pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF CLEAN WATER

Continuous Instream Monitoring Report (CIMR)

Most recent revision: 2/6/2017
Revised by: Lorson

STATION DESCRIPTION

STREAM CODE: 41420
STREAM NAME: Dunkard Creek
PA DEP SITE CODE: 99418732-001
USGS Station #: 03072000
SITE NAME: Dunkard Creek at Shannopin, Pa

COUNTY: Greene

LATITUDE: 39.7607 **LONGITUDE:** -79.9727

LOCATION DESCRIPTION: 3.5 mi upstream from mouth at the Bobtown Hill Road bridge near Bobtown, PA.

HUC: 05020005

DRAINAGE AREA: 229 sq. miles

BACKGROUND AND HISTORY: Dunkard Creek is a freestone tributary to the Monongahela River within Dunkard Township, Greene County (Figure 1). The basin is within the Appalachian Plateau Geologic Province with characteristic topography and land use 78% forested, 21% agriculture, and 1% urban. Property managed for public use as Pennsylvania State Game Lands (numbers 179 and 223) comprises 6% of the basin. Dunkard Creek has a designated use of Warm Water Fishes (WWF). Continuous Instream Monitoring (CIM) on Dunkard Creek is funded by the Department's Water Quality Network (WQN) and maintained by the United States Geological Survey (USGS) in an effort to establish a long-term dataset that will supplement ongoing surface water assessments of the basin. The Department's WQN Station # 0714 (WQN0714) has been active since the 1950's. In 2010 additional water quality parameters were added and the frequency of sampling was increased to monthly. CIM was implemented at WQN0714 beginning in 2013 in response to ongoing mine discharge abatement efforts as well as an increase in active oil, gas, and coal mining activities. The primary objective of this assessment is to evaluate the appropriateness and utility of the CIM monitor and associated data. In addition, CIM data was evaluated to characterize baseline water temperature, specific conductance, and pH conditions; and water quality data collected by the Department's Bureau of Clean Water, Monitoring Section are also summarized.

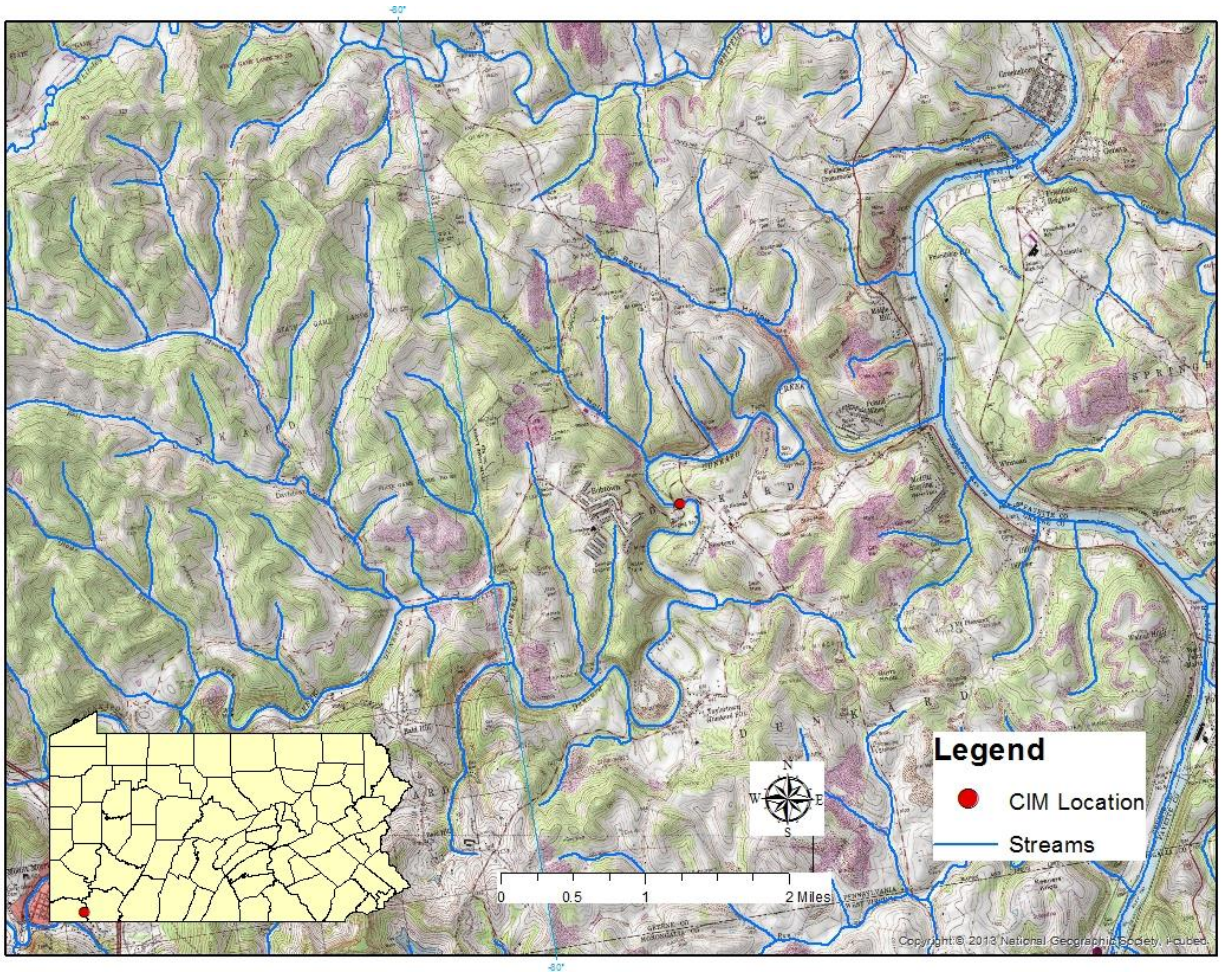

Figure 1. Dunkard Creek at Shannopin CIM location.

