



pennsylvania

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT & NON-POINT SOURCE MANAGEMENT

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 6/1/2015

Revised by: Hoger

STATION DESCRIPTION:

STREAM CODE: 03295

STREAM NAME: Cooks Creek

SITE CODE: 26054142-001

SITE NAME: Red Bridge Road

COUNTY: Bucks

LATITUDE: 40.582837 **LONGITUDE:** -75.205218

LOCATION DESCRIPTION: Cooks Creek off Red Bridge Road; sonde located approximately 100 meters upstream of Route 212 and Red Bridge Road.

HUC: 02040105

DRAINAGE AREA: 29.23 sq. miles

BACKGROUND AND HISTORY: Cooks Creek is a freestone tributary to the Delaware River located in Durham Township, Bucks County (Figure 1). The basin is characterized by relatively flat topography with some gently rolling hills of low relief with land use consisting of forested (60%), agricultural open (38%), and urban (2%) land. The purpose of this survey was to characterize early-spring water quality and biological conditions as part of a greater nutrient impact assessment development. Cooks Creek has a designated use of Exceptional Value, Migratory Fishes (EV, MF)

The primary objectives of the assessment were to:

1. Characterize baseline water temperature, specific conductance, pH, and dissolved oxygen using 24-hour monitoring.
2. Characterize water chemistry.
3. Characterize biological communities.

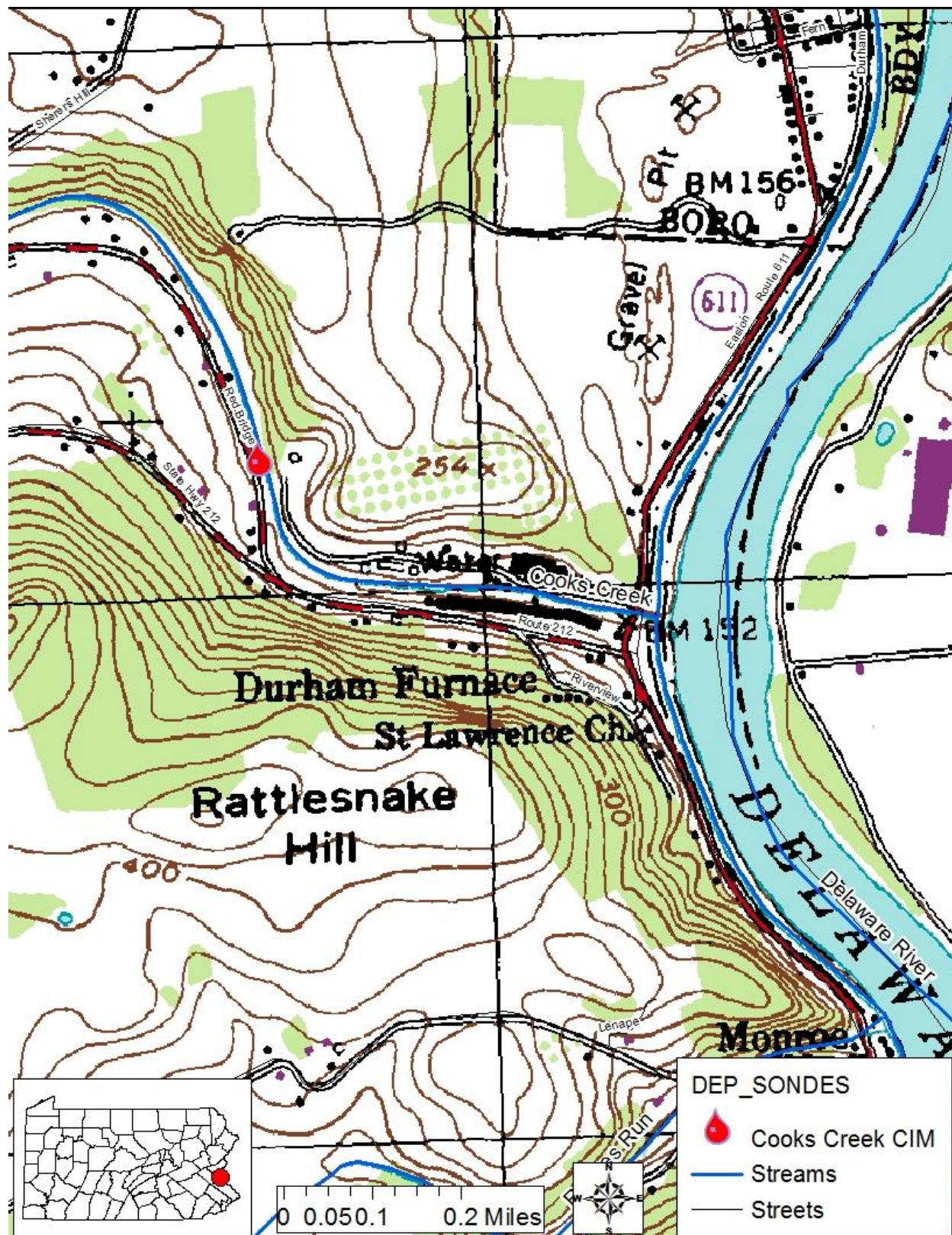


Figure 1. Map of the Cooks Creek continuous in-stream monitoring site.



