#1944431
Project 2009

NORWEST
Applied Hydrology

February 17, 2009

Peter Gintautas
Environmental Protection Specialist
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, CO 80203

Subject: Status Report, North Fork Ranch Groundwater Monitoring, Raton Basin, Colorado

Dear Mr. Gintautas:

Please find attached a status update of groundwater monitoring activities in the North Fork Ranch area of the Raton Basin, conducted by Norwest Applied Hydrology on behalf of Pioneer Natural Resources. This report was prepared, at your request, to update you on monitoring activities and data since the last update report on July 31st, 2008. Water level and water quality data collected through January 14th, 2009 are included in this report.

Please contact me if you have any comments or questions regarding the report.

Sincerely,
Norwest Applied Hydrology

Martin Johnson

Martin S. Johnson, P.G.
Senior Hydrogeologist

Attachments

cc. Gerald Jacob, Pioneer Natural Resources USA

STATUS REPORT
North Fork Ranch Groundwater Monitoring
January 31, 2009

Summary:

Four groundwater monitoring wells were installed in the North Fork Ranch subdivision of the Raton Basin (Figure 1) in September and November, 2006 to monitor groundwater conditions in the subdivision. A fifth well was installed in November, 2008. The five monitoring wells were equipped with transducers and dataloggers to measure and record water level and water temperature changes. Two of the wells, chosen because of their proximity to CBM wells, also monitor electrical conductivity. The purpose of the wells is to monitor background groundwater conditions and provide data on any changes in groundwater quality that occur as a result of coalbed methane (CBM) development in the area. The transducer data are supplemented by water samples collected periodically from each of the five wells and submitted for laboratory analysis, as described in the workplan for Groundwater Monitoring, North Fork Ranch Subdivision dated October 11, 2006.

This report summarizes groundwater monitoring activities and data obtained since July 1, 2008. Previous monitoring activities and data were documented in status reports dated February 15, 2008 and July 31, 2008. The next report will be submitted by July 31, 2009, and will include date collected through that date.

Water level data:

Water level measurements made in the five monitoring wells since installation are summarized in Table 1. Levels were measured with an electric sounding tape each time the wells were sampled or data were downloaded from the transducers. The Anna monitoring well, installed in November, 2008, was monitored only twice since installation. The Niagara monitoring well did not contain water when completed or when measured after six months; however, it contained sufficient water to measure beginning in September, 2007. Manual water-level measurements were used to check and verify the pressure transducer data presented below.

Sanchinator MW:

Water-level data recorded by the pressure transducer in the Sanchinator well are shown on Figure 2. The figure shows all data recorded since October, 2007, which includes the period when the Sanchinator 11-36 TR well was drilled, fraced, completed, and put into production. The chart shows a fairly constant water level from January 1, 2007 until purging for monthly well samples began in late March, 2008. A pattern of steep declines followed by more gradual recovery then followed each month through August, 2008.

The electrical conductivity measured and recorded by the transducer, also shown on Figure 2, rose gradually throughout the period of record; however, since the transducer had to be removed from the well each time it was sampled, the recorded conductivity generally did not return to the previous reading but took some time to equilibrate with the groundwater. After the August 28th, 2008 sampling event the recorded conductivity gradually increased to just over 600 *u*S. The water level and conductivity data do not show any changes during the period that can be attributed to CBM activities.

Keystone MW:

Water level data and water temperature measurements from January 30th, 2008 to December 19th, 2009 are shown on Figure 3. The chart shows that the water level and water temperature did not vary significantly over the period of record. The transducer in the Keystone well also records electrical conductivity; however, the EC has been constant since the well was installed so the data are not shown on Figure 3.

Niagara MW:

As Table 1 shows the Niagara MW has had measurable water since September, 2007 and had a steadily rising water level until March 25, 2008. The transducer record (Figure 4) indicates a rising water level from March, 2008 through January 14, 2009 except for a decline corresponding to pumping for the June 28th, 2008 sampling event. A replacement for the Niagara 23-35 CBM well was drilled in late May, 2008 after the original well was plugged and abandoned. The water level and temperature records do not show any changes coinciding with the well drilling, fracing, or production activities. As discussed in the July 31, 2008 Status Report, water level and water quality data continue to indicate the source of water in the Niagara well is bedrock groundwater and not infiltration from surface pits.

Dolores MW:

The transducer data for the Dolores monitoring well are shown on Figure 5 for the period of February 15, 2008 to January 13, 2009. As in the past, the water level record shows a pattern of regular fluctuations on an approximately weekly interval, probably reflecting hydraulic connection between the monitoring well and the Dolores domestic well, located 300 feet to the south. The short-term fluctuations are relatively small (<1 ft) and do not seem to affect the long-term trend, which is constant at a depth of about 67 feet. Water temperature data are very consistent with only minor fluctuations.

