pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT & NON-POINT SOURCE MANAGEMENT

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 2/4/19
Revised by: Hoger

STATION DESCRIPTION:
STREAM CODE: 01024
STREAM NAME: Skippack Creek
SITE NAME: Skippack Creek UPS Ridge Pike

COUNTY: Montgomery

LATITUDE: 40.172183 **LONGITUDE:** -75.430924

LOCATION DESCRIPTION: Skippack approximately 70 m upstream of Ridge Pike and 6 m off left bank.

HUC: 02040203

DRAINAGE AREA: 53.00 sq. miles

BACKGROUND AND HISTORY: Skippack Creek is a freestone tributary to Perkiomen Creek within Lower Providence Township, Montgomery County. The portion of the basin above this site is characterized by relatively shallow topography with land use consisting of urban (35.0%), forested (33.0%), and agricultural open (32.0%) 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. These data also allowed for comparison of the water quality throughout a basin as additional sites were located at Towamencin Creek, a tributary to Skippack Creek, and Skippack Creek at Route 63 in the upper portion of the watershed (Figure 1). Skippack Creek has a designated use of Trout Stocking, Migratory Fishes (TSF, MF). Seven sewage discharges are active in this portion of the basin.

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 baseline biological communities.

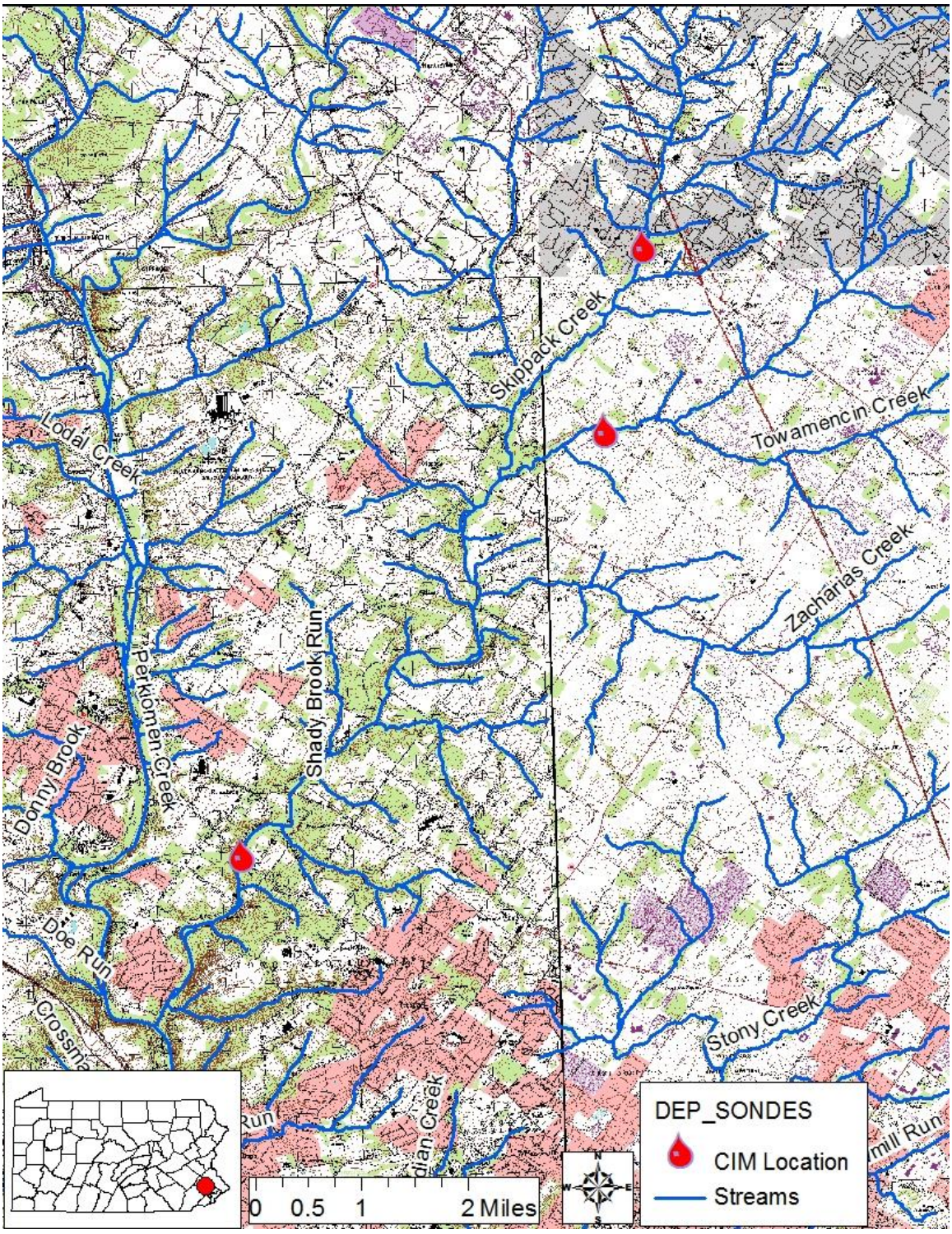

Figure 1. Map of the CIM locations within the Skippack Creek basin. Sites include a lower Skippack Creek location (at Ridge Pike), upper Skippack Creek location (Route 63), and one tributary (Towamencin Creek at Metz Rd).

Figure 2. Skippack Creek upstream of Ridge Pike sampling 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 single Yellow Springs Instruments (YSI) 6920-V2 water-quality sonde was used at this station. The sonde (Serial # 00018B75) was installed on March 5, 2013. 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, with a notch cut out 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 5, 2013 to April 25, 2013

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

DATA:

Water chemistry grabs were collected three times during the sampling period. Benthic macroinvertebrates were collected on April 17, 2013, periphyton was collected on April 25, 2013 and fishes were collected on July 17, 2013, using the Department's ICE protocol (PA DEP, 2013). Continuous data are graded based on a combination of fouling and calibration error (PA DEP, 2013). All periods were graded usable and are included in the final report.

