



# pennsylvania

DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF CLEAN WATER

## **Juniata River at Newport, 2013 to 2016** Continuous Instream Monitoring Report

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October 21, 2019

### **WATERBODY AND SITE DESCRIPTIONS**

**Stream Code:** 11414  
**Stream Name:** Juniata River  
**HUC:** 02050304 – Lower Juniata

#### **Site Description**

**Site Code:** 133431246-002  
**Site Name:** Juniata River at Newport (North)  
**Latitude:** 40.47798                      **Longitude:** -77.12644

The 2013 continuous instream monitoring (CIM) site was approximately 20 meters (m) downstream of the State Route 34 bridge and about 65 m from the left descending bank. The 2014 site was in the same approximate location of the 2013 deployment. In 2015 the site was moved downstream to approximately 220 m downstream of the State Route 34 bridge and about 55 m from the left descending bank. The site remained at the 2015 location through the 2016 data collection period.

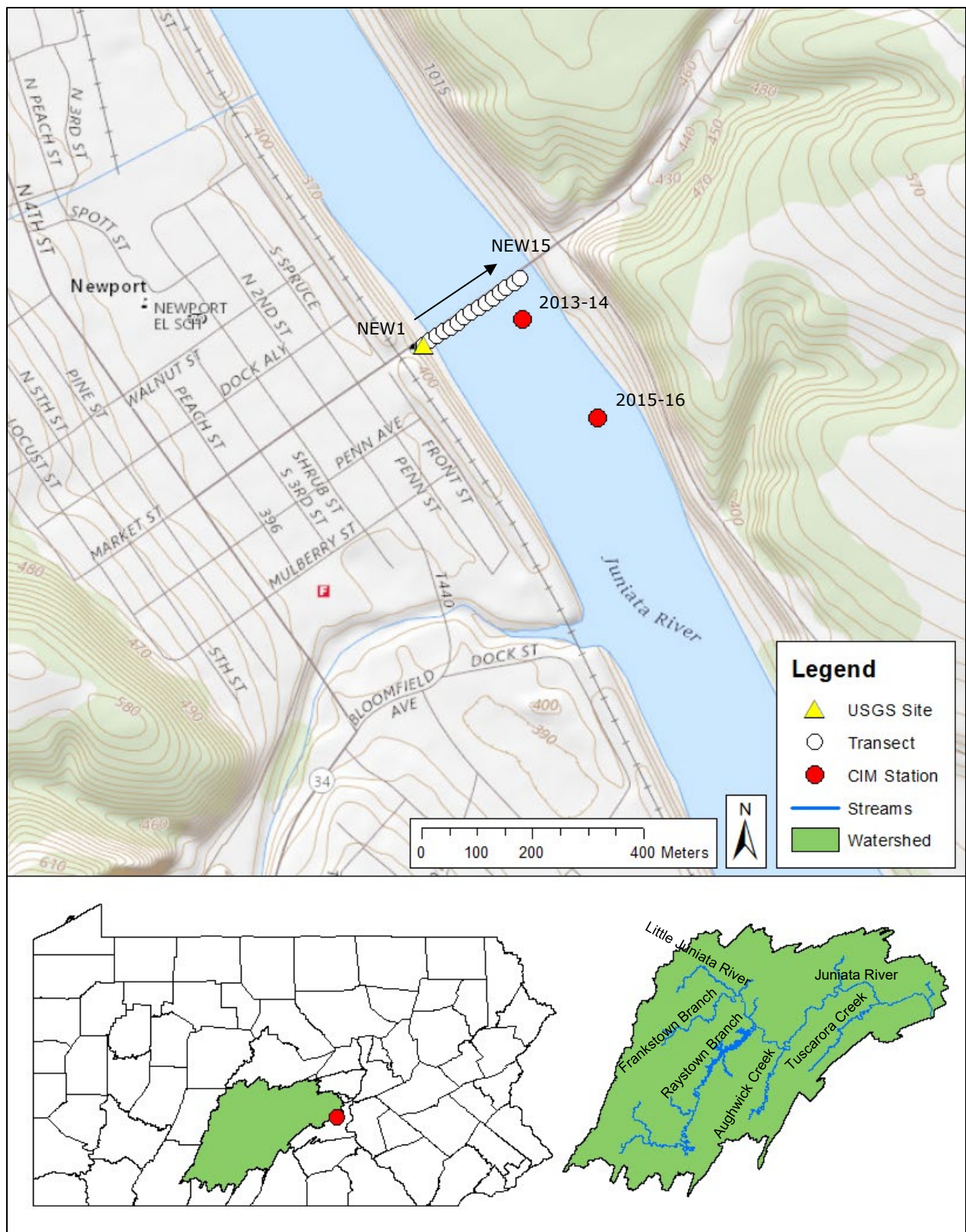
**County:** Perry  
**Drainage Area:** 8,682 km<sup>2</sup>  
**Strahler Stream Order:** 7  
**Designated Use:** Warm Water Fishes

## **BACKGROUND AND HISTORY**

The Juniata River is a freestone stream and one of the larger tributaries to the Susquehanna River. The watershed of the Juniata River is predominately characterized by ridge-and-valley topography and encompasses all or parts of Somerset, Bedford, Fulton, Cambria, Blair, Huntingdon, Franklin, Centre, Mifflin, Snyder, Juniata, and Perry counties in southcentral Pennsylvania (Figure 1). Land use in the watershed of the Juniata River at Newport consists of 70% forest, 22% agriculture, and 8% developed land. The designated aquatic life use of the Juniata River at Newport is Warm Water Fishes (WWF).

In addition to the CIM site described above, a transect across the width of the river was established at Newport according to the Pennsylvania Department of Environmental Protection's (DEP's) *In-situ Field Meter and Transect Data Collection Protocol* (Hoger 2018b) to characterize mixing patterns and identify any distinct zones of water quality across the width of the river. Discrete water quality measurements were taken at 15 equidistant points (NEW1 to NEW15) along the Route 34 bridge starting at the right descending bank (Figure 1); an additional point was established at the sonde location (NEW11.5).

The United States Geological Survey (USGS) operates a gaging station along the Juniata River at Newport where it monitors river stage and discharge. From 2008 to early 2015, DEP funded the additional collection of continuous physiochemical parameters as well. USGS station 01567000, Juniata River at Newport, Pennsylvania, is located on the right descending bank, the south bank, at the State Route 34 bridge (Figure 1). The NEW1 cross-sectional transect location was located at the USGS sonde (Figure 1). Data from the USGS station is used in this report to highlight spatial variability in water quality of the Juniata River at Newport.



**Figure 2.** Map of the Juniata River CIM site and cross-sectional transect sampling locations at Newport. USGS station 01567000 also shown.

Water quality data at this site were initially collected as part of the Susquehanna River Project investigating health and recruitment issues of smallmouth bass. This site has since become a long-term station to inform ongoing studies and trend analyses. This report focuses only on the CIM data and chemical grab samples collected from 2013 to 2016. Other data collected at this location include benthic macroinvertebrate and fish community surveys, periphyton and algal analyses, and analyses of emerging contaminants in sediment and water.

## **PRIMARY OBJECTIVES**

The primary objective of this report is to characterize temporal and spatial patterns in various physical and chemical water quality parameters in the Juniata River at Newport.

## **WATER QUALITY PARAMETERS**

Five water quality parameters were measured using CIM at the Newport site (Table 1).

**Table 1.** Water quality parameters monitored by CIM.

<b>Parameter</b>	<b>Units</b>
Water Temperature	°C
Specific Conductance (@ 25°C)	µS/cm <sup>c</sup>
pH	Standard Units (SU)
Dissolved Oxygen (DO)	mg/L
Turbidity	Formazin Nephelometric Unit (FNU)

## **EQUIPMENT**

A Yellow Springs Instruments (YSI) water quality sonde was used to collect CIM data at the Newport site each year. The first three years, a YSI 6920 V2 sonde was used. In 2016, a YSI EXO2 sonde was used.

Sondes were housed in a 24-inch length of 4-inch diameter schedule 80 PVC pipe with holes drilled to allow water to flow through the pipe. 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 river bed. The attachment bar was also clipped to a cable attached to a second piece of rebar located just upstream of the first.