Anna MW:

The pressure transducer was not installed in the Anna well until after it was sampled in December, 2008, therefore, there are no data to show water level trends at this time.

Water Quality:

The Keystone, Niagara, and Dolores monitoring wells were sampled in December, 2008 and January, 2009, and the samples submitted for laboratory analysis. Results of the analyses are shown on attached Table 2 along with previous data from the Keystone, Dolores, Niagara, and Sanchinator wells. The Anna well has been sampled only once since it was installed in November, 2008. The Sanchinator well was sampled monthly from March 25th to August 28th, 2008 to confirm that the groundwater chemistry at the well had stabilized after laboratory results from previous samples varied greatly in some constituent concentrations.

The December 2008/January 2009 analytical results for the Keystone and Dolores wells were generally consistent with previous sample results from 2006 through 2008. Variabilities in analyte concentrations for the period are generally within a range reflective of natural variablity and there are no trends that would suggest external influences. Likewise the laboratory results for the January 2009 samples from the Sanchinator well were consistent with the monthly samples and with samples collected in September, 2007. These data indicate that the first samples collected from the Sanchinator well in November, 2006 were not representative of the groundwater monitored by the well and likely were diluted by the water used during drilling.

The samples collected from the Niagara well in January, 2009 were generally similar to previous samples from the well but had higher concentrations of some constituents than the other monitoring wells, as discussed in the July 31, 2008 Status Report. The consistency of data from one sampling event to the next provides further evidence that the water in the Niagara well comes from bedrock groundwater and not from infiltration from surface pits as had been previously suspected.

One constituent that did increase greatly from previous samples was methane, which was present at 16 mg/L in the January, 2009 sample from the Niagara well. The source of the increased methane concentration is not apparent from the other water level and water quality data. Further investigation of the methane source will be undertaken to determine the cause of the concentration increases and will be presented in the next status report.

The monitoring well samples were not filtered in the field and so, could not be directly compared with Colorado Water Quality Control Commission Human Health Standards for most analytes. However, selected metals and TDS were filtered in the lab from unpreserved samples and could therefore be compared CWQCC Standards. Dissolved manganese exceeded Drinking Water Standards in samples from the Sanchinator, Anna, and Niagara wells. Total dissolved solids (TDS) exceeded drinking water standards in the Sanchinator and Niagara wells. Dissolved manganese and pH exceeded drinking water standards in some of the samples from the Keystone and Dolores wells. Also, although not directly comparable to CWQCC Standards, total fluoride concentrations exceeded Human Health Standards in all samples and total iron exceeded Drinking Water Standards in all samples.

Plans:

Transducers are continuing to record data at 15-minute intervals in all five monitoring wells and will be checked, downloaded, and recalibrated whenever the wells are sampled. The wells will be sampled on a quarterly frequency or more often if needed to monitor nearby CBM activity. Further investigation of the source of increased methane in the Niagara well will be conducted. The Anna well will be pump tested prior to the next sampling event, scheduled for the last week in March. The next update report, summarizing data collected from January 1st, 2009 to June 30th, 2009 will be prepared by July 31st, 2009.

Table 1
Water-level Data
Northfork Ranch Monitoring Wells

Well	Surface elevation (ft)	Date measured	Depth to water (ft)	Water level elevation (ft)
Anna MW	**7980**	12/10/2008	17.24	7902.76
		1/13/2009	17.40	7902.60
Dolores MW	**7920**	4/18/2007	63.41	7856.59
		5/16/2007	64.90	7855.10
		9/6/2007	64.90	7855.10
		2/1/2008	67.70	7852.30
		3/25/2008	66.34	7853.66
		7/7/2008	67.46	7852.54
		1/13/2009	67.60	7852.40
Keystone MW	**7957.71**	11/20/2006	28.30	7929.41
		12/1/2006	28.71	7929.00
		12/11/2006	29.45	7928.26
		3/1/2007	30.24	7927.47
		3/21/2007	29.50	7928.21
		9/6/2007	31.50	7926.21
		2/1/2008	33.93	7923.78
		3/25/2008	33.14	7924.57
		7/7/2008	33.43	7924.28
		1/14/2009	32.74	7924.97
Niagara MW	**8087.04**	12/1/2006	ND	ND
		5/16/2007	ND	ND
		9/6/2007	245.60	7841.44
		1/30/2008	231.49	7855.55
		3/25/2008	226.60	7860.44
		5/29/2008	227.40	7859.64
		6/25/2008	225.20	7861.84
		1/14/2009	218.09	7868.95
Sanchinator MW	**8384.29**	12/4/2006	488.33	7895.96
		12/5/2006	490.35	7893.94
		12/12/2006	500.73	7883.56
		3/21/2007	517.16	7867.13
		4/30/2007	519.60	7864.69
		5/10/2007	532.40	7851.89
		5/16/2007	526.68	7857.61
		9/5/2007	519.12	7865.17
		10/3/2007	523.20	7861.09
		1/30/2008	517.75	7866.54
		4/29/2008	521.30	7862.99
		5/29/2008	523.10	7861.19
		1/13/2009	520.55	7863.74