Figure 2. Cooks Creek sample location.

WATER QUALITY PARAMETERS:

Parameter	Units
Water Temperature	°C
Specific Conductance (@25°C)	µS/cm ^c
pH	standard units
Dissolved Oxygen	mg/L

EQUIPMENT:

A Measurement Specialties Eureka2 water-quality sonde (Serial #MM12100604) was used from March 4, 2013 to March 12, 2013. On March 12, 2013 a Yellow Springs Instruments (YSI) 6920-V2 water-quality sonde (Serial #00018B8B) was installed at the station. 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 30 minutes.

PERIOD OF RECORD: March 4, 2013 to April 24, 2013

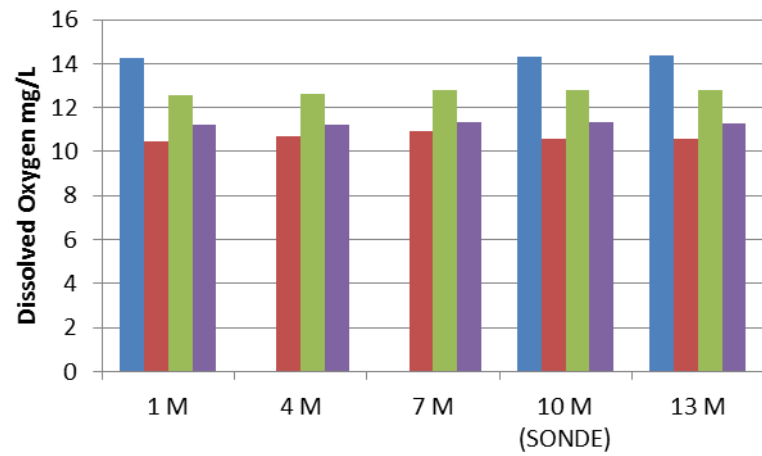
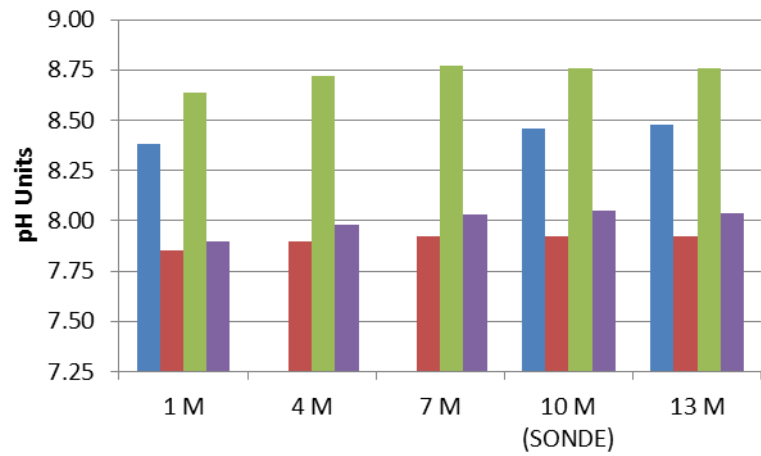
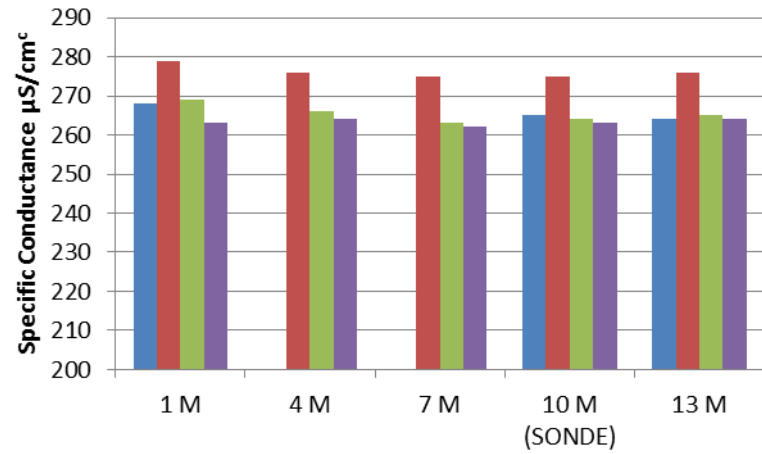
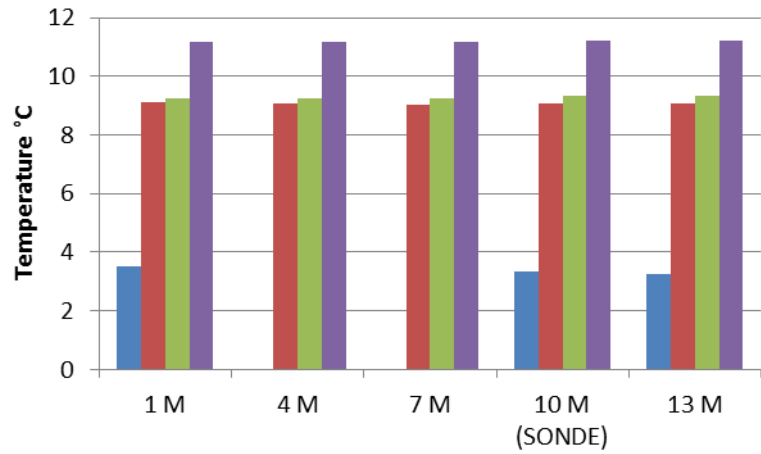
The station was revisited two times over two months for the purpose of downloading data, checking calibration, and cleaning.

