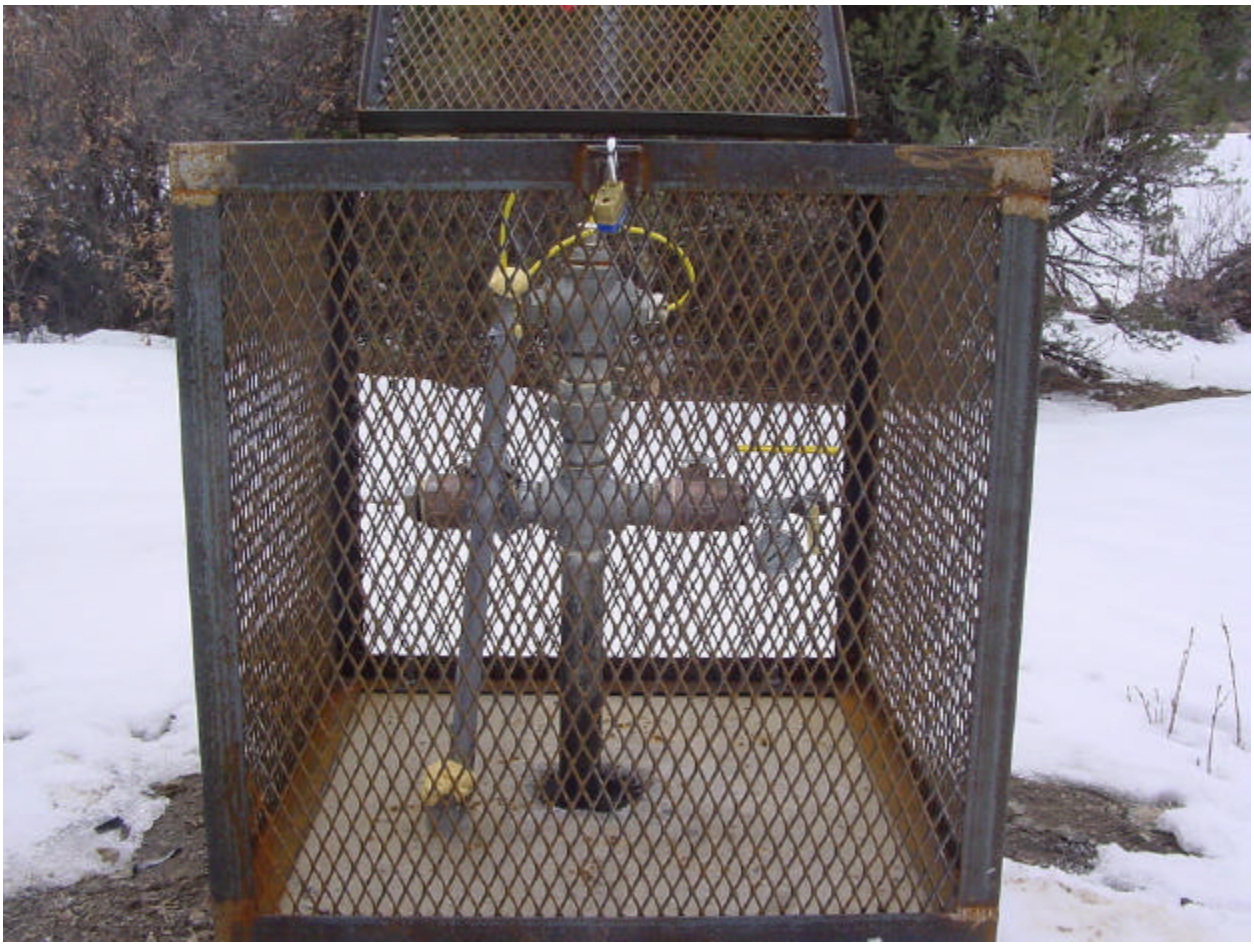
3M Project Monitoring Report
June 2003

`



Prepared For:

Colorado Oil and Gas Conservation Commission

Denver, Colorado

Prepared By:
Applied Hydrology Associates, Inc.
Denver, Colorado

July 2003

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

COVER PHOTOGRAPH

Shows the Basin Creek wellhead, January 18, 2002.

1.0 INTRODUCTION

The 3M Project Monitoring Program in La Plata County, Colorado was initiated by the Colorado Oil and Gas Conservation Commission(COGCC) in January 2001. This report describes the results of ground water and gas pressure monitoring at four monitoring well sites through June 15, 2003. The monitoring work was carried out by staff of the COGCC and Applied Hydrology Associates, Inc. (AHA) on behalf of the COGCC.

Table 1 identifies the monitoring wells, locations, and the depths of completion at the four monitoring well sites. Table 2 lists the depth and type of transducers used in each monitoring well.

2.0 MONITORING ACTIVITIES AND DATA SUMMARY

2.1 ACTIVITIES

Table 3 provides a chronology of monitoring well installation, operation and maintenance activities from January 2001 through June 15, 2003.

Modem automatic answer problems at all four monitoring well sites recurred in February 2003, preventing communication with the dataloggers via remote PC modem. However, power, pressure measurement and datalogger systems continued to operate properly at each site without data loss.

In-Situ technicians in Laramie were consulted regarding the telemetry system. Testing by In-Situ confirmed that the Motorola modem/cellular phone systems used at all of the sites were prone to malfunction when ambient temperatures fall below freezing.

Replacement Blue Bird modems and Motorola cellular phone transceivers were selected, tested and configured for the 3M sites by In-Situ in May 2003, as directed by COGCC. AHA and In-Situ field staff installed these new components at all sites on May 20, 2003. Proper operation of the new communication systems was confirmed by dial-up testing and downloading of In-Situ Hermit 3000 test data by both In-Situ in Laramie and AHA in Denver on May 20, 2003.

A bushing leak on the Beaver Creek Ranch MW 35-6-17-2 wellhead assembly was confirmed on May 20, 2003. On behalf of the COGCC, Raymond Construction was requested by AHA to inspect the wellhead on May 21, 2003 and develop a new wellhead design to safely control the shut-in pressure encountered at this well site, which in excess of 600 psi.

2.2 MONITORING WELL PRESSURE DATA SUMMARY

Well pressure is currently being measured and recorded twice daily (12-hour interval) at all sites. Data recorded for the period of February 2, 2003 to June 15, 2003 were downloaded by AHA via remote PC modem on June 15, 2003. Data for the entire period of record for each monitoring well are plotted on the attached annotated charts. Data analyses by site and monitoring well are summarized below.

2.2.1 BASIN CREEK

MW 34-9-7-1

Figures 1 and 1a both chart the upper and lower pressure transducer data. Figure 1 also shows the calculated water level for the period of recorded, based on the depth of the lower transducer and the difference between upper and lower well pressures. This well has been monitored continuously since November 29, 2001.

Both Figure 1 and the following table continue to indicate a trend of gradually increasing well gas pressure and corresponding declining water level for the period of record. The short-term interruption in this trend is due to venting of the well on January 20, 2003 to replace the upper transducer.

Well and Transducer	Period	Initial Pressure (psia)	Ending Pressure (psia)	Net Pressure Change (psi)	Initial Water Level (fbgs)	Ending Water Level (fbgs)	Net Water Level Change (ft)
MW 34-9-7-1 Upper XD	01/1/02 to 06/15/03	12.6	23.0	+10.4	23.5	65.5	-42.0
Lower XD		249.4	241.7	-7.7			
MW 34-9-7-2 Upper XD	05/24/02 to 06/15/03	33.2	30.9	-2.3	4.7	6.2	-1.5
Lower XD		241.4	238.3	-3.1			

MW 34-9-7-2

The pressure data for well MW-34-9-7-2 are plotted on Figures 2 and 2a. Figure 2 also shows the well water level data for the same period of record. This well has been monitored continuously since May 24, 2002.

Figure 2 and the table above indicate a trend of gradually declining well gas pressure and shallow water level for the period of record. Figure 2a shows that a gradual reversal in the gas pressure trend occurred in mid-March 2003, resulting in a small increase of 0.34 psi in well gas pressure, from a low of 30.53 to 30.87 psia, for the 3-month period from March 21, 2003 to June 15, 2003.

2.2.2 SOUTH FORK TEXAS CREEK

Both monitoring wells have been monitored continuously since November 29, 2001, except for the period between December 4, 2002 and January 20, 2003 when there was a battery power system failure.

MW 35-7-8-1

Data for MW 35-7-8-1 are summarized on Figures 3 and 3a and in the table below. Upper transducer data recorded since January 1, 2002 indicate a trend of relatively stable well gas pressure range between 13.1 and 13.4 psia. As described below, this gas pressure regime is about seven times lower than the gas pressure in MW 35-7-8-2.