Notes:
ND = no data because the well was dry at a TD of 261 feet when measured

TABLE 2
North Fork Ranch Monitoring Well Data

Constituent	Method	Reporting Limit	Units	Human Health Std.*	Drinking Water Std.**	Organic Chemical Std.***	Sanchinator MW 11/18/2006	Sanchinator MW 9/5/2007	Sanchinator MW 3/24/2008	Sanchinator MW 4/29/2008	Sanchinator MW 5/29/2008	Sanchinator MW 6/26/2008	Sanchinator MW 7/31/2008	Sanchinator MW 8/28/2008	Sanchinator MW 1/13/2009	Keystone MW 11/20/2006	Keystone MW 9/6/2007	Keystone MW 3/25/2008	Keystone MW 7/7/2008	Keystone MW 12/11/2009	Dolores MW 9/26/2006	Dolores MW 9/5/2007	Dolores MW 3/25/2008	Dolores MW 7/7/2008	Dolores MW 1/13/2009	Niagara MW 3/25/08	Niagara MW 6/27/08	Niagara MW 1/14/09	Anna MW 12/11/08
Alkalinity	310.1	5.0	mg/L				170	190	196	208	203	223	202	185	179	134	155	159	169	163	163	160	165	173	158	443	414	385	142
Arsenic - T.Rec	200.8	0.0025	mg/L				0.0081	0.0042	0.0055	0.0039		0.0030	0.0028		0.0033	0.0025	ND	ND	ND	ND	0.0026	ND	ND	ND	ND	0.004		0.0039	ND
Barium - T.Rec	200.8	0.0050	mg/L				0.170	0.1300	0.1200	0.1100		0.084	0.11		0.17	0.210	0.11	0.049	0.041	0.04	0.022	0.051	0.038	0.041	0.035	0.280		0.22	0.059
Benzene	8021B / 524.2	0.0005	mg/L			0.005	ND	ND	ND	0.0025	0.0066	ND	0.00054	ND	0.00059	0.00093	0.0021	0.0016	0.0013	0.0028	ND	ND	ND	ND	0.00059	0.0015	0.0019	0.0068	ND
Bicarbonate Alkalinity	310.1	5.0	mg/L				170	190	195	208	201	223	202	183	179	134	148	158	169	163	138	143	156	171	147	443	414	385	142
Boron - T.Rec	200.8	0.100	mg/L				ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND
Boron - Total	6010B	0.050	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide	300.0	0.20	mg/L				ND	0.52	ND	0.65	0.64	0.62	0.73	0.82	0.82	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.69	0.64	0.65	ND
Cadmium - Total	200.7	0.0050	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium - Total	200.7	0.20	mg/L				3.1	33.70	17.00	8.30	7.6	15.4	7.0	6.9	7.1	36.5	6.8	4.7	4.4	4.3	2.3	2.8	2.4	3.9	2.2	14.2	13.8	12.4	55
Calcium - Total	6010B	0.200	mg/L				3.1	33.9	17.0	8.2	7.0	15.1	6.6	6.7	7.4	32.3	7.1	5.1	4.7	3.8	9.5	2.8	2.6	3.9	2.2	15	12.8	12.4	62.3
Carbonate Alkalinity	310.1	5.0	mg/L				32.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.2	ND	ND	ND	25.1	17.8	9.8	ND	11.1	ND	ND	ND	ND
Chloride	300.0	1.0	mg/l				8.0	115	9.1	106	91.9	98.8	94.8	95.7	118	3.9	7.4	7.6	6.8	8.3	13.6	14.3	12.8	14.0	12.7	95.2	88.4	80.7	7.4
Chromium - Total	200.7	0.010	mg/L				0.012	0.25	0.027	ND	ND	0.017	ND	ND	ND	ND	0.014	ND	ND	ND	ND	0.011	ND	0.022	ND	0.02	ND	ND	ND
Copper - Diss.	200.7	0.010	mg/L		1		ND	0.023	0.067	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.023	ND	0.011	ND	ND	ND	ND	ND
Copper - T.Rec	200.8	0.0050	mg/L				0.0082	0.021	0.120	0.009		0.008	0.005		ND	ND	ND	ND	ND	ND	0.011	0.023	ND	0.032	ND	0.0091		0.015	0.0077
Ethane	RSK-175	0.0050	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	0.017	0.032	0.053	0.054	0.065	ND	ND	ND	ND	ND	0.18	ND	0.62	ND
Ethene	RSK-175	0.0050	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	8021B / 524.2	0.0005	mg/L			0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride	300.0	0.20	mg/L				8.3	8.2	0.260	7.50	7.7	8.4	8.5	7.5	7.7	0.66	6.1	4.9	5.1	5.4	7.3	7.2	6.5	6.9	7.4	7.6	8.9	9.9	0.27
Hydroxide Alkalinity	310.1	5.0	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron - T.Rec	200.7	0.10	mg/L				12.7	0.71	1.1	0.38	0.6	1.1	0.34	0.34	0.29	2.20	11.1	1.8	1.2	0.79	0.066	2.0	0.51	4.8	0.11	1.9	1.3	0.94	5.2