DATA:

Water chemistry grabs were collected two times during the sampling period. Benthic macroinvertebrates were collected on April 8, 2013, periphyton was collected on April 24, 2013, and fishes were collected on July 16, 2013 using the Department's ICE protocol (PA DEP, 2009). Continuous data are graded based on a combination of fouling and calibration error (PA DEP, 2012). No data were graded unusable.

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 in this report were corrected for barometric pressure using a Solinst Barologger located at the Skippack Creek at Highway 63 site. These data are used only as qualitative interpretation for changes in other parameters due to a lack of verification.

Discrete Water Quality Transect Characterization: A transect across the width of the stream was established to characterize water quality. The purpose of the transect was to determine if data collected by the sonde was representative of the surface water as a whole. Discrete water quality measurements were taken at five points across the stream in 3 meter increments from the left ascending bank. Transects were conducted four times throughout the sampling period. The sample on 3/12/13 was during a storm event. Temperature, specific conductance, pH, and dissolved oxygen measurements indicated a fairly homogenous system (Figure 3); however, the left bank typically showed slightly elevated specific conductance and lower pH. The sonde was located towards the right bank to avoid this inconsistency.



■ 3/4/2013 ■ 3/12/2013 ■ 3/27/2013 ■ 4/16/2013

Figure 3. Water quality transects at Cooks Creek.

Water Temperature: Average: 8.77 °C; Maximum: 18.96 °C; Minimum: 3.14 °C.