Depth: Depth measured by this non-vented YSI 6920 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 period to 3/13/2013 were not corrected for barometric pressure. Data recorded after 3/13/2013 were corrected for barometric pressure using a Solinst Barologger Edge located at the Skippack Creek at Route 63 location. 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 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 four points across the stream. Transects were conducted four times throughout the sampling period. The sample on 3/13/13 was during a storm event. Temperature, specific conductance, pH and dissolved oxygen measurements indicated a homogenous system (Figure 3).

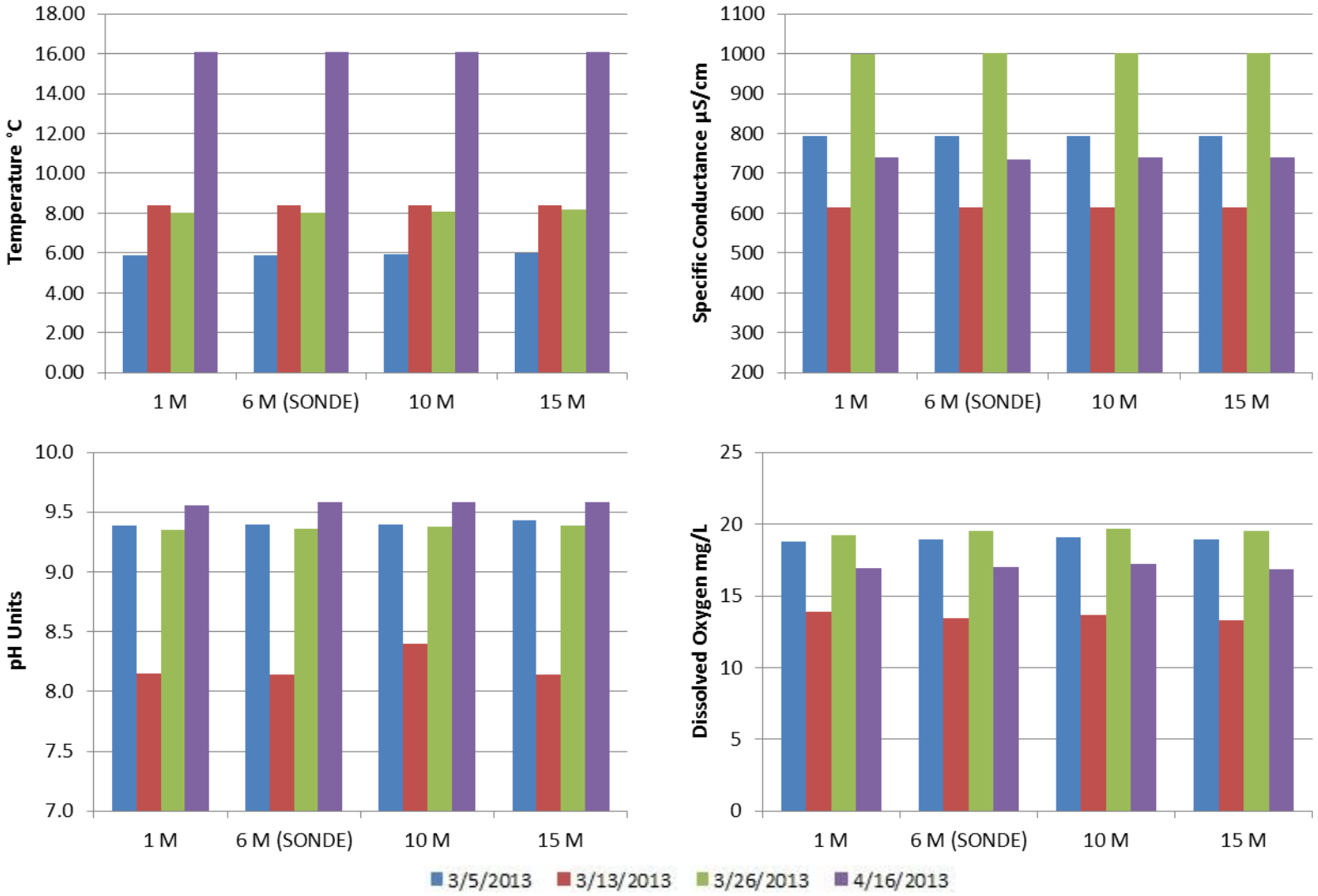

Figure 3. Discrete water quality transects. Points across the transect were measured from the right descending bank.

Water Temperature: Average: 9.63°C; Maximum: 21.86°C; Minimum: 3.43°C.