Iron - Total	6010B	0.10	mg/L				12.5	0.92	0.99	0.40	0.49	1.1	0.32	0.3	0.3	2.10	10.6	1.8	1.2	0.69	16.2	1.9	0.49	4.4	0.15	1.8	1.2	1.2	4.8
Lead - T.Rec	200.8	0.0015	mg/L				0.0036	0.0017	0.014	0.0018		4.9	0.0019		1.5	ND	0.0025	ND	ND	ND	0.0086	0.0027	0.0015	0.0052	ND	0.004		0.0054	ND
Magnesium - T.Rec	200.7	0.20	mg/L				1.30	0.81	0.69	0.51	0.46	0.88	0.39	0.38	0.37	4.90	2.5	0.79	0.55	0.43	0.29	0.47	ND	0.68	ND	0.65	0.56	0.64	5.9
Magnesium - Total	6010B	0.20	mg/L				1.30	0.85	0.63	0.54	0.42	0.86	0.37	0.35	0.37	4.40	2.4	0.79	0.57	0.39	3.6	0.47	0.15	0.57	ND	0.63	0.53	0.66	5.4
Manganese - Diss.	200.7	0.010	mg/L		0.05		0.12	0.011	0.085	0.066	0.086	0.072	0.049	0.042	0.061	0.260	0.20	0.06	0.049	0.05	0.12	0.011	0.016	0.063	ND	0.23	0.18	0.15	0.44
Manganese - T. Rec	200.7	0.010	mg/L				0.18	0.012	0.048	0.066	0.059	0.077	0.049	0.043	0.063	0.270	0.24	0.063	0.055	0.059	0.24	0.039	0.016	0.074	ND	0.24	0.19	0.15	0.51
Methane	RSK-175	0.0050	mg/L				1.40	0.92	1.80	3.10	4.40	5.20	6.50	10.00	14.00	0.460	3.10	4.00	3.70	3.60	1.4	2.8	6.3	0.96	8.8	4.2	0.02	16.00	0.0065
Nitrate	300.0	0.10	mg/L				ND	0.22	0.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oil & Grease	1664A HEM	5.0	mg/L				ND	ND	ND	ND	ND	6.9	ND	5.5	ND	ND	6.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
pH	150.1	0.10	-		6.5-8.5		9.2	8.2	8.2	8.2	8.3	8	8.3	8.4	8.1	7.8	8.8	8.7	8.5	8.4	9.1	9.2	9.0	8.9	9.0	7.8	8.4	7.6	7.6
Potassium - T.Rec	200.8	0.250	mg/L				1.90	1.20	1.300	0.880		0.890	0.690		0.650	2.50	1.3	0.75	0.5	0.57	1.9	0.49	0.41	1100	0.320	1.9		1.2	1.5
Potassium - Total	6010B	3.00	mg/L				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	ND	ND	ND	ND	ND	ND	ND	ND
Resistivity	120.1	0.00020	ohm-m				26.0	12.6	12.9	12	12.6	12.2	12.4	13.1	12.6	21.3	20.7	20.8	20	20	22.7	24.6	7.0	22.8	23.4	9.1	8.5	9.6	20
Selenium - T.Rec	200.8	0.0025	mg/L				ND	ND	ND	ND		ND	ND		ND	ND	ND	ND	ND	ND	0.004	ND	ND	ND	ND	ND		ND	ND
Silver - Total	200.7	0.010	mg/l				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium - Total	200.7	5.0	mg/L				95.6	141	152	179	181	173	171	170	165	57.1	113	112	119	126	95.4	102	98.7	105	97.6	257	259	245	48.4
Sodium - Total	6010B	5.0	mg/L				89.7	151	153	199	169	171	155	177	189	49.6	122	117	123	108	105	104	104	109	110	264	238	262	40.2
Specific Gravity	D1429	0.00010	-				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	0.997	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.997
Sulfate	300.0	5.0	mg/l		250		ND	9.3	41.7	33.2	22.6	24.6	18	11.5	12.5	85.8	67.9	69.1	64.2	60.5	24.7	11.9	15.7	21.2	19.4	7.1	8.2	ND	106
Sulfide	376.2	0.050	mg/L				ND	ND	ND	ND	0.060	ND	ND	ND	ND	ND	ND	0.067	ND	0.091	ND	ND	0.24	0.12	0.10	0.12	0.32	0.098	ND
TDS	160.1	10.0	mg/L		400****		245	483	435	480	425	485	447	421	433	308	382	322	322	301	265	248	234	262	239	664	653	618	314
TEPH - DRO	8015B	0.250	mg/L				ND	ND	0.27	0.82	ND	0.63	1.9	1.9		ND	ND		0.96		ND	ND		ND	ND		ND	ND	
Toluene	8021B / 524.2	0.0005	mg/L				ND	0.57	0.140	0.110	0.036	0.022	0.027	0.017	0.038	ND	ND	0.0011	0.00057	0.00095	0.11	0.00061	0.0020	ND	0.0015	ND	ND	ND	ND
TSS	160.2	4.0	mg/L				141	86.0	7.2	ND	11.2	27.6	11.2	13.2	ND	32	ND	10.8	8.4	ND	644	104	14.4	55.2	ND	27.6	21.2	52.4	65.6
Xylenes	8021B / 524.2	0.0005	mg/L				ND	ND	ND	ND	ND	ND	0.00064	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc - Diss.	200.7	0.020	mg/L		5		0.023	0.044	0.087	0.020	0.071	0.034	0.02	ND	ND	ND	0.033	0.02	ND	ND	0.029	0.044	ND	0.037	ND	0.054	0.025	0.054	0.02
Zinc - Total	200.7	0.020	mg/L				0.020	0.035	0.037	ND	ND	0.030	ND	ND	ND	ND	0.029	ND	ND	ND	0.056	ND	ND	0.026	ND	0.052	0.02	0.025	0.026