The lower transducer and calculated water level data indicate a rising water level amounting to a total rise of about 10 ft, from 88 to 78 fbgs, for the period of record, without a similar change in the well gas pressure. The rate of water rise for the period of record can be divided into three parts. A gradual rise of 2.7 ft, from about 88.4 to 85.7 fbgs, occurred during the 10-month period from December 2001 thru October 2002. The apparent rate of water level rise increased slightly in November 2002 and again in mid-March 2003. During the 6.5-month period between November 1, 2002 and June 15, 2003, the water level rose about 8 ft, from 86 to 78 fbgs, as compared to a rise of almost 3 ft during the first 11 months of monitoring.

Well and Transducers	Period	Initial Pressure (psia)	Ending Pressure (psia)	Net Pressure Change (psi)	Initial Water Level (fbgs)	Ending Water Level (fbgs)	Net Water Level Change (ft)
MW 35-7-8-1 Upper XD	1/1/02 to 06/15/03	13.6	13.2	-0.4	88.4	77.9	+10.5
Lower XD		144.4	148.5	+4.1			
MW 35-7-8-2 Upper XD	1/15/02 to 06/15/03	91.3	96.0	+4.7	Water is either > 225 fbgs, if any, or water is consistently 1-2 feet above the lower transducer		
Lower XD		91.9	96.8	+4.9			

MW 35-7-8-2

Figure 4 charts the pressure data for MW 35-7-8-2, which exhibits an entirely different pressure regime than the deeper monitoring well, MW 35-7-8-1. Figure 4 and the table above indicate that both lower and upper transducers are sensing essentially the same well gas pressure, currently at about 96 psia. The consistently small pressure differential between the two transducers may be due to slight differences in instrument calibration, or there is a consistent one to two feet of water above the lower transducer. If the apparent pressure differential is due to calibration, then the water level is deeper than 225 fbgs, which is the depth of the lower transducer.

The summary table above shows a net increase of 4.7 to 4.9 psi in gas pressure for the period of record. However, during the 13-month period from January 2002 to February 2003, there was a gradual, 9 psi decline in pressure, from 92 psia on January 15, 2002 to 83 psia on February 1, 2003 (Figure 4). This apparent trend reversed upward in March 2003. Between April 1, 2003 and June 15, 2003, the well gas pressure increased about 6 psi, from 90 psia to 96 psia.

Figure 4 also shows several downward spikes in the recorded gas pressure since January 2003. These occurrences may indicate that the transducer cable wellhead seals are subject to leaking under certain temperature and pressure conditions. The seals may contract just enough at sufficiently low temperatures to leak at the gas pressures exhibited by this well, and then re-expand and reseal once the temperature rises. A similar problem in December 2001 was solved by tightening the cable strain relief fittings. In July 2003, the well be vented and the fittings re-tightened to see if the problem recurs during cold spells this fall and next winter.

2.2.3 BEAVER CREEK RANCH

MW 35-6-17-1

Monitoring data for MW 35-6-27-1 are charted on Figures 5 and 5a and summarized in the table below. This well has been monitored almost continuously since May 21, 2002. There is no data for the periods December 1, 2002 to December 13, 2002 and December 19, 2002 to January 7, 2003 due to power system failures. As described below, the well gas and water pressure regime for this well is entirely different than the regime exhibited by well MW 35-6-17-2.

The data indicate a trend of gradual decline in well gas pressure from 15 to 13 psia for the 8-month period of August 2002 to March 2003, while the water level was relatively stable between 194 and 195 fbgs. There was an apparent trend reversal in the spring of 2003. During the 3-month period between March 15 and June 15, 2003, the well gas pressure increased about 2 psi, from 13 to 15 psia (average) on June 15. For the same period, the water level declined about 7 feet, from 196 to 203 fbgs.

Figure 5a and the table below include two different pressure values for June 15, 2003, which were recorded 12 hours apart, about 3am and 3 pm. This apparent diurnal pressure fluctuation of about 1 psi, recorded by both transducers at 12-hour intervals, has been occurring consistently since May 11, 2003. The reason for these fluctuations is not certain. They are not associated with barometric fluctuations because the recorded barometric measurements indicate daily barometric fluctuations of only 0.05 psi for the same time period. Figure 5a shows a period of similar fluctuations during the summer of 2002, which may indicate a seasonal phenomenon of daily fluctuations in well gas temperature at this particular location.

Well and Transducers	Period	Initial Pressure (psia)	Ending Pressure (psia)	Net Pressure Change (psi)	Initial Water Level (fbgs)	Ending Water Level (fbgs)	Net Water Level Change (ft)
MW 35-6-17-1 Upper XD	08/01/02 to 06/15/03	15.4	14.2 (am) 15.5 (pm)	-1.0	194.3	203.4	-9.1
Lower XD		609.6	604.4 (am) 605.7 (pm)	-4.6			
MW 35-6-17-2 Upper XD	06/15/02 to 06/15/03	614	595	-19	1,377.7	1,379.0	-1.3
Lower XD		632	613	-19			

MW 35-6-17-2

Well gas pressure and water level data for MW 35-6-17-2 are plotted on Figure 6 and summarized in the above table. This well has been monitored since December 3, 2001. No data were collected between April 8, 2002 and May 20 2002 due to a damaged lower transducer cable. There are no data for the periods December 1 to December 13, 2002 and December 19, 2002 to January 7, 2003 due to power system failures.

Well gas pressure is in excess of 600 psia, which is notably higher than the other 3M monitoring wells. The wellhead has not been completely shut in since February 2002 because the wellhead has been subject to a variety of wellhead fitting leaks. The site inspection on May 20, 2003 confirmed that one of the wellhead bushings continues to leak. Thus, the pressure data plotted on Figure 6 and summarized in the table above are only considered to be lower bounds. True pressures and trends will not be recognized until a complete shut in is accomplished.

The COGCC has authorized a redesign of the wellhead assembly to conform to high pressure gas well specifications, such as replacing threaded fittings with flanged or welded fittings. The new assembly is expected to be installed in July upon the approval of the COGCC.

2.2.4 SHAMROCK MINES

Well MW 35-6-13-1 monitoring data are plotted on Figures 7 and 7a and summarized in the table below for the entire period of record. This well has been monitored continuously since May 22, 2002.

The data indicate generally stable gas pressure and water level conditions. The well gas pressure fluctuates within a range of only 1 psi, between 11 and 12 psia for the period of record. The water level fluctuations exhibit a similar trend, varying within a range of one foot, between 39 and 40 fbgs.

Well and Transducers	Period	Initial Pressure (psia)	Ending Pressure (psia)	Net Pressure Change (psi)	Initial Water Level (fbgs)	Ending Water Level (fbgs)	Net Water Level Change (ft)
MW 35-6-13-1 Upper XD	5/22/02 to 06/15/03	211.5	211.4	-0.1	39.7	39.5	+0.2
Lower XD		12.1	11.8	-0.3			

3.0 FUTURE WORK

Routine work will continue to include periodic checks of monitoring systems and data downloads via telemetry. Beaver Creek Ranch well MW 35-6-17-1 will be inspected in July 2003 to assess possible conditions that may explain the apparent diurnal pressure fluctuation pattern. A new high pressure wellhead assembly for Beaver Creek Ranch well MW 35-6-17-2 is being designed and will be installed in July 2003. In addition, South Fork of Texas Creek well MW 35-7-8-2 will be inspected and cable seals tightened. No other work is planned.

Table 1
Monitoring Well Completion Summary

Location	Well ID	Construction Completion Date	Drilled Depth (fbgs)	Cored Intervals (fbgs)	Casing Depth (fbgs)	Casing Stickup (fags)	Well Casing Material	Perforated Interval(s) - Coal seam(s) (fbgs)	Wellhead Design (Figure Number)	Log Type	Logged Depth (fbgs)	Log Date
Basin Creek	MW 34-9-7-1	01/28/01	820		802	1	Schedule 40 galvanized steel pipe	578 - 609	2-1	gamma ray, bulk density, caliper, resistance	819	01/27/01
										64" normal resistivity, 16" normal resistivity, sp	822	01/27/01
										temperature, differential temperature	822	01/27/01
										gamma ray, casing collar locator	763	09/27/01
	MW 34-9-7-2	04/25/02	570	359 - 374 * 498 - 513 578 - 593	561	1.5	Oilfield steel tubing	496 - 526	2-2	gamma ray, casing collar locator	550	05/02/02
South Fork Texas Creek	MW 35-7-8-1	09/20/01	486		463	1.6	Schedule 40 galvanized steel pipe	403 - 416	2-1	gamma ray, bulk density, caliper, resistance	485	09/19/01
										64" normal resistivity, 16" normal resistivity, sp	485	09/19/01
										temperature, differential temperature	485	09/19/01
										gamma ray, casing collar locator	462	09/27/01
	MW 35-7-8-2	09/21/01	420	410 - 425	425	1.6	Schedule 40 galvanized steel pipe	235 - 241 254 - 258 264 - 274	2-1	gamma ray, casing collar locator	420	09/27/01
Beaver Creek Ranch	MW 35-6-17-1	04/04/02	1,645	1,457 - 1,467 1,564 - 1,572	1,631	1.5	Oilfield steel tubing	1,572 - 1,576 1,582 - 1,584	2-4	64" normal resistivity, 16" normal resistivity, sp	1,645	04/03/02
										temperature, differential temperature	1,640	04/03/02
										gamma ray, bulk density, caliper, resistance	1,643	04/03/02
										gamma ray, casing collar locator	1,618	05/02/02
	MW 35-6-17-2	10/04/01	1,550		1,500	2	Schedule 40 galvanized steel pipe	1,437 - 1,449 1,458 - 1,472	2-3	gamma ray, neutron	1,499	10/10/01
										temperature, 4Pi density	1,493	11/14/01
										signal amplitude, travel time \ D T, VDL	1,484	11/14/01
										gamma ray, casing collar locator	1,483	11/27/01
Shamrock Mines	MW 35-6-13-1	05/07/02	627		606	1.5	Oilfield steel tubing	507 - 511 517 - 533 539 - 562	2-2	gamma ray, bulk density, caliper, resistance	626	05/06/02
										64" normal resistivity, 16" normal resistivity, sp	626	05/06/02
										gamma ray, casing collar locator	626	05/10/02