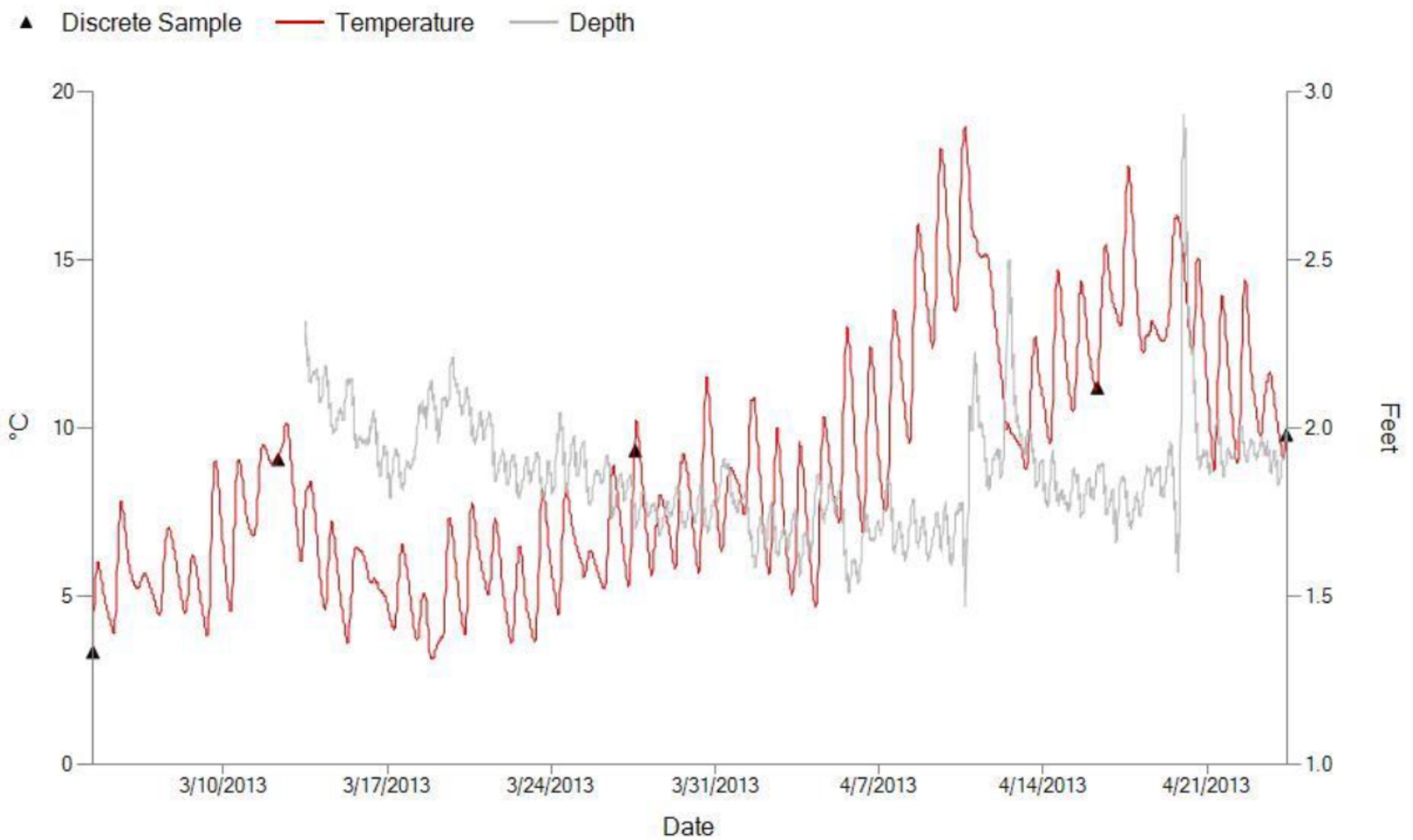


Figure 4. Continuous water temperature, continuous depth, and discrete samples from March 4, 2013 to April 24, 2013.

Specific Conductance: Average: 256.8 $\mu\text{S}/\text{cm}$; Maximum: 291 $\mu\text{S}/\text{cm}$; Minimum: 116 $\mu\text{S}/\text{cm}$.

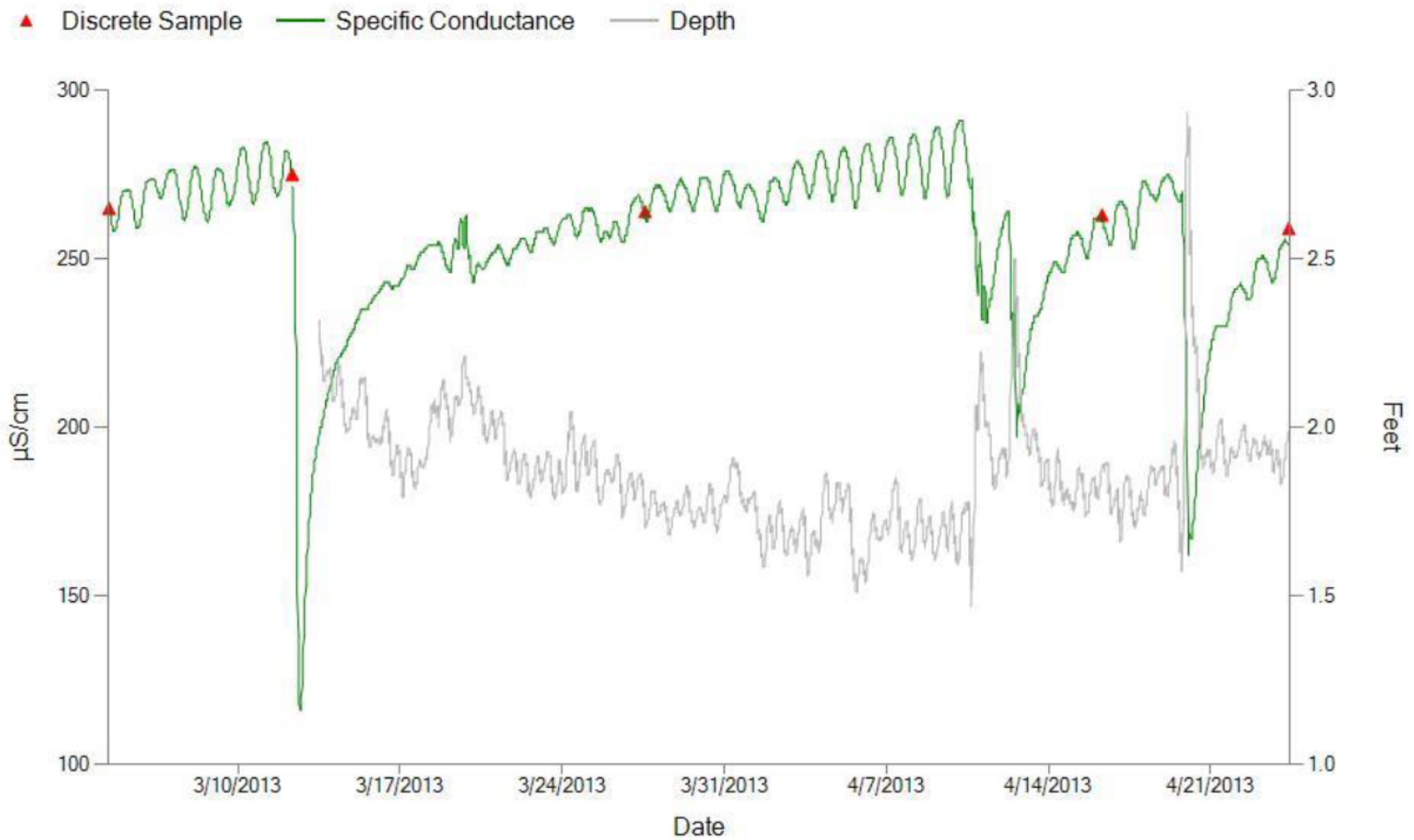


Figure 5. Continuous specific conductance, continuous depth, and discrete samples from March 4, 2013 to April 24, 2013.

