pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT & NON-POINT SOURCE MANAGEMENT

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 11/5/2015
Revised by: Bendick

Station Description

STREAM CODE: 12429

STREAM NAME: Kishacoquillas Creek

SITE NAME: UPS Kish Pike Bridge (2013); UPS USGS Gage Station (2014)

COUNTY: Mifflin

2013 SITE DESCRIPTION

Latitude: 40.618102 **Longitude:** -77.559602

Location Description: About 150 meters UPS of Kish Pike Bridge at Parcheytown Road, 37 feet from the left ascending bank located about mid-channel.

Drainage Area: 185.5 sq. miles

2014 SITE DESCRIPTION

Latitude: 40.654777 **Longitude:** -77.585817

Location Description: About 30 meters upstream of the route 322 bridge, off-center of the left ascending bank.

Drainage Area: 163.1 sq. miles

HUC: 02050304

BACKGROUND AND HISTORY: Kishacoquillas Creek, located in Mifflin County, is a freestone tributary to the Juniata River (Figure 1). The basin is characterized by ridge and valley topography with land use consisting of forested land (63%), urban land (2%, 1%; 2013 and 2014 respectively), and agricultural uses (35%, 36%; 2013 and 2014 respectively). Other influences to the basin include a run-of-the-river dam upstream of the site locations. The purpose of this survey was to collect baseline data on a Trout Stocking, Migratory Fishes (TSF, MF) stream to determine water quality and biological conditions.

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.

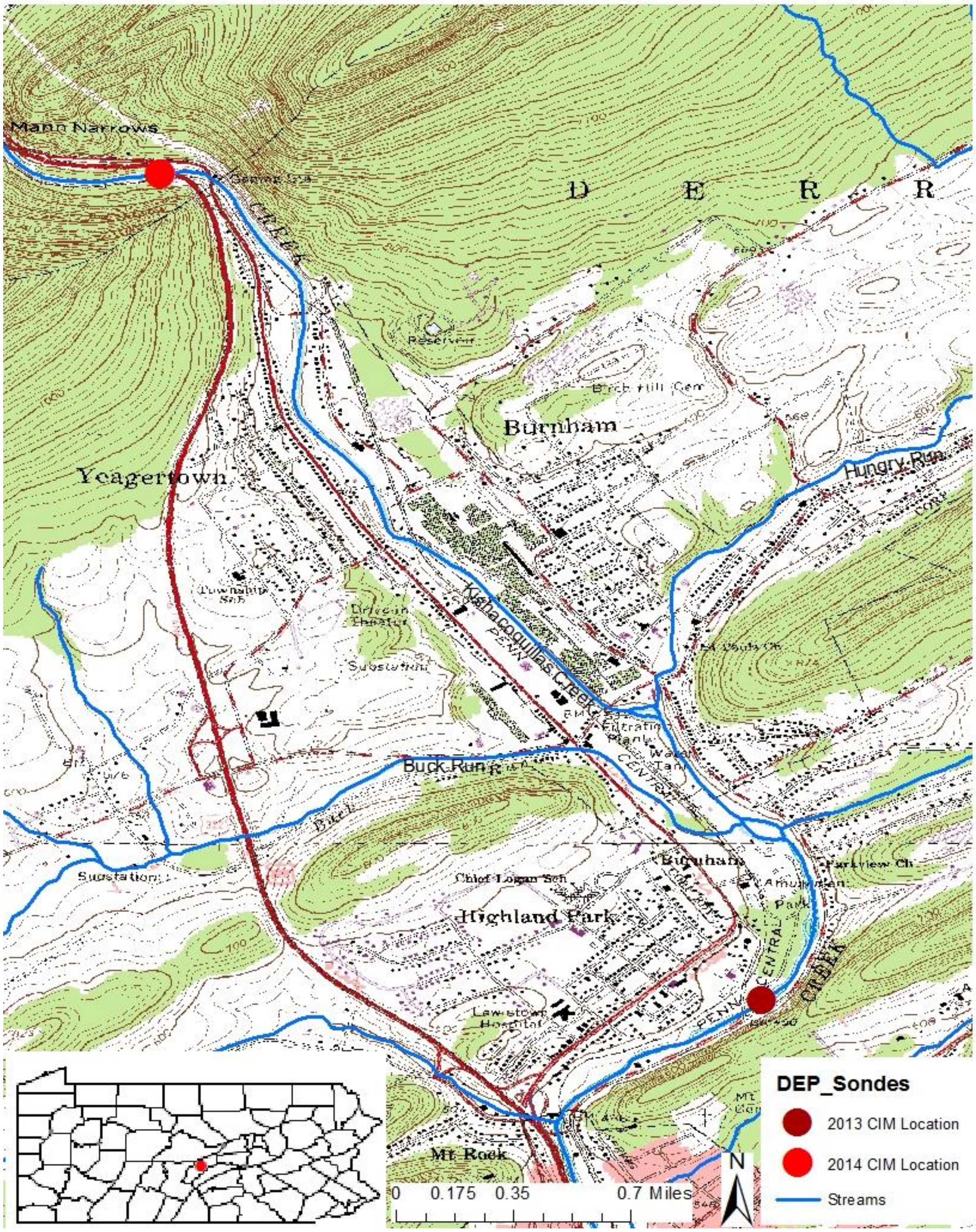

Figure 1. Map of the Kishacoquillas Creek continuous instream monitoring (CIM) sites.

Figure 2. Kishacoquillas Creek 2013 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:

2013 - A Yellow Springs Instruments (YSI) YSI 6920 V2 (Serial #00018B72) was used from April 23, 2013 to June 12, 2013. A new deployment of sonde equipment occurred on June 19, 2013 where a Yellow Springs Instruments (YSI) 6600 (Serial #00014797) was deployed until November 19, 2013.

2014 - A Yellow Springs Instruments (YSI) YSI 600XLM (Serial #00013B335) was used from March 7, 2014 to May 12, 2014, at which time the sonde was pulled and replaced. A Measurement Specialties Eureka2 water-quality sonde (Serial #MM12100604) was deployed from May 12, 2014 to July 15, 2014; the sonde was then pulled and replaced due to equipment failure. A Measurement Specialist Eureka2 water-quality sonde (Serial #MT04131235) was used from July 15, 2014 to November 13, 2014. A Yellow Springs Instruments (YSI) 6920 V2 was used as a field meter during revisits.

The sondes were housed in a 24-inch length of 4-inch diameter schedule 80 PVC pipe with holes drilled out to allow for flow through. One end of the pipe was capped and notched 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 sondes recorded water quality parameters every 30 minutes.

PERIOD OF RECORD: April 23, 2013 to November 19, 2013 AND March 7, 2014 to November 13, 2014.

In 2013, the station was revisited nine times over seven months for the purpose of downloading data, checking calibration, and cleaning. In 2014, the site was revisited eight times over eight months.

DATA:

Water chemistry grabs were collected eight times in 2013 and seven times during the 2014 sampling period. Benthic macroinvertebrates were collected on November 19, 2013 and November 13, 2014, fishes were collected on July 31, 2013, and periphyton samples were collected one time in 2013 and three times in 2014 according to the Department's ICE protocol (PA DEP, 2013). No fishes were collected in 2014.

Continuous data were graded based on a combination of fouling and calibration error (PA DEP, 2013). In 2013, two periods for pH and one period for dissolved oxygen were graded unusable and deleted from the final report. In 2014, one period for dissolved oxygen was graded unusable and deleted from the final report.

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 equidistant points across the transect starting at the right ascending bank. Transects were conducted one time in 2013 and three times throughout the 2014 sampling period. Temperature, specific conductance, pH, and dissolved oxygen measurements indicated a homogenous system (Figures 3, 4, and 5).

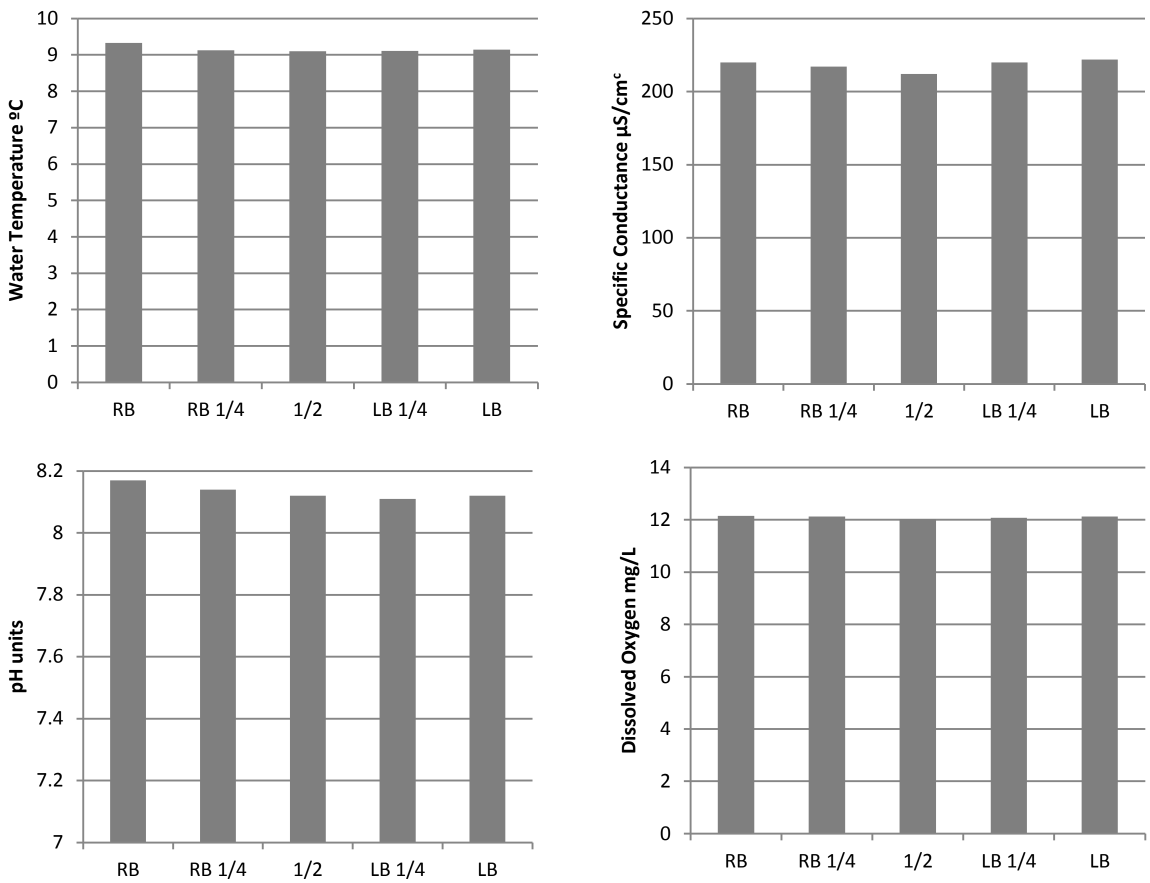

Figure 3: Initial 2013 discrete water quality data collected on April 23 at equidistant intervals from the right ascending bank to the left ascending bank.

