# Continuous Instream Monitoring Report (CIMR)

**Most recent revision:** 3/5/2014
**Revised by:** Shull

**STATION DESCRIPTION:**
STREAM CODE: 21883
STREAM NAME: Straight Run
SITE CODE: 66535371-001
SITE NAME: Straight Run Road

**COUNTY:** Tioga

**LATITUDE:** N41°47'24.913" **LONGITUDE:** W77°24'13.846"

**LOCATION DESCRIPTION:** Approximately 0.25 miles upstream of Straight Run Road Bridge.

**HUC:** 02050205

**DRAINAGE AREA:** 6.11 sq. miles

**BACKGROUND AND HISTORY:** Straight Run is a freestone tributary to Marsh Creek within Shippen Township, Tioga County (Figure 1). The basin is characterized by relatively steep topography with land use consisting mostly of forested land (99%). The site is located within the Tioga State Forest. The purpose of this survey was to collect baseline data on a High Quality-Cold Water Fishes stream where deep well activity, specifically Marcellus, is occurring. There are no historical shallow gas wells in the watershed. There are two active Marcellus gas well permits currently in the Straight Run watershed. This site was managed in collaboration with the USGS Northern Appalachian Research Laboratory. In July of 2012 a permanent USGS gauging station (station number: 01548303) with a multiparameter sonde was installed on Straight Run at the Straight Run Road Bridge. This allowed for data comparison between PA DEP and USGS methods.

The primary objectives of the assessment were to:

1. Characterize baseline water temperature, conductivity, pH, turbidity, and depth using 24-hour monitoring.
2. Characterize water chemistry.
3. Characterize baseline biological communities.
4. Compare PA DEP and USGS CIM methods.

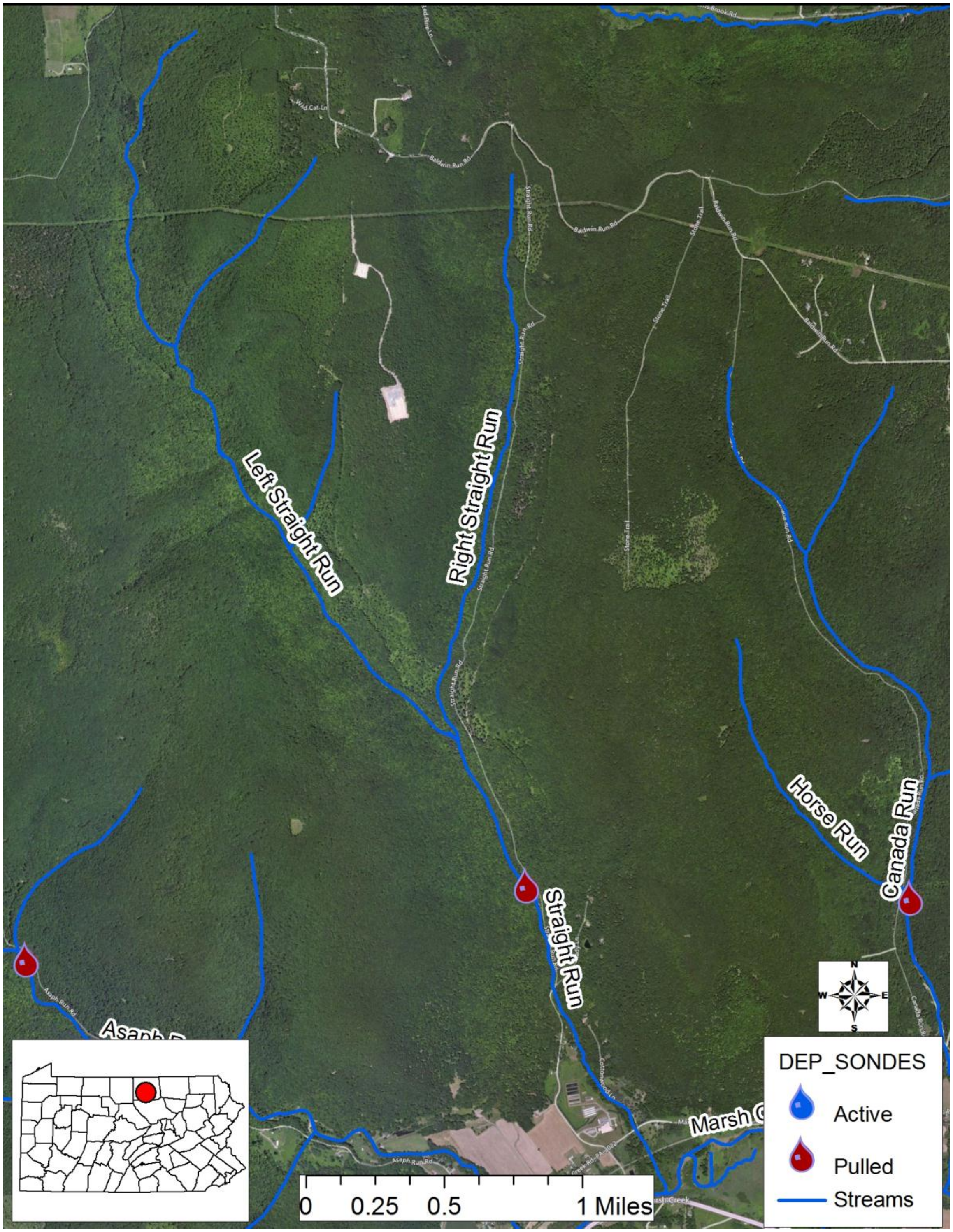

Figure 1. Map of the Straight Run continuous instream monitoring site.

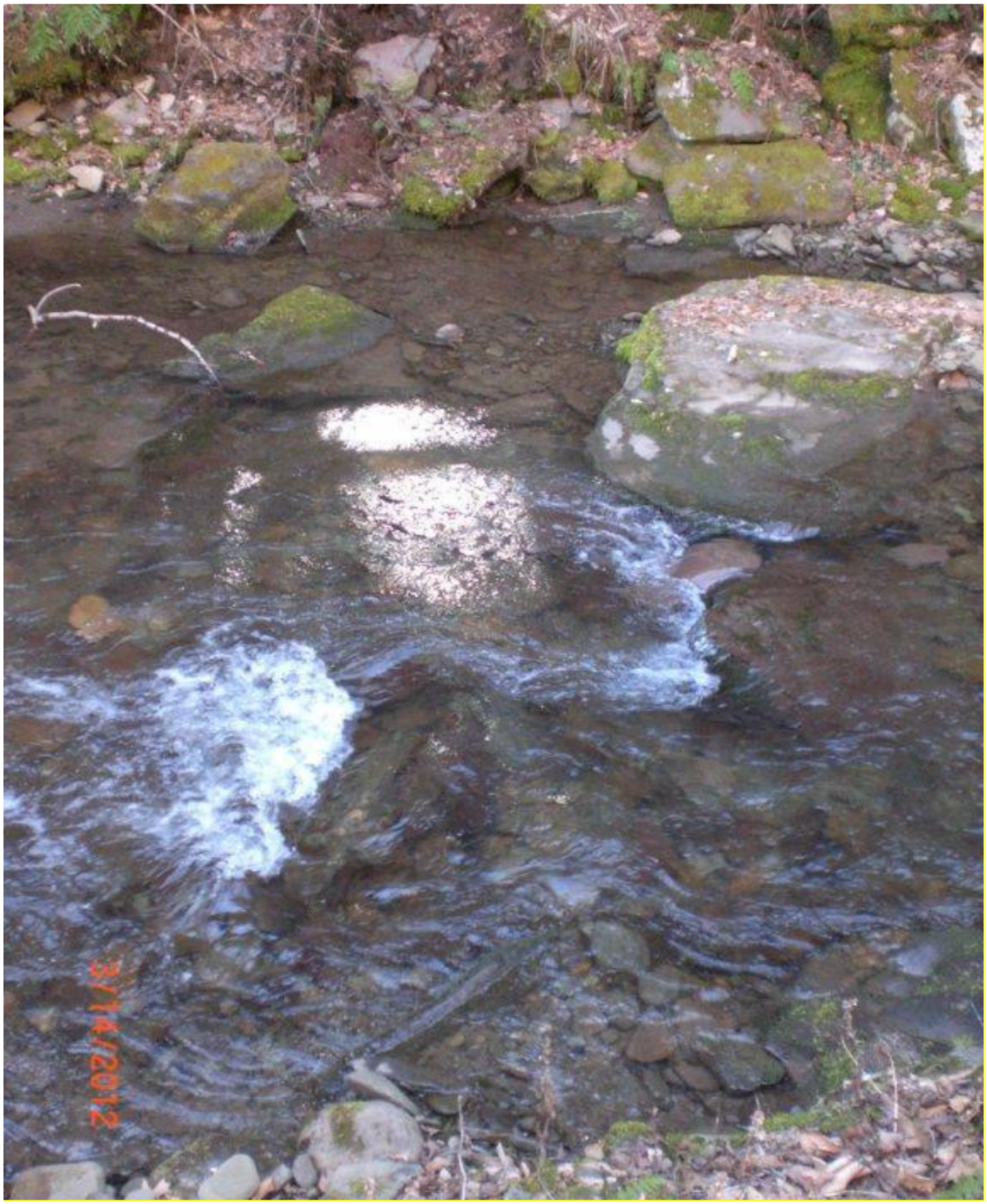

Figure 2. Straight Run sampling location.

