Colorado Oil and Gas Conservation Commission

Monitor Wells Summary Report 2019

4M Project Monitoring Program Archuleta and La Plata Counties Colorado

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1.0 INTRODUCTION

This report summarizes Colorado Oil and Gas Conservation Commission (COGCC) 4M Project monitoring well program activities and well pressure monitoring data through January 1, 2020 for Archuleta and La Plata Counties. Monitoring work was performed by COGCC staff and Resource Hydrogeologic Services, Inc. on behalf of COGCC. Activities completed during this reporting period included one field inspection tour of all accessible wells for general maintenance and documentation of all systems at all locations. Also conducted in 2019 was automated well pressure monitoring and data transmission to In-Situ® Data Center, online data retrieval, data analysis, and summary report preparation. Well pressure measurements recorded by data loggers in each monitoring well are available to all interested parties upon request.

The COGCC 4M Project monitoring well program includes 17 wells at 11 monitoring well sites. Figure 1-1 (following page) shows the location and name of all eleven monitoring well sites and individual site monitoring well names in accordance with the following well nomenclature.

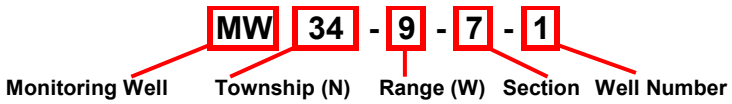

Table 1-1 lists the 4M project monitoring sites and wells by county, project phase and initiation date.

Table 1-1
4M Project Monitoring Well Program Phases

County	Site Name	Well Name	Project/Phase	Phase Initiation Date
Archuleta	Wagon Gulch	MW 34-5-4-1 MW 34-5-4-2	4M/Archuleta	October 2008
	Fosset Gulch	MW 34-5-14-1 MW 34-5-14-2		
	Highway 151	MW 34-4-30-1 MW 34-4-30-2		
	Deep Canyon	MW 34-4-32-1		June 2010
La Plata	Basin Creek	MW 34-9-7-1 MW 34-9-7-2	3M/La Plata	January 2001
	S. Fork Texas Creek	MW 35-7-8-1 MW 35-7-8-2		
	Beaver Creek Ranch	MW 35-6-17-1 MW 35-6-17-2		
	Shamrock Mines	MW 35-6-13-1		
	Palmer Ranch	MW 35-8-19-1	4M/La Plata	October 2009
	Fiddler	MW 35-8-10-1		
	BP Highlands	MW 35-7-15-1		

Table 1-2 lists monitoring well site locations and individual well completion details. Table 1-3 lists the depth and type of pressure transducers used in each monitoring well. Appendix A includes a chronology of monitoring well installation, operation and maintenance activities for the January 2001 through December 2019 period of record.

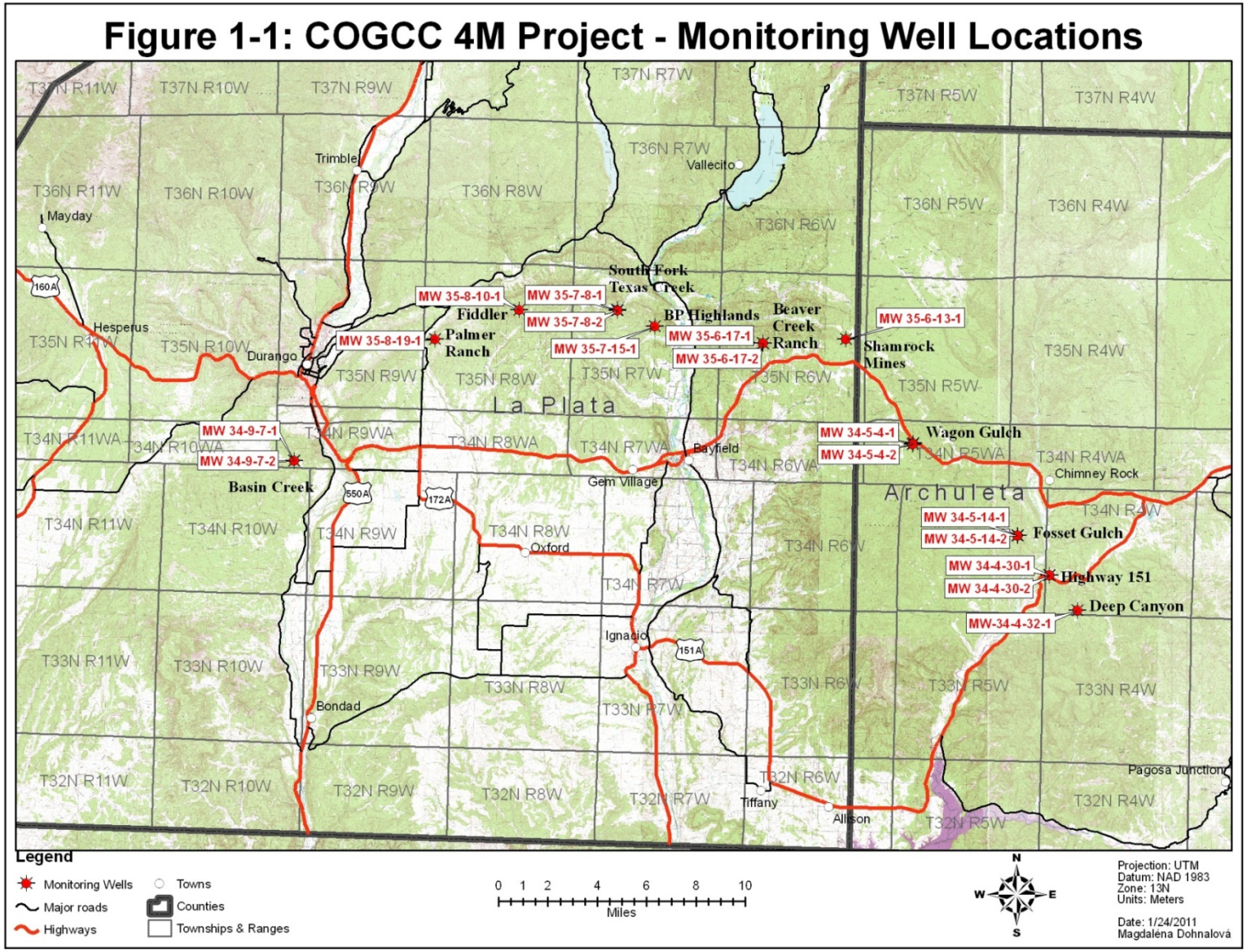

Figure 1-1
COGCC 4M Project – Monitoring Well Locations

Table 1-2
Monitor Well Completion Summary

Site Name	Well ID	Location (NAD 83)	Construction Completion Date	Drilled Depth (ft bgs)	Cored Intervals (ft bgs)	Casing Depth (ft bgs)	Casing Stickup (ft ags)	Well Casing Material	Perforated Interval in Coal seam(s) (ft bgs)	Log Type	Logged Depth (ft bgs)	Log Date
Basin Creek	MW 34-9-7-1	37.218482 N 107.887502 W	01/28/01	820		802	1	2 ", Schedule 40 galvanized steel pipe	578 - 609	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	37.218542 N 107.887442 W	04/25/02	570	359 - 374 * 498 - 513 578 - 593	561	1.5	2.875" & 2.375", Oilfield steel tubing	496 - 526	gamma ray, casing collar locator	550	05/02/02
Palmer Ranch	MW-35-8-19-1	37.292284 N 107.786741 W (Estimated-survey pending)	11/10/2009	747	NA	738	2.5	4.5" 10#/foot	623-628;634-637;640-657;662-671	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	725	11/6/09; 11/17/09
Fiddler	MW-35-8-10-1	37.311135 N 107.725623 W (Estimated-survey pending)	11/17/2009	457	NA	457	3	4.5" 10#/foot	174-190;220-226;276-291;354-363;378-380	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	457	10/16/09; 11/3/09
South Fork Texas Creek	MW 35-7-8-1	37.312493 N 107.653315 W	09/20/01	486		463	1.6	2 ", Schedule 40 galvanized steel pipe	403 - 416	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	37.312443 N 107.653315 W	09/21/01	420	410 - 425	425	1.6	2", Schedule 40 galvanized steel pipe	235 - 241 254 - 258 264 - 274	gamma ray, casing collar locator	420	09/27/01
BP Highlands	MW-35-7-15-1	37.303663 N 107.625489 W (Estimated-survey pending)	10/10/2009	276	NA	241	2.5	4.5" 10#/foot	182-194	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	276	10/3/09; 10/9/09
Beaver Creek Ranch	MW 35-6-17-1	37.295393 N 107.546011 W	04/04/02	1,645	1,457 - 1,467 1,564 - 1,572	1,631	1.5	2.875", Oilfield steel tubing	1,572 - 1,576 1,582 - 1,584	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	37.295503 N 107.545901 W	10/04/01	1,550		1,500	2	2", Schedule 40 galvanized steel pipe	1,437 - 1,449 1,458 - 1,472	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

* Cored interval from initial well drilled, plugged and abandoned in February 2001.

Table 1-2 (continued)
Monitor Well Completion Summary

Site Name	Well ID	Location (NAD 83)	Construction Completion Date	Drilled Depth (ft bgs)	Cored Intervals (ft bgs)	Casing Depth (ft bgs)	Casing Stickup (ft ags)	Well Casing Material	Perforated Interval in Coal seam(s) (ft bgs)	Log Type	Logged Depth (ft bgs)	Log Date
Shamrock Mines	MW 35-6-13-1	37.299063 N 107.484969 W	05/07/02	627		606	1.5	2.375", Oilfield steel tubing	507 - 511 517 - 533 539 - 562	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
Wagon Gulch	MW-34-5-4-1	37.238958 N 107.433631 W	10/2/2008	938	NA	927	2.5	4.5" 10.5#/foot	821-833	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	938	10/2/08; 10/16/08
	MW-34-5-4-2	37.238389 N 107.355340 W	10/13/2008	883	749-779 810-818	833	2.5	4.5" 10.5#/foot	752-767	Open Hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	883	10/12/08; 10/16/08
Fosset Gulch	MW-34-5-14-1	37.186510 N 107.355270 W	10/31/2008	624	480-506 524-532	618	2.5	4.5" 10.5#/foot	482-502	Cased hole: casing collar locator and gamma ray	624	11/14/08
	MW-34-5-14-2	37.186550 N 107.355340 W	10/22/2008	660	NA	660	2.5	4.5" 10.5#/foot	525-534 548-551	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	648	10/22/08; 11/14/08
Highway 151	MW-34-4-30-1	37.163685 N 107.331061 W	11/11/2008	340	226-247 266-287	330	2.5	4.5" 10.5#/foot	218-22 231-241	Open hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	326	11/16/09
	MW-34-4-30-2	37.163631 N 107.331008 W	11/7/2008	330	NA	330	2.5	4.5" 10.5#/foot	268-277 292-301	Open Hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	326	11/6/09; 11/16/09
Deep Canyon	MW 34-4-32-1	37.143311 N 107.309829 W	5/18/2010	895	NA	880	2.5	4.5" 10.5#/foot	752-761 763-765 804-813 836-838	Open Hole: gamma ray, bulk density, neutron, temperature, E-log, bore hole deviation and acoustical televiewer; Cased hole: casing collar locator and gamma ray	880	5/24/2010

Table 1-3
Monitor Well Pressure Transducers

Table 1-3
Monitor Well Pressure Transducers

Location	Well ID	Upper Transducer		Lower Transducer	
		Depth (ft bgs)	Type and Rating	Depth (ft bgs)	Type and Rating
Basin Creek	MW 34-9-7-1	5	LT 500 - 30 psia	570	LT 500 - 300 psia
	MW 34-9-7-2	5	AT 200 - 100 psia	484.6	LT 500 - 300 psia
Palmer Ranch	MW-35-8-19-1	3	LT 500 - 500 psia	690	LT 700 - 1000 psia
Fiddler	MW-35-8-10-1	7.5	LT 700 - 100 psia	390	LT 700 - 1000 psia
South Fork Texas Creek	MW 35-7-8-1	5	LT 500 - 30 psia	374	LT 500 - 300 psia
	MW 35-7-8-2	5	LT 500 - 300 psia	231.5	LT 500 - 300 psia
BP Highlands	MW-35-7-15-1	2	LT 500 - 30 psia	204	LT 500 - 500 psia
Beaver Creek Ranch	MW 35-6-17-1	6	LT 500 - 300 psia	1,551	LT 700 - 1000 psia
	MW 35-6-17-2	5	LT 700 - 1000 psia	1,406.5	LT 700 - 1000 psia
Shamrock Mines	MW 35-6-13-1	5	LT 500 - 30 psia	512	LT 500 - 300 psia
Wagon Gulch	MW-34-5-4-1	7	LT 700 - 1000 psia	794	LT 400 - 500 psia
	MW-34-5-4-2	2.5	LT 700 - 1000 psia	770	LT 700 - 1000 psia
Fosset Gulch	MW-34-5-14-1	2.3 (ft ags)	LT 700 - 1000 psia	510	LT 500 - 500 psia
	MW-34-5-14-2	2.3 (ft ags)	LT 700 - 1000 psia	560	LT 700 - 1000 psia
Highway 151	MW-34-4-30-1	2.3 (ft ags)	LT 500 - 30 psia	250	LT 700 - 1000 psia
	MW-34-4-30-2	2.3 (ft ags)	LT 700 - 1000 psia	310	LT 700 - 1000 psia
Deep Canyon	MW-34-4-32-1	2.5	LT 700 - 1000 psia	845.5	LT 700 - 1000 psia

ft bgs = feet below ground surface; ft ags = feet above ground surface; LT = LevelTROLL®, AT = AquaTROLL®

2.0 LA PLATA COUNTY MONITORING WELL DATA SUMMARY

Well pressure was measured and recorded twice daily (12-hour interval) for the 7 monitoring well sites located in La Plata County, Colorado. Applicable well pressure and calculated water level data for the entire period of record for each monitoring well are plotted in annotated charts. The water level in a well is calculated using the depth of the lower transducer and the difference in pressure between upper and lower transducers. This calculation is applicable at sites where the water level in a well is above the lower pressure transducer and below the upper pressure transducer.

2.1 BASIN CREEK

Monitor well MW 34-9-7-1 has been monitored since November 29, 2001 and monitor well MW 34-9-7-2 has been monitored since May 24, 2002. Initial and ending monitoring well pressures and calculated water levels in the wells for each period of record are summarized in Table 2-1.

Table 2-1
Well Pressure Data Summary for Basin Creek Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 34-9-7-1 Upper	11/29/01 to 1/1/20	11.46	52.00	40.54	20.97	320.32	-299.35
Lower		249.34	160.18	-89.16			
MW 34-9-7-2 Upper	5/24/02 to 11/16/19	33.26	16.34	-16.92	50.27 (ft ags)	70.16	-120.43
Lower		241.42	190.92	-50.50			

2.1.1 MW 34-9-7-1

Figure 2-1 charts the upper and lower pressure transducer data and the calculated water level in the well. Table 2-1 and Figure 2-1 show a net increase of 40.65 psi in wellhead pressure for the entire 18-year period of record from November 29, 2001 (11.46 psia) to January 1, 2020 (52.00 psia). Figure 2-1 generally shows a pattern of minor seasonal fluctuations within an overall stable trend in wellhead pressure prior to wellhead cable gland seal replacement on August 18, 2010, followed by a rise in wellhead pressure to a recorded high of 53.42 psia on September 11, 2013. A very minor leak persisted so on November 6, 2013 the well was vented to allow a safe condition to repair leaking threads at the wellhead. Recovery of the previous wellhead pressure occurred for about nine months following this wellhead venting. Since

recovery in the second half of 2014, wellhead pressure has remained relatively stable. 2019 data demonstrated a groundwater recharge response to the very wet winter of 2018-2019; this effect was greater in magnitude than a similar pressure and water level response to the wet winters of 2007-2008, 2009-2010, 2016-2017.

In contrast to the wellhead pressure patterns, Table 2-1 and Figure 2-1 show a substantial net decline of 299.35 feet in the calculated well water level and a corresponding net decline in downhole pressure of 89.16 psi for the period of record. Figure 2-1 also shows a pattern of slight seasonal fluctuations within the overall declining trend in the water level and corresponding downhole pressure for the period of record.

Figure 2-1
Pressure Transducer Data
Basin Creek Well MW-34-9-7-1

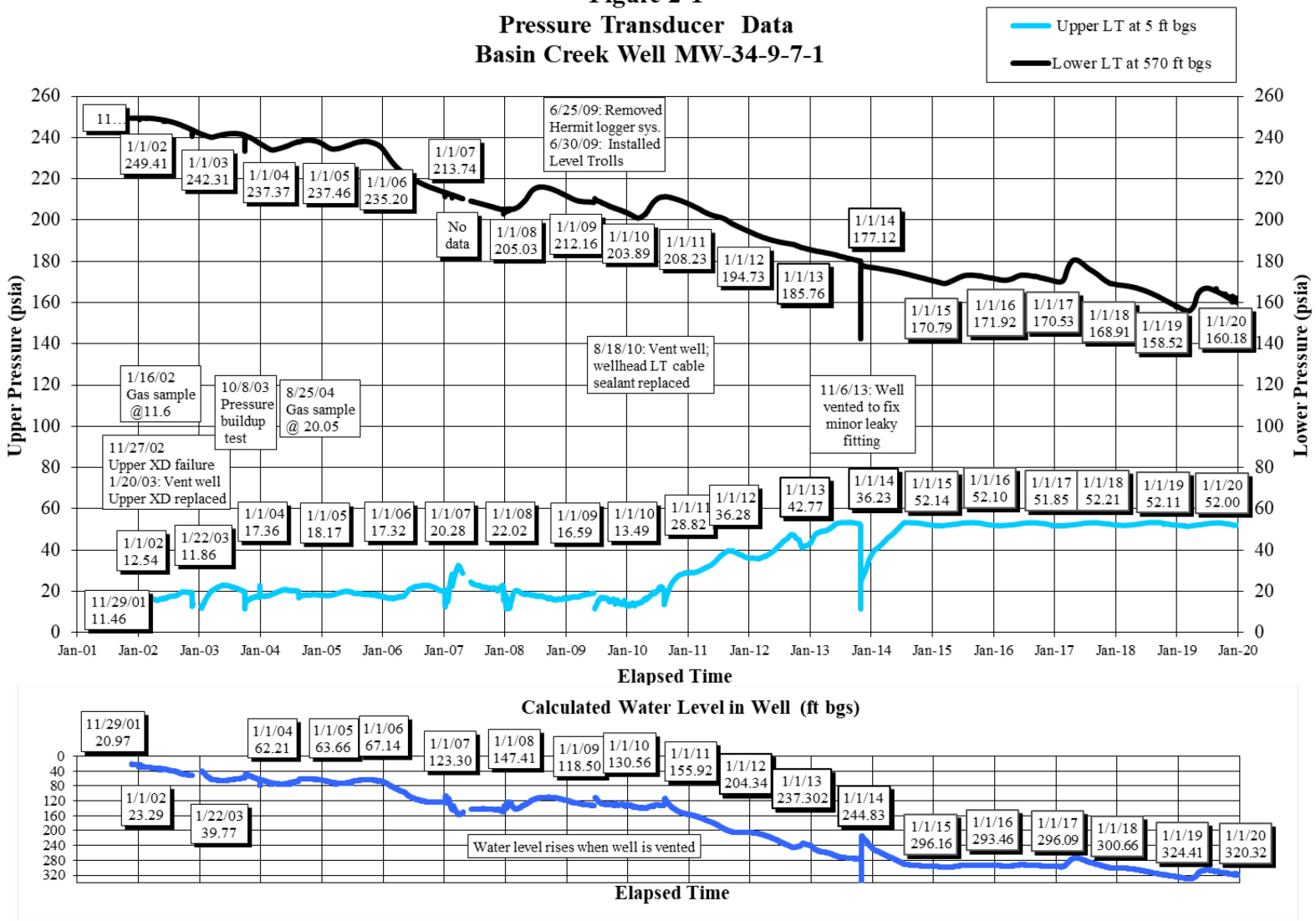

Figure 2-1
Pressure Transducer Data Basin Creek Well MW-34-9-7-1

2.1.2 MW 34-9-7-2

Recorded pressure data and calculated water level for well MW-34-9-7-2 are charted on Figure 2-2. Initial and ending monitoring well pressures and apparent water level in the well are summarized in Table 2-1.