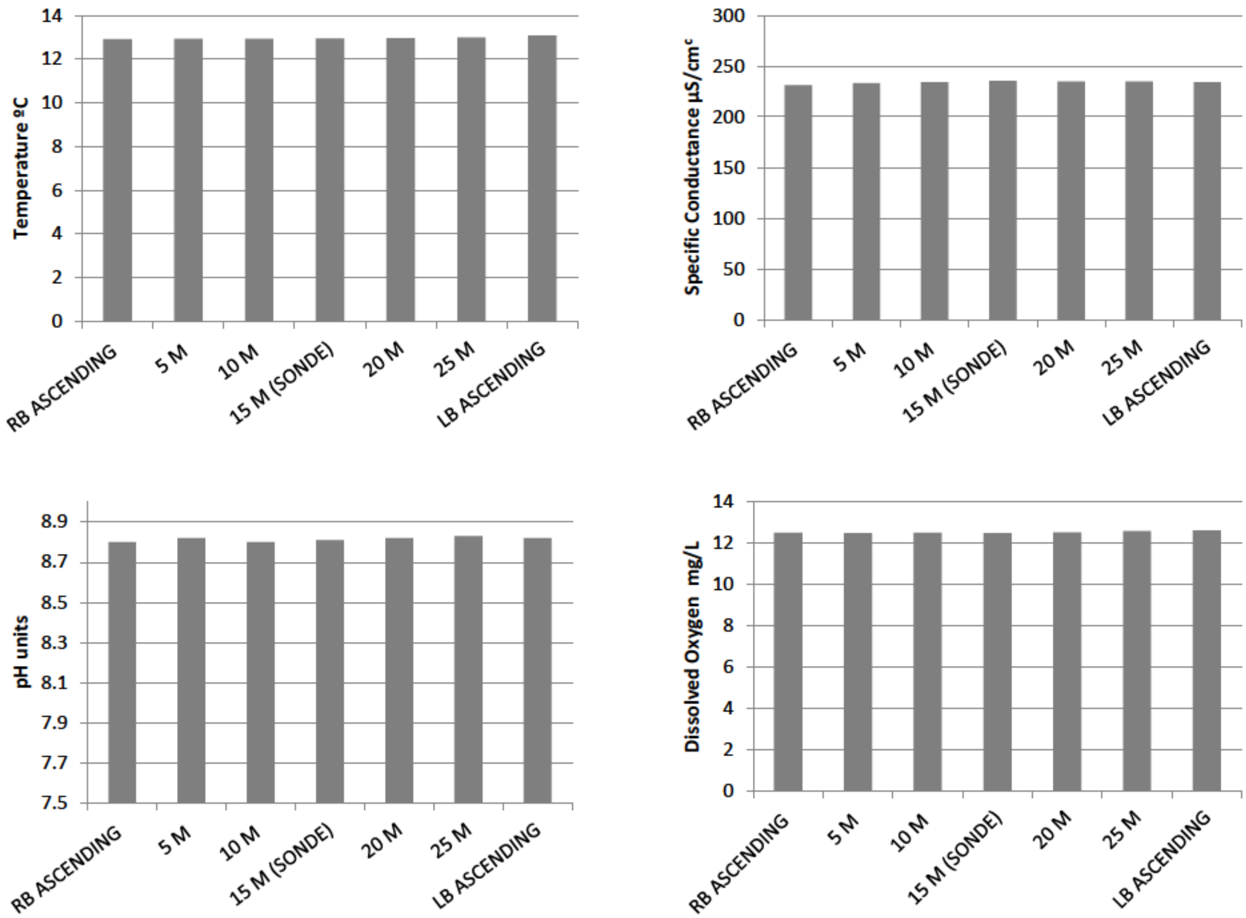

Figure 4: Initial 2014 discrete water quality data collected on April 14 at 5 meter increments from the right ascending bank to the left ascending bank.

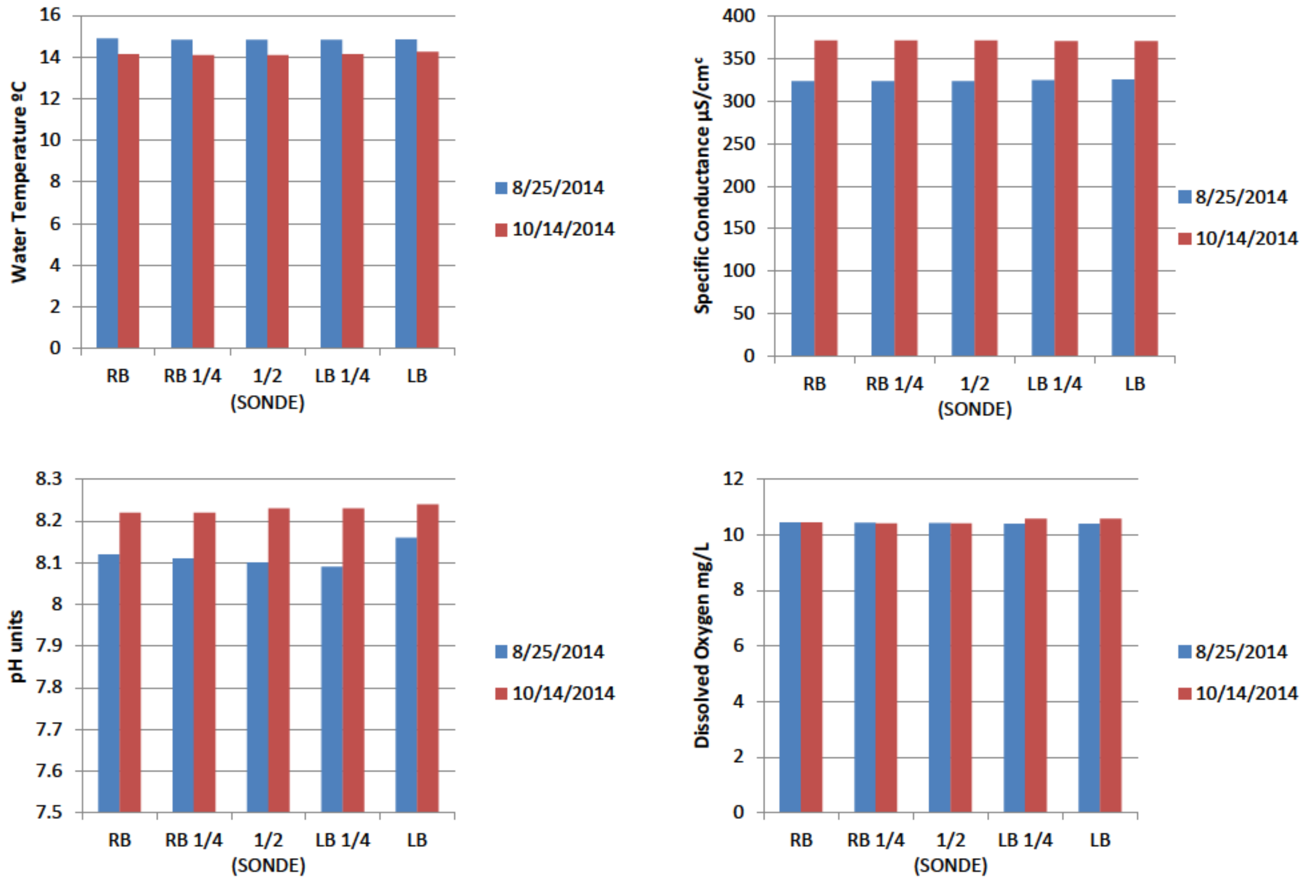

Figure 5: Seasonal 2014 discrete water quality data collected at equidistant intervals from the right ascending bank to the left ascending bank.

Depth and Discharge: Depth and discharge data are used only as qualitative interpretation for changes in other parameters due to a lack of verification. Depth measured by the non-vented YSI 6920 and YSI 6600 used during the 2013 sampling period 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 recorded were corrected for barometric pressure using a Solinst Barologger Edge located on site.

The 2014 site location allowed for the provisional use of discharge data from USGS. Data was downloaded from the U.S. Geological Survey's website using USGS station # 01565000, Kishacoquillas Creek at Reedsville, PA.

Comparatively, higher flows were observed in 2014. While storm events occurred around the same time in both years, storm events proved to have a stronger effect on flow status in 2014 than 2013 (Figure 6).

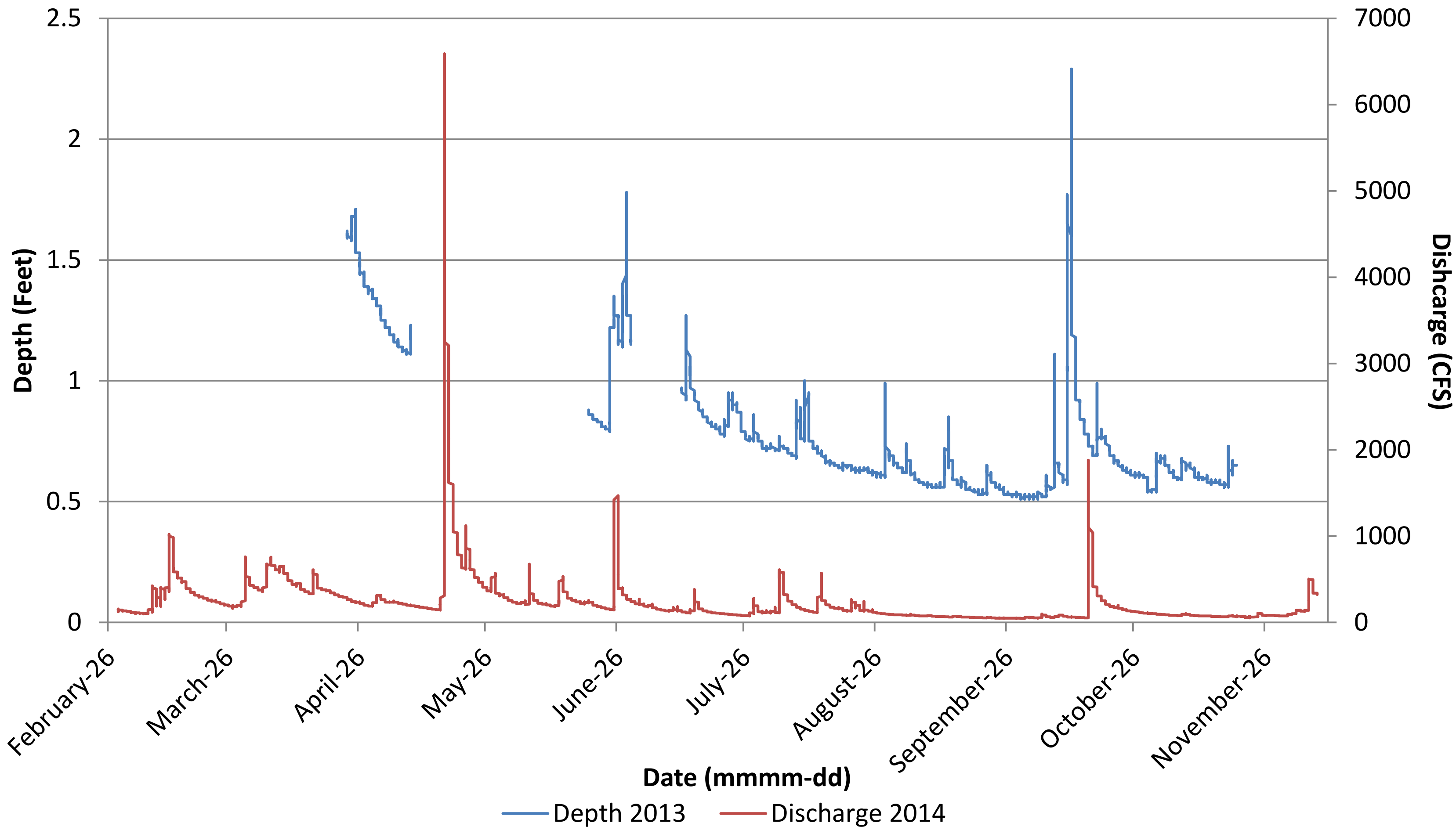

Figure 6. Continuous depth (2013) and discharge (2014) data compared.