* Cored interval from initial well drilled in February 2001 that was subsequently plugged and abandoned due to bad cement job.

Table 2
Monitoring Well Transducers

Location	Well ID	Upper Transducer		Lower Transducer	
		Depth (fbgs)	Type and Rating	Depth (fbgs)	Type and Rating
Basin Creek	**MW 34-9-7-1**	0.5	PXD-261-30 psig	570	PXD-461-500 psia
	MW 34-9-7-2	5	PXD-461-500 psia	485	PXD-461-500 psia
South Fork Texas Creek	**MW 35-7-8-1**	5	PXD-261-30 psig	390	PXD-461-500 psia
	MW 35-7-8-2	4	PXD-461-500 psia	225	PXD-461-500 psia
Beaver Creek Ranch	**MW 35-6-17-1**	5	PXD-461-500 psia	1,565	PXD-461-1,000 psia
	MW 35-6-17-2	5	PXD-461-1,000 psia	1,420	PXD-461-1,000 psia
Shamrock Mines	**MW 35-6-13-1**	5	PXD-461-500 psia	500	PXD-461-1,000 psia

Table 3
Monitoring Well Chronology

Location	Well	2001				2002								
		January	September	November	December	January	February	March	April	May	June	July	November	December
Basin Creek	MW 34-9-7-1	Jan. 24-28: Drill/install well	Sept. 27: Perforate well	Nov. 28: Set up telemetry unit; Replace bad xds cables	Surveyed	Jan. 18:Tighten wellhead fittings; Rewire telemetry system	Install new batteries in telemetry unit with In-Situ							Lost telemetry communitcation with Hermit due to faulty modem or cellular phone
	MW 34-9-7-2								April 24-25: Drill & install well	May 5: Perforate well May 9: Fish out cable: May 22: Install xds	Surveyed			
South Fork Texas Creek	MW 35-7-8-1		Sept. 17-20: Drill/install well; Sept. 27: Perforate well	Nov. 29: Set up telemetry unit; Replace bad xds cables	Surveyed	Jan. 18: Tighten wellhead fittings; Rewire telemetry unit	Install new batteries in telemetry unit with In-Situ			May 21: Ck for leaks				Dec. 4: Data lost through end of year due to Hermit internal battery failure; Lost telemetry communitcation with Hermit
	MW 35-7-8-2		Sept. 20-21: Drill/install well Sept. 27: Perforate well	Nov. 29: Set up telemetry unit; Replace bad xds cables	Surveyed	Jan. 18: Tighten wellhead fittings				May 21: Ck for leaks				
Beaver Creek Ranch	MW 35-6-17-1						Install new batteries in telemetry unit with In-Situ	Mar. 5-Apr 4: Drill & install well		May 2: Perforate well; May 20-21: Install xds	Surveyed	July 10: Replace lower xd cable with unvented cable		Dec 13: Insp by Raymond Const.- no wellhead gas leak; solar pwr @14.8 v; Hermit internal batt pack @ 0% capacity; modem pwr off (auto pwr-up disabled or modem memory prob); Dec. 19: Data lost through end of year due to Hermit internal battery failure; Lost telmetry communitcation with Hermit
	MW 35-6-17-2		Sept. 22-Oct. 4: Drill/install well	Nov. 26: Perforate well Nov. 27: Set up telemetry unit	Surveyed	Jan. 17 - Install new xds cables with swage fittings; Rewire telemetry unit			Apr 8: Pull lower xd cable; no data Apr 8 to May 20	May 21: Install unvented, heavy duty xd cable		Gas leak @ top bushing; July 10: Vent well & ck bushing galls; July 11: Reseal well	Nov. 14: Vent well; Replace valve and reseal all connections	
Shamrock Mines	MW 35-6-13-1									May 3-7: Drill/install well; May 10: Perforate well; May 20, 21: Install pad, telemetry & datalogger systems, & xds	Surveyed			Lost telmetry communitcation with Hermit

Table 3
Monitoring Well Chronology

Location	Well	2003									
		January	Feb - May	May	June	July	August	September	October	November	December
Basin Creek	MW 34-9-7-1	Jan 20: New well 34-9-7-1 upper transducer (30 psig, sn 7201); move Hermit ext pwr + wire to + pole on batt charger regul.; replace Hermit bkup lith. batt; re-flash modem memory; enable modem auto pwr-up; start new Hermit test	Telemetry system malfunction; datalogger & power OK	May 20: Replace modem and cell phone; power and datalogger systems OK							
	MW 34-9-7-2										
South Fork Texas Creek	MW 35-7-8-1	Jan 20: Move Hermit ext pwr + wire to + pole on batt charger regul.; replace Hermit bkup lith. batt; re-flash modem memory; enable modem auto pwr-up; start new Hermit test	Telemetry system malfunction; datalogger & power OK	May 20: Replace modem and cell phone; power and datalogger systems OK							
	MW 35-7-8-2										
Beaver Creek Ranch	MW 35-6-17-1	Jan 7 & Jan 21: No well-head gas leak detected @ MW35-6-17-2; Jan 21: Move Hermit,modem & solar panel pwr common wires to charger regul. common poles; replace Hermit bkup lith. batt; re-flash modem memory; enable modem auto pwr-up; start new Hermit test	Telemetry system malfunction; datalogger & power OK	May 20: Replace modem and cell phone; power and datalogger systems OK							
	MW 35-6-17-2		MW 35-6-17-2: Bushing leak	May 20: Location of wellhead threaded bushing leak identified; wellhead assembly to be redesigned							
Shamrock Mines	MW 35-6-13-1	Jan 21: Move solar pwr common wire to common pole on charger regul.; replace Hermit bkup lith. batt; re-flash modem memory; enable modem auto pwr-up; start new Hermit test	Telemetry system malfunction; datalogger & power OK	May 20: Replace modem and cell phone; power and datalogger systems OK							