**WATER QUALITY PARAMETERS:**

| Parameter | Units |
|---|---|
| Depth | Feet |
| Water Temperature | °C |
| Specific Conductance (@25°C) | μS/cm$^c$ |
| pH | standard units |
| Turbidity | Formazin Nephelometric Units (FNU) |

**EQUIPMENT:**

A single Yellow Springs Instruments (YSI) 6920-V2 water-quality sonde was used at this station. The sonde (Serial #00018B72) was installed on March 13, 2012. A Yellow Springs Instruments (YSI) 6920 V2 was used as a field meter during revisits.

The sonde was housed in a 24-inch length of 4-inch diameter schedule 80 PVC pipe with holes drilled in it to allow for flow through. One end of the pipe was capped, and a notch was cut to accommodate the metal attachment bar on the top of the sonde. The attachment bar was clipped to an eye-bolt attached to rebar driven into the stream bed. The attachment bar was also clipped to a cable attached to a second piece of rebar located just upstream of the first. The sonde recorded water quality parameters every 60 minutes.

**PERIOD OF RECORD:** March 13, 2012 to September 12, 2012

The station was revisited six times over six months for the purpose of downloading data, checking calibration, and cleaning.

**DATA:**

Water chemistry grabs collected six times during the sampling period. Benthic macroinvertebrates were collected on April 3, 2012, and fishes were collected on May, 15 2012 using the Department's ICE protocol (PA DEP, 2013a). Continuous data are graded based on a combination of fouling and calibration error (PA DEP, 2013b). Only one period for Turbidity was graded unusable and deleted from the final report.

**Depth:** Depth measured by this non-vented YSI 6920 is actually the measure of water column pressure plus atmospheric pressure. Depth was calibrated with the sonde in air during deployment. Changes in atmospheric pressure while the sonde was deployed appear as changes in depth. Data from the beginning of the period to 5/17/2012 (red line) were not corrected for barometric pressure. Data recorded after 5/17/2012 were corrected for barometric pressure using a Solinst Barologger Edge located at the USGS Northern Appalachian Research Laboratory. Figure 3 demonstrates the significant influence barometric pressure has on non-vented pressure sensors. These data are used only as qualitative interpretation for changes in other parameters due to a lack of verification.

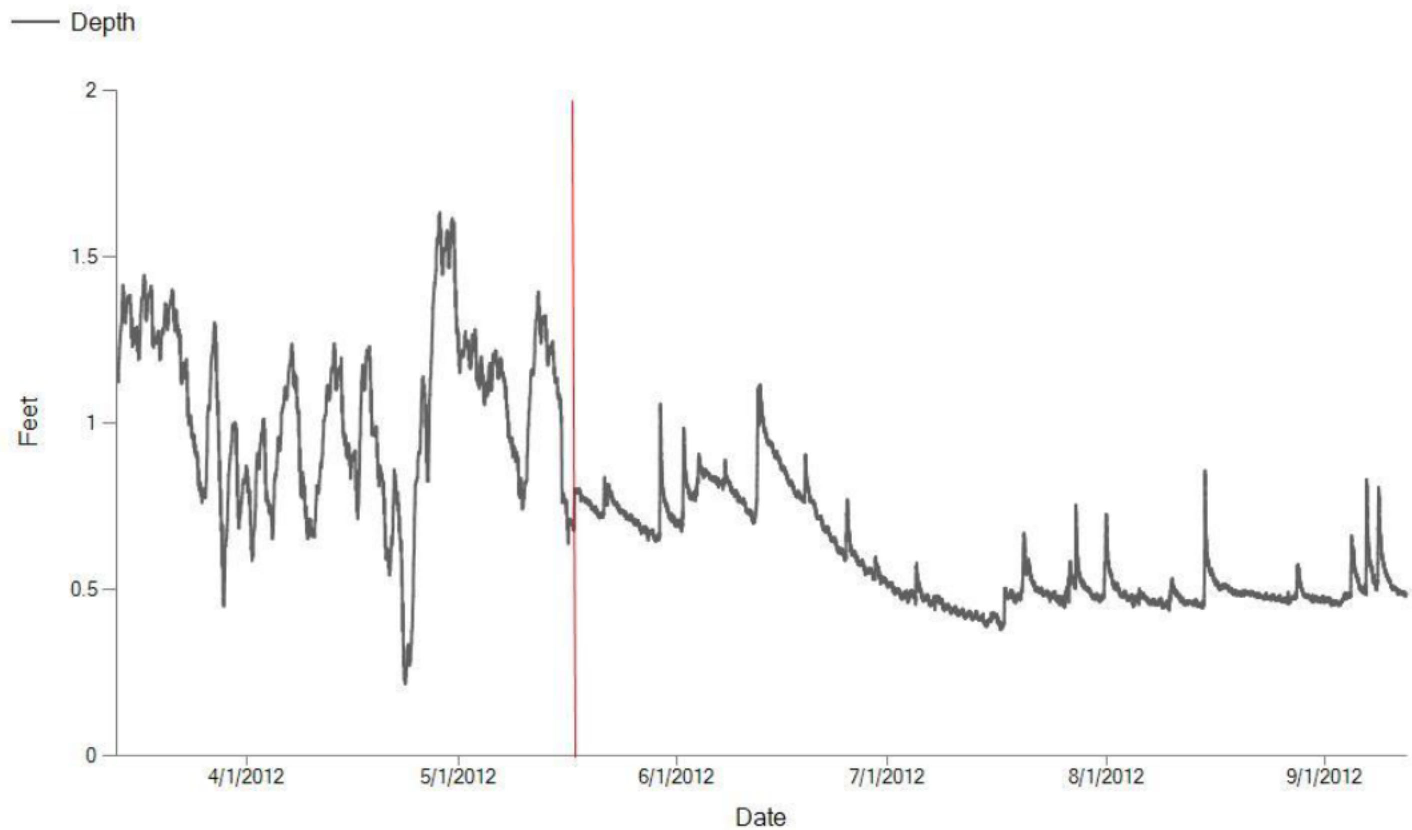


Figure 3. Continuous depth data from March 13, 2012 to September 12, 2012.