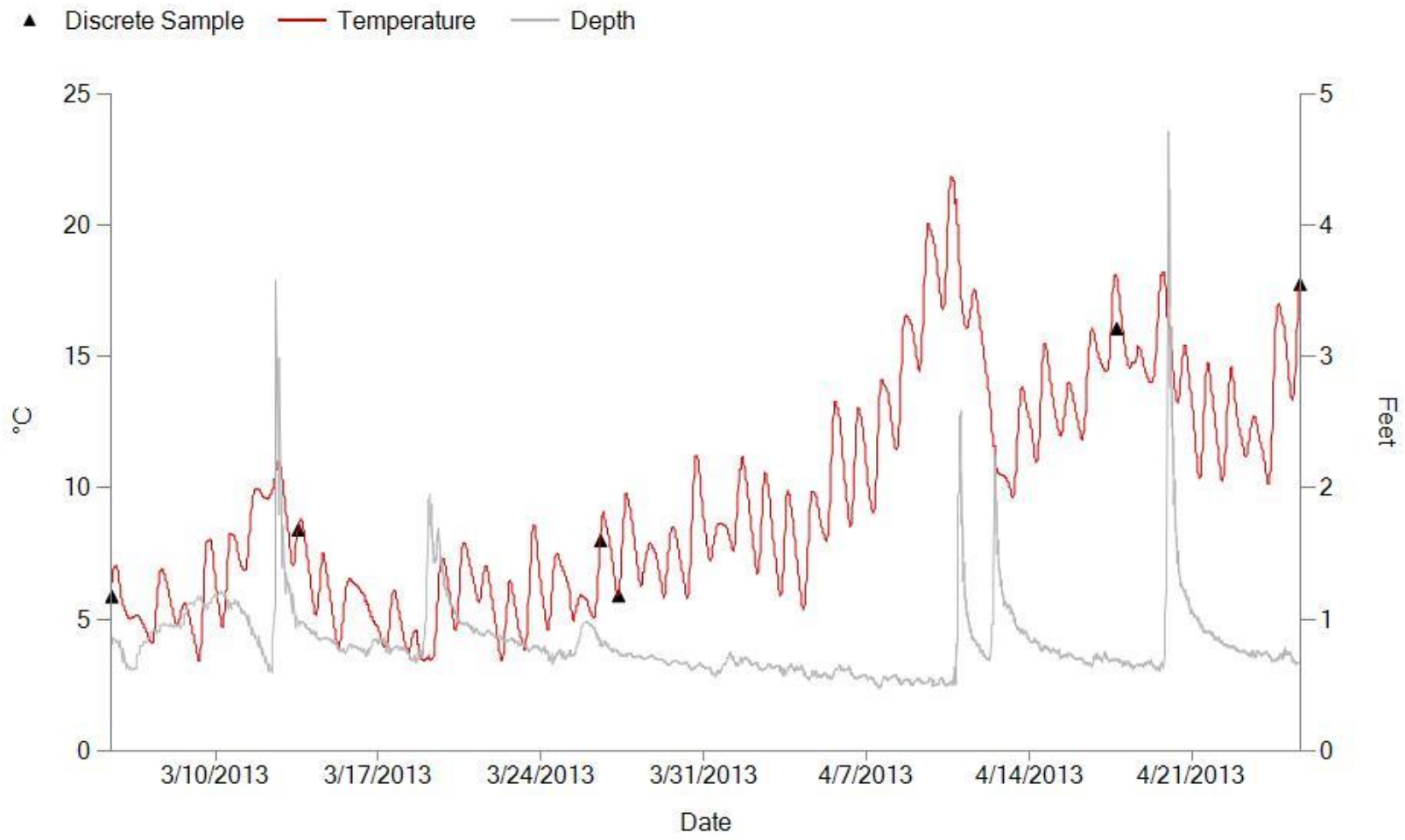

Figure 4. Continuous water temperature, continuous depth and discrete water temperature from March 5, 2013 to April 25, 2013.

Specific Conductance: Average: 622.1 µS/cm; Maximum: 951 µS/cm; Minimum: 238 µS/cm.

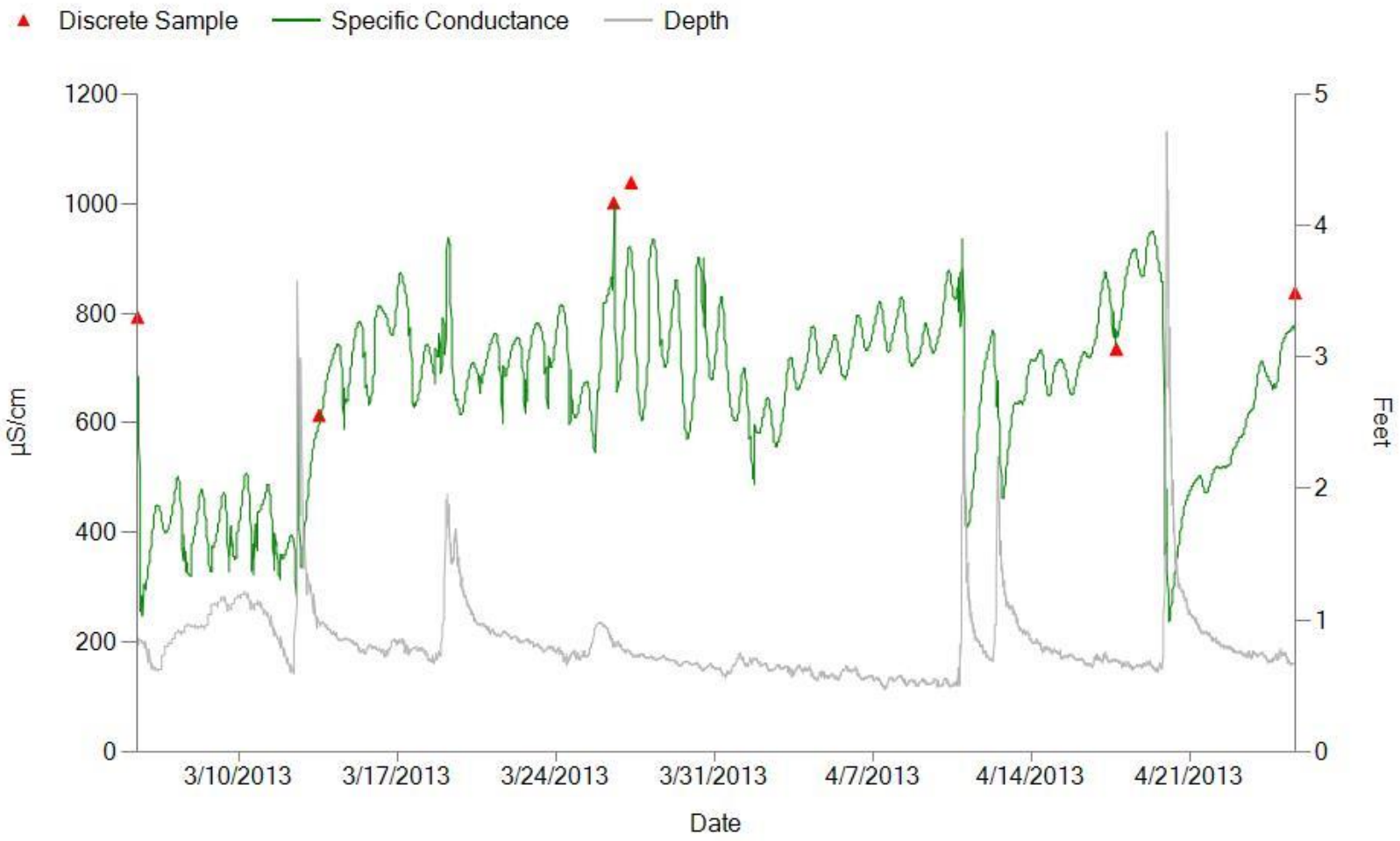

Figure 5. Continuous specific conductance, continuous depth and discrete specific conductance from March 5, 2013 to April 25, 2013.

pH: Average: 8.72 pH units; Maximum: 9.87 pH units; Minimum: 7.12 pH units.

