Batch Date: 05/03/2024	
Specific Conductance Solutions:	
100.0 mS/cm, Manufacturer: Ricca Chemical Co., Lot No. 2306G54, Expiration Date: 06-2025, Batch Date: 05/03/2024	
Calibrated By: G. DeYonge Date: 05/21/24-05/23/24	Approved By: L. Kirkes -- Field Team Lead Date:

Note: New pH Probe Installed 5/3/2024 |SN: 12103446

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