Water Temperature:

2013 Statistics – Average: 15.8 °C; Maximum: 24.5 °C; Minimum: 4.5 °C.

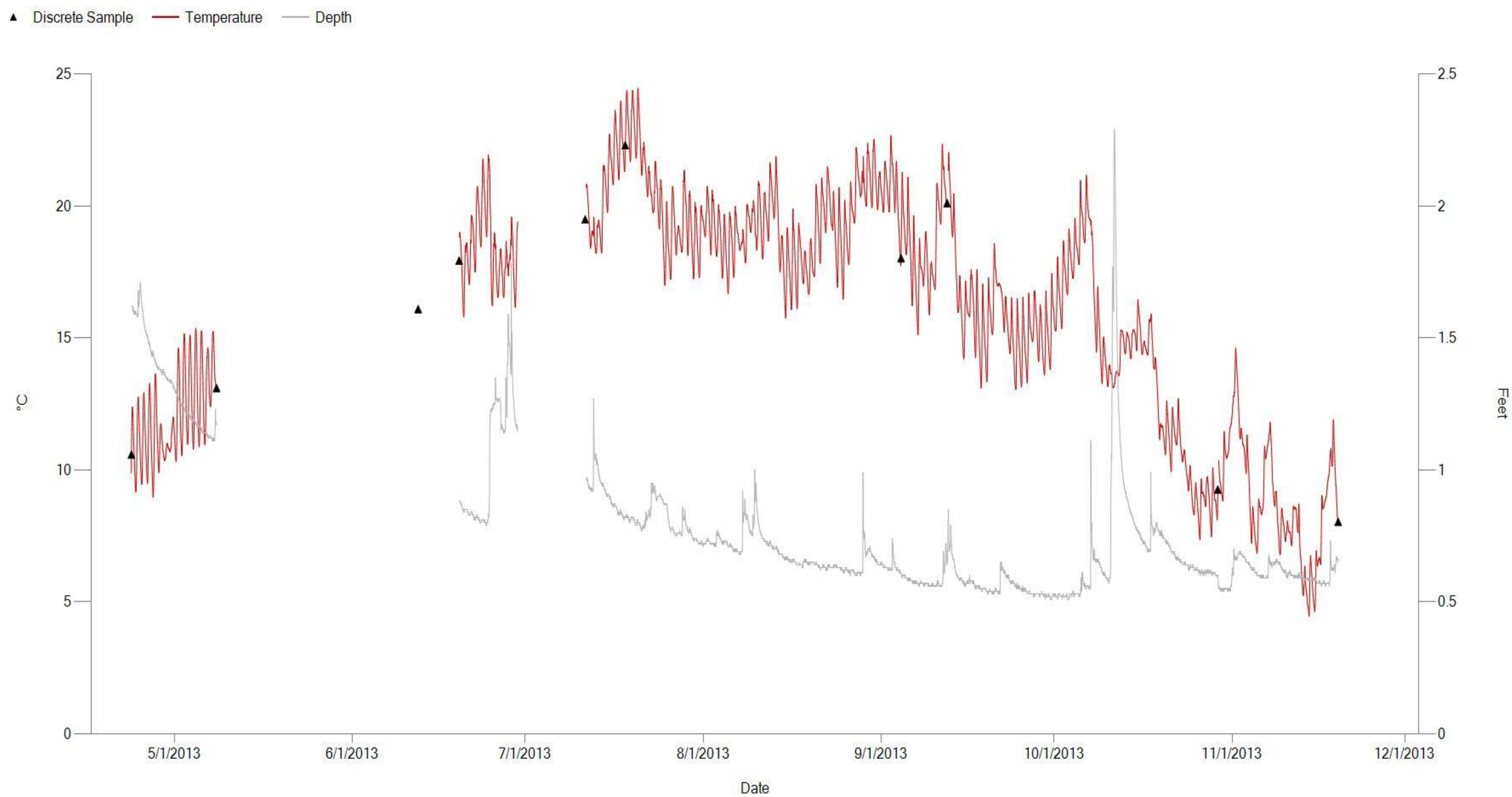

Figure 7. Continuous water temperature, continuous depth, and discrete samples from April 23, 2013 to November 19, 2013. All data gaps are due to equipment failure.

2014 Statistics – Average: 12.3 °C; Maximum: 20.4 °C; Minimum: 1.8 °C.

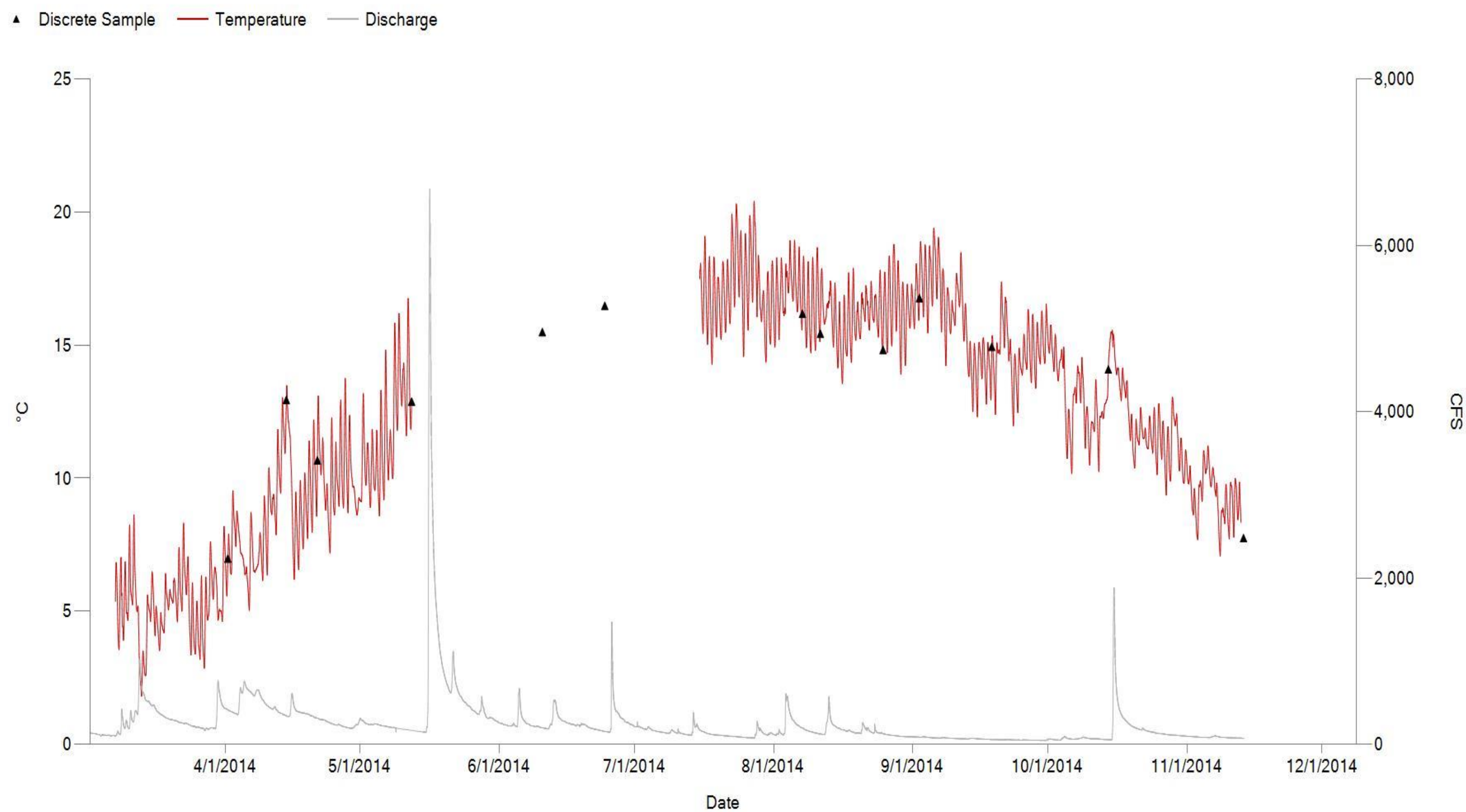

Figure 8. Continuous water temperature, continuous discharge, and discrete samples from March 7, 2014 to November 13, 2014. Due to equipment failure no data was recorded from May to July.

Specific Conductance:
2013 Statistics – Average: 404 µS/cm[c]; Maximum: 559 µS/cm[c]; Minimum: 210 µS/cm[c].