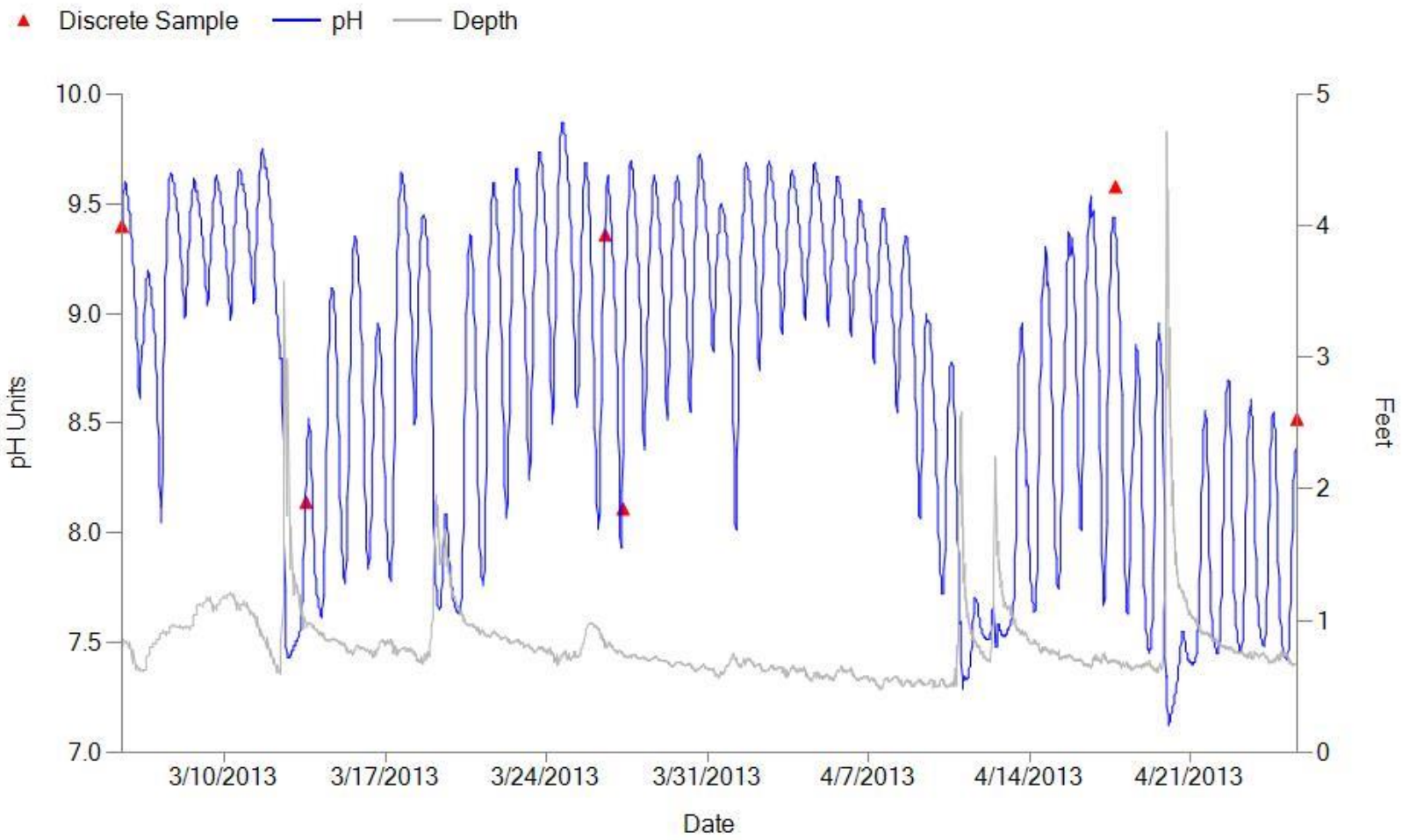

Figure 6. Continuous pH, continuous depth and discrete pH from March 5, 2013 to April 25, 2013.

Dissolved Oxygen: Average: 13.07 mg/L; Maximum: 23.11 mg/L; Minimum: 4.42 mg/L.