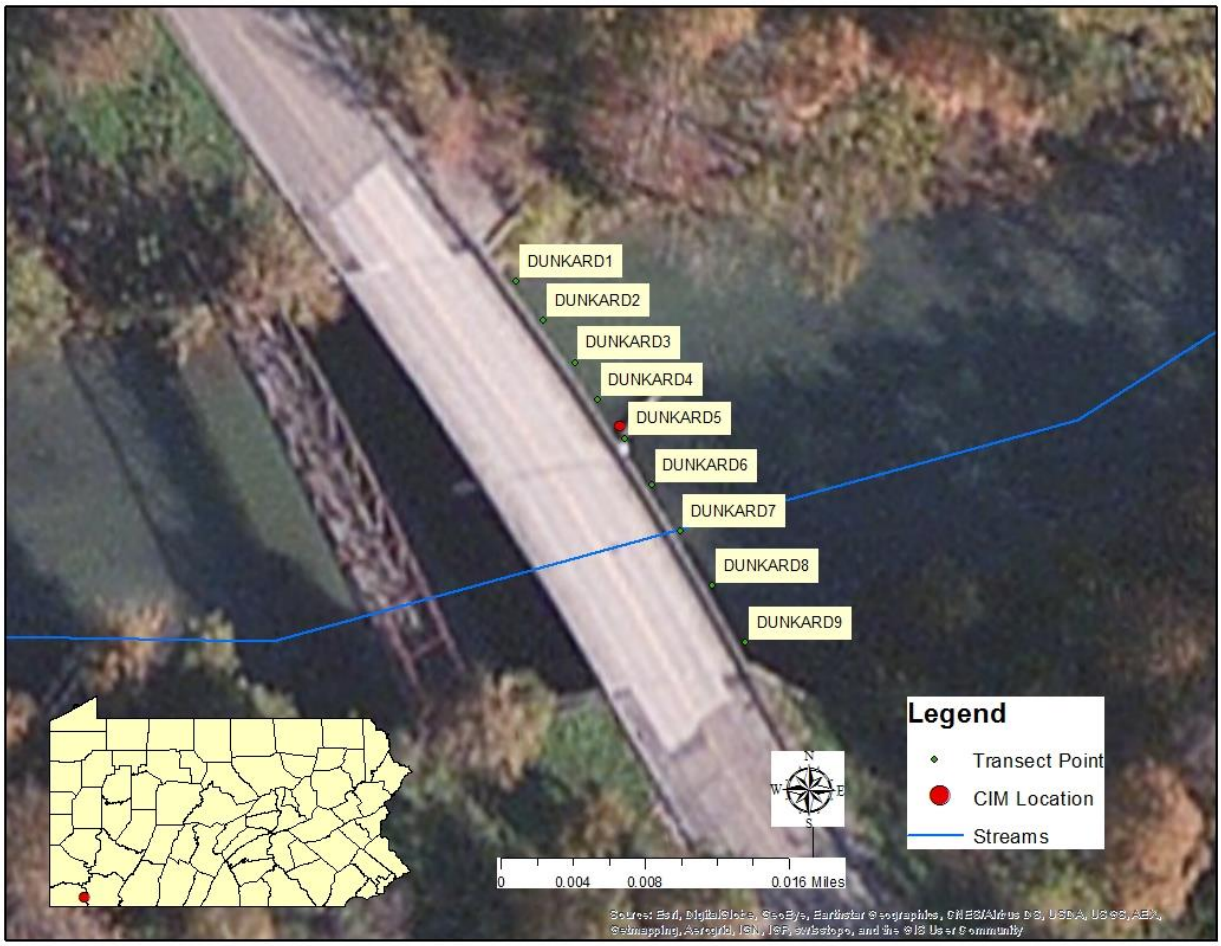

Figure 2. Transect point locations on Dunkard Creek at Shannopin (Bobtown Hill Road).

WATER QUALITY PARAMETERS:

Parameter	Units
Water Temperature	°C
Specific Conductance (@25°C)	µS/cm[c]
pH	standard units

PERIOD OF RECORD: October 1, 2013 to November 15, 2015

DATA

CIM: CIM equipment maintenance, data collection and data maintenance was completed by USGS personnel according to *Guidelines and standard procedures for continuous water quality monitors* (Wagner et al. 2006).

Discrete Water Quality Transect: A transect across the width of the stream was established to characterize water quality and to determine if data collected by the sonde is representative of the surface water as a whole. Discrete water quality measurements were taken at nine points across the stream including the right descending bank, left descending bank, and seven equidistant points approximately five meters apart (Figure 2.) Transects were conducted eight times throughout the sampling period.

Additional Field Data: Data was collected in 2014 during the Department's routine monitoring and assessment activities on the lower portion of the Dunkard Creek basin. Additional data includes field parameter readings, macroinvertebrate data, discrete water chemistry samples, and habitat assessments.

Discharge: Discharge data was provided by the USGS from station #03072000. Discharge data are used to aid in interpretation of changes in other water quality parameters.