**Water Temperature:** Average: 13.14°C; Maximum: 18.40°C; Minimum: 3.06°C.

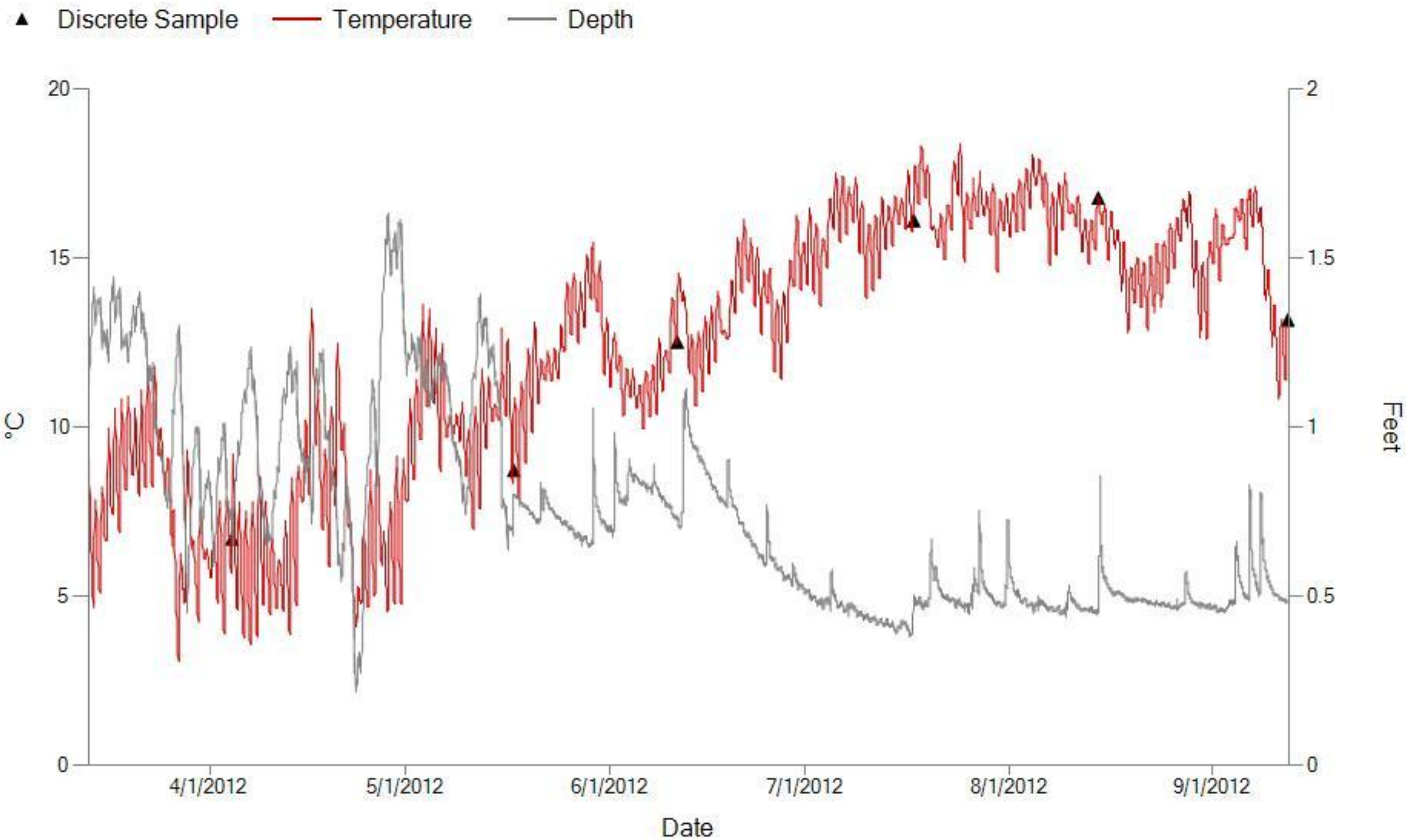


Figure 4. Continuous water temperature, continuous depth, and discrete samples from March 13, 2012 to September 12, 2012.

**Specific Conductance:** Average: 73.10 µS/cm; Maximum: 101.00 µS/cm; Minimum: 37.00 µS/cm.

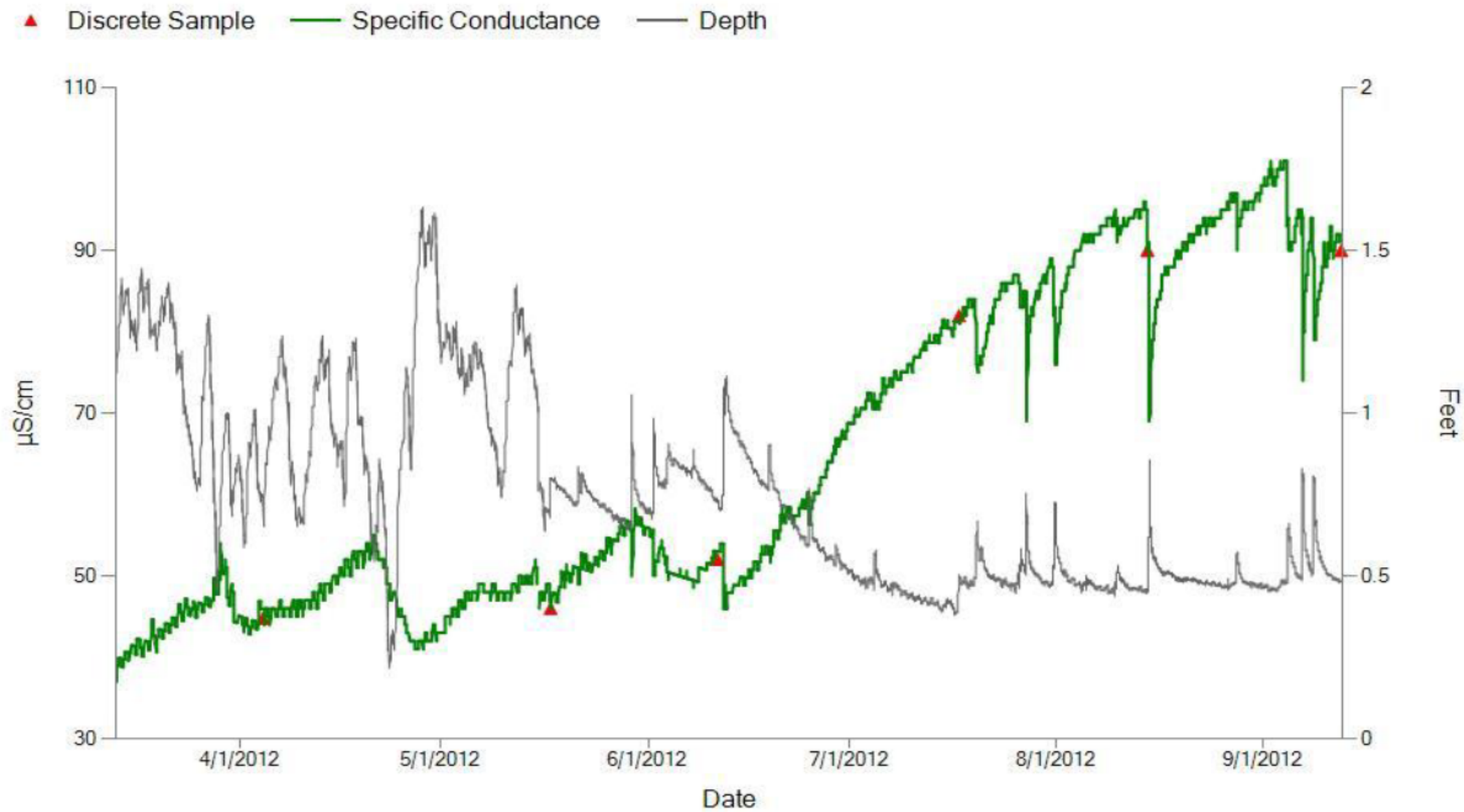


Figure 5. Continuous specific conductance, continuous depth, and discrete samples from March 13, 2012 to September 12, 2012.