## **PERIOD OF RECORD**

Continuous data were recorded from late winter or spring until late fall when the fall macroinvertebrate sample was collected in November each year (Table 2). The sonde was deployed earlier each year to document changes in water quality near the beginning of each growing season. Each year, the sonde was removed before winter to prevent damage from ice. The sonde was visited several times throughout each deployment period to download data, to check calibration, and for cleaning. The sondes recorded water quality parameter measurements once every 30 minutes.

**Table 2.** Continuous data period of record.

<b>Year</b>	<b>Deployment</b>	<b>Removal</b>
2013	May 03	November 19
2014	April 23	November 14
2015	April 06	November 04
2016	February 23	November 22

In addition to CIM data collected by DEP at the Newport site, continuous water quality data were also collected by USGS at station 01567000. Water temperature, specific conductance, and DO were recorded from May 9, 2008 to March 26, 2015, and pH was collected from May 9, 2008 to December 25, 2014. Where they overlap, USGS and DEP data are graphed and discussed in this report.

## **DATA**

### **Cross-Sectional Surveys**

To monitor variations in water quality throughout the year, cross-sectional transect surveys were conducted multiple times each year at various flows. Cross-section survey data were analyzed by comparing each survey point to NEW11.5, the DEP sonde site (Figure 2). For temperature and pH, the difference in readings between NEW11.5 and each transect point was considered significant if the difference was greater than 0.5 units. For specific conductance, DO, and turbidity, the difference was considered significant if it was greater than 10% of the NEW11.5 reading. When surveys were conducted when turbidity was low (less than 10 FNU), a difference of one FNU was equivalent to a 10% difference.

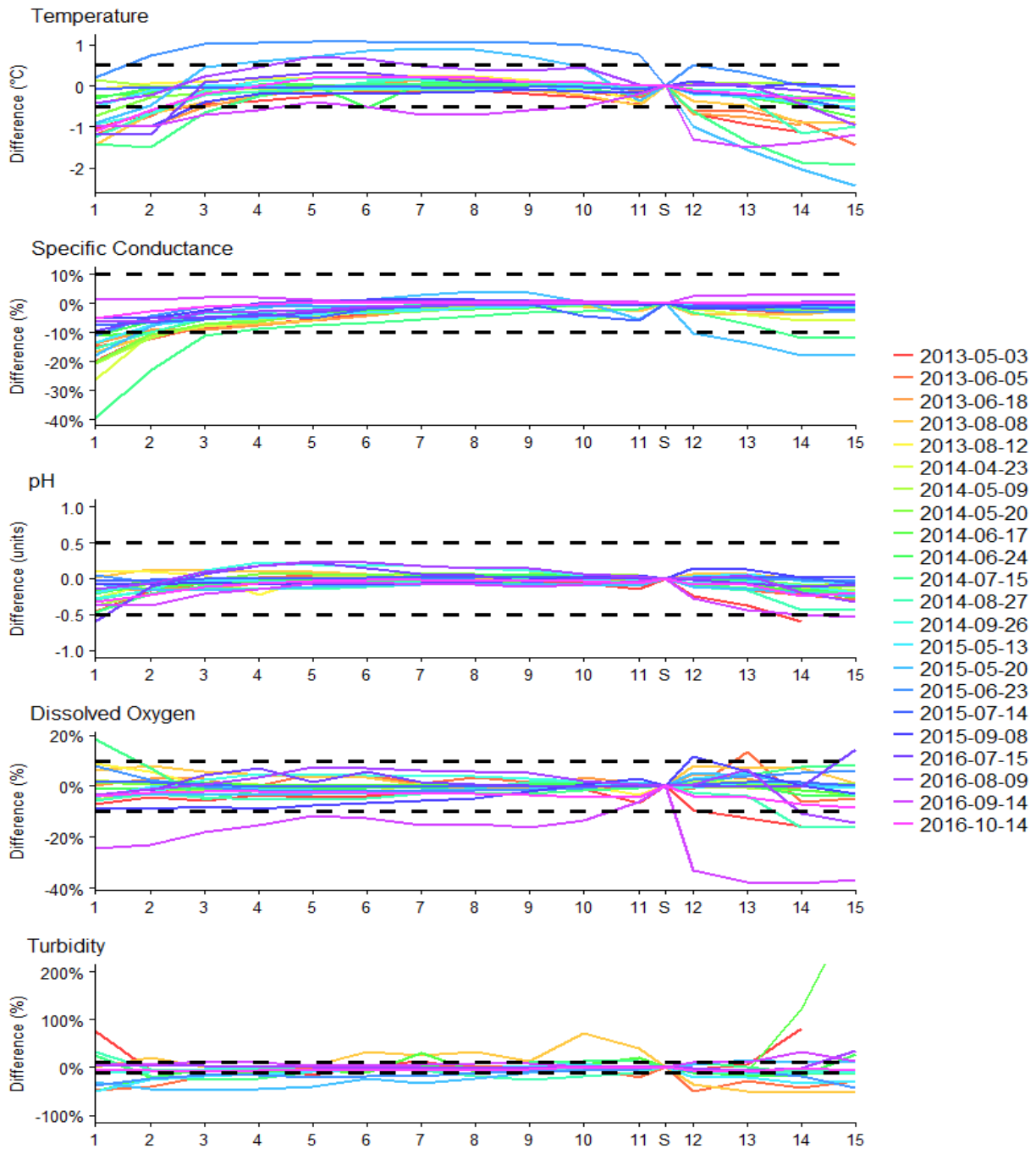
### **Continuous Monitoring**

Continuous data were collected and evaluated following DEP's *Continuous Physicochemical Data Collection Protocol* (Hoger et al. 2018). Grades and corrections were based on a combined evaluation of sensor fouling and calibration error. Gaps in the CIM data are attributable either to equipment or battery failure or to removal of data that did not meet usability standards due to excessive sensor fouling or calibration error. To show year-to-year variations in water quality, the four years of data for each parameter are overlaid in the plots below (Figures 4 to 8). Due to year-to-year differences in the timing of data collection and to data missing from some years but not others, comparison of the summary CIM data should be made with caution.

Discharge data from USGS station 01567000 are provided, in cubic feet per second (cfs), below (Figure 3). USGS CIM equipment maintenance, data collection, and data maintenance were completed by USGS personnel according to *Guidelines and Standard Procedures for Continuous Water Quality Monitors* (Wagner et al. 2006). A comparison of DEP and USGS continuous datasets from 2013 and 2014 is provided in Figure 9. To avoid bias when comparing the two datasets in the evaluation section, statistics are generated using only days when data were collected at both locations.