Figure 2-2 continues to show a trend of gradually declining wellhead pressure and minor seasonal fluctuations in downhole pressure within the overall declining trend for the period of record. As indicated in Table 2-1, there has been a net decline in well pressure of about 16.92 psi (wellhead) and 50.50 psi (downhole) for the 17.5-year period of record. Between February 18, 2008 and November 16, 2019, Figure 2-2 shows an apparent wellhead pressure seasonal fluctuation related to ambient air temperature within the overall declining well pressure trend. The record is incomplete for the full year of 2019 due to a lower pressure transducer and cable failure on November 17, 2019.

A small amount of gas was released and artesian flow (~0.2 gpm) from the well consistently occurred each time the well was vented for maintenance during the period of record between 2002 and 2010. The pressure regime documented was relatively high pressure but low volume based on the head pressure versus artesian flow. Artesian flow from the well did not occur when the wellhead was vented on August 18, 2010 to replace the Level Troll wellhead cable Conax gland sealants. The final recorded upper transducer pressure in 2011 of 13.7 PSI was very near atmospheric pressure indicating the well was essentially in hydrostatic balance. The pressure fluctuations since early 2009 suggest that ambient surface temperatures may be affecting the gas pressure as measured by the upper transducer. In order to attempt to distinguish water pressure versus gas pressure being recorded by the upper transducer, the Level Troll was replaced by an Aqua Troll, which records specific conductance (SC) in addition to pressure and temperature. The concept was that if water was present at the Aqua Troll, it would record an SC value greater than zero. If a value of zero was recorded for SC, then a pressure greater than atmospheric pressure would be gas pressure only. The Aqua Troll was installed on November 6, 2013, but it appears by this time the static water level in this well had dropped from the near-surface balance of 2009-2011. 2017 brought a change in trend of the downhole pressure; it increased slightly throughout the first half of 2017, plateaued and then continued to decrease in the linear trend followed since mid-2011. This was a similar trend as observed in 2010. 2019 data demonstrated a groundwater recharge response to the very wet winter of 2018-2019, similar to that observed after the wet winters of 2007-2008, 2009-2010, 2016-2017.

Substantial water level decline has been documented in this well, going from artesian flowing with a calculated shut-in head of approximately 53 feet above ground surface just after construction to 76.03 feet below ground surface on January 1, 2019. This calculated water level data set has been verified by a manual open-well water level measurement on November 6, 2013 of 40.20 ft bgs used as a calibration point for water level calculation using the lower Level Troll data within fifteen minutes on the same date of 40.46 feet below ground surface.

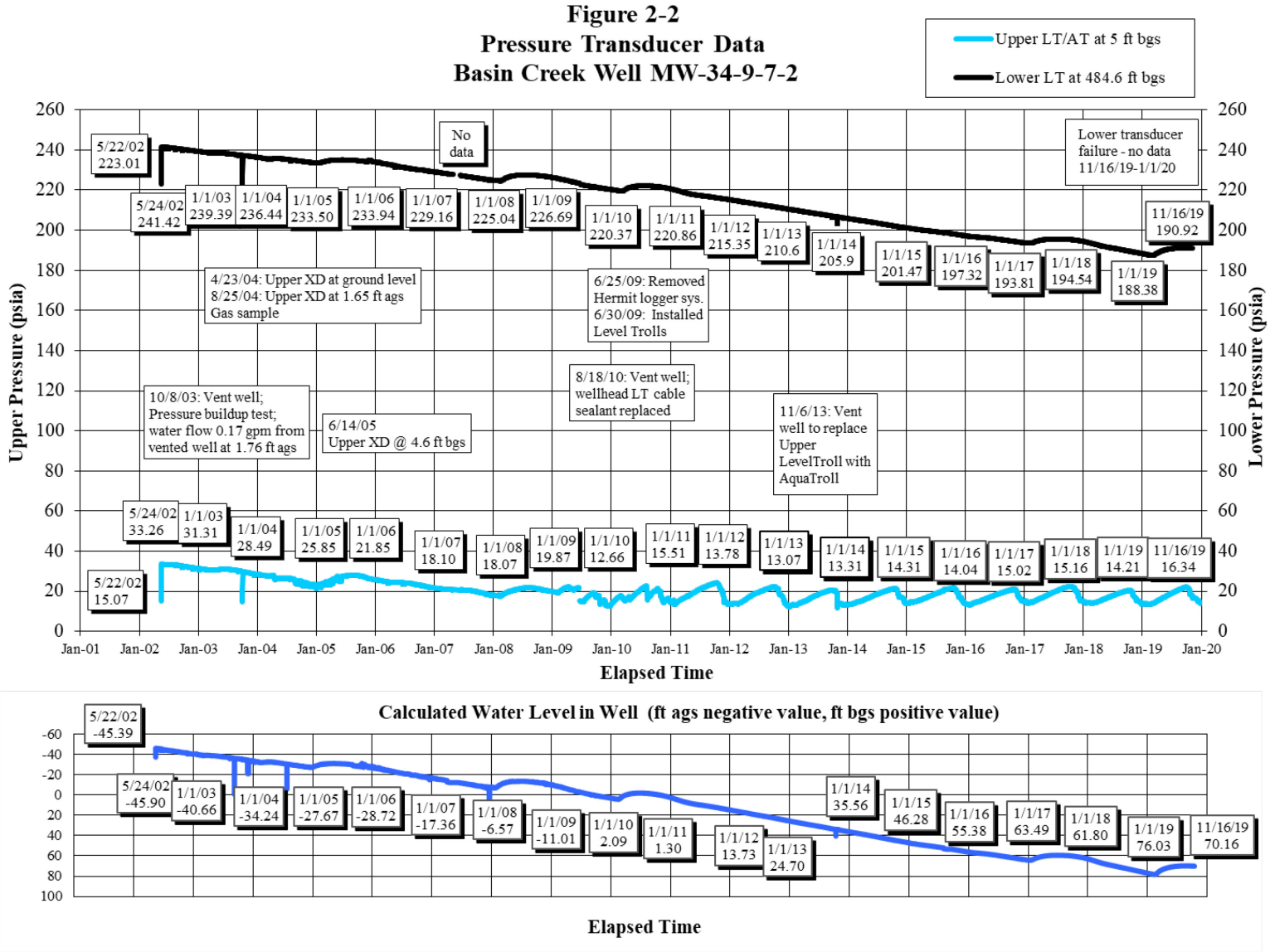

Figure 2-2
Pressure Transducer Data Basin Creek Well MW-34-9-7-2

2.2 PALMER RANCH

Monitor well MW 35-8-19-1 has been monitored since November 20, 2009. Initial and ending well pressures and calculated water level in the monitor well are summarized in Table 2-2 for the indicated period of record.

Table 2-2
Well Pressure Data Summary for Palmer Ranch Monitoring Well

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-8-19-1 Upper	11/20/09 to 1/1/20	45.17	14.95	-30.22	19.09	28.73	-9.64
Lower		335.86	301.46	-34.40			

Monitoring data for MW 35-8-19-1 are plotted in Figure 2-3. Since November 20, 2009, there has been seasonal fluctuation in wellhead pressure due to ambient air temperature effects and steady declining trend in downhole pressure. As summarized in Table 2-2 for the 10-year period of record, the net change in wellhead and downhole pressures are -30.22 psi and -34.40 psi respectively. The net change in the calculated water level in the well is an increase of -9.64 feet for the period of record.

Figure 2-3 shows an immediate water level rise in response to the drop in well pressure when the well was vented for maintenance on June 3, 2010, followed by a gradual, partial return of the wellhead pressure and water level to trends exhibited prior to June 3, 2010. By August 1, 2010, the wellhead pressure and water level reached about 64 percent of trends exhibited prior to June 3, 2010, then plateaued through late October, 2010. Figure 2-3 also shows a trend of water level rise in response to a steady drop in wellhead pressure between late October, 2010 and early February, 2011. The decrease in wellhead pressure after October 2010 was thought to possibly be due to an incomplete shut-in wellhead condition. A minor leak was detected at the wellhead during the 2011-2013 site inspections but not corrected because tightening the leaky pipe fitting would likely have caused more damage and further compromised the seal. However, upon inspections in 2014-2016, no leak could be detected and the trend in the years since appears to be due to real reservoir pressure fluctuations.

In late October 2015, wellhead pressure apparently began dropping slowly from approximately 33 psi to approximately 12 psi in mid-December 2015. Wellhead pressure then was fairly stable through the winter and then slowly built up from late winter through late summer. The pressure trend appears to be similar but stronger seasonal trend that has been occurring since 2011. The trend repeated in 2018 and suggests

the well has been demonstrating an apparent increased response to seasonal groundwater level changes, increased local groundwater production effects or coal seam reservoir pressure fluctuations. The Florida River runs immediately adjacent to the well and flows are significantly impacted by agricultural irrigation schedules, which may have both direct and indirect effects on observed Fruitland coal seam reservoir pressure and water levels.

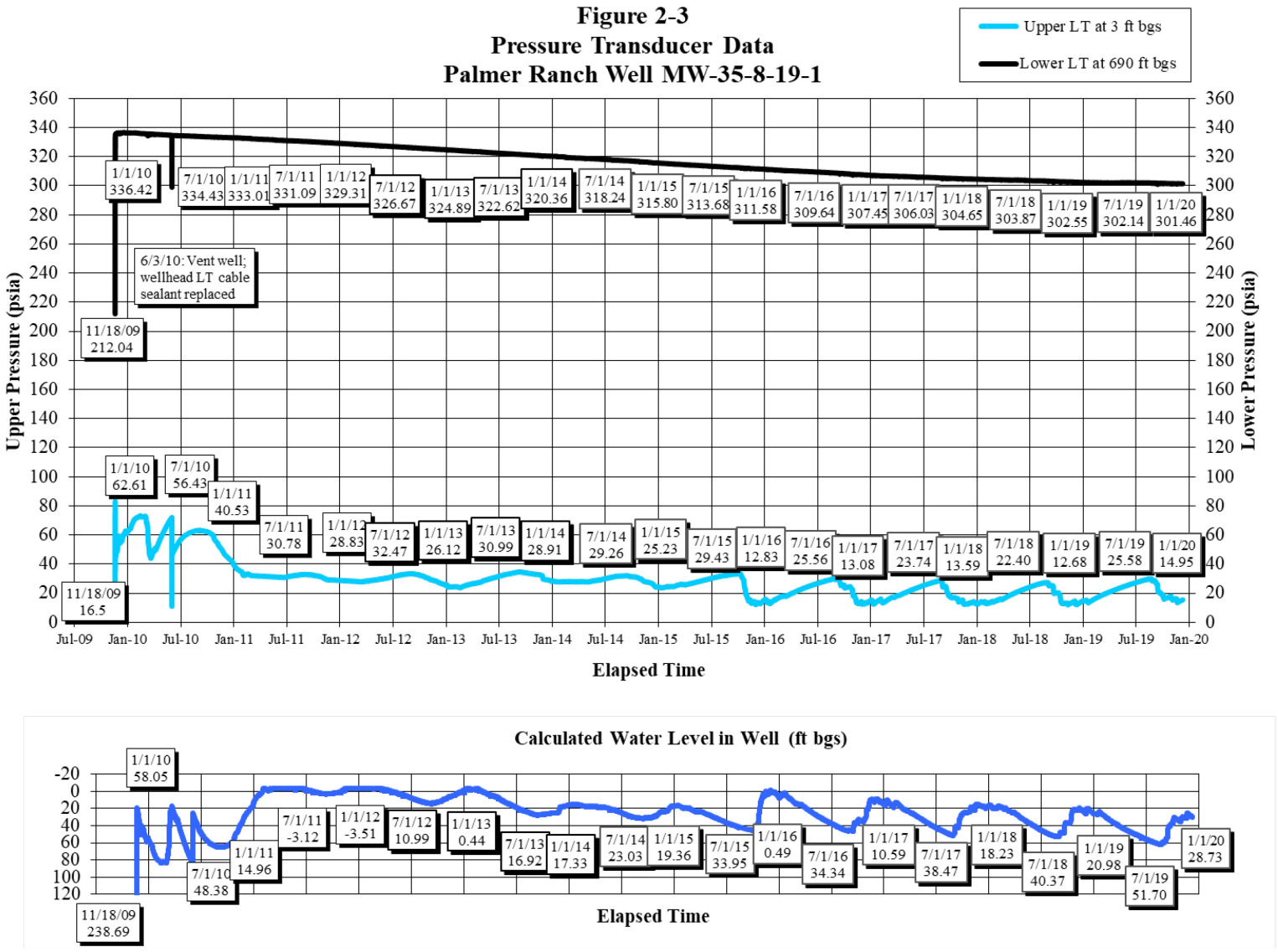

Figure 2-3
Pressure Transducer Data Palmer Ranch Well MW-35-8-19-1

2.3 FIDDLER

Monitor well MW 35-8-10-1 has been monitored since November 17, 2009. Initial and ending well pressures and calculated water level in the monitor well are summarized in Table 2-3 for the indicated period of record.

Table 2-3
Well Pressure Data Summary for Fiddler Monitoring Well

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-8-10-1 Upper	2/18/10 to 1/1/20	14.84	44.01	29.17	Upper transducer under water at 7.5 ft below ground surface		
Lower		184.30	208.77	24.47			

Monitoring data for MW 35-8-10-1 are plotted in Figure 2-4. The net change in wellhead pressure is 29.17 psi and the net change in downhole pressure is 24.47 psi for the 10-year period of record. As Figure 2-4 shows, both the wellhead pressure and downhole pressure steadily increased from installation on November 17, 2009 to early June, 2010. This well has seen moderate fluctuation in the pressure regime, however instrumentation problems and wellhead leakage occurred until 2013. These issues are discussed below.

As noted on Figure 2-4 the lower Level Troll was removed during wellhead maintenance on September 25, 2012 and reinstalled on October 31, 2012. A net water level change was not calculated because the upper transducer is below the water level in the well. Figure 2-4 documents a natural flow rate from the well at a rate of 0.25 gallons per minute (gpm) when the well was vented for maintenance on June 2, 2010. At the time of the well inspection on October 31, 2012, the flow rate was measured at 0.14 gpm. For charting purposes, the water level in the shut-in well is estimated to be at or near ground surface above the upper pressure transducer (set at 7.5 ft bgs).

Also noted on Figure 2-4, telemetry system communication with the In-Situ® Data Center for the upper transducer was lost from November 26, 2009 through February 11, 2010 due to cable connection problem and was intermittent from December 19, 2010 to January 1, 2011. The upper transducer and cable were replaced during the 2011 well inspection and the cable length was extended from 3 ft bgs to 7.5 ft bgs. Additionally, a wellhead fitting leak during the winter and spring of 2011 through the summer of 2012 caused a pressure decrease observed on both the upper and lower transducers. Related to the freeze-thaw cycles the upper transducer failed again March 1, 2012. Inspection of the wellhead on June 6, 2012

revealed the minor water leak at an estimated flow rate of 0.1 to 0.2 gpm. Evidence of the wellhead freezing and then popping the wellhead seal is observed by the minor pressure spiking on both transducers in January 2011 and February 2012. The tubing head threading was cleaned in an attempt to achieve a pressure tight seal at the mandrel head, but both the rubber seals and threading had deteriorated significantly. Documentation was conducted for a later wellhead replacement. Souder Miller Associates supervised installation of the new wellhead on September 25, 2012, which required removal of all instrumentation from the well. Rather than reset the instrumentation at that time, it was planned to remain out of service until the well inspection conducted by COGCC, Norwest and In-Situ, Inc. on October 31, 2012. During that well inspection the upper transducer was replaced with a new 100 psia Level Troll. Also, as planned, the lower transducer and cable was reset, however the new set depth was approximately 15 feet deeper than the previous set depth, so the proper offset has been incorporated into the lower transducer data in Figure 2-4.

Since mid-2014, the Fiddler monitoring well showed a fairly steady decline in bottom-hole and wellhead pressure of approximately 6 psi through January 1, 2016. However, bottom hole and wellhead pressure measurements show a steady increase of approximately 5 psi from late February 2016 through May 2016. This could have been a response related to temporary shut-in of one or more nearby coal bed methane production wells. A similar pressure decline trend as the 2014-2015 resumed in June 2016.

2017 demonstrated a substantial pressure build-up measured on both the upper and lower transducers. It appears to represent significant groundwater recharge to at least one, if not all of the five Fruitland coal seams monitored in the Fiddler well following the wet winter of 2016-2017. This effect is observed again with similar magnitude following the very wet winter of 2018-2019.