Figure 1.
Pressure Transducer Data Basin Creek MW-34-9-7-1

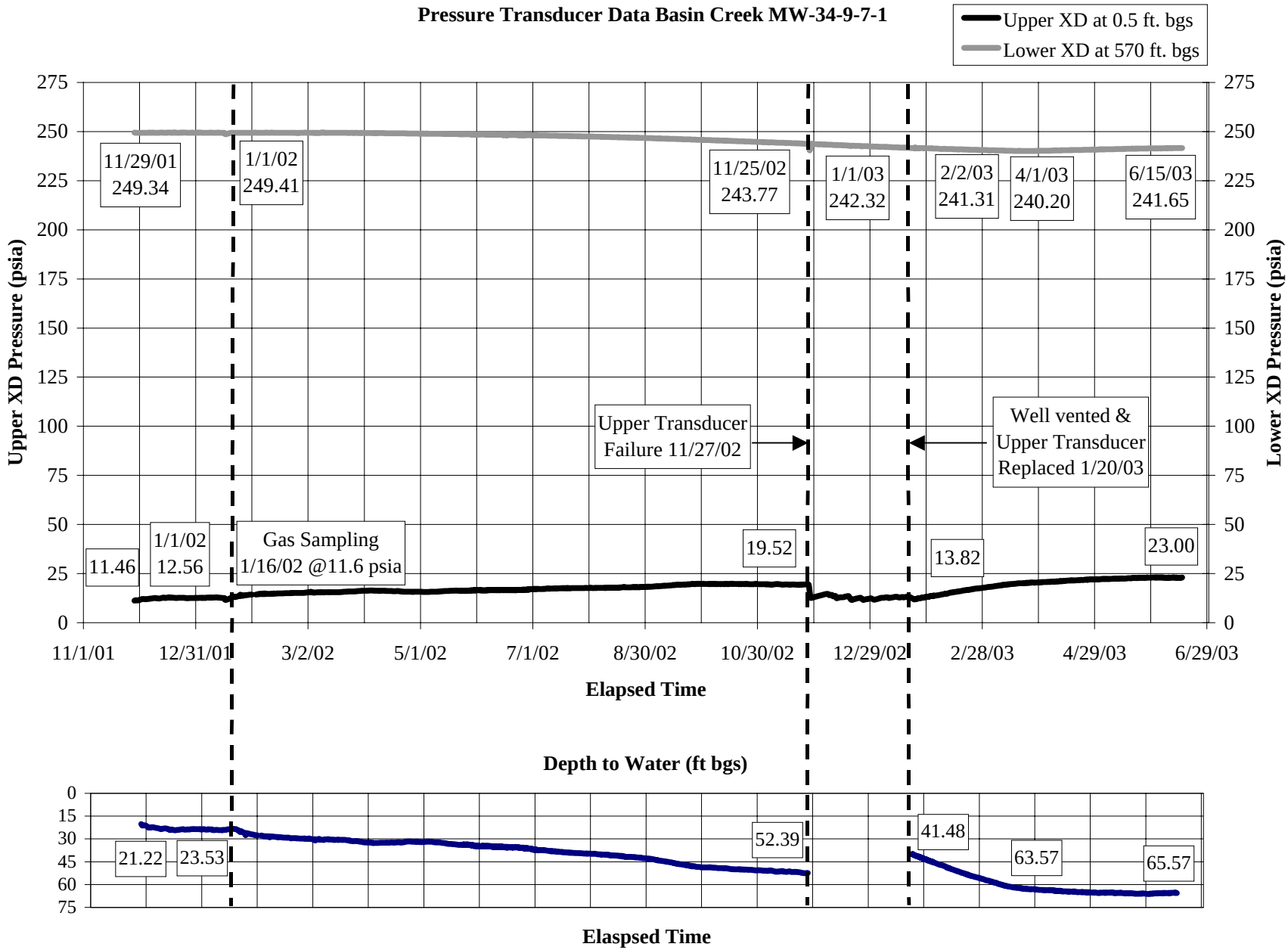


Figure 1a.
Pressure Transducer Data for Basin Creek MW-34-9-7-1

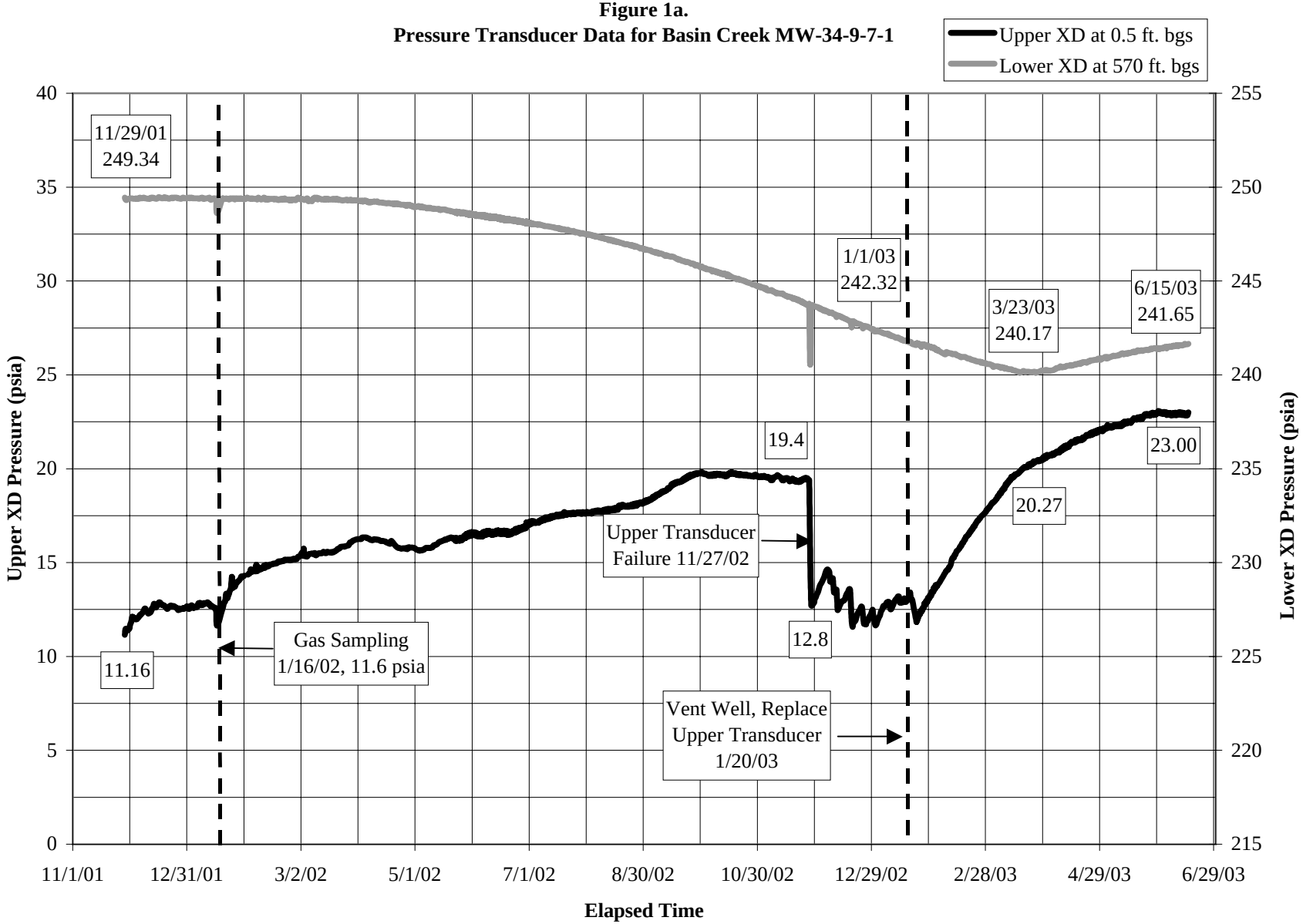
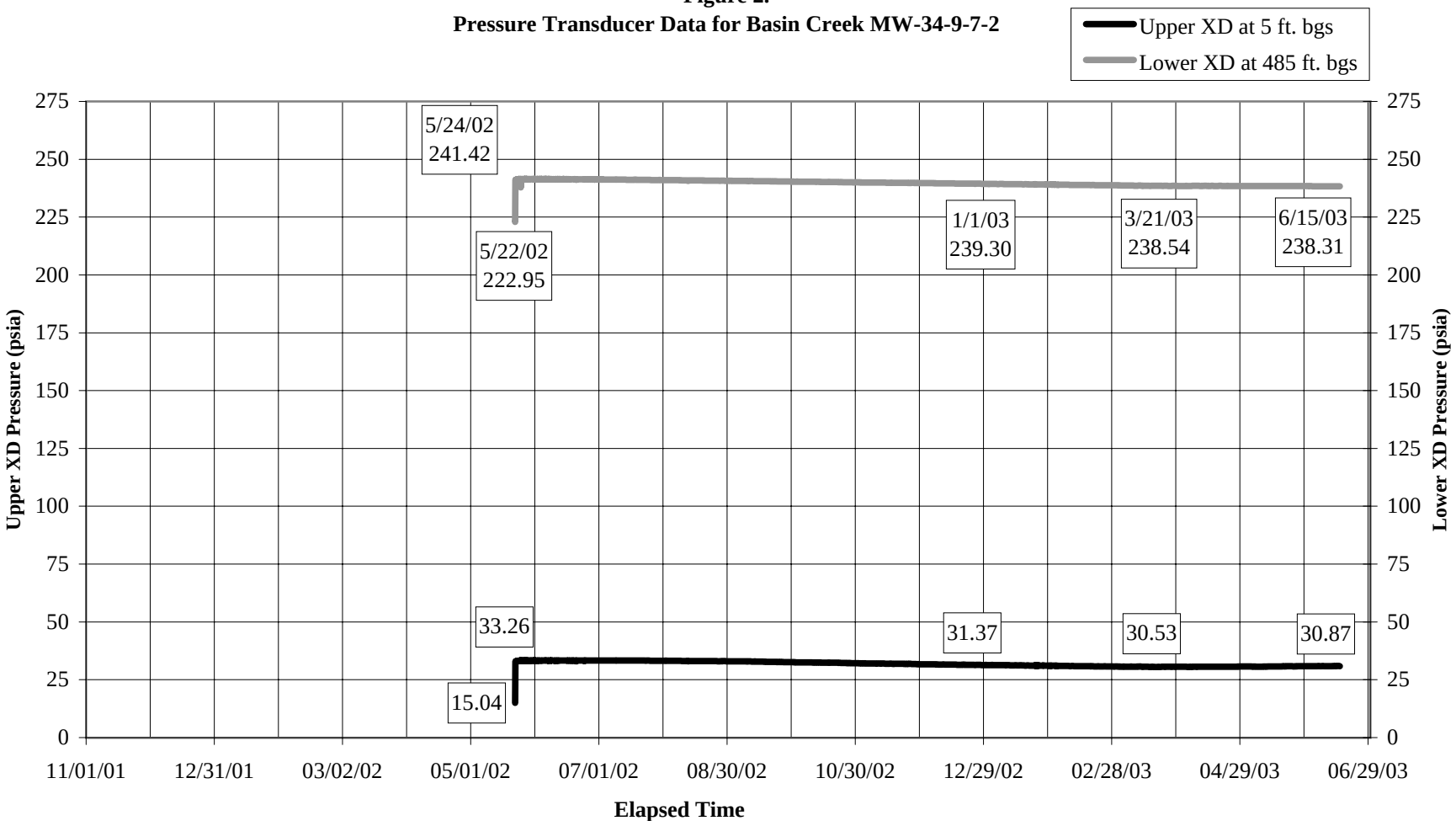