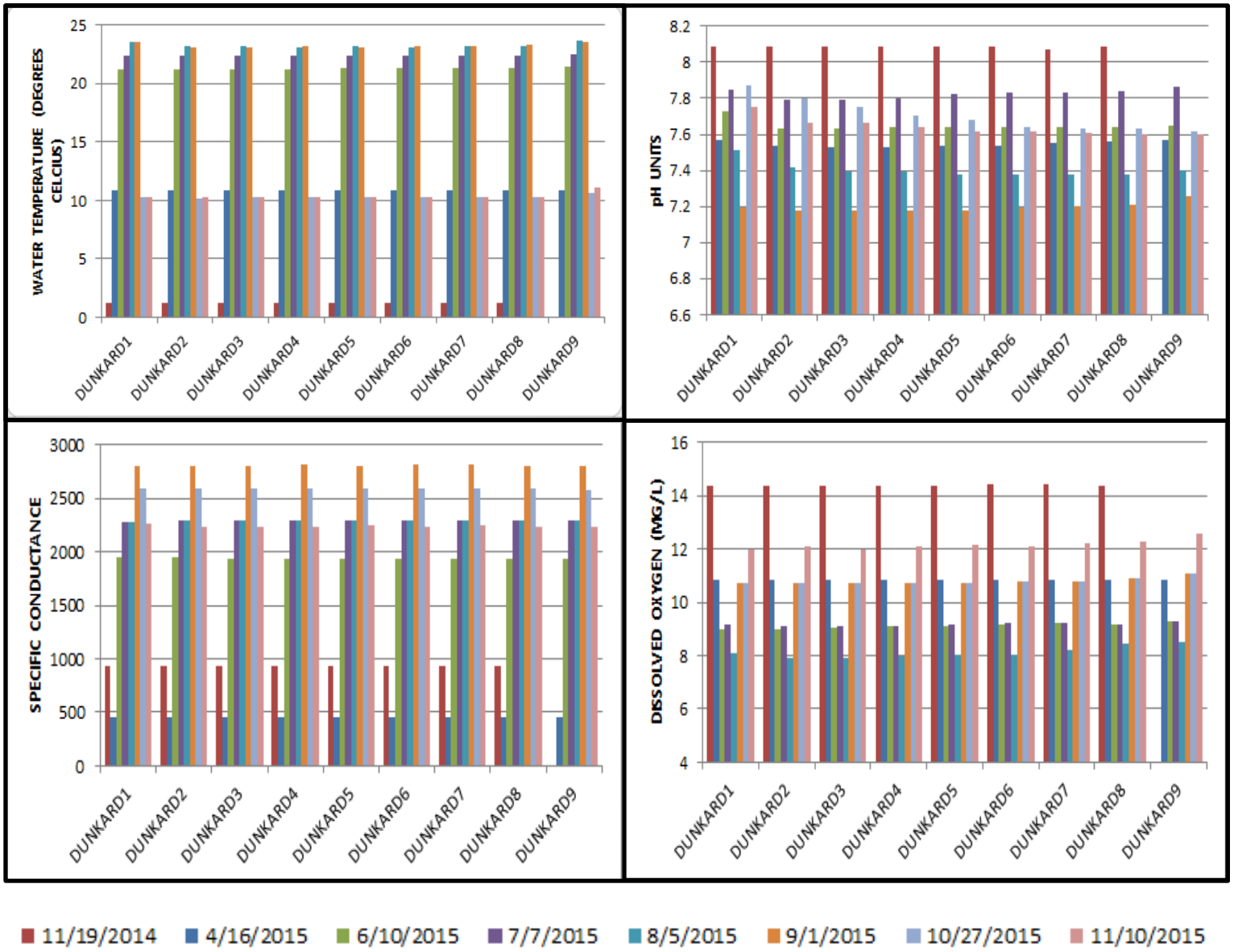

Figure 3. Discrete water quality transect data at Shannopin.

Specific Conductance:
2013 Statistics - Average: 1429 µS/cm; Maximum: 2310 µS/cm; Minimum: 279 µS/cm.
2014 Statistics - Average: 1481 µS/cm; Maximum: 3390 µS/cm; Minimum: 179 µS/cm.
2015 Statistics - Average: 1565 µS/cm; Maximum: 3430 µS/cm; Minimum: 298 µS/cm.

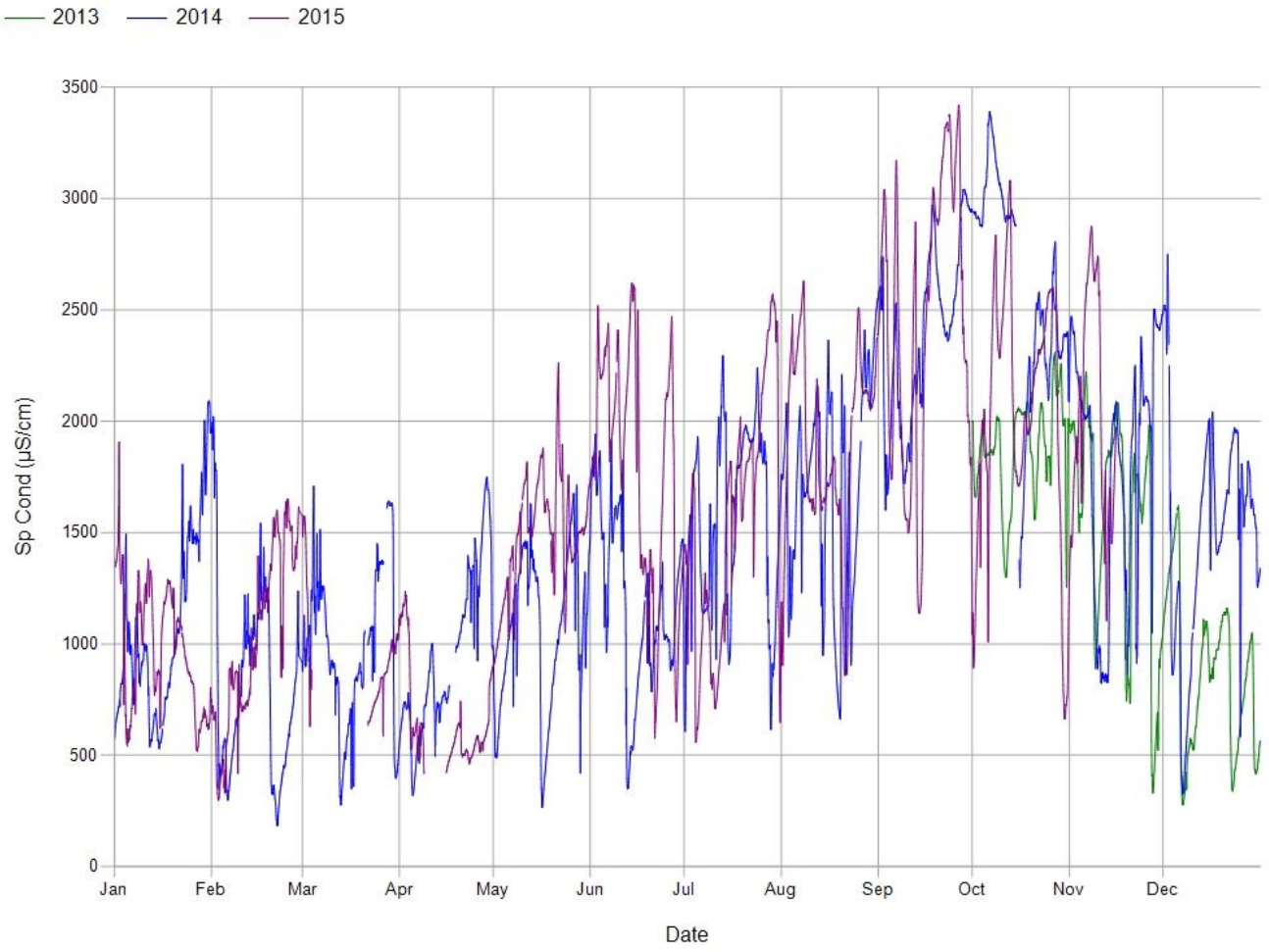

Figure 4. Continuous specific conductance from October 1, 2013 to November 15, 2015.