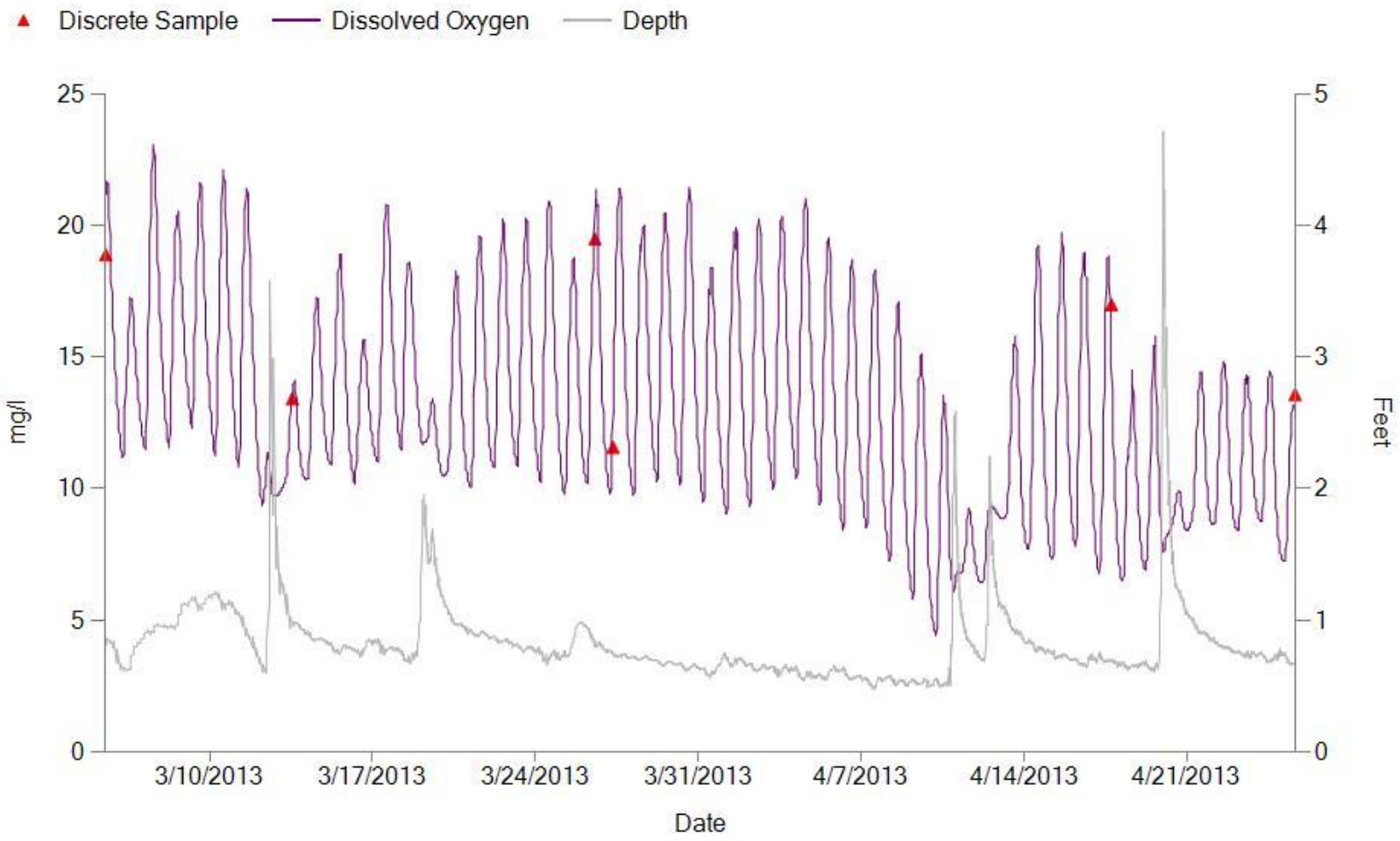

Figure 7. Continuous dissolved oxygen, continuous depth and discrete dissolved oxygen from March 5, 2013 to April 25, 2013.

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

Table 1. Chemical grab sample results.

PARAMETER	UNITS	03/13/2013	03/27/2013	04/25/2013
		13:20	07:55	13:20
DISCHARGE	CFS	141.9	57.608	52.4
ALUMINUM T	UG/L	557.000	29.000	24.000
BARIUM T	UG/L	64.000	93.000	72.000
BORON T	UG/L	60.00	40.00	50.00
BROMIDE	UG/L	45.0890	74.3130	72.9060
CALCIUM T	MG/L	27.400	41.000	32.600
CHLORIDE T	MG/L	129.0000	249.0000	172.0000
COPPER T	UG/L	5.000	4.000	3.520
IRON T	UG/L	548.000	103.000	96.000
LEAD T	UG/L	0.684	0.100	0.203
MAGNESIUM T	MG/L	8.707	12.800	10.500
MANGANESE T	UG/L	28.000	33.000	24.000
NICKEL T	UG/L	<13.7856	<13.7856	<13.7856
SELENIUM T	UG/L	<0.32605	<0.32605	<0.32605
SODIUM T	MG/L	72.200	129.000	104.000
STRONTIUM T	UG/L	184.000	269.000	239.000
SULFATE T	MG/L	19.0250	26.4280	26.6520
ZINC T	UG/L	7.000	7.000	9.000
HARDNESS T	MG/L	104		125
OSMOTIC PRESSURE	MOSM	6	17	15
pH	pH units	8.0	8.1	8.0
SPECIFIC COND @ 25 C	umhos/cm	608.00	1027.00	816.00
TDS @ 180C	MG/L	372	592	462
TSS	MG/L	10	6	<5
TURBIDITY	NTU	18.04	1.65	
TOC	MG/L	5.7520	3.5960	3.5960
ALKALINITY	MG/L	63.2	71.2	81.2
AMMONIA D	MG/L	0.022	0.010	0.037
AMMONIA T	MG/L	0.026	0.010	0.033
NITRATE & NITRITE D	MG/L	2.457	3.522	4.275
NITRATE & NITRITE T	MG/L	2.423	3.515	4.248
NITROGEN D	MG/L	2.828	4.172	4.843
NITROGEN T	MG/L	2.839	4.074	4.905
ORTHO PHOSPHORUS D	MG/L	0.091	0.023	0.111
ORTHO PHOSPHORUS T	MG/L	0.100	0.026	0.114
PHOSPHORUS D	MG/L	0.119	0.034	0.121
PHOSPHORUS T	MG/L	0.147	0.052	0.135

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.