Figure 2.
Pressure Transducer Data for Basin Creek MW-34-9-7-2



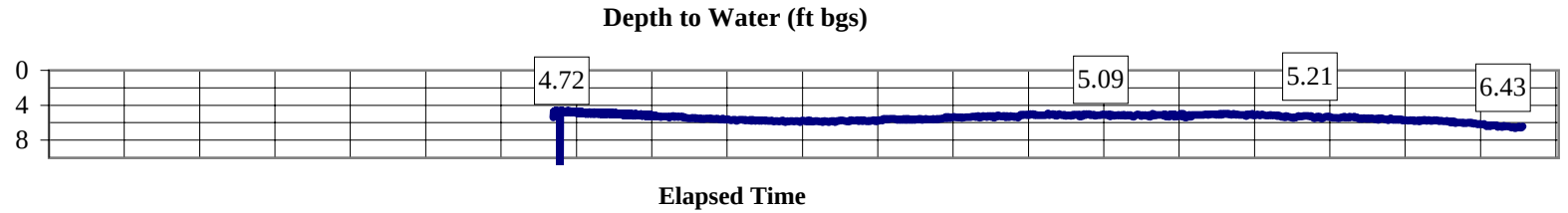


Figure 2a.
Pressure Transducer Data for Basin Creek MW-34-9-7-2

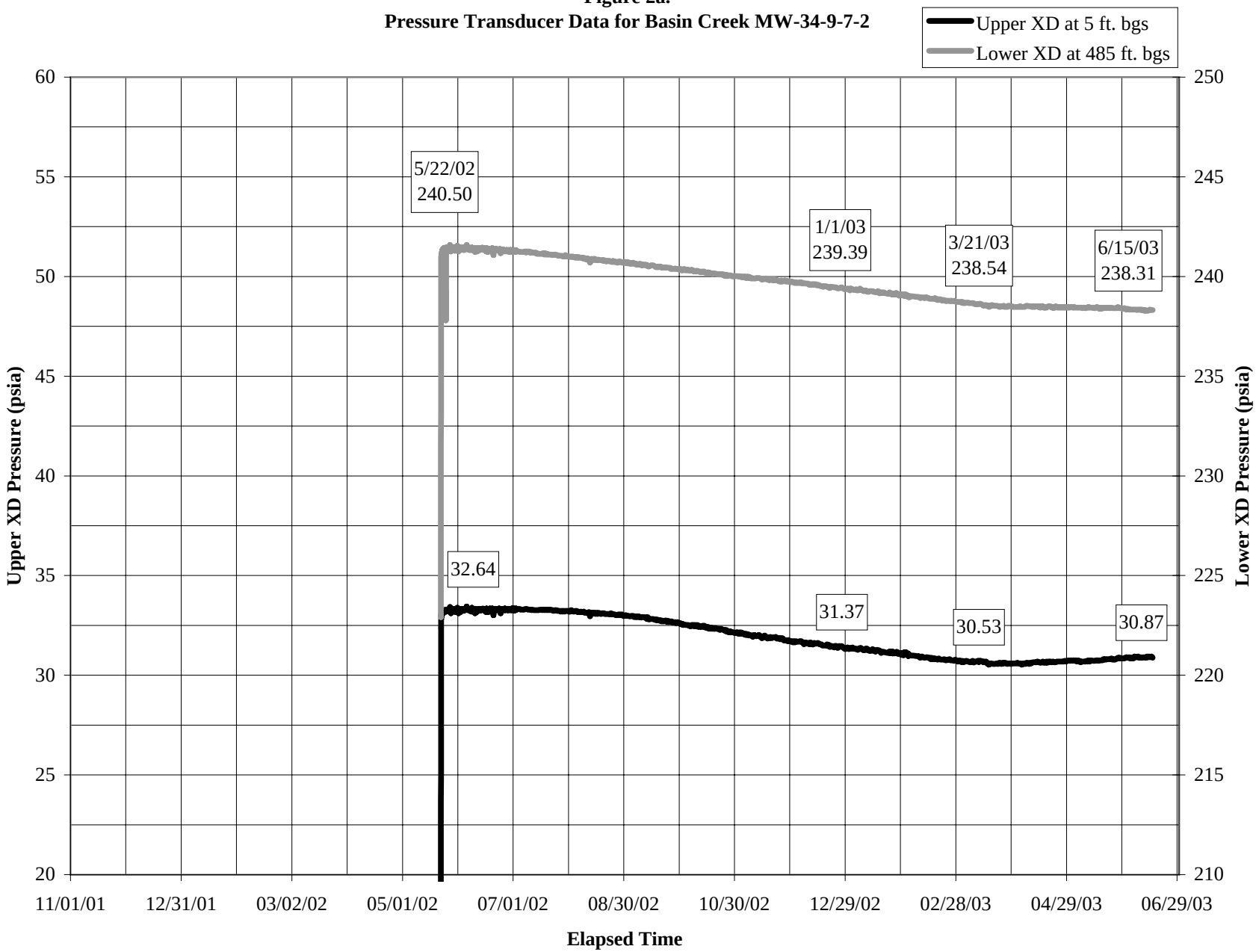


Figure 3.
Pressure Transducer Data for South Fork of Texas Creek MW-35-7-8-1