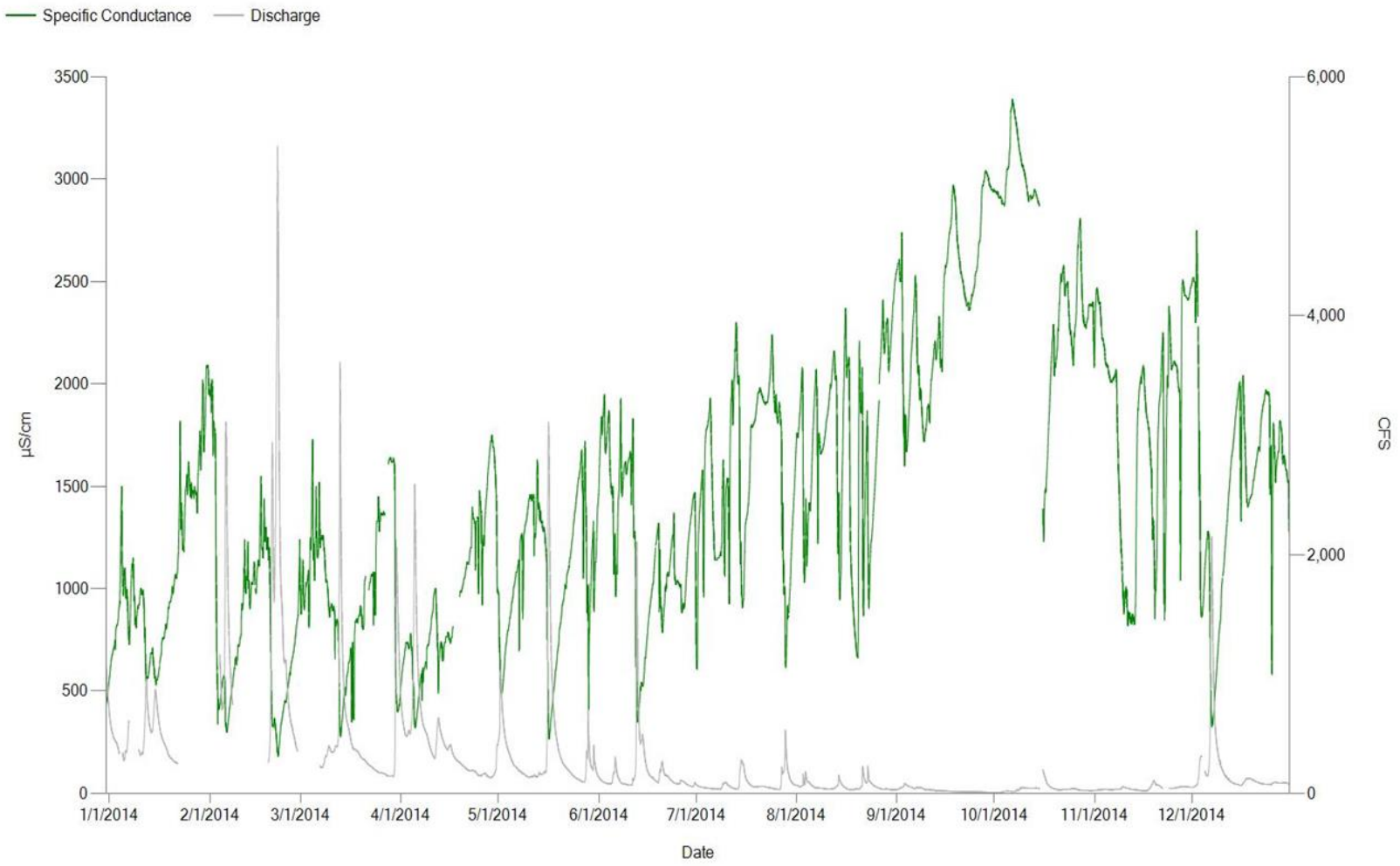

Figure 5. Continuous specific conductance from January 1, 2014 to December 31, 2014 illustrating depressed readings in response to elevated discharge events.

pH:
2013 Statistics - Average: 7.6 units; Maximum: 8.2 units; Minimum: 6.6 units.
2014 Statistics - Average: 7.8 units; Maximum: 8.7 units; Minimum: 7.2 units.
2015 Statistics - Average: 7.7 units; Maximum: 8.6 units; Minimum: 6.6 units.