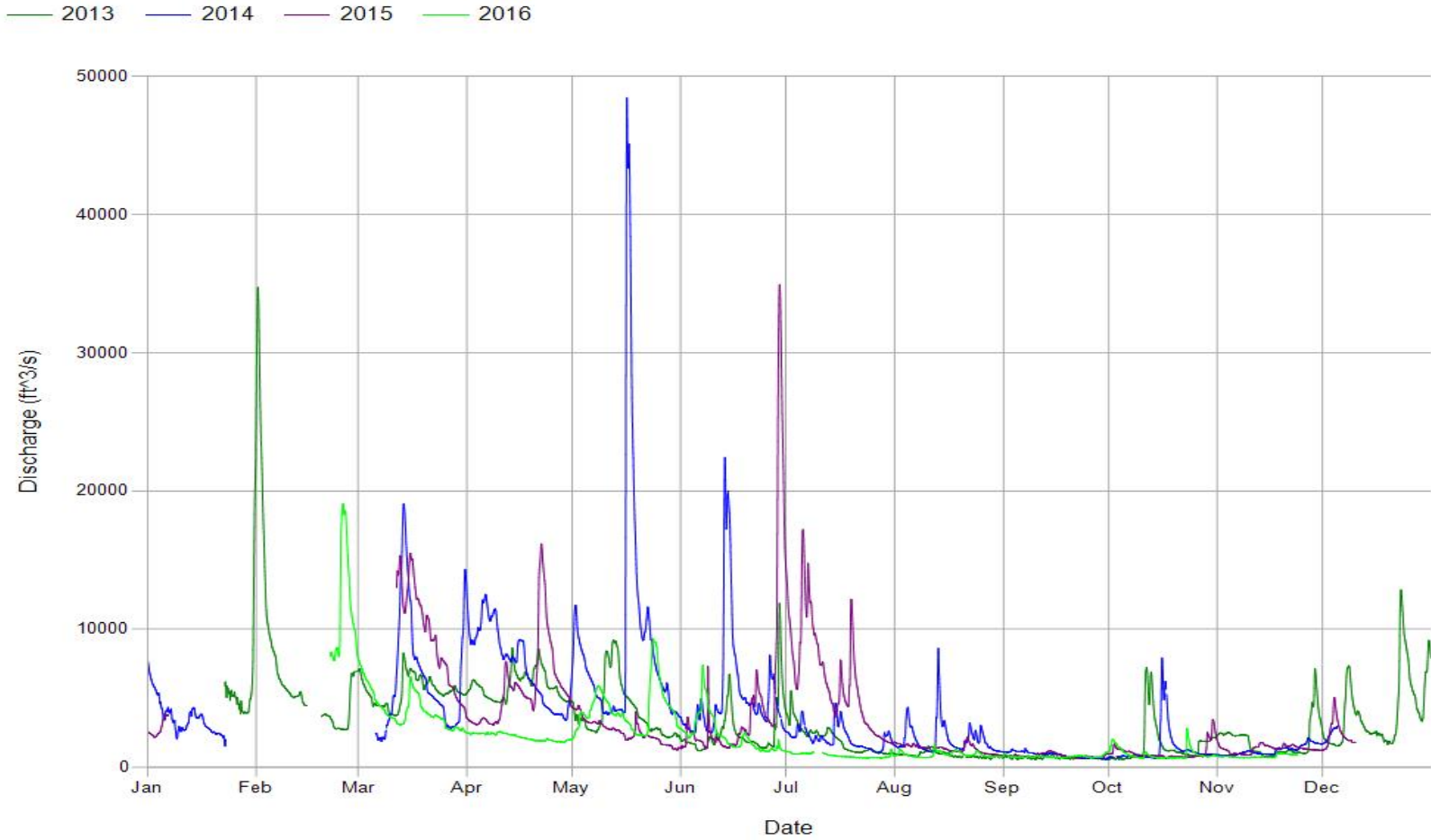
### **Discrete Water Chemistry Sampling**

Grab samples were collected several times each year at the Newport DEP CIM site (Table 3) according to DEP's *Discrete Water Chemistry Data Collection Protocol* (Shull 2013). Initial grab samples were analyzed using DEP's standard analysis code (SAC) 612, which includes general chemistry parameters, dissolved and total nutrients, and total metals. Beginning in 2014, dissolved metals were added to the suite of analytes for many grab samples. In 2016, the discrete samples were analyzed using the newly created SAC 087, which is SAC 612 plus the dissolved metals analytes. SAC 618 and SAC 779 were used to obtain concentrations of suspended sediment and acid-soluble aluminum, respectively. A complete list of grab sample analytes can be found in Table 3.



**Figure 2.** Cross-section surveys at Newport showing relative difference in readings compared to the DEP sonde location (NEW11.5). Transect points include NEW1 to NEW15, plus the DEP sonde location (S). Dashed, black lines indicate thresholds of significance. Turbidity chart cutoff at 200%, but the difference from NEW11.5 reached 342% along the left descending bank (NEW15) on June 17, 2014.

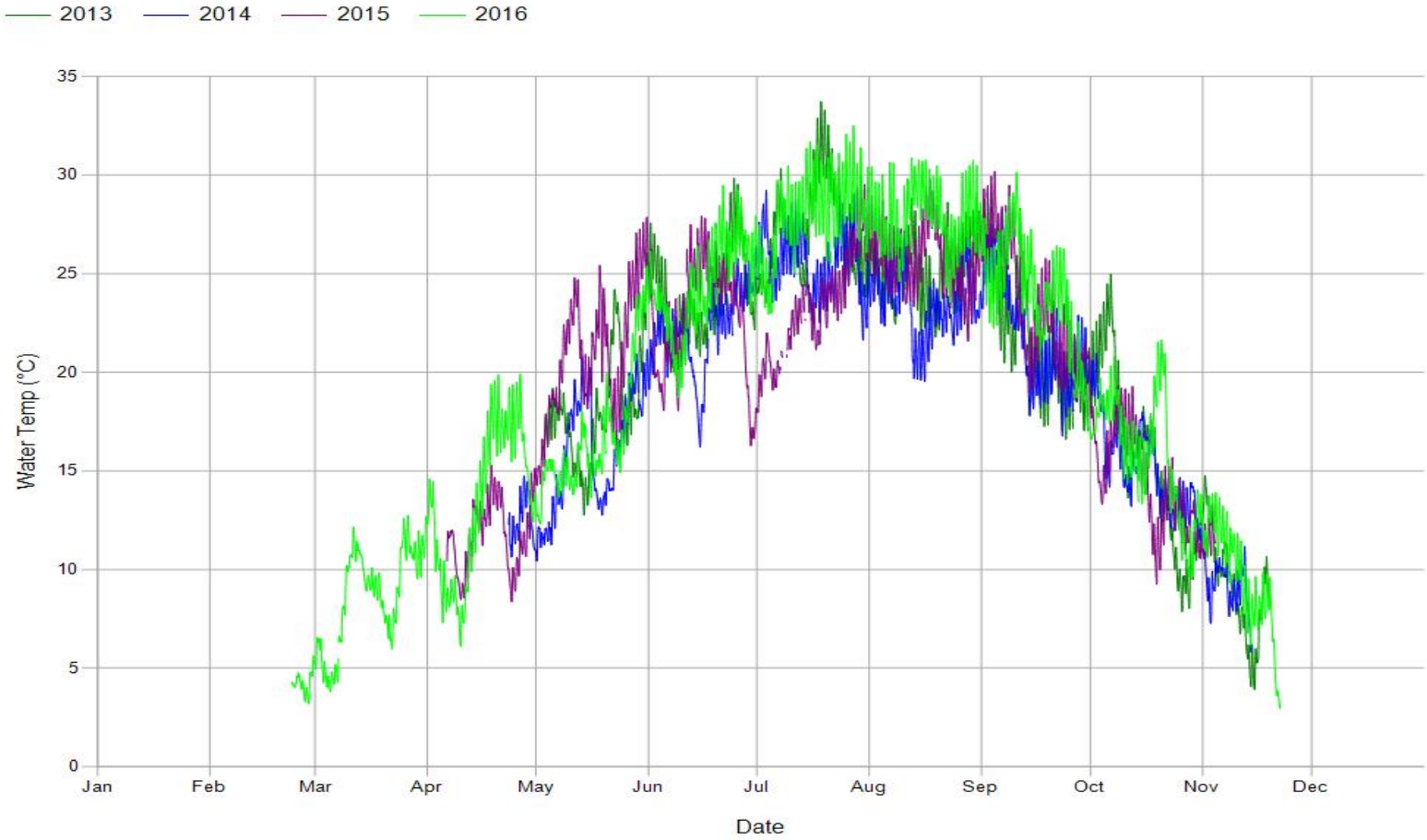
<b>Discharge:</b>	2013	Min: 561 cfs	Average: 3,332 cfs	Max: 34,800 cfs
	2014	Min: 604 cfs	Average: 3,918 cfs	Max: 48,600 cfs
	2015	Min: 661 cfs	Average: 3,439 cfs	Max: 35,000 cfs
	2016	Min: 649 cfs	Average: 2,253 cfs	Max: 19,100 cfs