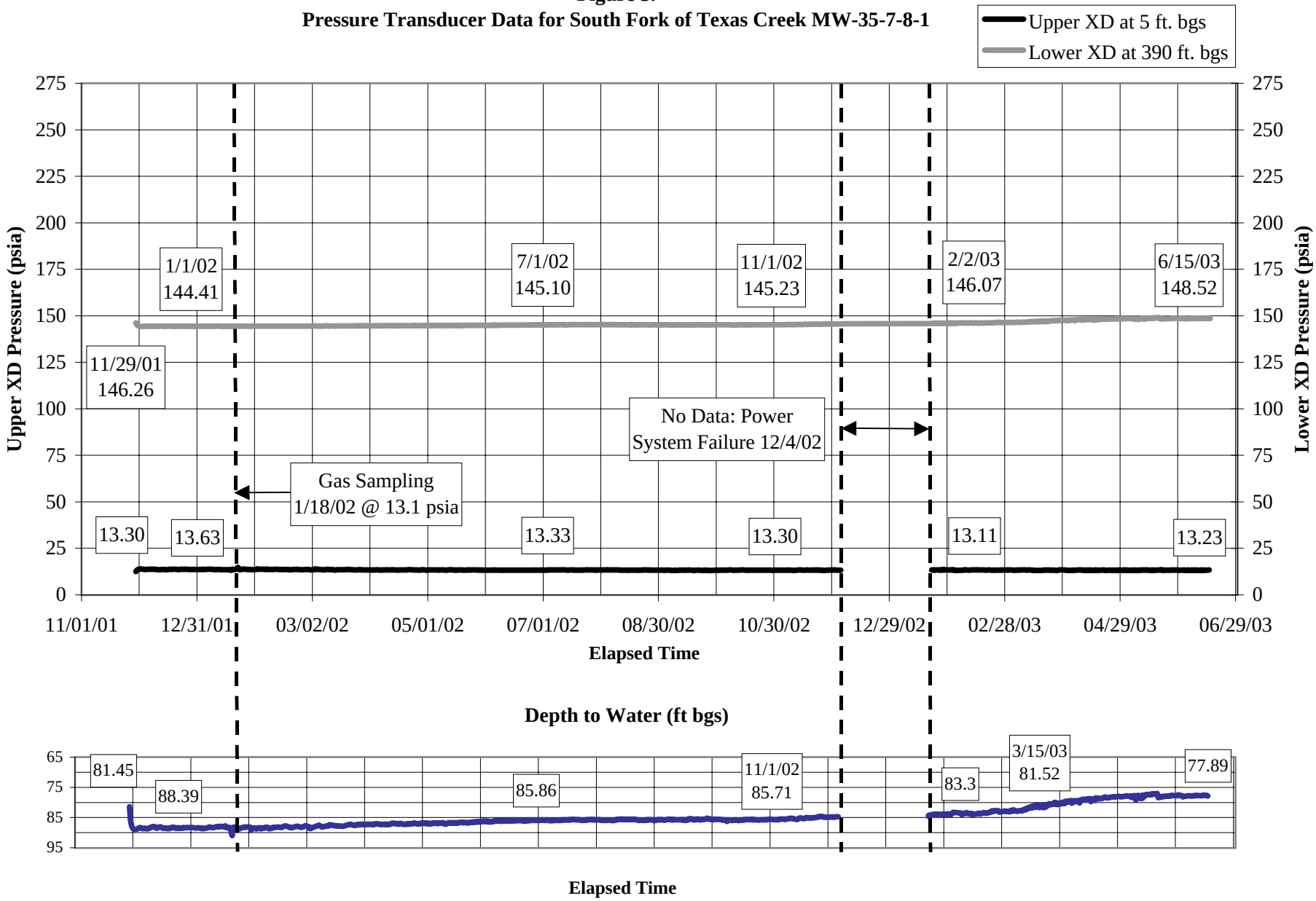


Figure 3a.
Pressure Transducer Data for South Fork of Texas Creek MW-35-7-8-1

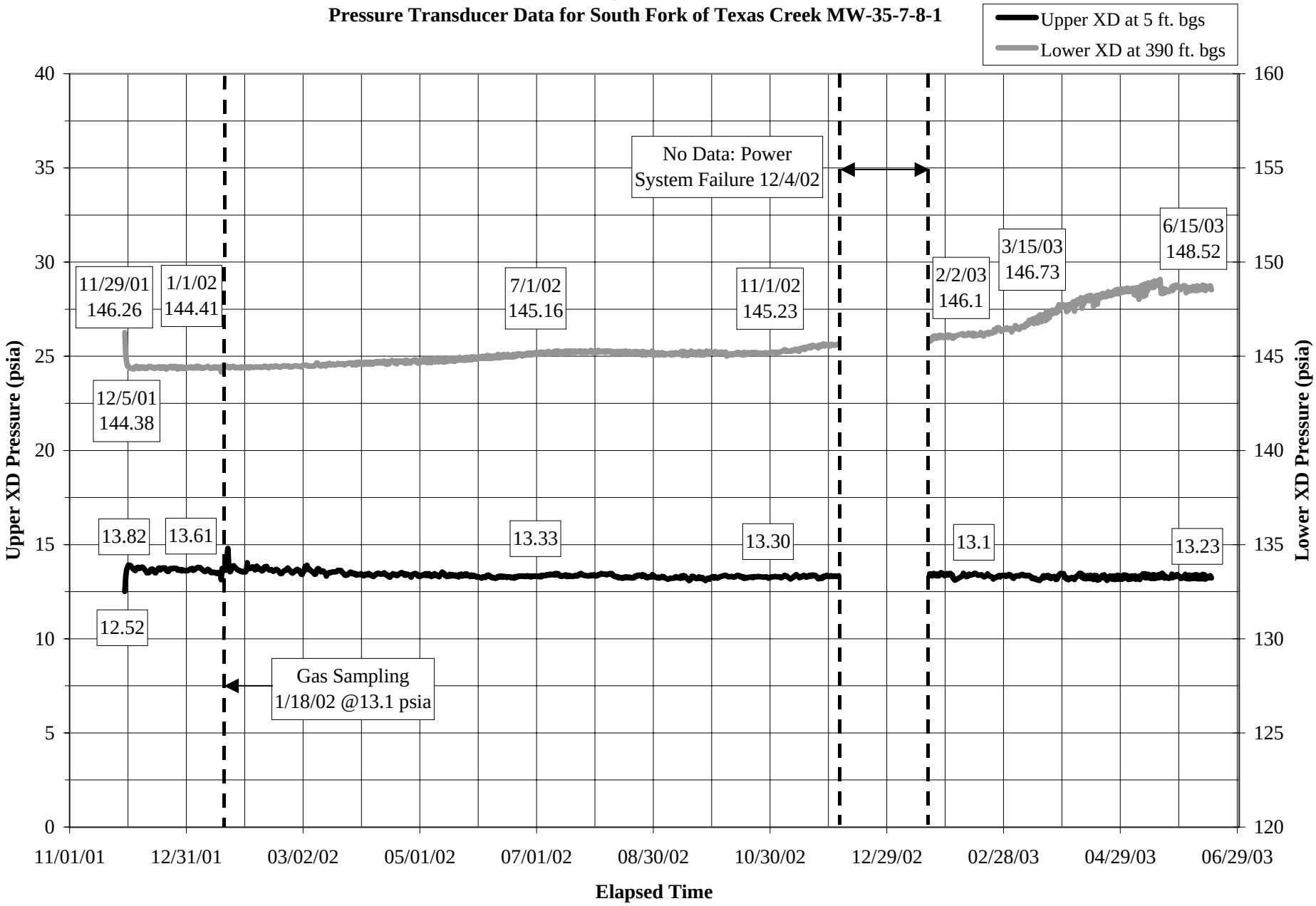


Figure 4.
Pressure Transducer Data for South Fork Texas Creek Well MW-35-7-8-2

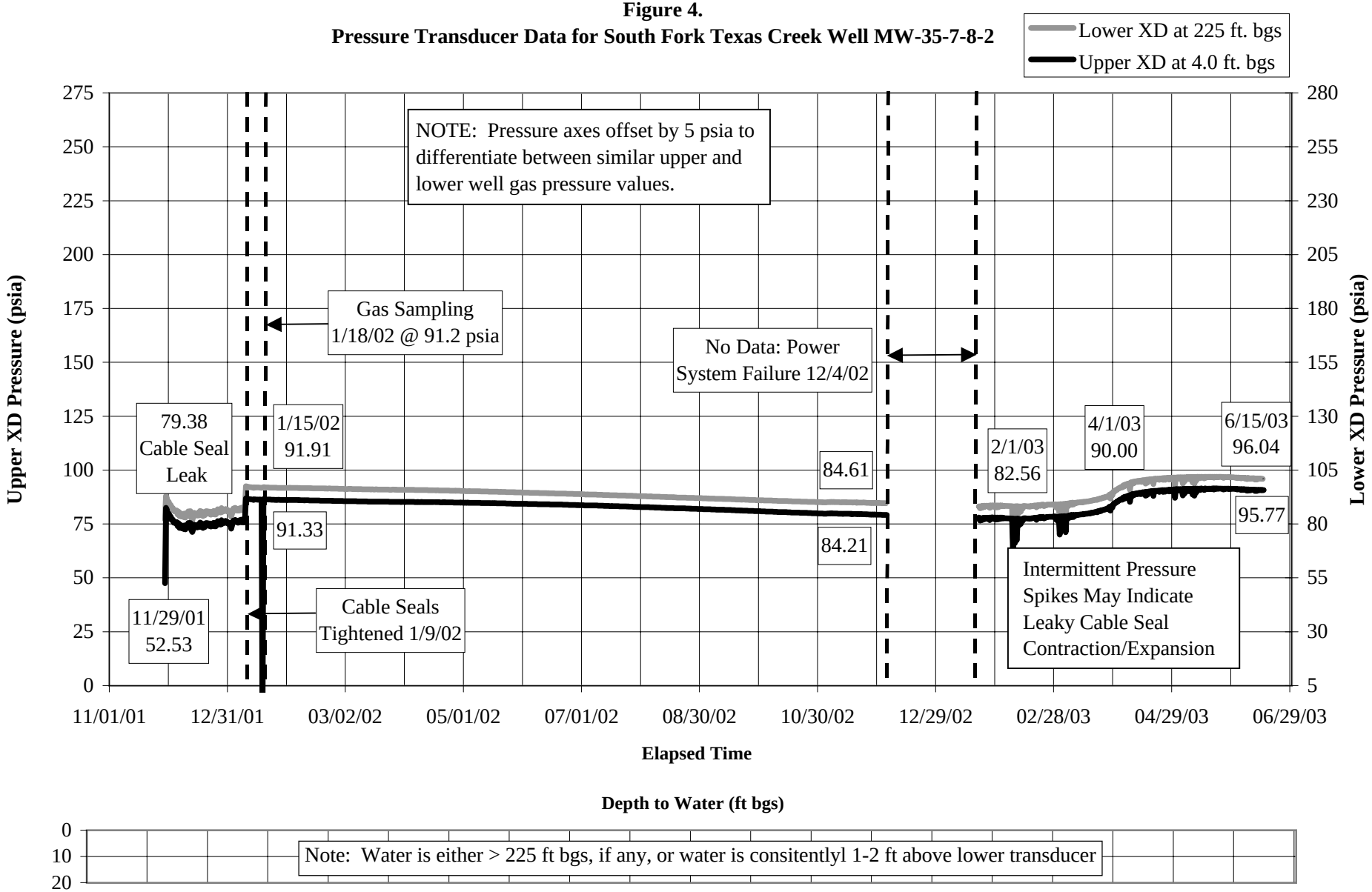