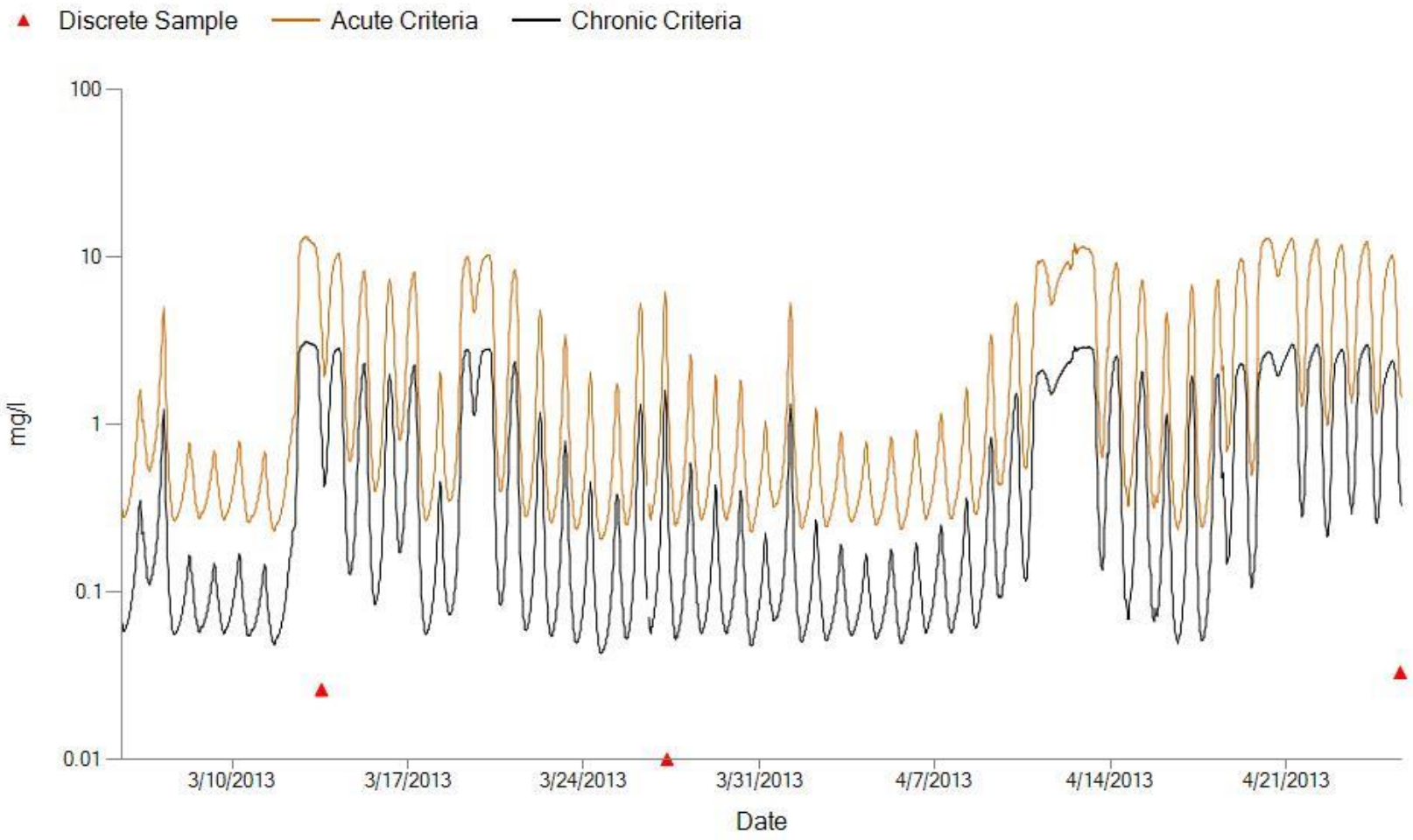

Figure 8. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity and measured ammonia concentrations.

Table 2. Ammonia concentrations and calculated toxicity values

Date and Time	Ammonia Concentration	Calculated Acute Toxicity	Calculated Chronic Toxicity
3/13/13 13:20	0.026	4.1	1.0
3/27/13 07:55	0.010	4.1	1.0
4/25/13 13:20	0.033	1.9	0.4

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 17, 2013. Fishes were collected on July 17, 2013 (Table 4). Periphyton was collected on April 25, 2013 and showed a chlorophyll-a concentration of 292 mg/m^2.

Table 3. Taxa list for benthic macroinvertebrate survey.

Family	Genus	20130417-1050-sunger
Baetidae	Baetis	1
Philopotamidae	Chimarra	13
Nemouridae	Amphinemura	6
Coenagrionidae	Argia	3
Hydropsychidae	Cheumatopsyche	1
	Hydropsyche	3
Hydroptilidae	Leucotrichia	1
Psephenidae	Psephenus	25
	Ectopria	1
Elmidae	Stenelmis	102
Empididae	Clinocera	1
Simuliidae	Simulium	2
Chironomidae	Chironomidae	59
	Hirudinea (subclass)	2
Gammaridae	Gammarus	1

Table 4. Taxa list for fish survey.

Family	Scientific Name	Common Name	20130717-1100-twertz
Catostomidae	*Catostomus commersonii*	White Sucker	24
Centrarchidae	*Lepomis auritus*	Redbreast Sunfish	99
	Amboplites rupestris	Rock Bass	27
	Micropterus dolomieu	Smallmouth Bass	10
	Lepomis cyanellus	Green Sunfish	7
	Micropterus salmoides	Largemouth Bass	1
Cyprinidae	*Luxilus cornutus*	Common Shiner	425
	Pimephales notatus	Bluntnose Minnow	213

	Notropis hudsonius	Spottail Shiner	137
	Rhinichthys cataractae	Longnose Dace	64
	Exoglossum maxillingua	Cutlip Minnow	40
	Cyprinella spiloptera	Spotfin Shiner	31
	Notropis amoenus	Comely Shiner	16
	Rhinichthys atratulus	Blacknose Dace	7
	Semotilus atromaculatus	Creek Chub	2
Fundulidae	*Fundulus diaphanus*	Banded Killifish	33
Ictaluridae	*Ameiurus natalis*	Yellow Bullhead	16
	Noturus insignis	Margined Madtom	5
Percidae	*Etheostoma olmstedi*	Tessellated Darter	8

ASSESSMENT:

The evaluation of CIM data incorporates water quality standards from 25 PA Code §93.7 and the 99% frequency rule from §96.3(c) (Hoger 2018). Because sondes at these sites recorded parameters every 30 minutes, 176 exceedances measured over a 365-day period constitutes a percentage greater than 1% (176 readings = 1.004% of a year). The evaluations in this report include 99% frequency rule calculations but do not include protected use assessment determinations.

Continuous: Data collected by the instream monitor indicated poor water quality. Max pH for the period was 9.87 units. The maximum pH criterion of 9.0 was exceeded 1,110 times during this period, representing 6.34% of a year. Specific conductance measurements were consistently high and showed a strong diel pattern throughout the sampling period. These fluctuations are indicative of strong anthropogenic influence. Finally, levels of dissolved oxygen further demonstrated a stressful environment for aquatic life. The minimum recorded value of 4.42 mg/L is below the listed criterion; however, the total number of exceedances represented less than one percent of a year (10 readings, 0.06%). Dissolved oxygen also exhibited extreme diel swings. Mean production-based diel variation for the period was 8.6 mg/L and maximum was 12.4 mg/L. Although there are no state criteria for daily changes in dissolved oxygen, changes of this degree indicate a highly productive environment, most likely due to excess nutrient loading.