pH: Average: 8.3 units; Maximum: 9.35 units; Minimum: 7.23 units.

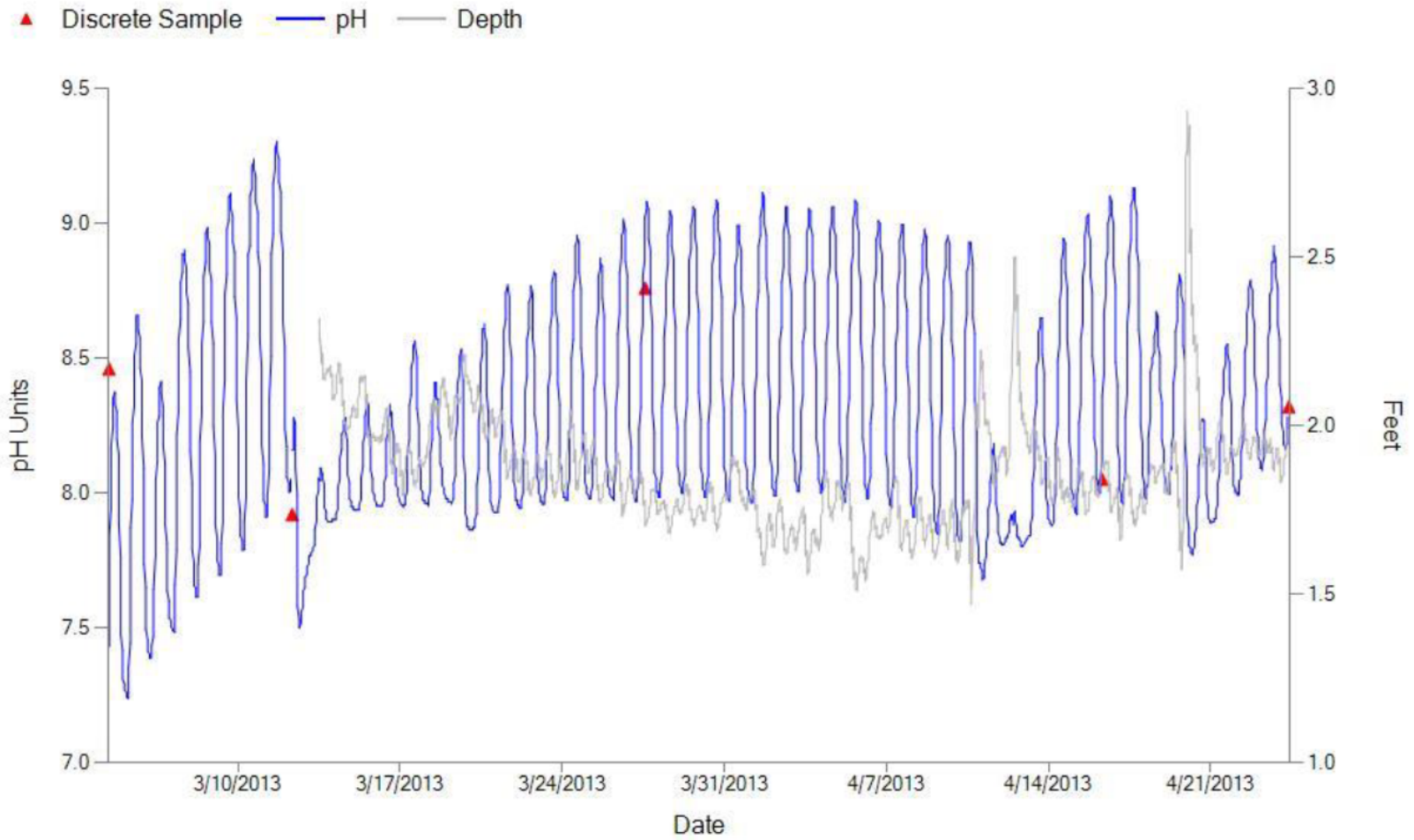


Figure 6. Continuous pH, continuous depth, and discrete samples from March 4, 2013 to April 24, 2013.

Dissolved Oxygen: Average: 11.74 mg/L; Maximum: 16.28 mg/L; Minimum: 8.05 mg/L.