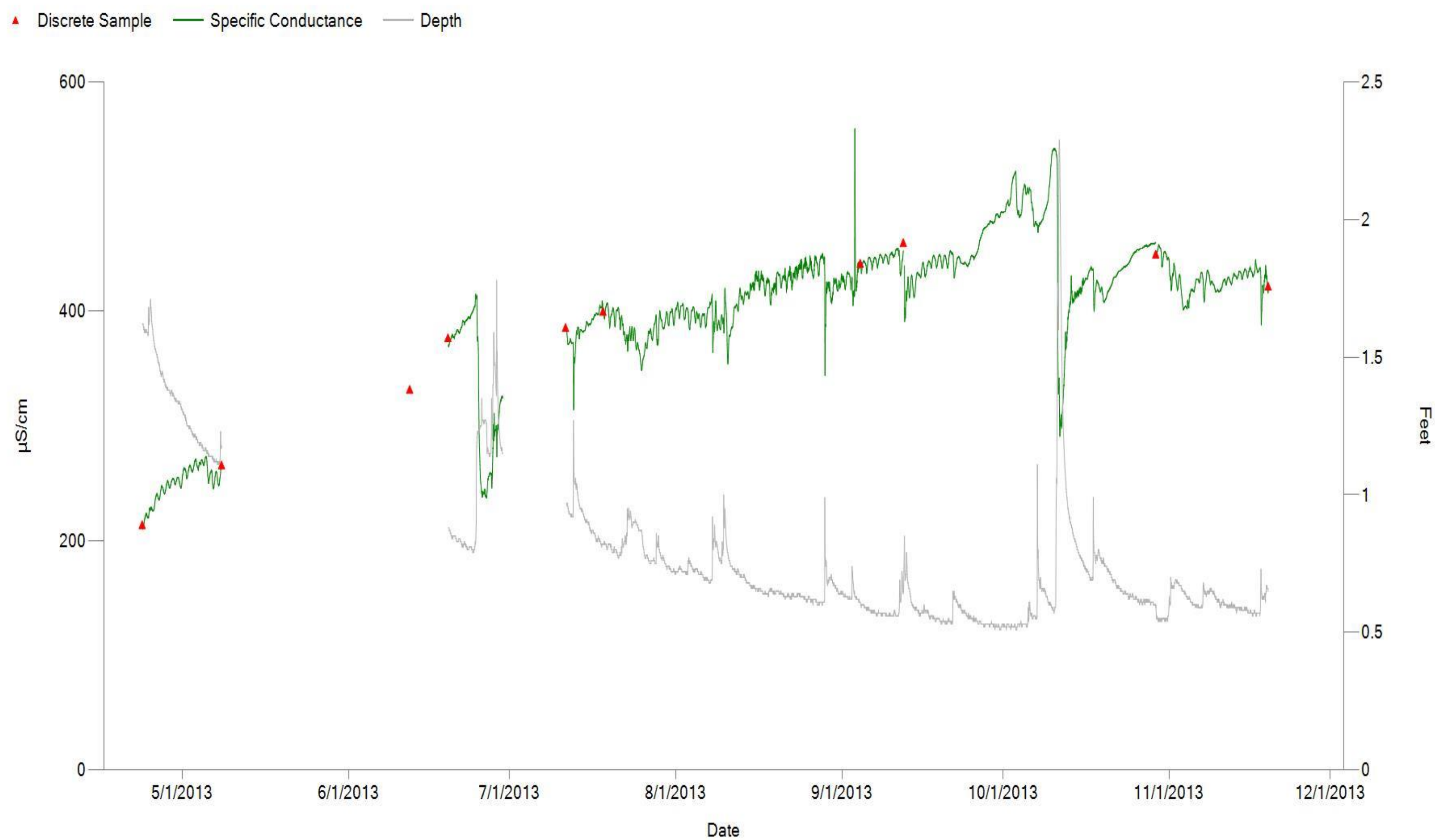

Figure 9. Continuous specific conductance, continuous depth, and discrete samples from April 23, 2013 to November 19, 2013. All data gaps are due to equipment failure.

2014 Statistics - Average: 288 µS/cm[c]; Maximum: 400 µS/cm[c]; Minimum: 134 µS/cm[c].

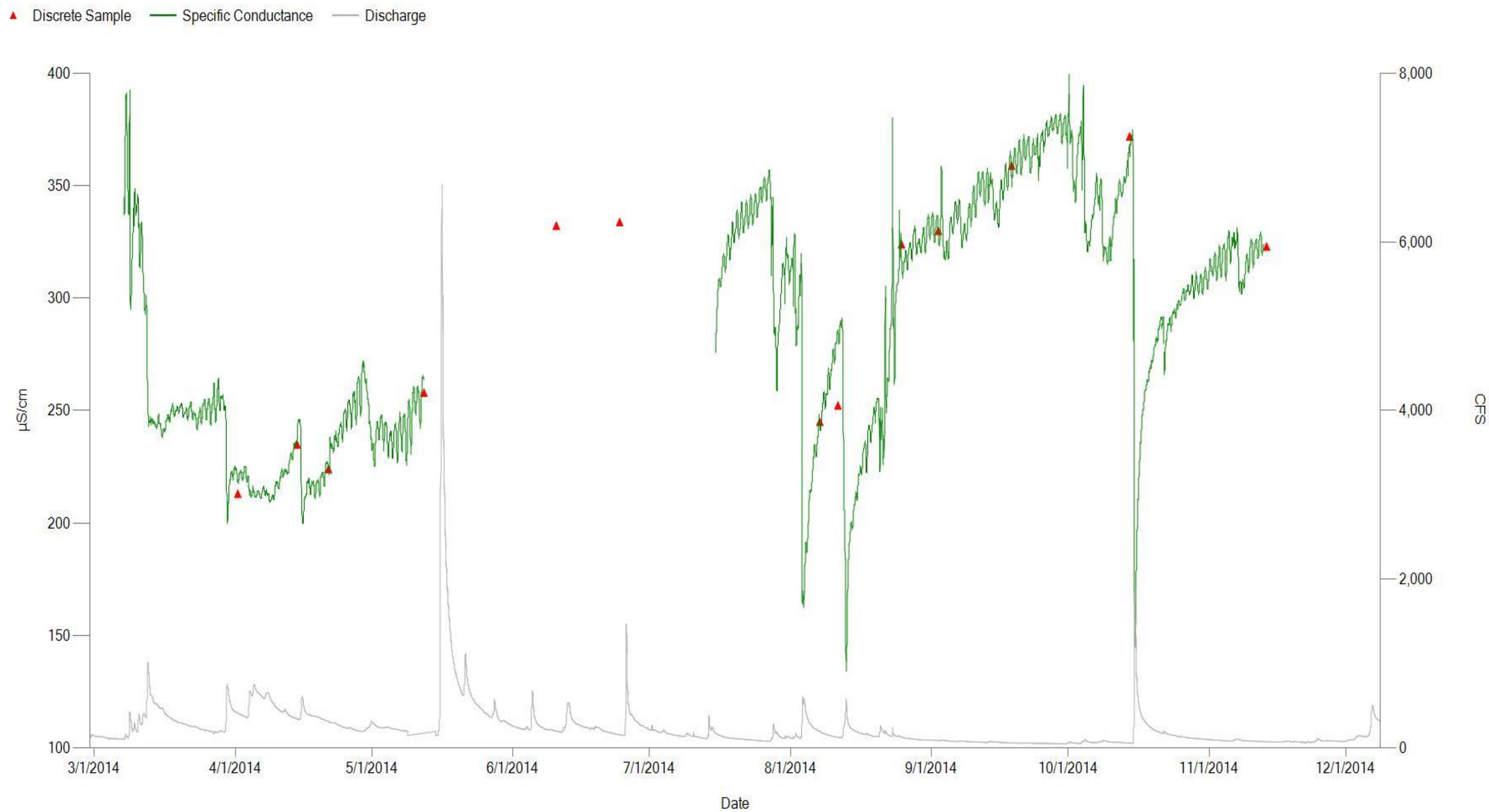

Figure 10. Continuous specific conductance, continuous discharge, and discrete samples from March 7, 2014 to November 13, 2014. Due to equipment failure no data was recorded from May to July.

pH:

2013 Statistics – Average: 8.1 units; Maximum: 8.7 units; Minimum: 7.5 units.

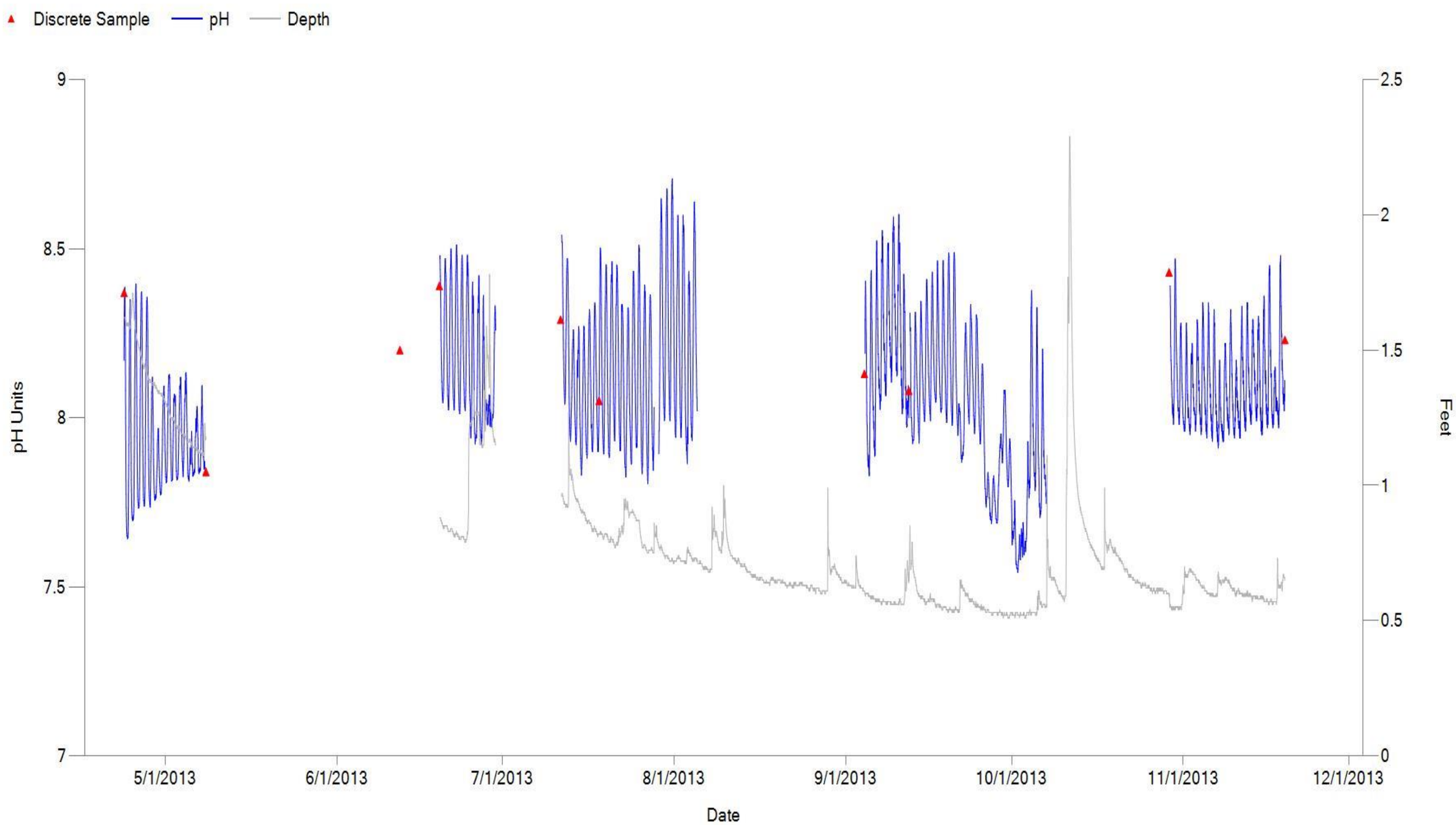

Figure 11. Continuous pH, continuous depth, and discrete samples from April 23, 2013 to November 19, 2013. The first two data gaps are due to equipment failure. The second two data gaps are a result of data being unusable.