Figure 5.
Pressure Transducer Data for Beaver Creek Ranch MW-35-6-17-1

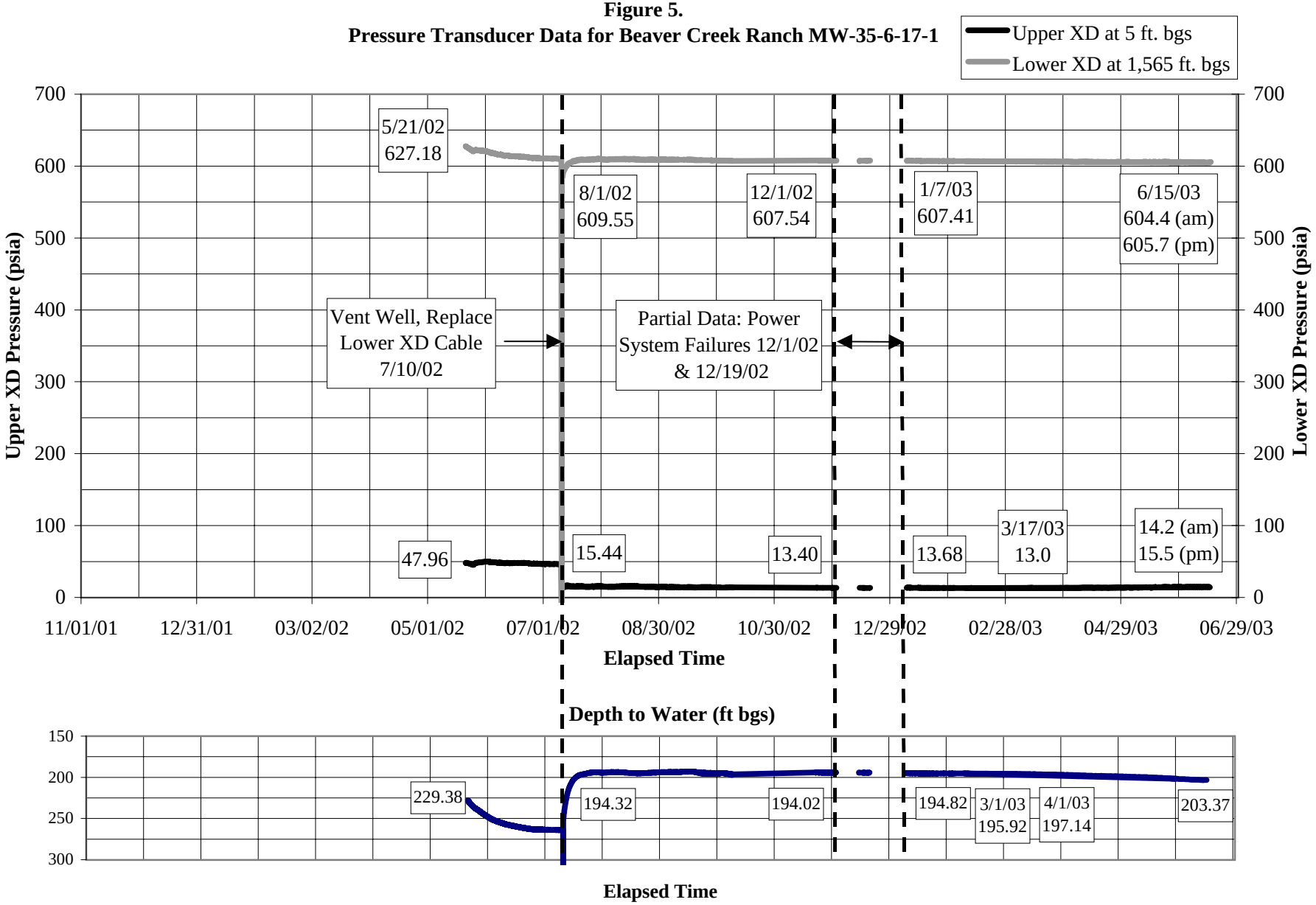


Figure 5a.
Pressure Transducer Data for Beaver Creek Ranch MW-35-6-17-1

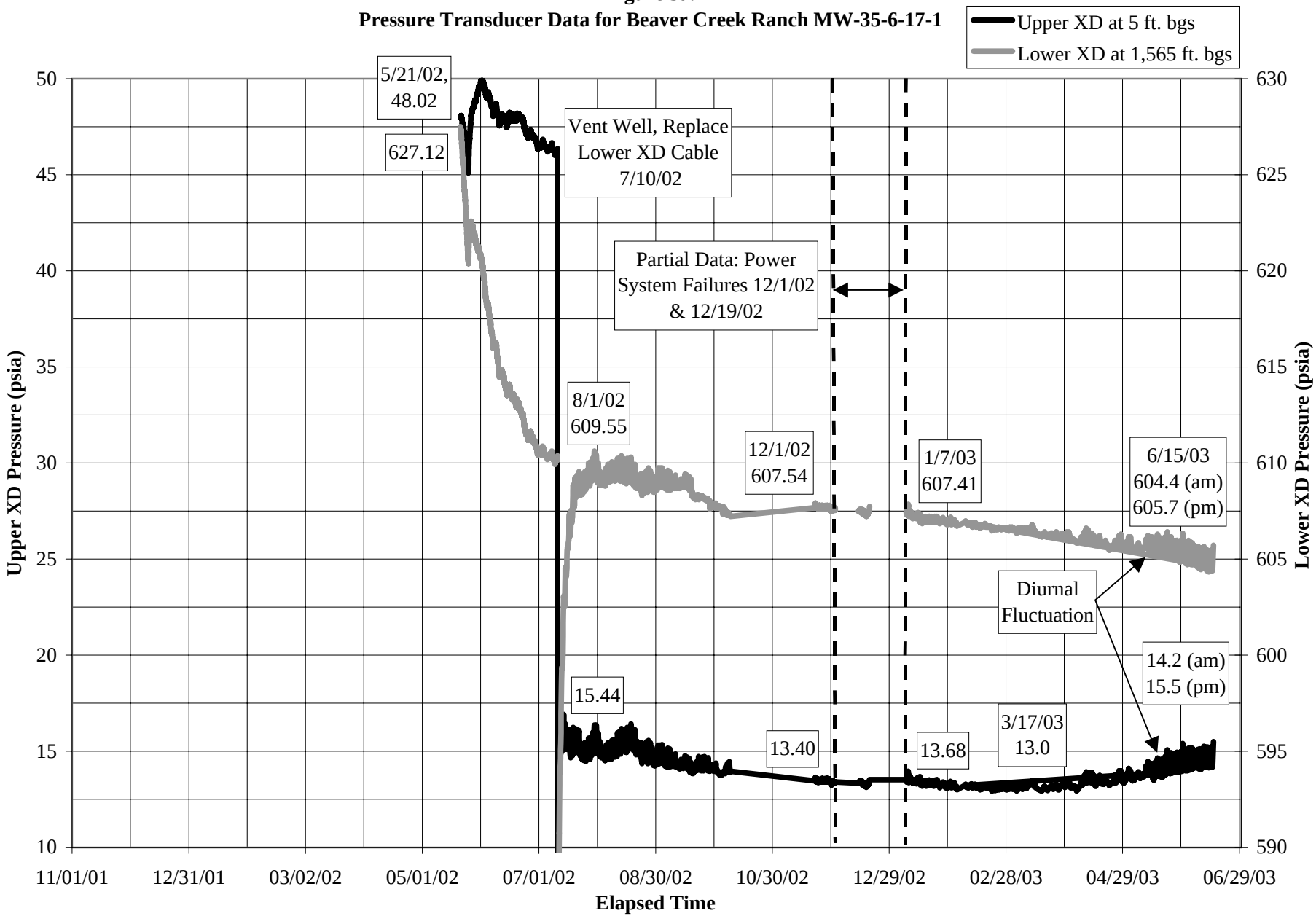


Figure 6.
Pressure Transducer Data for Beaver Creek Ranch MW-35-6-17-2