Figure 2-4
Pressure Transducer Data
Fiddler Well MW-35-8-10-1

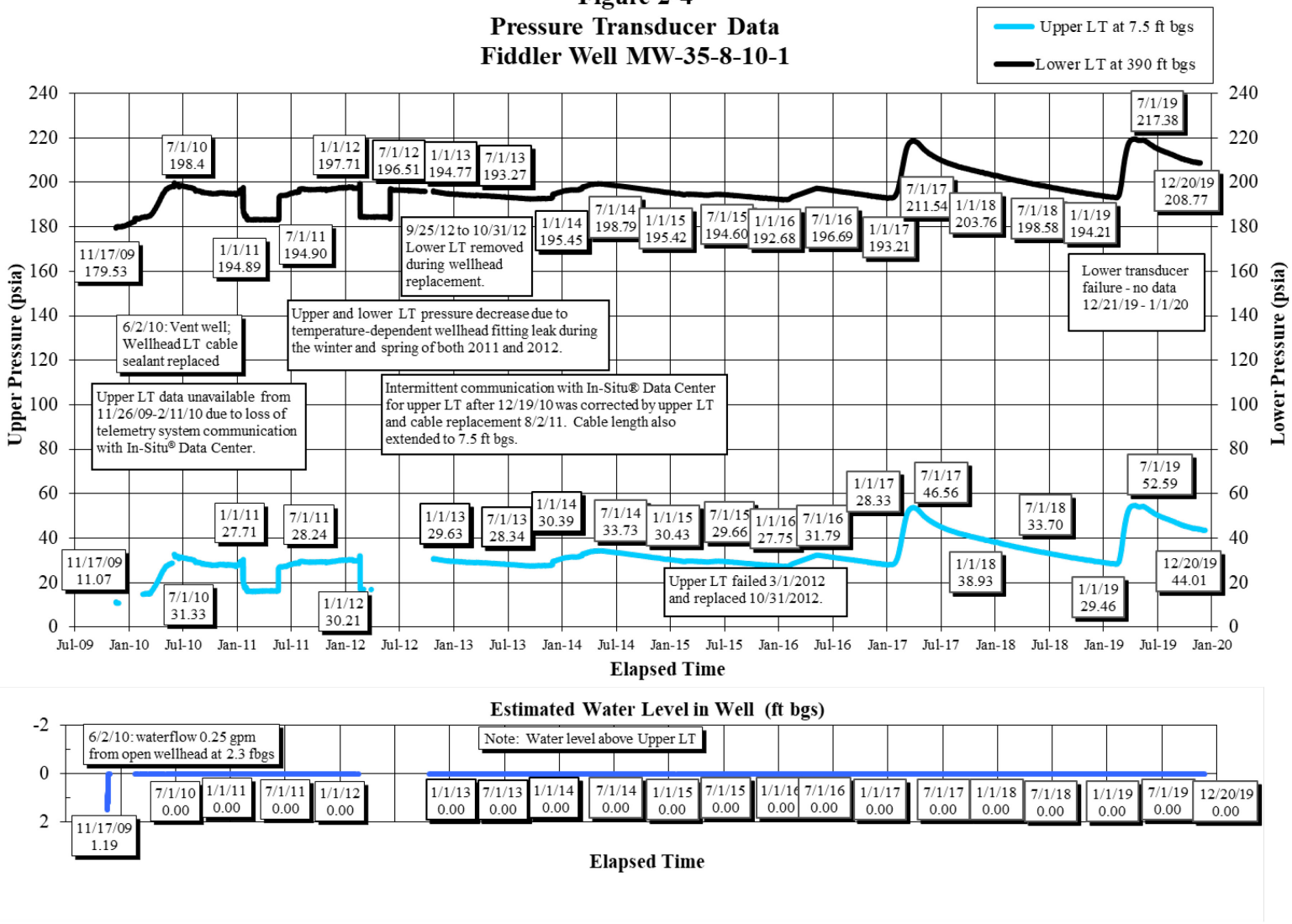

Figure 2-4
Pressure Transducer Data Fiddler MW-35-8-10-1

2.4 SOUTH FORK TEXAS CREEK

Monitor wells MW 35-7-8-1 and MW 35-7-8-2 have been monitored since November 29, 2001. Initial and ending well pressures and calculated water levels in the monitor wells are summarized in Table 2-4 for the indicated period of record.

Table 2-4
Well Pressure Data Summary for South Fork Texas Creek Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-7-8-1 Upper	12/01/01 to 1/1/20	13.79	22.60	8.81	88.39	136.72	-88.39
Lower		144.47	125.45	-19.02			
MW 35-7-8-2 Upper	1/15/02 to 1/1/20	91.32[1]	83.47	-7.85	Water level in well is >225 ft bgs with complete shut in		
Lower		91.91[1]	83.89	-8.02			

1 Both downhole and wellhead pressure are typically the same in MW 35-7-8-2 with complete shut in.

2.4.1 MW 35-7-8-1

Monitoring data for MW 35-7-8-1 are plotted in Figure 2-5. As summarized in Table 2-4, the net change in wellhead and downhole pressures is 8.81 psi and -19.02 psi respectively for the 19-year period of record. The net change in the calculated water level in the well for this period is -88.39 feet.

Figure 2-5 shows a relatively stable wellhead pressure (12 to 13.5 psia) prior to installation of the Level Troll instrument on June 30, 2009. After the transducer change-out, there was a build-up in wellhead pressure from 11.52 psia on June 30, 2009 to 33.76 psia on July 3, 2009 followed by frequent fluctuations in wellhead pressure ranging between 19 psia and 38 psia through January 18, 2010. Between January 19, 2010 and January 30, 2010, the wellhead pressure rose from 38 psia to 49 psia and then has remained fairly stable through January 1, 2018. The relatively stable wellhead pressure curve prior to June 30, 2009 is inconsistent with the fluctuating and notably higher pressure measurements recorded after June 30, 2009. Likewise, the lower Level Troll has recorded frequent downhole pressure fluctuations (between 129 and 142 psia) not previously observed in well pressure data prior to June 30, 2009. The higher well pressure regime since August 2010 may indicate complete well shut-in was not achieved until after the Level Troll cable wellhead seals were replaced on August 18, 2010. Some higher magnitude pressure fluctuations in the lower transducer began occurring in December of 2012 and were continuing through the current period of record during winter (cold) periods. In the summer of 2019, the lower transducer

and cable were replaced as planned to address the cold weather pressure spikes. Initial data from December 2019 seems to indicate the pressure fluctuations, while minimized compared to the past four years, continue to persist. Since the well was blown down for the instrument replacement, the wellhead pressure has remained approximately 30 psi below the previous fairly static observed pressure for the previous approximate ten years. This pressure likely represented gas trapped in the wellbore above fluid level which after release has yet to build to the previous pressure.

Figure 2-5
Pressure Transducer Data
South Fork Texas Creek Well MW-35-7-8-1

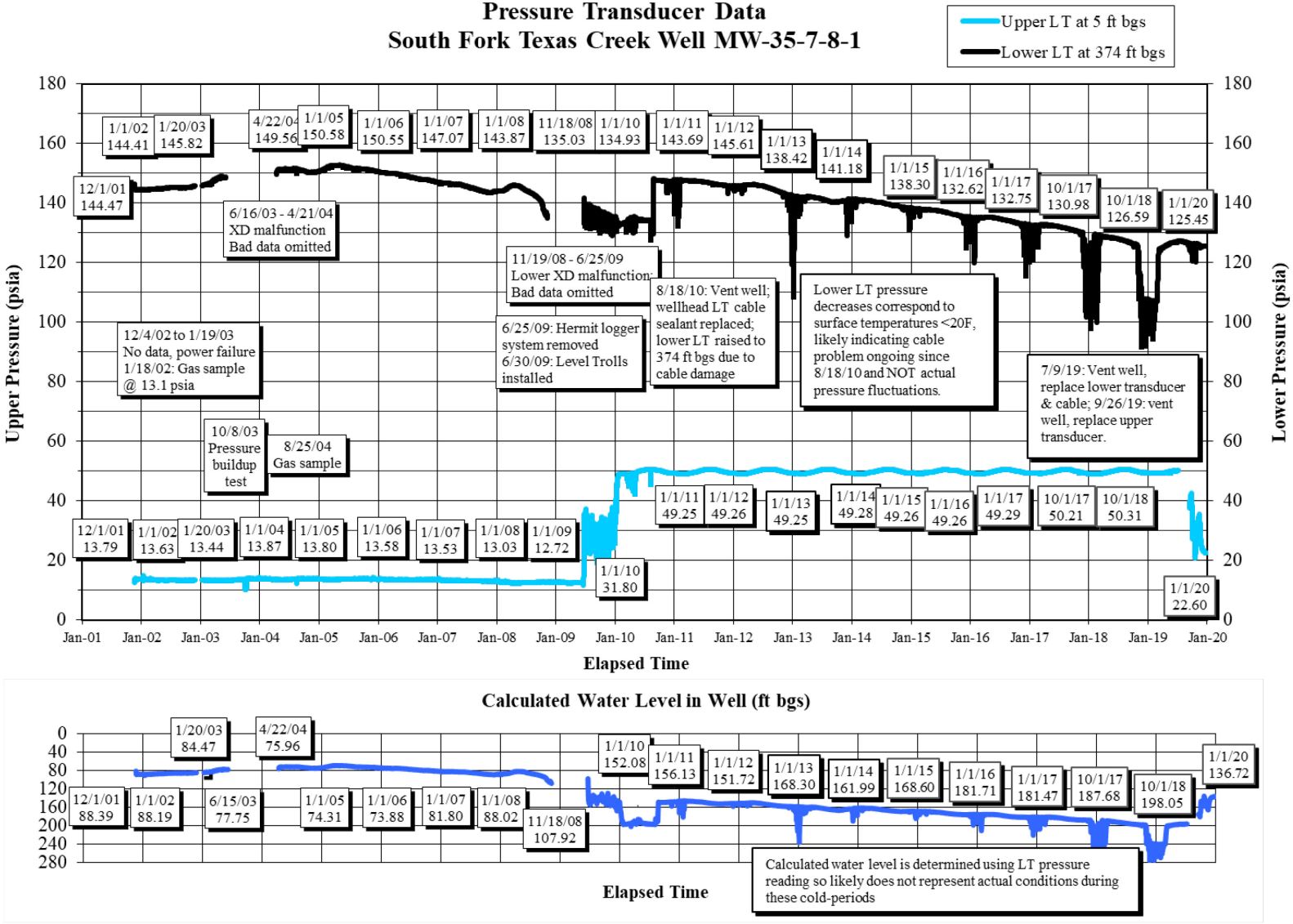

Figure 2-5
Pressure Transducer Data South Fork Texas Creek Well MW-35-7-8-1

2.4.2 MW 35-7-8-2

Figure 2-6 charts the pressure data for well MW 35-7-8-2, which exhibits an entirely different pressure regime than the deeper monitoring well MW 35-7-8-1. Figure 2-6 shows nearly equal wellhead and downhole pressures for the period of record when the well is completely shut in. For example, wellhead and downhole pressures recorded on January 1, 2020 were 83.47 psia and 83.89 psia respectively under shut-in conditions. Based on the period of record to date, incomplete well shut-in is indicated whenever the well pressure drops below about 70 psia.

The production casing at well MW 35-7-8-2 was connected, via transition to PVC pipeline, into the South Fork gas mitigation system in June 2010 by LT Environmental to test if there was enough gas in the well to supplement the larger-scale gas recovery and electrical generation system located along South Fork Texas Creek. The well was opened to the mitigation system on June 23, 2010. At 06:00 hours, the recorded wellhead and downhole pressures were about 88 psia. At 18:00 hours on June 23, 2010, the recorded wellhead pressure had dropped to 11.31 psia (atmospheric pressure) and the downhole pressure had dropped to about 74.8 psia. The well was removed from the gas mitigation system on August 6, 2010 due to lack of demonstrated performance. At that time, the recorded wellhead pressure was still about 11.3 psia and the downhole pressure was about 71 psia. The initial well pressure, 88 psia, was not sustained during system operation and there was no decrease in gas recovery system performance when the well was shut in on August 6, 2010. The well did not contribute enough gas to improve the gas recovery system operation. During a site-specific follow-up trip by Norwest on November 7, 2013, the entire wellhead was rebuilt to remove long-time leaky fittings and achieve complete shut-in. At that time the wellhead piping originally installed to deliver gas to the South Fork gas mitigation system was fully decommissioned. The 1-inch PVC gas pipeline that terminates beside the MW 35-7-8-2 well pad was fitted with a 1-inch ball valve, closed and the handle was removed to deter tampering. The 1-inch pipeline did not contain any pressure at this stage of decommissioning.

Figure 2-6 shows a fairly rapid increase in well pressure after the well was shut in on August 18, 2010. The peak build-up pressure of about 85 psia on September 28, 2010 was followed by an erratic decline in well pressure. The inspection of the well in 2013 documented a minor fitting leak at that time; this was a consistent leak on a pipe fitting that has been attempted to be tightened in the past years but required significant replacement of numerous wellhead fittings. The colder air temperatures occurring with early winter of 2012 and again in 2013 appeared to cause some erratic pressure fluctuations documented with the upper and lower transducers in Figure 2-6. This seemed to indicate that the leak was becoming more significant. On November 7, 2013 a site-specific follow-up trip was conducted to repair the leak that had been most recently documented on September 30, 2013. The well gas pressure was allowed to safely bleed down, with continuous gas detector monitoring. Both upper and lower Level Trolls were removed from the well and the wellhead was completely removed down to the 2-inch line pipe that is the well

casing extending up from the cement pad. The threads were reconditioned with a hand-operated 2-inch pipe die. The wellhead was reconstructed using all new carbon steel pipe fittings, with the exception of the Conax compression fittings secured around each Level Troll Rugged Cable, as they had not been documented as leaking. Several manual water level measurements were taken while the wellhead was open. Initially, the water level recovered fairly quickly as the gas pressure was vented. After approximately 2.5 hours open during the new wellhead installation, the water level was relatively stable and measured 110.64 ft bgs. This is the static water level when no gas pressure is allowed to depress the water column in the well. As can be seen in Figure 2-6, the upper and lower Level Troll pressure readings diverge at this time indicating that for the short period following well shut-in the lower Level Troll was actually submerged in water. The lower Level Troll pressure reading was approximately 63.6 psia, which calculates to 111.06 ft bgs. This gives good confidence in the calculated versus measured water level in this well, given error in the assumption of atmospheric pressure which is not currently recorded at this location. To prevent damage to the existing lower Level Troll cable, the Conax compression fitting was not adjusted to offset the new wellhead's increased height above ground surface of 0.25 feet, so the new set depth is 231.25 ft bgs. No leaks have been detected at this wellhead since the replacement.

A fairly consistent well pressure trend was observed for the previous four years, 2014 – 2017, whereby the well pressure builds in the first two quarters of the year and then falls off during the second two quarters. This trend may be documentation of seasonal effects of groundwater recharge and discharge, natural or otherwise. As 2018 was documented with extreme drought conditions, it appears that the monitored interval did not receive the typical magnitude of recharge. The pressure trend continued to decrease during the usual recharge period of early 2018, with minimal superimposed recharge noted as a slight reversal in the pressure curve character. The excessively wet winter of 2018-2019 appears to have caused a substantial well pressure increase in the late winter and early spring of 2019, with the usual pressure fall-off occurring following for the remainder of the year.

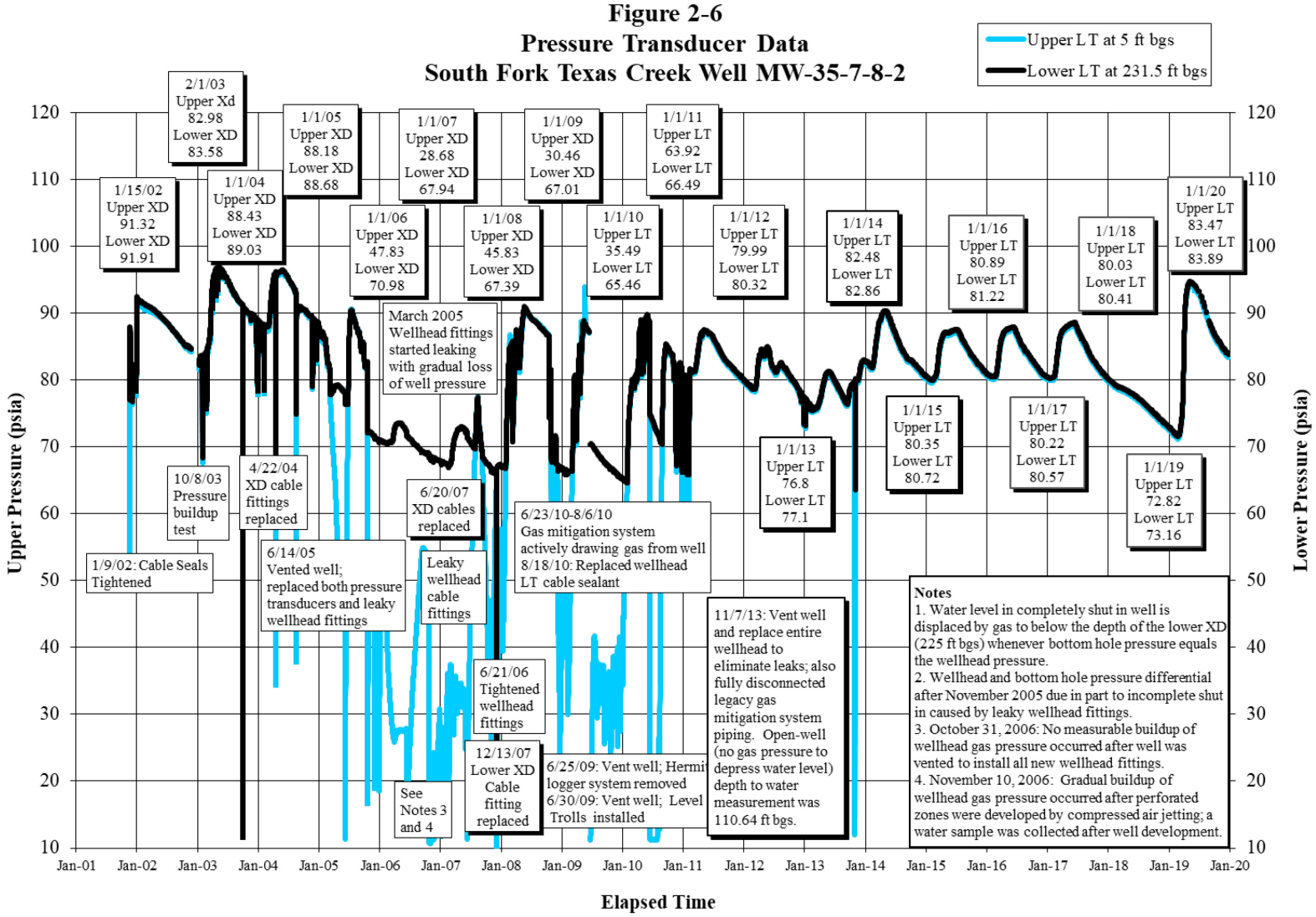

Figure 2-6
Pressure Transducer Data South Fork Texas Creek Well MW-35-7-8-2

2.5 BP HIGHLANDS

Monitor well MW 35-7-15-1 has been monitored since November 19, 2009. Initial and ending well pressures and calculated water levels in the monitor well are summarized in Table 2-5 for the indicated period of record.

Table 2-5
Well Pressure Data Summary for BP Highlands Monitoring Well

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-7-15-1 Upper	11/19/09 to 1/1/20	11.09	*8.19	-2.90	3.13	12.09	-8.96
Lower		98.12	91.34	-6.78			

* Well subject to a natural vacuum so upper transducer reports less than atmospheric pressure

Monitoring data for MW 35-7-15-1 are plotted in Figure 2-7. As summarized in Table 2-5 for the 10-year period of record, the net change in downhole pressures is a decrease of 6.78 psi. The well follows an overall decreasing pressure trend with seasonal variability dominated by late winter/early spring. The net change in the calculated water level in the well is a decrease of 8.96 feet. The magnitude of this decrease was approximately doubled in 2018 due to extreme drought conditions and complete lack of observable recharge. As noted on Figure 2-7, water flowed from the well at a rate of 0.25 gallons per minute (gpm) when the well was vented for maintenance on June 3, 2010. For charting purposes, the water level in the shut-in well at that time was estimated to be slightly above ground surface with the upper transducer under water at 2 ft bgs.

The wellhead pressure started dropping below atmospheric pressure around August 12, 2010. This condition suggested either a potential problem with the upper transducer or a well pressure vacuum effect created in a completely shut-in well under declining water level conditions. A well instrumentation inspection and atmospheric pressure check conducted during each subsequent site visit through 2013 has confirmed the proper function of the upper transducer. Venting the well allowed for physical confirmation that the well was under vacuum pressure conditions which have continued through January 1, 2020.