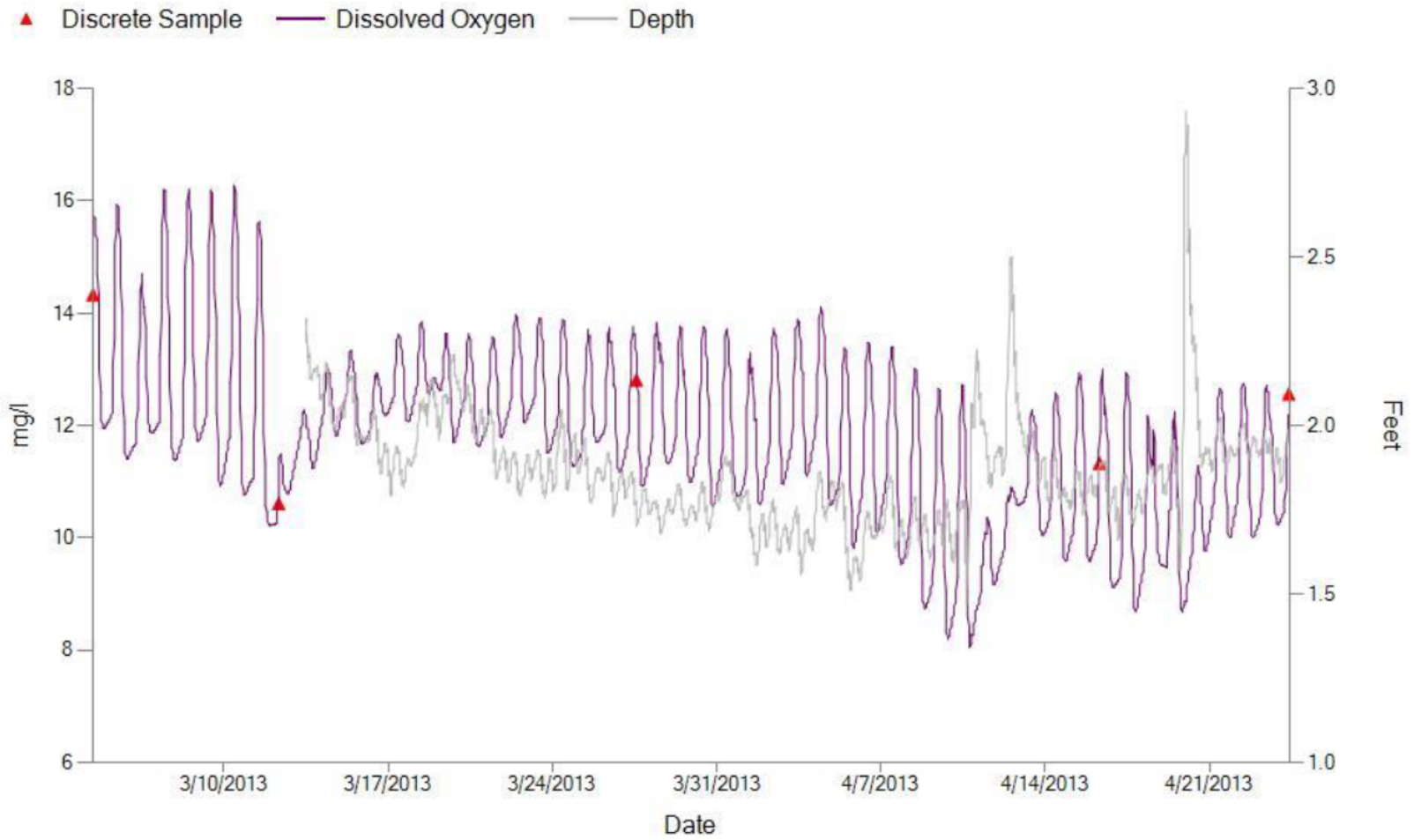


Figure 7. Continuous dissolved oxygen, continuous depth, and discrete samples from March 4, 2013 to April 24, 2013.

In-situ Water Chemistry: Samples were collected two times using standard analysis code 612. Measurements with "<" indicate concentrations below the reporting limit.

Table 1. Chemical grab sample results.