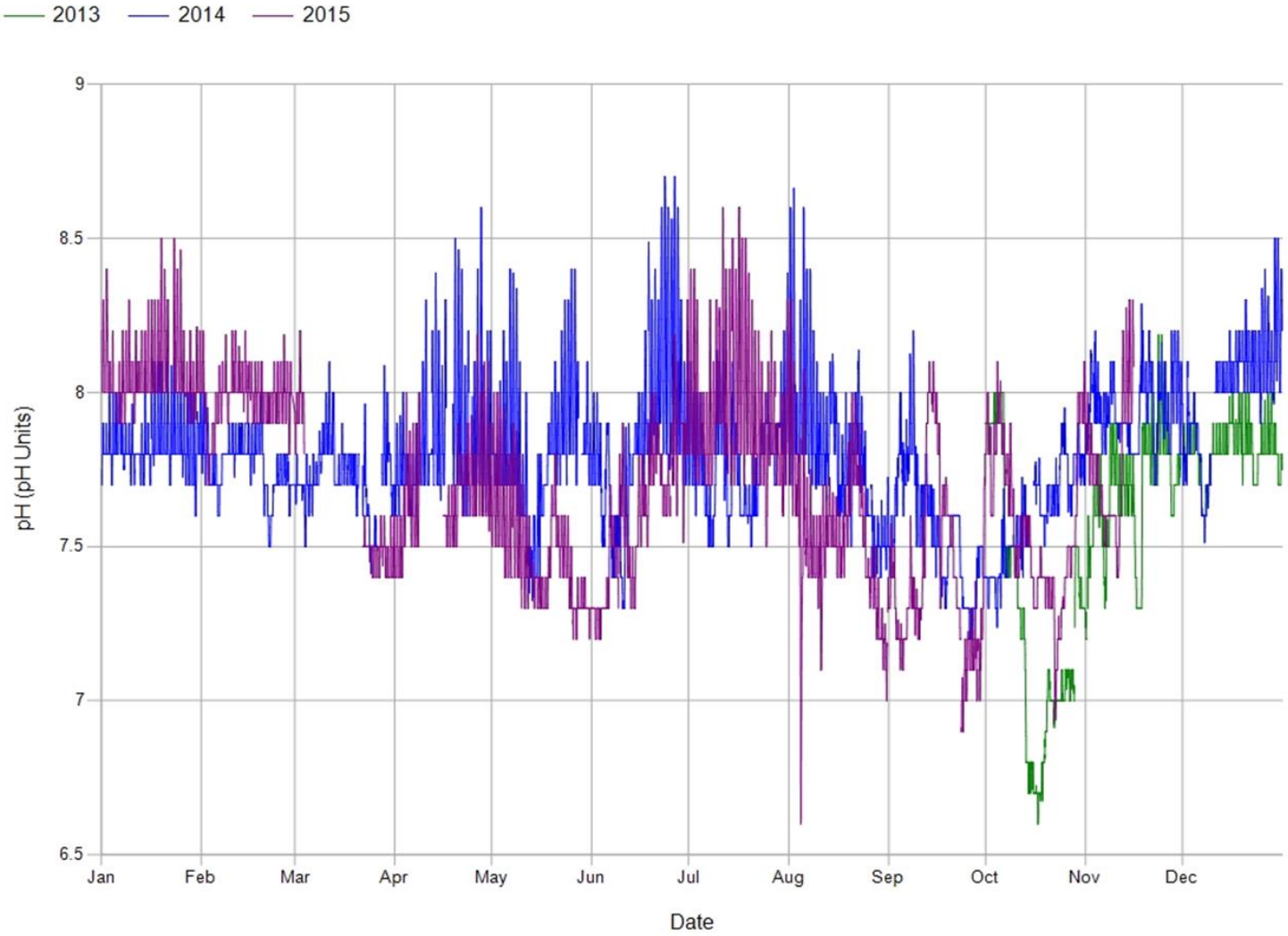

Figure 6. Continuous pH from October 1, 2013 to November 15, 2015.