Notes:
Table includes all laboratory analyses for all samples collected from each well since installation
Data reported in mg/L except as noted

The Reporting Limit may be adjusted due to high concentrations of the target constituent.

ND = Not Detected at requested reporting limit

* Domestic Water Supply - Human Health Standards from Table 1, Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41. Equivalent to Maximum Contaminant Levels for Public Water Supplies from National Primary Drinking Water Standards, 40 CFR Part 141

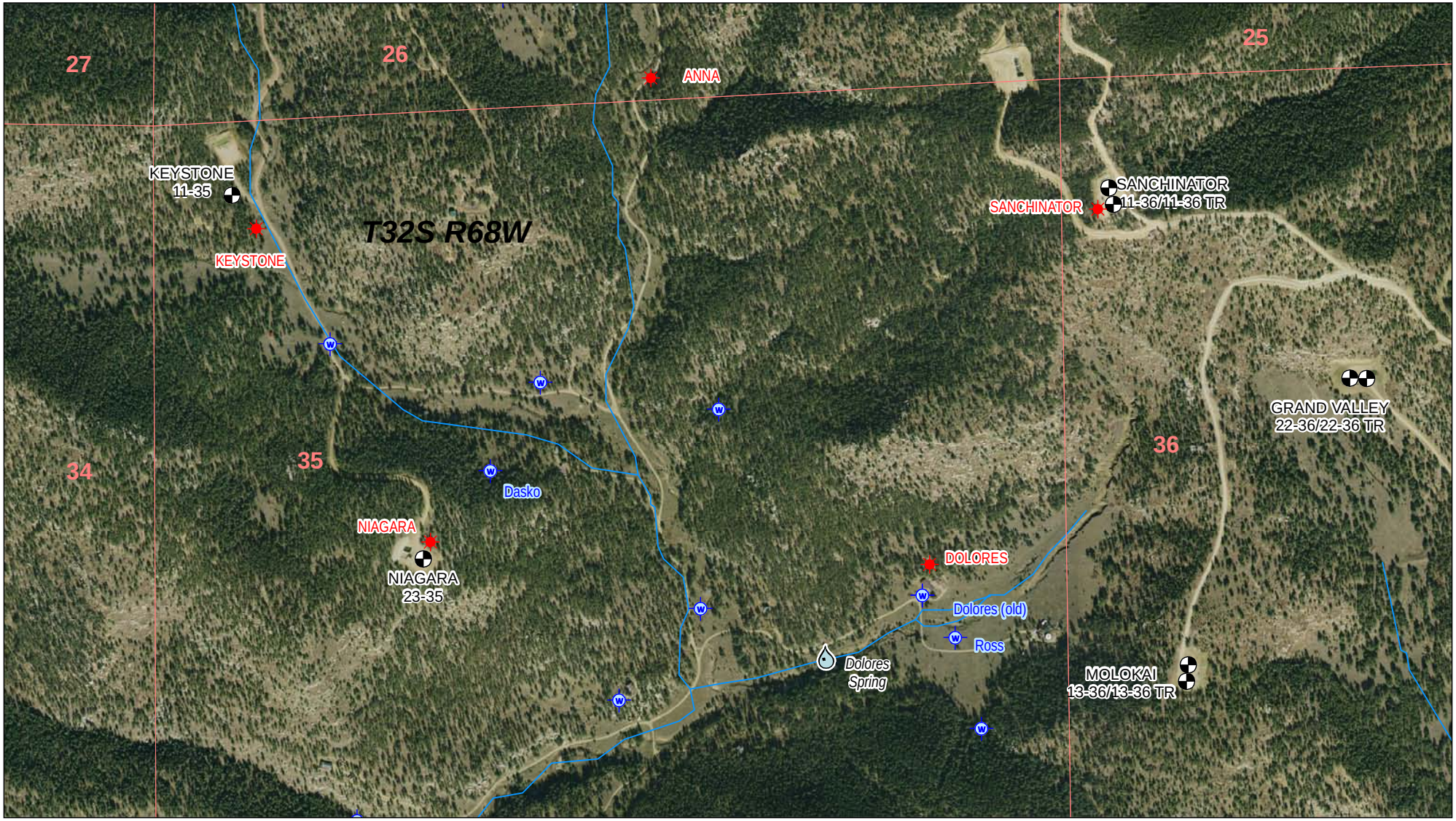
** Domestic Water Supply - Drinking Water Standards from Table 2, Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41. Equivalent to Secondary Maximum Contaminant Levels for Public Water Supplies from National Secondary Drinking Water Standards, 40 CFR Part 143