PARAMETER	UNITS	3/12/2013	3/27/2013
		08:15	13:58
DISCHARGE	CFS	42.328	42.781
ALUMINUM T	UG/L	24.000	17.000
BARIUM T	UG/L	30.000	27.000
BORON T	UG/L	<19.1058	<19.1058
BROMIDE	UG/L	12.1620	<7.03284
CALCIUM T	MG/L	25.000	23.700
CHLORIDE T	MG/L	14.7180	17.5120
COPPER T	UG/L	0.521	0.565
IRON T	UG/L	37.000	32.000
LEAD T	UG/L	0.138	<0.07258
MAGNESIUM T	MG/L	11.800	11.100
MANGANESE T	UG/L	4.000	3.000
NICKEL T	UG/L	<13.7856	<13.7856
SELENIUM T	UG/L	<0.32605	<0.32605
SODIUM T	MG/L	7.812	9.220
STRONTIUM T	UG/L	73.000	73.000
SULFATE T	MG/L	15.1390	14.9400
ZINC T	UG/L	<5.1325	6.000
HARDNESS T	MG/L	111	105
OSMOTIC PRESSURE	MOSM	5	5
pH	pH units	8.3	8.4
SPECIFIC COND @ 25C	µS/cm	268.00	265.00
TDS @ 180C	MG/L	154	168
TSS	MG/L	<5	<5
TURBIDITY	NTU	2.36	0.77
TOC	MG/L	1.4740	1.4280
ALKALINITY	MG/L	97.0	88.4
AMMONIA D	MG/L	<0.00672	<0.00672
AMMONIA T	MG/L	<0.00672	<0.00672
NITRATE & NITRITE D	MG/L	1.625	1.350
NITRATE & NITRITE T	MG/L	1.632	1.408
NITROGEN D	MG/L	1.692	1.533
NITROGEN T	MG/L	1.833	1.581
ORTHO PHOSPHORUS D	MG/L	0.007	0.010
ORTHO PHOSPHORUS T	MG/L	0.006	0.009
PHOSPHORUS D	MG/L	<0.00305	0.009
PHOSPHORUS T	MG/L	0.013	0.010

Ammonia Toxicity: The toxicity of ammonia in an aquatic environment varies with respect to the temperature and pH of the water. The ammonia concentrations measured from grab samples were compared to acute and chronic criteria derived from continuous temperature and pH data and formulas in Table 3 of §93.7(a) (Figure 8 and Table 2). Measured values were well below these calculated toxicity values.

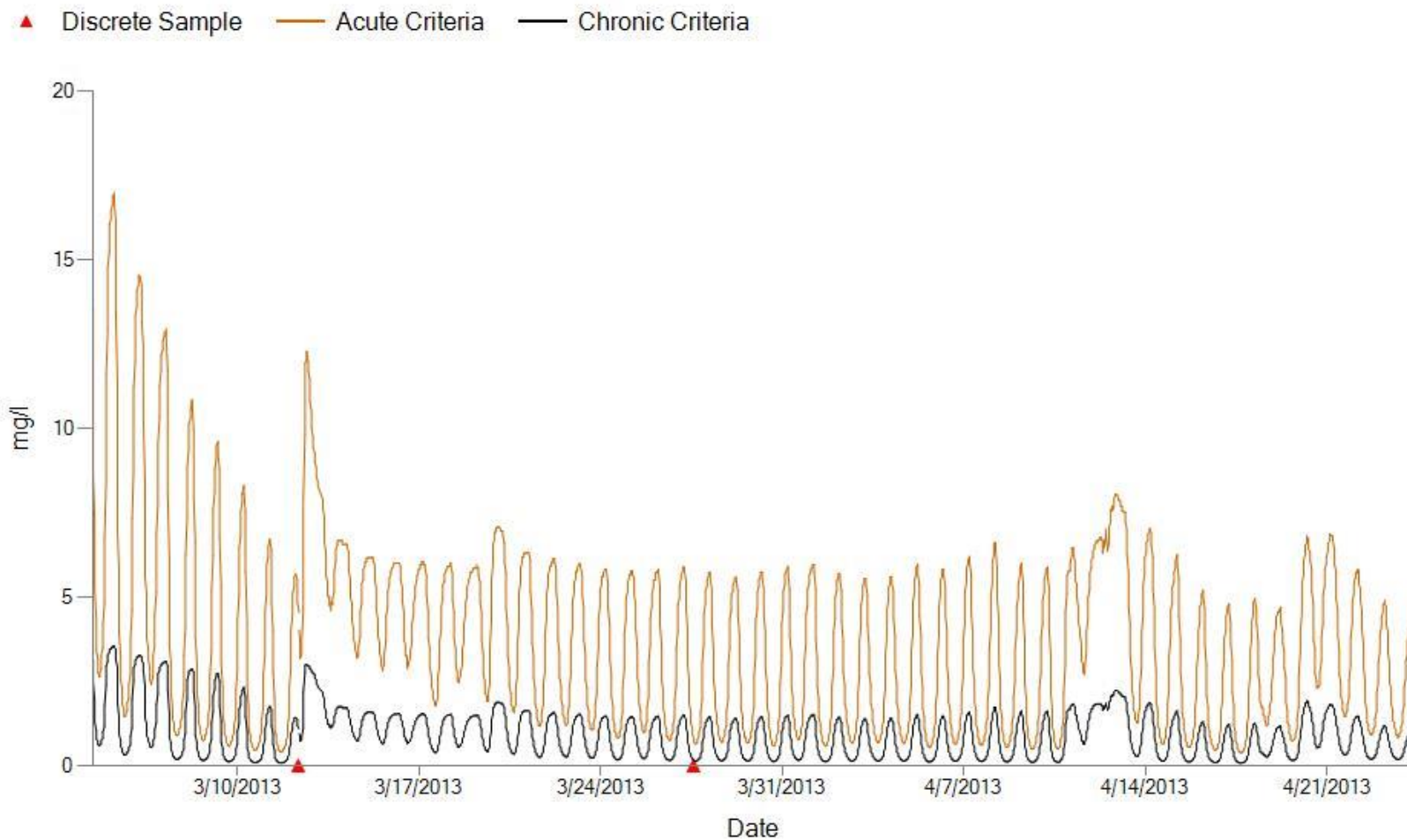


Figure 8. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations.