**pH:** Average: 7.36 Maximum: 7.59 Minimum: 6.98.

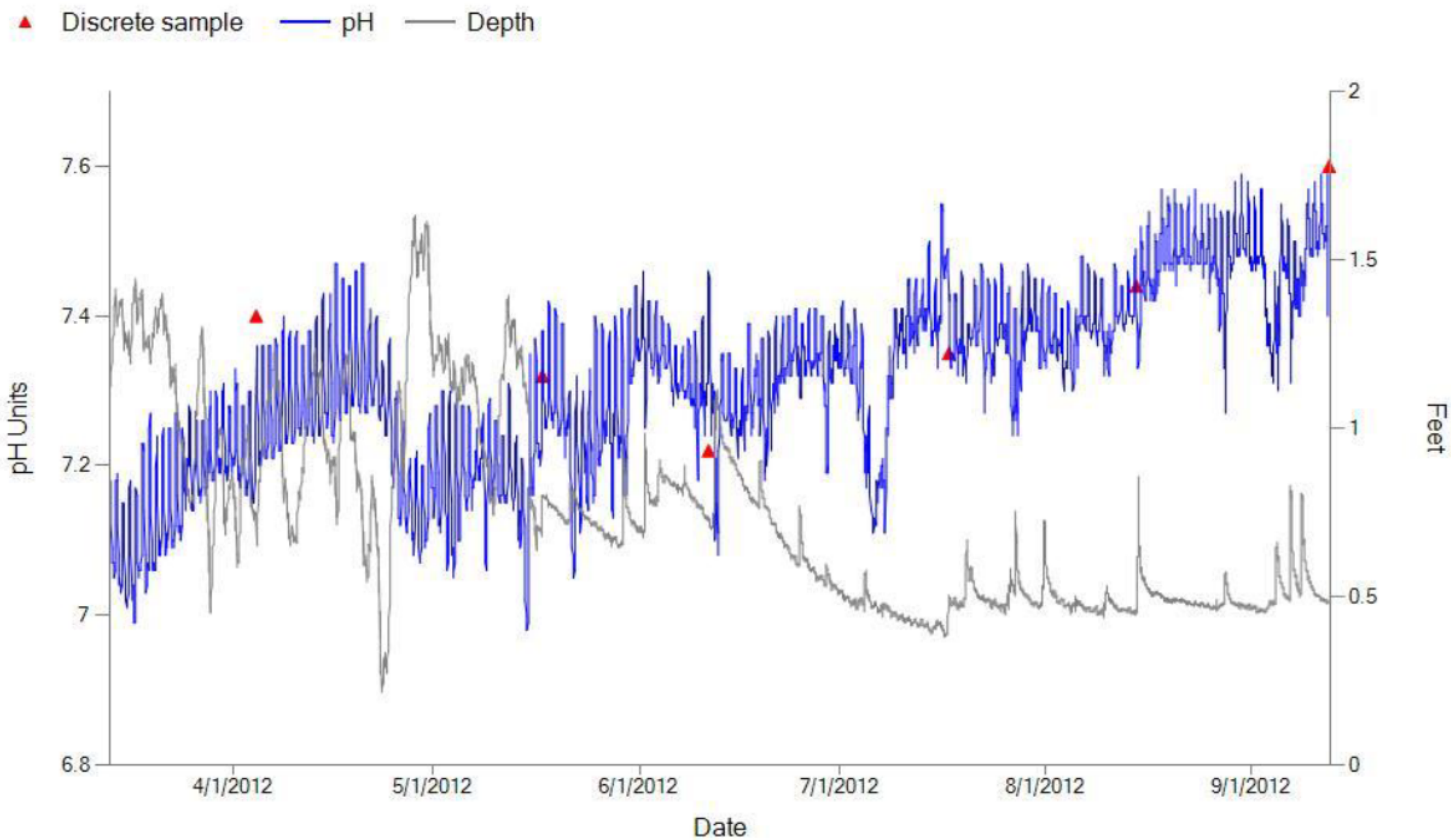


Figure 6. Continuous pH, continuous depth, and discrete samples from March 13, 2012 to September 12, 2012.

**Turbidity:** Average: 1.3 FNU; Maximum: 106.1 FNU; Minimum: 0.0 FNU.

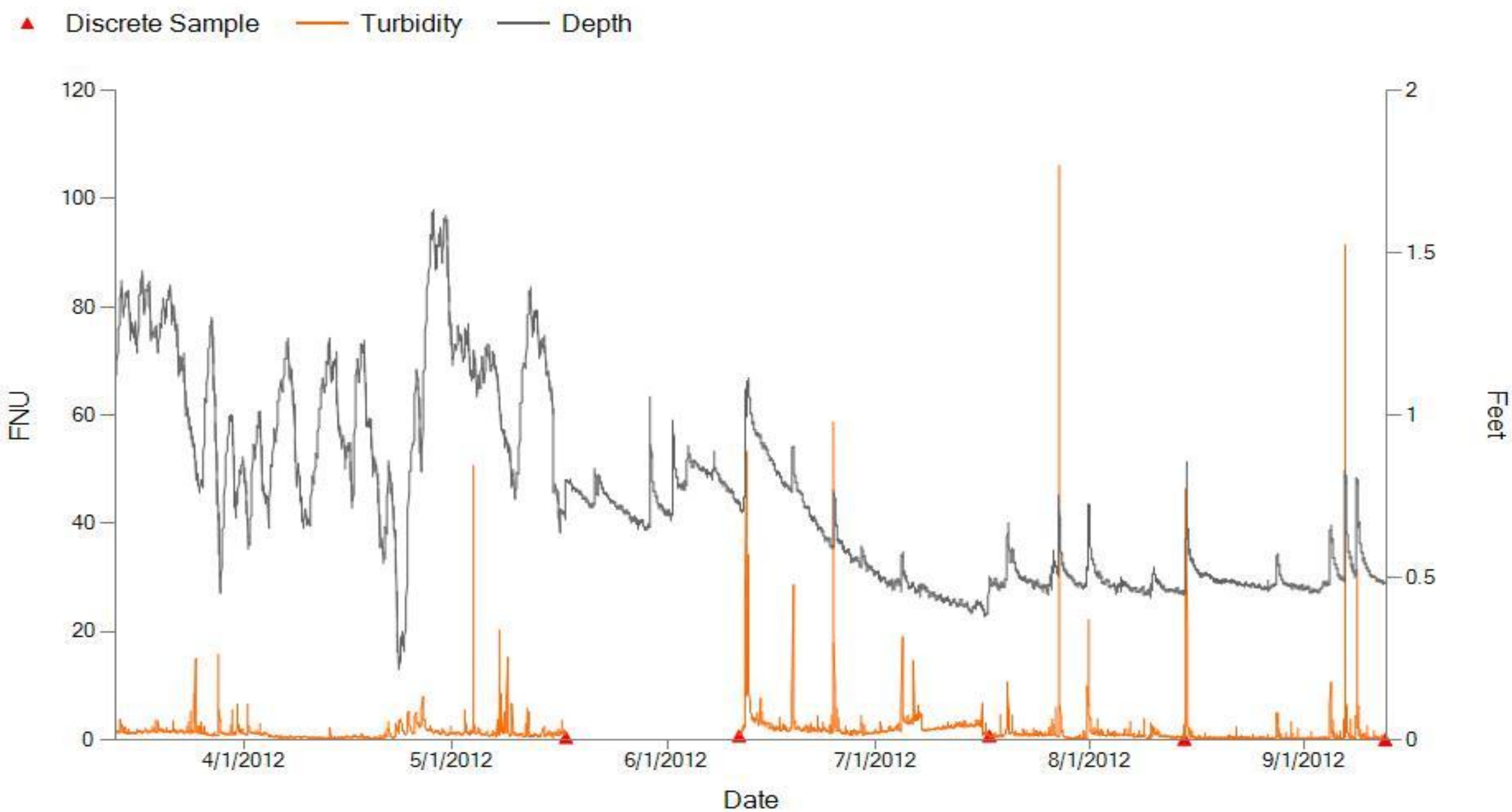


Figure 7. Continuous turbidity, continuous depth, and discrete samples from March 13, 2012 to September 12, 2012. The data gap was due to unacceptable sensor fouling.

**In-situ Water Chemistry:** Samples were collected six times using standard analysis code 046. Measurements with "<" indicate concentrations below the reporting limit. Values that follow "<" characterize the laboratory reporting limit.