**Figure 3.** Continuous discharge at USGS station 01567000, Juniata River at Newport, from 2013 to 2016.

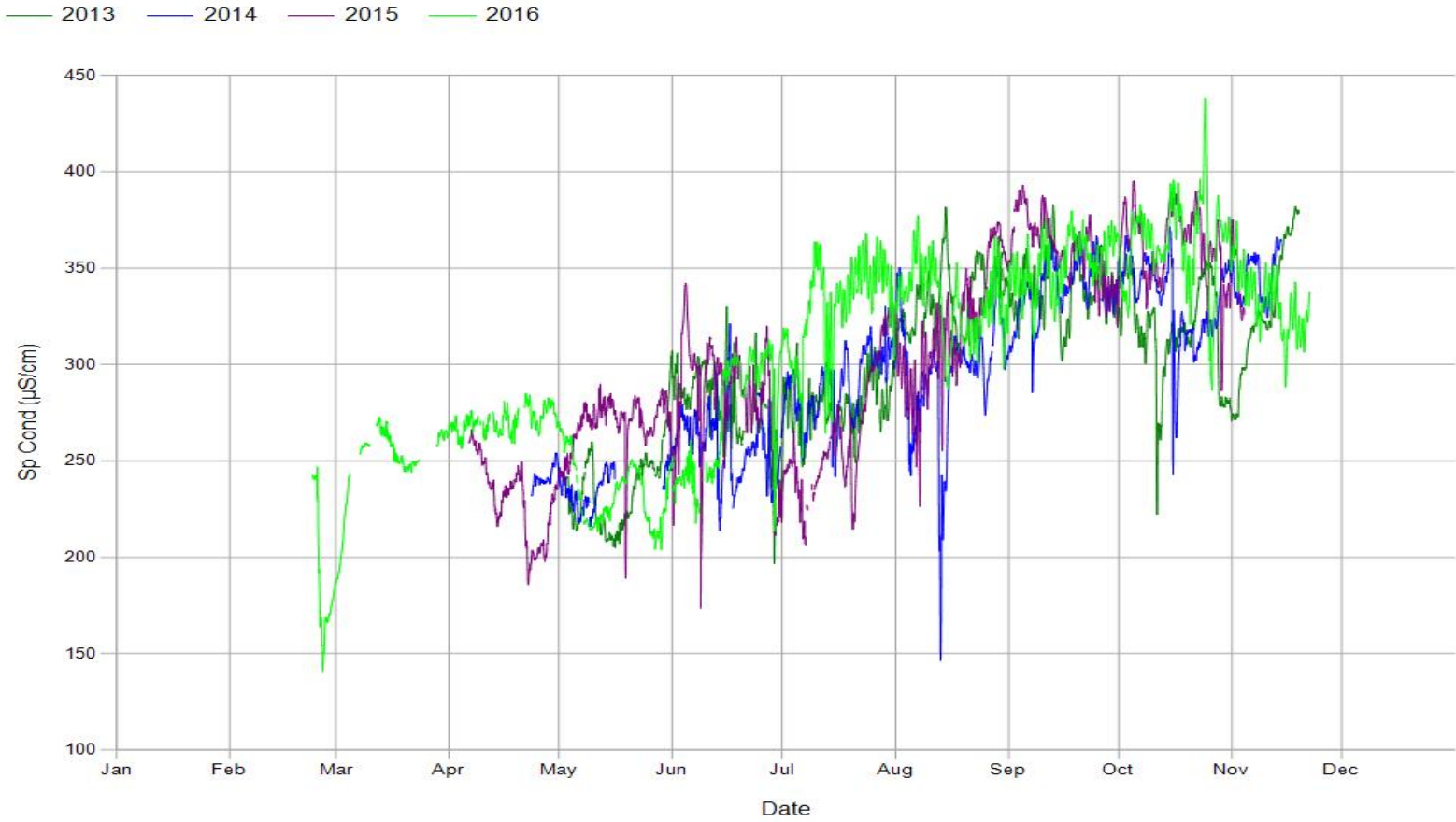


Water Temperature:	2013	Min: 3.91 °C	Average: 20.84 °C	Max: 33.74 °C
	2014	Min: 5.79 °C	Average: 19.63 °C	Max: 29.27 °C
	2015	Min: 8.34 °C	Average: 20.45 °C	Max: 30.26 °C
	2016	Min: 2.95 °C	Average: 18.68 °C	Max: 32.57 °C



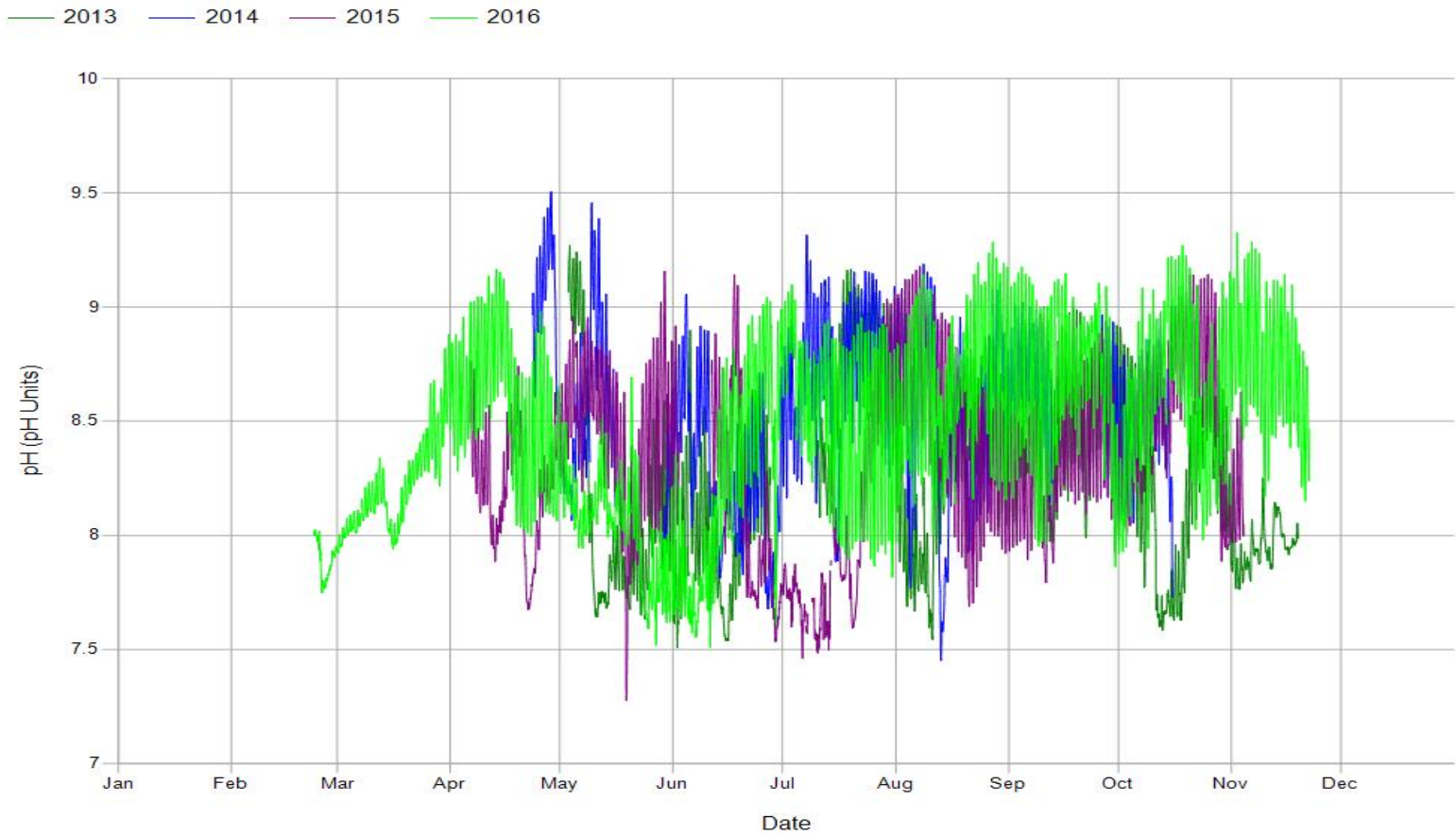
**Figure 4.** Continuous water temperature at DEP's Newport CIM site from 2013 to 2016.