2014 Statistics - Average: 8.2 units; Maximum: 9.2 units; Minimum: 7.3 units.

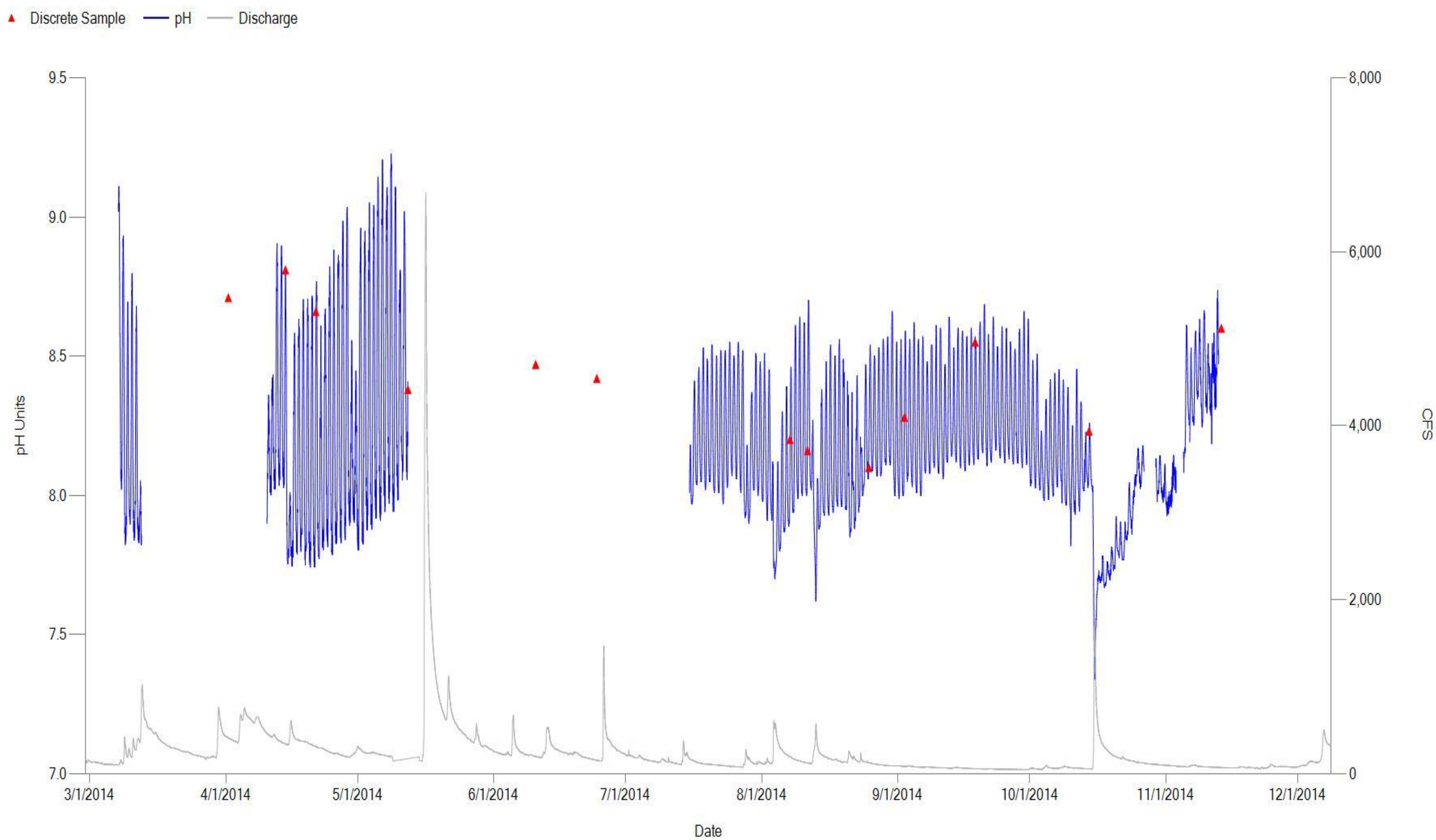

Figure 12. Continuous pH, continuous discharge, and discrete samples from March 7, 2014 to November 13, 2014. The first data gap was due to unacceptable undocumented monitor fouling. Due to equipment failure no data was recorded from May to July.

Dissolved Oxygen:
2013 Statistics – Average: 9.7 mg/L; Maximum: 14.1 mg/L; Minimum: 7.0 mg/L.

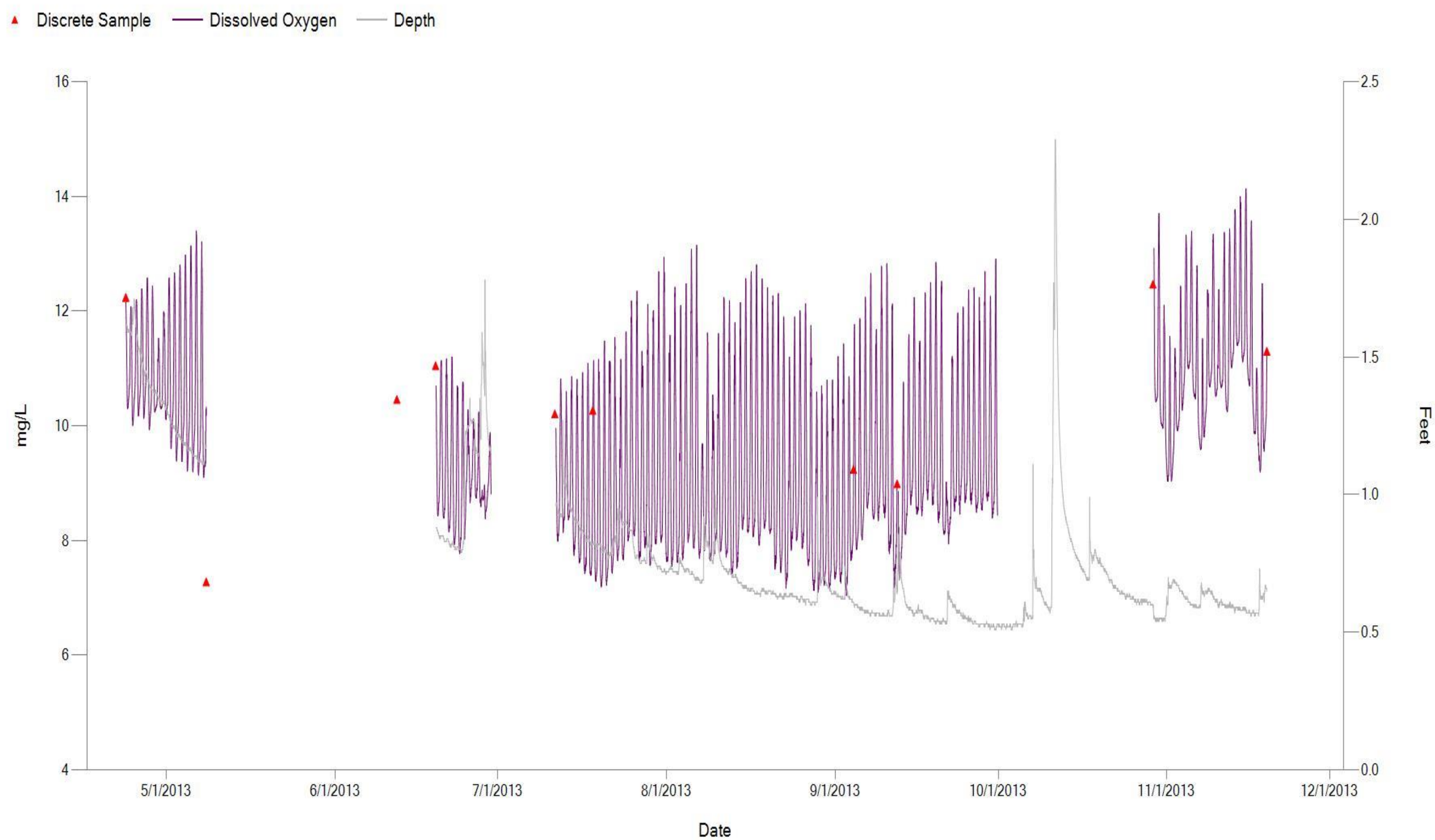

Figure 13. Continuous dissolved oxygen, continuous depth, and discrete samples from April 23, 2013 to November 19, 2013. The first two data gaps are due to equipment failure. The second data gap is a result of data being unusable.