Figure 2-7
Pressure Transducer Data
BP Highlands Well MW-35-7-15-1

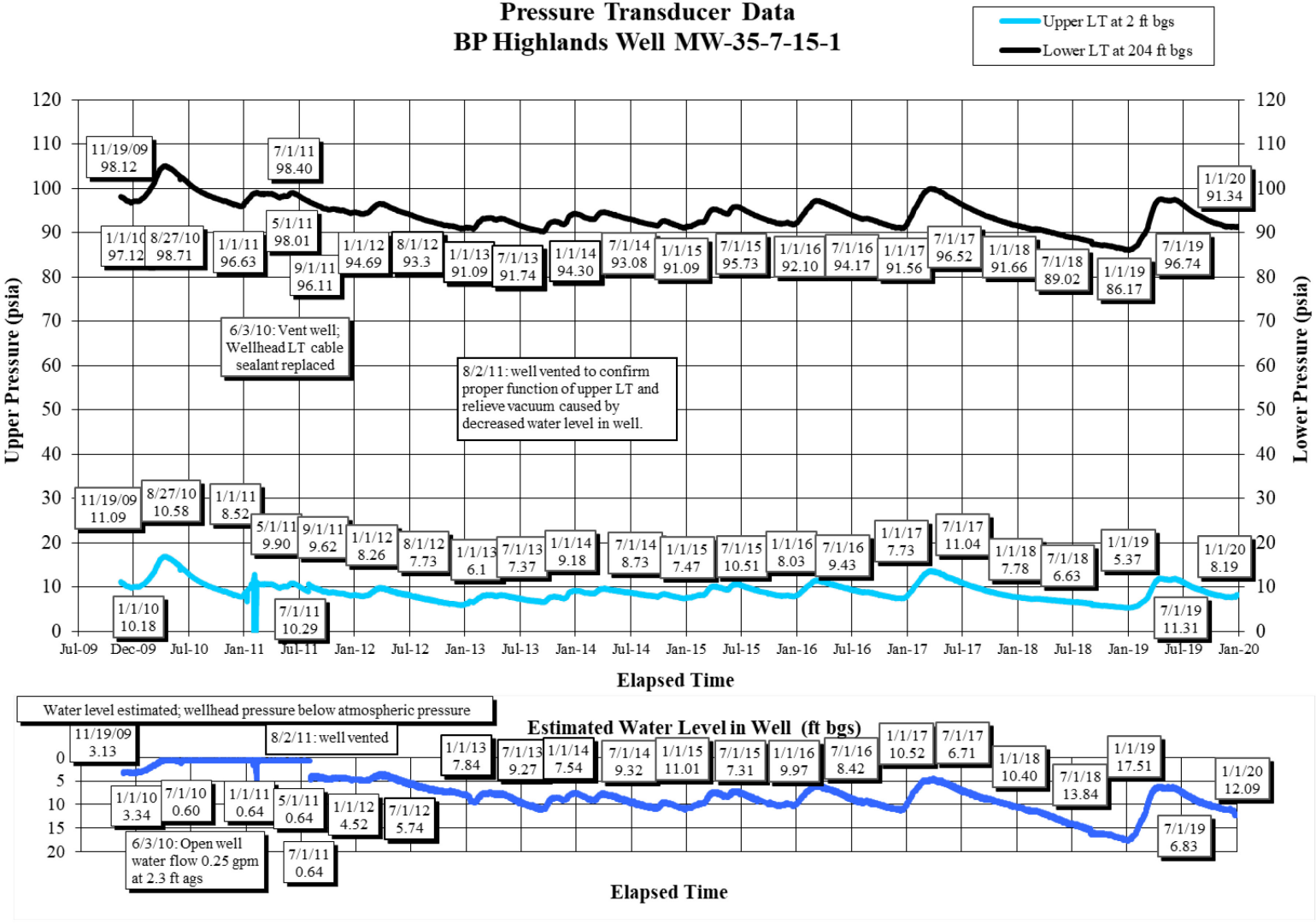

Figure 2-7
Pressure Transducer Data BP Highlands Well MW-35-7-15-1

2.6 BEAVER CREEK RANCH

Well MW 35-6-17-1 has been monitored since May 21, 2002 and well MW 35-6-17-2 has been monitored since November 30, 2001. Initial and ending well pressures and calculated water levels in the monitor wells are summarized in Table 2-6 for the indicated period of record.

Table 2-6
Well Pressure Data Summary for Beaver Creek Ranch Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-6-17-1 Upper	08/01/02 to 1/1/20	15.44	28.33	12.89	194.37	519.70	-325.33
Lower		609.55	475.36	-134.19			
MW 35-6-17-2 Upper	06/15/02 to 1/1/20	614.27	413.84	-200.43	1,377.64	1379.31	-1.67
Lower		632.63	426.19	-206.44			

2.6.1 MW 35-6-17-1

Monitoring data for well MW 35-6-27-1 are charted on Figure 2-8. As shown in Table 2-6, the pressure regime for this well is different than the regime exhibited by well MW 35-6-17-2.

Table 2-6 and Figure 2-8 show a net increase of 12.89 psi in wellhead pressure, a net decline of 134.19 psi in downhole pressure and a corresponding net decline of 325.33 feet in the water level in the well for the entire approximate 17.5-year period of record. Figure 2-8 also shows a steady decline in the bottom-hole pressure curve for the period of record, while the wellhead pressure curve shows two notable increases in the well pressure regime. Both increases in wellhead pressure suggest stimulation of gas flow into the well with corresponding declines in the water level occurred in response to venting the well in July 2003, June and July 2009 and August 2011. However, the most substantial cause for gas pressure increase during the period of record was the replacement of monitoring equipment and minimization of fittings leakage in July 2009. A significant leak was again repaired during the 2011 well inspection. In 2016 a failure of both LevelTrolls occurred requiring complete bleed-off of the well to install replacements. The pressure response shows that while the lower pressure regime appears to have returned to the previous trend, the wellhead pressure shows fall-off since the LevelTroll was replaced. This indicates that with the release of the wellhead pressure of nearly 300 psi during the well bleed-off, water was allowed to substantially flow to the well and disrupt the previous pressure regime. 2018-2019 pressure

data demonstrates that following this bleed-off the wellhead pressure has remained depressed at approximately 30 psi and relatively stable. This is likely because the water head pressure of approximately 500 feet (215 PSI) is effectively preventing significant gas build-up at the wellhead.

Figure 2-8
Pressure Transducer Data
Beaver Creek Ranch Well MW-35-6-17-1

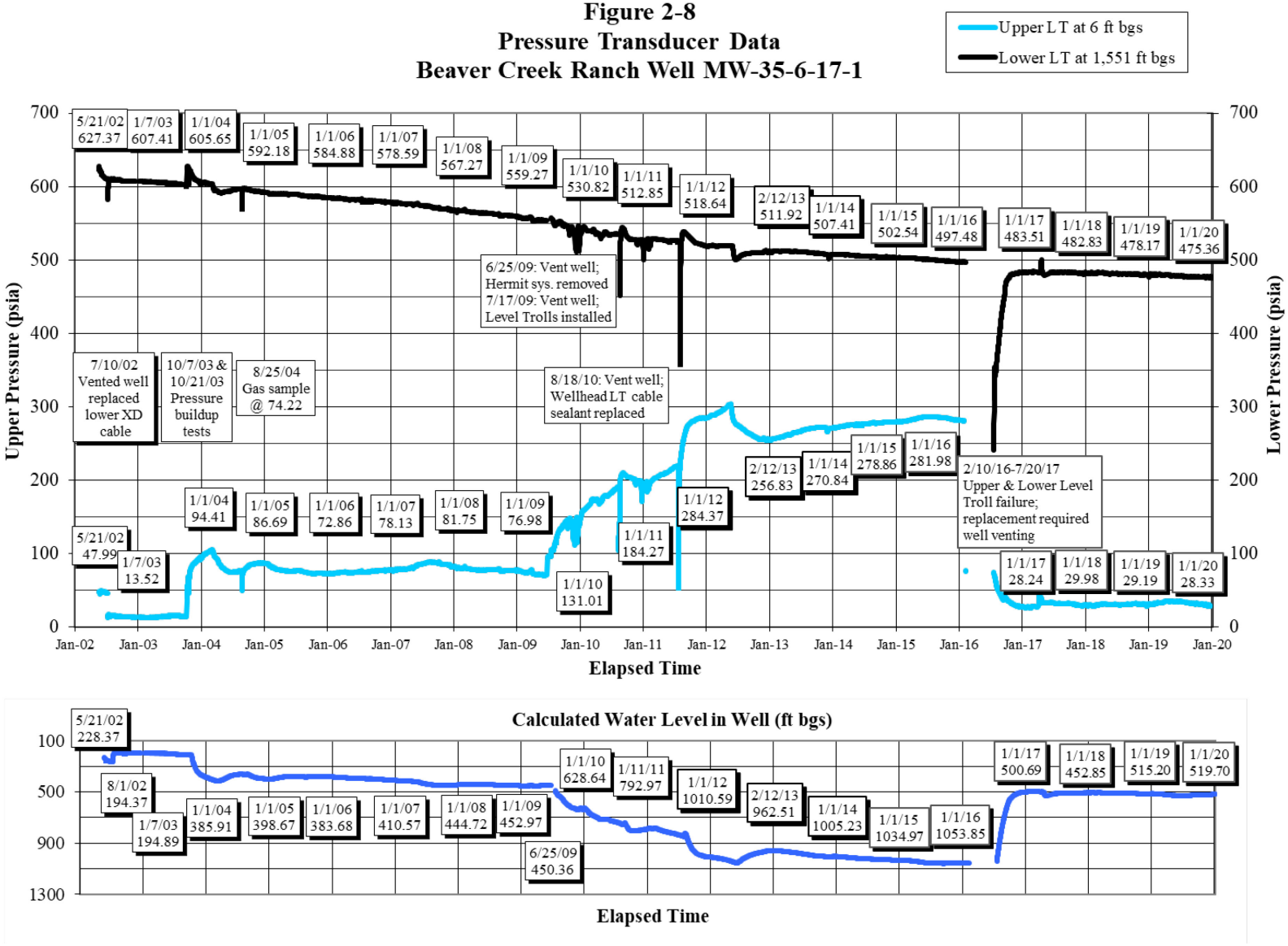

Figure 2-8
Pressure Transducer Data Beaver Creek Rach Well MW-35-6-17-1

2.6.2 MW 35-6-17-2

Wellhead pressure, downhole pressure, and calculated well water level data for well MW 35-6-17-2 are charted in Figure 2-9 and summarized in Table 2-6 for the period of record. Monitoring of downhole pressure was terminated after the lower transducer was removed from the well for the period of record between April 22, 2004 and June 25, 2009. The Hermit data logger and wellhead PXD pressure transducer were removed on June 25, 2009. New wellhead and downhole Level Trolls were installed in well MW 35-6-17-2 on July 17, 2009 to re-enable monitoring of both wellhead and downhole pressure regimes and the water level in the well.

Figure 2-9 shows the well pressure in a declining trend for the entire period record. There is a notable shift in the well pressure curve following the installation of Level Troll instruments on July 17, 2009, followed by erratic well pressure fluctuations associated with incomplete shut-in through August 17, 2010. After the well was vented August 18, 2010 to replace the Level Troll cable fitting sealants, there was a steady build-up of well pressure through early September 2010 followed by a return to a declining trend through the period of record.

As shown on Figure 2-9, no water level data is available for the 6-year period of record when there was only one well pressure transducer. Well pressure data available after installation of wellhead and downhole Level Trolls on July 19, 2009 shows very little change in the calculated water level and very little, if any seasonal influence on the overall well pressure regime, which is relatively linear decrease perhaps due to nearby coalbed methane production.

Figure 2-9
Pressure Transducer Data
Beaver Creek Ranch Well MW-35-6-17-2

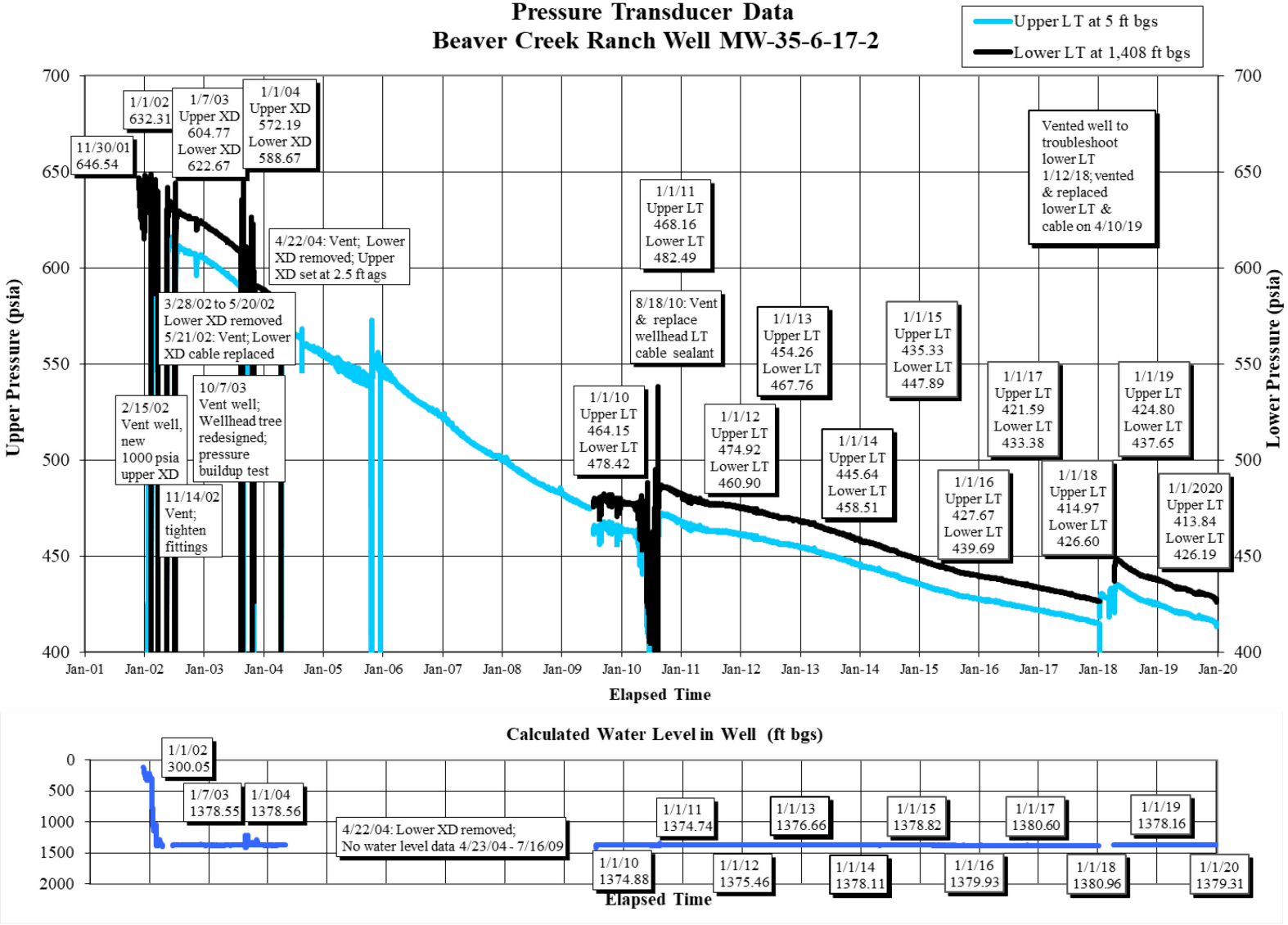

Figure 2-9
Pressure Transducer Data Beaver Creek Ranch Well MW-35-6-17-2

2.7 SHAMROCK MINES

Well MW 35-6-13-1 monitoring data are charted in Figures 2-10 and summarized in Table 2-7 for the entire 16.5-year period of record. Since there are no producing wells in close proximity to this area, this well is used to collect background data and has been monitored continuously since May 22, 2002.

Table 2-7
Well Pressure Data Summary for Shamrock Mines Monitoring Well

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 35-6-13-1 Upper	5/22/02 to 1/1/20	12.06	11.26	Atmospheric Pressure	39.66	57.90	-18.24
Lower		211.60	208.13	-3.47			

Figures 2-10 shows the wellhead pressure regime continues to be at atmospheric pressure and fluctuates within a range of 2 psi (between 10 psia and 12 psia). During the months of April and May 2010, the wellhead pressure steadily increased to around 13.4 psia. Wellhead pressure returned to the historic atmospheric pressure trend after the Level Troll wellhead cable sealants were replaced on June 2, 2010.

Figure 2-10 also shows the downhole pressure and calculated water level in the well continued to exhibit an overall declining well pressure trend for the period of record since April 2005. With wellhead pressure equal to atmospheric pressure, fluctuation of downhole pressure is associated with the fluctuation of the water level in the well. Downhole pressure and corresponding calculated water levels have documented seasonal groundwater recharge events following the wet winters of 2007-2008, 2009-2010, 2016-2017 and 2018-2019.