Table 1. Chemical grab sample results.

| PARAMETER | UNITS | 3/13/2012 11:15 | 4/3/2012 8:30 | 5/17/2012 9:35 | 6/12/2012 8:00 | 8/15/2012 9:30 | 9/13/2012 7:00 |
|---|---|---|---|---|---|---|---|
| ALKALINITY T | MG/L | 8.6 | 12.2 | 13 | 16.6 | 27.6 | 33.8 |
| ALUMINUM T | UG/L | < 200 | < 200 | < 200 | < 200 | < 200 | < 200 |
| AMMONIA T | MG/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| ARSENIC T | UG/L | < 3.0 | < 3.0 | < 3.0 | < 3.0 | < 3.0 | < 3.0 |
| BARIUM T | UG/L | 10 | 13 | 13 | 17 | 20 | 24 |
| BOD | MG/L | 0.3 | 2.7 | 1.3 | 0.7 | 0.8 | 0.9 |
| Boron T | UG/L | < 200 | < 200 | < 200 | < 200 | < 200 | < 200 |
| BROMIDE | UG/L | < 25.0 | < 25.0 | < 25.0 | < 25.0 | < 25.0 | < 25.0 |
| CALCIUM T | MG/L | 4.205 | 5.2 | 5.433 | 6.543 | 9.1 | 10.4 |
| CHLORIDE | MG/L | 0.64 | 0.79 | 0.65 | 0.8 | 1.24 | 1.88 |
| HARDNESS T | MG/L | 14 | 18 | 18 | 22 | 30 | 35 |
| IRON T | UG/L | 30 | 28 | 53 | 82 | 53 | < 22.0 |
| LITHIUM T | UG/L | < 25 | < 25 | < 25 | < 25 | < 25 | < 25 |
| MAGNESIUM T | MG/L | 0.909 | 1.1 | 1.15 | 1.341 | 1.802 | 2.088 |
| MANGANESE T | UG/L | < 10.00 | < 10.00 | < 10.00 | < 10.00 | < 10.00 | < 10.00 |
| NITRATE & NITRITE T | MG/L | < 0.05 | < 0.05 | < 0.05 | 0.12 | 0.27 | 0.12 |
| OSMOTIC PRESSURE | MOSM | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| PHOSPHORUS T | MG/L | < 0.01 | < 0.01 | < 0.01 | 0.012 | 0.014 | 0.011 |
| SELENIUM T | UG/L | < 7 | < 7 | < 7 | < 7 | < 7 | < 7 |
| SODIUM T | MG/L | 0.579 | 0.832 | 0.783 | 1.024 | 2.405 | 3.144 |
| SPC.COND. @ 25.0 C | µS/cm | 33.4 | 44.8 | 43.8 | 48.5 | 72.9 | 87.6 |
| STRONTIUM T | UG/L | 16 | 24 | 22 | 28 | 43 | 52 |
| SULFATE T | MG/L | 6.78 | 6.9 | 6.87 | 7 | 7.15 | 7.73 |
| TDS @ 180C | MG/L | 32 | 54 | 44 | 44 | 64 | 60 |
| TSS | MG/L | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 |
| ZINC T | UG/L | < 10.0 | < 10.0 | < 10.0 | < 10.0 | 17 | 45 |

**Biology:** The indigenous aquatic community is an excellent indicator of long-term conditions water quality. Benthic macroinvertebrates (Table 2) were collected on April 3, 2012. Fishes were collected on May 15, 2012 (Table 3).

Table 2. Taxa list for benthic macroinvertebrate survey.

| Family | Genus | 20120403-0809-dushull |
|---|---|---|
| Baetidae | Baetis | 3 |
| Heptageniidae | Epeorus | 64 |
| | Leucrocuta | 1 |
| | Maccaffertium | 1 |
| | Cinygmula | 53 |
| Ephemerellidae | Drunella | 9 |
| | Ephemerella | 8 |
| Leptophlebiidae | Habrophlebiodes | 1 |
| | Paraleptophlebia | 13 |
| Pteronarcidae | Pteronarcys | 1 |
| Nemouridae | Amphinemura | 3 |
| Leuctridae | Leuctra | 3 |
| Perlidae | Agnetina | 1 |
| | Acroneuria | 1 |
| Perlodidae | Malirekus | 1 |
| | Isoperla | 1 |
| Chloroperlidae | Haploperla | 2 |
| | Sweltsa | 1 |
| Corydalidae | Nigronia | 1 |
| Hydropsychidae | Diplectrona | 5 |
| | Ceratopsyche | 2 |
| | Cheumatopsyche | 2 |
| Rhyacophilidae | Rhyacophila | 2 |
| Elmidae | Oulimnius | 9 |
| | Promoresia | 2 |
| Tipulidae | Dicranota | 1 |
| | Hexatoma | 2 |
| Simuliidae | Prosimulium | 6 |
| Chironomidae | Chironomidae | 16 |
| | Oligochaeta (subclass) | 1 |

Table 3. Taxa list for fish survey.

| Family | Scientific Name | Common Name | 20120515-1615-dushull |
|---|---|---|---|
| Cottidae | *Cottus cognatus* | Slimy sculpin | 40 |
| Salmonidae | *Salvelinus fontinalis(wild)* | Brook trout (wild) | 36 |

**ASSESSMENT:**

**Continuous:** Overall, parameters collected by the instream monitor indicate excellent water quality conditions. Specific conductance measurements show a relatively consistent pattern throughout the sampling period with no unexpected variation. Continuous measurements in pH were remarkably consistent with little seasonal or diel variance. Constancy of pH through these two temporal scales suggests minimal anthropogenic influence and moderate buffering capacity. Turbidity data were measured in a quantitative manner. A relatively low maximum during high flow events suggests minimal surface disturbance. In addition, all high turbidity events corresponded to increased flow events. As a result, turbidity data support the conclusion that Straight Run was minimally impacted by anthropogenic activities during the sampling period.

**Biological:** The benthic macroinvertebrate community indicated excellent water quality during the period sampled. Approximately 82% of the total taxa consist of Ephemeroptera, Plecoptera & Trichoptera (EPT) taxa. The most dominant taxa were Epeorus and Cinygmula, two mayflies that are intolerant to pollution. A collection of only two cold water fishes is characteristic of this type of headwater stream.

Table 4. Metric calculations.

| Date | IBI | Richness | Mod EPT | HBI | % Dom | % Mod May | Beck3 | Shannon Div |
|---|---|---|---|---|---|---|---|---|
| April 03, 2012 | 94.8 | 30 | 18 | 1.51 | 29.6 | 69.0 | 40 | 2.38 |

**Specific Conductance and Total Dissolved Solids Relationship:** A significant relationship between specific conductance (SPC) and total dissolved solids (TDS) was created using discrete chemical data (Figure 7). Using the formula:
TDS = 22.851 + 0.4861*SPC estimates of TDS can be created with relative confidence. However, additional samples are needed to create a more meaningful relationship between TDS and SPC in Straight Run.