2014 Statistics - Average: 10.6 mg/L; Maximum: 16.7 mg/L; Minimum: 8.1 mg/L.

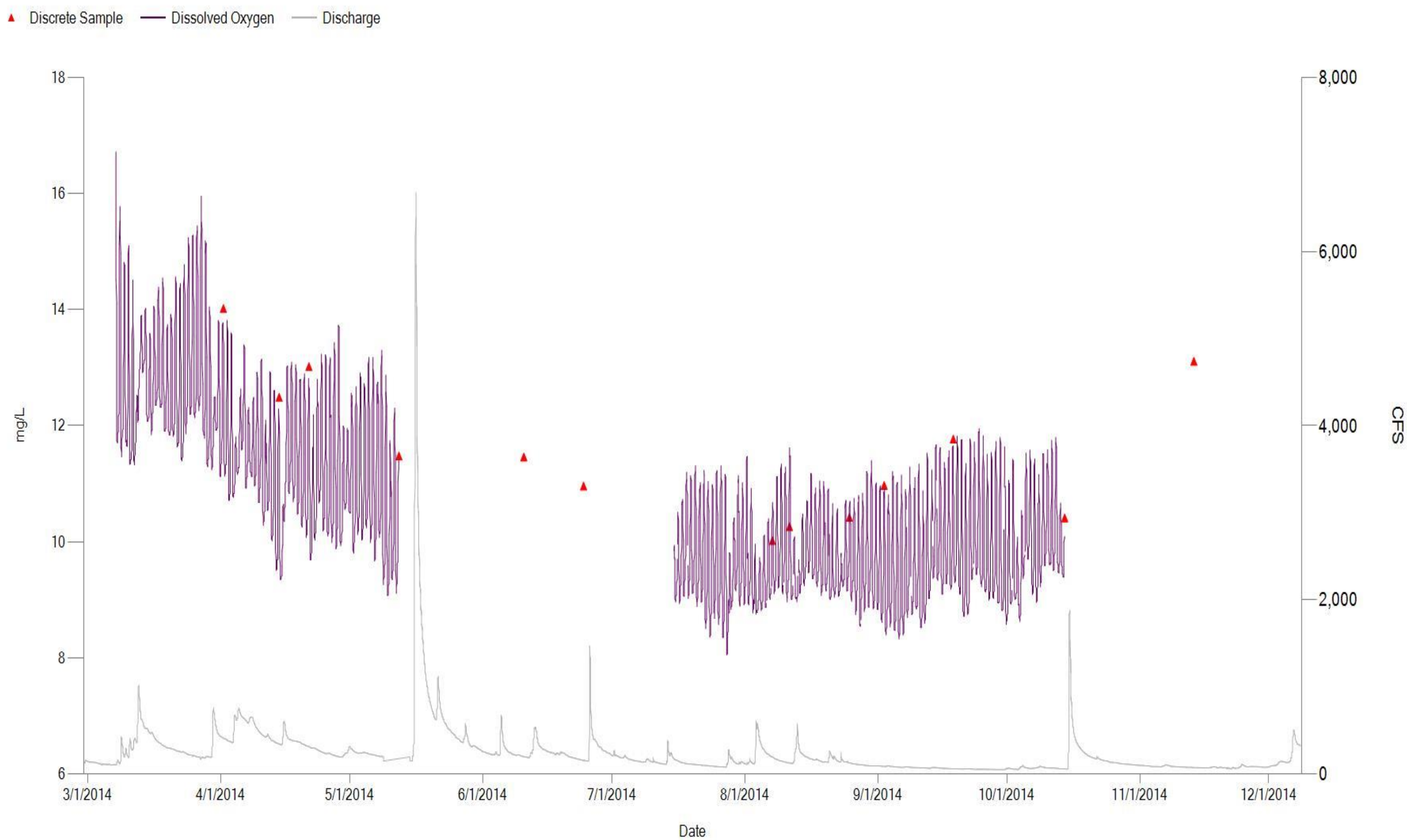

Figure 14. Continuous dissolved oxygen, continuous discharge, and discrete samples from March 7, 2014 to November 13, 2014. Due to equipment failure no data was recorded from May to July. Data at the end of the sampling period was graded unusable and deleted from the final data set.

In-situ Water Chemistry: In 2013 water chemistry samples were collected eight times using standard analysis code (SAC) 612. Samples were collected seven times in 2014 using SAC 612 with additional dissolved metal concentration analyses. Measurements with "<" indicate concentrations below the reporting limit.

Table 1. 2013 Chemical grab sample results.

Parameters	Units	04/23/2013	05/06/2013	05/08/2013	07/11/2013	07/11/2013	09/12/2013	10/29/2013	11/19/2013
		12:40	08:00	08:00	10:39	10:55	09:39	11:22	10:04
Stream Flow	CFS	406.7	233.586	--	106	106	47.4	35.33	44.0
ALUMINUM T	UG/L	133.000	116.000	185.000	150.000	147.000	76.000	<13.7514	34.000
BARIUM T	UG/L	22.000	30.000	32.000	46.000	45.000	48.000	45.000	44.000
BORON T	UG/L	20.00	20.00	30.00	30.00	20.00	30.00	20.00	50.00
BROMIDE	UG/L	<7.03284	<7.03284	<7.03284	10.6000	<7.03284	10.3180	14.8550	<7.03284
CALCIUM T	MG/L	24.800	32.000	34.410	44.900	45.500	53.900	58.230	54.560
CHLORIDE T	MG/L	7.7540	7.9640	8.0790	14.3100	14.2780	17.3430	17.9120	20.3660
COPPER T	UG/L	1.070	0.645	0.841	1.190	1.060	1.690	0.816	1.140
IRON T	UG/L	174.000	170.000	224.000	213.000	203.000	135.000	38.000	93.000
LEAD T	UG/L	0.250	0.720	0.330	0.320	0.327	0.337	0.098	0.243
MAGNESIUM T	MG/L	6.085	8.152	8.456	12.200	12.400	16.400	16.020	14.290
MANGANESE T	UG/L	13.000	13.000	18.000	16.000	15.000	16.000	6.000	8.000
NICKEL T	UG/L	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856
SELENIUM T	UG/L	<0.32605	<0.32605	<0.32605	<0.32605	<0.32605	1.000	<0.32605	0.354
SODIUM T	MG/L	4.450	4.608	5.227	7.389	7.141	7.994	8.937	7.720
STRONTIUM T	UG/L	245.000	340.000	347.000	605.000	586.000	834.000	933.000	816.000
SULFATE T	MG/L	12.7530	14.7490	14.4470	21.0760	21.2500	27.8790	32.3890	28.7930
ZINC T	UG/L	<5.1325	<5.1325	<5.1325	6.000	<5.1325	9.000	<5.1325	<5.1325
ALKALINITY @ pH 4.5	MG/L	77.6	105.2	100.2	152.4	141.4	180.2	173.8	164.6
HARDNESS T	MG/L	87	114	121	163	165	202	212	195
OSMOTIC PRESSURE	MOSM	4	6	4	5	7	8	9	6
pH	pH units	8.2	8.3	8.4	8.5	8.5	8.3	8.3	8.2
SPECIFIC COND @ 25 C	umhos/cm	206.00	262.00	259.00	375.00	402.00	442.00	441.00	401.00
TDS @ 1800 C	MG/L	136	170	154	246	260	264	264	248

Table 1 (continued). 2013 Chemical grab sample results.

Parameters	Units	04/23/2013	05/06/2013	05/08/2013	07/11/2013	07/11/2013	09/12/2013	10/29/2013	11/19/2013
		12:40	08:00	08:00	10:39	10:55	09:39	11:22	10:04
TOC	MG/L	1.2200	1.2950	1.6090	1.5530	1.6100	1.6920	1.2720	1.5460
TSS	MG/L	<5	<5	8	10	6	<5	<5	10
AMMONIA D	MG/L	0.014	<0.00672	<0.00672	0.035	0.035	0.024	0.00900	0.01400
AMMONIA T	MG/L	0.013	<0.00672	<0.00672	0.032	0.032	0.023	<0.00672	<0.008
NITRATE & NITRITE D	MG/L	1.481	1.912	1.925	3.098	3.083	3.624	3.198	2.676
NITRATE & NITRITE T	MG/L	1.482	1.914	1.906	3.086	3.087	3.627	3.197	2.682
NITROGEN D	MG/L	1.720	2.094	2.093	3.299	3.207	3.955	3.369	2.921
NITROGEN T	MG/L	1.678	2.123	2.186	3.282	3.290	3.924	3.388	2.824
ORTHO PHOSPHORUS D	MG/L	0.019	0.014	0.018	0.054	0.053	0.097	0.061	0.061
ORTHO PHOSPHORUS T	MG/L	0.020	0.013	0.018	0.056	0.056	0.098	0.065	0.062
PHOSPHORUS D	MG/L	0.017	0.017	0.020	0.055	0.055	0.101	0.063	0.068
PHOSPHORUS T	MG/L	0.028	0.026	0.039	0.067	0.068	0.115	0.064	0.070

Table 2. 2014 Chemical grab sample results.

Parameters	Units	04/14/2014	05/19/2014	06/10/2014	06/24/2014	08/07/2014	09/02/2014	11/13/2014
		13:27	8:12	12:30	10:29	9:48	10:16	13:25
ALUMINUM D	UG/L	--	--	<200.0	<200.0	<200.0	<200.0	11.000
ALUMINUM T	UG/L	109.000	426.000	130.000	105.000	116.000	50.000	30.000
BARIUM T	UG/L	28.000	30.000	41.000	36.000	30.000	34.000	34.000
BORON T	UG/L	20.00	<19.1058	<19.1058	<19.1058	<19.1058	<19.1058	<19.1058
BROMIDE	UG/L	11.6520	7.4700	<6.677	7.6610	6.9590	12.0910	<7.127
CALCIUM T	MG/L	29.800	25.900	42.300	46.730	31.700	43.300	41.800
CHLORIDE T	MG/L	8.8900	6.5600	11.0500	10.3200	9.5660	7.1110	11.2250
COPPER D	UG/L	--	--	<4	<4	<4	<4	<.412
COPPER T	UG/L	1.150	1.220	0.837	0.624	1.000	0.727	2.480
GLYPHOSATE	UG/L	--	--	nd*	nd*	nd*	--	--
IRON T	UG/L	159.000	606.000	172.000	159.000	174.000	92.000	52.000
LEAD D	UG/L	--	--	<1.0	<1.0	<1.0	<1.0	<.101
LEAD T	UG/L	0.253	0.673	0.253	0.256	0.291	0.204	<0.101
MAGNESIUM T	MG/L	7.472	5.520	10.500	11.820	6.980	10.600	10.100
MANGANESE D	UG/L	--	--	<10	<10	<10	<10	<3
MANGANESE T	UG/L	13.000	33.000	12.000	10.000	11.000	7.000	4.000
NICKEL T	UG/L	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<13.7856	<12
SELENIUM T	UG/L	<0.32605	0.507	<0.32605	0.427	<0.32605	0.341	<.763
SODIUM T	MG/L	4.961	3.895	5.967	5.446	5.468	5.636	5.500
STRONTIUM T	UG/L	276.000	201.000	441.000	396.000	285.000	433.000	456.000
Sulfate-Ion T	MG/L	12.6140	11.6220	15.8900	15.5080	12.3290	15.8620	16.8070
ZINC D	UG/L	--	--	<10.0	<10.0	<10.0	<10.0	13.000
ZINC T	UG/L	<5.1325	8.000	7.000	8.000	6.000	<5.1325	10.000
ALKALINITY @ pH 4.5	MG/L	86.2	67.8	129.2	129.4	91.4	127.6	126.6
HARDNESS T	MG/L	105	87	149	166	108	152	146
OSMOTIC PRESSURE	MOSM	3	2	6	7	5	5	7

*nd = Not detected

Table 2 (continued). 2014 Chemical grab sample results.

Parameters	Units	04/14/2014	05/19/2014	06/10/2014	06/24/2014	08/07/2014	09/02/2014	11/13/2014
		13:27	8:12	12:30	10:29	9:48	10:16	13:25
pH	pH units	8.6	7.8	8.5	8.4	8.2	8.3	8.5
SPECIFIC COND @ 25.0 C	umhos/cm	236.00	191.70	336.00	332.00	240.00	331.00	323.00
TDS @180C	MG/L	136	132	218	208	154	198	186
TSS	MG/L	<5	16	12	<5	<5	<5	<5
TOC	MG/L	1.4310	2.1430	1.2910	1.3170	2.0340	1.2890	1.1040
AMMONIA D	MG/L	0.01100	<0.008	0.01100	0.00900	0.01000	0.01500	<0.007
AMMONIA T	MG/L	0.009	<0.008	0.008	0.010	0.014	0.011	<0.007
NITRATE & NITRITE D	MG/L	2.119	1.968	3.364	3.474	1.645	2.646	2.451
NITRATE & NITRITE T	MG/L	2.066	1.951	3.383	3.460	1.639	2.620	2.444
NITROGEN D	MG/L	2.385	2.171	3.936	3.624	1.887	2.854	2.489
NITROGEN T	MG/L	2.349	2.134	3.738	3.587	1.824	2.832	2.589
PHOSPHORUS D	MG/L	0.027	0.027	0.029	0.028	0.027	0.052	0.013
PHOSPHORUS T	MG/L	0.037	0.045	0.036	0.036	0.033	0.053	0.016
ORTHO PHOSPHORUS D	MG/L	0.020	0.020	0.023	0.028	0.024	0.046	0.010
ORTHO PHOSPHORUS T	MG/L	0.022	0.020	0.024	0.027	0.029	0.045	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). Measured values were well below these calculated toxicity values (Table 3; Figures 15 and 16).