Figure 2-10
Pressure Transducer Data
Shamrock Mines Well MW-35-6-13-1

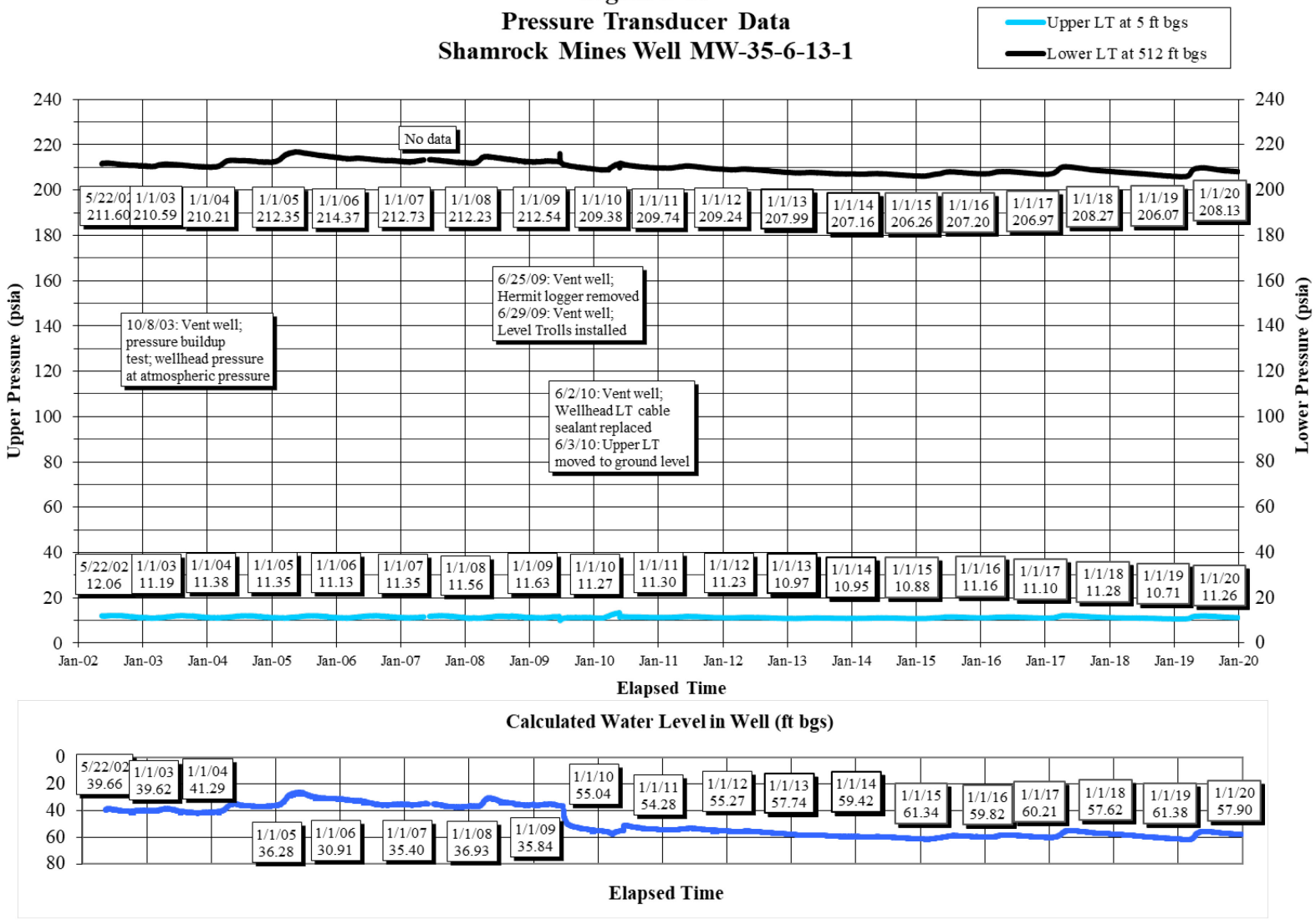

Figure 2-10
Pressure Transducer Data Shamrock Mines Well MW-35-6-13-1

3.0 ARCHULETA COUNTY MONITORING WELL DATA SUMMARY

Monitoring well pressure was measured and recorded twice daily (12-hour interval) at the 4 monitoring well sites located in Archuleta County, Colorado. Applicable well pressure and calculated water level data for the entire period of record for each monitoring well are plotted in annotated charts.

3.1 WAGON GULCH

Monitor wells MW 34-5-4-1 and MW 34-5-4-2 have been monitored since December 2, 2008. Initial and ending monitoring well pressures and calculated water levels in the wells for the period of record are summarized in Table 3-1.

Table 3-1
Well Pressure Data Summary for Wagon Gulch Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 34-5-4-1 Upper	12/26/08 to 1/1/20	50.14	27.27	-22.87	650.74	305.44	345.30
Lower		131.88	238.95	107.07			
MW 34-5-4-2 Upper	5/1/09 to 1/1/20	48.50	51.35	2.85	Upper transducer is under water at 2.5 ft below ground level		
Lower		391.07	379.16	-11.91			

3.1.1 MW 34-5-4-1

Figure 3-1 charts the upper and lower pressure transducer data and the calculated water level in the well. Although the well was shut in for monitoring on December 2, 2008, the wellhead pressure did not reach an initial stable pressure of about 50.1 psia until December 26, 2008, 24 days after shut-in. Table 3-1 and Figure 3-1 show approximately 23 psi net decline in wellhead pressure for the entire 11-year period of record from December 26, 2008 (50.14 psia) to January 1, 2020 (27.27 psia). Figure 3-1 shows the trend of decreasing wellhead pressure continued in 2010 until the trend reversed in mid-November 2010. From that time until 2012, the wellhead pressure increased approximately 8.25 psi before becoming relatively stable to date.

Table 3-1 and Figure 3-1 show a net increase in downhole pressure of 107.07 psi for the entire 11-year period of record from December 26, 2008 (131.88 psia) to January 1, 2020 (238.95 psia). The well pressure increase is primarily due to the 345.30 feet of net water level rise in the well since December 26,

2008. Figure 3-1 shows the trend of rising water level with corresponding increasing downhole pressure continued in 2010 until the trend reversed in mid-September 2010. This may have been related to the transducer cable sealant being changed on August 17, 2010 and possibly eliminating a partial shut-in condition. No leaks were detected during the site inspections in 2012-2014. Between October 1, 2010 and December 31, 2010, Figure 3-1 shows the water level decreased about 21.2 feet while the downhole pressure decreased about 2.7 psia.

During the winters of 2011-2012, 2012-2013, 2013-2014 and 2014-2015 pressure spikes in the upper transducer occurred due to the pressure transducer freezing within its deployment location in the wellhead 2.3 feet above ground surface. These are not actual increases in gas pressure within the well casing, but rather caused when the air volume next to the transducer inlet is trapped and then compressed by expanding frozen water condensate. When the 2011 well inspection was conducted at MW 34-5-4-1 the well was vented to ensure that the transducer would return to atmospheric pressure; this test successfully showed that the transducer continued to function properly and was not damaged. The transducer recovered after surface temperatures warmed each spring. The transducer was inspected for damage in each subsequent site visit since this problem began in 2011 until the 2015 site inspection when the Level Troll was replaced and lowered into the well to 7 ft bgs. As evidenced by the winter 2015 data shown in Figure 3-1, the condensate freezing problem in this location has been corrected by lowering the Level Troll below the ground surface.

Several pressure decreases on the order of 10 psi were observed by both the upper and lower transducers in the second half of 2018 and again in the second half of 2019. The duration of each event was on the order of days to weeks and full recovery to static pressure conditions occurred after each event. These are possibly responses to local drilling or water production from the monitored coal seam.

Figure 3-1
Pressure Transducer Data
Wagon Gulch Well MW-34-5-4-1

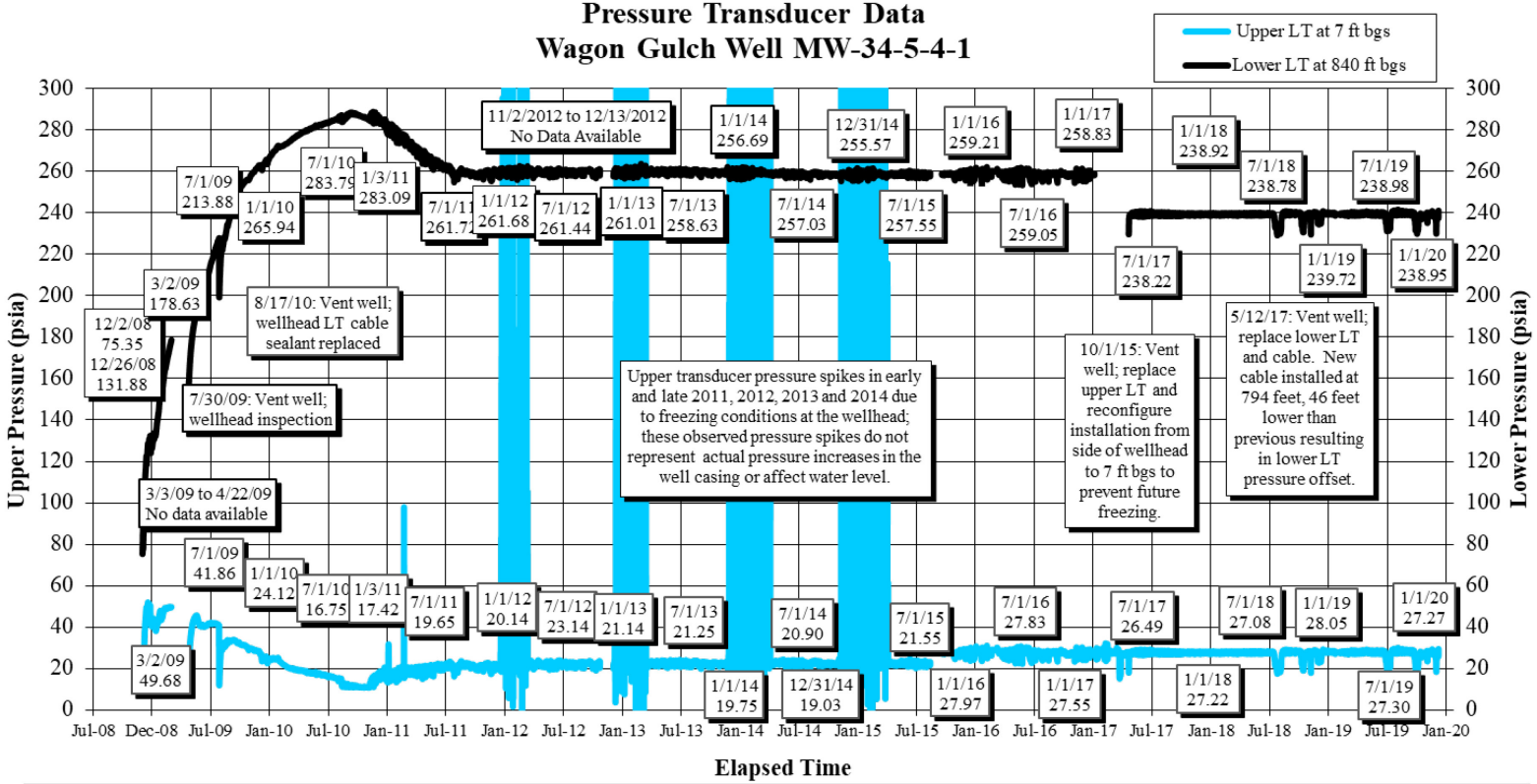

Figure 3-1
Pressure Transducer Data Wagon Gulch Well MW-34-5-4-1

3.1.2 MW 34-5-4-2

Figure 3-2 charts the upper and lower pressure transducer data and the estimated water level in the well. Although the well was shut in for monitoring on December 4, 2008, a well pressure build-up to a stable downhole pressure of about 391 psi and wellhead pressure of about 47-48 psia were not confirmed until May 2009. No data are available from February 15, 2009 to April 23, 2009 due to pressure transducer malfunction.

Figure 3-2 shows a relatively constant wellhead pressure of about 47 to 48 psia between April 24, 2009 and October 25, 2009. An erratic pressure spiking pattern between October 26, 2009 and May 12, 2010 suggested wellhead Level Troll pressure sensor freeze damage, so the data were omitted from Figure 3-2. Between May 13, 2010 and August 16, 2010, the wellhead pressure remained fairly constant at around 47 psia.

Freeze damage to the upper Level Troll pressure transducer sensor was confirmed after the well was vented on August 17, 2010. As noted on Figure 3-2, the water level inside the open wellhead was at a height of about 2.5 feet above ground level. The new upper Level Troll was changed from an external mount to an internal depth setting of 2.5 ft bgs on August 17, 2010 to protect the transducer sensor from freezing conditions. After well shut-in on August 17, 2010, Figure 3-2 shows a relatively rapid return of wellhead pressure to an average constant pressure of about 50 psia.

The lower Level Troll cable was damaged during replacement of Level Troll wellhead cable sealants on August 17, 2010. Cable repair performed on September 9, 2010 included raising the Level Troll 17 feet from 780 ft bgs to 763 ft bgs. As a result of this change, Figure 3-2 shows a shift in the downhole pressure curve to a corrected constant downhole pressure regime of 378 to 379 psia.

As noted above, the water level was inside the open wellhead at a height of about 2.5 feet above ground level on August 17, 2010. The wellhead pressure build-up after shut-in may reflect water and/or gas pressure build-up. For charting purposes, the water level in the shut-in well is estimated to be at or near ground surface above the upper Level Troll (set at 2.5 ft bgs). However, there is a possibility that the observed build-up in wellhead pressure is from gas pressure, which could result in a downward displacement of the water in the well to some level below the upper Level Troll.

The pressure regime observed in 2019, as well as for the full period of record since post-completion stabilization in 2009, has been quite stable with an overall minor decreasing trend.

Figure 3-2
Pressure Transducer Data
Wagon Gulch Well MW-34-5-4-2

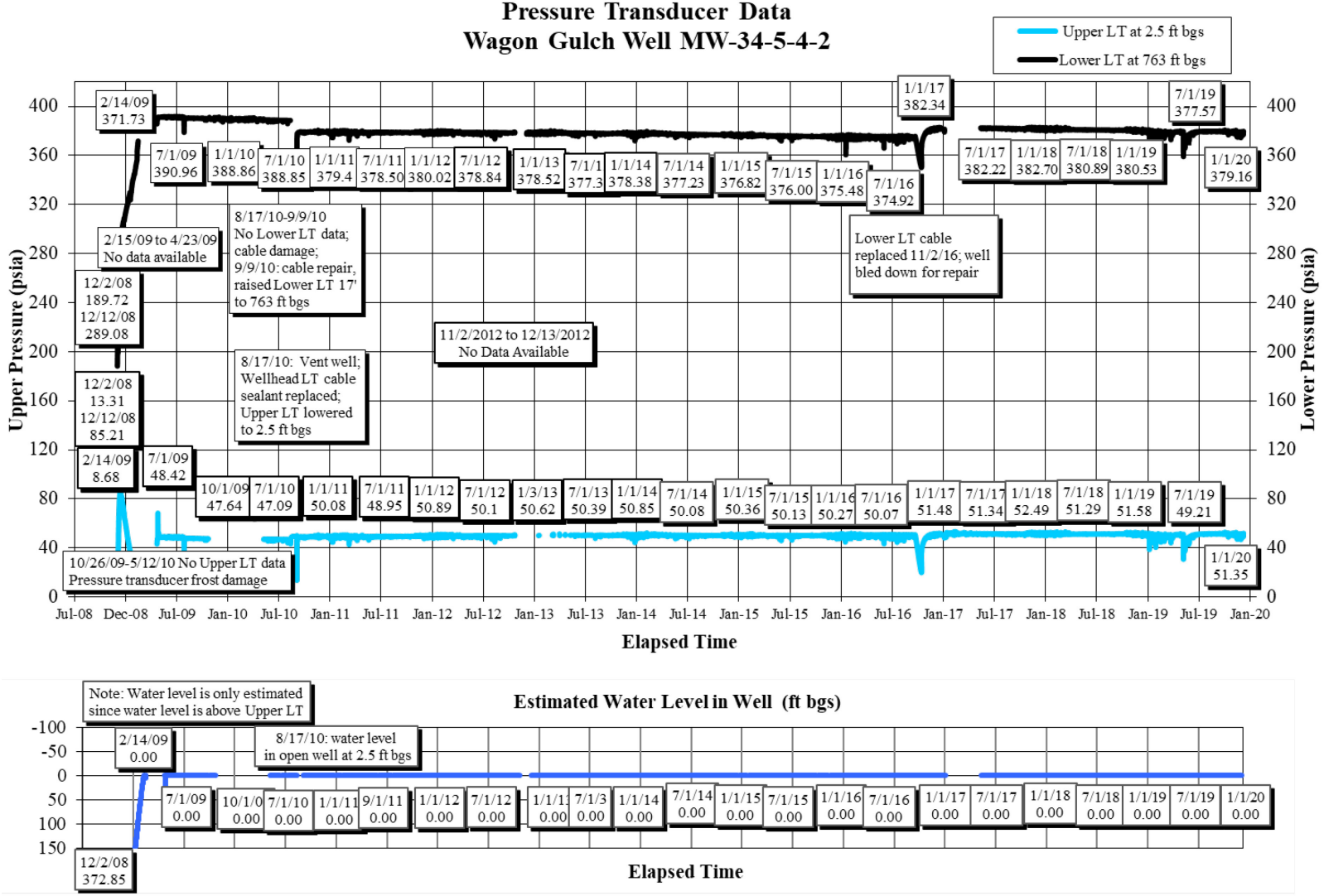

Figure 3-2
Pressure Transducer Data Wagon Gulch Well MW-34-5-4-2

3.2 FOSSET GULCH

Monitor wells MW 34-5-14-1 and MW 34-5-14-2 have been monitored since December 4, 2008. Initial and ending monitoring well pressures and calculated water levels in the wells for the period of record are summarized in Table 3-2.

Table 3-2
Well Pressure Data Summary for Fosset Gulch Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 34-5-14-1 Upper	12/4/08 to 1/1/20	11.31	15.05	3.74	43.58	50.38	-6.80
Lower		213.52	214.19	0.67			
MW 34-5-14-2 Upper	12/4/08 to 1/1/20	11.35	19.27	7.92	39.29	50.38	-11.09
Lower		242.65	240.05	-2.60			

3.2.1 MW 34-5-14-1

Figure 3-3 charts the upper and lower pressure transducer data and the calculated water level in the well. Table 3-2 and Figure 3-3 show the wellhead pressure at atmospheric pressure prior to 2010 followed by a gradual increase in pressure through August 16, 2010 to 14.19 psia. Following the August 17, 2010 well maintenance event including venting, the wellhead pressure has remained relatively constant within a normal atmospheric pressure range through November 16, 2016. At that time, upper transducer replacement required venting the wellhead. Following the maintenance, the wellhead pressure increased slowly until July 2018 when it began to trend down. This is likely a response to gas production stimulation that occurred when the well was vented. Figure 3-3 shows a stable downhole pressure trend (213.52-214.19 psia) for the entire period of record. Figure 3-3 also shows a stable water level averaging 43.0 ft bgs until November 2009, followed by a gradually declining water level trend through July 1, 2010 (50.13 ft bgs). The water level increased to 49.28 ft bgs until the well was vented on August 17, 2010. The water level immediately rose to 44.36 ft bgs when the well was vented on August 17, 2010 but has since followed apparent gentle seasonal fluctuation until November 16, 2016. At that time, the well was vented to replace the upper pressure transducer. Upon replacement, the pressure measured at the wellhead has steadily increased from approximately 12.20 psi to 17 psi on January 1, 2019 and then changed to a decreasing pressure trend. As such, the calculated water level was in steady decline during this time period as gas pressure has apparently depressed it. Likewise, with the 2018 reversal of the wellhead gas pressure

increase trend to a decreasing trend, the calculated water level is now shown to be increasing through 2019.