<b>Specific Conductance:</b>	<b>2013</b>	Min: 195.8 $\mu\text{S}/\text{cm}^\circ$	Average: 301.7 $\mu\text{S}/\text{cm}^\circ$	Max: 383.0 $\mu\text{S}/\text{cm}^\circ$
	<b>2014</b>	Min: 145.6 $\mu\text{S}/\text{cm}^\circ$	Average: 297.0 $\mu\text{S}/\text{cm}^\circ$	Max: 371.6 $\mu\text{S}/\text{cm}^\circ$
	<b>2015</b>	Min: 170.5 $\mu\text{S}/\text{cm}^\circ$	Average: 301.2 $\mu\text{S}/\text{cm}^\circ$	Max: 394.9 $\mu\text{S}/\text{cm}^\circ$
	<b>2016</b>	Min: 140.1 $\mu\text{S}/\text{cm}^\circ$	Average: 303.1 $\mu\text{S}/\text{cm}^\circ$	Max: 438.8 $\mu\text{S}/\text{cm}^\circ$



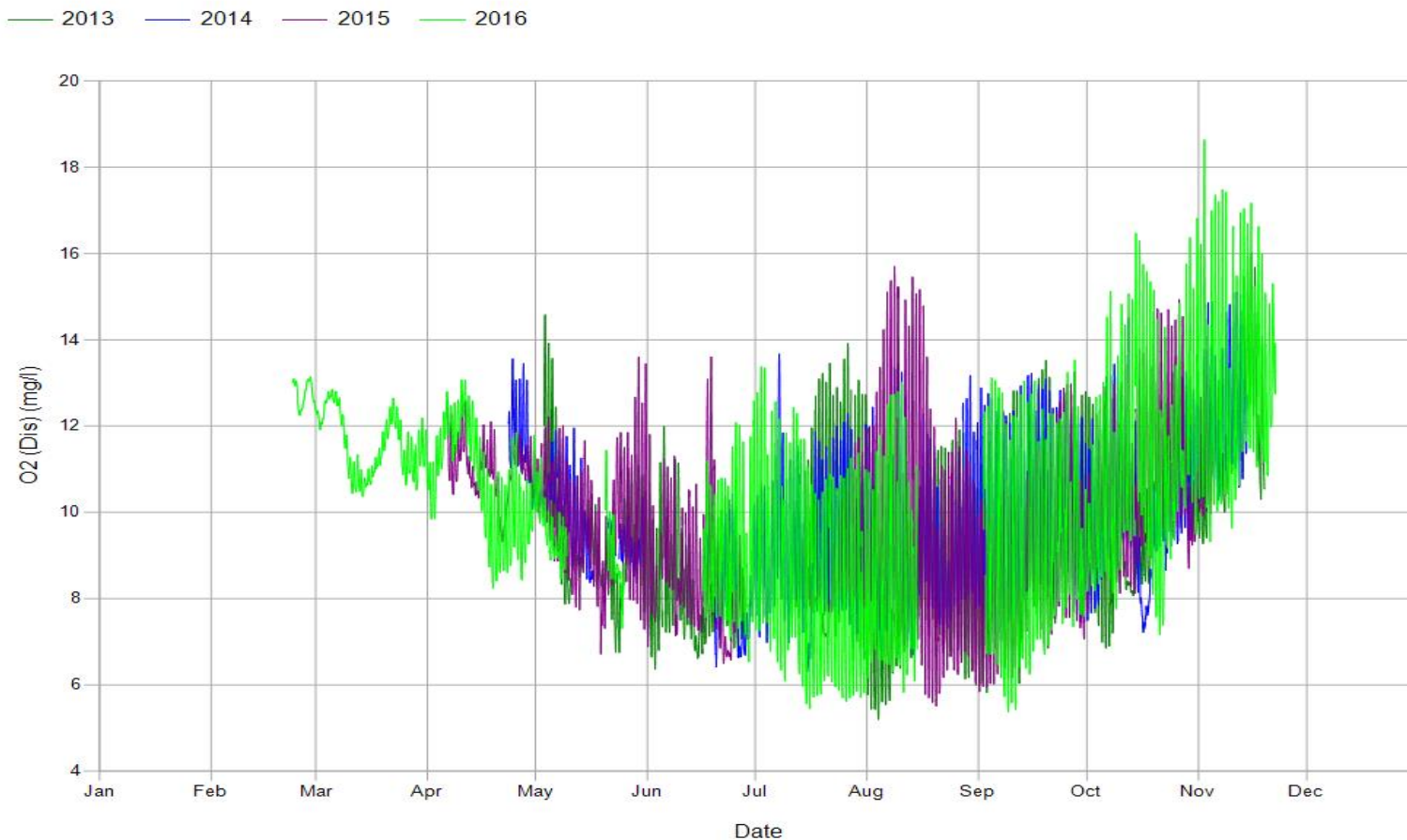
**Figure 5.** Continuous specific conductance at DEP’s Newport CIM site from 2013 to 2016.

pH:	2013	Min: 7.50 SU	Average: 8.27 SU	Max: 9.27 SU
	2014	Min: 7.45 SU	Average: 8.55 SU	Max: 9.50 SU
	2015	Min: 7.27 SU	Average: 8.33 SU	Max: 9.18 SU
	2016	Min: 7.61 SU	Average: 8.52 SU	Max: 9.34 SU



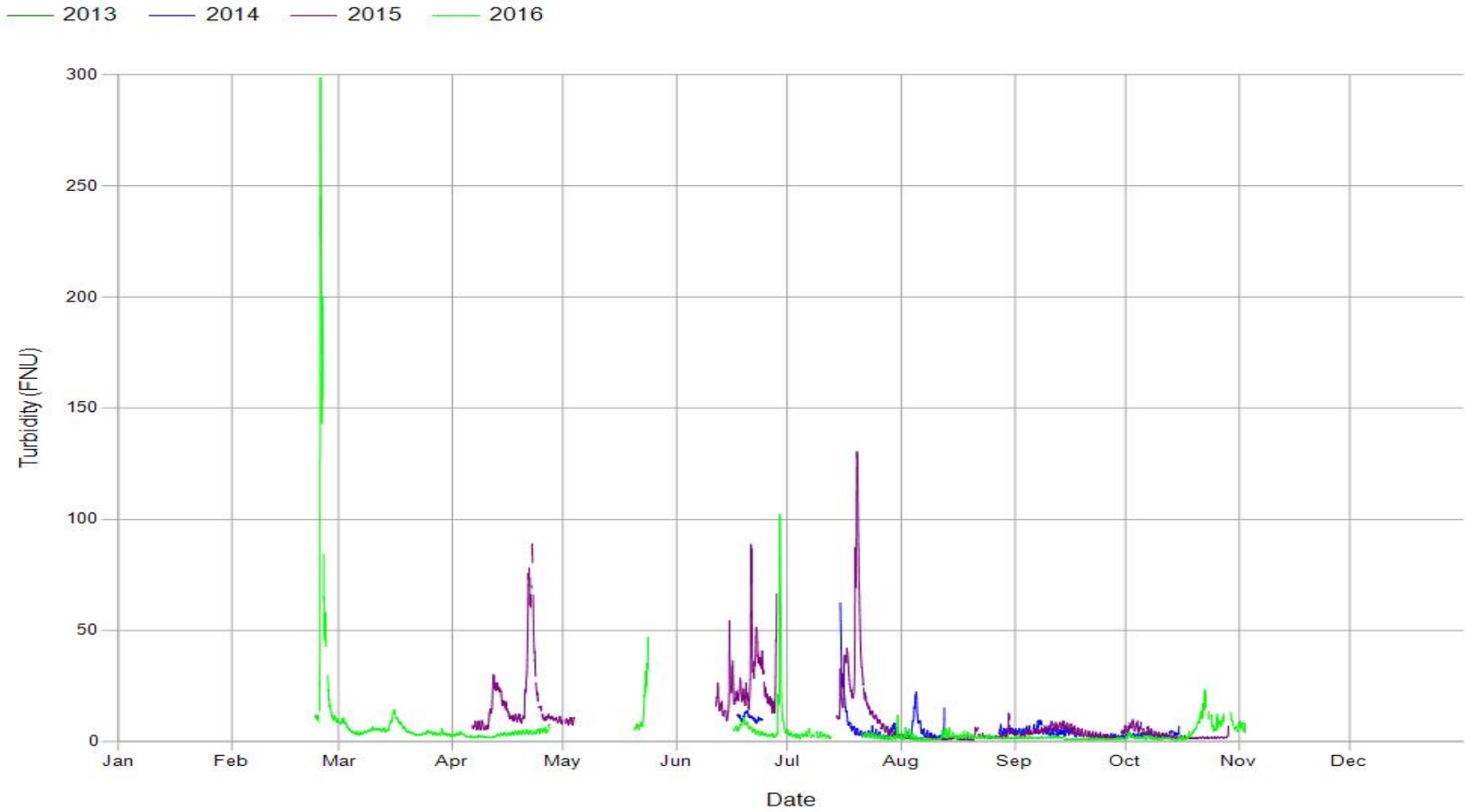
**Figure 6.** Continuous pH measurements at DEP's Newport CIM site from 2013 to 2016.

Dissolved Oxygen:	2013	Min: 5.07 mg/L	Average: 9.48 mg/L	Max: 16.05 mg/L
	2014	Min: 6.28 mg/L	Average: 9.80 mg/L	Max: 15.15 mg/L
	2015	Min: 5.50 mg/L	Average: 9.66 mg/L	Max: 15.75 mg/L
	2016	Min: 5.34 mg/L	Average: 10.38 mg/L	Max: 18.86 mg/L



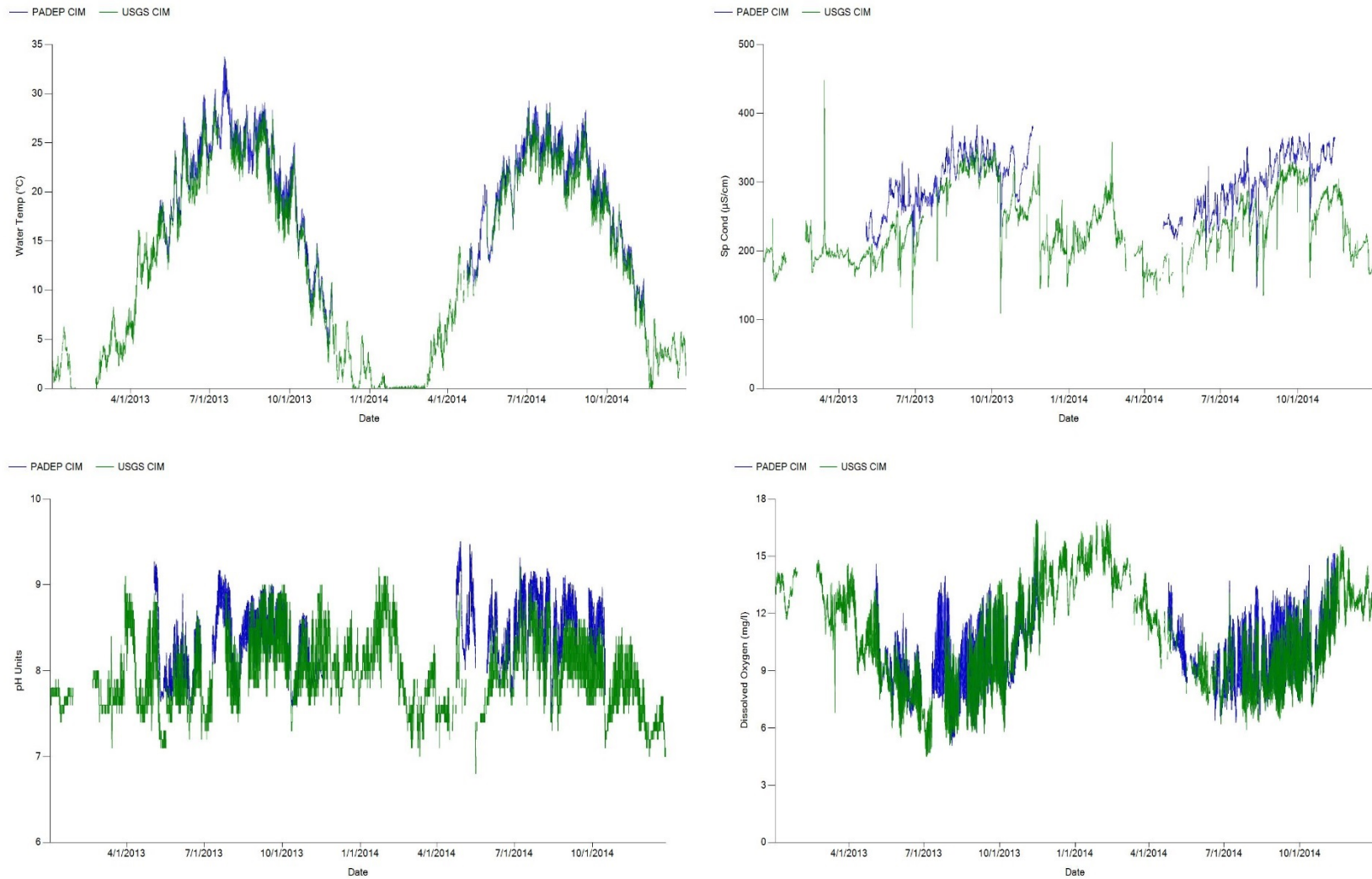
**Figure 7.** Continuous dissolved oxygen at DEP's Newport CIM site from 2013 to 2016.

<b>Turbidity:</b>	2013	No usable data		
	2014	Min: 0.8 FNU	Average: 5.2 FNU	Max: 64.7 FNU
	2015	Min: 0.5 FNU	Average: 10.1 FNU	Max: 133.3 FNU
	2016	Min: 0.1 FNU	Average: 5.1 FNU	Max: 316.9 FNU



**Figure 8.** Continuous turbidity measurements at DEP’s Newport CIM site from 2013 to 2016.

### DEP and USGS Comparison:



**Figure 9.** Temporally overlapping CIM data collected by DEP and USGS from 2013 and 2014 for water temperature, specific conductance, pH, and dissolved oxygen.

**Table 3.** Summary of discrete chemical sample results at the Newport CIM site.

	PARAMETERS	UNITS	JUNIATA RIVER AT NEWPORT			
			n	nd	mean	median
METALS AND IONS	ALUMINUM ACID SOLUBLE	µg/L	10	10	NA	NA
	ALUMINUM D	µg/L	21	14	13	13
	ALUMINUM T	µg/L	36	1	166	86
	BARIUM T	µg/L	37	1	42	42
	BORON T	µg/L	37	26	24	20
	BROMIDE	µg/L	39	15	15.706	14.745
	CADMIUM D	µg/L	15	14	0.260	0.260
	CALCIUM T	mg/L	37	0	29.4	30.2
	CHLORIDE T	mg/L	38	1	21	19
	COPPER D	µg/L	22	22	NA	NA
	COPPER T	µg/L	38	14	1.48	1.25
	IRON D	µg/L	22	6	80	26
	IRON T	µg/L	37	1	277	135
	LEAD D	µg/L	22	22	NA	NA
	LEAD T	µg/L	38	16	0.544	0.464
	LITHIUM D	µg/L	15	15	NA	NA
	LITHIUM T	µg/L	17	17	NA	NA
	MAGNESIUM T	mg/L	37	0	8.9	8.5
	MANGANESE D	µg/L	22	17	13.8	11
	MANGANESE T	µg/L	37	3	29.17647	25.5
	NICKEL D	µg/L	15	15	NA	NA
	NICKEL T	µg/L	37	37	NA	NA
	POTASSIUM T	mg/L	19	1	1.868	1.698
	SELENIUM T	µg/L	38	30	0.797	0.789
	SODIUM T	mg/L	37	1	12.596	11.400
	STRONTIUM T	µg/L	38	1	341	328
	SULFATE T	mg/L	38	1	24.259	23.700
ZINC D	µg/L	22	20	12	12	
ZINC T	µg/L	37	17	10	10	
NUTRIENTS	AMMONIA D	mg/L	37	6	0.034	0.026
	AMMONIA T	mg/L	37	6	0.039	0.030
	NITRATE & NITRITE D	mg/L	37	1	0.936	0.951
	NITRATE & NITRITE T	mg/L	38	1	0.912	0.927
	NITROGEN D	mg/L	22	0	1.291	1.287
	NITROGEN T	mg/L	38	1	1.222	1.246
	ORTHO PHOSPHORUS D	mg/L	37	5	0.017	0.013
	ORTHO PHOSPHORUS T	mg/L	38	5	0.017	0.015
	PHOSPHORUS D	mg/L	38	3	0.022	0.020
PHOSPHORUS T	mg/L	38	1	0.036	0.031	
PHYSICAL/OTHER	ALKALINITY	mg/L	38	0	86.4	87.4
	GLYPHOSATE	µg/L	6	6	NA	NA
	HARDNESS T	mg/L	37	0	110	111
	OSMOTIC PRESSURE	mOsm	22	2	6	4
	pH	SU	38	0	8.41	8.50
	SPECIFIC COND	µS/cm <sup>c</sup>	38	0	281.4	285.5
	SSC - TOTAL	PPM	22	0	7.9	6.3
	SSC - COARSE	PPM	22	0	1.4	1.9
	SSC - FINE	PPM	22	0	6.5	3.7
	TDS	mg/L	37	0	180	176
	TOC	mg/L	36	1	2.507	2.448
TSS	mg/L	37	19	16	13	

Means and medians were calculated from measurements greater than the relevant detection limit.  
n = number of samples. nd = number of non-detects. NA = mean/median not available, all data were non-detect

## **EVALUATION**

The evaluation of CIM data incorporates water quality criteria from 25 Pa. Code § 93.7 and the 99% frequency rule from 25 Pa. Code § 96.3(c) as described in Hoger 2018a. Each reading represents a period of time equal to the recording interval. Because the sondes at this site recorded measurements every 30 minutes, 176 exceedances measured over a 365-day period constitutes a percentage greater than 1% (176 x 30 minutes = 5,280 minutes or 1.004% of a year). The evaluations in this report include 99% frequency rule calculations but do not include protected use assessment determinations.

### **Annual Variation and Critical Conditions**

A major determinant of variation in water quality is the amount, timing, and location of precipitation in the watershed upstream of a site. Elevated precipitation will result in increased surface water discharge, which can moderate some instream conditions stressful for certain forms of aquatic life. In past surveys, DEP has documented that elevated discharge can reduce the magnitudes of daily fluctuations of DO, pH, and temperature, and can increase daily minimum DO and decrease daily maximum pH and temperature.

Average annual discharge of the Juniata River at Newport was similar across 2013, 2014, and 2015, with 2014 exhibiting the highest annual average and maximum flow (Figure 3). The annual average and maximum discharge at Newport were markedly lower in 2016 compared to the preceding three years (Figure 3). The frequency of higher-flow events was much greater in 2014 and 2015 than in the other two years (Figure 3).

### **Cross-Sectional Surveys**

Transect survey data indicate relatively homogenous, well-mixed conditions across most of the width of the Juniata River at Newport during most cross-section surveys (Figure 3). However, significant cross-sectional differences in water quality were most common along both banks, with lower temperature, lower specific conductance, and higher turbidity observed during several transect surveys (Figure 3). The differences observed along the right descending bank are largely attributable to the confluence of Buffalo Creek 1.4 km upstream, with Wildcat Run (3.7 km) and Cocolamus Creek (6.8 km) influencing the left descending bank. The transects show that location of the USGS sonde (NEW1) is heavily influenced by Buffalo Creek. The DEP sonde location (NEW11.5) was found to have water quality consistent with most of the width of the river (NEW3 to NEW12)

One DO cross-section survey stands out, with significantly reduced DO relative to the sonde location through most of the transect. This survey was completed in the morning on September 14, 2016 during an extended period of low flows (Figure 3). Early morning is the time of day when daily low DO typically occurs.



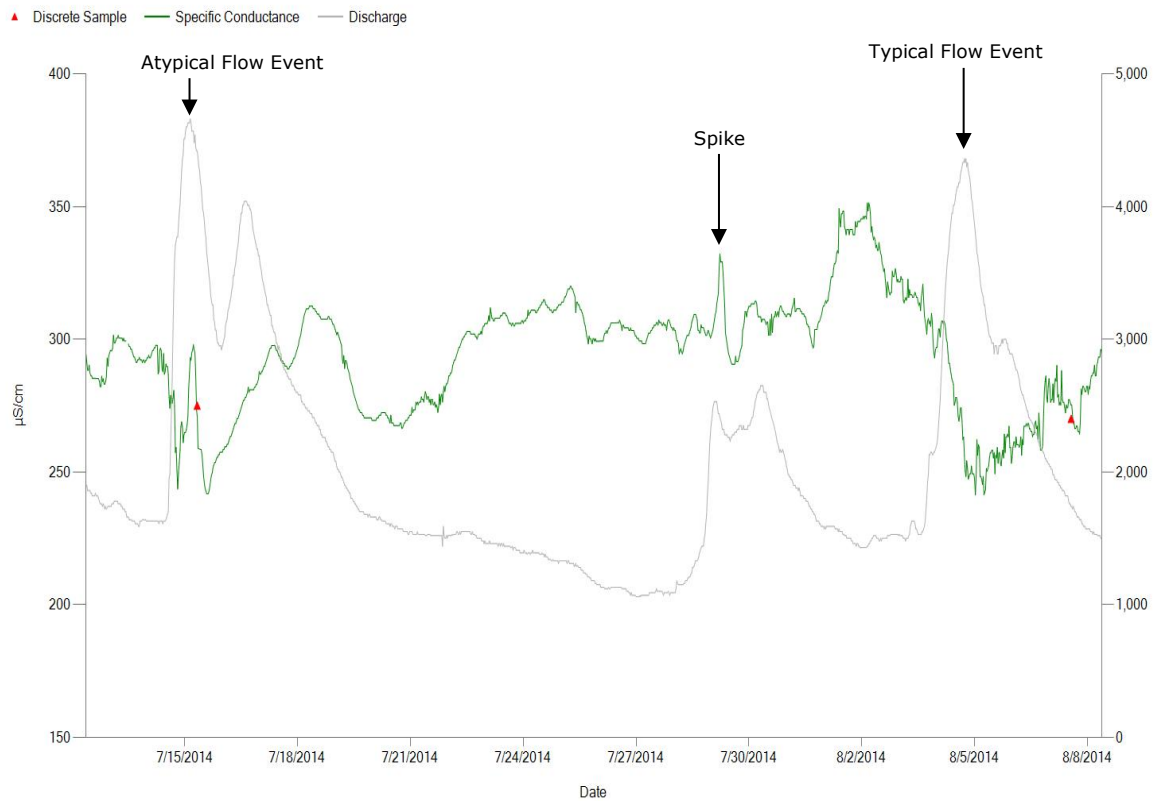
### **CIM, Temperature**

The highest annual maximum water temperatures during this period of record occurred in July of 2013 and 2016 (Figure 4). The 2013 high of over 33°C and the 2016 high of over 32°C were both more than 2°C higher than the other years. Consistently higher temperatures were observed in May of 2015 than other years, but temperatures in late June and early July of 2015 were lower than other years.

The water temperatures measured by the USGS sonde deployed close to the right descending bank generally were slightly lower than the water temperatures measured by the DEP sonde (Figure 9) deployed further out in the river channel (Figure 1). The annual maximum water temperature at the USGS station was 29.6°C in 2013 and 28.6°C in 2014 (Figure 9), whereas the annual maximum water temperature recorded in the DEP CIM data was 33.7°C in 2013 and 29.3°C in 2014 (Figures 4 and 9). These cross-sectional temperature differences were also observed in the transect survey data collected by DEP (Figure 2). As mentioned above, the USGS sonde location is heavily influenced by Buffalo Creek which has a designated use of High Quality – Cold Water Fishes.

### **CIM, Specific Conductance**

Specific conductance measurements were relatively consistent year to year (Figure 5). The highest annual maximum specific conductance occurred in 2016, but annual average specific conductance was similar all four years (Figure 5). Specific conductance exhibited the typical inverse relationship with flow during much of this period of record, but the CIM data recorded some instances where specific conductance measurements spiked near the crest of a higher-flow event or during the subsequent descending limb (Figure 10). This atypical response of specific conductance to higher-flow events occurred most frequently in 2014.



**Figure 10.** Example of specific conductance response to changing discharge. Period July 12, 2014 to August 8, 2014 shows a typical response, atypical response and spike in measurements as it is attributed to discharge.

The DEP specific conductance data collected in-channel were typically slightly higher than the USGS data collected near the bank (Figure 9). The annual average specific conductance at the USGS station was 261  $\mu\text{S}/\text{cm}^\circ$  in 2013 and 254  $\mu\text{S}/\text{cm}^\circ$  in 2014 (Figure 9), whereas the annual average specific conductance at the PADEP CIM site was 302  $\mu\text{S}/\text{cm}^\circ$  in 2013 and 297  $\mu\text{S}/\text{cm}^\circ$  in 2014 (Figures 5 and 9). These cross-sectional differences in specific conductance were also observed in the transect survey data collected by DEP (Figure 2).

### CIM, pH

Continuous data documented exceedances of the pH maximum criterion maximum (9.0) at a frequency greater than 1% of each year (Table 4). The greatest number of exceedances for a rolling 365-day period during the period of record was 1,022 from November 18, 2015 to November 17, 2016, representing an exceedance frequency of 5.8% (Figure 6, Table 4). In 2013 and 2014, most exceedances of the pH criterion occurred in July, whereas in 2015 and 2016 most exceedances occurred in August (Figure 6). Other months with relatively large numbers of exceedances included May 2013, April 2014, October 2015, and September through November 2016. No pH values were recorded less than the criterion minimum of 6.0, and annual minimum pH values were similar each year (Figure 6). A consistent diel pH pattern was observed

with daily pH maxima occurring during the mid- to late afternoon as photosynthetic activity peaked and daily pH minima occurring before dawn as respiratory activity peaked (Figure 6).

**Table 4.** Annual exceedances of pH water quality criteria.

Year	pH Exceedance	
	No.	%
2013	276	1.58
2014	764	4.36
2015	319	1.82
2016	1022	5.83
rolling year	1022	5.83

Percent calculations are percentages of each year.

Red text indicates > 1% exceedance frequency.

In-channel pH measurements recorded by the DEP sonde were consistently higher than measurements taken near the bank by the USGS sonde (Figure 9). Annual average pH at the USGS site was 8.0 in 2013 and 7.9 in 2014 whereas annual average pH at the DEP CIM site was 8.3 in 2013 and 8.5 in 2014 (Figures 6 and 9). The transects also showed consistently lower pH along the right descending bank as well, however, the difference rarely surpassed the 0.5 unit threshold of significance (Figure 2).

### **CIM, Dissolved Oxygen**

Continuous DO data recorded no exceedances of the WWF minimum DO criterion of 5.0 mg/L. Each year, the greatest diel swings in DO were observed during baseflow conditions with the largest magnitudes of daily DO fluctuations observed in 2015 and 2016 (Figure 7). Annual average and maximum DO were also notably higher in 2016 than in other years (Figure 7).

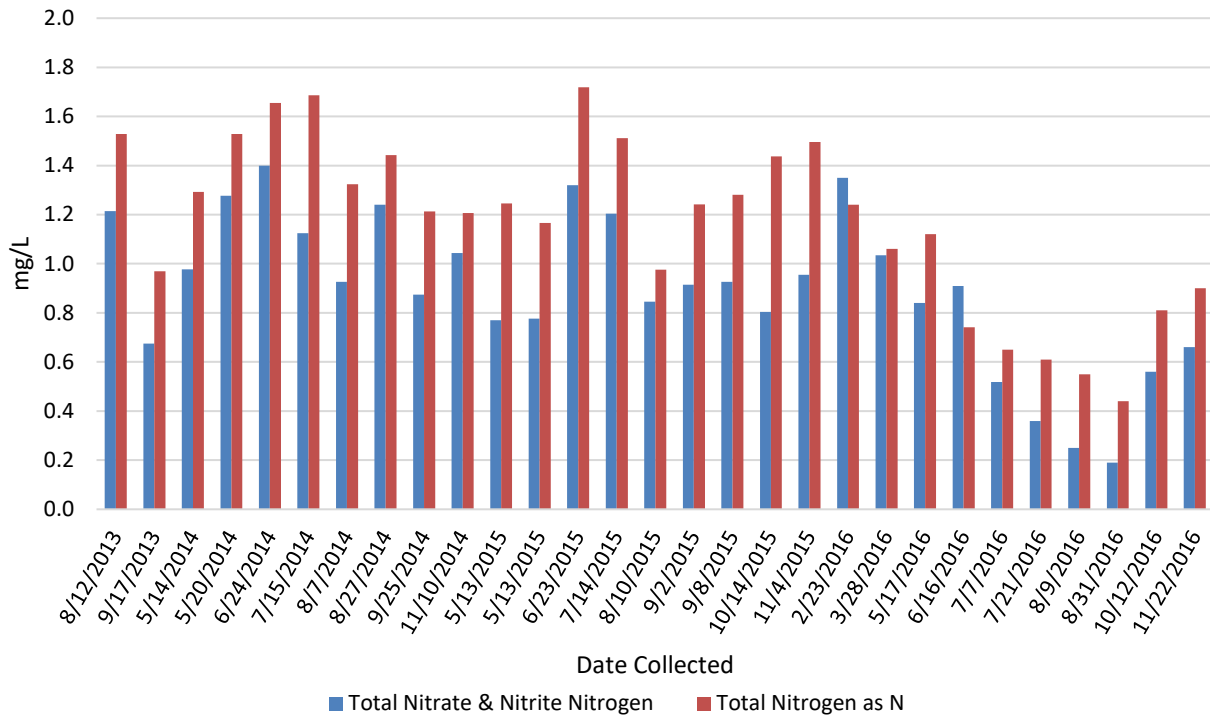
The relationship between the DO measurements at the DEP and USGS sites varied. The annual averages of DO were higher at the USGS station (10.6 mg/L in 2013 and 11.1 mg/L in 2014) than at the DEP CIM site (9.5 mg/L in 2013 and 9.8 mg/L in 2014); however, Figure 9 shows frequent occurrences of higher DO at the DEP site. The transect data (Figure 2) were also variable, with DO at the USGS site (NEW1) sometimes being higher and sometimes lower than the DEP site (NEW11.5).

### **CIM, Turbidity**

Much of the turbidity data for the Juniata River at Newport – including all of the 2013 turbidity data and about half of the 2014 turbidity data – was graded as unusable due to extreme fouling issues with the sonde. The usable turbidity data generally showed the typical relationship with flow, with increased turbidity measurements occurring during higher-flow events and low turbidity measurements coinciding with baseflow conditions (Figures 3 and 8). However, during baseflow conditions from mid-September to early October, turbidity measurements were somewhat higher in 2015 compared with 2014 and 2016 (Figures 3 and 8).

## Discrete Water Chemistry Sampling

Results from chemical analyses of the grab samples (Table 3) are consistent with the CIM data. The concentrations of most metals were fairly consistent across samples, except for iron, magnesium, and manganese, which exhibited greater variability in concentrations sample to sample. In addition, aluminum and iron were measured at higher concentrations in samples taken during elevated discharge conditions. Nitrogen analytes, with the exception of ammonia, showed a marked decline in concentrations beginning in early 2016 (Figure 11).



**Figure 11.** Nitrogen analyte concentrations from grab samples over the period of record.

## **SUMMARY**

CIM data collected from the Juniata River at Newport documented exceedances of the maximum pH criterion at a frequency greater than 1% of the year each year from 2013 to 2016 (Figure 6, Table 4). However, all measurements of DO were above the WWF minimum water quality criterion. Exceedances of the maximum pH criterion occurred most frequently in the months of July and August. In 2016, when there was an extended period of low flow during the summer and early fall, regular pH exceedances continued until mid-November.

The chemical grab sample data documented relatively consistent water chemistry throughout the period of record, except for the notable reductions in nitrogen concentrations in 2016 (Figure 11).

The importance of collecting cross-section transect data is demonstrated in this report, as significant differences in water quality were observed on either bank of the Juniata River at Newport compared to those observed in-channel. Contributing to these differences is the complexity of tributary mixing in a large river system like the Juniata River. Tributary influences at this location (Buffalo Creek on the right descending bank and Wildcat Run and Cocolamus Creek on the left descending bank) impacted water quality along both sides of the river. Data show that deploying a water quality sonde near a bank may only provide data representative of a small segment of the width and volume of the stream. Water quality will continue to be monitored at the DEP site to further characterize long-term trends.

## **LITERATURE CITED**

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