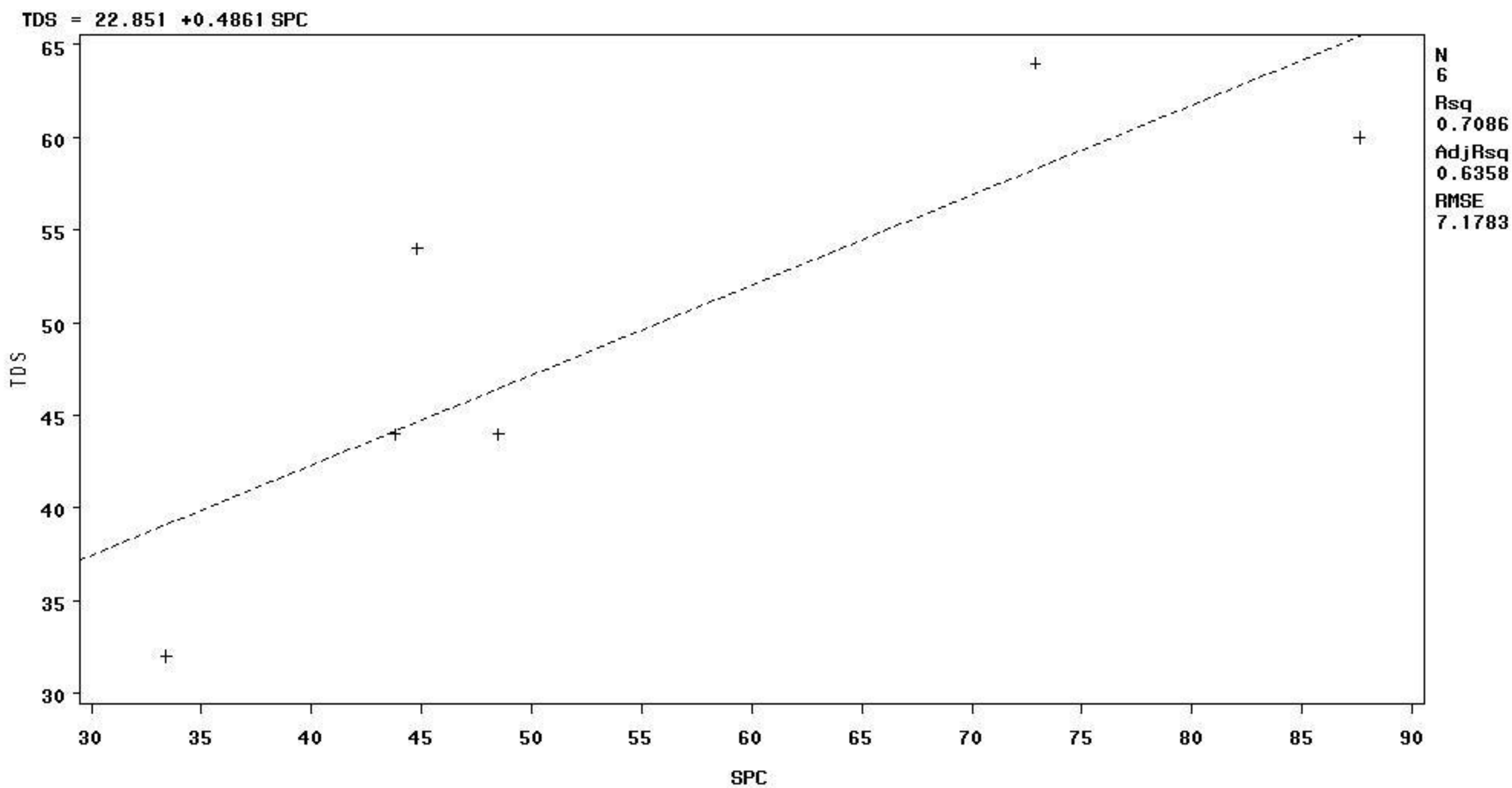


Figure 7. Relationship between specific conductance and total dissolved solids for Straight Run.

**Comparison of USGS and PADEP data:**

In July of 2012 a permanent USGS gauging station (station number: 01548303) with a multiparameter sonde was installed on Straight Run at the Straight Run Road Bridge. This allowed for data comparison between PA DEP and USGS methods. There was approximately one month (August, 2012) of overlapping data between the PADEP and USGS deployments. Spatially, the PADEP monitor was about 0.25 miles upstream of the USGS monitor (Figure 8) and Straight Run Road. Both monitors were YSI instruments.

Several differences between the site locations and deployment methodologies caused significant dissimilarities between most co-measured parameters. The USGS monitor was deployed just upstream of the Straight Run Road Bridge. Consequently, the water around the USGS monitor was exposed to more sunlight from the open canopy. Additionally, water velocity was slower just upstream of the bridge allowing for longer residence time in the open area. This potentially resulted in the observed increased diel fluctuations in several parameters (specifically, temperature, pH and to a lesser extent, specific conductance) at the USGS monitor. Temperature (Figure 9) and pH (Figure 11) show the greatest perceivable difference between the two sites. Specific conductance (Figure 10) shows a slightly greater diel fluctuation in the USGS data, but overall, USGS data is lower than PADEP data by approximately 10 µS/cm[c] difference at the end of the comparison period. It is possible that a higher contribution of surface water at the USGS monitor is causing the difference in measurements between the two sites.

Turbidity (Figure 12) was fairly consistent with the exception of two areas. First, the USGS monitor tended to always have higher peak measurements during storm events, and second, there was a significant period of time around 8/19/2012 where the USGS monitor had greater noise in measurements compared to the PADEP monitor. Higher peak measurements at the USGS site were probably due to the monitor's close proximity to the road. Hence, the USGS monitor was more likely to capture direct runoff. It is difficult to determine why the USGS monitor experienced a greater fluctuation in measurements around 8/19/2012, or if these results were truly experienced instream at that location. However, it is possible that this period of data is uncorrected fouling of the USGS turbidity sensor.

It's important to note that water traveling from the PADEP monitor to the USGS monitor was exposed to several open canopy areas and potential input form a small pond located just to the east of the stream (circled in Figure 8). Changes in basin characteristics between the two sites possibly confound any direct comparison between the two instruments. Yet, it does highlight the importance of site selection and data representativeness for future deployments.

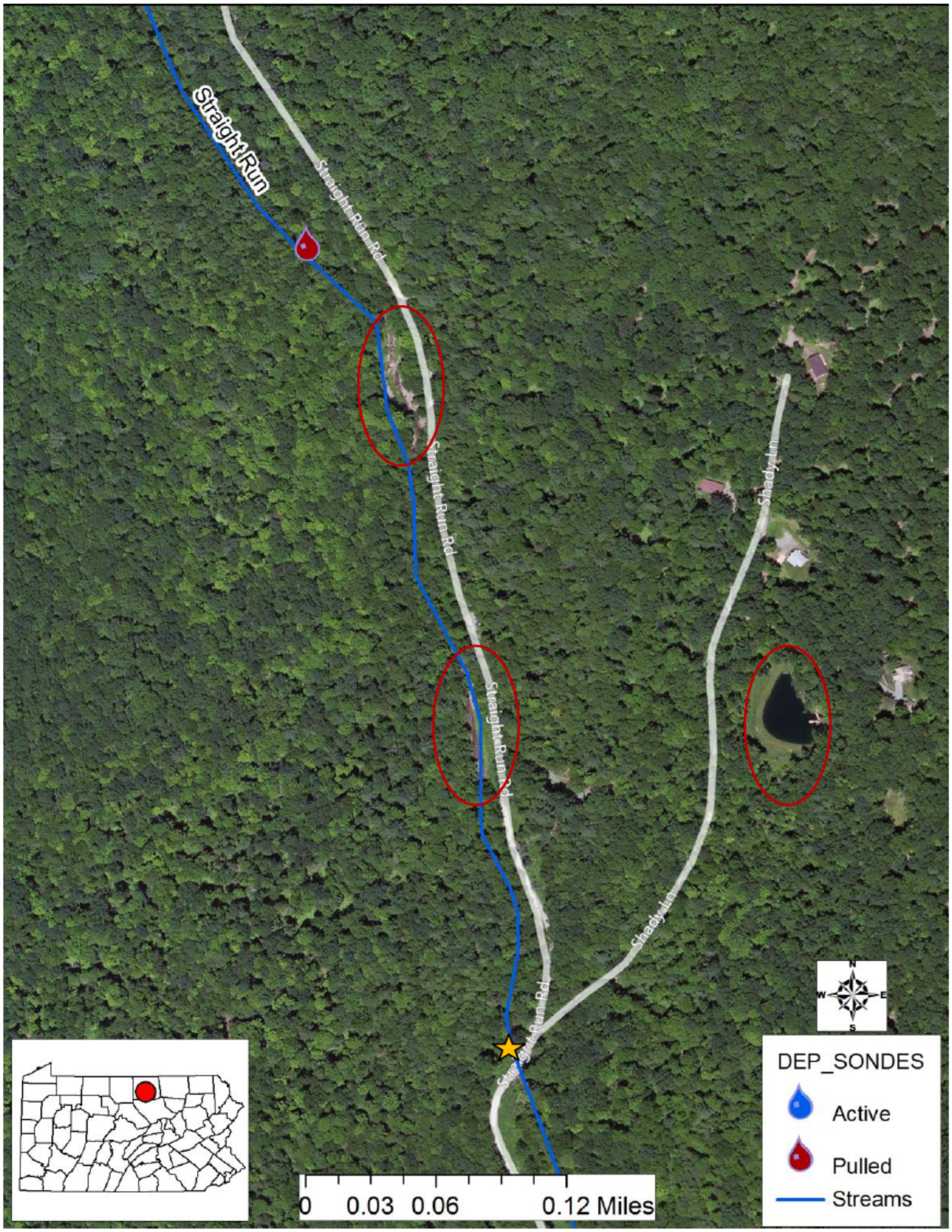


Figure 8. Location of the PADEP monitor and USGS monitor (yellow star). Areas circled in red indicate possible causes of differences in water quality parameters between the monitoring sites.