Figure 3-3
Pressure Transducer Data
Fosset Gulch Well MW-34-5-14-1

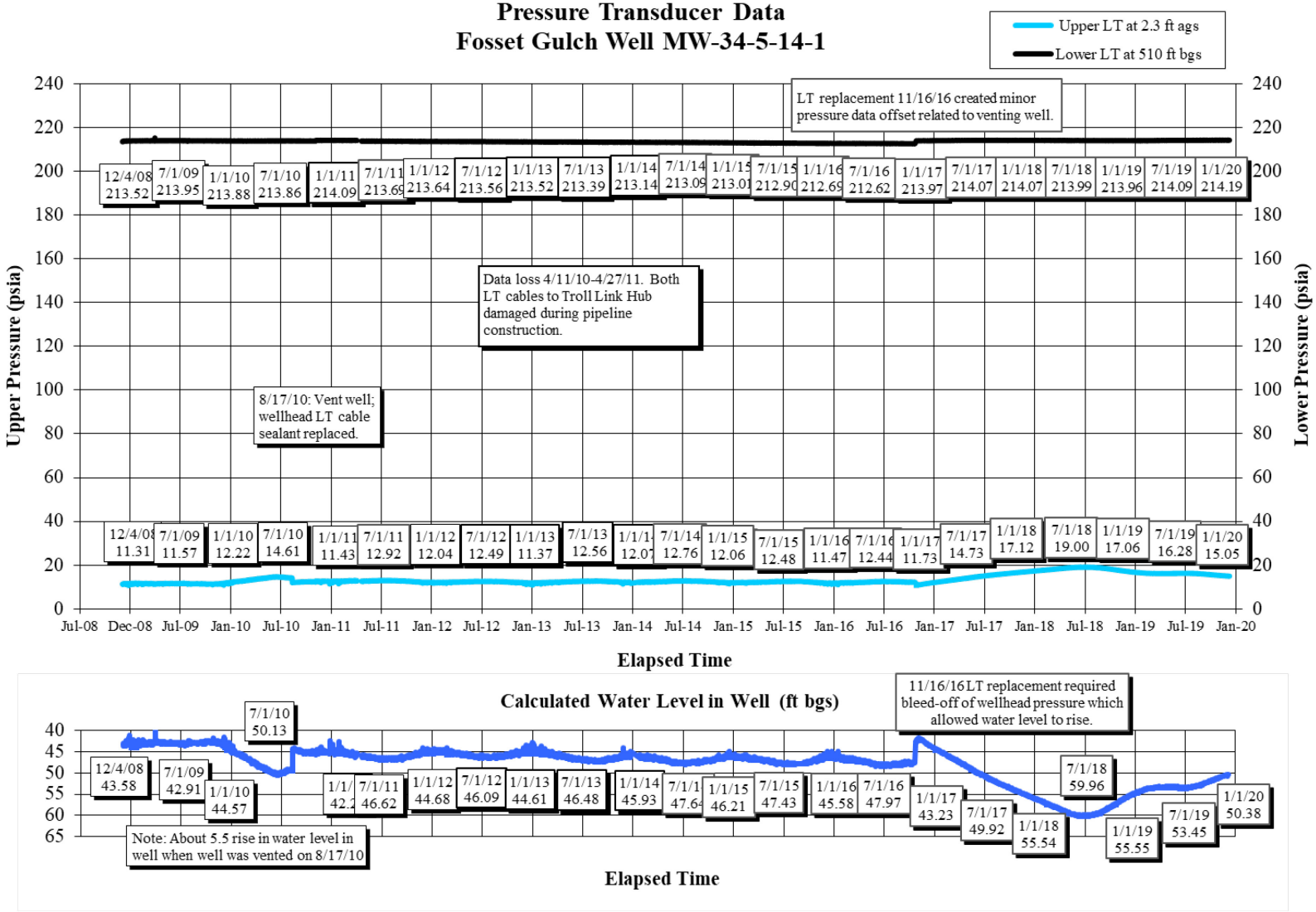

Figure 3-3
Pressure Transducer Data Fosset Gulch Well MW-34-5-14-1

3.2.2 MW 34-5-14-2

Figure 3-4 plots the upper and lower pressure transducer data and the calculated water level in the well. Although the well was shut in for monitoring on December 4, 2008, wellhead pressure did not stabilize at about 17 psia until July 2009. Table 3-2 and Figure 3-4 show a net increase of 7.13 psi in wellhead pressure for the period of record between December 4, 2008 (11.35 psia) and January 1, 2019 (18.48 psia). Figure 3-4 shows a stable but slightly declining downhole well pressure trend for the entire period of record, with fluctuations ranging between a minimum pressure of about 240.12 psia to a maximum pressure of 242.78 psia. The downhole pressure was 240.05 psia on January 1, 2020.

Table 3-2 indicates a net water level drop of 11.09 feet in the well as of January 1, 2020. However, Figure 3-4 shows that the wellhead pressure and water level on January 1, 2019 has possibly shown an effect of venting MW 34-5-14-1 for maintenance on 11/16/16. This would suggest some amount of hydraulic connection between the two wells. Although there is an immediate drop in wellhead pressure and corresponding rise in the water level each time the well is vented to the atmosphere in the past, Figure 3-4 also shows the build-up in wellhead pressure takes approximately 12 months to return to the pressure exhibited prior to each venting event so unless required for servicing the instrumentation, the well will not be vented in attempt to determine the static wellhead pressure.

Figure 3-4
Pressure Transducer Data
Fosset Gulch Well MW-34-5-14-2

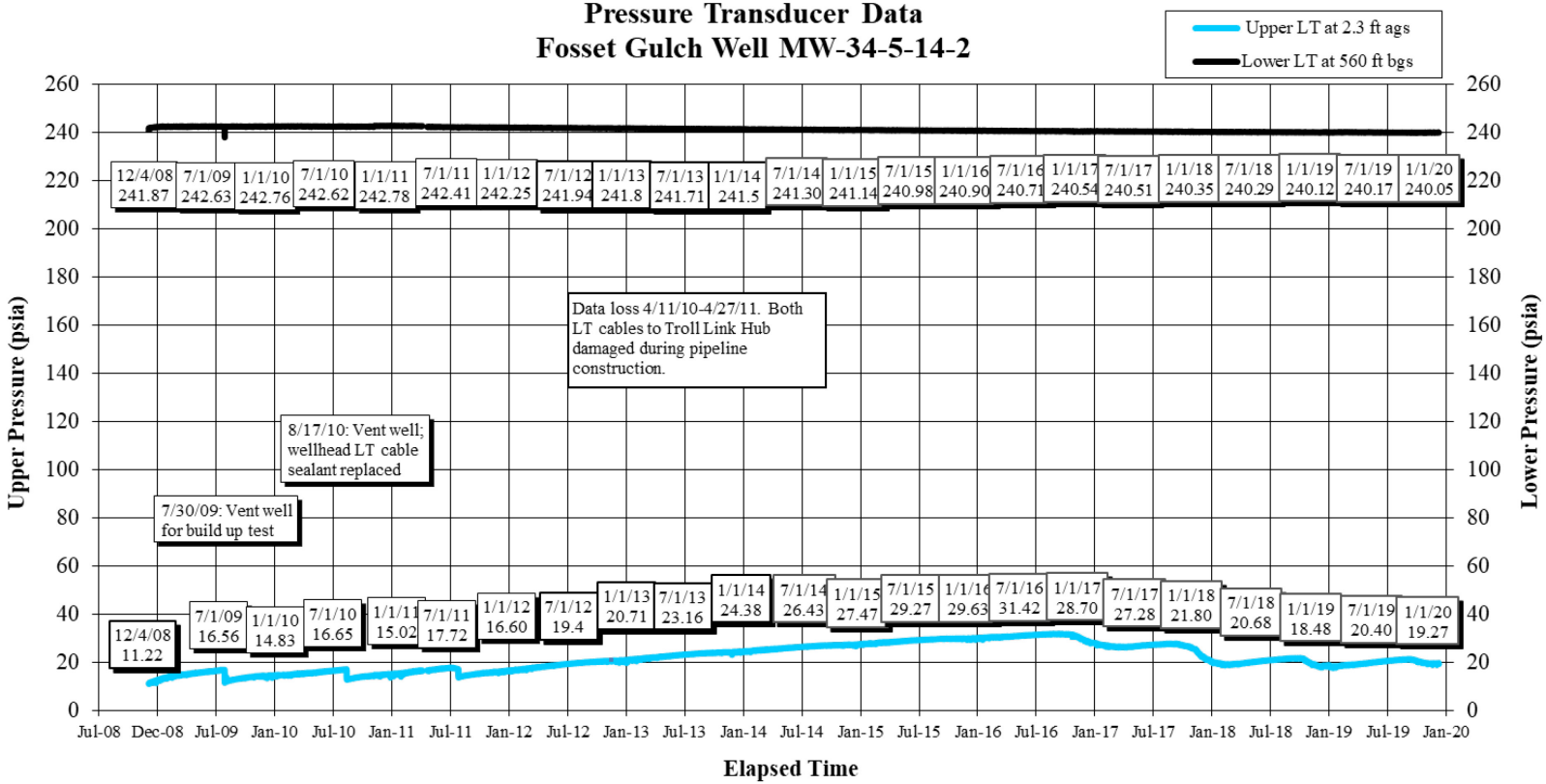

Figure 3-4
Pressure Transducer Data Fosset Gulch Well MW-34-5-14-2

3.3 HIGHWAY 151

Monitor wells MW 34-4-30-1 and MW 34-4-30-2 have been monitored since December 3, 2008. Initial and ending monitoring well pressures and calculated water levels in the wells for the period of record are summarized in Table 3-3.

Table 3-3
Well Pressure Data Summary for Highway 151 Monitoring Wells

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 34-4-30-1 Upper	12/3/08 to 1/1/20	11.56	11.40	Atmospheric Pressure	35.54	32.45	3.09
Lower		104.43	105.66	1.23			
MW 34-4-30-2 Upper	12/3/08 to 1/1/20	13.18	13.75	0.57	41.65	44.95	-3.3
Lower		129.59	128.59	-1.00			

3.3.1 MW 34-4-30-1

Figure 3-5 charts the upper and lower pressure transducer data and the calculated water level in the well. Table 3-3 and Figure 3-5 show a relatively stable well pressure regime with a stable wellhead pressure trend at atmospheric pressure, a stable downhole pressure trend of about 104-107 psia, and a fluctuating water level trend of 30-39 ft bgs since August 2009. Sharp fluctuations in both wellhead pressure and the calculated water level shown on Figure 3-5 correspond to the immediate loss of pressure when the well is vented (e.g., June 2, 2010), followed by a gradual return to the well pressure regime exhibited prior to venting the well.

Figure 3-5
Pressure Transducer Data
Highway 151 Well MW-34-4-30-1

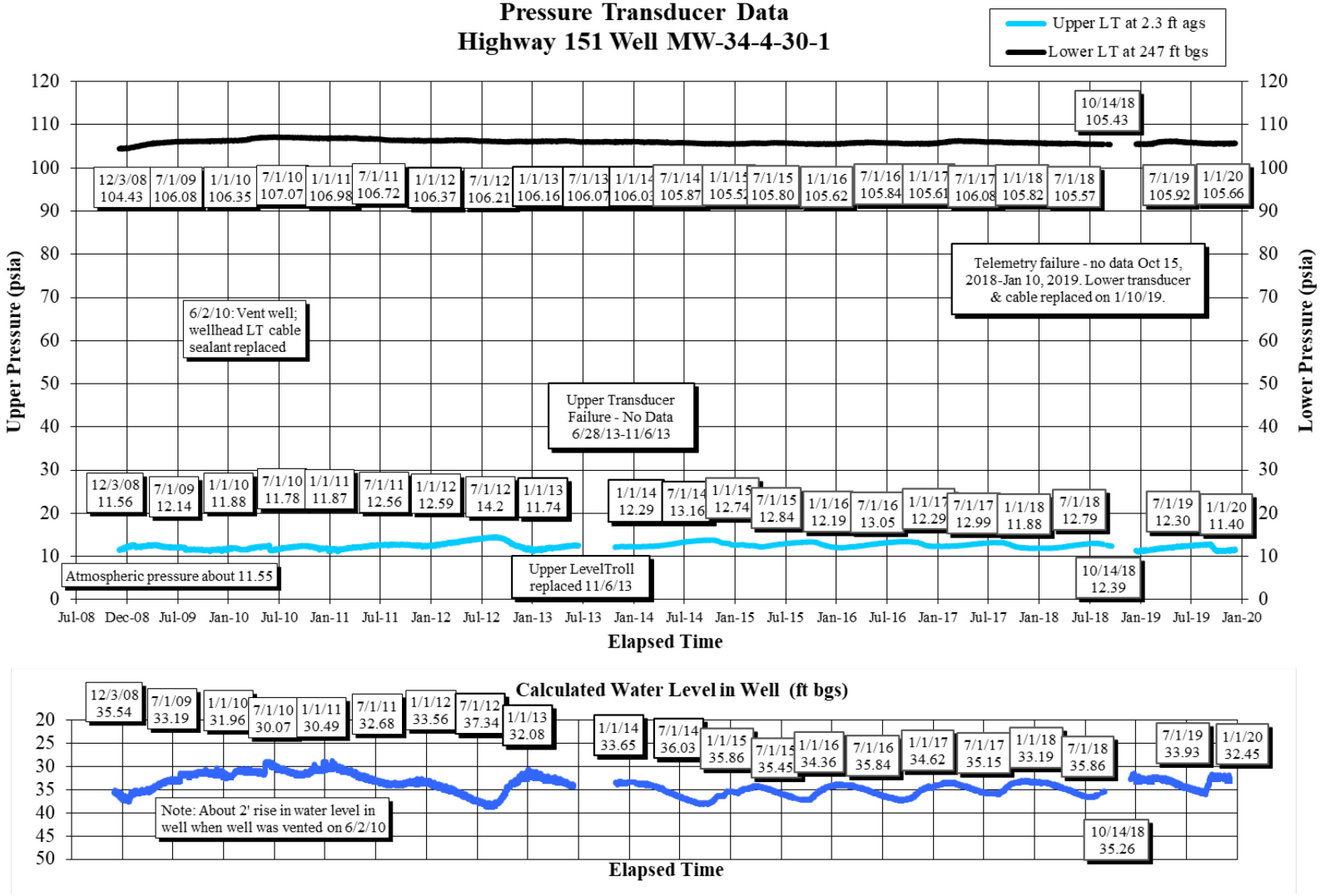

Figure 3-5
Pressure Transducer Data Highway 151 Well MW-34-4-30-1

3.3.2 MW 34-4-30-2

Figure 3-6 charts the upper and lower pressure transducer data and the calculated water level in the well. Table 3-3 and Figure 3-6 shows a stable downhole pressure trend with 1.00 psi change from 129.59 psia on December 3, 2008 to 128.59 psia on January 1, 2020. In addition, there was a net wellhead pressure decrease of 0.57 psi with a corresponding net water level decline of 3.30 feet for the entire period of record from December 3, 2008 to January 1, 2020. However, the wellhead pressure decreased slowly in the fourth quarter of 2017 with a loss measured at approximately 4.3 psi in 3 months. The pressure then stabilized at atmospheric pressure and has remained in that range through 2019. The well was inspected in 2019 during routine maintenance and no wellhead pressure leaks were found.

Figure 3-6
Pressure Transducer Data
Highway 151 Well MW-34-4-30-2

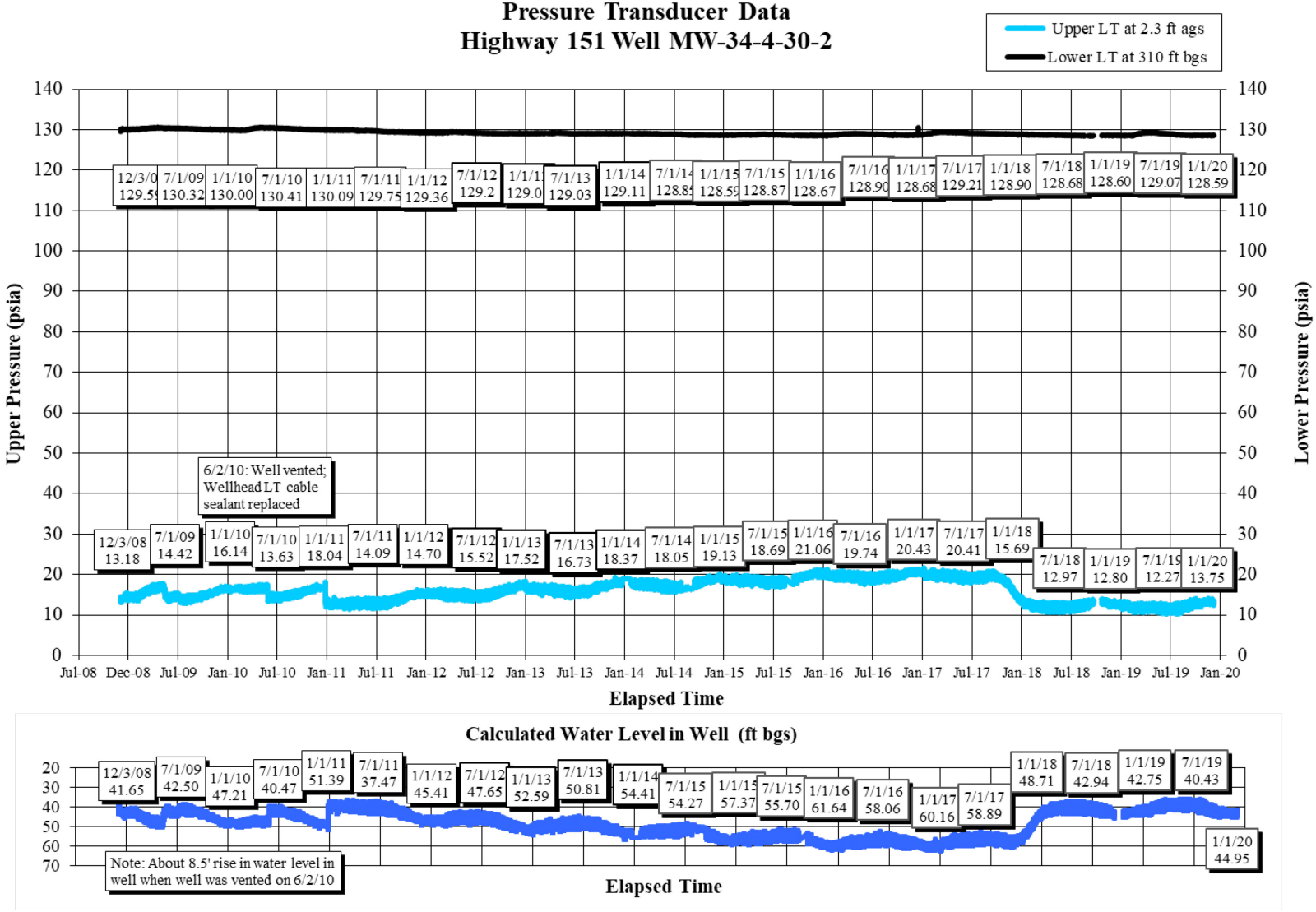

Figure 3-6
Pressure Transducer Data Highway 151 Well MW-34-4-30-2

3.4 DEEP CANYON

Monitor well MW 34-4-32-1 has been monitored since June 2, 2010. Initial and ending well pressures and calculated water levels in the monitor well are summarized in Table 3-4 for the indicated period of record.

Table 3-4
Well Pressure Data Summary for Deep Canyon Monitoring Well

Well ID and Transducers	Period of Record	Initial Shut-In Well Pressure (psia)	Ending Shut-In Well Pressure (psia)	Net Change in Well Pressure (psi)	Initial Water Level in Well (ft bgs)	Ending Water Level in Well (ft bgs)	Net Change in Water Level (ft)
MW 34-4-32-1 Upper	6/8/10 to 1/1/20	13.41	11.34	-2.07	251.21	258.60	-7.39
Lower		270.90	269.94	-0.96			

3.4.1 MW 34-4-32-1

Figure 3-7 charts the upper and lower pressure transducer data and the calculated water level in the well. Table 3-4 and Figure 3-7 show the well pressure initially stabilized on June 8, 2010, six days after the well was shut in for monitoring on June 2, 2010. Table 3-4 and Figure 3-7 also show a relatively stable well pressure regime for the 9.5-year period of record through November 23, 2018 with only a slight increase in well pressure and a corresponding net water level decrease of 7.39 feet in the well. Data for this well is limited from November 23, 2018 due to an upper Level Troll transducer failure. When investigated in early 2019 after the location was accessible it was found that the surface cable for this Level Troll was damaged by what appeared to be a bear mauling based on the type of cable damage and muddy paw prints on the telemetry instrumentation enclosure. At that time the cable was repaired, the Level Troll was replaced and full function has resumed.