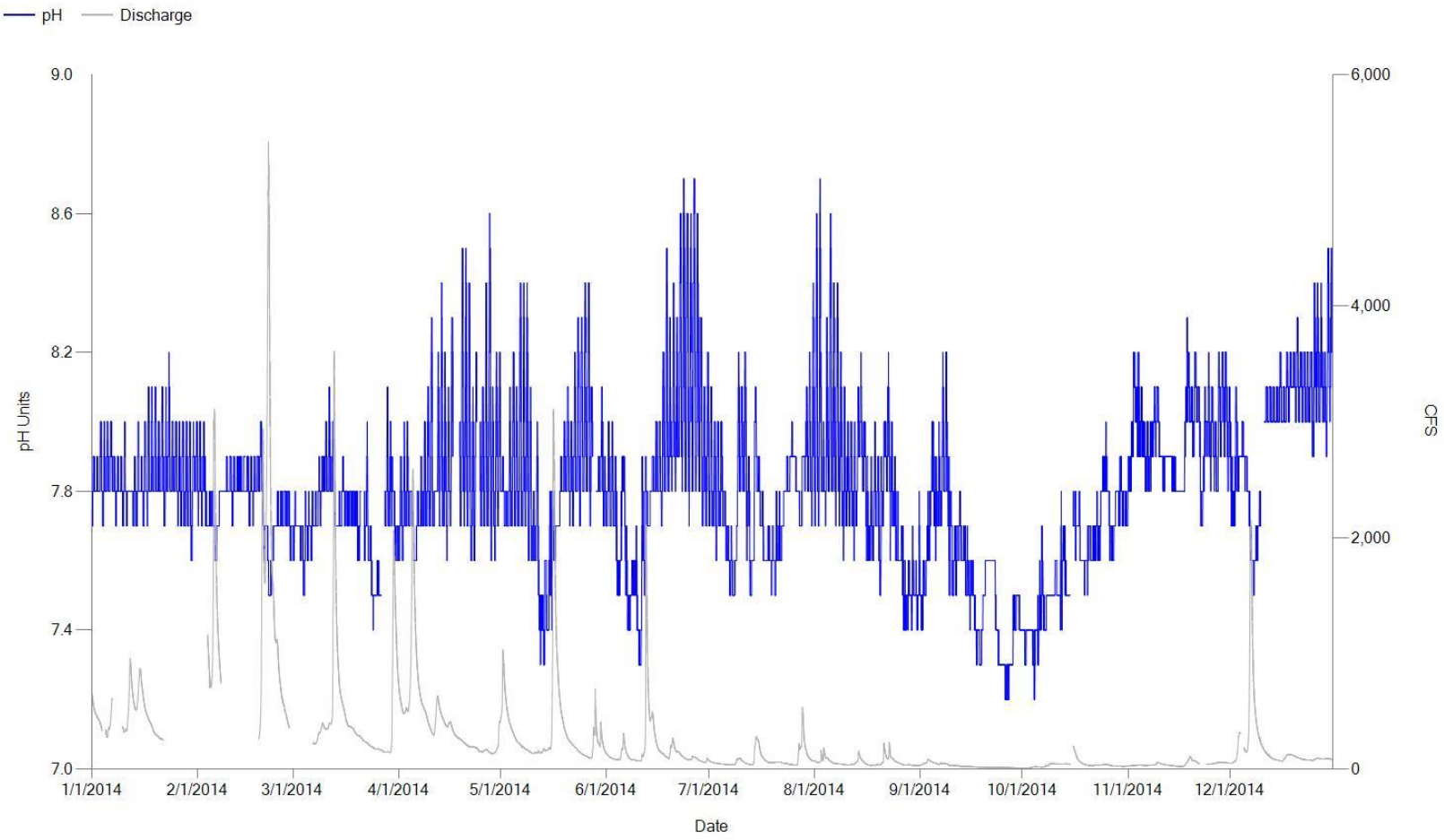

Figure 7. Continuous pH measurements from January 1, 2014 to December 31, 2014 showing the response to elevated discharge events.

Water Temperature:
2013 Statistics - Average: 8.5°C; Maximum: 22.3°C; Minimum: 0.6°C.
2014 Statistics - Average: 12.7°C; Maximum: 28.7°C; Minimum: -0.1°C.
2015 Statistics - Average: 13.1°C; Maximum: 30.0°C; Minimum: -0.2°C.

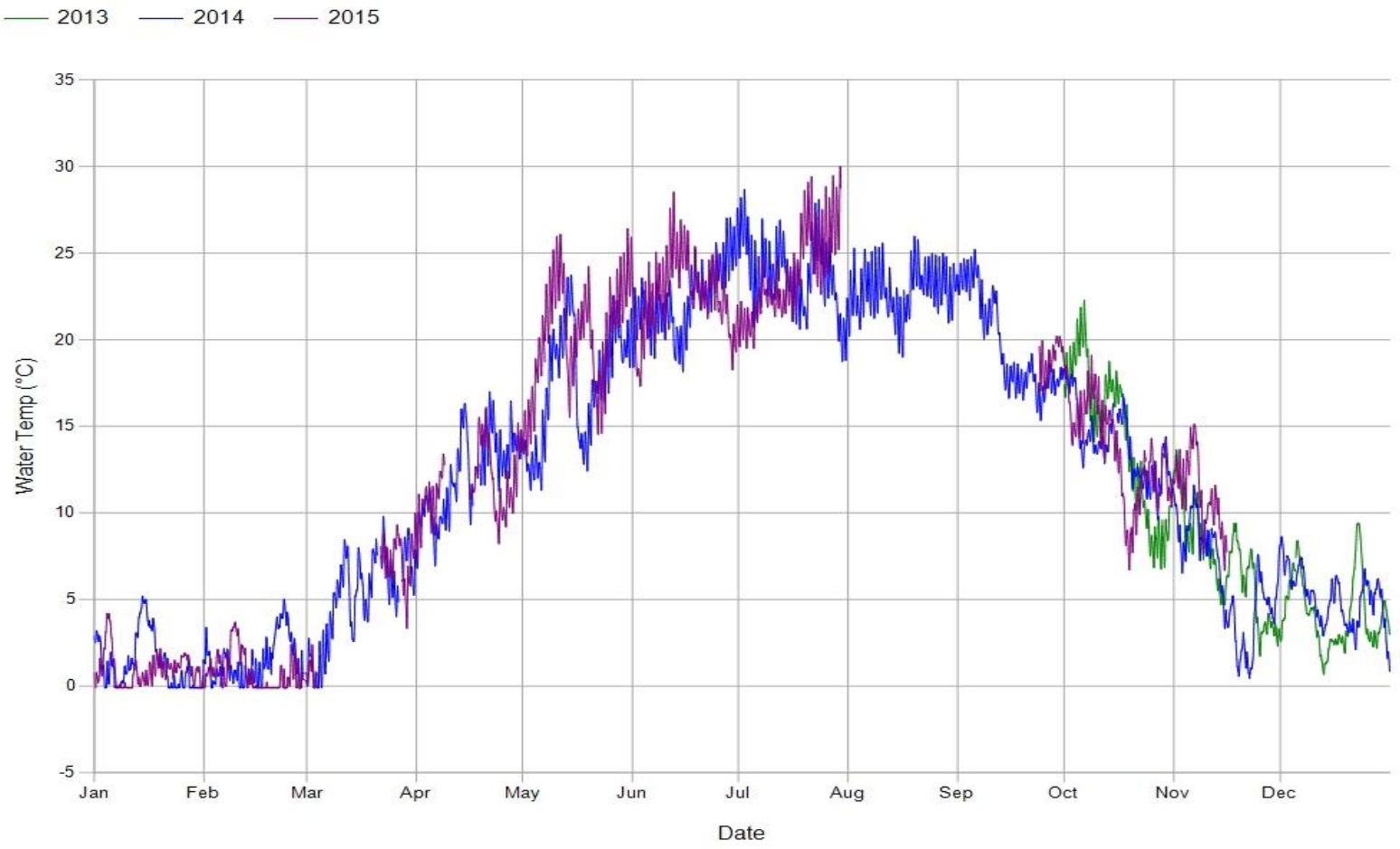

Figure 8. Continuous water temperature from October 1, 2013 to November 15, 2015.