Biological: The benthic macroinvertebrate community indicated very poor water quality (Table 5). Only 15 taxa were collected and EPT taxa were only 11.3% of the total community. The two most abundant taxa were Stenelmis and Chironomidae which are both fairly pollution tolerant. The fish community had a high proportion of pollution tolerant species including white suckers, banded killifish, and yellow bullhead. Additionally, there was a general lack of benthic fishes.

Table 5. Benthic macroinvertebrate metric calculations.

Date	IBI	Richness	Mod EPT	HBI	% Dom	% Mod May	Beck3	Shannon Div
April 17, 2013	31.7	15	2	5.10	46.2	0.0	0	1.57

Intra-basin Comparison: Data were collected at two different sites on Skippack Creek during early spring of 2013. An upstream site was located at the crossing of Route 63 and a

downstream site at the crossing of Ridge Pike (Figure 1). There are three active sewage discharges in the upstream portion of the basin and an additional four sewage discharges before the lower site. Specific conductance was considerably higher at Route 63 (Figure 9). Additionally, nutrient concentrations were significantly greater at this upstream site (Table 6), which likely contributed to the greater diel swings observed (Figure 10). These differences in water quality were reflected in the biological communities of the two sites. The macroinvertebrate community indicated poorer water quality at the upper site than the lower site (IBI scores of 21.8 and 31.7, respectively), and the while the fish community at both locations was dominated by tolerant species, Skippack Creek at Ridge Pike had a more balanced fish community with a greater percentage of insectivores. The pH data, however, was notably higher at the lower site, with considerably more exceedances of the maximum pH criterion (Figure 10).

A third site was located in this basin during early spring of 2013 on Towamencin Creek, a tributary to Skippack Creek between the upper and lower sites (Figure 1). Data collected at Towamencin Creek more closely resembled water quality of the upper Skippack Creek site and therefore do not account for the slight improvement in water quality at the lower site of Skippack Creek. While water quality does appear to improve at the lower portion of the basin, these data show a highly impacted watershed with extremely poor water quality throughout the basin.

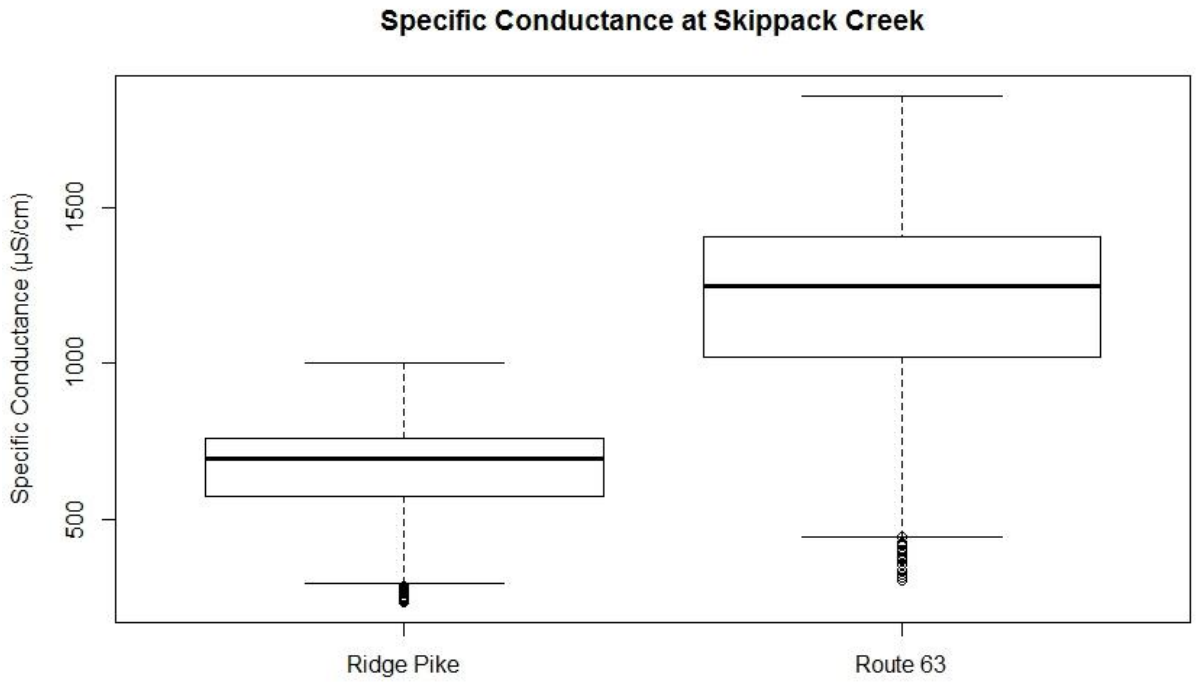

Figure 9. Comparison of specific conductance at two Skippack Creek sites.

Table 6. Comparison of nutrients from chemical grab samples.

Parameter	Units	3/27/2013		4/25/2013	
		Route 63	Ridge Pike	Route 63	Ridge Pike
NITRATE & NITRITE D	MG/L	13.737	3.522	13.618	4.275
NITRATE & NITRITE T	MG/L	13.807	3.515	13.705	4.248
NITROGEN D	MG/L	14.957	4.172	15.155	4.843
NITROGEN T	MG/L	14.957	4.074	14.730	4.905
ORTHO PHOSPHORUS D	MG/L	0.126	0.023	0.314	0.111
ORTHO PHOSPHORUS T	MG/L	0.128	0.026	0.317	0.114
PHOSPHORUS D	MG/L	0.153	0.034	0.329	0.121
PHOSPHORUS T	MG/L	0.179	0.052	0.348	0.135