Figure 3-7
Pressure Transducer Data
Deep Canyon Well MW-34-4-32-1

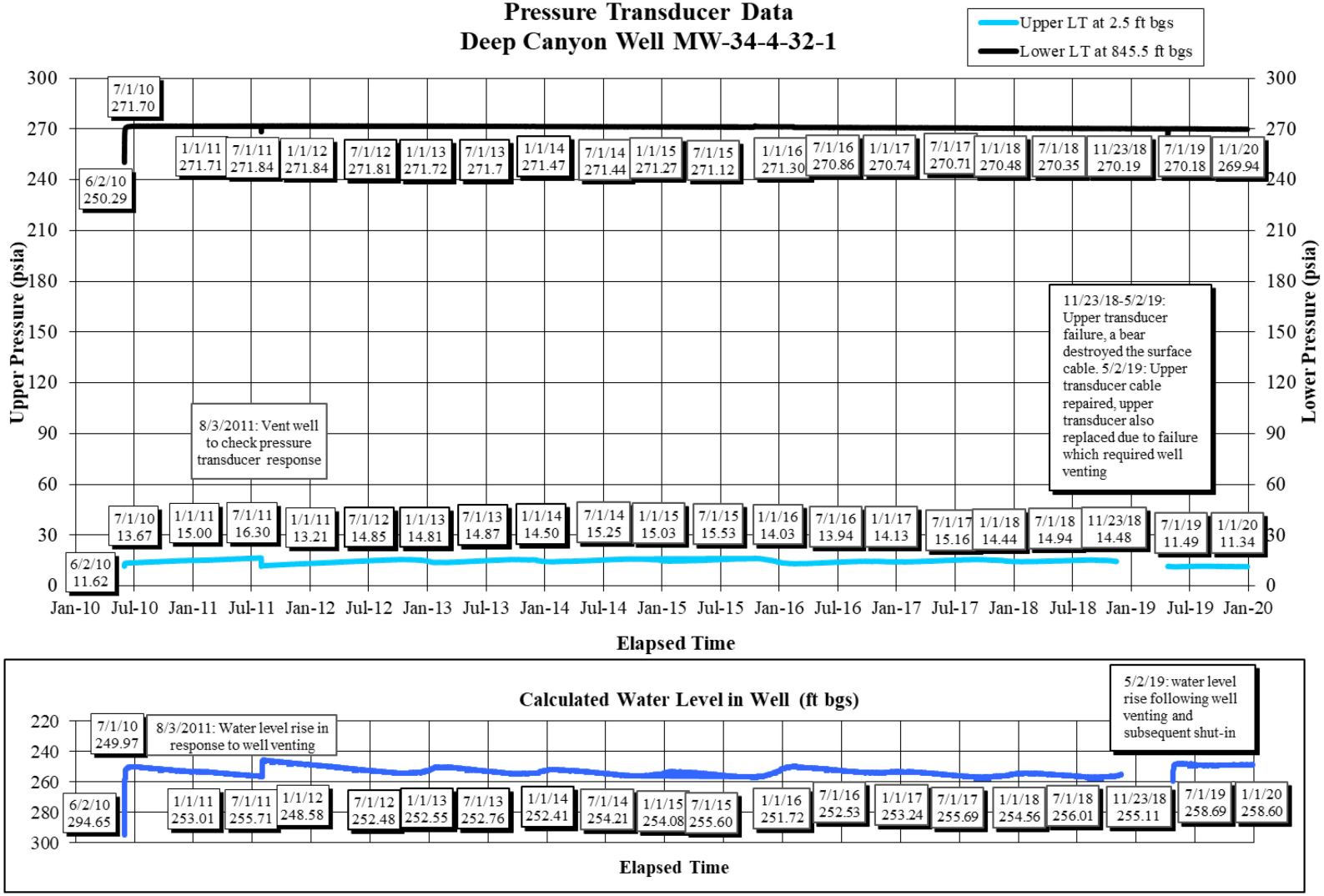

Figure 3-7
Pressure Transducer Data Deep Canyon Well MW-34-4-32-1

4.0 FUTURE WORK

Future routine work will consist of periodic field checks of each monitoring system and remote retrieval of recorded pressure measurement data using the In-Situ Inc. TROLL® Link telemetry system and ISI Data Center. COGCC staff will schedule an inspection and testing of all wellhead components and instruments during 2020 when all monitoring well sites are safely accessible and replacement equipment, as needed, has been procured.

Specifically, all site instrumentation enclosure desiccants will be replaced. Additionally, the Fiddler well (MW 35-8-10-1) will be visited for troubleshooting to determine the cause of the missed telemetry data reporting by the lower transducer in late 2019. The lower transducer and/or cable will be replaced as necessary to return full data collection at this location.

APPENDIX A
4M PROJECT MONITOR WELL CHRONOLOGY

4M Project Monitor Well Chronology

Location	Well	2001				2002								
		Jan	Sep	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Oct - Nov	Dec
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	Survey	Jan. 18:Tighten wellhead fittings; rewire telemetry sys	Replace telemetry 12v battery sys, In-Situ assist							Lost telemetry communitcation with data logger
	MW 34-9-7-2								April 24-25: Drill & install well	May 5: Perforate well May 9: Fish out cable May 22: Install xds	Survey			
Palmer Ranch	MW-35-8-19-1													
Fiddler	MW-35-8-10-1													
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 xd cables	Survey	Jan. 18: Tighten wellhead fittings; rewire telemetry sys	Replace telemetry 12v battery sys, In-Situ assist			May 21: Ck for leaks				Dec. 4: Data lost through end of year due to Hermit internal battery failure; lost telemetry communitcation with data logger Dec 7: Tightened wellhead fittings
	MW 35-7-8-2		Sept. 20-21: Drill/install well Sept. 27: Perforate well	Nov. 29: Set up telemetry unit; replace bad xd cables	Survey	Jan. 18: Tighten wellhead fittings				May 21: Ck for leaks			Oct 25: Vent well; replaced strain relief fittings; shut in well	
BP Highlands	MW-34-7-15-1													
Beaver Creek Ranch	MW 35-6-17-1						Replace telemetry 12v battery sys, In-Situ assist	Mar. 5-Apr 4: Drill & install well		May 2: Perforate well; May 20-21: Install xds	Survey	July 10: Replace lower xd cable with unvented cable		Dec 13: Insp by Raymond Const.- no wellhead gas leak; logger batt @ 0% capacity; modem problem Dec. 19: Data lost through end of year due to bad data logger bkup battery
	MW 35-6-17-2		Sept. 22-Oct. 4: Drill/install well	Nov. 26: Perforate well Nov. 27: Set up telemetry unit	Survey	Jan. 17 - Install new xd cables with SwageLok 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; shut in well		Gas leak @ top bushing; July 10: Vent well & ck bushing seals; July 11: shut in well	Nov. 14: Vent well; replaced 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 & data logger systems, & xds	Survey			Lost telmetry communitcation with data logger
Wagon Gulch	MW-34-4-30-1													
	MW-34-4-30-2													
Fosset Gulch	MW-35-5-14-1													
	MW-35-5-14-2													
Highway 151	MW-34-4-30-1													
	MW-34-4-30-2													
Deep Canyon	MW-34-4-32-1													

4M Project Monitor Well Chronology

Location	Well	2003					2004		
		Jan	Feb - Apr	May - Jun	Aug	Oct - Dec	Jan - Mar	Apr	Aug
Basin Creek	MW 34-9-7-1	Jan 20: New well 34-9-7-1 upper xd (30 psig, sn 7201); rewire pwr regultr; replace logger bkup lith. batt; re-flash modem memory; enable modem auto pwr-up	Telemetry system malfunction	May 20: Replace modem and cell phone	Aug 21: Vent both wells and tighten wellhead xd cable strain relief fittings	Oct 8: Conduct rapid blowdown & shutin test			Aug 25: New data logger battery pack; vent well; gas sample
	MW 34-9-7-2				Aug 21: Vent both wells and tighten wellhead xd cable strain relief fittings	Oct 8: Conduct rapid blowdown & shut-in test		Apr 23: vent well & raise upper xd from 5 fbgs to ground surface	Aug 25: vent well; raise upper xd to 1.65 ft above ground; gas sample
Palmer Ranch	MW-35-8-19-1								
Fiddler	MW-35-8-10-1								
South Fork Texas Creek	MW 35-7-8-1	Jan 20: rewire pwr regultr; replace logger bkup lith. batt; re-flash modem memory; enable modem auto pwr-up	Telemetry system malfunction;	June 16: lower xd failed		Oct 8: Well pressure buildup test	No data reported for 6/16/03 to 4/22/04 - lower xd failed	Apr 22: vent well; temperarily replaced lower xd with 1000 psia xd	Aug 25: New data logger battery pack; vent well; tighten xd fittings; gas sample
	MW 35-7-8-2			May 20: Replace modem and cell phone		Oct 8: Well pressure buildup test	Well pressure data suggest that wellhead xd cable strain relief fittings leak intermittently in winter	Apr 22: vent well; replaced strain relief fittings	Aug 25: vent well; tighten xd fittings replace lwr 1000 psia xd with new 500 psia xd; gas sample
BP Highlands	MW-34-7-15-1								
Beaver Creek Ranch	MW 35-6-17-1	Jan 7 & Jan 21: No wellhead gas leak @ MW35-6-17-2 Jan 21: rewire pwr regultr; replace logger bkup lith. batt; re-flash modem memory; enable modem auto pwr-up	Telemetry system malfunction	May 20: Replace modem and cell phone;		Oct 7 & 21: Well pressure buildup test			Aug 24: New data logger battery pack; vent well; Aug 25: gas sample
	MW 35-6-17-2		Wellhead bushing leak	May 20: Wellhead bushing leak; wellhead assembly to be redesigned	Aug 20: New flanged wellhead assembly; xd cable leak at swagelok fitting	Oct 8 & 21: Well pressure buildup test; wellhead leaks @ pressure >570 psia;	Wellhead leaks @ pressure >570 psia	Apr 22: vent well/removed lower xd; attached upper xd externally to wellhead; no leaks	Aug 24: vent well; Aug 25: gas sample
Shamrock Mines	MW 35-6-13-1	Jan 21: rewire pwr regultr; replace logger bkup lith. batt; re-flash modem memory; enable modem auto pwr-up	Telemetry system malfunction	May 20: Replace modem and cell phone;	Aug 20: Modem pwr down; replaced 12v battery	Oct 7: Replaced 12v battery pack Oct 8: well pressure buildup tests Oct 21: Replaced solar panel			Aug 24: New data logger battery pack; vent well, no gas to sample
Wagon Gulch	MW-34-4-30-1								
	MW-34-4-30-2								
Fosset Gulch	MW-35-5-14-1								
	MW-35-5-14-2								
Highway 151	MW-34-4-30-1								
	MW-34-4-30-2								
Deep Canyon	MW-34-4-32-1								

4M Project Monitor Well Chronology

Location	Well	2005			2006			2007		
		Mar	Jun	Oct - Dec	Jan	Jun -Nov	Dec	Jun	Aug	Nov - Dec
Basin Creek	MW 34-9-7-1		June 14: Inspection			June 21: Inspection		June 20: Inspection; replace logger battery; start new test	Analog modem telemtry sys. off line; local telecom. service changed to digital by provider; Hermit logger data must be extracted to a PC on site.	Nov 12 & Dec 12: Inspection and Hermit logger data extraction
	MW 34-9-7-2		June 14: Inspection; pressure gauge leaking; vented well (artesian flow < 0.5 gpm); lowered upper xd to 4.6 fbgs (under water); replaced gauge with plug			June 21: Inspection				
Palmer Ranch	MW-35-8-19-1									
Fiddler	MW-35-8-10-1									
South Fork Texas Creek	MW 35-7-8-1		June 13: Inspection; new data logger test started			June 21: Inspection		June 20: Inspection; replace logger battery; start new test	See above	Nov 12 & Dec 12: Inspection and Hermit logger data extraction
	MW 35-7-8-2	Mar: Well pressure deviation from previous norm; possible wellhead leak or xd failure or decline in well gas pressure	June 13: Wellhead fitting leaks detected June 14: Vented well and replaced both 500 psia xds; new data logger test started	Oct 25: Vent well; replaced strain relief fittings Dec 7: Tightened wellhead fittings	Jan 3: Tightened wellhead fittings	June 21: Tightened wellhead fittings October 31: Replaced all well head fittings November 10: Developed well and water sample collected	Dec 11 &13: Tightened wellhead strain relief fittings	June 20: Wellhead fittings leak; vent well; replaced xd cables with rugged polyethylene cables		Dec 12: Wellhead strain relief cable fitting leak; vent well; installed Swaglok tube fitting on upper xd cable at wellhead
BP Highlands	MW-34-7-15-1									
Beaver Creek Ranch	MW 35-6-17-1		June 13: Inspection			June 21: Inspection		June 20: Inspection; replace logger battery; start new test	See above	Nov 12 & Dec 12: Inspection and Hermit logger data extraction
	MW 35-6-17-2		June 13: Inspection; slight leak detected from wellhead xd bushing			June 21: Inspection; slight leak detected from wellhead xd bushing October 31: Leaky wellhead xd bushing sealed				
Shamrock Mines	MW 35-6-13-1		June 13: Inspection			June 21: Inspection		June 20: Inspection; replace logger battery; start new test	See above	Nov 12 & Dec 12: Inspection and Hermit logger data extraction
Wagon Gulch	MW-34-4-30-1									
	MW-34-4-30-2									
Fosset Gulch	MW-35-5-14-1									
	MW-35-5-14-2									
Highway 151	MW-34-4-30-1									
	MW-34-4-30-2									
Deep Canyon	MW-34-4-32-1									

4M Project Monitor Well Chronology

Location	Well	2008					2009		
		May	Sep	Oct	Nov	Dec	Jun-Jul	Oct	Nov
Basin Creek	MW 34-9-7-1	May 6: Inspection and Hermit logger data extraction	Sept 3: Inspection and Hermit logger data extraction			Dec 10: Inspection and Hermit logger data extraction	June 25: Inspection and Hermit logger data extraction, removal of data logger equipment from well June 30: Installation of Level Troll data logger equipment		
	MW 34-9-7-2								
Palmer Ranch	MW-35-8-19-1							Installed Well	Nov 18: Installed Level Troll data logger & telemetry system
Fiddler	MW-35-8-10-1							Installed Well	Nov 17: Installed Level Troll data logger & telemetry system
South Fork Texas Creek	MW 35-7-8-1	May 6: Inspection and Hermit logger data extraction	Sept 3: Inspection and Hermit logger data extraction			Dec 10: Inspection and Hermit logger data extraction	June 25: Inspection and Hermit logger data extraction, removal of data logger equipment from well June 30: Installation of Level Troll data logger equipment		
	MW 35-7-8-2	May 6: Inspection and Hermit logger data extraction; Slight leak at lower xd cable wellhead strain relief fitting	Sept 3: Inspection and Hermit logger data extraction; Very slight leak at lower xd cable wellhead strain relief fitting			Dec 10: Inspection and Hermit logger data extraction; Slight leak at lower xd cable wellhead strain relief fitting			
BP Highlands	MW-34-7-15-1							Installed Well	Nov 19: Installed Level Troll data logger & telemetry system
Beaver Creek Ranch	MW 35-6-17-1	May 6: Inspection and Hermit logger data extraction	Sept 3: Inspection and Hermit logger data extraction			Dec 10: Inspection and Hermit logger data extraction	June 25: Inspection and Hermit logger data extraction, removal of data logger equipment from well June 30: Installation of Level Troll data logger equipment		
	MW 35-6-17-2								
Shamrock Mines	MW 35-6-13-1	May 6: Inspection and Hermit logger data extraction	Sept 3: Inspection and Hermit logger data extraction			Dec 10: Inspection and Hermit logger data extraction	June 25: Inspection and Hermit logger data extraction, removal of data logger equipment from well June 30: Installation of Level Troll data logger equipment		
Wagon Gulch	MW-34-4-30-1			Oct 2: Installed Well		Dec 2: Installed Level Troll data logger equipment & telemetry system			
	MW-34-4-30-2			Oct 13: Installed Well					
Fosset Gulch	MW-35-5-14-1			Oct 31: Installed Well		Dec 4 :I Installed Level Troll data logger equipment & telemetry system			
	MW-35-5-14-2			Oct 22: Installed Well					
Highway 151	MW-34-4-30-1				Nov 11: Installed Well	Dec 3: Installed Level Troll data logger equipment & telemetry system			
	MW-34-4-30-2				Nov 7: Installed Well				
Deep Canyon	MW-34-4-32-1								

4M Project Monitor Well Chronology

Location	Well	2010					2011	
		May	Jun	Aug	Sept	Nov	Apr	Aug
Basin Creek	MW 34-9-7-1	May 18: Well Inspection		Aug 18: Vented well; Replaced all wellhead LT cable Conax Teflon gland seals with Neoprene seals				Aug 2: Well inspection
	MW 34-9-7-2							
Palmer Ranch	MW-35-8-19-1	May 18: Not able to inspect well due to reclamation	Jun 3: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals					Aug 2: Well inspection, minor leak at busing below Conax fitting
Fiddler	MW-35-8-10-1	May 18: Well Inspection	Jun 3: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals; TROLL® Link cables checked/connections cleaned					Aug 2: Change out upper LT; Replaced upper LT cable
South Fork Texas Creek	MW 35-7-8-1	May 18: Well Inspection; Tightened small leak on upper LT Conax fitting		Aug 18: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals; Lower LT raised from 390 fbgs to 374 fbgs due to cable damage				Aug 2: Well inspection
	MW 35-7-8-2	May 18: Well Inspection; Tightened small leak on upper LT Conax fitting and ball plug; Ball plug fitting leak on lower LT	Jun 14-24: Well spliced into gas mitigation system Jun 25: Gas mitigation system actively drawing gas from well	Aug 6: Well shut in from gas mitigation system Aug 18: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals				Aug 2: Well inspection
BP Highlands	MW-34-7-15-1	May 18: Not able to inspect well due to reclamation	Jun 3: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals					Aug 2: Attempted toreplace upper LT but fittings too tight; blowdown test showed LT OK
Beaver Creek Ranch	MW 35-6-17-1	May 18: Well Inspection; Tightened small leak on upper and lower LT cable Conax fitting		Aug 18: Vented well; Replaced all wellhead LT cable Conax Teflon gland seals with Neoprene seals				Aug 3: Slight leak in lower LT well head Conax 3/4" bushing and well head pressure gauge fitting
	MW 35-6-17-2	May 18: Well Inspection; Tightened hissing leak on upper LT cable Conax fitting; Small leak at fitting into flange						Aug 3: Leak in with both Conax fitting 3/4" bushings
Shamrock Mines	MW 35-6-13-1	May 18: Well Inspection; No leaks; Tightened upper and lower LT cable Conax fitting	Jun 2: Vented well; Replaced both wellhead LT cable Conax Teflon gland seals with Neoprene seals Jun 3: Upper LT raised to ground level after removal of 4 ft of damaged cable					Aug 3: Well Inspection
Wagon Gulch	MW-34-4-30-1	May 18: Well Inspection; No leaks; Solar power instrument pool-cable conduit sealed		Aug 17: Vented well; Replaced lower LT wellhead cable Conax Teflon gland seal with Neoprene seal				Aug 3: blowdown; cleaned bushing
	MW-34-4-30-2			Aug 17: Vented well; Replaced lower LT wellhead cable Conax Teflon gland seal with Neoprene seal; Upper LT external mount changed to down-hole mount 2.5 fbgs	Sept 9: Vented well; raised lower LT from 780 fbgs to 763 fbgs due to cable damage			Aug 3: Well Inspection
Fosset Gulch	MW-35-5-14-1	May 18: Well Inspection; No leaks		Aug 17: Vented well; Replaced both lower LT wellhead cable Conax Teflon gland seals with Neoprene seals		Nov 11: Telemetry sys off-line; cable damage during pipeline construction	Apr 27: Surface transducer cables replaced; Telemetry system back online	Aug 3: Well Inspection; Tightened cable fitting
	MW-35-5-14-2							Aug 3: Tightened leaky bull plug
Highway 151	MW-34-4-30-1	May 18: Well Inspection; No leaks	Jun 2: Vented well; Replaced both lower LT wellhead cable Conax Teflon gland seals with Neoprene seals					Aug 3: Well head inspection
	MW-34-4-30-2							
Deep Canyon	MW-34-4-32-1	May 18: Well installed	Jun 2: Installed Level Troll data logger equipment & telemetry system					Aug 3: Well inspection; blowdown test