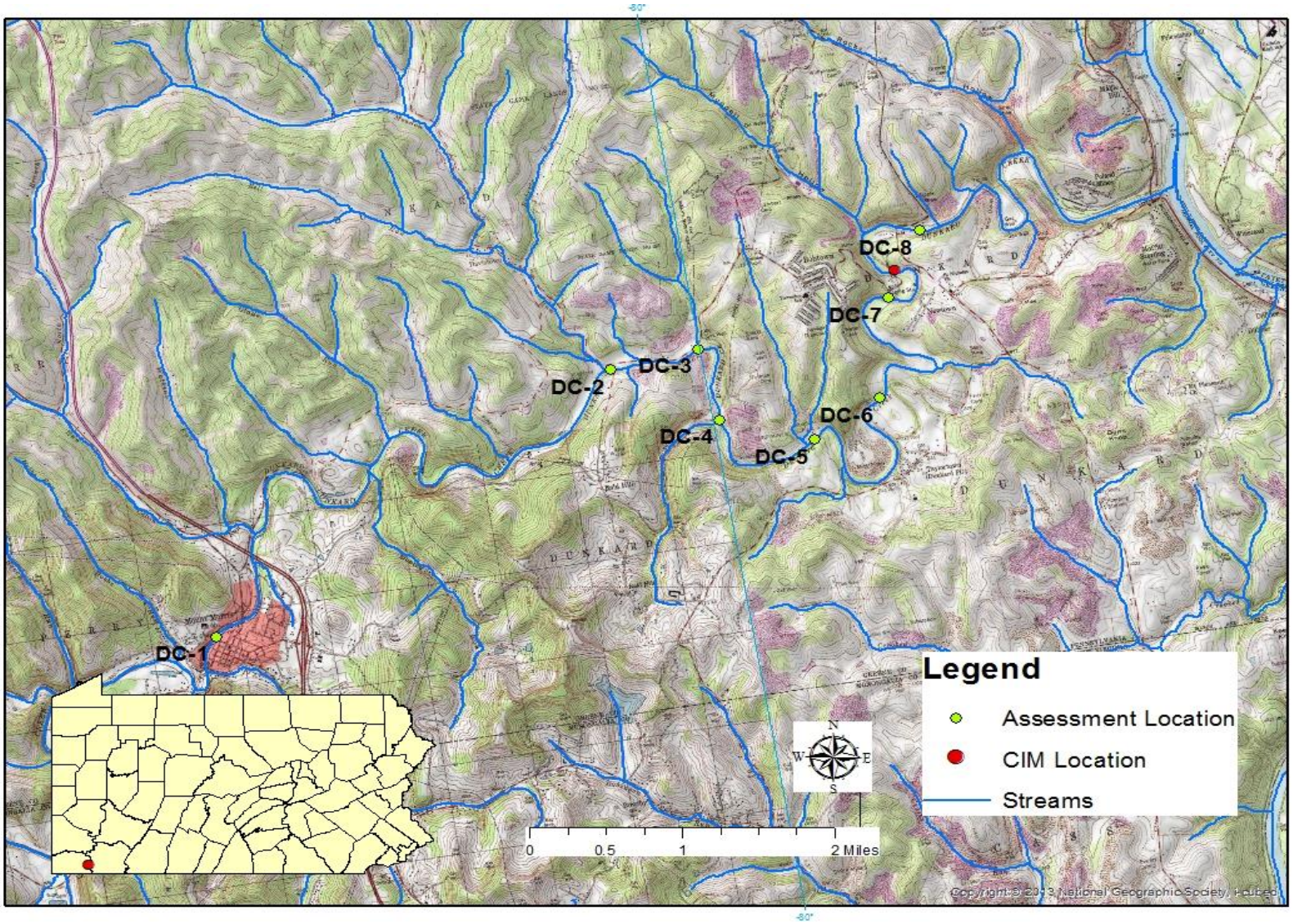

Figure 9. Station locations – 2014 Dunkard Creek stream assessment and Shannopin CIM.