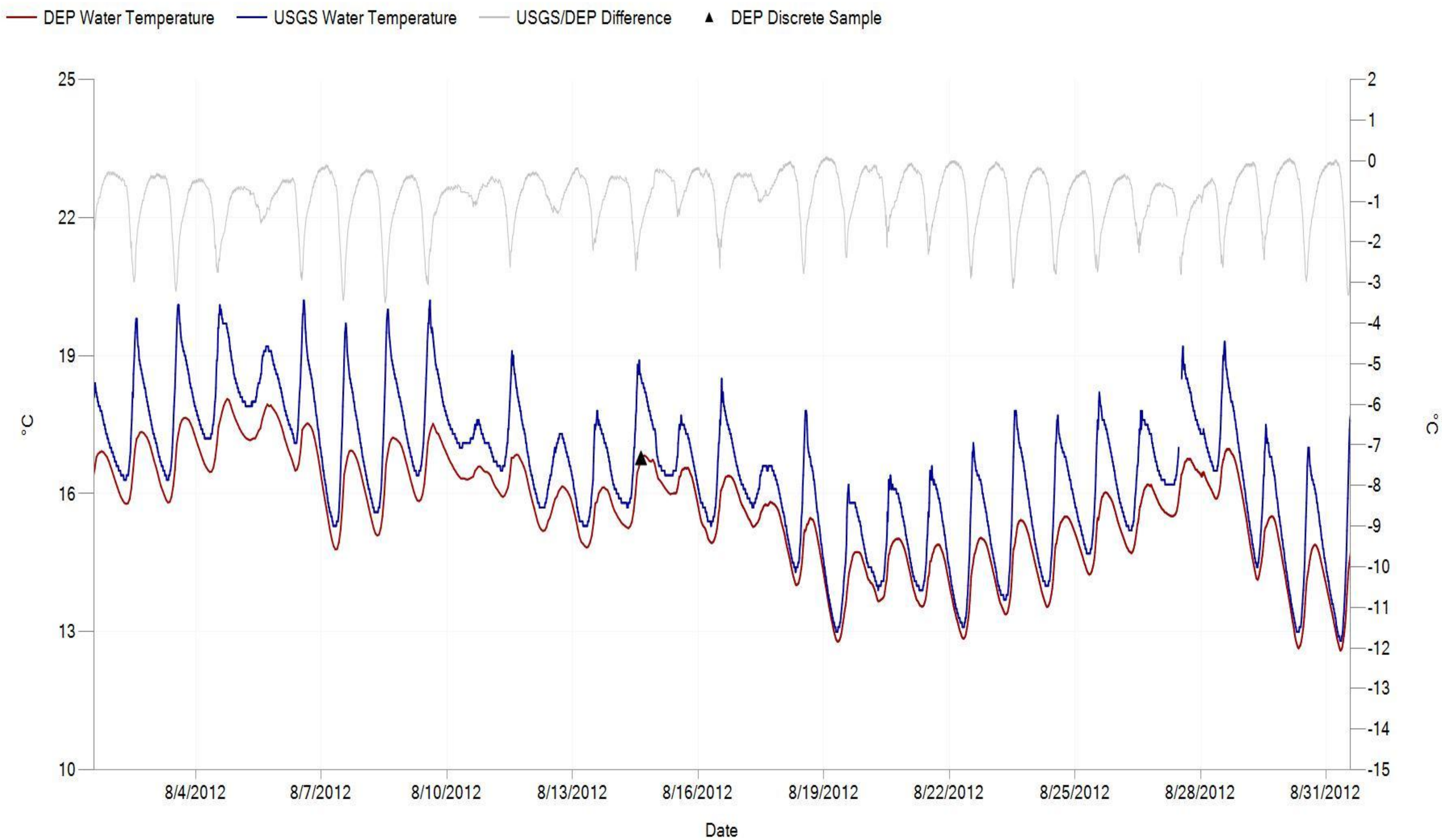


Figure 9. Comparison of water temperature between USGS and PADEP monitors. The gray line corresponds to USGS data subtracted by PADEP data to obtain difference (units on the right Y axis). For example, negative "USGS/DEP Difference" values indicate that USGS data was reading higher than PADEP data.

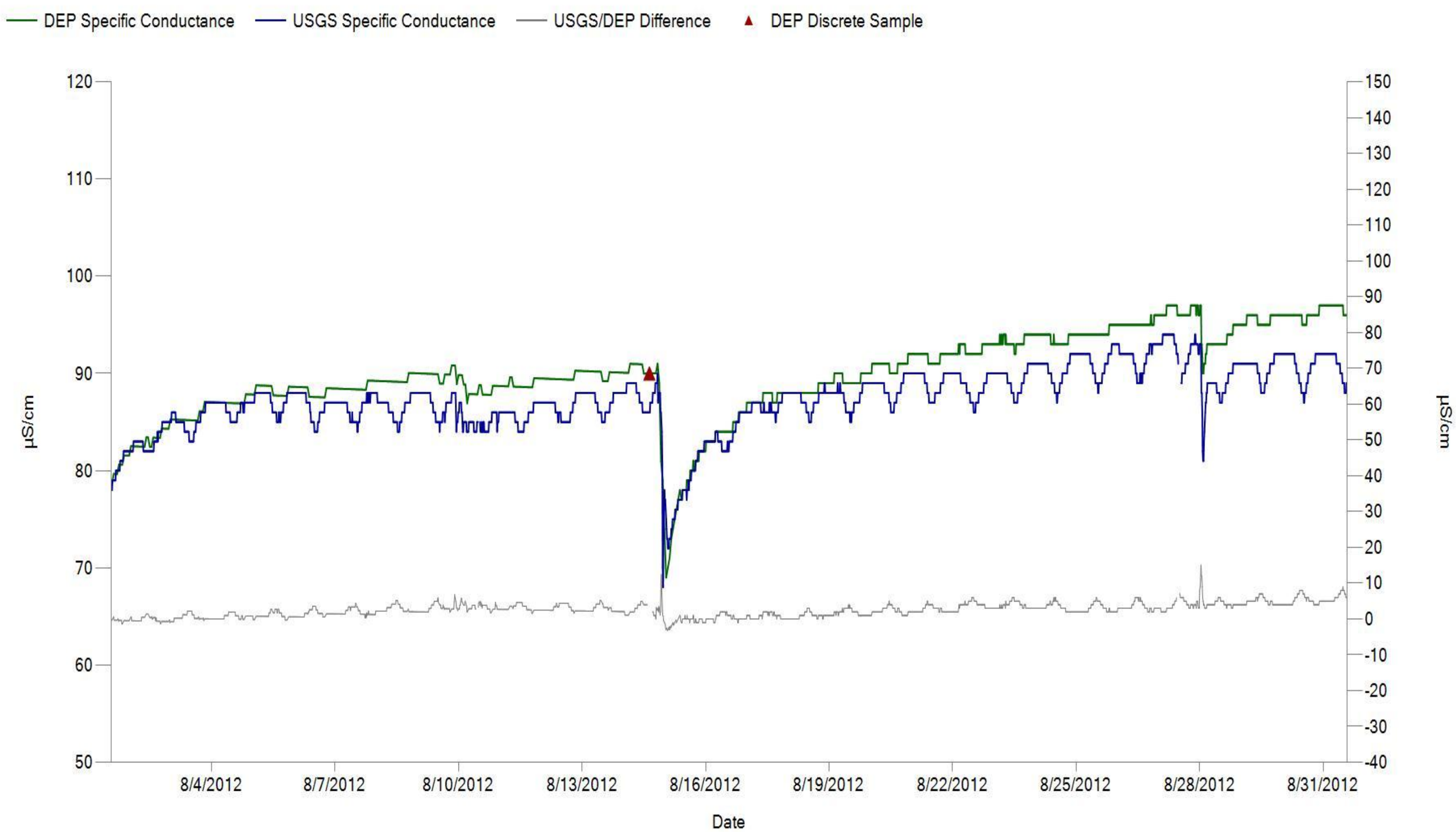


Figure 10. Comparison of specific conductance between USGS and PADEP monitors. The gray line corresponds to USGS data subtracted by PADEP data to obtain difference (units on the right Y axis). For example, negative "USGS/DEP Difference" values indicate that USGS data was reading higher than PADEP data.