4M Project Monitor Well Chronology

Location	Well	2012			
		Jun	Sep	Oct	Nov
Basin Creek	MW 34-9-7-1	June 6: Well inspection; no leaks or noticeable issues			November 1: Minor leaks at bushings, left as is.
	MW 34-9-7-2				November 1: Well inspection; All ok
Palmer Ranch	MW-35-8-19-1	June 6: Well inspection; minor leak at bull plug			November 1: Well inspection; All ok
Fiddler	MW-35-8-10-1	June 6: Water leak at wingnut on well tubing head, clean and make-up wingnut, no leaks after repair	September 25: Wellhead replacement by SMA to replace original leaking wellhead; all transducers taken out of service at this time	October 31: Reinstall LTs following wellhead replacement in September. Installed new In-Situ 100PSI LT 700 as upper LT.	
South Fork Texas Creek	MW 35-7-8-1	June 6: Well inspection, All OK		October 31: Well inspection; Telemetry shack damaged approximately 2 ft above ground level to the right of east facing door.	
	MW 35-7-8-2	June 6: Well inspection, leak at 2" bull plug		October 31; minor leak on top of cross at tapped bull plug, minor leak that would require major rebuild	
BP Highlands	MW-34-7-15-1	June 6: Well inspection, All OK		October 31: Well inspection; All ok	
Beaver Creek Ranch	MW 35-6-17-1	No access to site, need new landowner access agreement		No access to site, need new landowner access agreement	No access to site, need new landowner access agreement
	MW 35-6-17-2				
Shamrock Mines	MW 35-6-13-1	No access to site, new locked FS gate			November 1: Well inspection; All ok
Wagon Gulch	MW-34-4-30-1	June 6: Well inspection; All ok			November 1: Well inspection: All ok
	MW-34-4-30-2				
Fosset Gulch	MW-35-5-14-1	June 6: Well Inspection; Tightened nut			November 1: Well inspection: Replace dust cap with 2" bull plug
	MW-35-5-14-2	June 6: Well inspection; All ok			November 1: Well inspection; All ok
Highway 151	MW-34-4-30-1	June 6: Tightened bull plugs			November 1: Well inspection; All ok
	MW-34-4-30-2				
Deep Canyon	MW-34-4-32-1	June 6: LT cable sprawled out on the ground within the stock fencing. Mud smeared on In-Situ enclosure housing batteries and solar converter (middle box). One LT cable pulled through strain relief on lowermost enclosure exposing single conductors (insulation intact). No wellhead issues observed			November 1: Well inspection; All ok

4M Project Monitor Well Chronology

Location	Well	2013	
		Sep-Oct	Nov
Basin Creek	MW 34-9-7-1	Oct 1: Well inspection, minor leak at threads between 2" tapped bull plug and Conax bushing will require removal and conditioning of threads.	Nov 6: Vent well, repair damaged threads at 2" tapped bull plug, measure water level, shut-in.
	MW 34-9-7-2	Oct 1: Well inspection, document materials needed to replace upper LT with AT, found substantial corrosion on negative battery post in the telemetry solar battery enclosure, cleaned post and tested voltage good at 14.4V	Nov 6: Vent well, replace upper LT with AT to allow water conductivity measurement and reset to same depth, measure water level, shut-in, function test AT OK
Palmer Ranch	MW-35-8-19-1	Oct 1: Well inspection; minor leak at threads between 2" tapped bull plug and Conax bushing will require removal and conditioning of threads	
Fiddler	MW-35-8-10-1	Oct 1: Well inspection, All OK	
South Fork Texas Creek	MW 35-7-8-1	Sept 30: Well inspection, All OK	
	MW 35-7-8-2	Sept 30: Well inspection, minor gas leak at 2" side of tapped bull plug at entry to 2" tee will require wellhead rebuild due to numerous attempts to fix in the past.	Nov 7: Vent well, remove upper and lower LTs, tear down wellhead, isolate old gas mitigation system 1" PVC pipeline, rebuild wellhead with all new pipe fittings, reinstall upper and lower LT's, measure water level, shut-in, function test LTs OK
BP Highlands	MW-34-7-15-1	Oct 1: No access due to road washout	
Beaver Creek Ranch	MW 35-6-17-1	No access to site, need new landowner access agreement	
	MW 35-6-17-2		
Shamrock Mines	MW 35-6-13-1	Sept 30: Well inspection, All OK, access road needs brush cutting	
Wagon Gulch	MW-34-4-30-1	Sept 30: Well inspection, All OK	
	MW-34-4-30-2	Sept 30: Well inspection, found loose RS485(+) wire in Troll NetHub responsible for intermittent telemetry communication of MW 34-5-4-2 upper LT, tightened connection	
Fosset Gulch	MW-35-5-14-1	Sept 30: Well Inspection, All OK	
	MW-35-5-14-2	Sept 30: Well inspection, All OK	
Highway 151	MW-34-4-30-1	Sept 30: Well inspection, troubleshoot malfunctioning upper LT and found it required replacement	Nov 6: Vent well, replace bad upper LT, shut-in, function test LT OK, find Troll NetHub channel for this LT bad. Nov 8: Troubleshoot Troll NetHub, requires replacement. Nov 26: Replace Troll NetHub circuit board, function test telemetry OK.
	MW-34-4-30-2	Sept 30: Well inspection, All OK	
Deep Canyon	MW-34-4-32-1	Sept 30: Well inspection, All OK	

4M Project Monitor Well Chronology

Location	Well	2014	
		Sep	Oct
Basin Creek	MW 34-9-7-1		Oct 8: Well inspection, all OK, some evidence of stormwater run-off through site but no damage to wells or instrumentation shack, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
	MW 34-9-7-2		Oct 8: Well inspection, all OK, some evidence of stormwater run-off through site but no damage to wells or instrumentation shack, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
Palmer Ranch	MW-35-8-19-1		Oct 8: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
Fiddler	MW-35-8-10-1		Oct 8: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
South Fork Texas Creek	MW 35-7-8-1		Oct 8: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
	MW 35-7-8-2		Oct 8: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
BP Highlands	MW-34-7-15-1	Sep 25: Well inspection, All OK, road rough from storm run-off but passable.	Oct 23: Replace all In-Situ enclosure desiccants.
Beaver Creek Ranch	MW 35-6-17-1		No access to site, need new landowner access agreement.
	MW 35-6-17-2		
Shamrock Mines	MW 35-6-13-1		Oct 8: Well inspection, all OK, road rough from storm run-off and encroaching brush but passable. Oct 23: Replace all In-Situ enclosure desiccants.
Wagon Gulch	MW-34-4-30-1		Oct 7: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
	MW-34-4-30-2		Oct 7: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
Fosset Gulch	MW-35-5-14-1		Oct 8: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
	MW-35-5-14-2		Oct 8: Well inspection, annular valve 2" NPT bull plug missing and valve open. Valve was painted in open position since original installation in 2008. Close valve. Manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
Highway 151	MW-34-4-30-1		Oct 7: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
	MW-34-4-30-2		Oct 7: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.
Deep Canyon	MW-34-4-32-1		Oct 7: Well inspection, all OK, manually download both LTs. Oct 23: Replace all In-Situ enclosure desiccants.

4M Project Monitor Well Chronology

Location	Well	2015 Sept-Oct-Nov
Basin Creek	MW 34-9-7-1	Sept 28: Well inspection, minor gas leak at side bull plug/bushing threaded connection. Did not attempt to correct due to concern it would become worse based on past experience. Telemetry system battery shows corrosion on post but function is OK. Manually download both LTs. Replace all In-Situ enclosure desiccants.
	MW 34-9-7-2	Sept 28: Well inspection, all OK. Telemetry system battery shows corrosion on post but function is OK. Manually download both LTs. Replace all In-Situ enclosure desiccants.
Palmer Ranch	MW-35-8-19-1	Sept 28: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
Fiddler	MW-35-8-10-1	Oct 1: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Splice twist-lock cable ends onto both previously direct-wired In-Situ LT cable to allow manual downloads to PC.
South Fork Texas Creek	MW 35-7-8-1	Sept 28: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Splice twist-lock cable end onto previously direct-wired In-Situ LT cable to allow manual downloads to PC.
	MW 35-7-8-2	Sept 28: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
BP Highlands	MW-35-7-15-1	Sept 28: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
Beaver Creek Ranch	MW 35-6-17-1	Oct 2: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Troubleshoot telemetry system and replace old Troll NetHub with new unit. Did not correct problem. Nov 3: Remove Troll Link 201 (modem) to send to In-Situ for evaluation.
	MW 35-6-17-2	Oct 2: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Troubleshoot telemetry system and replace old Troll NetHub with new unit. Did not correct problem. Nov 3: Remove Troll Link 201 (modem) to send to In-Situ for evaluation.
Shamrock Mines	MW 35-6-13-1	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Splice twist-lock cable end onto previously direct-wired In-Situ upper LT cable to allow manual downloads to PC.
Wagon Gulch	MW-34-5-4-1	Sept 30: Well inspection, all OK, manually download both LTs. Replace upper LT and change monitoring location from side of wellhead to deployed 7 ft bgs by installing new cable with Conax fitting.
	MW-34-5-4-2	Sept 30-Oct 1: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Splice twist-lock cable end onto previously direct-wired In-Situ LT cable to allow manual downloads to PC.
Fosset Gulch	MW-34-5-14-1	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
	MW-34-5-14-2	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
Highway 151	MW-34-4-30-1	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
	MW-34-4-30-2	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants.
Deep Canyon	MW-34-4-32-1	Sept 30: Well inspection, all OK, manually download both LTs. Replace all In-Situ enclosure desiccants. Telemetry system battery shows corrosion on post but function is OK.

4M Project Monitor Well Chronology

Location	Well	2016
Basin Creek	MW 34-9-7-1	Sept: Well inspection and desiccant replacement.
	MW 34-9-7-2	Sept: Well inspection and desiccant replacement.
Palmer Ranch	MW-35-8-19-1	Sept: Well inspection and desiccant replacement.
Fiddler	MW-35-8-10-1	Mar 17: Replace original 12V, 7Ah batteries in Troll Link 201and solar enclosures (3) due to failure (corroded terminals). Mar 18: Troubleshoot Troll Link 201 failure and solar controller, remove Troll Link unit and send to In-situ for service. Replace solar controller with temporary loaner. May 23-24 replace Troll Link 201 with new unit. July 20: Replace loaner solar controller.
South Fork Texas Creek	MW 35-7-8-1	Sept: Well inspection and desiccant replacement.
	MW 35-7-8-2	Sept: Well inspection and desiccant replacement.
BP Highlands	MW-35-7-15-1	Sept: Well inspection and desiccant replacement.
Beaver Creek Ranch	MW 35-6-17-1	Feb 9-10: Stop all independent LevelTroll logs and download data, upload new firmware, troubleshoot Troll Net Hub and Troll Link 201. Telemetry upload misses continue. May 24: Troubleshoot continued telemetry issues and find well #1 LevelTrolls are malfunctioning likely due to degraded battery (age) and need replacement. July 20: Replace upper and lower LevelTrolls. July 21: Replace upper LevelTroll cable.
	MW 35-6-17-2	Feb 9-10: Stop all independent LevelTroll logs and download data, upload new firmware, troubleshoot Troll Net Hub and Troll Link 201. Telemetry upload misses continue. See details for MW 35-6-17-1.
Shamrock Mines	MW 35-6-13-1	Sept: Well inspection and desiccant replacement.
Wagon Gulch	MW-34-5-4-1	Oct 12: Well inspection, telemetry and LevelTroll troubleshooting.
	MW-34-5-4-2	Oct 12: Well inspection, telemetry and LevelTroll troubleshooting. Oct 19: Troubleshoot lower LevelTroll cable and find it bad and needs replacement. Nov 2: Replace lower LevelTroll cable.
Fosset Gulch	MW-34-5-14-1	Oct 12: Well inspection, replace original 12V, 7Ah batteries in Troll Link and solar enclosures (3) due to dropping voltage, expected near-future failure due to age. Oct 19: Reconnect loose wire on Troll Link 201. Nov 15-16: troubleshoot lower LevelTroll and find it malfunctioning and limiting all other LevelTrolls from uploading through telemetry system so replaced with spare.
	MW-34-5-14-2	Oct 12: Well inspection, replace original 12V, 7Ah batteries in Troll Link and solar enclosures (3) due to dropping voltage, expected near-future failure due to age. Oct 19: Reconnect loose wire on Troll Link 201.
Highway 151	MW-34-4-30-1	Oct 12: Well inspection.
	MW-34-4-30-2	Oct 12: Well inspection.
Deep Canyon	MW-34-4-32-1	Oct 12: Well inspection.

4M Project Monitor Well Chronology

Location	Well	2017
Basin Creek	MW 34-9-7-1	No activity.
	MW 34-9-7-2	No activity.
Palmer Ranch	MW-35-8-19-1	No activity.
Fiddler	MW-35-8-10-1	No activity.
South Fork Texas Creek	MW 35-7-8-1	No activity.
	MW 35-7-8-2	No activity.
BP Highlands	MW-35-7-15-1	No activity.
Beaver Creek Ranch	MW 35-6-17-1	Nov 1: Troubleshoot telemetry.
	MW 35-6-17-2	Nov 1: Troubleshoot telemetry, found bad lower LT and/or cable. Order replacements for spring installation.
Shamrock Mines	MW 35-6-13-1	No activity.
Wagon Gulch	MW-34-5-4-1	Jan 25, 31: Telemetry troubleshooting. Apr 13: Troubleshoot lower LT and cable, found bad. May 12: Replace lower LT and cable.
	MW-34-5-4-2	Jan 25, 31: Telemetry troubleshooting.
Fosset Gulch	MW-34-5-14-1	No activity.
	MW-34-5-14-2	No activity.
Highway 151	MW-34-4-30-1	No activity.
	MW-34-4-30-2	No activity.
Deep Canyon	MW-34-4-32-1	No activity.

4M Project Monitor Well Chronology

Location	Well	2018
Basin Creek	MW 34-9-7-1	Desiccants replaced.
	MW 34-9-7-2	Desiccants replaced.
Palmer Ranch	MW-35-8-19-1	Desiccants replaced.
Fiddler	MW-35-8-10-1	Desiccants replaced.
South Fork Texas Creek	MW 35-7-8-1	Desiccants replaced.
	MW 35-7-8-2	Desiccants replaced.
BP Highlands	MW-35-7-15-1	Desiccants replaced.
Beaver Creek Ranch	MW 35-6-17-1	Desiccants replaced.
	MW 35-6-17-2	Mar 13: Desiccants replaced. Vent well and remove lower LT and cable, both found to be bad. Apr 10: Vent well and replace lower LT and cable.
Shamrock Mines	MW 35-6-13-1	Desiccants replaced.
Wagon Gulch	MW-34-5-4-1	Desiccants replaced.
	MW-34-5-4-2	Desiccants replaced.
Fosset Gulch	MW-34-5-14-1	Desiccants replaced.
	MW-34-5-14-2	Desiccants replaced.
Highway 151	MW-34-4-30-1	Nov 11-20: Troubleshoot LTs and telemetry system
	MW-34-4-30-2	Nov 11-20: Troubleshoot LTs and telemetry system
Deep Canyon	MW-34-4-32-1	Desiccants replaced.

4M Project Monitor Well Chronology

Location	Well	2019
Basin Creek	MW 34-9-7-1	Oct 1: troubleshoot station PV charging system, replace desiccants; Oct 28: replace station solar panel; Nov 8: replace solar charging regulator module; Dec 6: replace all 3 station batteries, troubleshoot all 4 LT outputs and find #2 lower was drawing excessive power.
	MW 34-9-7-2	Oct 1: troubleshoot station PV charging system, replace desiccants; Oct 28: replace station solar panel; Nov 8: replace solar charging regulator module; Dec 6: replace all 3 station batteries, troubleshoot all 4 LT outputs and find #2 lower was drawing excessive power.
Palmer Ranch	MW-35-8-19-1	Desiccants replaced.
Fiddler	MW-35-8-10-1	Desiccants replaced.
South Fork Texas Creek	MW 35-7-8-1	Jul 9: Replace lower LT & cable, replace desiccants; Sep 26: replace upper LT; Nov 26: inspect for wellhead leaks, find leak at 2" brass valve packing, tighten and confirm no more leaks.
	MW 35-7-8-2	Desiccants replaced.
BP Highlands	MW-35-7-15-1	Desiccants replaced.
Beaver Creek Ranch	MW 35-6-17-1	Desiccants replaced.
	MW 35-6-17-2	Mar 13: Desiccants replaced. Vent well and remove lower LT and cable, both found to be bad. Apr 10: Vent well and replace lower LT and cable.
Shamrock Mines	MW 35-6-13-1	Desiccants replaced.
Wagon Gulch	MW-34-5-4-1	Desiccants replaced.
	MW-34-5-4-2	Desiccants replaced.
Fosset Gulch	MW-34-5-14-1	Desiccants replaced.
	MW-34-5-14-2	Desiccants replaced.
Highway 151	MW-34-4-30-1	Jan 10: Replace lower LT and cable, upper LT, desiccants replaced; May 2: Download upper & lower LT; May 14: fish lower LT cable replaced Jan 10 through buried conduit now that it is clear of ice.
	MW-34-4-30-2	Jan 10: desiccants replaced.
Deep Canyon	MW-34-4-32-1	May 2: Repair upper LT cable ripped in half by bear, replace upper LT that shorted out when cable damaged; desiccants replaced.