Table 3: Grab sample ammonia concentrations and calculated toxicity values in mg/L.

Date	Time	Ammonia Concentration	Calculated Acute Toxicity	Calculated Chronic Toxicity
2013 Samples				
04/23/2013	12:40	0.013	3.56	0.834
05/06/2013	08:00	<0.00672	2.82	0.646
05/08/2013	08:00	<0.00672	1.98	0.445
07/11/2013	10:39	0.032	1.05	0.232
09/12/2013	09:39	0.023	1.48	0.338
10/29/2013	11:22	<0.00672	3.05	0.45
11/19/2013	10:04	<0.008	3.72	0.872
2014 Samples				
04/14/2014	13:27	0.009	1.34	0.293
06/10/2014	12:30	0.008	1.37	0.3
06/24/2014	10:29	0.010	1.56	0.35
08/07/2014	9:48	0.014	2.38	0.52
09/02/2014	10:16	0.011	1.86	0.426
11/13/2014	13:25	<0.007	1.43	0.315

2013 Ammonia Toxicity Comparison

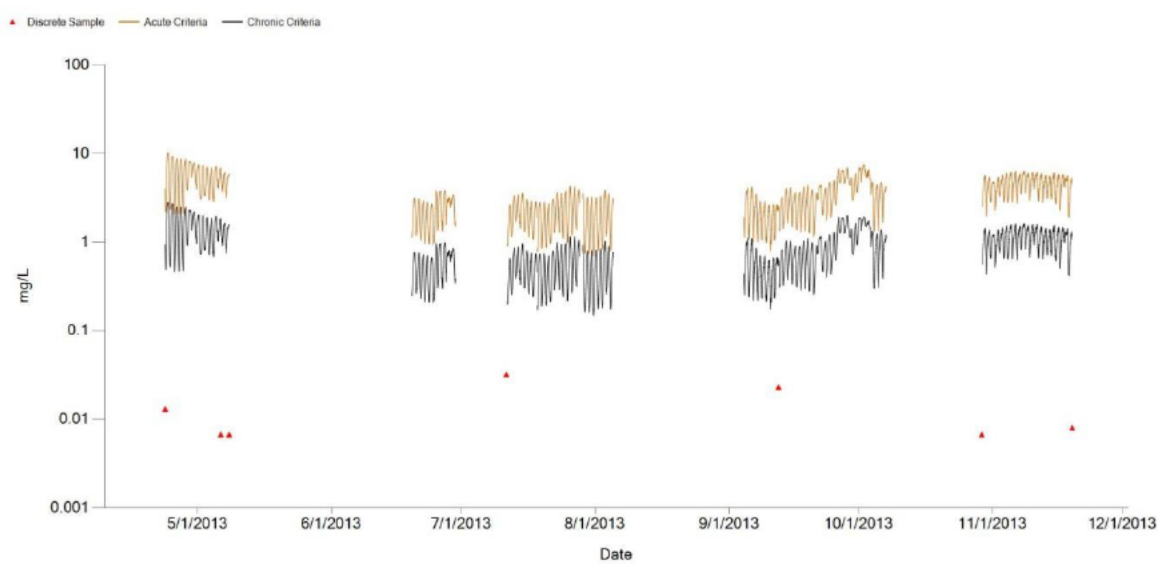

Figure 15. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations from April 23, 2013 to November 19, 2013. The first two data gaps are due to equipment failure. The second two data gaps are a result of data being unusable.

2014 Ammonia Toxicity Comparison

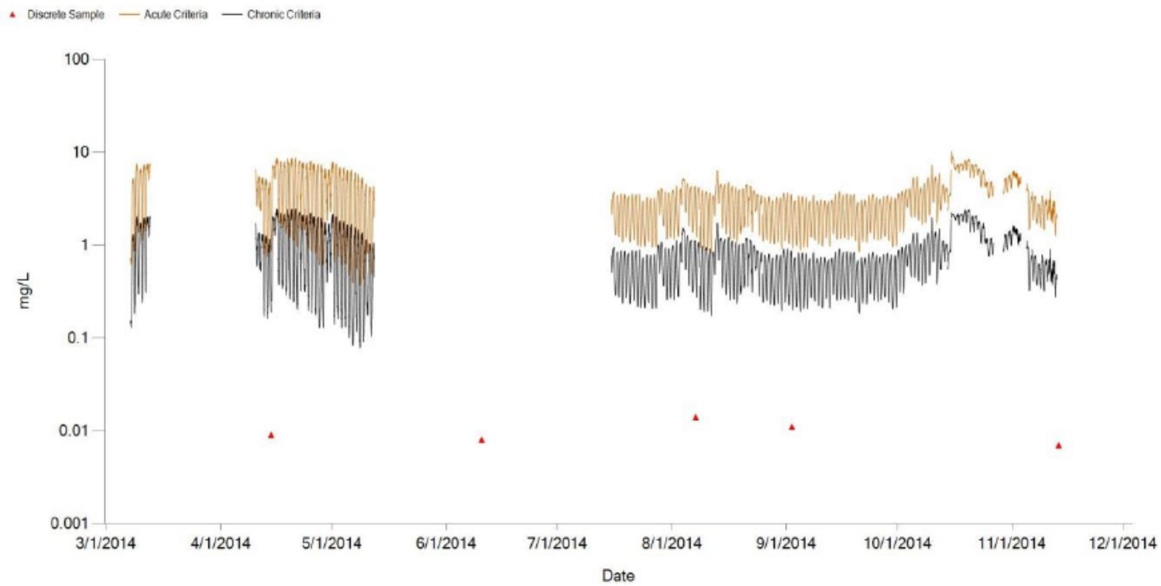

Figure 16. Calculated acute ammonia toxicity, calculated chronic ammonia toxicity, and measured ammonia concentrations from March 7, 2014 to November 13, 2014. The first data gap was due to unacceptable undocumented monitor fouling. Due to equipment failure no data was recorded from May to July.

Biology: The indigenous aquatic community is an excellent indicator of long-term conditions and is used as a measure of water quality. Benthic macroinvertebrates were collected on November 19, 2013 and November 13, 2014 (Table 4). Fishes were collected on July 31, 2013 (Table 5) and periphyton was sampled on May 6, 2013, June 24, 2014, July 17, 2014 and August 25, 2014 (Table 6).

Table 4. Taxa list for benthic macroinvertebrate surveys, 2013 and 2014.

Family	Genus	20131119-1220-jbutt	20141113-1315-mhoger
Baetidae	*Baetis*		6
Ephemeridae	*Stenacron*		1
Ephemerellidae	*Ephemerella*		38
Ephemerellidae	*Serratella*		6
Caenidae	*Caenis*		1
Leptophlebiodae	*Habrophlebiodes*		1
Hydropsychidae	*Cheumatopsyche*	11	22
Hydropsychidae	*Hydropsyche*	16	20
Limniphilidae	*Pseudostenophylax*		1
Elmidae	*Macronychus*		1
Elmidae	*Optioservus*	74	11
Elmidae	*Psephenus*	1	
Elmidae	*Promoresia*		2
Elmidae	*Stenelmis*	4	1
Tipulidae	*Antocha*		3
Chironomidae		4	13
Turbellaria		10	2
Oligochaeta		43	6
Gammaridae	*Gammarus*	21	30
Bryozoa			2

Table 5. Taxa list for 2013 fish survey. No fishes were collected in 2014.

Family	Scientific Name	Common Name	20130731-1530-twertz
Catostomidae	*Catostomus commersonii*	White Sucker	168
Catostomidae	*Hypentelium nigricans*	Northern Hogsucker	6
Centrarchidae	*Lepomis auritus*	Redbreast Sunfish	1
Centrarchidae	*Lepomis cyanellus*	Green Sunfish	12
Centrarchidae	*Micropterus dolomieu*	Smallmouth Bass	1
Centrarchidae	*Lepomis gibbosus*	Pumpkinseed	5
Centrarchidae	*Lepomis macrochirus*	Bluegill	7
Centrarchidae	*Ambloplites rupestris*	Rock Bass	22
Cottidae	*Cottus bairdii*	Mottled Sculpin	58
Cyprinidae	*Campostoma anomalum*	Central Stoneroller	6
Cyprinidae	*Rhinichthys atratulus*	Blacknose Dace	53
Cyprinidae	*Semotilus atromaculatus*	Creek Chub	4
Cyprinidae	*Cyprinus carpio*	Common Carp	1
Cyprinidae	*Rhinichthys cataractae*	Longnose Dace	87
Cyprinidae	*Luxilus cornutus*	Common Shiner	7
Cyprinidae	*Semotilus corporalis*	Fallfish	16
Cyprinidae	*Notropis hudsonius*	Spottail Shiner	1
Cyprinidae	*Exoglossum maxillingua*	Cutlip Minnow	59
Cyprinidae	*Nocomis micropogon*	River Chub	4
Cyprinidae	*Pimephales notatus*	Bluntnose Minnow	13
Cyprinidae	*Notropis rubellus*	Rosyface Shiner	38
Cyprinidae	*Notropis volucellus*	Mimic Shiner	66
Ictaluridae	*Noturus insignis*	Margined Madtom	1
Ictaluridae	*Ameiurus natalis*	Yellow Bullhead	4
Percidae	*Etheostoma blennioides*	Greenside Darter	5
Percidae	*Etheostoma olmstedi*	Tessellated Darter	12
Percidae	*Percina peltata*	Shield Darter	24
Percidae	*Etheostoma zonale*	Banded Darter	24
Salmonidae	*Salmo trutta*	Brown Trout	35

Table 6. Periphyton analysis data, 2013 and 2014

	Chlorophyll-a	Pheophytin-a
May 6, 2013	595 mg/m^3	0 mg/m^3
July 17, 2014	163 mg/m^3	66 mg/m^3
August 25, 2014	174 mg/m^3	102 mg/m^3

ASSESSMENT:

Continuous:
2013 – Water quality based on continuous instream monitoring indicated good water quality. Specific conductance measurements were fairly consistent throughout the sampling period, steadily increasing over time. A few inconsistencies in specific conductance were observed in the months of September and October, where measurements were slightly elevated from normal values with one strong spike in September. Measurements of pH and dissolved oxygen were consistent with expected diel and seasonal swings, with a subtle dilution effect during high flow events.