*** Organic Chemical Standard - Interim Organic Pollutant Standards from Table A, Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41

**** TDS Water Quality Standards from Table 4, Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41

NORWEST CORPORATION

Figure 1
Site Location Map



Legend

- Monitoring Well
- Water Well
- Spring
- CBM Well
- Stream
- Section Line

1:10,000

N W E S

0 250 500 1,000 1,500 2,000

Feet

Projection: UTM
Datum: NAD 1927
Zone: 13N
Units: Feet

Created: MD
Date 2/12/2009

PIONEER NATURAL RESOURCES

Figure 2
Sanchinator MW Transducer Data
10/3/2007 to 1/14/2009

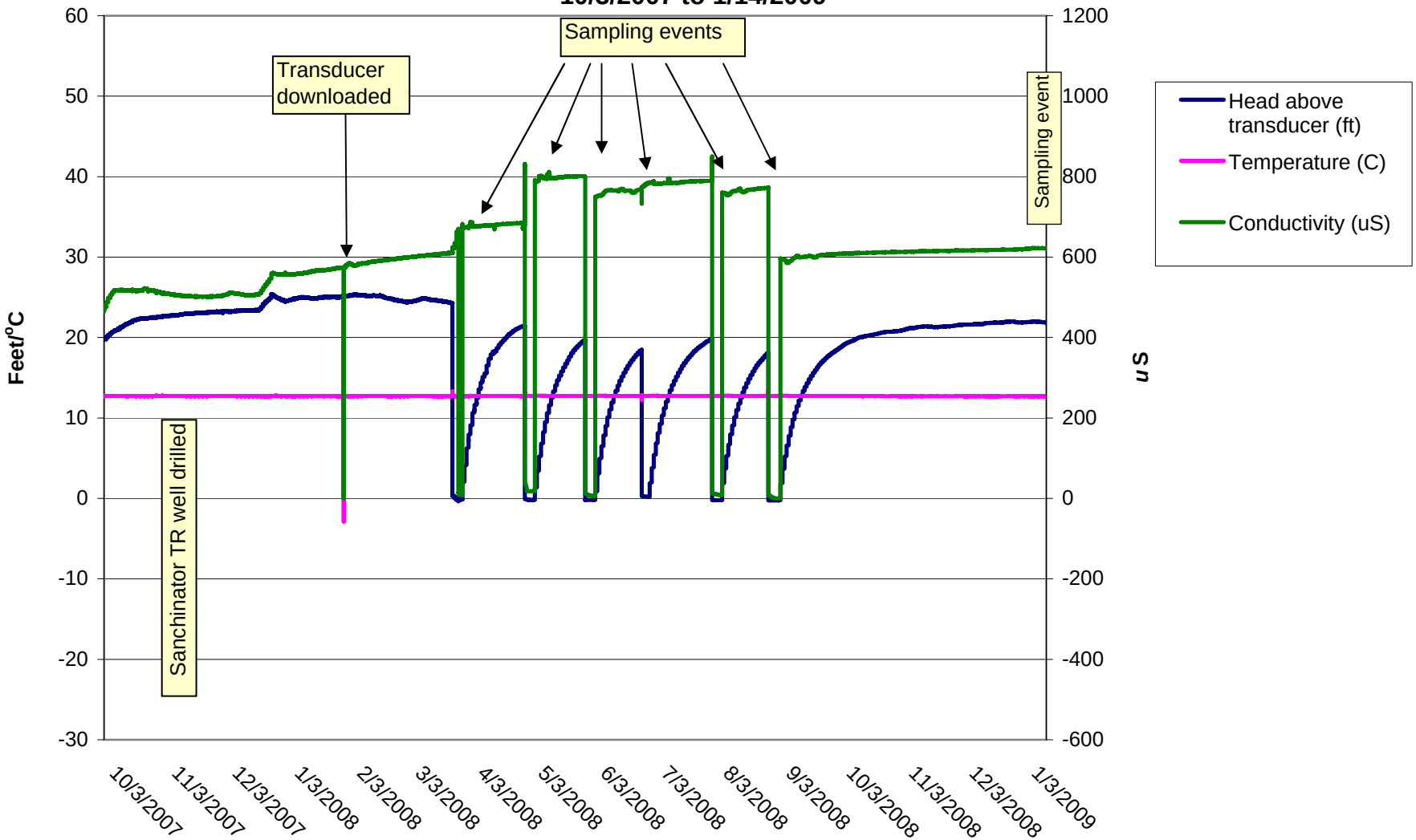


Figure 3
Keystone MW Transducer Data
2/1/2008 to 12/14/2008

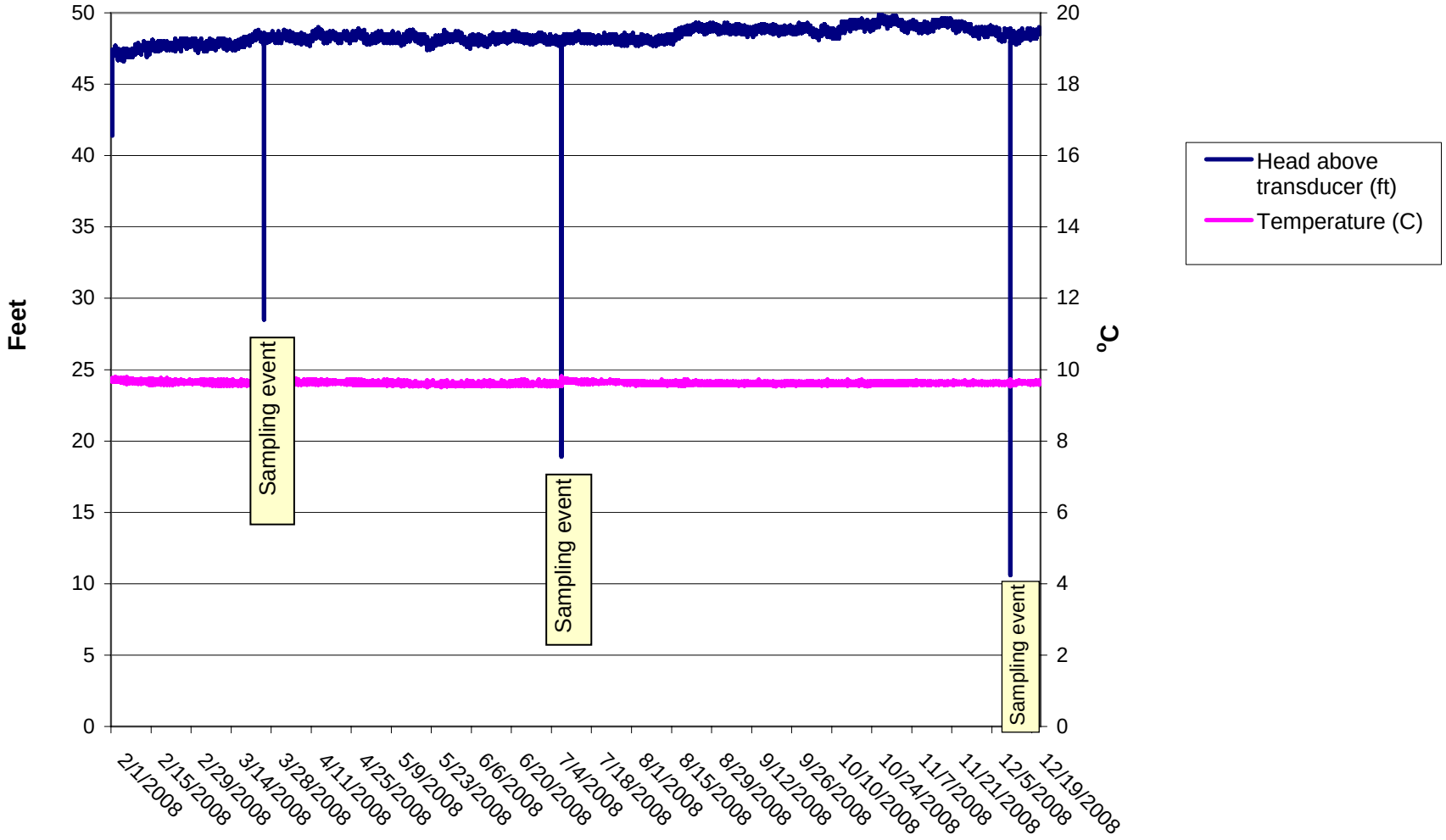


Figure 4
Niagara MW Transducer Data
3/25/2008 to 1/14/2009

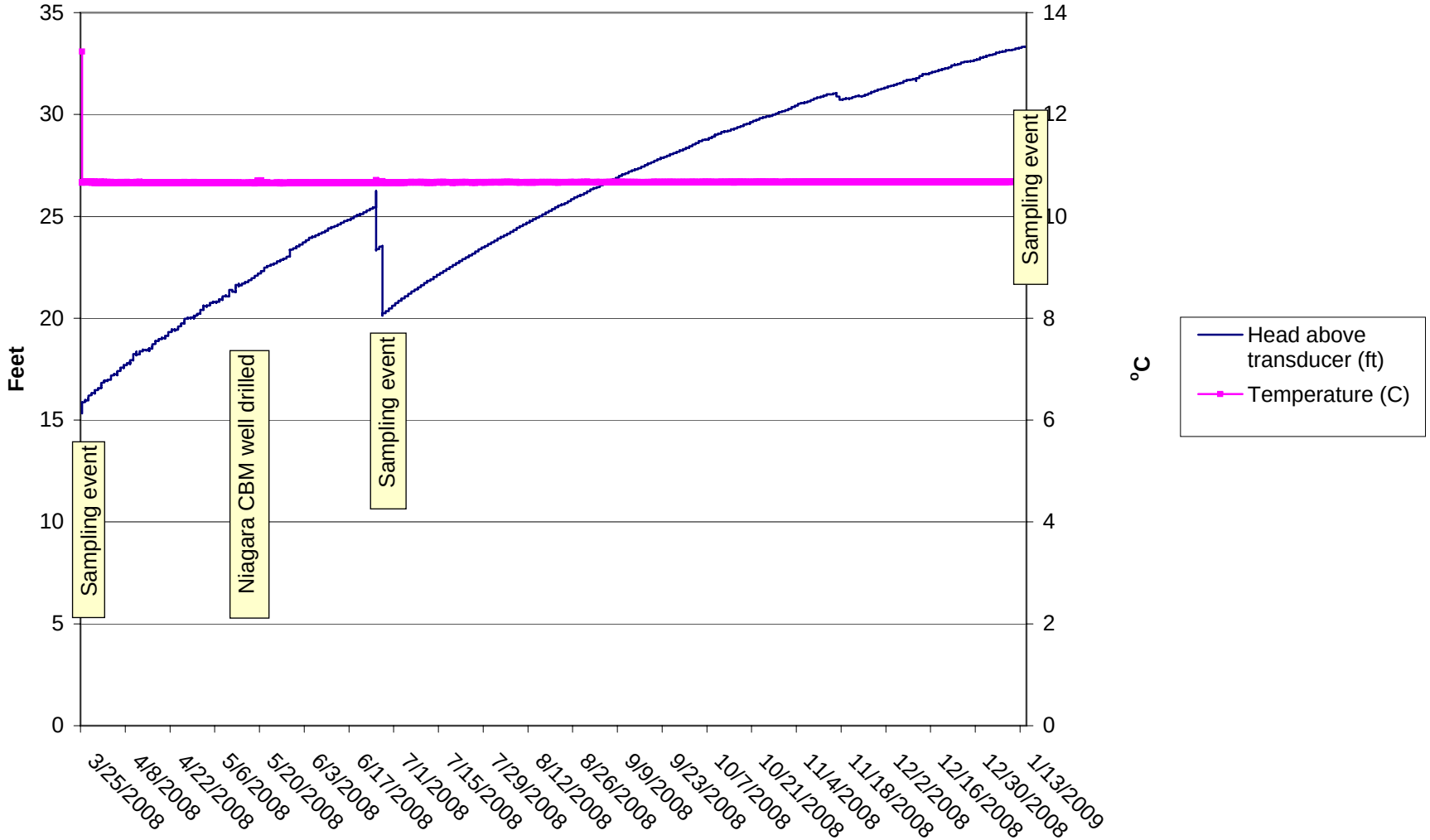


Figure 5
Dolores MW Transducer Data
2/15/2008 to 1/13/2009