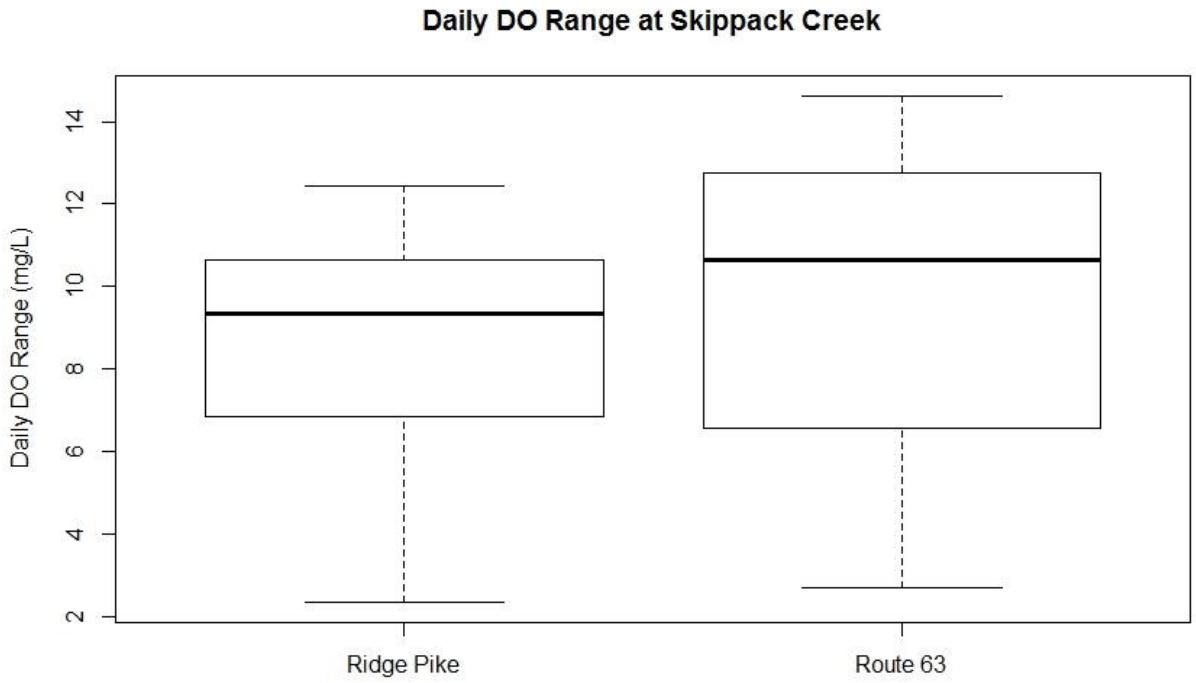

Figure 10. Comparison of daily dissolved oxygen range at two Skippack Creek sites.

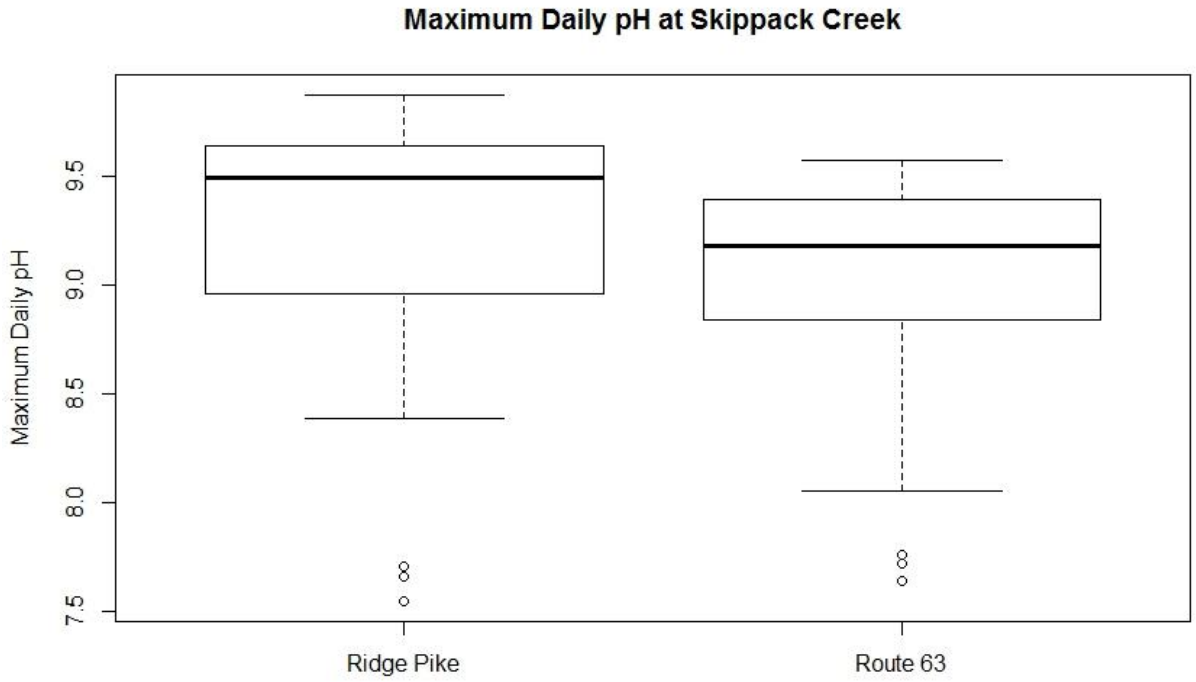

Figure 11. Comparison of daily maximum pH at two Skippack Creek sites.

SUMMARY:

This section of Skippack Creek is currently impaired for aquatic life citing nutrients from small residential runoff. Continuous monitoring, in-situ lab chemistries, and biological data from this report all support poor water quality conditions in Skippack Creek. Recorded pH data did not meet the criterion listed in Table 3 of §93.7(a), while high specific conductance and highly variable dissolved oxygen further characterized a highly impacted watershed. This poor water quality is also expressed in the biological communities which are dominated by tolerant taxa. A comparison of multiple sites within the basin revealed marginally better water quality at this lower site within the Skippack Creek basin; however, water quality throughout the watershed has been shown to be highly influenced by human activity.

REVISION NOTES, FEBRUARY 2019:
Revisions were made to the 'Assessment' section of this report (original date 6/25/15), reflecting changes to the Department's assessment of CIM data. Previously, in evaluating CIM data, the Department had taken into consideration the analytical uncertainty of the method used to measure the data when an ambient measurement is compared to a numeric Water Quality Standard (WQS) criterion; this is inconsistent with the Department's established Assessment Methods. Therefore, this report was updated to provide exceedances of pH and DO criteria as listed in Table 3 of §93.7(a). A paragraph summarizing the approved assessment methodology, and a reference to it, were also added.

LITERATURE CITED

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