pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 9/18/2014

Revised by: Jeffery Butt

STATION DESCRIPTION:
STREAM CODE: 24704
STREAM NAME: Deep Hollow Run
SITE CODE: 66909423
SITE NAME: Lake Wood – Deep Hollow Run

COUNTY: Sullivan

LATITUDE: N41°24'08.316" **LONGITUDE:** W76°29'31.2612"

LOCATION DESCRIPTION: Small stream inlet at north end of Lake Wood at Deep Hollow Road.

HUC: 02050206

DRAINAGE AREA: 0.44 sq. miles

BACKGROUND AND HISTORY: Deep Hollow Run is a freestone tributary to Lake Wood within Laporte Township, Sullivan County (Figures 1 & 2). Deep Hollow Run basin is characterized by rolling hills with land use consisting mostly of forest cover (~88%) and a small portion (~5.0%) described as urban landscape.

The purpose of this survey was to collect baseline data on streams supplying water to Lake Mokoma and Lake Wood prior to possible Marcellus gas well development on Lake Mokoma Home Owners Association land.

Continuous data was initially collected in Deep Hollow Run with a Solinst three-parameter data logger then later by a Onset Hobo two-parameter data logger. Water chemistries and discrete field parameters were collected periodically during the period of the sonde deployment. Sonde deployment began on August 2, 2011 and concluded on July 26, 2012.

The primary objectives of the assessment were to:

1. Characterize baseline water temperature, specific conductance, and depth using 24-hour monitoring and water chemistry.

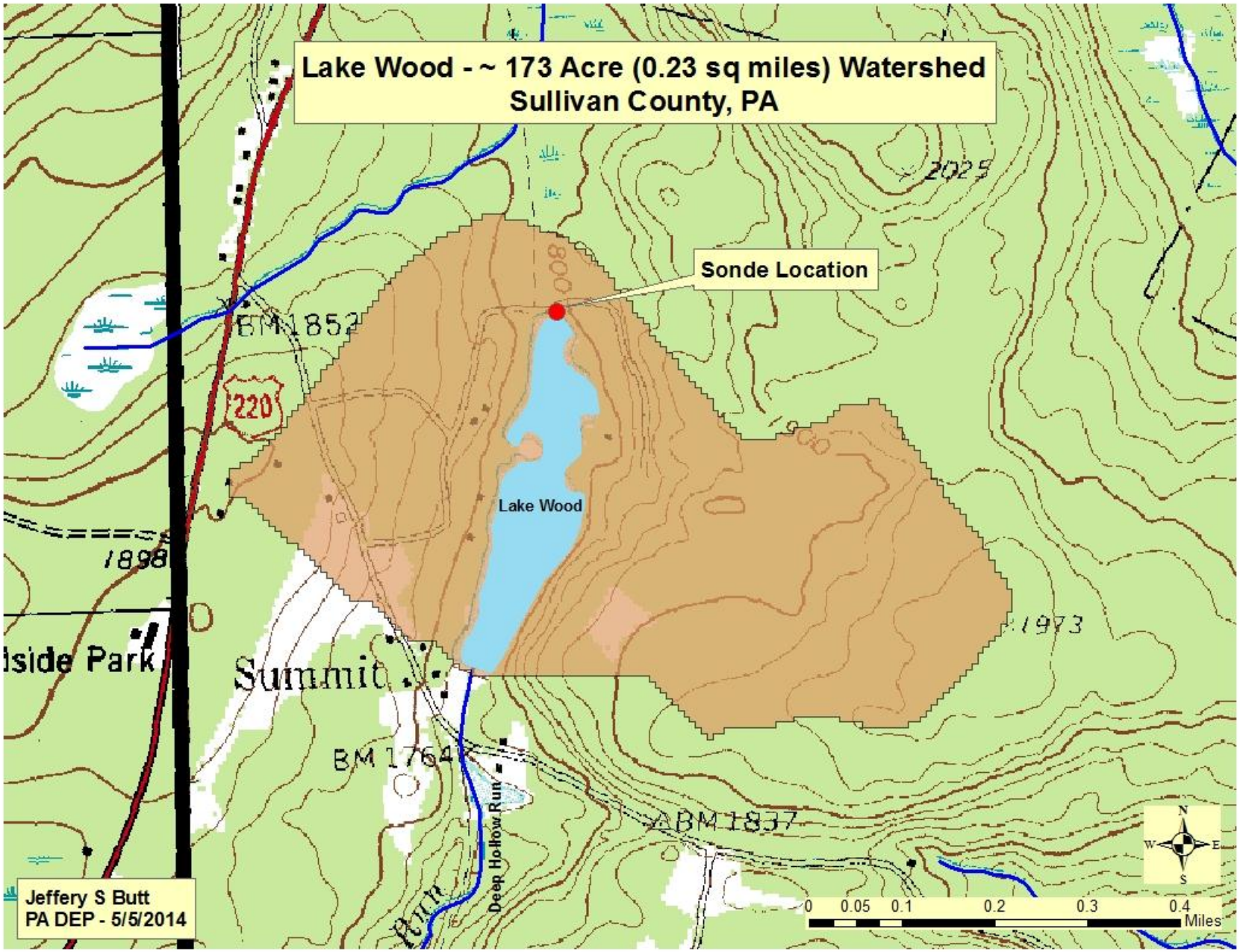

Figure 1. Map of Lake Wood Watershed.