Table 2. Ammonia concentrations and calculated toxic values

Date and Time	Ammonia Concentration	Calculated Acute Toxicity	Calculated Chronic Toxicity
3/12/13 08:15	<0.00672	5.0	2.7
3/27/13 13:58	<0.00672	0.9	0.2

Biology: The indigenous aquatic community is an excellent indicator of long-term conditions and is used as a measure of water quality. Benthic macroinvertebrates (Table 3) were collected on April 8, 2013. Fishes were collected on July 16, 2013 (Table 4). Periphyton was collected on April 24, 2013 and showed a chlorophyll-a concentration of 258 mg/m².

Table 3. Taxa list for benthic macroinvertebrate survey.

Family	Genus	20130408-1115-sunger
Baetidae	<i>Baetis</i>	22
Heptageniidae	<i>Epeorus</i>	3
	<i>Maccaffertium</i>	1
Ephemerellidae	<i>Ephemerella</i>	86
Perlidae	<i>Agnetina</i>	4
	<i>Acroneuria</i>	1
Philopotamidae	<i>Chimarra</i>	3
Hydropsychidae	<i>Ceratopsyche</i>	9
	<i>Cheumatopsyche</i>	21
Rhyacophilidae	<i>Rhyacophila</i>	2
Psephenidae	<i>Psephenus</i>	1
Elmidae	<i>Optioservus</i>	3
	<i>Stenelmis</i>	8
Limoniidae	<i>Antocha</i>	1
Simuliidae	<i>Prosimulium</i>	16
Chironomidae		24
Gammaridae	<i>Gammarus</i>	2

Table 4. Taxa list for fish survey.

Family	Scientific Name	Common Name	20130716-1400-twertz
Anguillidae	<i>Anguilla rostrata</i>	American Eel	77
Catostomidae	<i>Catostomus commersonii</i>	White Sucker	6
Centrarchidae	<i>Lepomis cyanellus</i>	Green Sunfish	1
	<i>Micropterus dolomieu</i>	Smallmouth Bass	1
	<i>Lepomis macrochirus</i>	Bluegill	1
Cyprinidae	<i>Rhinichthys atratulus</i>	Blacknose Dace	60
	<i>Rhinichthys cataractae</i>	Longnose Dace	44
	<i>Exoglossum maxillingua</i>	Cutlip Minnow	1
Percidae	<i>Etheostoma olmstedi</i>	Tessellated Darter	8
Salmonidae	<i>Oncorhynchus mykiss</i>	Rainbow Trout	1
	<i>Salmo trutta</i>	Brown Trout	6

ASSESSMENT:

Continuous: Overall, parameters collected by the instream monitor indicate average water quality conditions. Specific conductance measurements are somewhat elevated and show a strong dilution effect during storm events. Continuous measurements of pH were elevated, particularly at the beginning of the sampling period, with readings exceeding nine on a few days. Strong diel swings in dissolved oxygen (approximately 4 mg/L) were also observed at the beginning of the period. These observations demonstrate anthropogenic influences on the water quality conditions of the watershed.

Biological: Approximately 73% of the total benthic macroinvertebrate taxa consist of Ephemeroptera, Plecoptera & Trichoptera (EPT) taxa; however, the community indicated water quality below that typical of an exceptional value (EV) stream. The fish collected are typical of a small, cold-water stream. The most abundant fish was the American Eel, a migratory fish. The large presence of dace is common in small, cold-water streams.

Table 5. Benthic macroinvertebrate metric calculations.

Date	IBI	Richness	Mod EPT	HBI	% Dom	% Mod May	Beck3	Shannon Div
April 08, 2013	57.5	17	8	3.13	41.55	43.48	12	2.00

SUMMARY:

Continuous instream monitor and biological data suggest an impacted watershed. This is further supported by elevated pH data and the extent of diel swings in dissolved oxygen. Many streams in this region of the state show strong impacts from urbanization within the watershed. This is not the case with Cooks Creek as less than 2% of the watershed is urban. Agriculture, however, represents almost 40% of the watershed and is likely a strong contributor to the impacts observed.

LITERATURE CITED

PA DEP. 2009. Instream Comprehensive Evaluations (ICE).
http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Methodology/ice_2009am.pdf

PA DEP. 2012. Continuous Instream Monitoring Protocol. Internal Department Document.