2014 – Overall, parameters collected by the instream monitor indicated average water quality conditions. Specific conductance measurements were fairly consistent throughout the sampling period. A qualitative comparison of specific conductance and discharge data showed a strong dilution effect with high flow events and probable anthropogenic discharge events which caused spikes in specific conductance in March, August, and October. Continuous measurements of pH were elevated, particularly at the beginning of the sampling period, with readings exceeding nine on a few days. pH measurements remained somewhat elevated throughout the sampling period, but diel and seasonal swings were consistent with the expected trends. Dissolved oxygen concentrations were elevated in the beginning of the sampling period; otherwise measurements were consistent with expected diel and seasonal swings.

Chemistry: Average specific conductance measurements collected by the continuous instream monitoring (CIM) efforts suggest a difference in water chemistry between the two sites. The average CIM specific conductance at Parcheytown Road was 404 µS/cm and the average CIM specific conductance at the Route 322 Bridge was 288 µS/cm. Upon further analysis of chemistry data (Tables 1 & 2), differences in the water column CIM specific conductance were reflected in water chemistry parameters measured.

In both years grab samples were collected in April, May, September, and November. Means were calculated from those four months and were used as a basis for highlighting chemistry parameters showing the most change between the Parcheytown site and Route 322 Bridge site. Chemistry parameters of interest were all of the nutrient analytes except ammonia, all of salt analytes except sodium, total dissolved solids, aluminum, barium, boron, iron, magnesium, manganese, and strontium (Table 7).

Overall, the Parcheytown Road site yielded higher water chemistry values compared to the Route 322 Bridge site (Figure 17). A cumulative effect and a seasonal trend were observed in all instances. As time progressed, concentrations generally increased. Early in the season concentrations were lowest, mid-season concentrations were the greatest, and end of season concentrations began to taper off. In both cases each site reacted similarly; however, with the higher concentrations at Parcheytown Road, land use impacts seem to have more of an influence. The most probable contributor is the increase in urban land use situated between the two sites, refer to Figure 1. Eleven discharge points all of which are from Water Pollution Control Facilities (WPCF) lie between the two sites. Of those eleven sites, five are publically owned sewage discharge points and the remaining six are from industrial waste facilities. In addition, an increase in impervious surfaces and the resulting runoff could also have been impacting the surface water at Parcheytown Road.

Table 7. Analytes grouped with means and standard deviations calculated as described above. Parameters in blue text were not further compared; all other parameters were further analyzed.

Nutrients	Year	Mean (mg/L)	SD (mg/L)	Metals	Year	Mean (ug/L)	SD (ug/L)
AMMONIA T [2]	2013	--	--	ALUMINUM T	2013	98.375	46.262
	2014	--	--		2014	153.750	159.844
NITRATE & NITRITE T	2013	2.017	0.939	BARIUM T	2013	36.250	10.353
	2014	1.676	1.183		2014	31.500	2.598
NITROGEN T	2013	2.195	1.050	BORON T	2013	--	--
	2014	1.750	1.268		2014	--	--
ORTHO PHOSPHORUS T	2013	2.148	1.021	COPPER T [2]	2013	1.161	0.340
	2014	1.789	1.289		2014	--	--
PHOSPHORUS T	2013	0.050	0.012	IRON T	2013	149.750	39.556
	2014	0.016	0.007		2014	227.250	221.988
				LEAD T [1]	2013	0.339	0.114
Solids and Salts	Year	Mean (mg/L)	SD (mg/L)		2014	0.377	0.248
CALCIUM T	2013	41.616	12.961	BROMIDE [1]	2013	10.318	5.957
	2014	35.200	7.497		2014	10.404	4.990
SODIUM T [1]	2013	6.270	1.598	MAGNESIUM T *	2013	11.270	4.217
	2014	4.998	0.685		2014	8.423	2.054
CHLORIDE T	2013	13.371	5.587	MANGANESE T	2013	13.125	3.170
	2014	8.447	1.821		2014	14.250	11.300
TDS @ 1800 C	2013	202.500	54.578	NICKEL T [2]	2013	--	--
	2014	163.000	29.343		2014	--	--
TOC [1]	2013	1.478	0.172	SELENIUM T [1 & 2]	2013	0.677	0.429
	2014	1.492	0.393		2014	0.424	0.240
SULFATE T	2013	21.006	7.366	STRONTIUM T	2013	559.625	267.726
	2014	14.226	2.163		2014	341.500	106.669
TSS [2]	2013	9.000	4.980	ZINC T [2]	2013	9.000	5.196
	2014	16.000	8.764		2014	9.000	4.980

[1] means similar at each site

[2] values below the reporting limit, means not calculated

*magnesium reported in mg/L

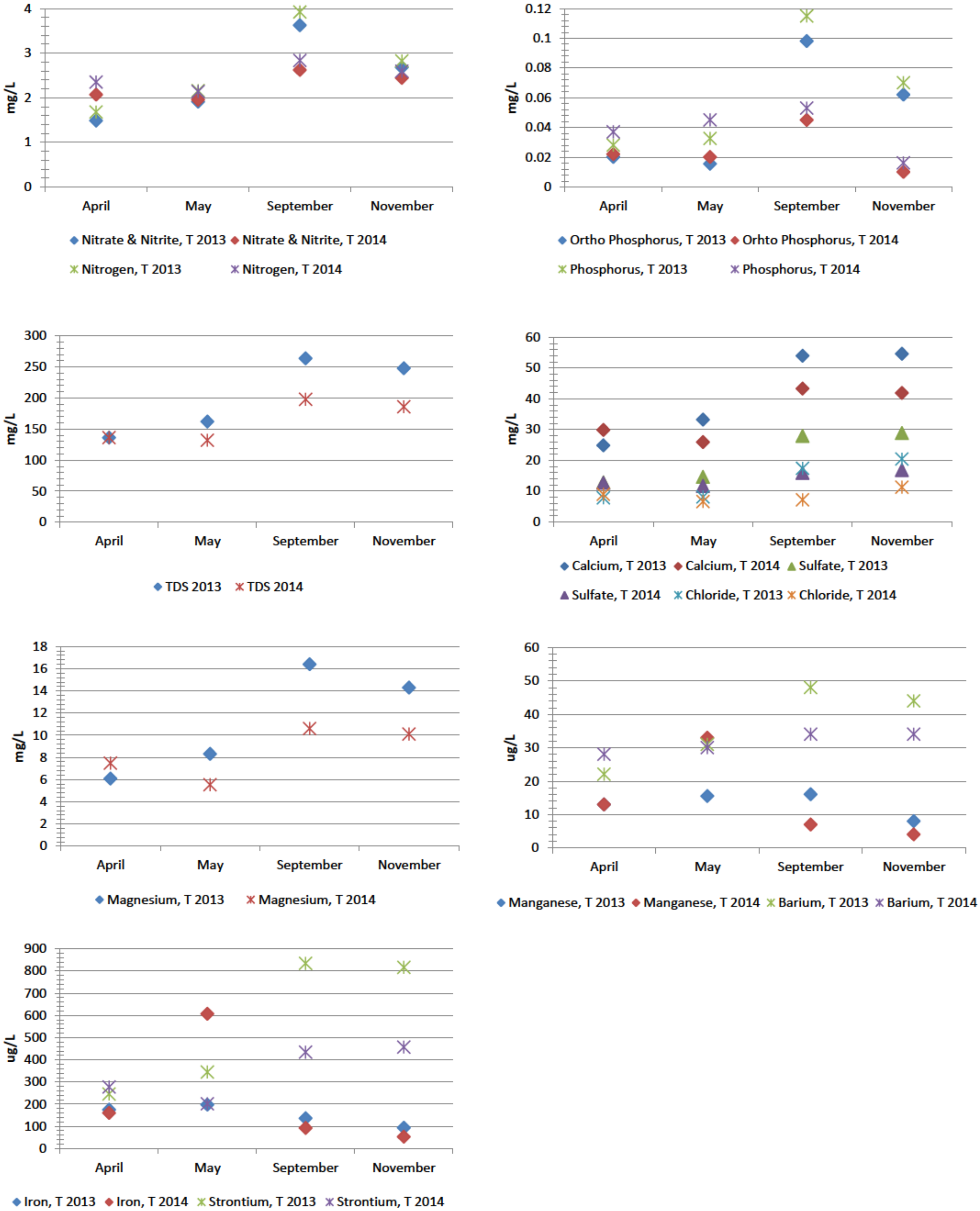

Figure 17. A visual comparison of analytes at each site by month.

Biological: The biological assessment of Kishacoquillas Creek suggests an impacted watershed. The benthic macroinvertebrate community in 2013 indicated aquatic life impairment (Table 8). Approximately 14% of the total benthic macroinvertebrate taxa consisted of Ephemeroptera, Plecoptera & Trichoptera (EPT), where no individuals in the orders Ephemeroptera or Plecoptera were observed. The most abundant fishes were the white sucker and longnose dace. Periphyton analysis resulted in elevated levels of chlorophyll-a (Table 6) which further suggest anthropogenic influences on the watershed.

In 2014, the benthic macroinvertebrate sample scored higher; however, this might be a result of habitat variation and change in land use impacts due to site relocation. Approximately 57.4% of the total benthic macroinvertebrate taxa consisted of EPT taxa; however, no individuals were observed from the order Plecoptera. The most dominant taxa were *Ephemerella* and *Gammarus*, a mayfly intolerant and a crustacean somewhat tolerant of pollution. An IBI score of 55.8 signifies an attaining community; however, this low score may be indicative of anthropogenic influences on the watershed. The periphyton analysis showed a presence of chlorophyll-a but not at the levels found in 2013. In addition to chlorophyll-a, pheophytin-a was also detected (Table 5).

Table 8. Benthic macroinvertebrate metric calculations.

Date	IBI	Richness	Mod EPT	HBI	% Dom	% Mod May	Beck3	Shannon Div
November 19, 2013	27.1	10	0	5.81	38.3	0.0	0	1.80
November 13, 2014	55.8	19	9	4.09	22.8	31.7	8	2.32

SUMMARY: Continuous instream monitor (CIM), water chemistry, and biological data suggest anthropogenic influences on the watershed. Spikes in CIM specific conductance measurements in both the 2013 and 2014 sampling periods and the elevated pH measurements at the beginning of the period in 2014 indicate an impacted watershed. Spatial comparisons further support an impacted watershed. Urban influences seem to be a contributing factor in differences between the 2013 and 2014 data. Average CIM specific conductance measurements were greater at the Parcheytown Road site than the Route 322 Bridge site. In addition, water chemistry grab samples yielded higher concentrations in all analyte groups at the Parcheytown Road site. The increase in urban development, presence of discharges, and more agricultural land use lying between the two sites is the likely contributor to these differences. Influences on the watershed by land use were also observed in the biological data. While macroinvertebrate taxa composition and the low IBI scores obtained suggests overall poor habitat conditions and average water quality at both sites, the Route 322 Bridge scored significantly higher than the Parcheytown Road site which is likely attributed to habitat variation and differences in land use influences.

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