WATER QUALITY PARAMETERS:

Parameter	Units
Depth	Feet
Water Temperature	°C
Specific Conductance (@25°C)	µS/cm[c]

EQUIPMENT:

Two different instruments were used to record continuous stream data in Deep Hollow Run. A Solinst Levelogger (Serial #1064134) was deployed from August 2, 2011 to July 26, 2012. An Onset Hobo data logger (Serial # 9896835) was deployed from February 15, 2012 to July 26, 2012. The Solinst recorded temperature, specific conductance, and depth parameters and the Hobo recorded temperature and conductivity parameters. A Yellow Springs Instruments (YSI) ProPlus and a 6920-V2 were used as field meters during sonde maintenance and data retrieval visits.

The Onset Hobo data logger was housed in a protective PVC shroud. This shroud contained many drilled holes to allow for water flow through. Both the Hobo PVC shroud and the Solinst Levelogger were anchored by being clipped directly to the stream rebar. The stream rebar included a top-mounted eye bolt attachment to which the Solinst and Hobo data loggers were clipped. This rebar was driven into the stream bed so as to locate the data loggers in the thalweg.

A Solinst Levelogger (serial #1061914) was used at the nearby Mill Creek site to record barometric pressure. Barometric pressure was then used to correct stream depth for all four of the Lake Mokoma and Lake Wood stream monitoring stations.

PERIOD OF RECORD: The period of record for Deep Hollow Run is August 2, 2011 to July 26, 2012. Interruptions in the record for individual parameters may have been invoked as a consequence of data being declared unusable during the data approval process.

The stream mounted Solinst Levelogger was revisited six times during the deployment period for the purpose of downloading data, checking calibration, and cleaning. The Hobo data logger was revisited three times.

DATA:

Water chemistry was collected eight times during the deployment period and once after sonde extraction on June 27, 2013. No benthic macroinvertebrate or fish samples were collected on Deep Hollow Run. Continuous data are graded based on a combination of fouling and calibration error (PA DEP, 2013b).

Depth (stage): Depth measured by this non-vented Solinst Levelogger is actually the measure of water column pressure plus atmospheric pressure. Changes in atmospheric pressure while the sonde was deployed appear as changes in depth. Data from the beginning of the monitoring to February 1, 2012 (vertical line) were not corrected for barometric pressure. Data recorded after 1300 hours on February 1, 2012 were corrected for barometric pressure. Barometric pressure was measured with a Solinst Levelogger mounted in air. Figure 2 demonstrates the appreciable influence barometric pressure has on non-vented pressure sensors. Depth (stream stage) is used qualitatively for the interpretation of changes in other parameters.