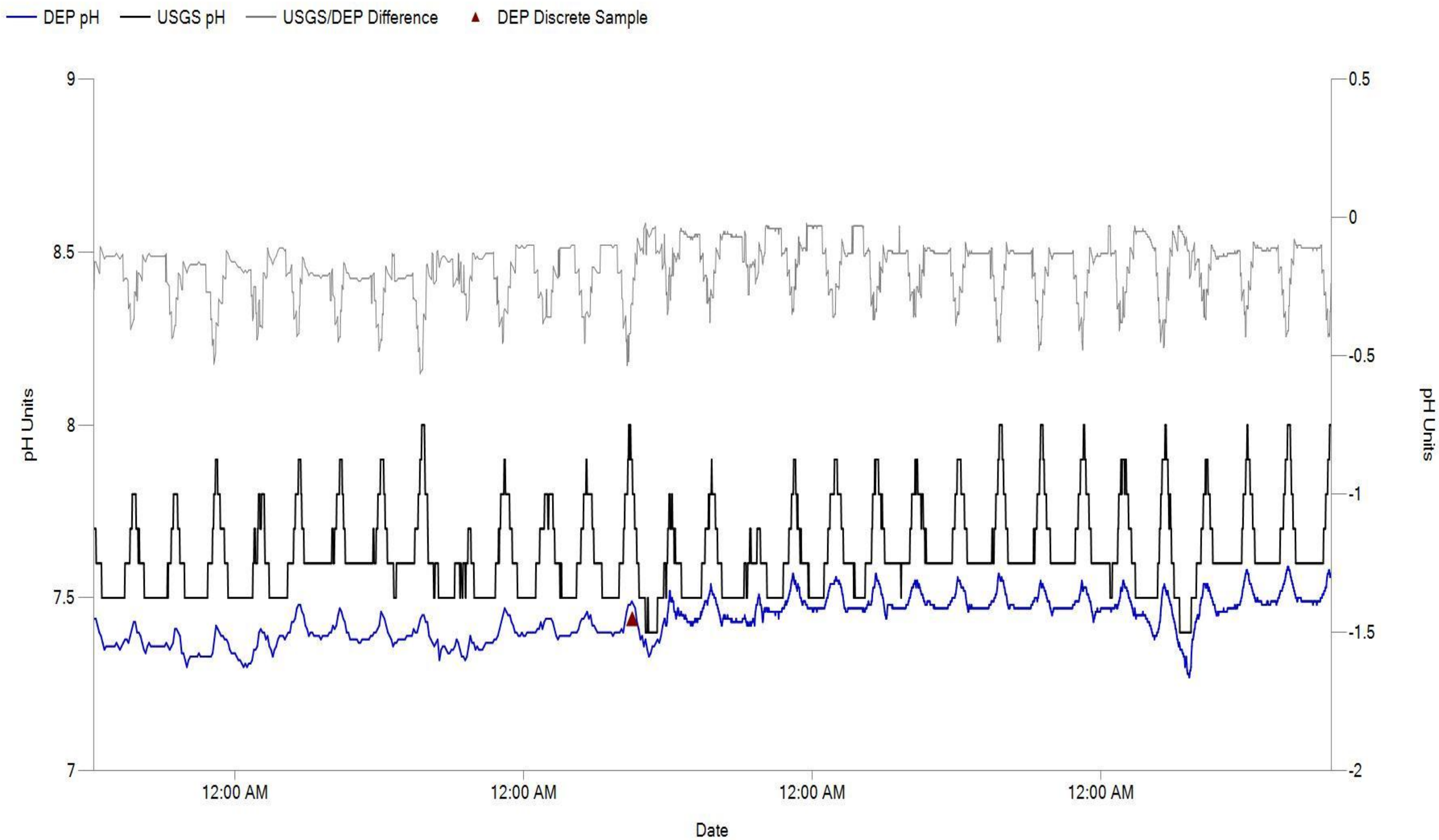


Figure 11. Comparison of pH between USGS and PADEP monitors. The gray line corresponds to USGS data subtracted by PADEP data to obtain difference (units on the right Y axis). For example, negative “USGS/DEP Difference” values indicate that USGS data was reading higher than PADEP data.

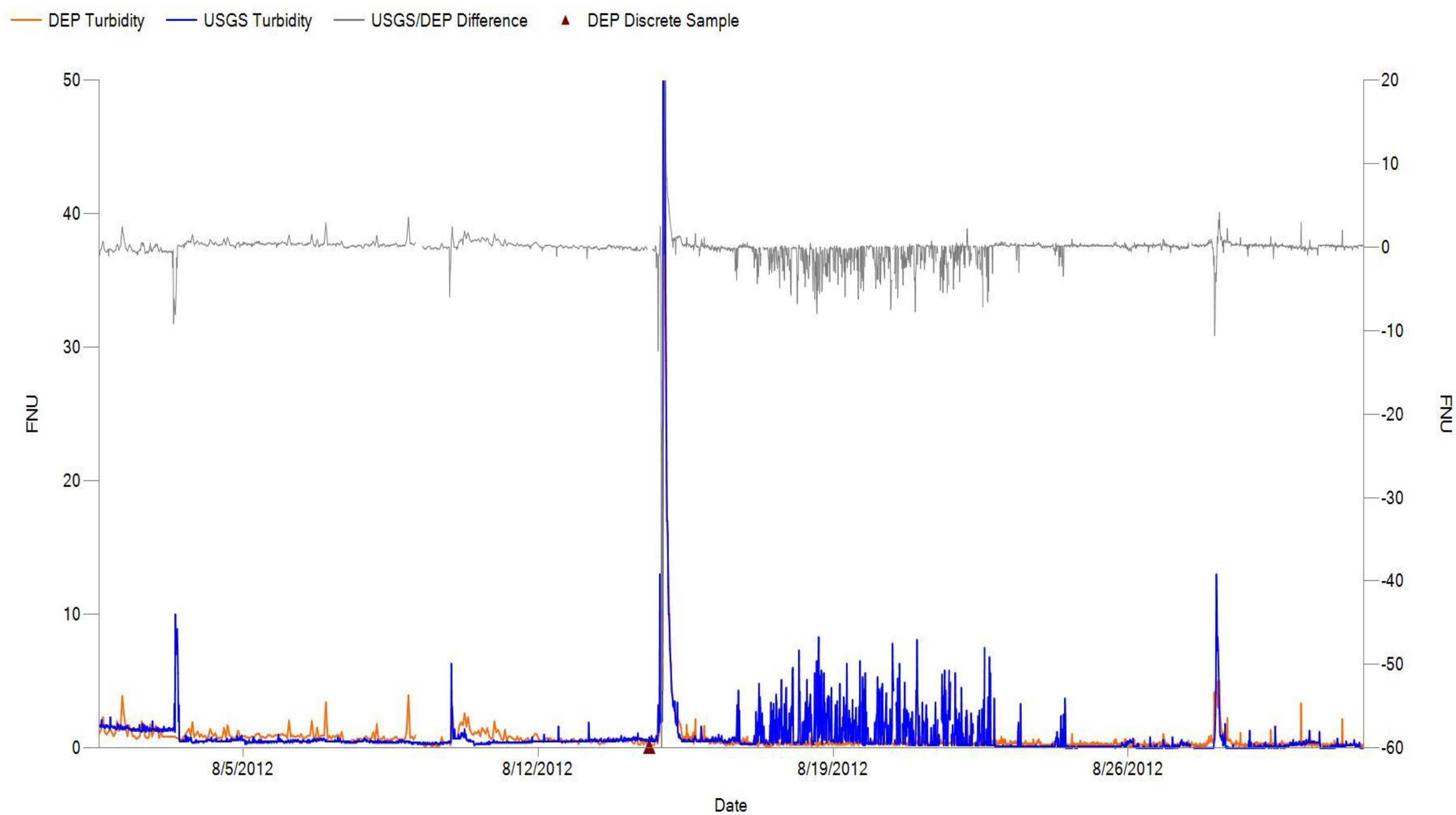


Figure 12. Comparison of turbidity between USGS and PADEP monitors. The gray line corresponds to USGS data subtracted by PADEP data to obtain difference (units on the right Y axis). For example, negative "USGS/DEP Difference" values indicate that USGS data was reading higher than PADEP data.

**SUMMARY:**

Continuous monitoring, in-situ lab chemistries, and biological data all suggest that Straight Run has excellent water quality conditions. Establishing baseline conditions for a stream segment typically takes one year to determine seasonal variances in measured parameters. However, the PADEP monitor in Straight Run was pulled after six months due to the deployment of the USGS gauging station that currently reports flow, water temperature, specific conductance, pH, dissolved oxygen, and turbidity online. The comparison between PADEP and approved USGS data show interesting differences between the two sites and suggest that careful attention to deployment location and methodology should be incorporated into any data evaluation. The Division of Water Quality Standards will continue to refine turbidity and depth data in order to establish rating curves for parameters such as discharge, total suspended solids, and others.

**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