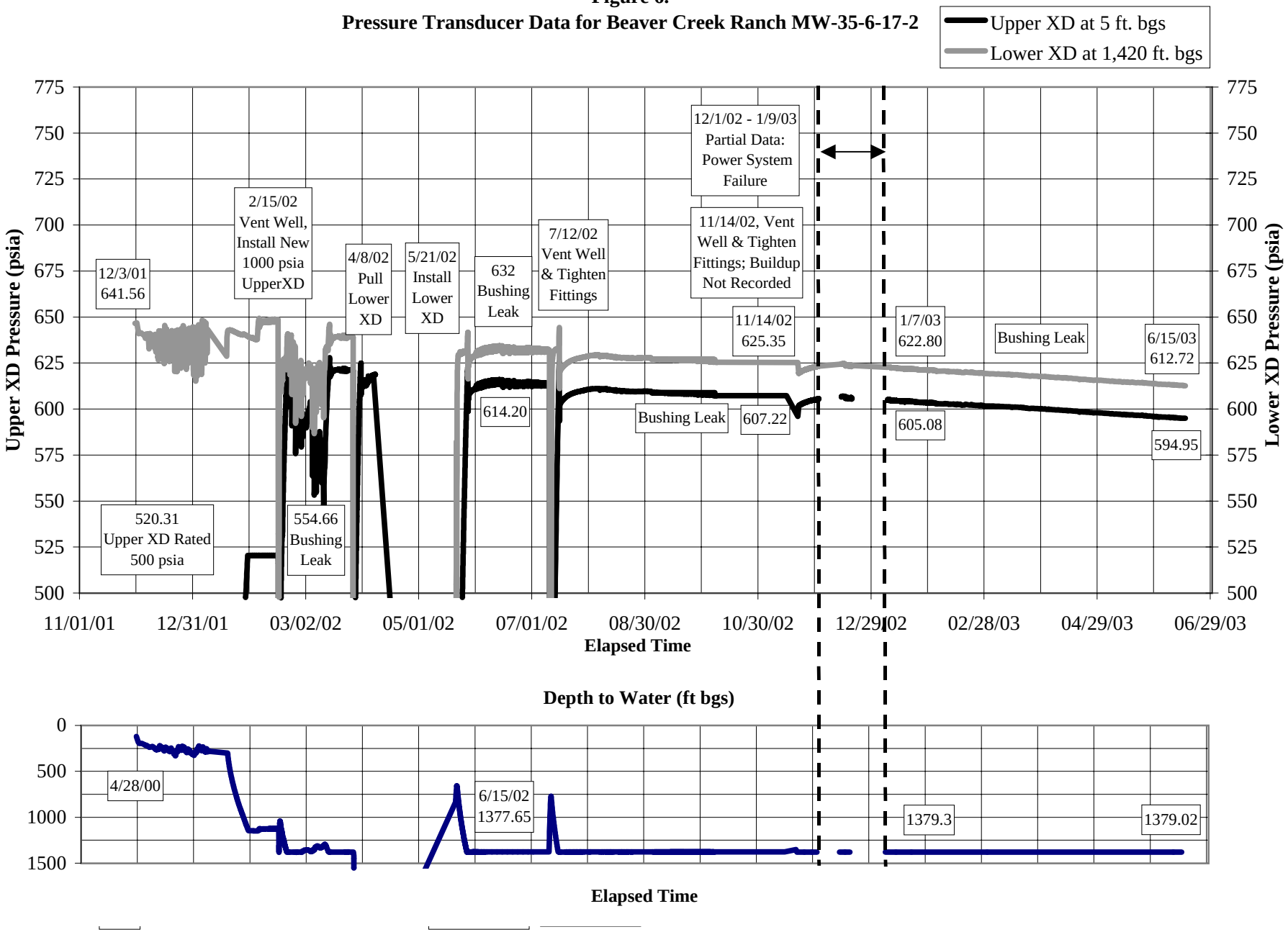
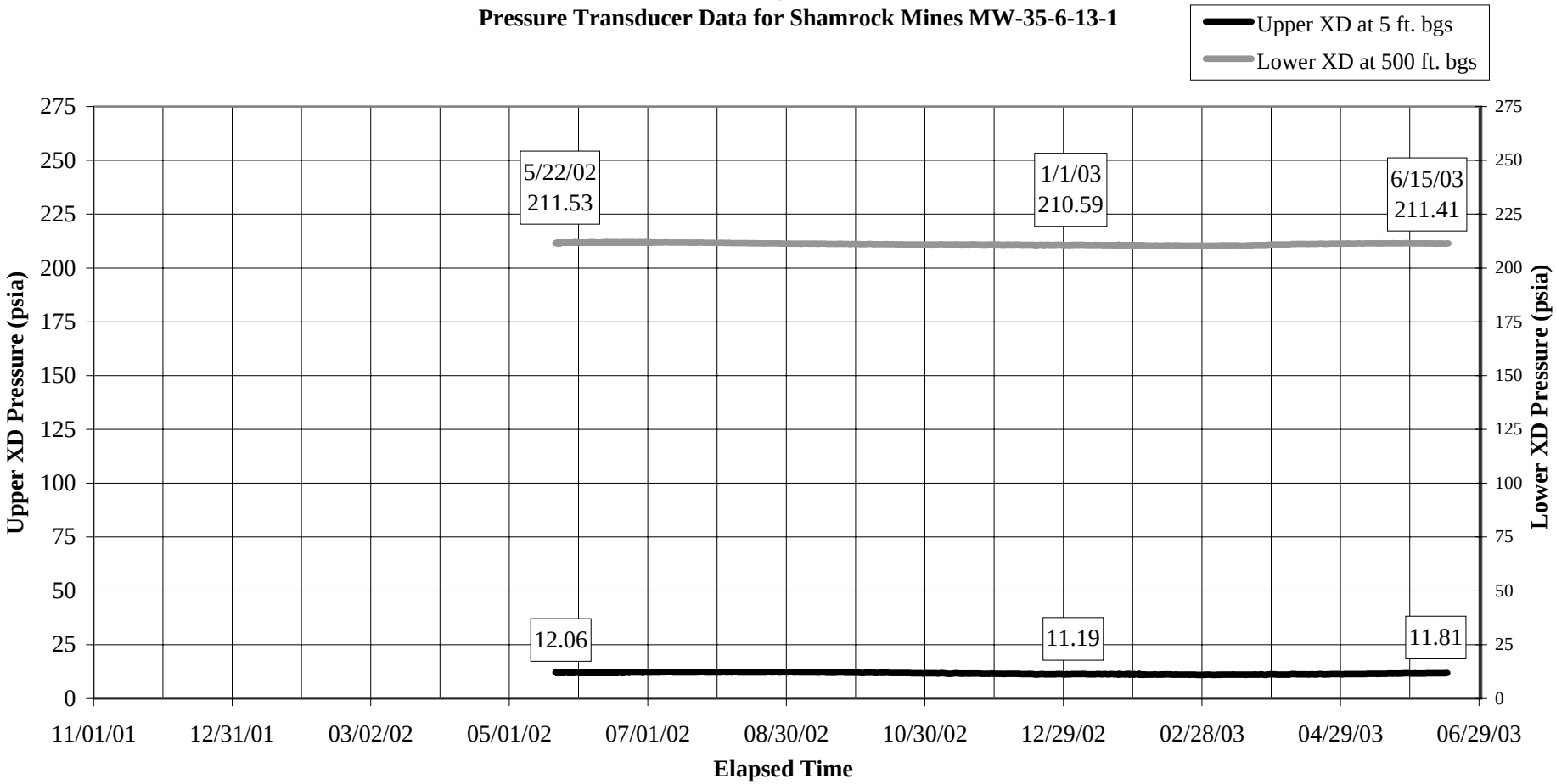


Figure 7.
Pressure Transducer Data for Shamrock Mines MW-35-6-13-1



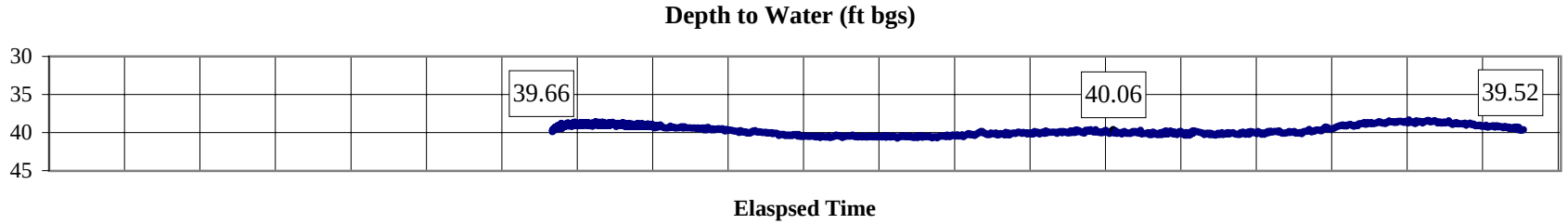


Figure 7a.
Pressure Transducer Data for Shamrock Mines MW-35-6-13-1