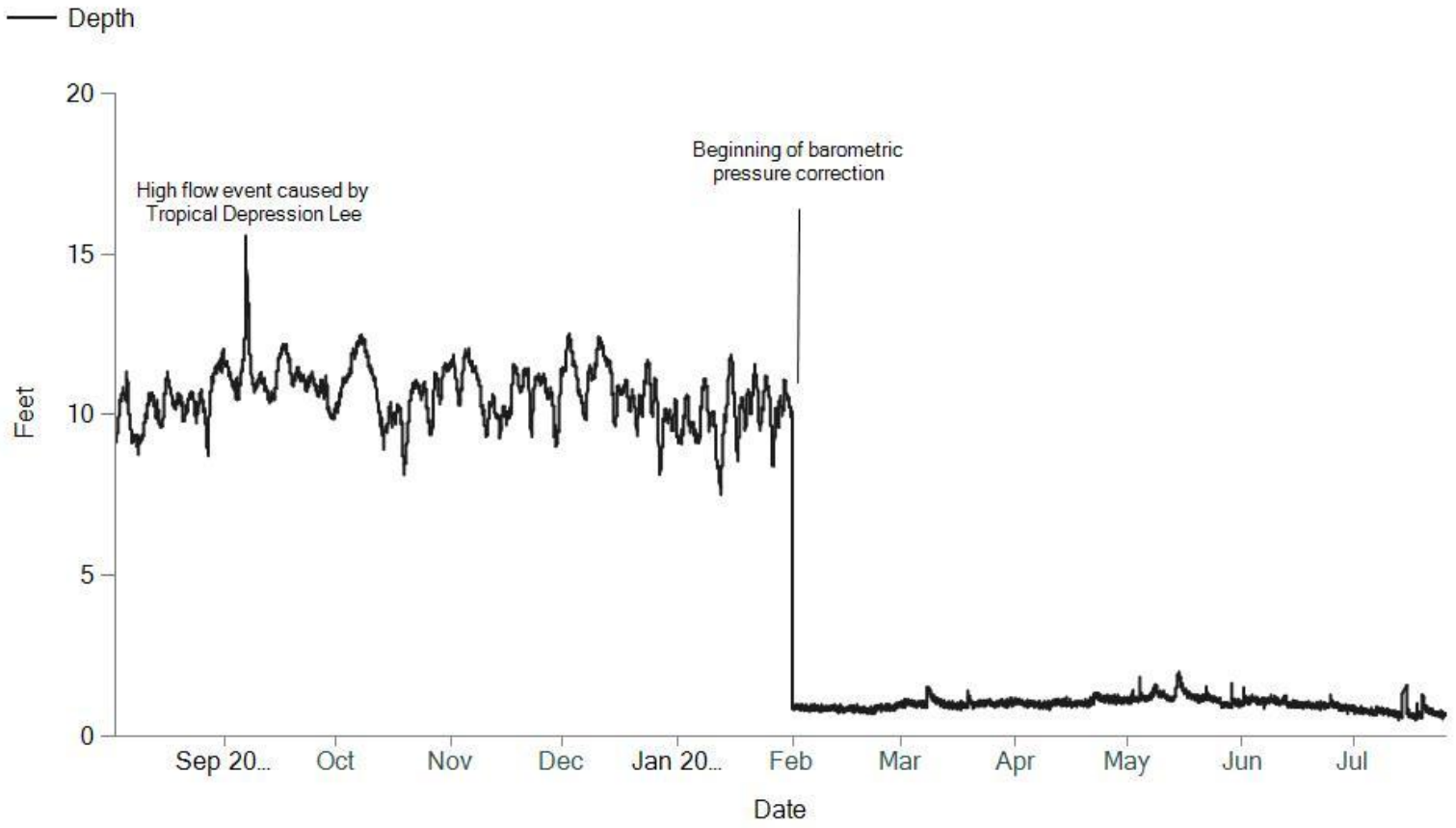

Figure 2. Continuous depth data for August 2, 2011 to July 26, 2012.

Water Temperature: Solinst Average: 9.22°C; Solinst Maximum: 28.0°C; Solinst Minimum: -0.005°C. Hobo Average: 10.68 °C; Hobo Maximum: 28.8°C: Hobo Minimum: 0.53°C. Differences between these Solinst and Hobo average, maximum, and minimum temperatures are due in part by the unequal deployment periods of the two data loggers. Figure 3 shows the Solinst record. Figure 4 shows the Hobo record. Figure 5 shows the difference between the Solinist and Hobo usable data records. Temperature variation in the Solinst and Hobo record are due primarily to seasonal climate variation and daily weather variation and normal diurnal fluctuation.

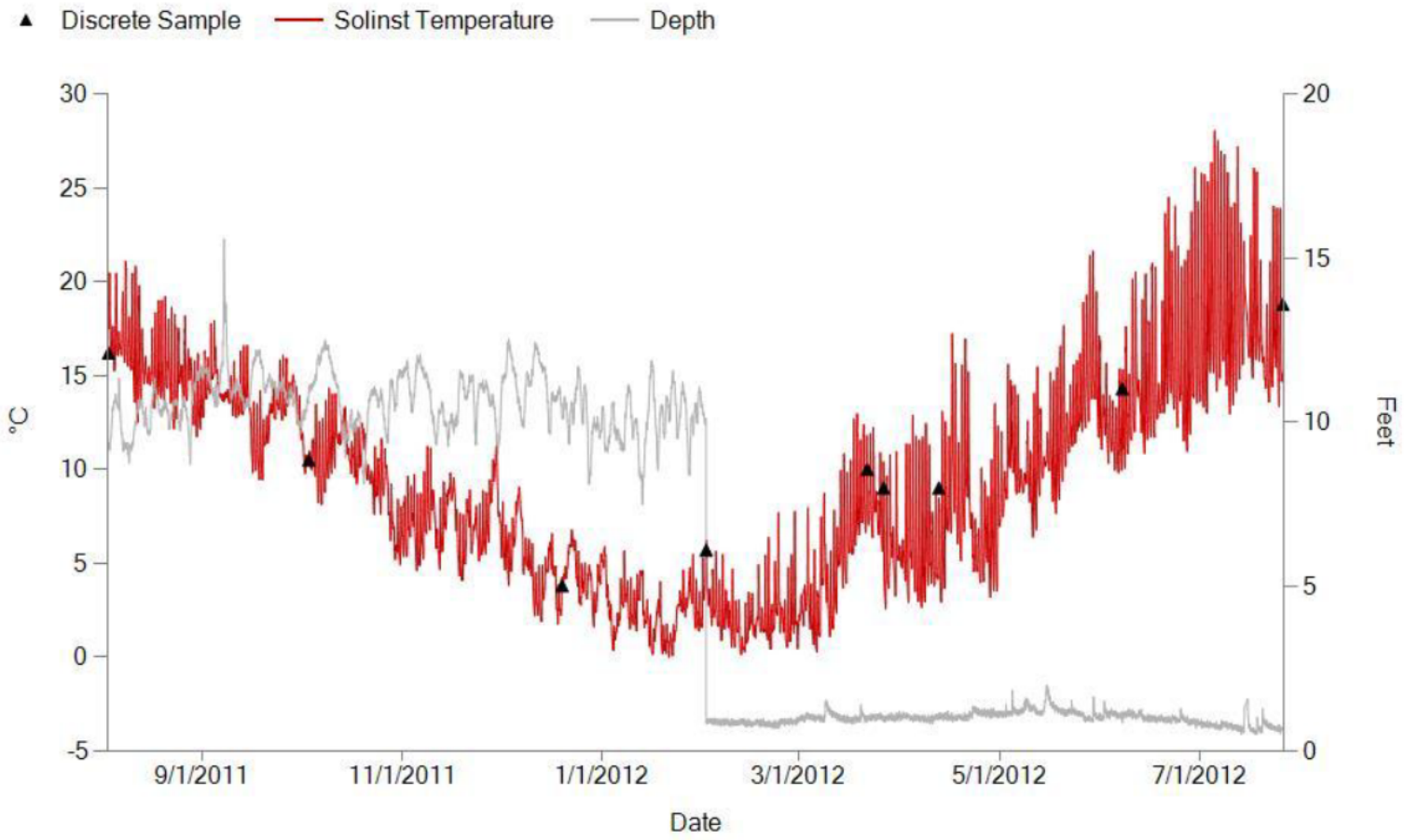

Figure 3. Solinst continuous water temperature, continuous depth, and discrete samples from May 4, 2011 to July 26, 2012.

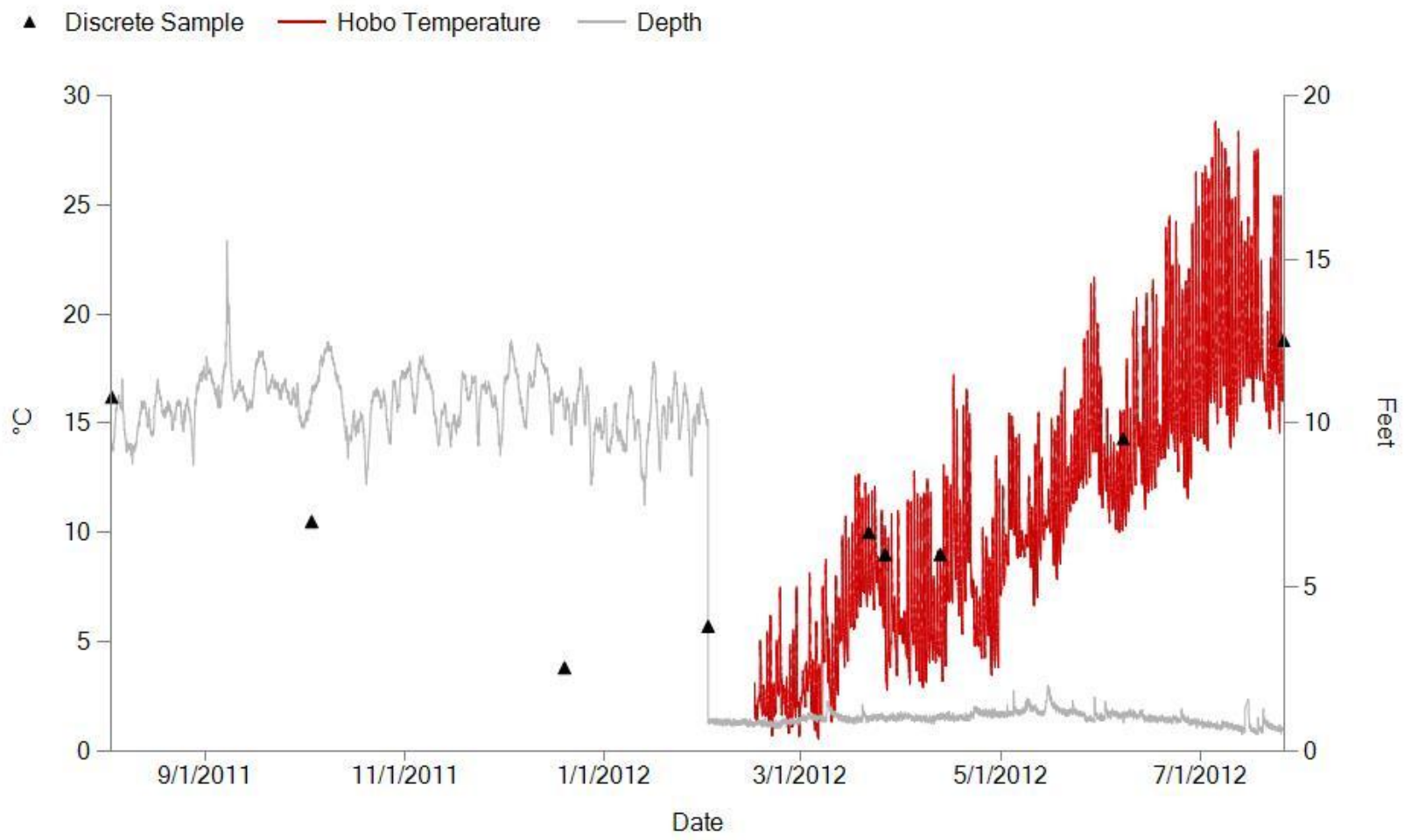

Figure 4. Hobo continuous water temperature, continuous depth, and discrete samples from May 4, 2011 to July26, 2012.

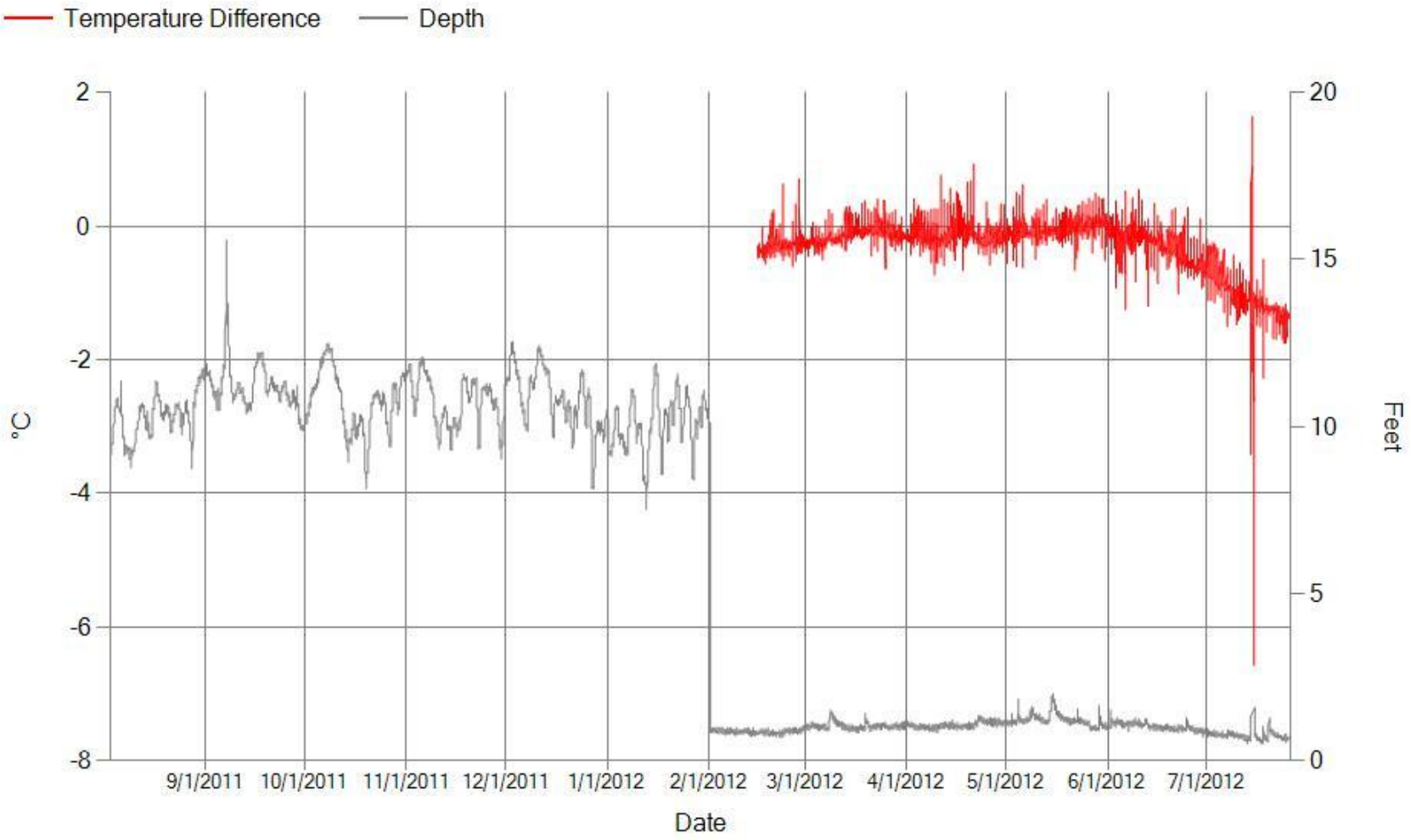

Figure 5. Temperature difference between Solinst and Hobo data loggers, and depth from August 2, 2011 to July 26, 2012.

The temperature difference is shown only for that part of the record in which Solinist and Hobo usable data overlap. The temperature difference is numerically equal to the Solinst temperature minus the Hobo temperature. Often, the Hobo recorded a higher temperature than did the Solinst (indicated by a negative difference). Even though the two data loggers were mounted in the same location, differences between the two sometimes exceeded ± 0.2 °C (equal to 0.1°C advertised accuracy of Solinst plus the 0.1°C advertised accuracy of the Hobo) and also occasionally exceeded ±1.6°C (two times the 0.8°C USGS usable data allowance permitted for each logger). However, data from each logger graded as usable (within the 0.8°C USGS tolerance for usable data) based upon fouling error and discrete error checks at the end of each maintenance period. Temperature differences appear to be unrelated to depth.

Specific Conductance: Figure 6 shows the Solinst record. Figure 7 shows the Hobo record. Importantly, the continuous specific conductance from the Solinst has been declared as UNUSABLE by PA DEP 2013b, whereas the Hobo data has been declared as UNVERIFIED. Consequentially, the Solinst and Hobo record should not be used for quantitative analysis. However, the Hobo record may be used to make qualitative inferences. Because the Solinst data is declared as unusable, no comparison between the Solinst and Hobo data is made. There is a relationship between specific conductance and flow (as characterized by depth) and this relationship is demonstrated in Figure 9.

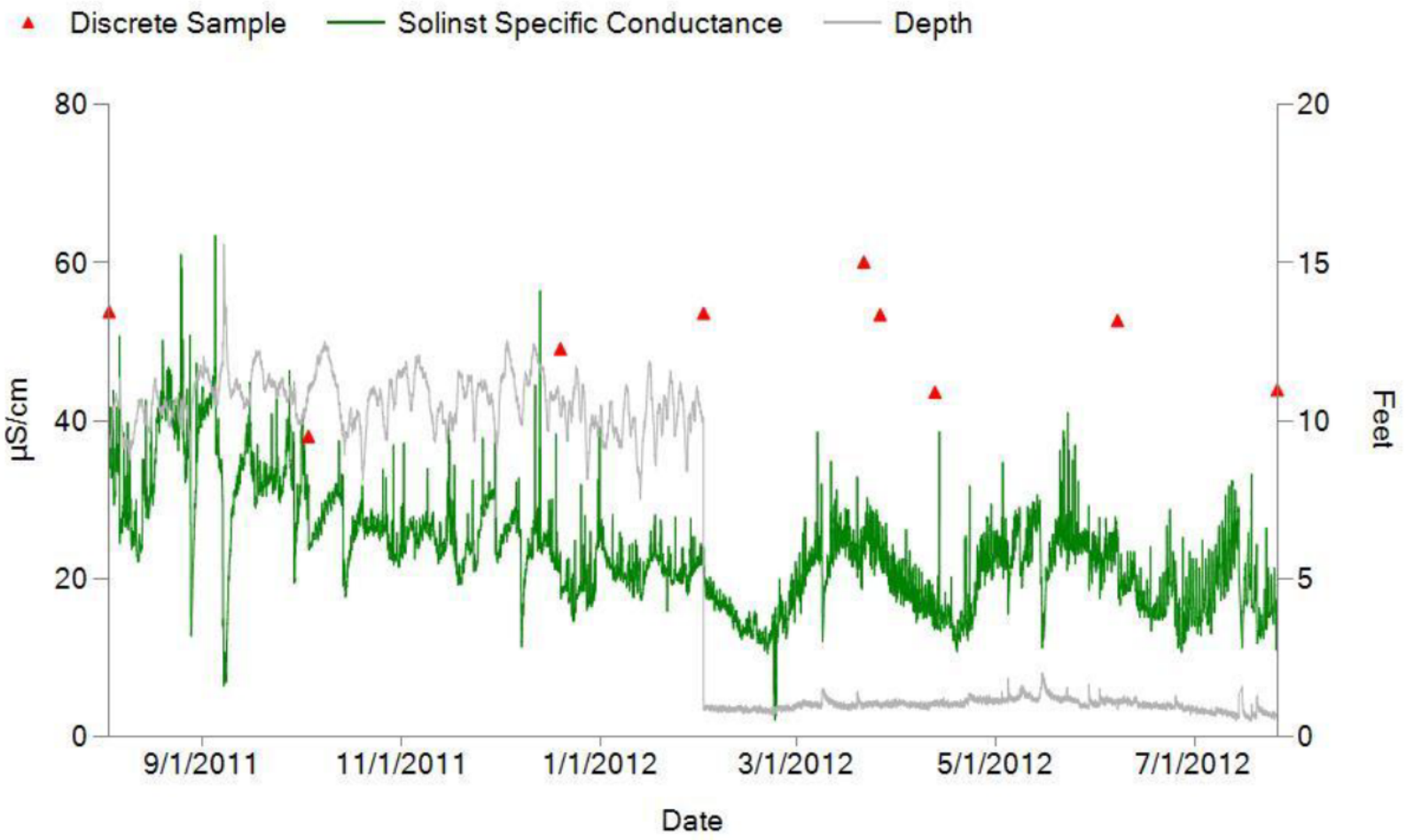

Figure 6. UNUSABLE Solinst Continuous specific conductance, continuous depth, and discrete samples from August 2, 2011 to July 26, 2012.

All Solinst data graded as unusable due to data logger calibration issues occurring throughout the period of deployment and difference from discrete values typically exceeding 15% (USGS threshold for unusable data).

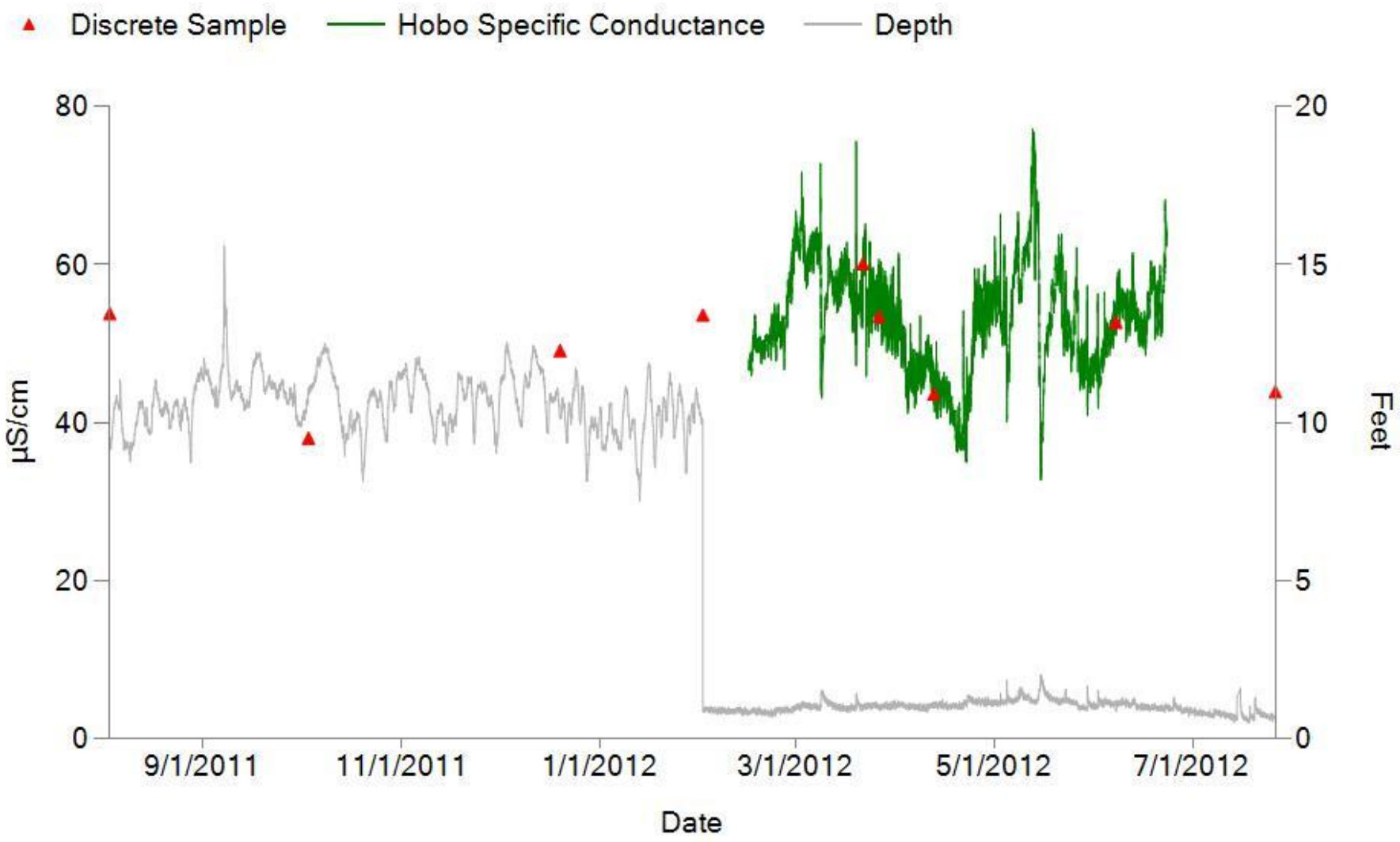

Figure 7. UNVERIFIED Hobo continuous water temperature, continuous depth, and discrete samples from August 2 2011 to July 26, 2012. All Hobo data graded as unverified due in part to inability to calibrate Hobo data loggers.

Discrete pH: Discrete pH values were recorded during Solinst and Hobo data logger maintenance visits. These recorded pH values are shown in Table 1. Deep Hollow Run experiences pH values that are more circum-neutral when compared to that of Conklin Run.

Table 1. Discrete pH values

Date and Time			pH
			pH Units
08/03/2011	0920-826	8:30	6.58
10/03/2011	0942-006	10:15	6.0
12/19/2011	0942-048	16:00	6.63
02/01/2012	0942-069	13:15	6.16
02/15/2012	0942-076	14:47	6.37
03/21/2012	0942-116	16:35	6.30
03/26/2012	0942-122	16:15	6.34
04/12/2012	0942-159	12:25	6.32
06/07/2012	0942-178	11:30	6.12
07/26/2012	0942-208	10:30	6.21
6/27/2013	0942-521	10:35	6.35

In-situ Water Chemistry: Samples were collected ten times using standard analysis code 046. Measurements with "<" indicate concentrations below the reporting limit. Values that follow "<" characterize the laboratory reporting limit. Samples 0942-521 and 0942-522 were taken on the same day. Sample 0942-521 was taken on the Lake Wood side of Deep Hollow Road and 0942-522 was taken on the upstream side of Deep Hollow Road. Notice the total iron content difference between samples 0942-521 and 0942-522 – a result that is likely caused by corrosion in the flow pipe that carries the stream under Deep Hollow Road.

Table 2. Chemical grab sample results.

PARAMETER	UNITS	08/03/2011	10/03/2011	12/19/2011	02/01/2012	03/21/2012	04/12/2012	06/07/2012	07/26/2012	6/27/2013	06/27/2013
		0920-826	0942-006	0942-048	0942-069	0942-116	0942-159	0942-178	0942-208	0942-521	0942-522
		8:30	10:15	16:00	13:15	16:35	12:25	11:30	10:30	10:35	10:50
ALKALINITY T	mg/L	7.2	5.8	3.4	4.2	5.6	5.2	6.0	9.8	7.6	6.8
ALUMINUM T	µg/L	< 200	270.000	< 200	< 200	458.000	< 200	< 200	< 200	< 200	< 200
AMMONIA T	mg/L	0.03	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02
ARSENIC T	µg/L	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
BARIUM T	µg/L	26.000	22.000	16.000	17.000	31.000	17.000	23.000	23.000	23.000	18.000
BOD	mg/L	0.60	0.60	1.30	< 0.20	1.60	0.80	0.90	0.80	0.90	0.70
BORON T	µg/L	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200
BROMIDE	µg/L	< 50.00	< 50.00	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 25.0	< 25.0	< 25.0
CALCIUM T	mg/L	4.021	4.190	3.088	3.683	4.818	3.759	4.191	4.854	4.014	3.770
Hardness T	mg/L	14	14	10	13	16	13	14	16	14	13
IRON T	µg/L	241.000	325.000	33.000	48.000	851.000	107.000	116.000	344.000	453.000	183.000
LITHIUM T	µg/L		< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
MAGNESIUM T	mg/L	0.927	0.765	0.669	0.800	1.004	0.821	0.878	0.976	0.855	0.814
MANGANESE T	µg/L	391.000	70.000	28.000	19.000	221.000	75.000	126.000	529.000	322.000	212.000
MOLYBDENUM T	µg/L									< 70	< 70
OSMOTIC PRESSURE	MOSM	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	2
SELENIUM T	µg/L	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
SODIUM T	mg/L	2.018	2.981	1.746	3.371	3.692	1.989	3.021	1.089	2.023	1.150
STRONTIUM T	µg/L	19.000	15.000	13.000	14.000	19.000	15.000	18.000	22.000	20.000	20.000
CHLORIDE T	mg/L	5.48	4.32	2.89	6.49	6.97	4.08	6.45	3.23	4.28	4.34
TOTAL DISSOLVED SOLIDS @ 180C	mg/l	44	40	40	74	56	42	44	38	32	32
NITRATE & NITRITE NITROGEN T	mg/L	0.05	0.05	0.21	0.27	0.22	0.17	0.12	0.07	0.10	0.12
PHOSPHORUS T	mg/L	0.015	< 0.01	< 0.01	< 0.01	0.011	< 0.01	< 0.01	< 0.01	0.011	< 0.01
SULFATE T	mg/L	5.34	6.11	7.04	7.80	7.01	7.08	6.73	4.85	5.64	5.74
TOTAL SUSPENDED SOLIDS	mg/L	< 5	< 5	< 5	< 5	26	< 5	28	< 5	16	< 5
ZINC T	µg/L	19.000	15.000	< 10.0	< 10.0	13.000	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0

Relationship between Specific Conductance and Stream Flow Discrete Values: Discrete values for specific conductance were collected during each maintenance visit to the sonde. Often, stream flows were also obtained using a Marsh-McBirney Flo-Mate during the maintenance visits. Figure 9 demonstrates the relationship between specific conductance and stream flow in Deep Hollow Run. Unlike Conklin Run, Deep Hollow Run demonstrates the more typical negative relationship between these two parameters. This relationship between specific conductance and stream flow is less strong than those for Mill Creek and Doe Run as evidences by the low R-squared value (R^2 = 0.3541).

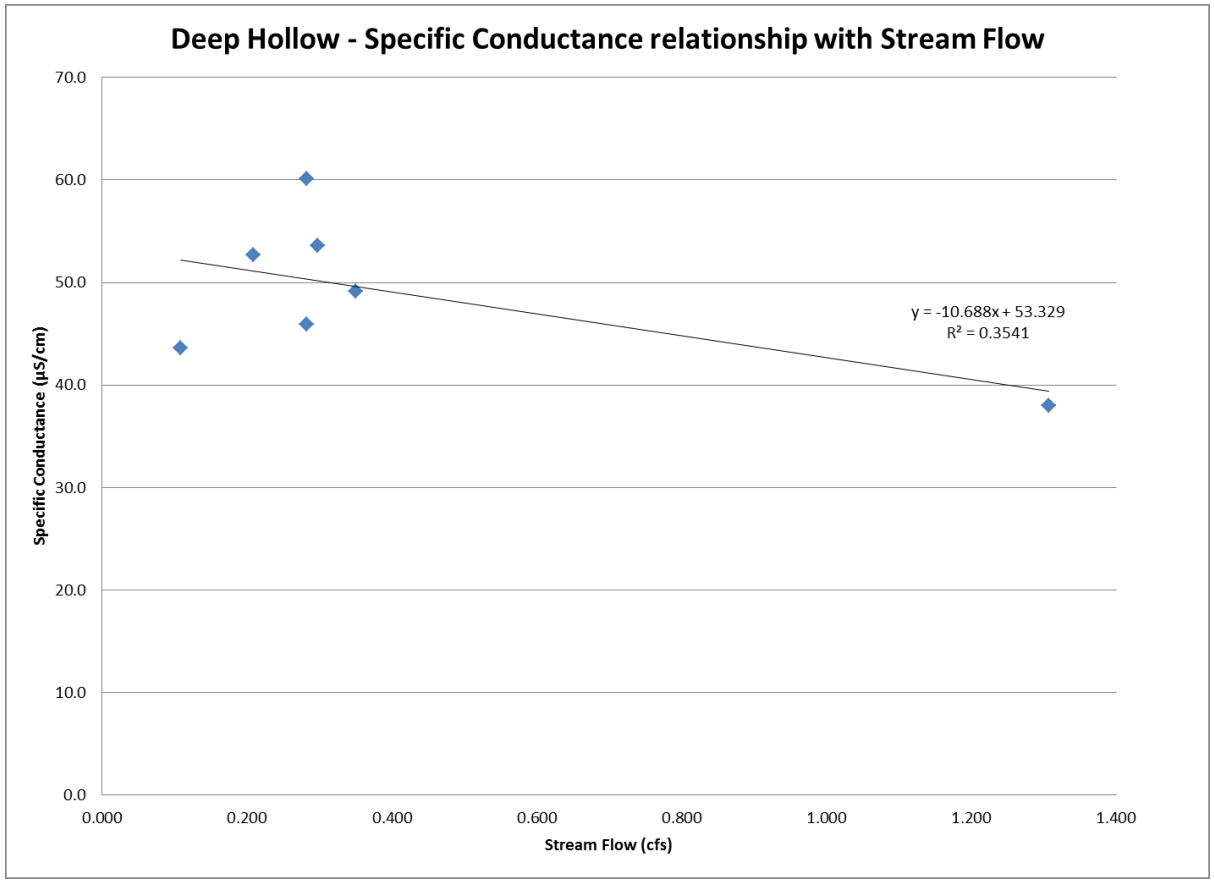

Figure 9. Relationship between Specific conductance and stream flow discrete values.

SUMMARY:

Continuous monitoring and in-situ lab chemistries data provided in this report may be used to establish a baseline for water quality in Deep Hollow Run preliminary to potential Marcellus gas well development.

LITERATURE CITED

PA DEP. 2013a. Instream Comprehensive Evaluations (ICE). http://www.portal.state.pa.us/portal/server.pt/community/water_quality_standards/10556/2013_assessment_methodology/1407203

PA DEP. 2013b. Continuous Instream Monitoring Protocol. http://www.portal.state.pa.us/portal/server.pt/community/water_quality_standards/10556/2013_assessment_methodology/1407203