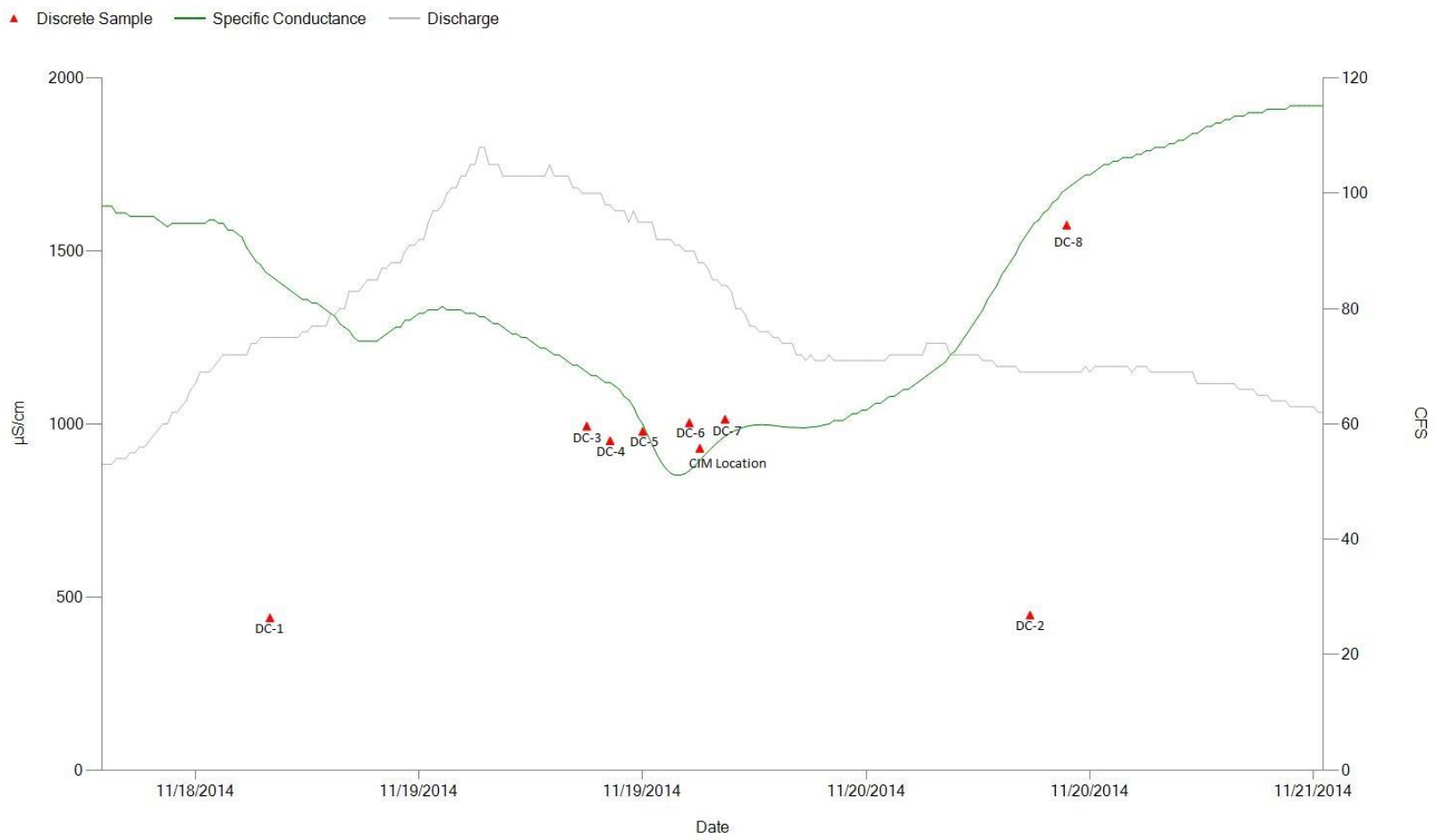

Figure 10. Specific conductance CIM data overlayed by discrete water quality readings taken during the stream assessment field data collection from November 18 to November 20, 2014.

ASSESSMENT:

Discrete Water Quality Transect Characterization: Temperature, specific conductance, pH and dissolved oxygen measurements indicate homogenous conditions at Shannopin (Figure 3.) The only variation observed across the transect was slightly elevated dissolved oxygen data along the left descending side on a couple of the visits.

Continuous: Data collected by the instream monitor illustrates poor water quality, indicative of mining activities. Specific conductance was extremely high throughout the period of record and readings were elevated seasonally and depressed with discharge events (Figures 4 and 5.) Maximum specific conductance values typically occur September through October and correlate with baseflow conditions. Maximum specific conductance reached 3390 µS/cm in September of 2014 and 3430 µS/cm in October of 2015. The 2013 data record begins in October. The maximum specific conductance in 2013 was 2310 µS/cm, but may not have had an opportunity to experience maximum values as recorded in 2014 and 2015.

Water temperature and pH data showed typical seasonal and diel swings throughout the period of record. The pH values did not exceed water quality standards (WQS) in 25 Pa Code §93.7, with values ranging 6.6-8.7 throughout the entire data set (Figure 6). Elevated flow events result in slightly depressed pH values as seen in Figure 7, but readings rebounded as flows recede. Maximum temperatures are typically observed in August and low temperatures were below zero from January to early March (Figure 8). Water temperature at Shannopin is seasonally predictable.

Field Parameter Data: Field parameter data from the 2014 Dunkard Creek stream assessment (Table 1) and CIM data from Dunkard Creek at Shannopin were compared. Field parameter data are most consistent with those stations on the lower reaches of Dunkard Creek (DC-3 through DC-8). This is most evident with the specific conductance data. DC-3 is located approximately nine km upstream of the CIM station, and DC-8 is located approximately one km downstream. Specific conductance increases upstream to downstream, with significant increases between DC-2 and DC-3. A second significant increase in specific conductance occurs between DC-7 and DC-8 in the field data, however this change can be attributed to temporal differences in data collection when comparing the CIM data to field readings in Figure 10. The response to decreasing discharge values between the timing of field readings at DC-7 and DC-8 correlated to an increase in Specific conductance CIM readings of approximately 700 µS/cm. Full results of the 2014 stream assessment including water chemistry field readings, macroinvertebrate samples, water chemistry grab samples and habitat assessments are compiled in the *Dunkard Creek Stream Assessment Report.*

Table 1. Field Parameter data from the Dunkard Creek 2014 stream assessment.

FIELD PARAMETERS	DATE	20141118	20141120	20141119	20141119	20141119	20141119	20141119	20141120
	TIME	16:00	8:47	9:00	10:15	12:00	14:30	16:25	10:45
	STATION	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6	DC-7	DC-8
TEMPERATURE	°C	1.8	1 25	1.12	1.02	0.73	1.33	1.31	2 31
SPECIFIC CONDUCTANCE	µS/cm	440	448	994	952	979	1004	1014	1575
PH	pH units	7.97	7 97	7.91	8.18	8.2	8.19	8.18	7 92
DISSOLVED OXYGEN	MG/L	13.33	13.23	13.51	15	15.23	15.67	15.69	13.26

Water Quality Network: Water quality data collected on Dunkard Creek at Shannopin, PA (WQN0714) further supports an impaired watershed. A trend analysis was completed for WNQ0714 by the Department in the 2014 Integrated Report. The analysis was completed on long-term data (1992-2012) and short-term data (2003-2012), both showing similar results. The analysis indicates a statistically significant (p-value < 0.05) increasing trend for nutrient substituents including total nitrogen, total ammonia, total nitrate (short-term only), and total phosphorus. Alkalinity, hardness, and sulfate are observed as having an increasing trend, where metals constituents analyzed including aluminum, copper, iron, lead, and zinc (long-term only) show a decreasing trend. For a complete description of trend analysis for Dunkard Creek see the *2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report*.

SUMMARY:

The lower reaches of Dunkard Creek are currently listed as impaired for aquatic life use; cause-abandoned mine drainage, source-suspended solids and metals; and cause-subsurface mining, source-exotic species and total dissolved solids. It is also impaired for fish consumption; source-mercury, cause-unknown. The 2013-2015 CIM data supports the aquatic life use impairments and should be referenced as such in subsequent surface water quality assessments.

Based on a comparison of the transect data, CIM data, and field parameter data from the 2014 stream assessment, the CIM data from the Shannopin site provides important information for documenting changes in water quality. The CIM data should be referenced in subsequent water quality assessments to the lower reaches of Dunkard Creek. The transect data indicates homogenous water quality conditions across Dunkard Creek at Shannopin, and the location of the CIM monitor across the width of the stream should remain consistent.

LITERATURE CITED

PA DEP. 2017. Dunkard Creek, Greene County, Stream Assessment Report.

PA DEP 2014. 2014 Pennsylvania integrated water quality monitoring and assessment report – Clean Water Act Section 305(b) report and 303(d) list. http://www.dep.pa.gov/Business/Water/PointNonPointMgmt/WaterQuality/Pages/Integrated-Water-Quality-Report-2014.aspx

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A. 2006. Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods