Big Creek Research and Extension Team

University of Arkansas System Division of Agriculture

Quarterly Report – January 1 to March 31, 2018

MONITORING THE SUSTAINABLE MANAGEMENT OF NUTRIENTS ON C&H FARM IN BIG CREEK WATERSHED

Mission of the University of Arkansas System Division of Agriculture

The mission of the **Division of Agriculture** is to advance the stewardship of natural resources and the environment, cultivate the improvement of agriculture and agribusiness, develop leadership skills and productive citizenship among youth and adults, enhance economic security and financial responsibility among the citizens of the state, ensure a safe, nutritious food supply, improve the quality of life in communities across Arkansas, and strengthen Arkansas families.

Dr. Mark J. Cochran
Vice President for Agriculture

Executive Summary

This is the first Quarterly Report of 2018 for the Big Creek Research and Extension Team that details activities and progress made from October 1 through December 31, 2017.

1. We continue to collect weekly base flow and periodic stormflow water samples from Big Creek above and below the C&H Farm, along with water from a spring (reflecting shallow aquifer flow), ephemeral stream (reflecting landscape drainage from the area of the holding ponds and operational facilities), surface runoff sites on Fields 1, 5a, and 12, two interceptor trenches below the slurry holding ponds (reflecting subsurface flow below the holding ponds), and house well (reflecting deeper ground water) for chemical and bacterial analysis.
2. This Quarterly Report contains certified analyses of samples collected between January 1, 2017 and March 31, 2018.
3. The surface runoff of nutrients and sediment form the three monitored fields (i.e., Fields 1, 5a, and 12) are presented along with runoff volumes for each storm flow event in 2014, 2015, 2016, and 2017. From these flows and concentrations, the amount of nutrients and sediment runoff from each field are estimated and presented. We determined the catchment area contributing runoff to the flumes and from this, calculated the amounts of nutrient and sediment transported from each field. Additionally, from the amount of slurry and commercial fertilizer applied, the amount of applied P and N transported from the fields was calculated. Losses tend to be dominated by twice the annual rainfall in 2015 than the other years of monitoring, which led to high runoff volumes.
4. The concentration of P, N, sediment, E. coli, coliform, chloride, and electrical conductivity from well, ephemeral stream, and trench sites since sampling began, are presented. Any seasonal or annual trends will be statistically evaluated when a 5-year period of record has been obtained. Analysis of seasonal or annual trends over a shorter period can lead to incorrect interpretations.
5. Although not part of the BCRET work plan, dissolved oxygen concentrations were monitored between 2014 and 2017 at the site downstream of the C&H farm (i.e., USGS 07055790 Big Creek near Mt. Judea). These data are given in this report and have been made available to ADEQ and on the BCRET website.

Big Creek Science Team

Andrew Sharpley, Ph.D., TEAM LEADER – Distinguished Professor - Soil science, water quality, soil phosphorus chemistry, agricultural management

Kris Brye, Ph.D., Professor - Effects of land application of poultry litter on in-situ nutrient leaching, effects of land use and management practices on soil physical, chemical, and biological properties related to soil quality and sustainability

Mike Daniels, Ph.D., Professor – Extension water quality and nutrient management specialist

Ed Gbur, Ph.D., Professor and Director, Agricultural Statistics Laboratory - Experimental design, linear and generalized linear mixed models, regression, agricultural applications of statistics.

Brian Haggard, Ph.D., Professor - Ecological engineering, environmental soil and water sciences, water quality chemistry, water quality monitoring and modeling, algal nutrient limitation, pollutant transport in aquatic systems

Phil Hays, Ph.D. Ground Water Specialist, U.S. Geological Survey and Research Professor with Geosciences Dept., University of Arkansas, application of stable isotopes and other geochemical indicators in delineating movement and behavior of contaminants in ground-water systems

Mary Savin, Ph.D. - Structure and function of microbial communities in natural and managed ecosystems, microorganisms in nutrient cycling, contaminant degradation

Karl VanDevender, Ph.D. and P.E., Professor - Extension Engineer, Livestock and poultry manure and mortality management, nutrient management planning

Jun Zhu, PhD., Professor - Biological and agricultural engineering, agricultural sustainability, manure treatment technologies

Adam Willis, M.Sc., Newton County Extension Agent - Agriculture

Field Technicians - The Big Creek Research and Extension Team are ably supported by several outstanding and dedicated Program Technicians based in Fayetteville and Little Rock.

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Site 3. Edge-of-field monitoring on Field 12 permitted to receive slurry.

Site 4. Ephemeral stream flow draining a subwatershed containing the production facilities.

Site 5. Spring below Field 1.

Site 6. Big Creek upstream of the C&H Farm operation.

Site 7. Big Creak downstream of the C&H Farm operation.

Site 8. Left Fork downstream of the C&H Farm operation.

Site 9. North interceptor trench below the manure holding ponds.

Site 10. South interceptor trench below the manure holding ponds.

Site 11. House well at animal facility.

Table 1. Location of sampling sites on the Big Creek Research and Extension Team project.

Site description	Latitude	Longitude	Elevation, ft
Field 1	35 55’ 06.42”	93 03’ 38.34”	984
Field 5a	35 56’03.01”	93 04’ 25.85”	778
Field 12	35 54’ 13.57”	93 04’ 04.76”	838
Ephemeral stream	35 55’ 25.89”	93 04’ 14.94”	824
Spring	35 54’ 57.06”	93 03’ 34.64”	977
Big Creek upstream of farm	35 53’ 32.28”	93 04’ 06.38”	857
Big Creek downstream of farm	35 56’ 18.98”	93 04’ 21.81”	769
Left Fork	35 5’”48.04”	93 04” 02.02”	760
Trench 1 (south)	35 55’ 19.24”	93 04’ 23.04”	896
Trench 2 (north)	35 55’ 21.39”	93 04’ 19.93”	883
House well	35 55’ 27.02”	93 04’ 22.71”	915

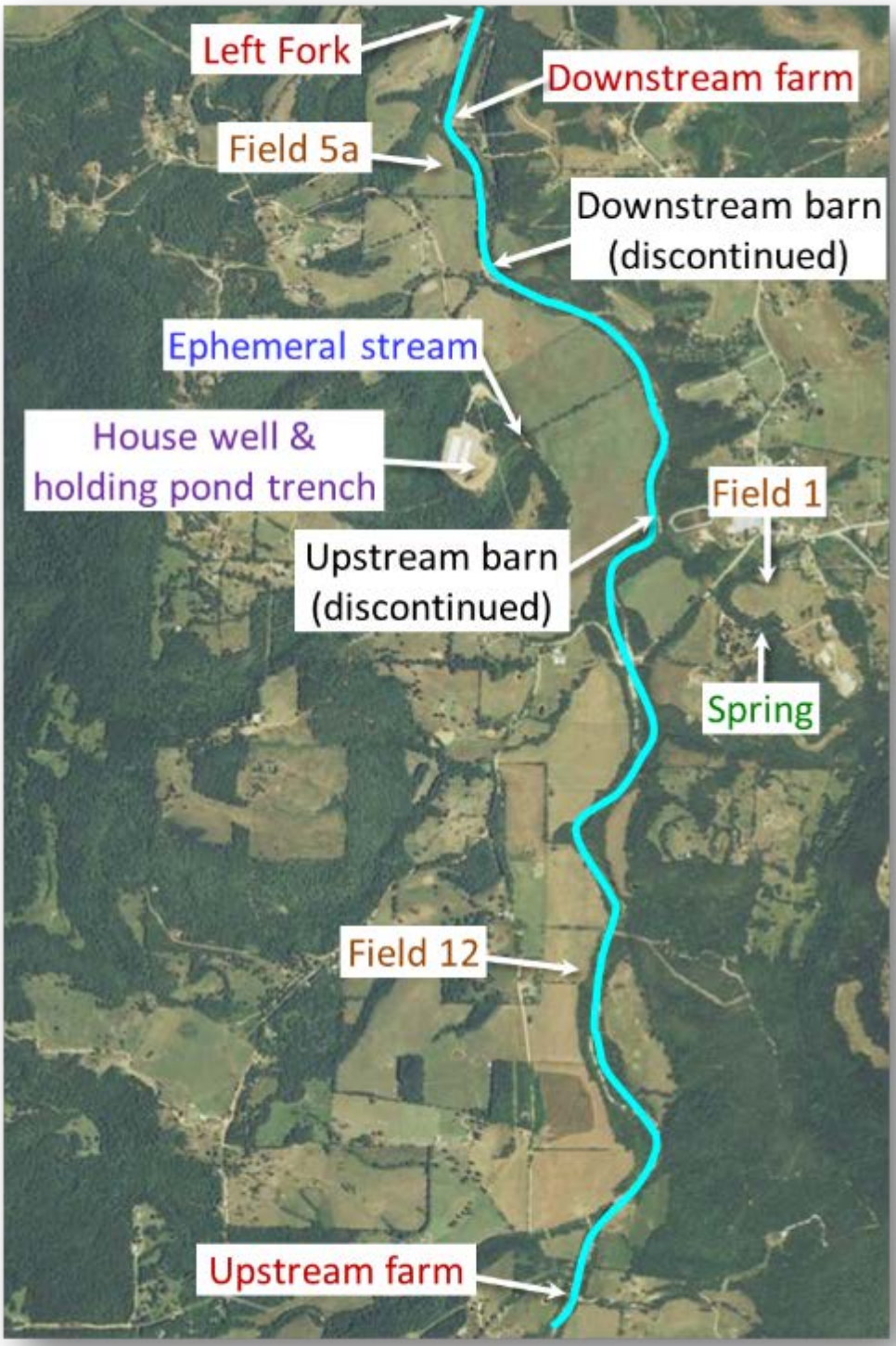

Figure 1. Location of sampling sites for the Big Creek Research and Extension Team project.

Sampling Protocols and Analyses

The following protocols were used to collect, prepare, and analyze all water samples:

1. One-liter acid-washed bottles were used to collect the stream samples for nutrient analyses.
2. Water was collected from just beneath the surface, where the stream was actively moving and well-mixed.
3. The bottle was rinsed with stream water before collecting the sample.
4. Sterilized specimen cups were used to collect samples for bacterial evaluation.
5. Time of collection was noted, and samples placed in a cooler on ice to preserve them until processed and were submitted to the Arkansas Water Resources Center Water Quality Lab on the day of collection for analyses.
6. The ISCO autosamplers collect storm flow samples at sites edge-of-field sites on Fields 1, 5a, and 12, and at the ephemeral stream, upstream of the C&H Farm, and downstream of the C&H Farm sites (i.e., BC1, BC2, BC3, BC4, BC 6, and BC 7, respectively). Water sample collection criteria for each site are detailed in Tables 2 and 3.
7. Analyses included Alkalinity (APHA 2320-B), Ammonia (EPA 351.2), Chloride (EPA 300.0), Dissolved Phosphorus (EPA 365.2), E. coli (APHA 9223-B), Electrical Conductivity (EPA 120.1), Nitrate (EPA 300.0), pH (EPA 150.1), Total Coliforms (APHA 9223-B), Total Dissolved Solids (EPA 160.1), Total Nitrogen (APHA 4500-P J), Total Phosphorus (APHA 4500-P J), and Total Suspended Solids (EPA 160.2). APHA is American Public Health Association from the Wadeable Streams Assessment, Water Chemistry Laboratory Manual http://www.epa.gov/owow/monitoring/wsa/WRS_lab_manual.pdf
8. Prior to collection of a house well water sample, the well is purged and water temperature, pH, and electrical conductivity measured on-site every 30 seconds until all values stabilize (primarily water temperature). At that point, a sample of water is collected in a 1-L acid-washed bottle. This method is taken from USGS and EPA well-water sampling protocols. See USGS methods for sampling at https://water.usgs.gov/owq/FieldManual/chapter4/pdf/Chap4_v2.pdf. Specific and detailed guidance on the collected of water quality data can be found in the USGS National Field Manual at file:///U:/Words/C&H%20Farm/Publications/Planning/USGS%20National%20Field%20Mannual_complete%202015.pdf

   The U.S. EPA also recommend that selected water quality parameters can be monitored during low-rate purging, with stabilization of these parameters indicating when the discharge water represents aquifer water or source well water. See: http://www.csus.edu/indiv/h/hornert/Geol_210_Summer_2012/Week%202%20readings/Puls%20and%20Barcelona%201996%20Low%20flow%20sampling.pdf and https://in-situ.com/wp-content/uploads/2015/01/Low-Flow-Groundwater-Sampling-Techniques-Improve-Sample-Quality-and-Reduce-Monitoring-Program-Costs-Case-Study.pdf
9. Minimum detection limits (MDLs) for each chemical and biological constituent are listed in Table 4. Some constituent concentrations were reported by the laboratory as less than the MDL but greater

than zero. Those values are given in subsequent tables but have less confidence in their accuracy than concentrations above the MDL.

10. Chemical and biological analyses of samples collected from the beginning of 2017 to the current date are given in Tables 5, 6, 7, and 8.

Table 2. Parameters used to enable ISCO auto-samplers at BCRET edge-of-field sites Field 1, 5a, and 12.

Site	Identifier	ISCO enabled when stage height (inches) above	Volume pacing, 100 mL water collected per gallon of water		
			Rainfall, inches		
			<2.5	2.5 to 4	>4
Field 1	BC1	> 0.75	500	1,000	5,000
Field 5a	BC2	> 0.75	5,000	10,000	50,000
Field 12	BC3	> 0.75	500	1,000	5,000

Table 3. Parameters used to enable ISCO auto-samplers at BCRET stream sites BC4, BC6, and BC7.

Site	Identifier	ISCO enabled when, over a 30-minute period, stage height (inches) increases by	Volume pacing, 100 mL water collected per gallon of water		
			Rainfall, inches		
			<2.5	2.5 to 4	>4
Ephemeral stream	BC4	> 2.0 *	25,000	50,000	100,000
Upstream Big Creek	BC6	1.2	40,000,000	50,000,000	70,000,000
Downstream Big Creek	BC7	1.8	60,000,000	80,000,000	100,000,000

* For ephemeral stream stage height increases >2.0 inches over a 30-min period.

Table 4. Minimum detection limits (MDLs) for each chemical and biological constituent.

Constituent	Minimum detection limit [1]
Alkalinity, mg/L as $CaCO_3$	2
Chloride, mg/L	0.093
Dissolved P, mg/L	0.002
Conductivity, uS/cm	1
Ammonia-N, mg/L	0.03
Dissolved organic carbon, mg/L	0.18
E. coli, MPN/100 mL	1
Nitrate-N, mg/L	0.004
pH	0.1
Total coliform, MPN/100 mL	1
Total dissolved solids, mg/L	15.22
Total N, mg/L	0.006
Total P, mg/L	0.012
Total suspended solids, mg/L	6.58

[1] MDL the Minimum Detection Limit of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Further information is available at http://water.usgs.gov/owq/OFR_99-193/detection.html

Big Creek Research and Extension Team Monitoring Data

Nutrients, Sediment, and Bacteria by Date of Sampling

Table 5. Water quality analyses at each sample site since January 2017, with those collected since the last report noted. Coliform units are Most Probable Number (MPN) per 100 mL of water.

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
			---------- mg/L ----------							-- MPN/100 mL --	
1/5/2017	**1/25/2017**	**Grab sample**									
12:28	15:25	Spring	0.004	0.026	0.04	0.276	0.390	9.5	0.94	74.4	1413.6
13:12	15:25	Upstream farm	0.009	0.014	0.02	0.059	0.090	0.7	0.66	52.0	2419.2
12:00	15:25	Downstream farm	0.012	0.019	0.04	0.257	0.310	1.3	0.55	5.2	1986.3
11:42	15:25	Left Fork	0.006	0.011	0.03	0.229	0.260	0.7	0.85	6.2	1732.9
12:47	15:25	House well	0.008	0.014	0.04	0.610	0.660	0.3	0.30	<1.0	<1.0
1/19/2017	**1/19/2017**	**Grab sample**									
10:41	14:30	Spring	0.009	0.017	0.04	0.286	0.600	33.0	13.31	<1.0	2260.0
11:27	14:30	Upstream farm	0.010	0.016	0.03	0.050	0.140	1.9	4.22	137.6	>2419.2
10:30	14:30	Downstream farm	0.014	0.024	0.02	0.121	0.210	2.5	3.19	60.1	3990.0
10:10	14:30	Left Fork	0.010	0.019	0.03	0.243	0.360	2.6	4.25	55.4	>2419.2
11:00	14:30	House well	0.009	0.013	0.03	0.617	0.690	0.9	7.87	<1.0	<1.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
2/2/2017	**2/2/2017**	**Grab sample**									
10:45	14:30	Spring	0.011	0.030	<0.03	0.823	0.890	7.3	5.06	6.3	1732.9
11:20	14:30	Upstream farm	0.009	0.017	<0.03	0.056	0.070	1.1	1.72	41.9	>2419.2
10:30	14:30	Downstream farm	0.014	0.026	0.01	0.160	0.210	5.1	2.21	41.3	>2419.2
10:15	14:30	Left Fork	0.008	0.019	0.01	0.139	0.180	1.1	1.69	17.1	>2419.2
10:57	14:30	House well	0.011	0.031	0.01	0.614	0.780	0.4	2.22	<1.0	<1.0
2/15/2017	**2/15/2017**	**Grab sample**									
11:50	15:35	Spring	0.013	0.093	0.02	0.201	0.570	12.7	8.76	178.5	4350.0
13:30	15:35	Upstream farm	0.009	0.060	0.01	0.132	0.300	5.0	3.04	1986.3	6570.0
11:24	15:35	Downstream farm	0.012	0.082	0.03	0.159	0.420	9.0	3.46	1732.9	11000.0
12:08	15:35	Ephemeral stream	0.020	0.064	0.02	1.323	1.450	3.1	5.06	166.9	5630.0
11:11	15:35	Left Fork	0.015	0.080	0.03	0.314	0.600	17.7	4.66	648.8	11060.0
12:46	15:35	Trench 1	0.004	0.023	0.01	0.141	0.200	1.3	0.45	1.0	1299.7
12:56	15:35	Trench 2	0.004	0.087	0.04	0.486	1.120	6.1	5.99	19.7	42860.0
12:25	15:35	House well	0.008	0.023	0.02	0.649	0.720	0.5	2.07	<1.0	<1.0
3/1/2017	**3/1/2017**	**Grab sample**									

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:38	14:55	Upstream farm	0.009	0.044	0.03	0.069	0.240	4.7	3.93	2590.0	7940.0
11:18	14:55	Downstream farm	0.005	0.016	0.03	0.148	0.270	2.6	3.24	71.7	2430.0
11:43	14:55	Ephemeral stream	0.011	0.016	0.02	0.659	0.710	1.5	6.75	195.6	5730.0
11:00	14:55	Left Fork	0.008	0.024	0.02	0.136	0.280	4.3	2.46	1119.9	4260.0
12:16	14:55	Trench 2	0.002	0.050	0.04	0.345	0.760	11.6	4.90	98.8	34480.0
11:52	14:55	House well	0.012	0.040	0.03	0.620	0.720	0.5	5.85	<1.0	<1.0
3/16/2017	**3/16/2017**	**Grab sample**									
7:30	11:45	Spring	0.009	0.061	<0.03	0.729	0.990	15.5	2.69	24.0	>2419.2
8:38	11:45	Upstream farm	0.006	0.046	<0.03	0.118	0.290	1.7	1.08	75.9	1299.7
7:13	11:45	Downstream farm	0.010	0.031	<0.03	0.266	0.300	2.9	0.97	68.3	1986.3
7:38	11:45	Ephemeral stream	0.005	0.021	<0.03	0.738	0.800	0.8	2.99	14.8	2419.2
7:00	11:45	Left Fork	0.009	0.043	<0.03	0.300	0.410	3.1	1.77	45.5	>2419.2
8:00	11:45	Trench 1	0.006	0.020	<0.03	0.083	0.110	1.1	1.87	<1.0	179.3
7:46	11:45	House well	0.009	0.023	<0.03	0.856	0.880	0.1	1.52	<1.0	<1.0
3/27/2017	**3/27/2017**	**Grab sample**									
11:27	15:40	Spring	0.007	0.044	<0.03	0.213	0.600	7.2	9.58	770.1	8800.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:51	15:40	Upstream farm	0.012	0.122	0.06	0.181	0.740	131.4	5.72	1986.3	17850.0
10:51	15:40	Downstream farm	0.047	0.096	0.20	0.173	1.490	321.9	6.68	9840.0	72150.0
10:37	15:40	Left Fork	0.058	0.164	0.17	0.206	1.500	1005.1	8.51	9330.0	38770.0
11:50	15:40	Trench 1	0.004	0.048	0.03	0.129	0.390	3.1	4.36	387.3	17230.0
11:55	15:40	Trench 2	0.009	0.102	0.13	0.060	0.820	7.0	7.13	488.4	29240.0
12:38	15:40	House well	0.007	0.038	0.02	0.573	0.630	1.6	3.83	18.1	261.3
3/27/2017	**3/27/2017**	**Storm sample**									
11:40	15:40	Ephemeral stream	0.151	0.268	0.29	1.704	3.300	448.3	16.47	18500.0	66530.0
11:05	15:40	Field 1	0.420	0.670	0.43	0.090	1.870	124.4	9.29	8390.0	45690.0
12:15	15:40	Field 5a	2.980	3.232	1.40	0.122	1.800	30.2	32.01	2419.2	69100.0
13:06	15:40	Field 12	0.800	1.276	2.02	2.798	6.040	134.2	9.35	7120.0	96060.0
3/30/2017	**3/30/2017**	**Storm sample**									
11:15	14:15	Ephemeral stream	0.005	0.032	0.01	0.796	0.860	8.6	1.89	ND §	ND
4/6/2017	**4/6/2017**	**Grab sample**									
11:40	15:25	Spring	0.009	0.032	0.01	0.265	0.420	5.2	6.36	1413.6	1413.6
11:30	15:25	Upstream farm	0.007	0.038	0.01	0.099	0.210	2.3	2.53	72.0	>2419.2

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:55	15:25	Downstream farm	0.009	0.034	0.01	0.173	0.260	3.1	1.96	107.6	>2419.2
11:20	15:25	Ephemeral stream	0.008	0.022	<0.03	0.717	0.760	1.6	1.69	148.3	1986.3
11:50	15:25	Left Fork	0.010	0.048	0.01	0.222	0.410	4.7	2.32	135.4	2780.0
10:20	15:25	Trench 1	0.004	0.022	0.03	0.165	0.300	17.2	1.98	47.2	2750.0
4/6/2017	**4/6/2017**	**Storm sample**									
11:15	15:25	Ephemeral stream	0.018	0.080	0.06	0.807	1.140	19.9	4.14	ND	ND
4/13/2017	**4/13/2017**	**Grab sample**									
12:22	15:30	Spring	0.011	0.022	<0.03	0.600	0.630	3.6	15.57	8.6	816.4
13:05	15:30	Upstream farm	0.008	0.054	<0.03	0.026	0.110	2.5	4.64	83.6	2419.2
11:56	15:30	Downstream farm	0.009	0.028	0.01	0.092	0.170	1.1	2.33	135.4	>2419.2
12:50	15:30	Ephemeral stream	0.010	0.018	<0.03	0.593	0.600	1.5	7.73	71.7	6700.0
11:33	15:30	Left Fork	0.010	0.024	<0.03	0.123	0.210	1.6	2.75	22.3	>2419.2
12:35	15:30	House well	0.011	0.020	<0.03	0.564	0.590	0.1	6.22	<1.0	1.0
4/17/2017	**4/17/2017**	**Grab sample**									
12:02	14:55	Spring	0.007	0.044	0.02	0.154	0.400	5.3	6.46	1413.6	18420.0
11:45	14:55	Upstream farm	0.019	0.054	<0.03	0.025	0.120	5.3	1.55	1553.1	9330.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
10:51	14:55	Downstream farm	0.011	0.046	0.01	0.129	0.240	3.3	1.51	866.4	8360.0
11:10	14:55	Ephemeral stream	0.005	0.018	<0.03	0.651	0.680	0.9	1.71	410.6	7270.0
10:40	14:55	Left Fork	0.040	0.112	0.02	0.173	0.460	19.5	4.55	9090.0	129970.0
11:25	14:55	House well	0.006	0.016	0.01	0.563	0.570	0.2	1.94	<1.0	12.1
4/24/2017	**4/24/2017**	**Storm sample**									
11:50	15:30	Ephemeral stream	0.007	0.128	0.04	0.000	1.830	318.0	7.35	ND	ND
11:15	15:30	Field 1	0.395	0.592	0.13	0.143	1.500	43.1	7.25	ND	ND
11:35	15:30	Field 5a	0.961	1.212	0.12	0.321	1.530	11.7	11.53	ND	ND
12:15	15:30	Trench 1	0.005	0.040	21.95	0.133	22.760	18.5	7.04	ND	ND
12:20	15:30	Trench 2	0.010	0.084	0.04	0.087	0.930	8.2	8.78	ND	ND
4/27/2017	**4/27/2017**	**Grab sample**									
11:05	16:25	Spring	0.011	0.022	<0.03	0.380	0.440	3.1	2.58	165.8	>2419.2
12:10	16:25	Upstream farm	0.010	0.036	<0.03	0.117	0.120	7.1	1.34	172.3	2430.0
10:35	16:25	Downstream farm	0.014	0.042	<0.03	0.231	0.240	10.7	1.70	214.3	6090.0
10:20	16:25	Left Fork	0.016	0.046	<0.03	0.306	0.320	16.4	2.08	275.5	7230.0
11:30	16:25	House well	0.011	0.014	<0.03	0.532	0.530	0.1	0.69	5.1	52.8

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:43	16:25	Trench 2	0.006	0.046	0.04	0.029	0.420	2.4	4.95	115.3	2419.2
4/27/2017	**4/27/2017**	**Storm sample**									
11:52	16:25	Ephemeral stream	0.042	0.253	0.01	0.302	2.570	734.5	8.29	186.0	>2419.2
10:50	16:25	Field 1	0.550	0.784	0.08	0.107	1.320	52.2	8.46	ND	ND
11:15	16:25	Field 5a	0.686	0.846	0.07	0.063	0.860	11.3	7.26	ND	ND
13:40	16:25	Field 12	0.326	0.544	0.02	0.105	0.710	102.3	5.64	ND	ND
11:40	16:25	Trench 1	0.006	0.048	1.04	0.081	1.430	7.2	4.04	40.4	3990.0
5/1/2017	**5/1/2017**	**Grab sample**									
11:35	15:45	Spring	0.012	0.012	<0.03	0.343	0.480	0.3	4.34	127.4	2419.2
13:05	15:45	Upstream farm	0.013	0.026	<0.03	0.144	0.250	4.1	1.01	95.9	2280.0
11:01	15:45	Downstream farm	0.018	0.032	<0.03	0.279	0.390	6.9	1.22	187.2	3010.0
12:54	15:45	Ephemeral stream	0.014	0.018	<0.03	0.681	0.750	68.2	1.12	146.7	1986.3
10:50	15:45	Left Fork	0.019	0.068	<0.03	0.362	0.550	14.1	1.68	129.1	7430.0
12:15	15:45	House well	0.015	0.042	<0.03	0.529	0.650	1.8	1.59	4.1	3740.0
12:30	15:45	Trench 1	0.007	0.008	<0.03	0.124	0.180	2.3	1.05	435.2	12960.0
12:40	15:45	Trench 2	0.013	0.022	<0.03	0.000	0.230	3.4	3.02	435.2	3890.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
5/1/2017	**5/1/2017**	**Storm sample**									
11:20	15:45	Field 1	0.534	0.760	0.33	0.321	2.200	36.7	12.66	ND	ND
12:00	15:45	Field 5a	0.734	0.916	0.22	0.281	1.560	13.1	9.81	ND	ND
13:15	15:45	Field 12	0.224	0.374	0.03	0.166	1.060	40.6	7.25	ND	ND
12:30	15:45	Trench 1	0.009	0.050	0.61	0.076	2.400	10.7	4.56	ND	ND
12:40	15:45	Trench 2	0.008	0.066	0.02	0.010	0.810	11.2	8.31	ND	ND
5/11/2017	**5/11/2017**	**Grab sample**									
7:40	12:05	Spring	0.013	0.016	<0.03	0.406	0.410	0.9	4.97	30.5	1986.3
8:25	12:05	Upstream farm	0.009	0.022	<0.03	0.125	0.170	2.4	1.32	165.8	2419.2
7:24	12:05	Downstream farm	0.010	0.026	<0.03	0.397	0.400	2.4	1.18	93.3	3090.0
7:50	12:05	Ephemeral stream	0.009	0.018	<0.03	0.682	0.740	1.5	1.49	48.0	2419.2
7:13	12:05	Left Fork	0.012	0.024	<0.03	0.383	0.380	1.3	1.09	78.9	5460.0
7:55	12:05	House well	0.010	0.016	<0.03	1.023	1.080	0.6	1.19	<1.0	6.3
5/18/2017	**5/18/2017**	**Grab sample**									
10:55	15:00	Spring	0.006	0.018	<0.03	0.220	0.340	0.4	4.91	88.0	2419.2
11:40	15:00	Upstream farm	0.006	0.048	<0.03	0.067	0.190	2.9	1.50	260.2	>2419.2

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
10:45	15:00	Downstream farm	0.008	0.024	<0.03	0.189	0.300	1.9	1.10	129.6	3690.0
11:05	15:00	Ephemeral stream	0.012	0.020	<0.03	0.692	0.750	1.7	1.76	49.6	2419.2
10:30	15:00	Left Fork	0.009	0.022	<0.03	0.167	0.260	1.9	1.54	50.4	2419.2
11:15	15:00	House well	0.011	0.020	<0.03	0.431	0.600	0.6	5.05	1.0	3.1
5/25/2017	**5/25/2017**	**Grab sample**									
12:16	15:27	Spring	0.007	0.042	0.01	0.219	0.330	22.2	3.76	68.9	2419.2
13:06	15:27	Upstream farm	0.007	0.052	0.01	0.109	0.240	1.9	1.53	ND	ND
11:35	15:27	Downstream farm	0.008	0.020	0.01	0.295	0.300	1.7	1.41	101.7	>2419.2
12:25	15:27	Ephemeral stream	0.013	0.016	0.01	0.661	0.710	0.4	2.01	72.8	>2419.2
11:18	15:27	Left Fork	0.010	0.022	0.01	0.303	0.320	1.4	1.48	58.1	2419.2
12:48	15:27	House well	0.010	0.016	0.02	0.525	0.570	0.3	1.71	<1.0	613.1
5/25/2017	**5/25/2017**	**Storm sample**									
11:35	15:27	Downstream farm	0.006	0.050	<0.03	0.274	0.310	3.0	1.35	ND	ND
5/31/2017	**5/31/2017**	**Grab sample**									
10:38	13:50	Spring	0.007	0.036	<0.03	0.163	0.320	13.2	3.81	235.9	4280.0
11:05	13:50	Upstream farm	0.009	0.020	<0.03	0.053	0.140	1.9	1.34	157.6	2419.2

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
10:30	13:50	Downstream farm	0.008	0.052	<0.03	0.188	0.250	1.6	1.33	150.0	2419.2
10:55	13:50	Ephemeral stream	0.009	0.020	<0.03	0.769	0.790	2.5	1.53	275.5	3500.0
10:20	13:50	Left Fork	0.008	0.020	<0.03	0.156	0.220	1.5	1.58	260.2	4720.0
10:51	13:50	House well	0.019	0.026	<0.03	0.605	0.920	0.4	1.86	<1.0	22.1
6/5/2017	**6/5/2017**	**Grab sample**									
10:53	14:35	Spring	0.007	0.026	0.02	0.225	0.330	9.7	6.63	160.7	4640.0
11:51	14:35	Upstream farm	0.007	0.054	0.01	0.114	0.210	8.3	3.01	178.5	5040.0
10:35	14:35	Downstream farm	0.013	0.064	0.01	0.185	0.290	12.9	1.81	313.0	9330.0
11:03	14:35	Ephemeral stream	0.010	0.028	<0.03	0.706	0.710	1.5	2.38	613.1	5830.0
10:25	14:35	Left Fork	0.011	0.070	0.01	0.179	0.320	14.4	1.63	579.4	24000.0
11:09	14:35	House well	0.008	0.026	0.01	0.586	0.590	0.3	0.00	6.3	48.0
11:30	14:35	Trench 2	0.003	0.086	0.02	0.018	0.750	8.7	7.04	2780.0	>241920
6/6/2017	**6/6/2017**	**Storm sample**									
11:17	15:30	Field 1	0.747	0.998	0.51	0.438	2.340	56.0	10.39	ND	ND
12:12	15:30	Field 5a	1.000	1.430	0.05	1.861	2.380	<10.0	6.21	ND	ND
12:46	15:30	Field 12	0.316	0.470	0.03	0.166	1.660	280.8	6.65	ND	ND

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:30	15:30	Ephemeral stream	0.041	0.816	0.14	0.580	4.610	1788.2	9.24	ND	ND
11:02	15:30	Downstream farm	0.018	0.118	0.03	0.073	0.900	291.5	6.35	ND	ND
6/12/2017	**6/12/2017**	**Grab sample**									
10:27	14:25	Spring	0.006	0.084	0.01	0.193	0.400	53.3	2.57	29.5	155310.0
11:02	14:25	Upstream farm	0.008	0.026	0.01	0.105	0.130	2.0	1.01	121.1	6280.0
10:14	14:25	Downstream farm	0.009	0.020	0.01	0.256	0.270	1.6	0.77	119.8	4350.0
10:35	14:25	Ephemeral stream	0.010	0.882	<0.03	0.732	0.730	0.6	0.67	33.6	2419.2
10:05	14:25	Left Fork	0.006	0.016	<0.03	0.143	0.190	0.9	1.17	77.1	4350.0
10:40	14:25	House well	0.010	0.012	0.00	0.591	0.590	0.0	1.20	<1.0	3.1
6/19/2017	**6/19/2017**	**Grab sample**									
10:45	14:25	Spring	0.007	0.046	0.01	0.227	0.710	25.6	7.34	9.6	1986.3
11:17	14:25	Upstream farm	0.009	0.014	<0.03	0.089	0.120	1.4	2.99	60.1	3640.0
10:35	14:25	Downstream farm	0.007	0.016	0.01	0.256	0.300	1.9	2.75	75.9	7590.0
10:25	14:25	Left Fork	0.006	0.018	0.01	0.226	0.280	2.1	2.15	32.3	4130.0
11:00	14:25	House well	0.009	0.014	0.02	0.582	0.580	0.3	6.92	<1.0	<1.0
6/29/2017	**6/29/2017**	**Grab sample**									

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:47	14:55	Spring	0.006	0.016	0.01	0.244	0.280	5.0	9.08	9.8	866.4
12:19	14:55	Upstream farm	0.007	0.016	0.01	0.083	0.130	1.1	3.10	52.9	3950.0
11:35	14:55	Downstream farm	0.010	0.018	0.02	0.293	0.360	1.8	2.27	28.8	3410.0
11:24	14:55	Left Fork	0.010	0.016	0.02	0.236	0.320	1.3	2.77	29.8	3640.0
12:01	14:55	House well	0.009	0.014	0.01	0.574	0.640	0.3	4.39	1.0	2.0
7/5/2016	**7/5/2016**	**Grab sample**									
11:25	14:55	Spring	0.008	0.022	<0.03	0.107	0.250	1.9	9.11	90.7	4430.0
12:15	14:55	Upstream farm	0.011	0.028	<0.03	0.094	0.180	2.5	2.76	261.3	9060.0
11:05	14:55	Downstream farm	0.011	0.026	<0.03	0.169	0.270	3.1	2.29	185.0	18500.0
10:55	14:55	Left Fork	0.014	0.040	<0.03	0.220	0.390	8.7	3.37	387.3	28510.0
12:30	14:55	House well	0.009	0.010	<0.03	0.570	0.570	0.0	2.61	1.0	31.1
7/11/2017	**7/11/2017**	**Grab sample**									
10:40	13:48	Spring	0.004	0.008	<0.03	0.296	0.330	1.5	7.60	20.1	>2419.2
11:23	13:48	Upstream farm	0.004	0.026	0.01	0.064	0.110	1.5	2.56	585.0	5860.0
10:26	13:48	Downstream farm	0.006	0.014	<0.03	0.154	0.210	1.5	1.45	55.4	11120.0
10:17	13:48	Left Fork	0.005	0.020	0.02	0.125	0.210	3.0	2.52	73.8	12590.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
10:50	13:48	House well	0.006	0.012	0.03	0.573	0.570	0.3	3.50	<1.0	1.0
7/19/2017	**7/19/2017**	**Grab sample**									
10:51	15:30	Spring	0.002	0.214	0.03	0.295	0.770	156.7	0.75	4.1	1119.9
12:04	15:30	Upstream farm	0.003	0.030	0.01	0.105	0.130	1.3	0.92	27.2	7514.7
10:26	15:30	Downstream farm	0.005	0.016	0.01	0.232	0.280	1.7	0.53	35.0	9060.0
10:12	15:30	Left Fork	0.004	0.018	0.01	0.213	0.310	6.4	1.62	19.3	10810.0
11:40	15:30	House well	0.005	0.012	0.04	0.730	0.730	0.0	0.47	<1.0	<1.0
7/26/2017	**7/26/2017**	**Grab sample**									
7:28	11:40	Spring	0.001	0.248	0.02	0.209	0.760	174.7	3.47	2.0	>2419.2
8:08	11:40	Upstream farm	0.005	0.014	0.04	0.162	0.290	3.6	1.87	166.4	11530.0
7:05	11:40	Downstream farm	0.005	0.018	0.03	0.364	0.450	3.1	1.78	28.1	15660.0
6:51	11:40	Left Fork	0.003	0.016	0.05	0.223	0.370	2.7	1.89	27.8	14670.0
7:44	11:40	House well	0.004	0.012	0.01	0.779	0.820	0.1	2.62	<1.0	<1.0
8/3/2017	**8/3/2017**	**Grab sample**									
11:52	15:08	Spring	0.001	0.036	0.01	0.156	0.240	7.5	3.98	33.1	3680.0
12:32	15:08	Upstream Farm	0.005	0.022	<0.03	0.136	0.210	1.0	0.89	27.2	6500.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:25	15:08	Downstream Farm	0.007	0.026	0.02	0.297	0.390	1.5	0.84	43.2	12110.0
11:12	15:08	Left Fork	0.003	0.022	0.04	0.221	0.360	2.0	1.24	14.6	7800.0
12:09	15:08	House well	0.006	0.018	0.02	0.542	0.630	0.0	1.09	<1.0	1.0
8/3/2017	**8/3/2017**	**Storm sample**									
11:25	15:08	Downstream farm	0.000	0.032	0.01	0.185	0.250	1.1	7.88	ND	ND
8/9/2017	**8/9/2017**	**Grab sample**									
11:56	15:00	Spring	0.004	0.024	0.04	0.158	0.200	3.5	0.59	22.8	>2419.2
12:36	15:00	Upstream farm	0.008	0.022	0.04	0.162	0.210	1.0	0.50	177.9	7710.0
11:29	15:00	Downstream farm	0.010	0.036	0.02	0.351	0.440	1.5	0.38	23.1	7980.0
11:11	15:00	Left Fork	0.007	0.032	0.03	0.259	0.370	2.1	0.78	60.9	5300.0
12:10	15:00	House well	0.008	0.020	0.00	0.596	0.630	0.3	0.03	<1.0	<1.0
8/16/2017	**8/16/2017**	**Grab sample**									
7:04	11:50	Spring	0.005	0.094	0.01	0.111	0.470	40.7	7.99	816.4	16690.0
7:58	11:50	Upstream farm	0.010	0.030	<0.03	0.092	0.210	3.9	2.50	648.8	13540.0
6:47	11:50	Downstream farm	0.010	0.028	<0.03	0.216	0.320	3.3	1.66	157.6	12960.0
6:29	11:50	Left Fork	0.010	0.028	0.01	0.659	0.770	4.6	2.20	517.2	15530.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
7:24	11:50	House well	0.016	0.016	<0.03	0.652	0.650	0.3	1.83	<1.0	2.0
8/24/2016	**8/24/2016**	**Grab sample**									
11:58	14:55	Spring	0.005	0.064	<0.03	0.075	0.360	27.0	4.38	435.2	20140.0
12:38	14:55	Upstream farm	0.011	0.038	<0.03	0.132	0.280	3.3	2.35	344.8	18420.0
11:23	14:55	Downstream farm	0.012	0.040	0.01	0.192	0.330	3.5	2.37	261.3	31300.0
11:11	14:55	Left Fork	0.011	0.044	<0.03	0.175	0.330	5.3	2.14	461.1	17820.0
12:15	14:55	House well	0.014	0.018	<0.03	0.625	0.640	0.2	0.59	<1.0	4.1
8/24/2017	**8/24/2017**	**Storm sample**									
11:23	14:55	Downstream farm	0.007	0.126	<0.03	0.182	0.570	38.1	26.88	ND	ND
8/31/2017	**8/31/2017**	**Grab sample**									
11:28	14:15	Spring	0.008	0.084	0.16	0.299	0.520	42.3	2.77	101.7	7490.0
11:55	14:15	Upstream farm	0.009	0.024	0.02	0.075	0.150	1.5	0.73	105.0	5370.0
11:18	14:15	Downstream farm	0.010	0.026	<0.03	0.167	0.230	2.7	1.08	47.2	10460.0
11:00	14:15	Left Fork	0.008	0.024	<0.03	0.063	0.140	2.2	0.00	55.7	6570.0
11:41	14:15	House well	0.010	0.018	0.01	0.664	0.660	0.5	0.52	1.0	4.1
9/6/2017	**9/6/2017**	**Grab sample**									

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
8:41	12:15	Spring	0.006	0.116	<0.03	0.255	0.550	62.8	1.06	31.7	2419.2
9:20	12:15	Upstream farm	0.008	0.020	<0.03	0.126	0.180	1.1	0.50	66.3	4280.0
8:22	12:15	Downstream farm	0.019	0.019	0.01	0.246	0.330	1.7	0.51	51.2	6970.0
8:06	12:15	Left Fork	0.011	0.024	0.01	0.101	0.200	1.9	0.76	133.3	7800.0
8:57	12:15	House well	0.010	0.018	0.01	0.669	0.690	0.3	0.25	<1.0	<1.0
9/13/2017	**9/13/2017**	**Grab sample**									
10:02	13:25	Spring	0.007	0.132	0.01	0.193	0.400	80.0	0.85	8.6	6970.0
10:30	13:25	Upstream farm	0.011	0.022	0.01	0.132	0.220	2.3	0.87	410.6	16070.0
9:46	13:25	Downstream farm	0.015	0.024	0.02	0.355	0.430	2.5	0.52	18.7	7280.0
9:36	13:25	Left Fork	0.010	0.028	0.02	0.130	0.220	1.7	0.69	18.7	6270.0
10:15	13:25	House well	0.012	0.016	0.02	0.664	0.690	1.2	0.33	<1.0	<1.0
9/21/2017	**9/21/2017**	**Grab sample**									
10:50	14:40	Downstream farm	0.012	0.026	0.02	0.418	0.470	1.8	1.93	101.4	6240.0
10:34	14:40	Left Fork	0.007	0.026	<0.03	0.143	0.270	2.1	2.43	10.9	6380.0
11:25	14:40	House well	0.007	0.016	<0.03	0.671	0.680	0.0	1.33	<1.0	1.0
9/28/2017	**9/28/2017**	**Grab sample**									

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:29	14:19	Downstream farm	0.015	0.028	0.04	0.402	0.480	1.3	2.14	62.7	3320.0
11:17	14:19	Left Fork	0.010	0.026	0.02	0.106	0.200	1.8	2.64	3.1	7120.0
11:45	14:19	House well	0.014	0.018	0.03	0.623	0.680	0.6	2.16	<1.0	<1.0
10/5/2017	**10/5/2017**	**Grab sample**									
9:15	13:20	Downstream farm	0.014	0.022	0.01	0.478	0.560	2.1	0.76	99.1	7030.0
9:03	13:20	Left Fork	0.011	0.022	0.01	0.135	0.240	2.3	0.24	10.9	8570.0
9:46	13:20	House well	0.014	0.014	0.03	0.660	0.690	0.2	0.60	<1.0	17.5
10/12/2017	**10/12/2017**	**Grab sample**									
8:13	12:40	Downstream farm	0.012	0.024	0.02	0.511	0.580	0.7	0.55	72.7	3690.0
8:01	12:40	Left Fork	0.011	0.020	<0.03	0.122	0.180	0.8	0.80	17.3	4410.0
8:40	12:40	House well	0.010	0.016	<0.03	0.660	0.730	0.0	0.28	<1.0	<1.0
10/18/2017	**10/18/2017**	**Grab sample**									
12:12	15:00	Downstream farm	0.012	0.020	0.02	0.495	0.700	2.1	0.42	11.0	3010.0
11:59	15:00	Left Fork	0.010	0.018	0.01	0.129	0.270	2.3	1.14	4.1	3640.0
12:35	15:00	House well	0.009	0.010	0.01	0.632	0.780	0.5	0.04	<1.0	1.0
10/23/2017	**10/23/2017**	**Grab sample**									
12:00	15:20	Spring	0.011	0.220	0.04	0.402	1.100	124.4	4.37	1986.3	28090.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:52	15:20	Upstream farm	0.025	0.042	0.02	0.469	0.640	1.7	1.26	1046.2	39680.0
11:28	15:20	Downstream farm	0.017	0.044	0.02	1.056	1.370	4.5	2.25	1732.9	270.0
11:10	15:20	Left Fork	0.022	0.058	0.01	1.042	1.350	5.9	2.36	3090.0	39680.0
12:31	15:20	House well	0.010	0.012	<0.03	0.641	0.800	0.0	0.13	<1.0	6.3
10/23/2017	**10/23/2017**	**Storm sample**									
12:16	15:20	Ephemeral stream	0.109	0.348	0.70	5.834	9.820	538.3	13.53	ND	ND
11/1/2017	**11/1/2017**	**Grab sample**									
8:06	12:15	Downstream farm	0.017	0.024	0.02	0.510	0.650	1.5	0.22	20.1	4260.0
7:51	12:15	Left Fork	0.010	0.014	0.01	0.189	0.270	0.0	0.94	23.8	2419.2
8:43	12:15	House well	0.012	0.018	0.01	0.833	0.960	0.0	0.24	<1.0	<1.0
11/9/2017	**11/9/2017**	**Grab sample**									
7:59	12:05	Downstream farm	0.013	0.018	0.02	0.466	0.570	0.7	6.04	9.8	6440.0
7:42	12:05	Left Fork	0.009	0.016	0.01	0.130	0.250	0.6	6.44	16.9	4410.0
8:30	12:05	House well	0.009	0.012	0.01	0.770	0.860	0.3	7.98	<1.0	<1.0
11/15/2017	**11/15/2017**	**Grab sample**									
7:36	13:15	Downstream farm	0.013	0.022	0.04	0.475	0.660	4.1	0.63	6.3	4640.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
7:24	13:15	Left Fork	0.006	0.015	0.03	0.142	0.260	0.2	0.68	3.1	198630.0
8:54	13:15	House well	0.007	0.007	0.02	0.789	0.850	0.0	0.00	<1.0	1.0
9:10	13:15	Trench 2	0.009	0.275	0.06	5.959	8.280	23.0	4.20	9080.0	241960
11/15/2017	**11/15/2017**	**Storm sample ‡**									
8:37	13:15	Downstream farm	0.036	0.085	0.04	0.443	0.770	18.5	2.04	4220.0	61310.0
8:27	13:15	Left Fork	0.012	0.021	0.04	0.155	0.340	1.1	1.01	124.6	7430.0
11/30/2017	**11/30/2017**	**Grab sample**									
7:45	12:20	Downstream farm	0.012	0.029	0.05	0.361	0.500	0.9	0.11	2.0	2419.2
7:28	12:20	Left Fork	0.005	0.016	0.05	0.122	0.230	1.1	0.48	10.0	1732.0
8:24	12:20	House well	0.009	0.024	0.04	0.717	0.850	0.0	0.00	<1.0	<1.0
Samples collected and analyzed since the last quarterly report											
12/13/2017	**12/13/2017**	**Grab sample**									
8:15	12:35	Upstream farm	0.007	0.164	0.01	0.067	0.100	0.3	0.41	10.8	>2419.2
7:25	12:35	Downstream farm	0.012	0.016	0.02	0.438	0.520	1.1	0.16	3.1	1553.1
7:04	12:35	Left Fork	0.005	0.007	0.01	0.256	0.300	0.1	0.34	8.4	1299.7
7:57	12:35	House well	0.010	0.011	0.03	0.683	0.840	0.3	0.00	<1.0	2.0
12/18/2017	**12/18/2017**	**Grab sample**									

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
12:02	14:43	Downstream farm	0.011	0.011	0.02	0.356	0.460	1.0	1.61	7.1	>2419.2
11:15	14:43	Left Fork	0.004	0.004	0.01	0.194	0.300	0.0	1.53	27.2	>2419.2
11:33	14:43	House well	0.010	0.010	0.02	0.683	0.810	0.5	1.76	<1.0	<1.0
1/4/2018	**1/4/2018**	**Grab sample**									
12:45	15:20	Upstream farm	0.006	0.006	0.01	0.165	0.270	1.3	2.19	18.3	2880.0
12:05	15:20	Downstream farm	0.009	0.009	0.01	0.300	0.410	0.5	2.22	2.0	613.1
11:52	15:20	Left Fork	0.004	0.005	0.01	0.228	0.310	0.7	1.58	1.0	461.1
12:/22	15:20	House well	0.007	0.007	0.01	0.683	0.840	0.1	3.05	<1.0	1.0
1/18/2018	**1/18/2018**	**Grab sample**									
11:50	14:45	Upstream farm	0.005	0.005	0.02	0.125	0.180	0.5	2.14	24.7	>2419.2
11:01	14:45	Downstream farm	0.007	0.007	0.01	0.214	0.300	0.5	1.97	14.5	547.5
10:45	14:45	Left Fork	0.002	0.002	0.01	0.128	0.180	0.6	1.17	1.0	461.1
11:24	14:45	House well	0.006	0.006	0.03	0.670	0.820	0.3	0.72	<1.0	<1.0
1/30/2018	**1/30/2018**	**Grab sample**									
12:13	14:30	Upstream farm	0.006	0.007	0.00	0.143	0.210	1.1	2.40	18.9	613.1
11:36	14:30	Downstream farm	0.005	0.005	0.00	0.163	0.230	4.6	2.22	4.1	579.4

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:24	14:30	Left Fork	0.005	0.005	0.00	0.216	0.280	4.0	2.37	9.7	686.7
12:00	14:30	House well	0.009	0.009	0.00	0.642	0.800	0.4	4.84	<1.0	<1.0
2/14/2018	**2/14/2018**	**Grab sample**									
10:46	13:20	Upstream farm	0.006	0.006	0.01	0.064	0.090	0.7	0.82	53.0	613.1
10:00	13:20	Downstream farm	0.008	0.008	0.01	0.150	0.220	1.4	1.29	35.5	816.1
9:44	13:20	Left Fork	0.004	0.004	0.01	0.143	0.130	1.2	1.29	13.4	866.4
10:31	13:20	House well	0.008	0.008	0.04	0.611	0.820	0.6	1.27	<1.0	<1.0
2/21/2018	**2/21/2018**	**Storm sample**									
11:32	15:32	Field 5a	1.496	2.078	0.14	0.307	2.990	66.9	17.12	ND	ND
2/22/2018	**2/22/2018**	**Grab sample**									
11:16	14:35	Spring	0.010	0.032	0.02	0.560	0.780	1.1	8.28	86.0	>2419.2
12:16	14:35	Upstream farm	0.008	0.043	0.01	0.358	0.460	5.7	2.89	261.3	>2419.2
11:00	14:35	Downstream farm	0.011	0.050	0.03	0.499	0.720	6.5	3.19	387.3	2650.0
12:04	14:35	Ephemeral stream	0.009	0.037	0.01	1.869	2.030	1.4	4.22	90.6	2720.0
10:52	14:35	Left Fork	0.015	0.057	0.02	0.660	0.880	7.4	3.32	238.2	4130.0
11:38	14:35	House well	0.007	0.024	0.01	0.697	0.900	0.2	3.19	<1.0	<1.0

Time sample collected	Time received @ laboratory	Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic Carbon	E. coli	Total coliform
11:43	14:35	Trench 1	0.008	0.043	0.06	1.334	1.590	2.1	3.55	8.4	6113.0

¶ Values proceeded by '<' were reported by the analytical laboratory as zero and the minimum detection limit is given.
§ ND is No Data, due to coliform not measured on water samples collected automatically by non-sterilized ISCO sampler.
‡ Storm sample collected by hand after a 30-minute storm in the watershed at 7:35 on 11/15/2017.

Nutrients, Sediment, and Bacteria by Date Spring, Upstream, and Downstream Sites

Table 6. Water quality analyses in Big Creek upstream and downstream of the C&H Farm boundary of permitted land application since January 2017, with those collected since the last report noted.

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
	---------- mg/L ----------							--- MPN/100 mL ---	
1/5/2017									
Upstream	0.009	0.014	0.02	0.059	0.09	0.7	0.66	52.0	2419.2
Downstream	0.012	0.019	0.04	0.257	0.31	1.3	0.55	5.2	1986.3
1/19/2017									
Upstream	0.010	0.016	0.03	0.050	0.14	1.9	4.22	137.6	2419.2
Downstream	0.014	0.024	0.02	0.121	0.21	2.5	3.19	60.1	3990.0
2/2/2017									
Upstream	0.009	0.017	<0.03 ¶	0.056	0.07	1.1	1.72	41.9	>2419.2
Downstream	0.014	0.026	0.01	0.160	0.21	5.1	2.21	41.3	>2419.2
2/15/2017									
Upstream	0.009	0.060	0.01	0.132	0.30	5.0	3.04	1986.3	6570.0
Downstream	0.012	0.082	0.03	0.159	0.42	9.0	3.46	1732.9	11000.0
3/1/2017									
Upstream	0.009	0.044	0.03	0.069	0.24	4.7	3.93	2590.0	7940.0

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.005	0.016	0.03	0.148	0.27	2.6	3.24	71.7	2430.0
3/16/2017									
Upstream	0.006	0.046	<0.03	0.118	0.29	1.7	1.08	75.9	1299.7
Downstream	0.010	0.031	<0.03	0.266	0.30	2.9	0.97	68.3	1986.3
3/27/2017									
Upstream	0.012	0.122	0.06	0.181	0.74	131.4	5.72	1986.3	17850.0
Downstream	0.047	0.096	0.20	0.173	1.49	321.9	6.68	9840.0	72150.0
4/6/2017									
Upstream	0.007	0.038	0.01	0.099	0.21	2.3	2.53	72.0	>2419.2
Downstream	0.009	0.034	0.01	0.173	0.26	3.1	1.96	107.6	>2419.2
4/13/2017									
Upstream	0.008	0.054	<0.03	0.026	0.11	2.5	4.64	83.6	2419.2
Downstream	0.009	0.028	0.01	0.092	0.17	1.1	2.33	135.4	>2419.2
4/17/2017									
Upstream	0.019	0.054	<0.03	0.025	0.12	5.3	1.55	1553.1	9330.0
Downstream	0.011	0.046	0.01	0.129	0.24	3.3	1.51	866.4	8360.0
4/27/2017									
Upstream	0.010	0.036	<0.03	0.117	0.12	7.1	1.34	172.3	2430.0

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.014	0.042	<0.03	0.231	0.24	10.7	1.70	214.3	6090.0
5/18/2017									
Upstream	0.006	0.048	<0.03	0.067	0.19	2.9	1.50	260.2	>2419.2
Downstream	0.008	0.024	<0.03	0.189	0.30	1.9	1.10	129.6	3690.0
5/31/2017									
Upstream	0.009	0.020	0.00	0.053	0.14	1.9	1.34	157.6	2419.2
Downstream	0.008	0.052	0.00	0.188	0.25	1.6	1.33	150.0	2419.2
6/5/2017									
Upstream	0.007	0.054	0.01	0.114	0.210	8.3	3.01	178.5	5040
Downstream	0.013	0.064	0.01	0.185	0.290	12.9	1.81	313.0	9330
6/12/2017									
Upstream	0.008	0.026	0.01	0.105	0.130	2	1.01	121.1	6280
Downstream	0.009	0.02	0.01	0.256	0.270	1.6	0.77	119.8	4350
6/19/2017									
Upstream	0.009	0.014	<0.03	0.089	0.120	1.4	2.99	60.1	3640
Downstream	0.007	0.016	0.01	0.256	0.300	1.9	2.75	75.9	7590
6/29/2017									
Upstream	0.007	0.016	0.01	0.083	0.130	1.1	3.1	52.9	3950

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.010	0.018	0.02	0.293	0.360	1.8	2.27	28.8	3410
7/5/2016									
Upstream	0.011	0.028	<0.03	0.094	0.180	2.5	2.76	261.3	9060
Downstream	0.011	0.026	<0.03	0.169	0.270	3.1	2.29	185.0	18500
7/11/2017									
Upstream	0.004	0.026	0.01	0.064	0.110	1.5	2.56	585.0	5860
Downstream	0.006	0.014	<0.03	0.154	0.210	1.5	1.45	55.4	11120
7/19/2017									
Upstream	0.003	0.03	0.01	0.105	0.130	1.3	0.92	27.2	7514.7
Downstream	0.005	0.016	0.01	0.232	0.280	1.7	0.53	35.0	9060
7/26/2017									
Upstream	0.005	0.014	0.04	0.162	0.290	3.6	1.87	166.4	11530
Downstream	0.005	0.018	0.03	0.364	0.450	3.1	1.78	28.1	15660
8/3/2017									
Upstream	0.005	0.022	0	0.136	0.210	1	0.89	27.2	6500
Downstream	0.000	0.032	0.01	0.185	0.250	1.1	7.88	ND §	ND
8/9/2017									
Upstream	0.008	0.022	0.04	0.162	0.210	1	0.5	177.9	7710

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.010	0.036	0.02	0.351	0.440	1.5	0.38	23.1	7980
8/16/2017									
Upstream	0.010	0.03	<0.03	0.092	0.210	3.9	2.5	648.8	13540
Downstream	0.010	0.028	<0.03	0.216	0.320	3.3	1.66	157.6	12960
8/24/2017									
Upstream	0.011	0.038	<0.03	0.132	0.280	3.3	2.35	344.8	18420
Downstream	0.012	0.040	0.01	0.192	0.330	3.5	2.37	261.3	31300
8/31/2017									
Upstream	0.009	0.024	0.02	0.075	0.150	1.5	0.73	105.0	5370
Downstream	0.010	0.026	<0.03	0.167	0.230	2.7	1.08	47.2	10460
9/6/2017									
Upstream	0.008	0.020	<0.03	0.126	0.180	1.1	0.50	66.3	4280.0
Downstream	0.019	0.019	0.01	0.246	0.330	1.7	0.51	51.2	6970.0
9/13/2017									
Upstream	0.011	0.022	0.01	0.132	0.220	2.3	0.87	410.6	16070.0
Downstream	0.015	0.024	0.02	0.355	0.430	2.5	0.52	18.7	7280.0
10/23/2017									
Upstream	0.025	0.042	0.02	0.469	0.640	1.7	1.26	1046.2	39680.0

Sample location	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
Downstream	0.017	0.044	0.02	1.056	1.370	4.5	2.25	1732.9	270.0
Samples collected and analyzed since the last quarterly report									
12/13/2017									
Upstream	0.007	0.164	0.01	0.067	0.100	0.3	0.41	10.8	>2419.2
Downstream	0.012	0.016	0.02	0.438	0.520	1.1	0.16	3.1	1553.1
1/4/2018									
Upstream	0.006	0.006	0.01	0.165	0.270	1.3	2.19	18.3	2880.0
Downstream	0.009	0.009	0.01	0.300	0.410	0.5	2.22	2.0	613.1
1/18/2018									
Upstream	0.007	0.007	0.01	0.214	0.300	0.5	1.97	14.5	547.5
Downstream	0.005	0.005	0.02	0.125	0.180	0.5	2.14	24.7	>2419.2
1/30/2018									
Upstream	0.006	0.007	0.00	0.143	0.210	1.1	2.40	18.9	613.1
Downstream	0.005	0.005	0.00	0.163	0.230	4.6	2.22	4.1	579.4
2/14/2018									
Upstream	0.006	0.006	0.01	0.064	0.090	0.7	0.82	53.0	613.1
Downstream	0.008	0.008	0.01	0.150	0.220	1.4	1.29	35.5	816.1
2/22/2018									

Upstream	0.008	0.043	0.01	0.358	0.460	5.7	2.89	261.3	>2419.2
Downstream	0.011	0.050	0.03	0.499	0.720	6.5	3.19	387.3	2650.0

¶ Values proceeded by '<' were reported by the analytical laboratory as zero and the Minimum detection limit is given.

§ ND is No Data, due to coliform not measured on water samples collected automatically by non-sterilized ISCO sampler.

Nutrients, Sediment, and Bacteria by Site for Ephemeral Stream, Trenches, Left Fork and Field Runoff

Table 7. Water quality analyses at the ephemeral stream draining the subwatershed containing the production houses and manure holding ponds, and surface runoff from Fields 1, 5a, and 12 since January, 2017, with those collected since the last report noted.

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
	---------- mg/L ----------							--- MPN/100 mL ---	
Ephemeral stream									
2/15/2017	0.020	0.064	0.02	1.323	1.45	3.1	5.06	166.9	5630.0
3/1/2017	0.011	0.016	0.02	0.659	0.71	1.5	6.75	195.6	5730.0
3/16/2017	0.005	0.021	<0.03 ¶	0.738	0.800	0.8	2.99	14.8	2419.2
3/27/2017	0.151	0.268	0.29	1.704	3.30	448.3	16.47	18500.0	66530.0
3/30/2017	0.005	0.032	0.01	0.796	0.86	8.6	1.89	2.7	224.0
4/6/2017	0.008	0.022	<0.03	0.717	0.76	1.6	1.69	148.3	1986.3
4/6/2017	0.018	0.080	0.06	0.807	1.14	19.9	4.14	ND §	ND
4/17/2017	0.005	0.018	<0.03	0.651	0.68	0.9	1.71	410.6	7270.0
4/24/2017	0.007	0.128	0.04	0.000	1.83	318.0	7.35	ND	ND
4/27/2017	0.042	0.253	0.01	0.302	2.57	734.5	8.29	186.0	>2419.2
5/18/2017	0.012	0.020	<0.03	0.692	0.75	1.7	1.76	49.6	2419.2
5/31/2017	0.009	0.020	<0.03	0.769	0.79	2.5	1.53	275.5	3500.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
6/5/2017	0.010	0.028	<0.03	0.706	0.710	1.5	2.38	613.1	5830
6/6/2017	0.041	0.816	0.14	0.58	4.610	1788.2	9.24	ND	ND
6/12/2017	0.010	0.882	<0.03	0.732	0.730	0.6	0.67	33.6	2419.2
10/23/2017	0.109	0.348	0.70	5.834	9.820	538.3	13.53	ND	ND
Samples collected and analyzed since the last quarterly report									
2/22/2018	0.009	0.037	0.01	1.869	2.030	1.4	4.22	90.6	2720.0
House well									
1/5/2017	0.008	0.014	0.04	0.610	0.66	0.3	0.30	<1.0	<1.0
1/19/2017	0.009	0.013	0.03	0.617	0.69	0.9	7.87	<1.0	<1.0
2/2/2017	0.011	0.031	0.01	0.614	0.78	0.4	2.22	<1.0	<1.0
2/15/2017	0.008	0.023	0.02	0.649	0.72	0.5	2.07	<1.0	<1.0
3/1/2017	0.012	0.040	0.03	0.620	0.72	0.5	5.85	<1.0	<1.0
3/16/2017	0.009	0.023	<0.03	0.856	0.88	0.1	1.52	<1.0	1.0
3/27/2017	0.007	0.038	0.02	0.573	0.63	1.6	3.83	18.1	261.3
4/13/2017	0.011	0.020	<0.03	0.564	0.59	0.1	6.22	<1.0	1.0
4/17/2017	0.006	0.016	0.01	0.563	0.57	0.2	1.94	<1.0	12.1

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/27/2017	0.011	0.014	<0.03	0.532	0.49	0.1	0.69	5.1	52.8
5/18/2017	0.011	0.020	<0.03	0.431	0.60	0.6	5.05	1.0	3.1
5/31/2017	0.019	0.026	<0.03	0.605	0.92	0.4	1.86	<1.0	22.1
6/5/2017	0.008	0.026	0.01	0.586	0.590	0.3	0	6.3	48
6/12/2017	0.010	0.012	<0.03	0.591	0.590	0	1.2	<1.0	3.1
6/19/2017	0.009	0.014	0.02	0.582	0.580	0.3	6.92	<1.0	<1.0
6/29/2017	0.009	0.014	0.01	0.574	0.640	0.3	4.39	1.0	2
7/5/2016	0.009	0.01	<0.03	0.57	0.570	0	2.61	1.0	31.1
7/11/2017	0.006	0.012	0.03	0.573	0.570	0.3	3.5	<1.0	1
7/19/2017	0.005	0.012	0.04	0.73	0.730	0	0.47	<1.0	<1.0
7/26/2017	0.004	0.012	0.01	0.779	0.820	0.1	2.62	<1.0	<1.0
8/3/2017	0.006	0.018	0.02	0.542	0.630	0	1.09	<1.0	1
8/9/2017	0.008	0.02	<0.03	0.596	0.630	0.3	0.03	<1.0	<1.0
8/16/2017	0.016	0.016	<0.03	0.652	0.650	0.3	1.83	<1.0	2
8/24/2016	0.014	0.018	<0.03	0.625	0.640	0.2	0.59	<1.0	4.1
8/31/2017	0.010	0.018	0.01	0.664	0.660	0.5	0.52	1.0	4.1
9/6/2017	0.010	0.018	0.01	0.669	0.690	0.3	0.25	<1.0	<1.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
9/13/2017	0.012	0.016	0.02	0.664	0.690	1.2	0.33	<1.0	<1.0
9/21/2017	0.007	0.016	<0.03	0.671	0.680	0.0	1.33	<1.0	1.0
9/28/2017	0.014	0.018	0.03	0.623	0.680	0.6	2.16	<1.0	<1.0
10/5/2017	0.014	0.014	0.03	0.660	0.690	0.2	0.60	<1.0	17.5
10/12/2017	0.010	0.016	<0.03	0.660	0.730	0.0	0.28	<1.0	<1.0
10/18/2017	0.009	0.010	0.01	0.632	0.780	0.5	0.04	<1.0	1.0
10/23/2017	0.010	0.012	<0.03	0.641	0.800	0.0	0.13	<1.0	6.3
11/1/2017	0.012	0.018	0.01	0.833	0.960	0.0	0.24	<1.0	<1.0
11/9/2017	0.009	0.012	0.01	0.770	0.860	0.3	7.98	<1.0	<1.0
11/15/2017	0.007	0.007	0.02	0.789	0.850	0.0	0.00	<1.0	1.0
11/30/2017	0.009	0.024	0.04	0.717	0.850	0.0		<1.0	<1.0
Samples collected and analyzed since the last quarterly report									
12/13/2017	0.010	0.011	0.03	0.683	0.840	0.3	0.00	<1.0	2.0
12/18/2017	0.010	0.010	0.02	0.683	0.810	0.5	1.76	<1.0	<1.0
1/4/2018	0.007	0.007	0.01	0.683	0.840	0.1	3.05	<1.0	1.0
1/18/2018	0.006	0.006	0.03	0.670	0.820	0.3	0.72	<1.0	<1.0
1/30/2018	0.009	0.009	0.00	0.642	0.800	0.4	4.84	<1.0	<1.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
2/14/2018	0.008	0.008	0.04	0.611	0.820	0.6	1.27	<1.0	<1.0
2/22/2018	0.007	0.024	0.01	0.697	0.900	0.2	3.19	<1.0	<1.0
Interceptor Trench 1 (South)									
2/15/2017	0.004	0.023	0.01	0.141	0.20	1.3	0.45	1.0	1299.7
3/16/2017	0.006	0.020	<0.03	0.083	0.11	1.1	1.87	<1.0	179.3
3/27/2017	0.004	0.048	0.03	0.129	0.39	3.1	4.36	387.3	17230.0
4/6/2017	0.004	0.022	0.03	0.165	0.30	17.2	1.98	47.2	2750.0
4/24/2017	0.005	0.040	0.20	0.133	1.76	18.5	7.04	ND	ND
4/27/2017	0.006	0.048	1.04	0.081	1.43	7.2	4.04	40.4	3990.0
Samples collected and analyzed since the last quarterly report									
2/22/2018	0.008	0.043	0.06	1.334	1.590	2.1	3.55	8.4	6113.0
Interceptor Trench 2 (North)									
2/15/2017	0.004	0.087	0.04	0.486	1.12	6.1	5.99	19.7	42860.0
3/1/2017	0.002	0.050	0.04	0.345	0.76	11.6	4.90	98.8	34480.0
3/27/2017	0.009	0.102	0.13	0.060	0.82	7.0	7.13	488.4	29240.0
4/24/2017	0.010	0.084	0.04	0.087	0.93	8.2	8.78	ND	ND

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/27/2017	0.006	0.046	0.04	0.029	0.42	2.4	4.95	115.3	2419.2
6/5/2017	0.003	0.086	0.02	0.018	0.750	8.7	7.04	2780.0	241920
11/15/2017	0.009	0.275	0.06	5.959	8.280	23.0	4.20	9080.0	241960
No samples collected since the last quarterly report									
Left Fork									
1/5/2017	0.006	0.011	0.03	0.229	0.26	0.7	0.85	6.2	1732.9
1/19/2017	0.010	0.019	0.03	0.243	1.00	2.6	4.25	55.4	>2419.2
2/2/2017	0.008	0.019	0.01	0.139	0.18	1.1	1.69	17.1	>2419.2
2/15/2017	0.015	0.080	0.03	0.314	0.60	17.7	4.66	648.8	11060.0
3/1/2017	0.008	0.024	0.02	0.136	0.28	4.3	2.46	1119.9	4260.0
3/16/2017	0.009	0.043	<0.03	0.300	0.41	3.1	1.77	45.5	>2419.2
3/27/2017	0.058	0.164	0.17	0.206	1.50	1005.1	8.51	9330.0	38770.0
4/6/2017	0.010	0.048	0.01	0.222	0.41	4.7	2.32	135.4	2780.0
4/13/2017	0.010	0.024	<0.03	0.123	0.21	1.6	2.75	22.3	>2419.2
4/17/2017	0.040	0.112	0.02	0.173	0.46	19.5	4.55	9090.0	129970.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/27/2017	0.016	0.046	<0.03	0.306	0.32	16.4	2.08	275.5	7230.0
5/18/2017	0.009	0.022	<0.03	0.167	0.26	1.9	1.54	50.4	2419.2
5/31/2017	0.008	0.020	0.00	0.156	0.22	1.5	1.58	260.2	4720.0
6/5/2017	0.011	0.07	0.01	0.179	0.320	14.4	1.63	579.4	24000
6/12/2017	0.006	0.016	<0.03	0.143	0.190	0.9	1.17	77.1	4350
6/19/2017	0.006	0.018	0.01	0.226	0.280	2.1	2.15	32.3	4130
6/29/2017	0.010	0.016	0.02	0.236	0.320	1.3	2.77	29.8	3640
7/11/2017	0.005	0.02	0.02	0.125	0.210	3	2.52	73.8	12590
7/19/2017	0.004	0.018	0.01	0.213	0.310	6.4	1.62	19.3	10810
7/26/2017	0.003	0.016	0.05	0.223	0.370	2.7	1.89	27.8	14670
8/3/2017	0.003	0.022	0.04	0.221	0.360	2	1.24	14.6	7800
8/9/2017	0.007	0.032	0.03	0.259	0.370	2.1	0.78	60.9	5300
8/16/2017	0.010	0.028	0.01	0.659	0.770	4.6	2.2	517.2	15530
8/31/2017	0.008	0.024	<0.03	0.063	0.140	2.2	0	55.7	6570
9/6/2017	0.011	0.024	0.01	0.101	0.200	1.9	0.76	133.3	7800.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
9/13/2017	0.010	0.028	0.02	0.130	0.220	1.7	0.69	18.7	6270.0
9/21/2017	0.007	0.026	<0.03	0.143	0.270	2.1	2.43	10.9	6380.0
9/28/2017	0.010	0.026	0.02	0.106	0.200	1.8	2.64	3.1	7120.0
10/5/2017	0.011	0.022	0.01	0.135	0.240	2.3	0.24	10.9	8570.0
10/12/2017	0.011	0.020	<0.03	0.122	0.180	0.8	0.80	17.3	4410.0
10/18/2017	0.010	0.018	0.01	0.129	0.270	2.3	1.14	4.1	3640.0
10/23/2017	0.022	0.058	0.01	1.042	1.350	5.9	2.36	3090.0	39680.0
11/1/2017	0.010	0.014	0.01	0.189	0.270	0.0	0.94	23.8	2419.2
11/9/2017	0.009	0.016	0.01	0.130	0.250	0.6	6.44	16.9	4410.0
11/15/2017	0.006	0.015	0.03	0.142	0.260	0.2	0.68	3.1	198630.0
11/30/2017	0.005	0.016	0.05	0.122	0.230	1.1		10.0	1732.0
Samples collected and analyzed since the last quarterly report									
12/13/2017	0.005	0.007	0.01	0.256	0.300	0.1	0.34	8.4	1299.7
12/18/2017	0.004	0.004	0.01	0.194	0.300	0.0	1.53	27.2	>2419.2
1/4/2018	0.004	0.005	0.01	0.228	0.310	0.7	1.58	1.0	461.1

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
1/18/2018	0.002	0.002	0.01	0.128	0.180	0.6	1.17	1.0	461.1
1/30/2018	0.005	0.005	0.00	0.216	0.280	4.0	2.37	9.7	686.7
2/14/2018	0.004	0.004	0.01	0.143	0.143	1.2	1.29	13.4	866.4
2/22/2018	0.015	0.057	0.02	0.660	0.880	7.4	3.32	238.2	4130.0
Field 1									
10/13/2016	0.940	1.231	0.13	0.335	2.36	59.0	16.67	N.S.	N.S.
3/27/2017	0.420	0.670	0.43	0.090	18.70	124.4	9.29	8390.0	45690.0
4/24/2017	0.395	0.592	0.13	0.143	1.50	43.1	7.25	ND	ND
4/27/2017	0.550	0.784	0.08	0.107	1.32	52.2	8.46	ND	ND
6/6/2017	0.747	0.998	0.51	0.438	2.340	56	10.39	ND	ND
No samples collected and analyzed since the last quarterly report									
Field 5a									
3/31/2016	1.154	1.352	0.27	0.302	1.67	26.5	32.74	ND	ND
5/10/2016	1.114	1.458	1.69	2.894	6.35	79.9	12.82	ND	ND
3/27/2017	2.980	3.232	1.40	0.122	1.80	30.2	32.01	2419.2	69100.0

Date sample collected	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Total suspended solids	Dissolved Organic C	E. coli	Total coliform
4/24/2017	0.961	1.212	0.12	0.321	1.53	11.7	11.53	ND	ND
4/27/2017	0.686	0.846	0.07	0.063	0.86	11.3	7.26	ND	ND
6/6/2017	1.000	1.430	0.05	1.861	2.380	<10.0	6.21	ND	ND
Samples collected and analyzed since the last quarterly report									
2/21/2018	1.496	2.078	0.14	0.307	2.990	66.9	17.12	ND	ND
Field 12									
3/10/2016	0.411	0.522	1.17	0.852	4.49	621.5	12.58	ND	ND
5/10/2016	0.370	0.666	0.12	0.062	1.03	96.7	6.92	ND	ND
3/27/2017	0.800	1.276	2.02	2.798	6.04	134.2	9.35	7120.0	96060.0
4/27/2017	0.326	0.544	0.02	0.105	0.71	102.3	5.64	ND	ND
6/6/2017	0.316	0.470	0.03	0.166	1.660	280.8	6.65	ND	ND
No samples collected since the last quarterly report									

¶ Values proceeded by '<' were reported by the analytical laboratory as zero and the minimum detection limit is given.

§ ND is No Sample. E. coli and total coliform were not measured on surface runoff samples collected by ISCO samplers when sample holding time exceeded the required 8-hour threshold.

Water pH, Alkalinity, Chloride, Electrical Conductivity, and Total Dissolved Solids for Several Big Creek Sites

At the beginning of 2015, the pH, alkalinity, chloride concentration, electrical conductivity and total dissolved solids were determined on water samples collected at the upstream and downstream sites, spring, house well, and trenches, to build a data base that will enable to eventually source track the major water source pathways at these sites. These values are given below in Table 8.

Table 8. The pH, Chloride concentration, and electrical conducting of water samples collected at upstream, downstream, spring, ephemeral stream, house well and trench sites, initiated at the beginning of 2017, with those collected since the last report noted.

Date	pH	Chloride	Electrical conductivity
		mg/L	µS/cm
Upstream			
1/5/2017	8.8	2.264	142.0
1/19/2017	7.9	2.089	
2/2/2017	8.4	2.044	112.0
2/15/2017	7.9	2.022	128.0
3/1/2017	8.4	1.696	115.0
3/16/2017	7.8	1.508	88.0
3/27/2017	7.6	0.997	50.0
4/6/2017	7.5	1.436	72.0
4/13/2017	7.8	1.392	76.0
4/17/2017	7.9	1.372	95.8
4/27/2017	7.7	1.003	68.0
5/18/2017	8.3	1.518	110.0
5/31/2017	8.0	1.296	122.0
6/5/2017	7.9	0.781	75.0
6/12/2017	8.0	1.231	120.0
6/19/2017	7.8	1.379	146.0

Date	pH	Chloride	Electrical conductivity
6/29/2017	7.8	1.554	170.0
7/5/2017	7.6	1.235	109.0
7/11/2017	8.2	1.543	113.0
7/19/2017	8.4	1.415	174.0
7/26/2017	7.8	1.664	193.0
8/3/2017	7.9	1.690	206.0
8/9/2017	8.0	1.930	206.0
8/16/2017	7.4	1.199	163.0
8/24/2017	8.1	1.381	133.0
8/31/2017	8.2	1.461	161.0
9/6/2017	8.0	1.697	184.0
9/13/2017	7.9	2.009	194.0
10/23/2017	7.9	2.082	253.0
Samples collected and analyzed since the last quarterly report			
12/13/2017	8.0	2.126	168.0
1/4/2018	8.1	1.771	153.0
1/18/2018	8.3	2.198	143.0
1/30/2018	7.8	2.148	111.0
2/14/2018	8.5	4.213	129.0
2/22/2018	7.5	1.430	66.0
Downstream			
1/5/2017	8.1	5.692	220.0
1/19/2017	7.6	2.390	
2/2/2017	7.9	2.414	171.0
2/15/2017	8.2	2.199	119.0
3/1/2017	7.8	2.926	162.0

Date	pH	Chloride	Electrical conductivity
3/16/2017	7.5	1.792	128.0
3/27/2017	7.5	1.113	69.0
4/6/2017	7.5	1.649	106.0
4/13/2017	7.7	1.665	114.0
4/17/2017	7.8	1.849	162.9
4/27/2017	7.6	1.160	102.0
5/18/2017	7.7	2.009	172.0
5/31/2017	8.0	1.714	171.0
6/5/2017	7.7	1.810	178.0
6/12/2017	7.9	1.942	225.0
6/19/2017	7.9	2.643	224.0
6/29/2017	7.6	2.652	231.0
7/5/2017	7.7	2.841	246.0
7/11/2017	7.8	1.716	201.0
7/19/2017	7.8	1.350	161.0
7/26/2017	7.3	1.690	213.0
8/3/2017	7.9	1.810	178.0
8/9/2017	7.9	1.942	225.0
8/16/2017	7.6	2.643	224.0
8/24/2017	7.9	2.652	231.0
8/31/2017	8.0	2.841	246.0
9/6/2017	7.7	2.132	214.0
9/13/2017	7.7	2.517	251.0
9/21/2017	7.5	2.788	282.0
9/28/2017	7.8	2.882	281.0
10/5/2017	7.5	3.041	292.0
10/12/2017	7.5	3.305	272.0

Date	pH	Chloride	Electrical conductivity
10/18/2017	7.8	3.391	307.0
10/23/2017	7.6	3.722	292.0
11/1/2017	7.5	3.016	262.0
11/9/2017	7.6	3.640	268.0
11/15/2017	7.8	3.114	217.0
11/30/2017	7.6	3.163	176.0
Samples collected and analyzed since the last quarterly report			
12/13/2017	7.8	3.041	280.0
12/18/2017		3.288	
1/4/2018	8.3	2.288	210.0
1/18/2018	8.1	2.516	224.0
1/30/2018	8.0	2.330	160.0
2/14/2018	7.9	2.598	178.0
2/22/2018	7.4	1.559	96.0
Spring			
1/5/2017	7.2	2.462	504.0
1/19/2017	7.1	2.397	
2/2/2017	7.1	3.099	546.0
2/15/2017	7.3	2.305	353.0
3/16/2017	7.4	2.618	602.0
3/27/2017	7.3	1.223	373.0
4/6/2017	7.1	2.010	486.0
4/13/2017	7.1	2.810	547.0
4/17/2017	7.2	1.720	445.0
4/27/2017	7.4	1.565	476.0
5/18/2017	7.0	1.988	474.0

Date	pH	Chloride	Electrical conductivity
5/31/2017	7.5	1.305	471.0
6/5/2017	7.5	1.042	469.0
6/12/2017	8.0	1.532	482.0
6/19/2017	7.5	1.766	527.0
6/29/2017	7.2	1.982	451.0
7/5/2017	7.0	1.265	438.0
7/11/2017	7.1	1.972	521.0
7/19/2017	7.1	2.299	567.0
7/26/2017	6.8	2.394	559.0
8/3/2017	7.4	2.349	539.0
8/9/2017	7.4	2.129	518.0
8/16/2017	7.5	1.590	430.0
8/24/2017	7.2	1.690	459.0
8/31/2017	7.5	2.068	560.0
9/6/2017	7.1	2.276	570.0
9/13/2017	7.0	2.133	317.0
10/23/2017	7.0	2.784	409.0
Samples collected and analyzed since the last quarterly report			
2/22/2018	7.2	2.067	371.0
Ephemeral Stream			
2/15/2017	7.7	3.366	270.0
3/1/2017	7.8	4.328	396.0
3/16/2017	7.5	3.415	354.0
3/27/2017	7.4	4.373	180.0
3/30/2017	7.8	2.705	224.0
4/6/2017	7.3	3.154	223.0

Date	pH	Chloride	Electrical conductivity
4/13/2017	7.7	3.585	377.0
4/17/2017	7.5	3.997	394.0
4/23/2017	7.5	2.221	321.0
4/27/2017	7.5	1.414	109.0
5/18/2017	7.6	3.247	346.0
5/31/2017	8.0	3.161	380.0
6/5/2017	7.3	1.834	230.0
6/12/2017	8.1	2.961	363.0
10/23/2017	7.7	2.149	152.0
Samples collected since the last quarterly report			
2/22/2018	7.1	2.460	236.0
House Well			
1/5/2017	7.8	5.371	421.0
1/19/2017	7.4	5.234	420.0
2/2/2017	7.5	5.290	420.0
2/15/2017	7.6	5.401	397.0
3/1/2017	7.5	5.162	432.0
3/16/2017	7.5	5.453	416.0
3/27/2017	7.8	5.192	438.0
4/13/2017	7.4	5.508	445.0
4/17/2017	7.5	5.315	285.0
4/27/2017	7.5	5.000	429.0
5/1/2017	7.6	5.021	436.0
5/11/2017	7.4	6.819	433.0
5/18/2017	7.4	5.024	406.0
5/25/2017	7.7	4.124	442.0
5/31/2017	7.7	4.859	327.0

Date	pH	Chloride	Electrical conductivity
6/5/2017	7.82	4.744	425
6/12/2017	7.87	5.025	415
6/19/2017	7.57	5.140	185
6/29/2017	7.44	5.209	438
7/5/2016	7.36	5.105	417
7/11/2017	7.65	5.136	389
7/19/2017	7.45	12.717	430
7/26/2017	7.34	5.722	402
8/3/2017	7.75	5.085	419
8/9/2017	7.75	5.107	419
8/16/2017	8.00	5.121	413
8/24/2016	7.80	5.115	314
8/31/2017	7.75	4.910	419
9/13/2017	7.6	5.198	426.0
9/21/2017	7.4	5.065	440.0
9/28/2017	7.5	5.555	442.0
10/5/2017	7.2	5.461	433.0
10/12/2017	7.5	5.544	429.0
10/18/2017	7.5	5.149	436.0
10/23/2017	7.6	5.143	427.0
11/1/2017	7.3	5.622	457.0
11/9/2017	7.4	5.375	464.0
11/15/2017	7.7	5.431	446.0
11/30/2017	7.4	6.020	334.0
Samples collected and analyzed since the last quarterly report			
12/13/2017	7.4	7.786	434.0
12/18/2017		5.410	

Date	pH	Chloride	Electrical conductivity
1/4/2018	7.8	5.025	321.0
1/18/2018	8.3	5.282	450.0
1/30/2018	7.7	5.334	436.0
2/14/2018	7.5	5.684	405.0
2/22/2018	7.3	5.088	317.0
Trench 1			
2/15/2017	8.0	2.344	397.0
3/16/2017	7.8	1.483	164.0
3/27/2017	7.4	1.018	164.0
4/6/2017	7.4	1.877	168.0
4/24/2017	7.4	0.895	160.0
4/27/2017	7.8	0.557	150.0
5/1/2017	7.7	1.193	172.0
Samples collected and analyzed since the last quarterly report			
2/22/2018	7.2	1.094	134.0
Trench 2			
2/15/2017	8.0	1.164	135.0
3/1/2017	7.3	0.808	159.0
3/27/2017	7.1	0.376	90.0
4/6/2017	7.0	0.325	175.0
4/24/2017	7.3	0.322	134.0
4/27/2017	7.5	0.217	129.0
5/1/2017	7.7	0.340	157.0
6/5/2017	7.0	0.298	160.0
11/15/2017	7.7	3.490	264.0
No samples collected since the last quarterly report			

Discharge at USGS 07055790 Site Downstream of C&H Operation

Discharge downstream of the C&H Farm (USGS station 07055790 Big Creek near Mt. Judea, AR) is available at https://nwis.waterdata.usgs.gov/ar/nwis/uv/?cb_00065=on&cb_00045=on&cb_00010=on&format=gif_default&period=&begin_date=2014-04-16&end_date=2014-04-23&site_no=07055790

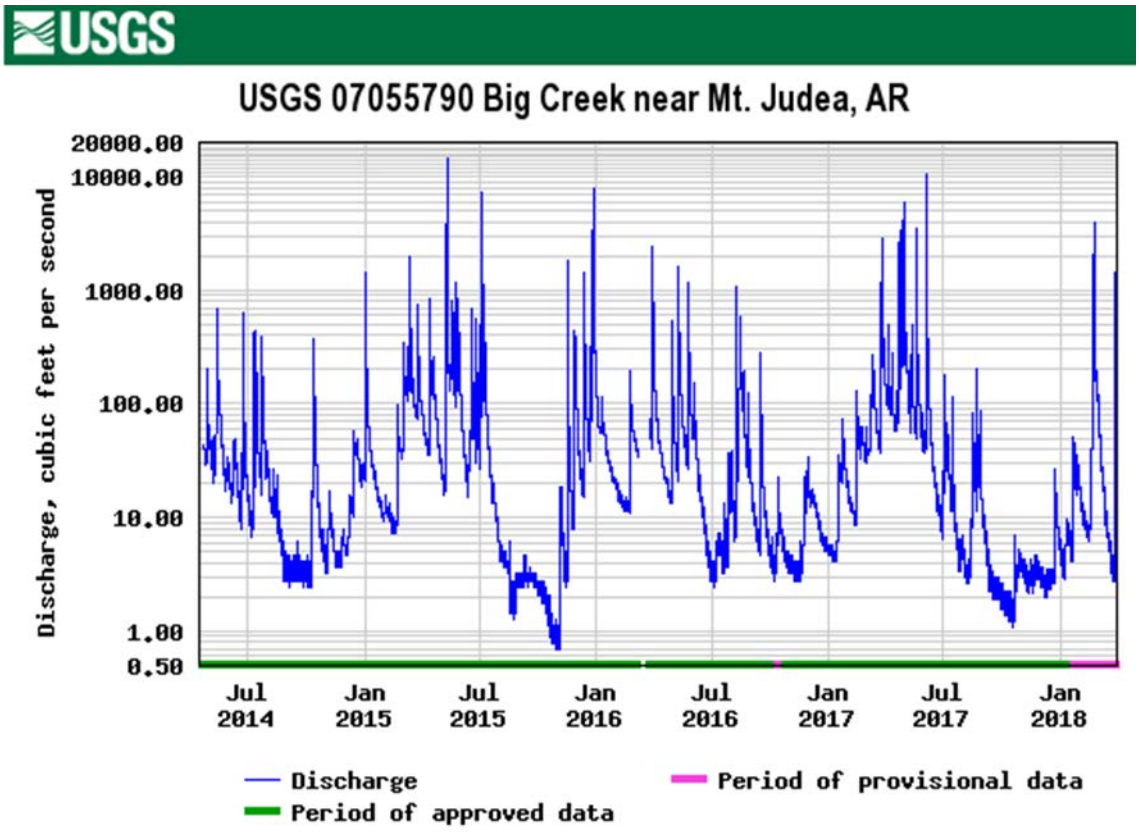

Figure 2. Discharge in Big Creek downstream of the C&H Farm for the period of monitoring; December 1, 2017 to April 1, 2018.

Surface Runoff from Fields 1, 5a and 12

Field Site Description

Surface runoff from Fields 1, 5a, and 12 has been collected after storm rainfall-induced runoff. The catchment area for each flume located on Fields 1, 5a, and 12 is depicted in Figures 3, 4, and 5, respectively. The catchment area is that which contributes runoff water to our monitoring site. Due to natural slope and elevation changes in all fields, the flumes do not collect runoff water from the entire field. Also depicted on Figures 3, 4, and 5, are buffers imposed by the C&H ADEQ permit for ponds, school, slope, and stream, where no slurry can be applied to Fields 1, 5a, and 12, respectively. On Fields 5a and 12, the owners of the C&H Farm have implemented a 100 ft. buffer along the Big Creek boundary, rather than the required 50 ft. buffer. These buffers are delineated on Fields 5 and 5a on Figure 4, even though Field 5a is not permitted to receive, nor has received swine slurry to date. Field 5 is not part of the C&H Farm plan does not receive slurry. We do not have an agreement to work with the owners of Field 5 and thus do not know how much fertilizer, in mineral or chicken litter form, has or is being applied.

The field area, flume catchment area, and area to which slurry can be applied to Fields 1, 5a, and 12 is given in Table 9. Annual amounts and rates of commercial fertilizer (Field 5a) and slurry from the C&H operation (Fields 1 and 12) are given in Table 10. The slurry rates are obtained from ADEQ annual management reports for the farm and commercial fertilizer application from the landowner.

Surface Runoff of Nutrient and Sediment

The flow-weighted event concentration of nutrients and sediment in surface runoff from each Field are detailed in Table 11, along with runoff volume. As noted earlier in the Methods section, all surface runoff samples are collected by ISCO autosamplers programed to initiate sample collection when a critical stage height is exceeded (see Table 2). Pacing of sample collection is subsequently programmed to a specific volume of flow, as detailed in Table 2. This standard operating procedure for ISCO autosamplers results in the collection of one flow-weighted sample, which is subsequently analyzed.

Based on flow-weighted concentration and flow for each surface runoff event, the amount of nutrients and sediment based on flume catchment area are determined and presented in Table 12 in English units (i.e., lbs/acre) and in Table 13 in metric units (i.e., g/ha). There was no surface runoff as measured at the flume for Field 12 in 2014.

The annual flow and mean annual flow-weighted concentrations of P, N, and sediment in runoff for 2014, 2015, 2016, and 2017 are given in Table 14. The annual loss of P, N, and sediment in surface runoff from Fields 1, 5a, and 12 for 2014, 2015, 2016, and 2017 is given Table 15 in both English and metric units.

Finally, the amount of P and N applied to the flume catchment area of Fields 1, 5a, and 12, loss in runoff, and percent of applied lost in runoff for 2014, 2015, 2016, and 2017 are given in Table 16. Losses are dominated by high rainfall in 2015 than the other years of monitoring, which led to large runoff volumes (Table 16).

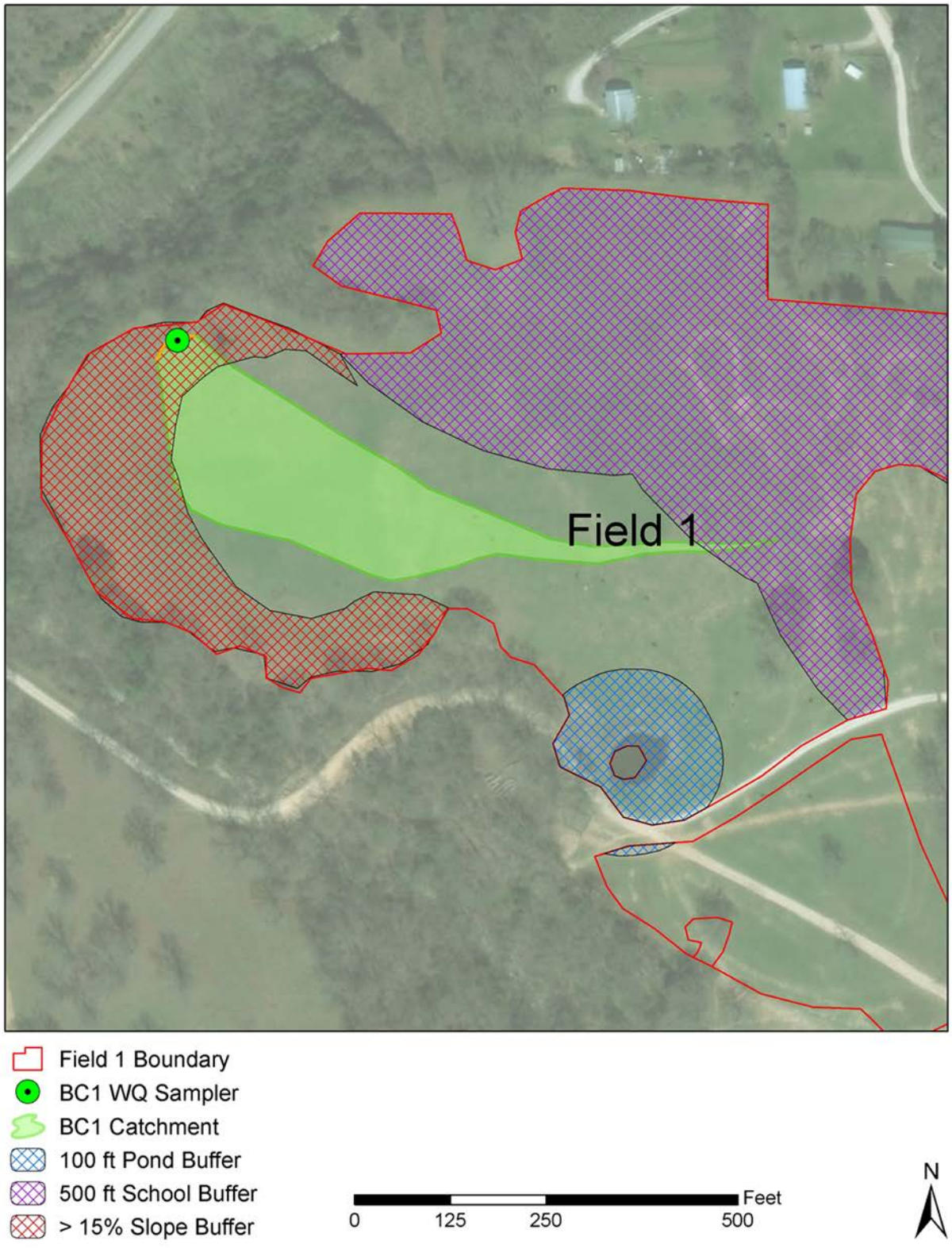

Figure 3. Map of Field 1 showing catchment area for surface runoff flume and buffers where no slurry can be applied.

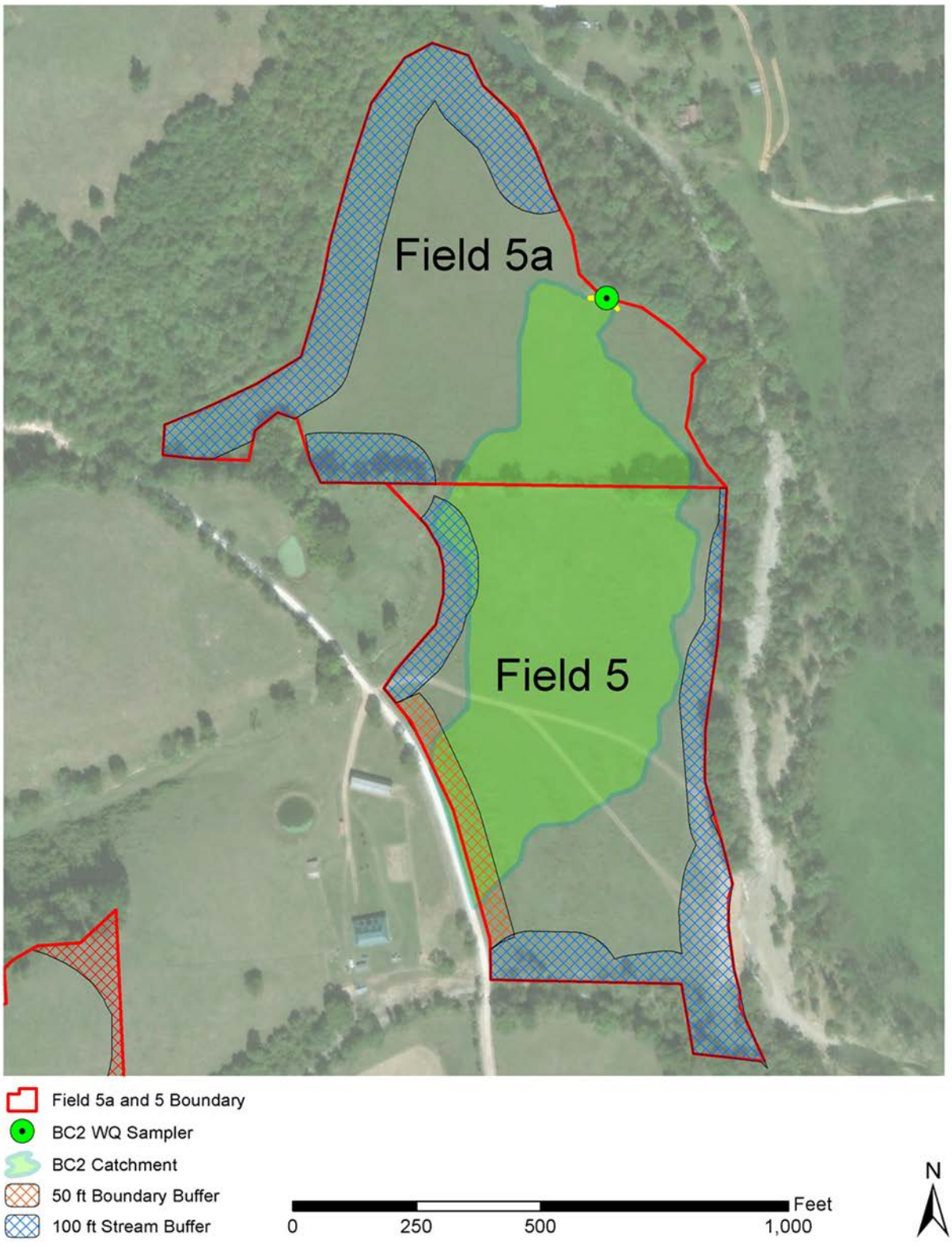

Figure 4. Map of Field 5a showing catchment area for surface runoff flume and buffers where no slurry can be applied.

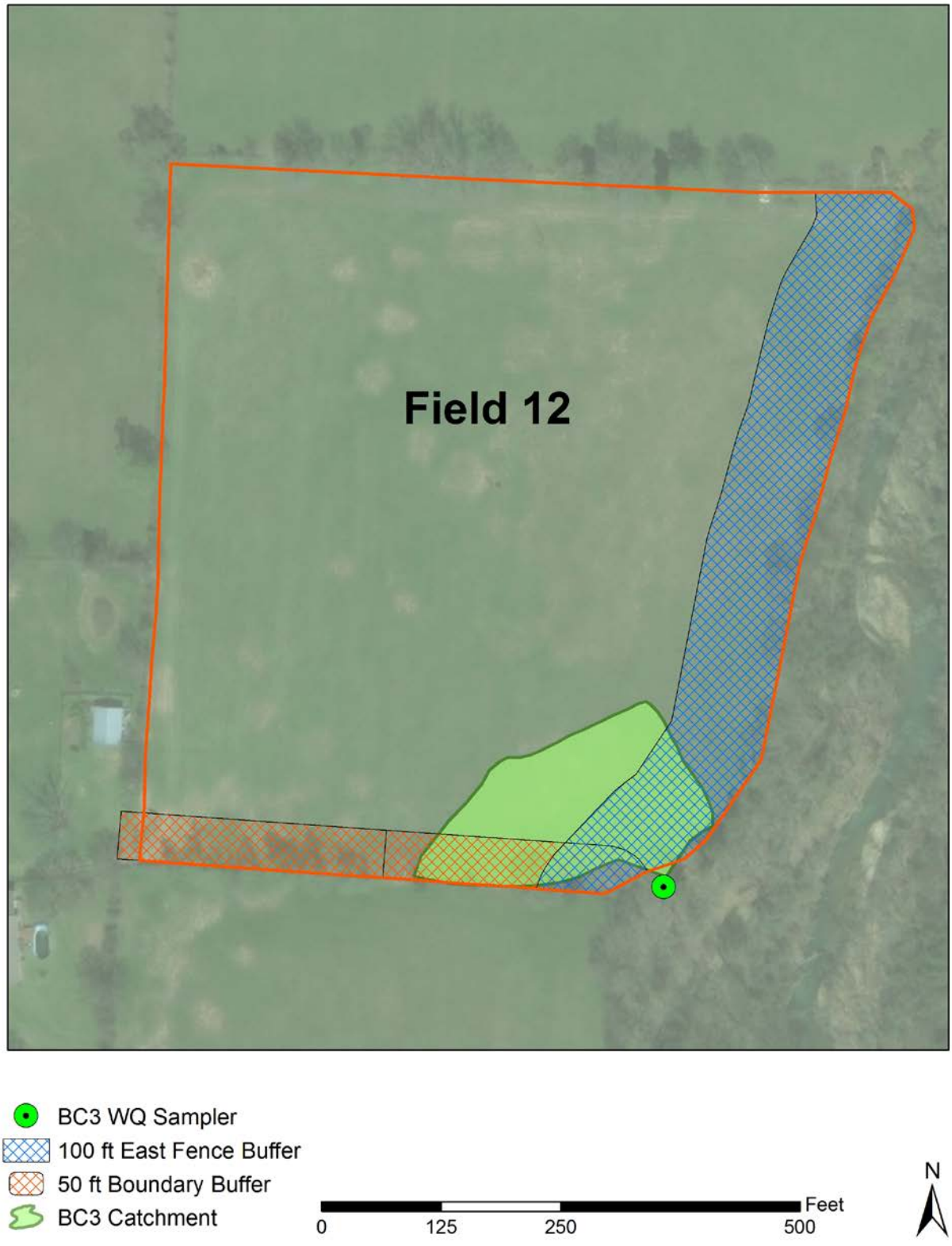

Figure 5. Map of Field 12 showing catchment area for surface runoff flume and buffers where no slurry can be applied.

Table 9. Area of Field 1, 5a, and 12 monitored for surface runoff, area of flume catchment, area of buffers where no slurry is applied, and area of flume receiving slurry.

Site	Site ID	Field area		Flume catchment area		Buffer		Flume catchment area minus buffer		Flume catchment receiving slurry	Area of flume catchment in designated field	
		acres	hectares	acres	hectares	acres	hectares	acres	hectares	%	acres	hectares
Field 1	BC 1	15.6	6.31	1.76	0.71	0.15	0.06	1.61	0.65	91.4	1.76	0.71
Field 5a	BC 2	23.5	9.51	9.58	3.88	0.54	0.22	9.04	3.66	0 [1]	2.21	0.89
Field 12	BC 3	28.7	11.61	0.84	0.34	0.46	0.19	0.38	0.15	45	0.84	0.34

[1] Slurry has not been applied to Field 5a or the adjacent Field 5.

Table 10. Slurry (i.e., Fields 1 and 12) and fertilizer (i.e., Fields 5a) application to the monitored fields for 2014 to 2017.

Site	2014		2015		2016		2017	
Slurry applied, gals								
Field 1	46,000		48,000		78,000		60,000	
Field 12	48,000		93,000		156,000		90,000	
Nutrients applied in slurry, lbs/1000 gallons								
	P	**N**	**P**	**N**	**P**	**N**	**P**	**N**
Field 1	18.1	16.8	60.4	53.2	17.5	30.3	60.3	47.2
Field 12	18.1	16.8	4.8	20.1	17.5	30.3	60.3	47.2
Nutrients applied to field, lbs/acre								
Field 1	53.4	49.5	185.8	163.7	87.5	151.5	231.9	181.5
Field 5a [1]	25.0	57.2	25.0	57.2	25.0	57.2	25.0	57.2
Field 12	30.3	28.1	15.6	65.1	95.1	164.7	189.1	148.0
Nutrients applied to flume catchment, lbs								
Field 1	86	80	299	263	141	244	373	292
Field 5a [1]	55	126	55	126	55	126	55	126
Field 12	12	11	6	25	36	63	72	56
Nutrients applied to field, kg/ha								
Field 1	60	55	208	183	98	170	260	203
Field 5a [1]	28	64	28	64	28	64	28	64
Field 12	34	31	17	73	107	184	212	166
Nutrients applied to flume catchment, kg								
Field 1	39	36	136	120	64	111	169	133
Field 5a [1]	25	57	25	57	25	57	25	57
Field 12	5	5	3	11	16	28	33	26

1. Nutrient applied as 19-19-19 mineral fertilizer (i.e., 19% N, 19% P_2O_5, and 19% K_2O) in early spring at a rate of 300 lbs/acre.

Table 11. Flow and flow-weighted concentration of phosphorus and nitrogen in each runoff event for Fields 1, 5a, and 12 in 2014, 2015, 2016, and 2017.

Date	Flow	Flow	Flow	Flow	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
	gal	L	gal/acre	L/ha	mg/L					
Field 1										
4/4/2014	20,795	78,709	11,815	110,520	0.181	0.638	0.250	0.106	2.080	207.0
5/9/2014	15,956	60,393	9,066	84,802	0.079	0.312	0.170	0.209	1.630	125.9
5/13/2014	15,420	58,365	8,761	81,953	0.190	0.366	0.100	0.126	1.330	42.1
5/28/2014	17,600	66,616	10,000	93,539	0.235	0.310	0.000	0.000	0.000	56.1
6/24/2014	1,440	5,450	818	7,653	0.228	0.498	0.180	0.114	2.390	23.2
6/27/2014	41,380	156,623	23,511	219,924	1.166	1.374	0.100	0.333	1.180	12.3
7/25/2014	4,920	18,622	2,795	26,149	0.648	0.794	0.160	0.388	1.650	5.6
10/14/2014	970	3,671	551	5,155	0.529	0.746	0.980	0.698	2.890	65.7
3/25/2015	4,642	17,570	2,638	24,671	0.143	0.346	0.410	0.216	2.680	65.5
5/8/2015	12,510	47,350	7,108	66,487	0.525	0.714	0.160	0.475	2.190	16.9
5/11/2015	53,439	202,265	30,363	284,013	0.251	0.386	0.090	0.055	0.860	44.4
5/18/2015	960	3,634	545	5,102	0.208	0.512	0.540	0.410	3.590	53.7

Date	Flow	Flow	Flow	Flow	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
5/26/2015	6,010	22,748	3,415	31,942	0.245	0.432	0.200	0.174	1.660	37.8
6/29/2015	6,133	23,214	3,485	32,596	0.354	0.524	0.370	0.226	1.640	11.0
7/7/2015	20,060	75,927	11,398	106,614	0.387	0.444	0.230	0.345	1.300	4.9
10/13/2016	3,755	14,212	2,133	19,955	0.940	1.231	0.130	0.335	2.360	59.0
3/27/2017	19,430	73,543	11,040	103,265	0.420	0.670	0.430	0.090	1.870	124.4
4/24/2017	21,120	79,939	12,000	112,247	0.395	0.592	0.130	0.143	1.500	43.1
4/27/2017	33,110	125,321	18,813	175,971	0.550	0.784	0.080	0.107	1.320	52.2
5/1/2017	49,820	188,569	28,307	264,780	0.534	0.760	0.330	0.321	2.200	36.7
6/6/2017	559,309	2,116,985	317,789	2,972,581	0.747	0.998	0.510	0.438	2.340	56.0
Field 5a										
6/27/2014	20,630	78,085	2,154	20,148	0.506	0.656	0.060	0.000	0.530	39.7
7/25/2014	2,000	7,570	209	1,953	0.625	0.754	0.090	0.000	0.610	9.0
10/13/2014	11,720	44,360	1,224	11,446	0.707	0.926	0.360	0.068	0.910	38.1

Date	Flow	Flow	Flow	Flow	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
3/26/2015	42,743	161,782	4,463	41,745	0.813	1.330	0.390	0.225	2.590	72.3
5/11/2015	5,158,670 [1]	19,525,566	538,621	5,038,229	0.248	0.968	0.260	0.127	1.500	320.1
7/7/2015	155,650	589,135	16,252	152,016	0.094	0.448	0.130	0.172	1.010	261.3
3/31/2016	139,510	528,045	14,566	136,253	1.154	1.352	0.270	0.302	1.670	26.5
5/10/2016	153	580	16	150	1.114	1.458	1.690	2.894	6.350	79.9
4/24/2017	46,638	176,525	4,870	45,549	0.961	1.212	0.120	0.321	1.530	11.7
4/27/2017	251,410	951,587	26,250	245,540	0.686	0.846	0.070	0.063	0.860	11.3
5/1/2017	381,570	1,444,242	39,840	372,661	0.734	0.916	0.220	0.281	1.560	13.1
6/6/2017	359,490	1,360,670	37,535	351,097	1.000	1.430	0.050	1.861	2.380	10.0
Field 12										
5/8/2015	13,630	51,590	16,226	151,779	0.675	0.956	0.140	0.303	1.820	57.0
5/11/2015	853,555	3,230,706	1,016,137	9,504,884	0.194	0.364	0.090	0.135	0.830	36.7
6/1/2015	110	416	131	1,225	0.235	0.482	0.120	0.210	1.110	33.2
6/29/2015	470	1,779	560	5,234	0.396	0.687	0.020	0.143	1.230	22.8

Date	Flow	Flow	Flow	Flow	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
7/6/15	7,000	26,495	8,333	77,950	0.796	0.910	0.130	0.567	1.580	29.0
3/10/2016	2,496	9,445	2,971	27,789	0.411	0.522	1.170	0.852	4.490	621.5
5/2/2016	209	791	249	2,327	0.381	0.600	0.100	0.093	1.268	321.0
5/10/2016	183	694	218	2,042	0.370	0.666	0.120	0.062	1.030	96.7
4/27/2017	73,890	279,674	87,964	822,813	0.326	0.544	0.020	0.105	0.710	102.3
5/1/2017	226,240	856,318	269,333	2,519,328	0.224	0.374	0.030	0.166	1.060	40.6
6/6/2017	102,970	389,741	122,583	1,146,637	0.316	0.470	0.030	0.166	1.660	280.8

[1] Flow measurement by the flume on Field 5a was affected by Big Creek breeching its banks during the 5-11-2015 rainfall – runoff event.

Table 12. Loss of phosphorus and nitrogen in each runoff event as pounds per acre for Fields 1, 5a, and 12 in 2014, 2015, 2016, and 2017.

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
	lbs/ac					
Field 1						
4/4/2014	0.018	0.063	0.025	0.010	0.205	20.393
5/9/2014	0.006	0.024	0.013	0.016	0.123	9.517
5/13/2014	0.014	0.027	0.007	0.009	0.097	3.075
5/28/2014	0.020	0.026	0.000	0.000	0.000	4.678
6/24/2014	0.002	0.003	0.001	0.001	0.016	0.158
6/27/2014	0.229	0.269	0.020	0.065	0.231	2.411
7/25/2014	0.015	0.019	0.004	0.009	0.038	0.131
10/14/2014	0.002	0.003	0.005	0.003	0.013	0.302
3/25/2015	0.003	0.008	0.009	0.005	0.059	1.440
5/8/2015	0.031	0.042	0.009	0.028	0.130	1.002
5/11/2015	0.064	0.098	0.023	0.014	0.218	11.240
5/18/2015	0.001	0.002	0.002	0.002	0.016	0.244
5/26/2015	0.007	0.012	0.006	0.005	0.047	1.076
6/29/2015	0.010	0.015	0.011	0.007	0.048	0.320
7/7/2015	0.037	0.042	0.022	0.033	0.124	0.466
10/13/2016	0.017	0.022	0.002	0.006	0.042	1.049
3/27/2017	0.039	0.062	0.040	0.008	0.172	11.451

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
4/24/2017	0.040	0.059	0.013	0.014	0.150	4.312
4/27/2017	0.086	0.123	0.013	0.017	0.207	8.188
5/1/2017	0.126	0.179	0.078	0.076	0.519	8.662
6/6/2017	1.979	2.644	1.351	1.161	6.200	148.383
Field 5a						
6/27/2014	0.009	0.012	0.001	0.000	0.010	0.713
7/25/2014	0.001	0.001	0.000	0.000	0.001	0.016
10/13/2014	0.007	0.009	0.004	0.001	0.009	0.389
3/26/2015	0.030	0.049	0.015	0.008	0.096	2.690
5/11/2015	1.114	4.347	1.168	0.570	6.736	1437.560
7/7/2015	0.013	0.061	0.018	0.023	0.137	35.407
3/31/2016	0.140	0.164	0.033	0.037	0.203	3.219
5/10/2016	0.000	0.000	0.000	0.000	0.001	0.011
4/24/2017	0.039	0.049	0.005	0.013	0.062	0.475
4/27/2017	0.150	0.185	0.015	0.014	0.188	2.473
5/1/2017	0.244	0.304	0.073	0.093	0.518	4.352
6/6/2017	0.313	0.448	0.016	0.582	0.745	3.130
Field 12						
5/8/2015	0.091	0.129	0.019	0.041	0.246	7.712
5/11/2015	1.644	3.084	0.763	1.144	7.032	310.939
6/1/2015	0.000	0.001	0.000	0.000	0.001	0.036

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
6/29/2015	0.002	0.003	0.000	0.001	0.006	0.106
7/6/15	0.055	0.063	0.009	0.039	0.110	2.015
3/10/2016	0.010	0.013	0.029	0.021	0.111	15.395
5/2/2016	0.001	0.001	0.000	0.000	0.003	0.666
5/10/2016	0.001	0.001	0.000	0.000	0.002	0.176
4/27/2017	0.239	0.399	0.015	0.077	0.521	75.031
5/1/2017	0.503	0.840	0.067	0.373	2.380	91.174
6/6/2017	0.323	0.480	0.031	0.170	1.697	287.002

Table 13. Loss of phosphorus and nitrogen in each runoff event as grams per hectare for Fields 1, 5a, and 12 in 2014, 2015, 2016, and 2017.

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
	g/ha					
Field 1						
4/4/2014	20.0	70.5	27.6	11.7	229.9	22,877.6
5/9/2014	6.7	26.5	14.4	17.7	138.2	10,676.6
5/13/2014	15.6	30.0	8.2	10.3	109.0	3,450.2
5/28/2014	22.0	29.0	0.0	0.0	0.0	5,247.6
6/24/2014	1.7	3.8	1.4	0.9	18.3	177.6
6/27/2014	256.4	302.2	22.0	73.2	259.5	2,705.1
7/25/2014	16.9	20.8	4.2	10.1	43.1	146.4
10/14/2014	2.7	3.8	5.1	3.6	14.9	338.7
3/25/2015	3.5	8.5	10.1	5.3	66.1	1,616.0
5/8/2015	34.9	47.5	10.6	31.6	145.6	1,123.6
5/11/2015	71.3	109.6	25.6	15.6	244.3	12,610.2
5/18/2015	1.1	2.6	2.8	2.1	18.3	274.0
5/26/2015	7.8	13.8	6.4	5.6	53.0	1,207.4
6/29/2015	11.5	17.1	12.1	7.4	53.5	358.6
7/7/2015	41.3	47.3	24.5	36.8	138.6	522.4
10/13/2016	18.8	24.6	2.6	6.7	47.1	1,177.4
3/27/2017	43.4	69.2	44.4	9.3	193.1	12,846.2

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
4/24/2017	44.3	66.5	14.6	16.1	168.4	4,837.9
4/27/2017	96.8	138.0	14.1	18.8	232.3	9,185.7
5/1/2017	141.4	201.2	87.4	85.0	582.5	9,717.4
6/6/2017	2,220.5	2,966.6	1,516.0	1,302.0	6,955.8	166,464.5
Field 5a						
6/27/2014	10.2	13.2	1.2	0.0	10.7	799.9
7/25/2014	1.2	1.5	0.2	0.0	1.2	17.6
10/13/2014	8.1	10.6	4.1	0.8	10.4	436.1
3/26/2015	33.9	55.5	16.3	9.4	108.1	3,018.2
5/11/2015	1,249.5	4,877.0	1,309.9	639.9	7,557.3	1,612,737.1
7/7/2015	14.3	68.1	19.8	26.1	153.5	39,721.8
3/31/2016	157.2	184.2	36.8	41.1	227.5	3,610.7
5/10/2016	0.2	0.2	0.3	0.4	1.0	12.0
4/24/2017	43.8	55.2	5.5	14.6	69.7	532.9
4/27/2017	168.4	207.7	17.2	15.5	211.2	2,774.6
5/1/2017	273.5	341.4	82.0	104.7	581.4	4,881.9
6/6/2017	351.1	502.1	17.6	653.4	835.6	3,511.0
Field 12						
5/8/2015	102.5	145.1	21.2	46.0	276.2	8,651.4
5/11/2015	1,843.9	3,459.8	855.4	1,283.2	7,889.1	348,829.2

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
6/1/2015	0.3	0.6	0.1	0.3	1.4	40.7
6/29/2015	2.1	3.6	0.1	0.7	6.4	119.3
7/6/15	62.0	70.9	10.1	44.2	123.2	2,260.5
3/10/2016	11.4	14.5	32.5	23.7	124.8	17,270.9
5/2/2016	0.9	1.4	0.2	0.2	3.0	747.1
5/10/2016	0.8	1.4	0.2	0.1	2.1	197.5
4/27/2017	268.2	447.6	16.5	86.4	584.2	84,173.7
5/1/2017	564.3	942.2	75.6	418.2	2,670.5	102,284.7
6/6/2017	362.3	538.9	34.4	190.3	1,903.4	321,975.7

Table 14. Annual flow and flow-weighted concentrations of phosphorus, nitrogen, and sediment in runoff for 2014, 2015, 2016, and 2017.

	Flow	Flow	Flow	Flow	Dissolved P	TP	Ammonia-N	Nitrate-N	Total N	Solids
	gal	L	gal/acre	L/ha	mg/L					
Field 1										
2014	118,481	448,451	67,319	629,696	0.407	0.630	0.243	0.247	1.644	67.238
2015	103,754	392,708	58,951	551,425	0.302	0.480	0.286	0.272	1.989	33.457
2016	3,755	14,212	2,133	19,955	0.940	1.231	0.130	0.335	2.360	59.000
2017	682,789	2,584,356	387,948	3,628,845	0.529	0.761	0.296	0.220	1.846	62.480
Field 5a										
2014	34,350	130,015	3,587	33,548	0.613	0.779	0.170	0.023	0.683	28.933
2015	5,357,063	20,276,483	559,335	5,231,990	0.385	0.915	0.260	0.175	1.700	217.900
2016	139,663	528,625	14,582	136,402	1.134	1.405	0.980	1.598	4.010	53.200
2017	1,039,108	3,933,024	108,494	1,014,848	0.845	1.101	0.115	0.632	1.583	11.525
Field 12										
2014	N.D. [1]	N.D.	N.D.	N.D.						
2015	874,765	3,310,986	1,041,387	9,741,071	0.459	0.680	0.100	0.272	1.314	35.740

	Flow	Flow	Flow	Flow	Dissolved P	TP	Ammonia-N	Nitrate-N	Total N	Solids
2016	2,888	10,931	3,438	32,159	0.387	0.596	0.463	0.336	2.263	346.400
2017	403,100	1,525,734	479,881	4,488,778	0.289	0.463	0.027	0.146	1.143	141.233

1- No runoff occurred from Field 12, while the site was operational in 2014.

Table 15. Annual loss of phosphorus and nitrogen in surface runoff from Fields 1, 5a, and 12 for 2014, 2015, 2016, and 2017.

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
	---------- lbs/ac ----------					
Field 1						
2014	0.30	0.43	0.07	0.11	0.72	41
2015	0.15	0.22	0.08	0.09	0.64	16
2016	0.02	0.02	0.00	0.01	0.04	1
2017	2.27	3.07	1.49	1.28	7.25	181
Field 5a						
2014	0.02	0.02	0.00	0.00	0.02	1
2015	1.16	4.46	1.20	0.60	6.97	1,476
2016	0.14	0.16	0.03	0.04	0.20	3
2017	0.75	0.99	0.11	0.70	1.51	10
Field 12						
2014	N.D. [1]	N.D.	N.D.	N.D.	N.D.	N.D.
2015	1.79	3.28	0.79	1.23	7.40	321
2016	0.01	0.02	0.03	0.02	0.12	16
2017	1.07	1.72	0.11	0.62	4.60	453
	---------- g/ha ----------					
Field 1						
2014	342.1	486.6	82.8	127.6	813.0	45,620
2015	171.4	246.5	92.0	104.3	719.4	17,712
2016	18.8	24.6	2.6	6.7	47.1	1,177
2017	2,546.4	3,441.5	1,676.5	1,431.2	8,132.1	203,052

Date	Dissolved P	Total P	Ammonia-N	Nitrate-N	Total N	Solids
Field 5a						
2014	19.5	25.3	5.5	0.8	22.3	1,254
2015	1,297.7	5,000.6	1,346.0	675.4	7,819.0	1,655,477
2016	157.4	184.4	37.0	41.6	228.5	3,623
2017	836.8	1,106.4	122.2	788.2	1,697.8	11,700
Field 12						
2014	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2015	2,010.8	3,680.0	887.1	1,374.4	8,296.2	359,901
2016	13.1	17.3	33.0	24.0	129.8	18,215
2017	1,194.9	1,928.8	126.4	694.9	5,158.1	508,434

1- No runoff occurred from Field 12, while the site was operational in 2014.

Table 16. Amount of phosphorus and nitrogen applied to the flume catchment area of Fields 1, 5a, and 12, loss in runoff, and percent of applied lost in runoff for 2014, 2015, 2016, and 2017.

Date	Rain	Phosphorus			Nitrogen		
		Applied	Loss in runoff	Percent applied lost in runoff	Applied	Loss in runoff	Percent applied lost in runoff
	inches	lbs		%	lbs		%
Field 1							
2014	25.13	86	0.76	0.9	80	1.28	1.6
2015	52.84	299	0.39	0.1	263	1.13	0.4
2016	29.50	141	0.04	0.0	244	0.07	0.0
2017	29.13	373	5.40	1.4	292	12.76	4.4
Field 5a							
2014	25.13	55	0.22	0.4	126	0.19	0.2
2015	52.84	55	42.70	77.3	126	66.77	52.9
2016	29.50	55	1.57	2.9	126	1.95	1.5
2017	29.13	55	9.45	17.1	126	14.50	2.8
Field 12							
2014	25.13	12	0	0.0	11	0	0.0
2015	52.84	6	2.76	45.9	25	6.21	24.8
2016	29.50	36	0.01	0.0	63	0.10	0.2
2017	29.13	72	1.44	2.1	56	3.86	6.9

Temporal Trends in Phosphorus, Nitrogen, Bacteria, and Chloride in Big Creek Above and Below the C&H Farm

The concentration of dissolved P, total P, nitrate-N, total N, bacteria and chloride in Big Creek above and below the C&H Farm are presented in subsequent figures to show the season / temporal trends in measured concentrations (Figures 3, 4, 5, 6, 7, 8, and 9).

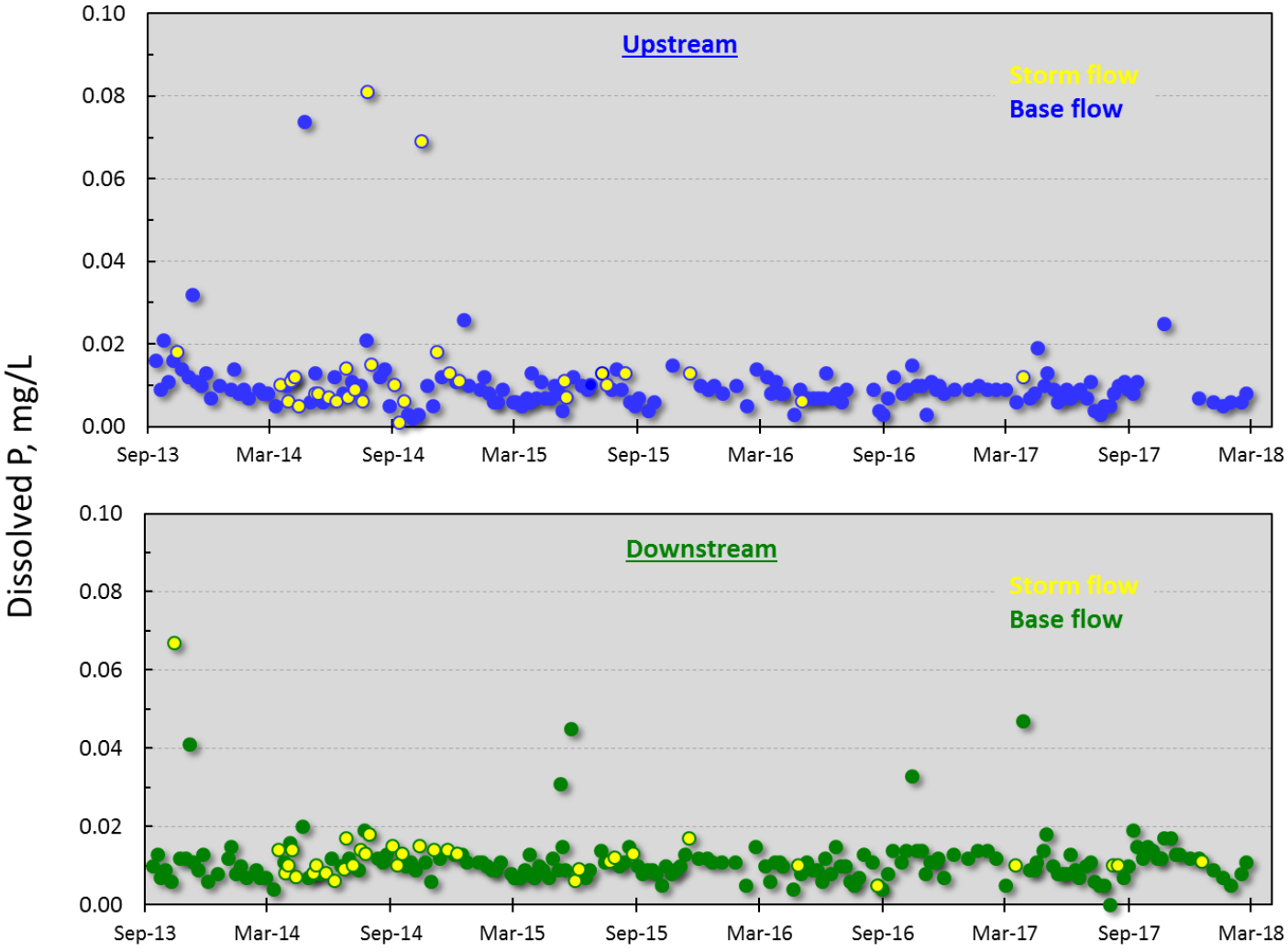

Figure 6. Dissolved P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

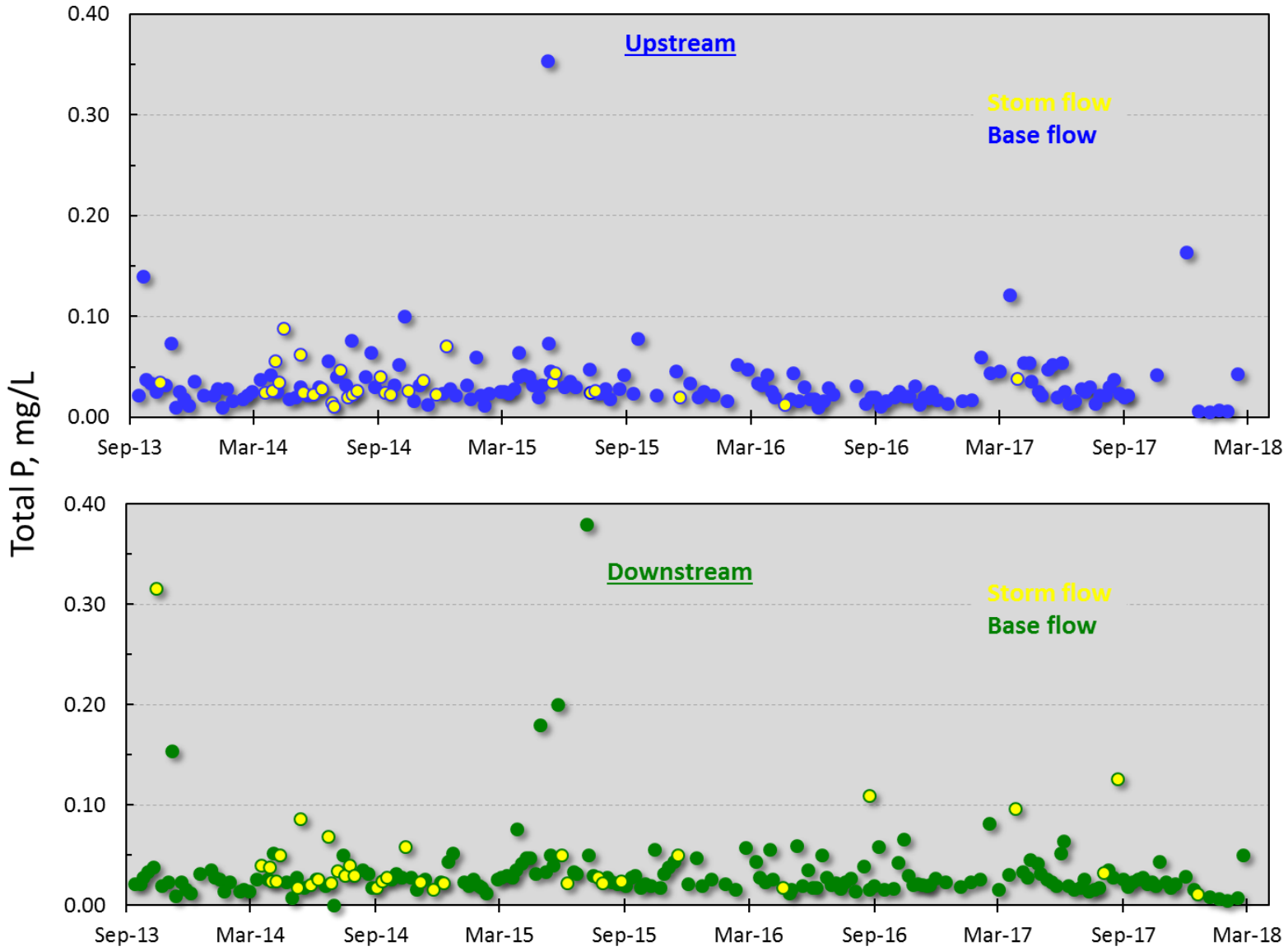

Figure 7. Total P concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

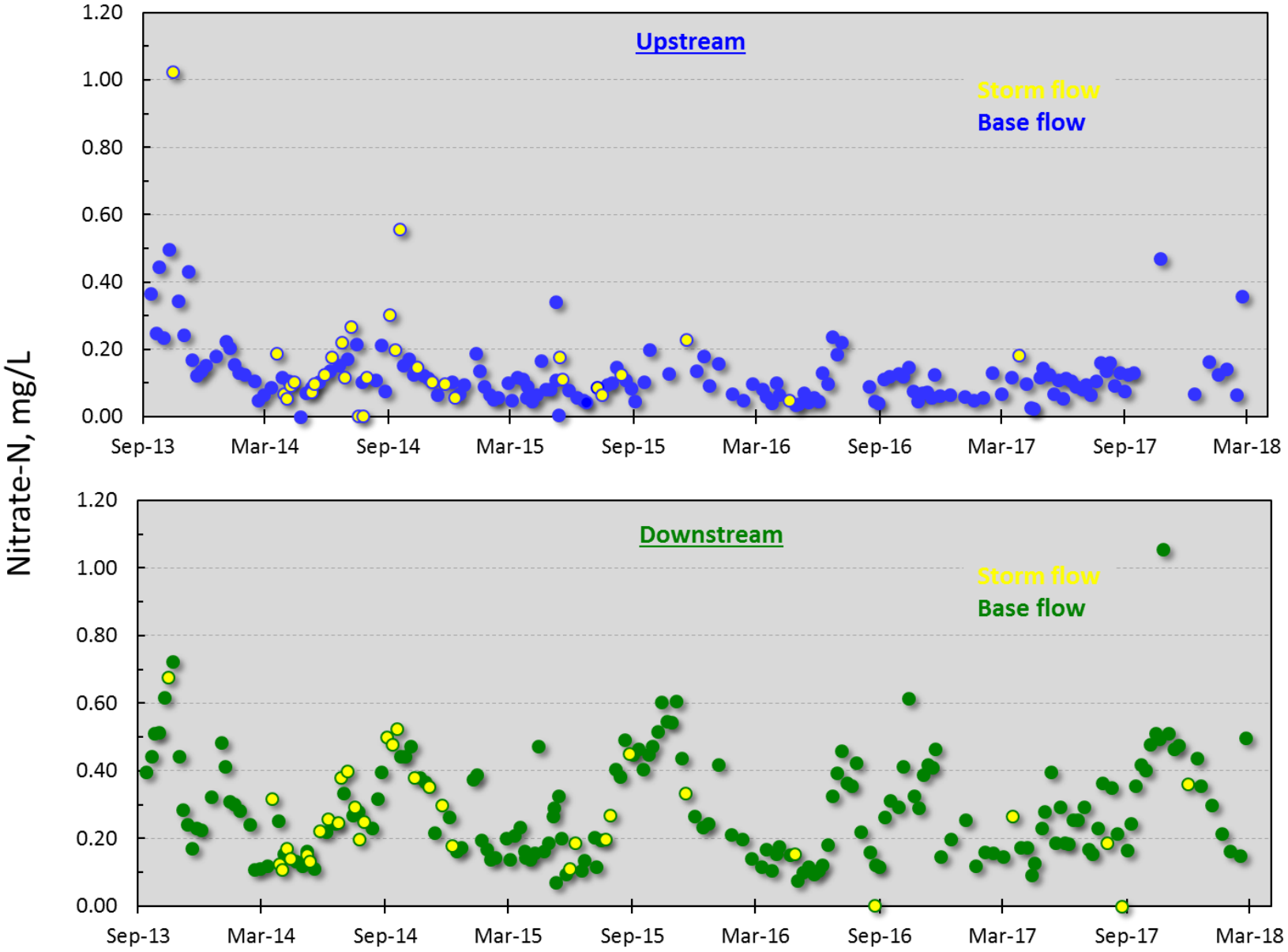

Figure 8. Nitrate-N concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

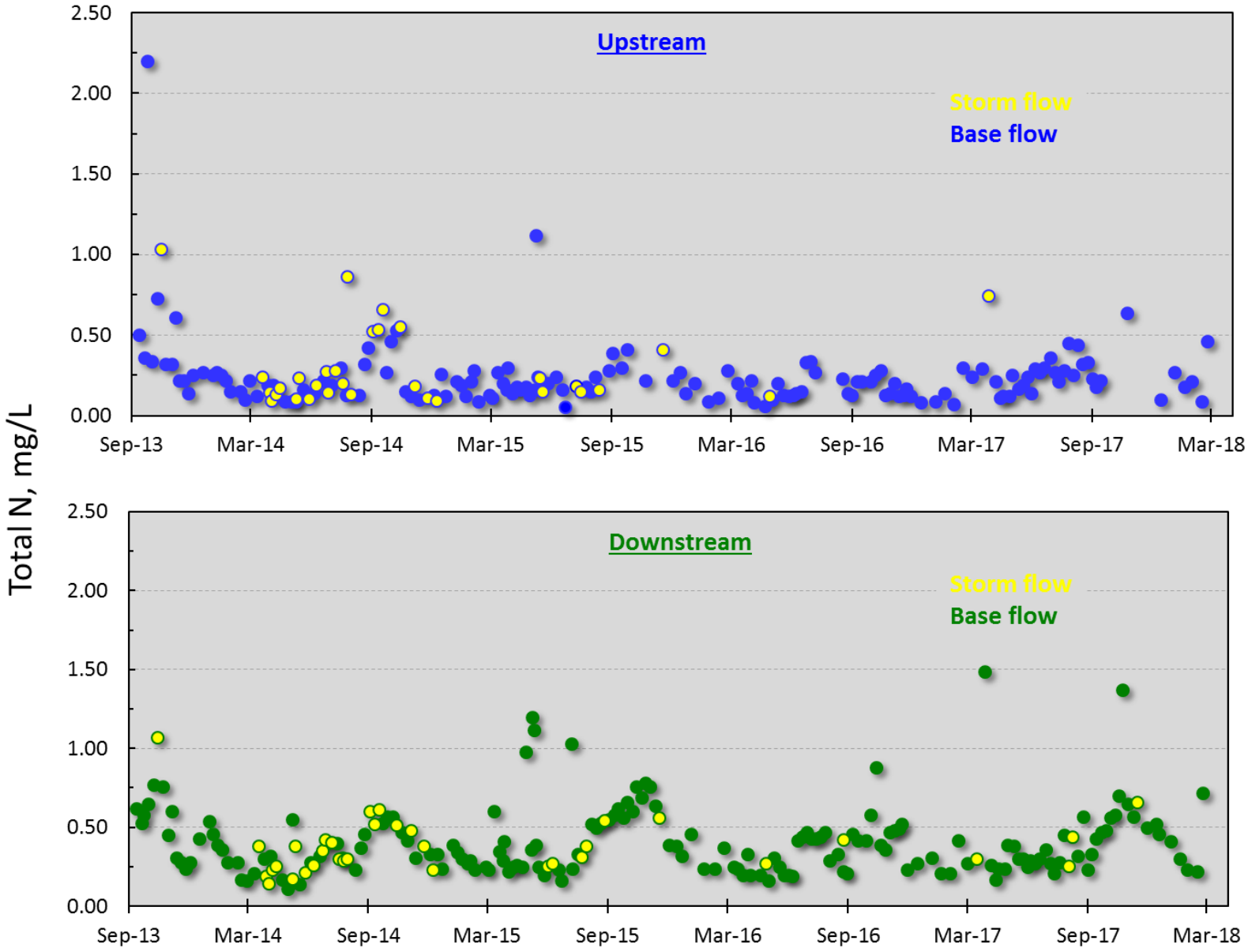

Figure 9. Total N concentration at **the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.**

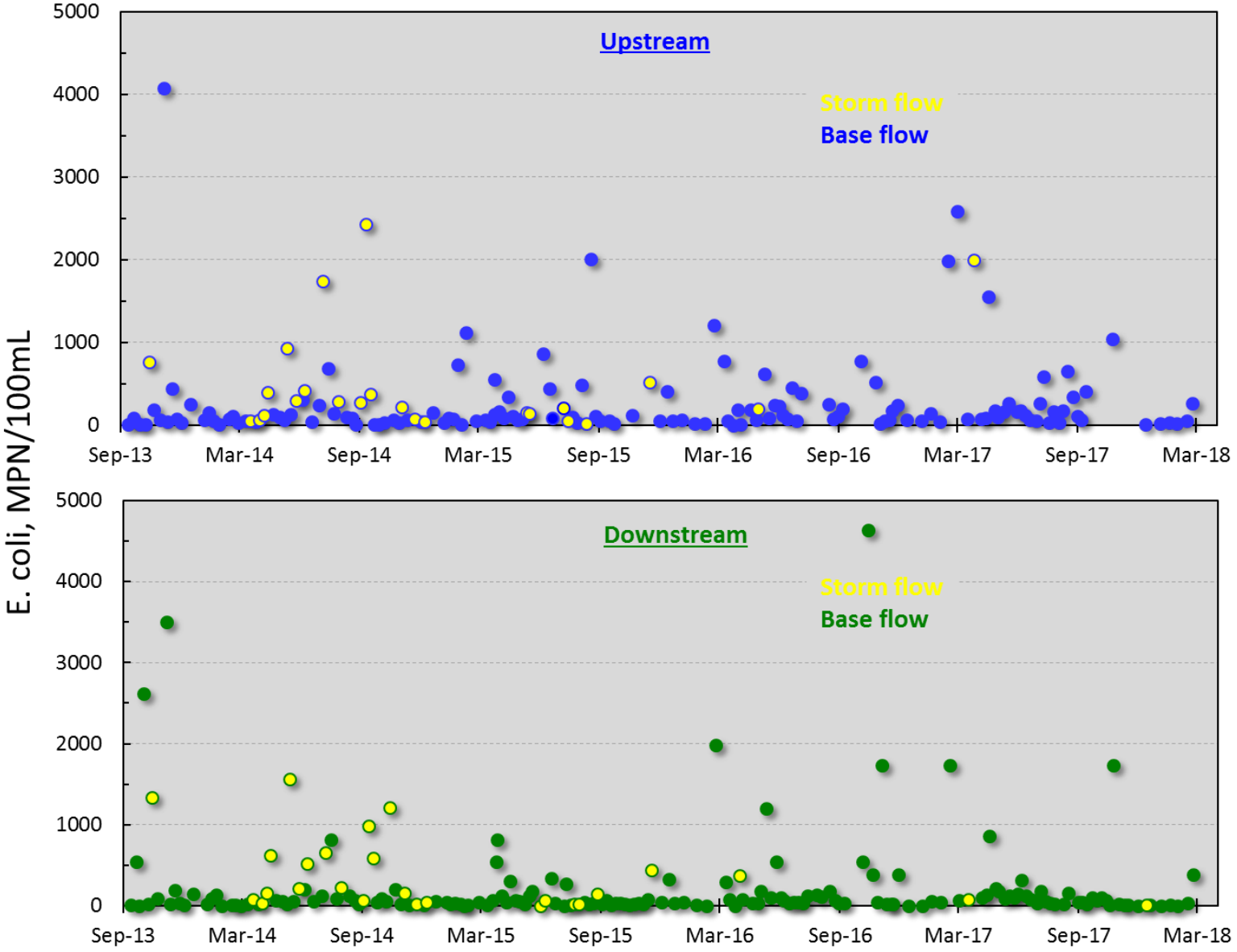

Figure 10. E. coli numbers at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

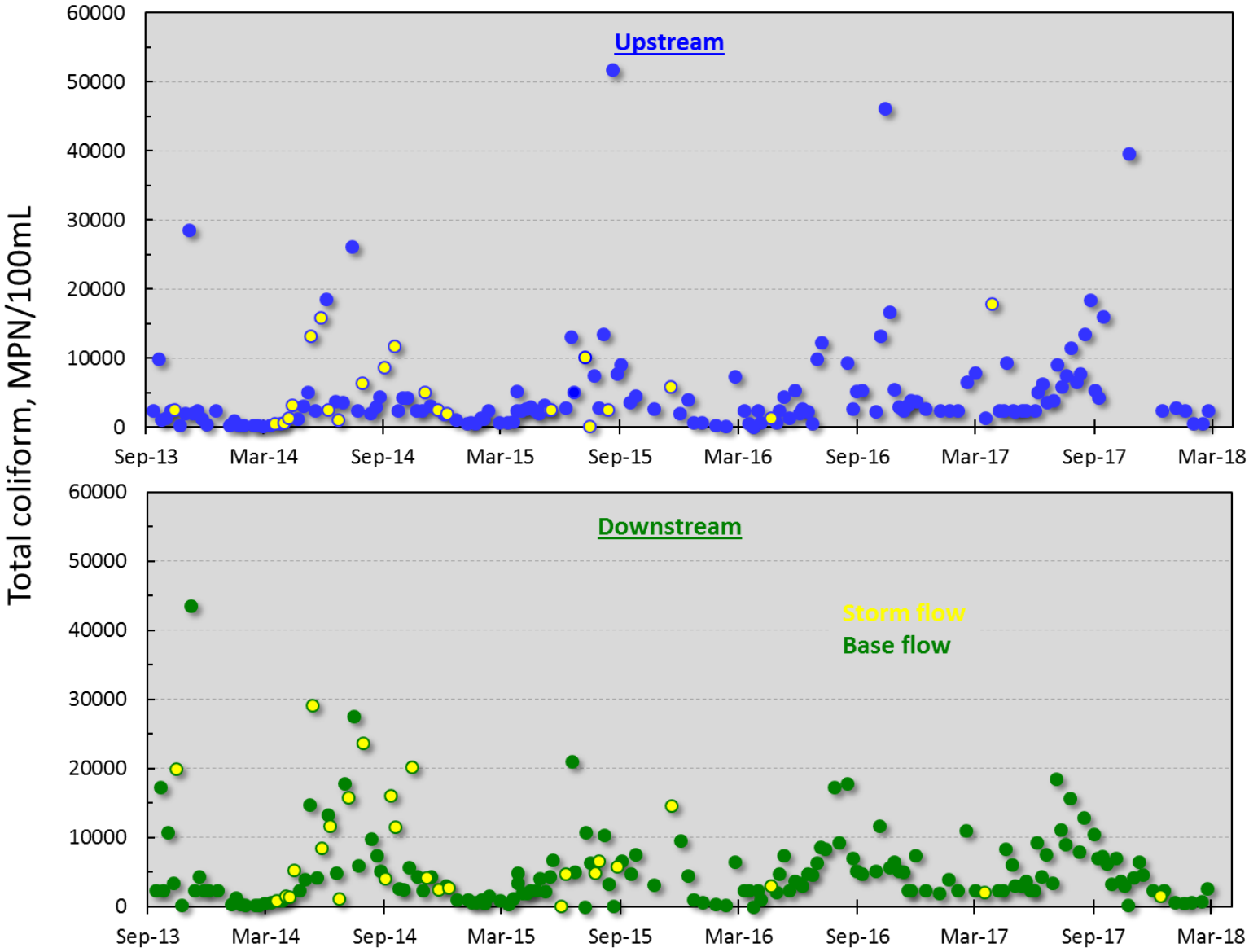

Figure 11. Total coliform numbers at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

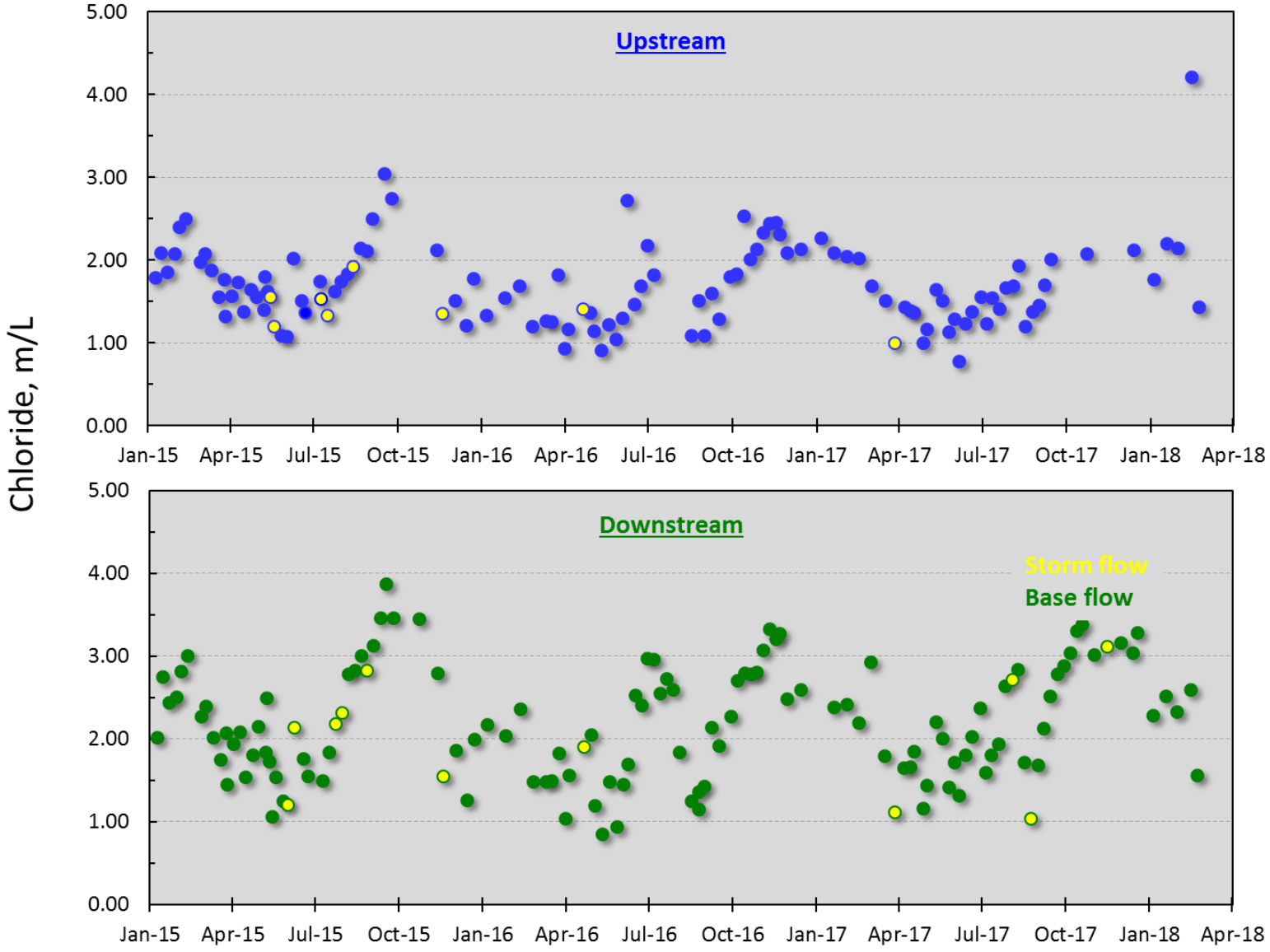

Figure 12. Chloride concentration at the Big Creek monitoring site up- and downstream of the C&H Farm, Newton County, AR.

Nutrient Concentrations in Well, Ephemeral Stream, and Trenches

The concentration of P, N, sediment, E. coli, coliform, chloride, and electrical conductivity from well, ephemeral stream, and trench sites with time since sampling began are presented in Figures 13 to 20. Any seasonal or annual trends will be statistically evaluated when a 5-year period of record has been obtained. Analysis of seasonal or annual trends over a shorter period can lead to incorrect interpretations.

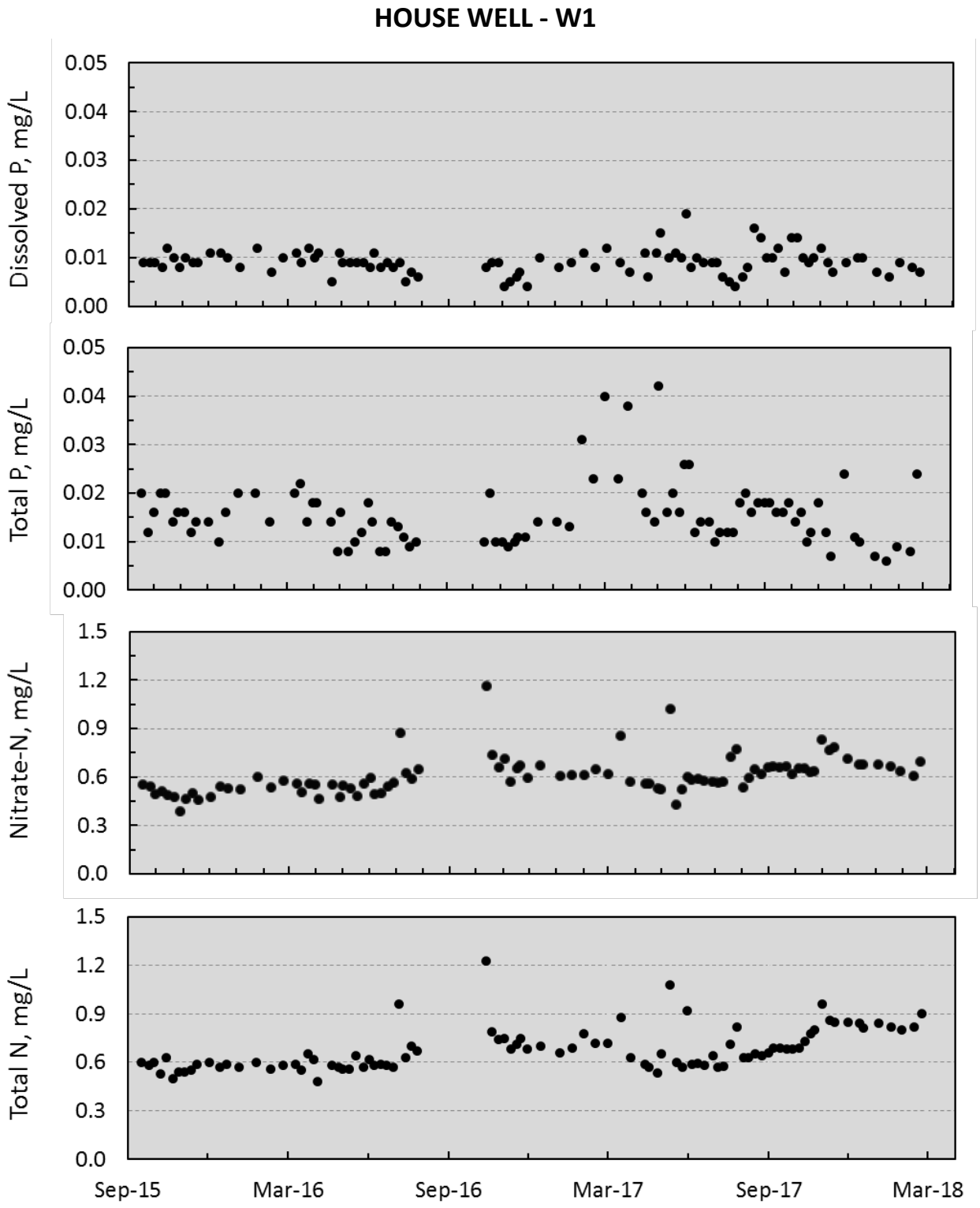

Figure 13. Phosphorus and nitrogen concentrations in house well samples over the period of monitoring.

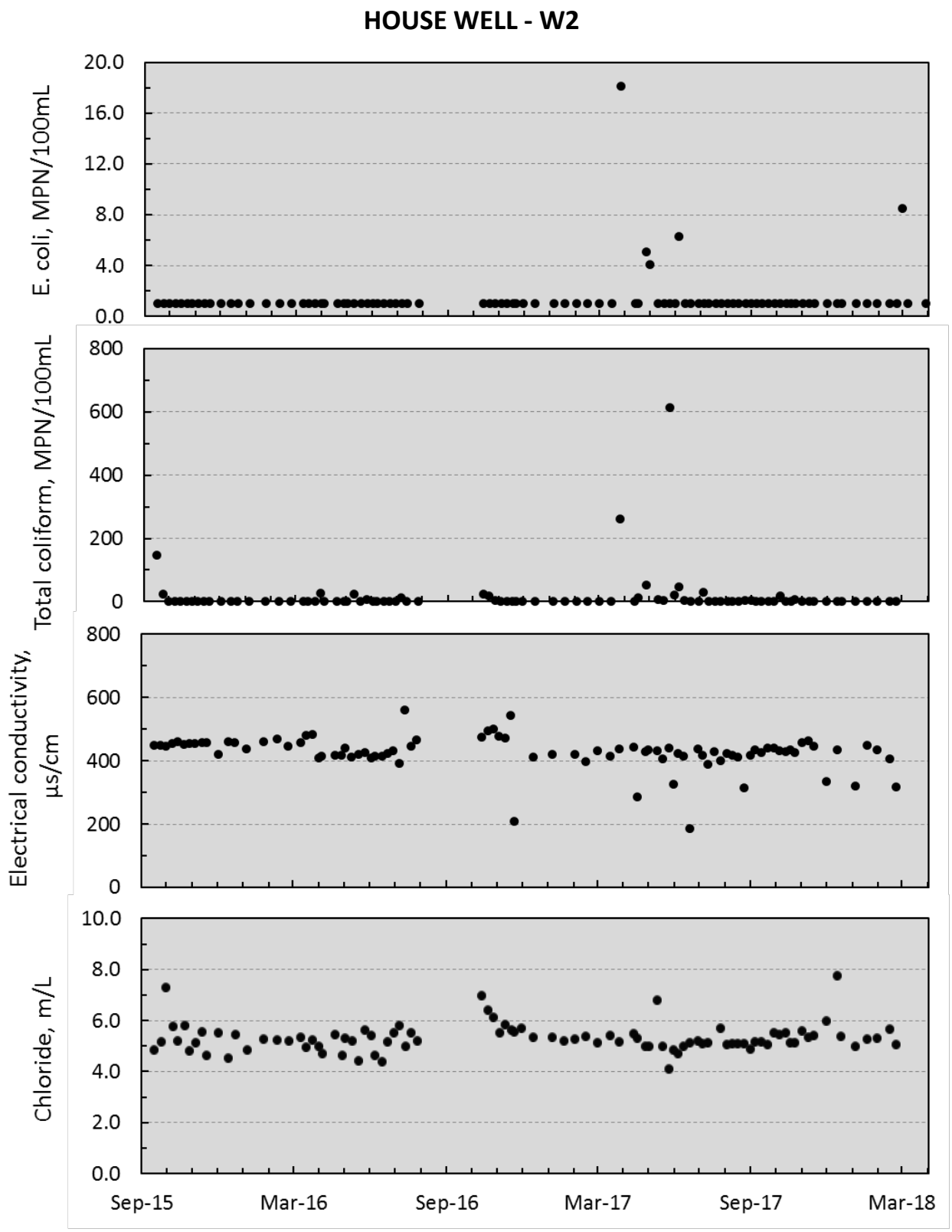

Figure 14. E. coli, total coliform, electrical conductivity, chloride concentrations in house well samples over the period of monitoring.

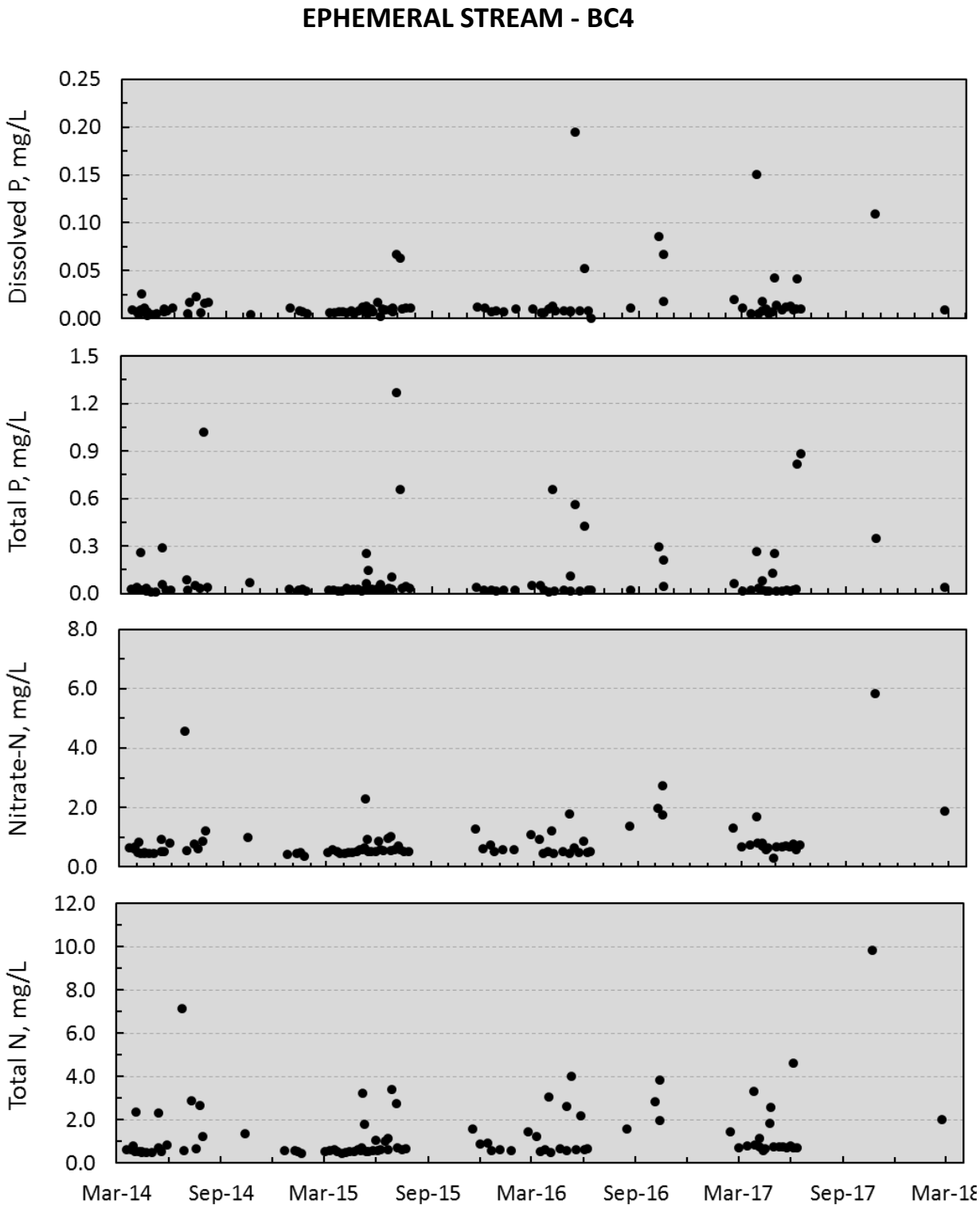

Figure 15. Phosphorus and nitrogen concentrations in the ephemeral stream over the period of monitoring.

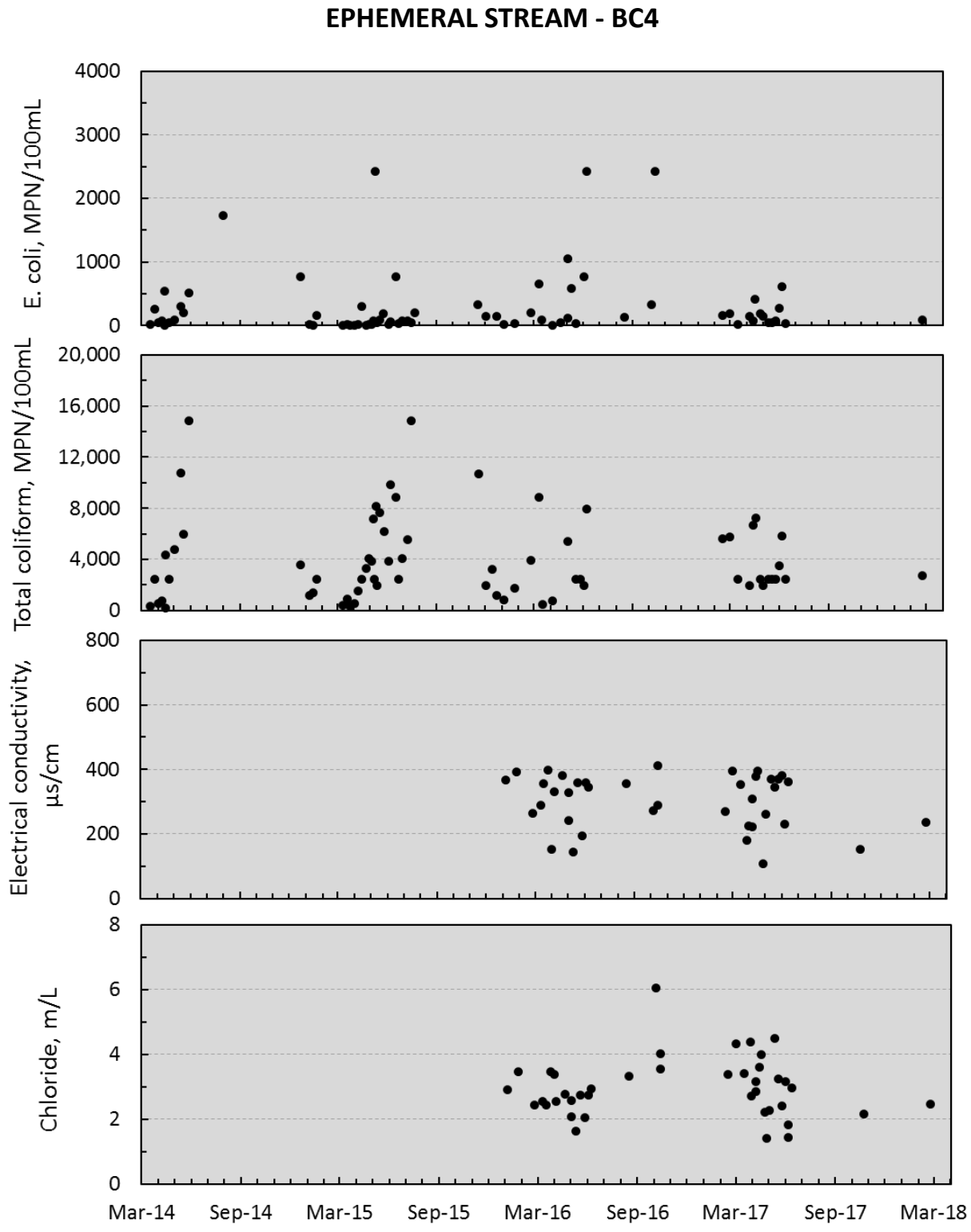

Figure 16. E. coli, total coliform, electrical conductivity, chloride concentrations in the ephemeral stream over the period of monitoring.

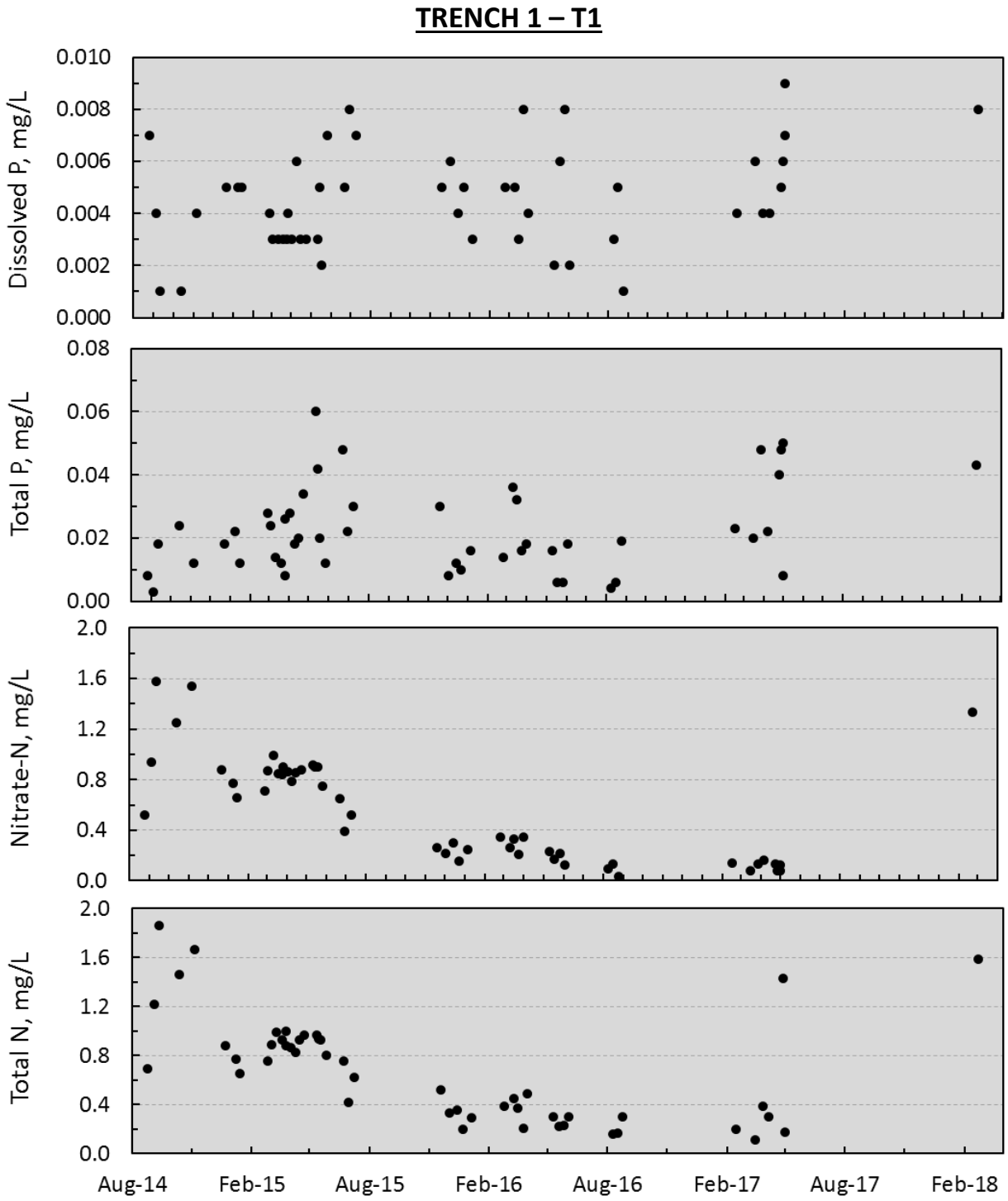

Figure 17. Phosphorus and nitrogen concentrations in Trench 1 over the period of monitoring.

TRENCH 1 – T1

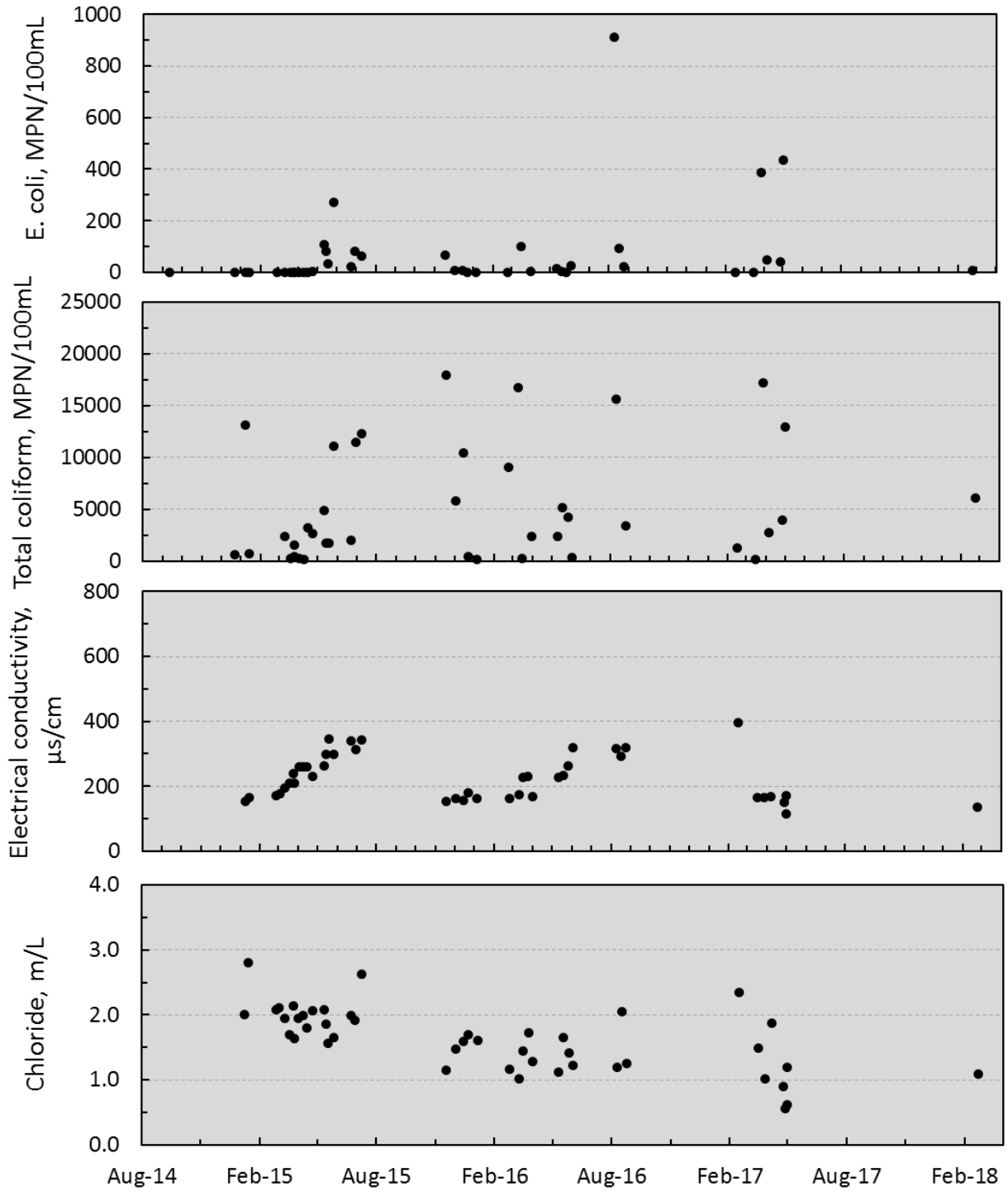

Figure 18. E. coli, total coliform, electrical conductivity, chloride concentrations in Trench 1 over the period of monitoring.

TRENCH 2 – T2

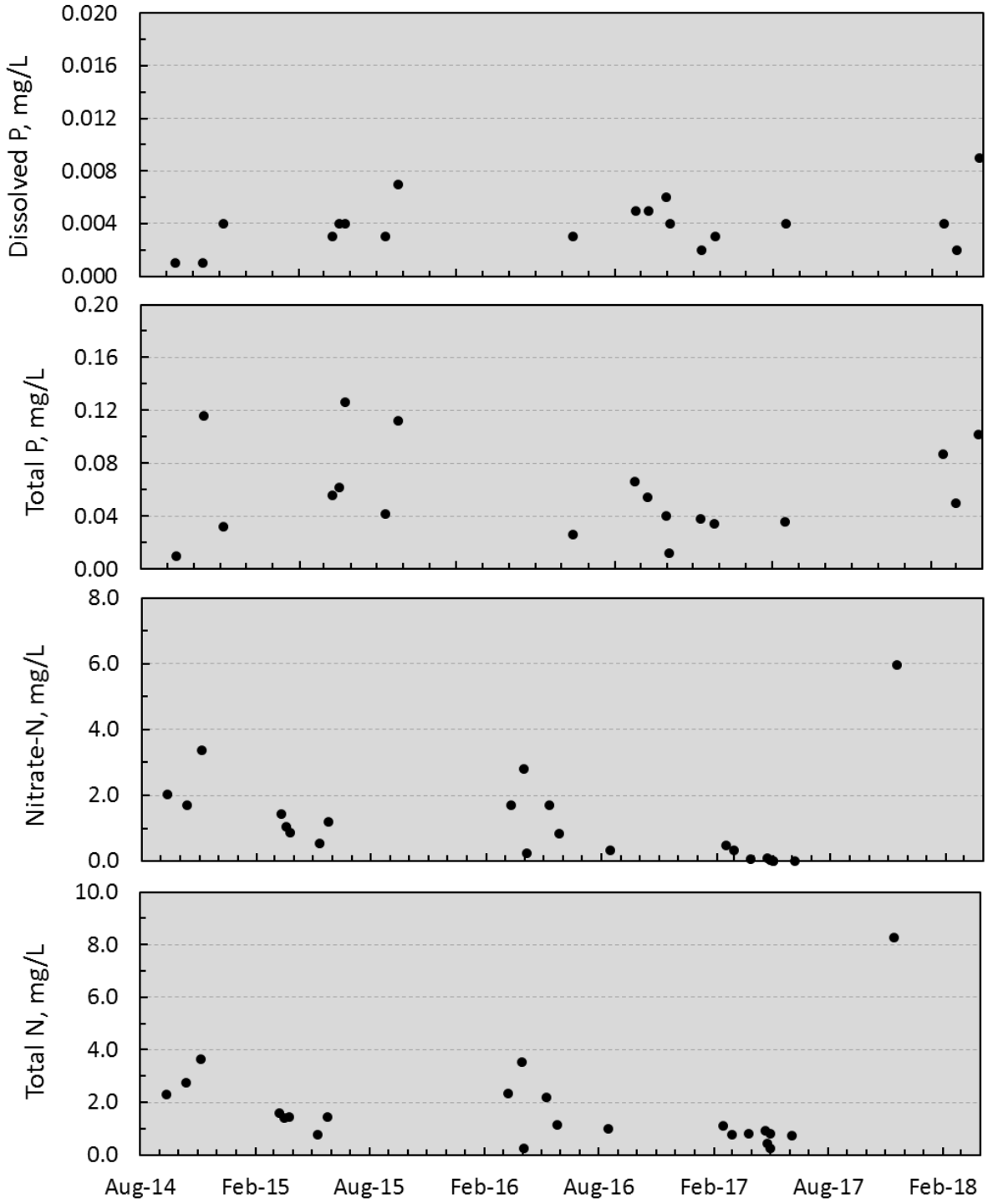

Figure 19. Phosphorus and nitrogen concentrations in Trench 2 over the period of monitoring.

TRENCH 2 – T2

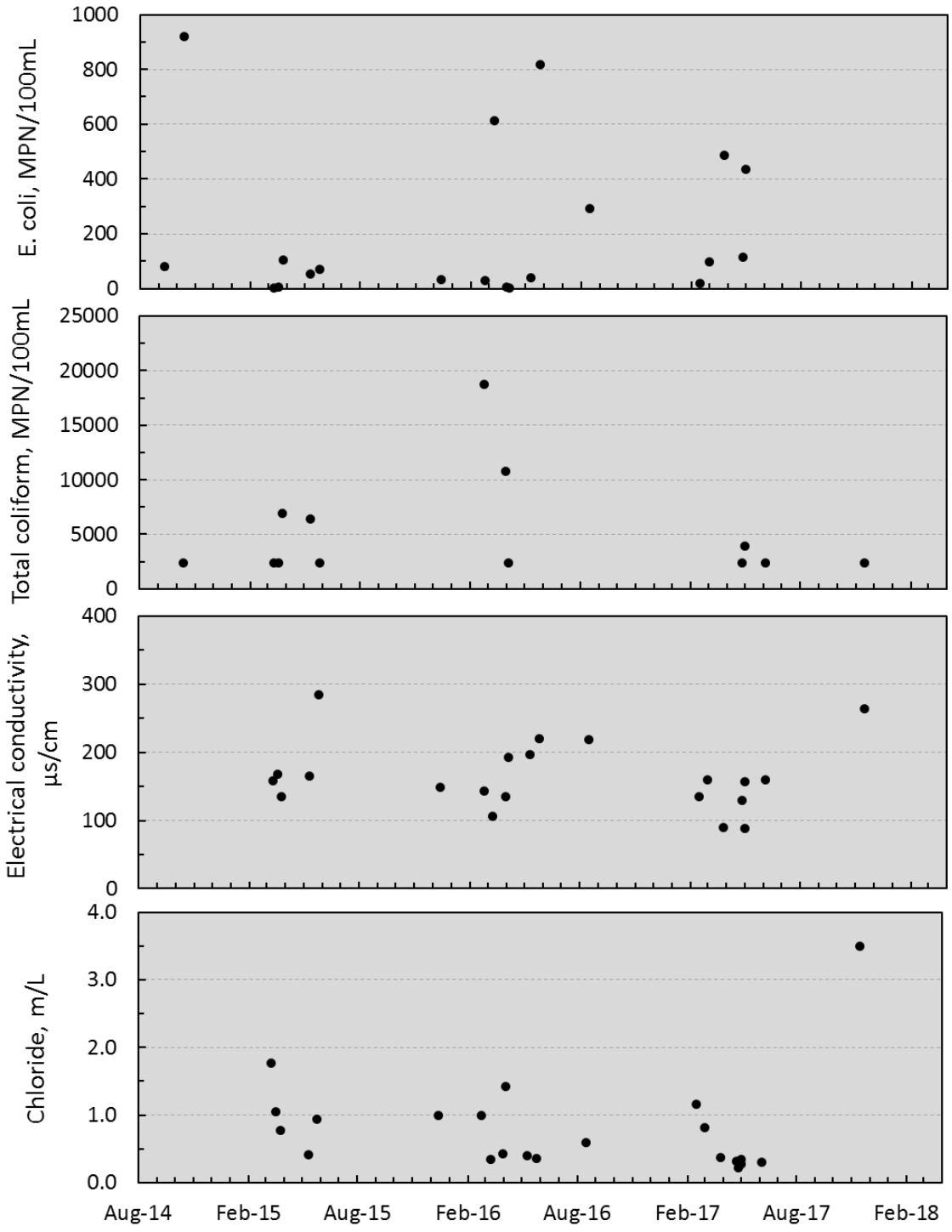

Figure 20. E. coli, total coliform, electrical conductivity, chloride concentrations in Trench 2 over the period of monitoring.

Big Creek Dissolved Oxygen

Dissolved oxygen is an important indicator of aquatic ecosystem health and as such is a key water-quality parameter measured in many water studies and is a guiding regulatory standard for evaluating and protecting stream health. Arkansas Pollution Control and Ecology Commission Regulation 2.505 establishes the standards for surface-water dissolved oxygen values.

Regulation 2.505 Establishing Dissolved Oxygen Standards for Surface Waters of the State of Arkansas

Arkansas Pollution Control and Ecology Commission Regulation No. 2, as amended by Pollution Control and Ecology Commission # 014.00-002 from Arkansas Department of Environmental Quality (ADEQ), 2018, pages 45-48 of "Assessment methodology: For the Preparation of the 2016 Integrated Water Quality Monitoring and Assessment Report pursuant to the Clean Water Act Sections 303(d) and 305(b). Final Draft 2017." 72 pages total. Available at https://www.adeq.state.ar.us/water/planning/integrated/assessment/pdfs/final-draft-2018-am_10oct2017-(2).pdf provides the specific dissolved oxygen standard for surface waters in the State.

Dissolved oxygen levels are specified in water quality standards. In the 2 to 5 mg/L range, most fish and aquatic life will survive, but will not thrive. At less than 2 mg/L, mortality begins.

The following dissolved oxygen standards are applicable for rivers and streams (Table 7).

Table 17. Dissolved oxygen criteria for area rivers and streams

Watershed area, mi^2	Ozark Highlands		Boston Mountains	
	Primary [1]	Critical [2]	Primary [1]	Critical [2]
	---------- mg/L ----------			
<10 mi^2 watershed	6	2	6	2
10 to 100 mi^2 watershed	6	5	None	None
>100 mi^2 watershed	6	6	6	6

1. Primary season is defined as when water temperatures are at or below 22 °C.
2. Critical season is defined as when water temperatures are greater 22 °C.

In streams with watersheds of less than 10 mi^2, it is assumed that insufficient water exists to support aquatic life during the critical season. During this time, a dissolved oxygen standard of 2 mg/L will apply to prevent nuisance conditions. However, field verification is required in

areas suspected of having significant groundwater flows or enduring pools, which may support unique aquatic biota. In such waters, the critical season standard for the next size category of stream shall apply.

All streams with watersheds of less than 10 mi^2 are expected to support aquatic life during the primary season when stream flows, including discharges, equal or exceed 1 cubic foot per second (cfs). However, when site verification indicates that aquatic life exists at flows below 1 cfs, such aquatic biota will be protected by the primary standard (refer to the State of Arkansas Continuing Planning Process for field verification requirements).

Also, in these streams with watersheds of less than 10 mi^2, where waste discharges are 1 cfs or more, they are assumed to provide sufficient water to support aquatic life and, therefore, must meet the dissolved oxygen standards of the next size category of streams.

For purposes of determining effluent discharge limits, the following conditions apply:

A. The primary season dissolved oxygen standard is to be met at a water temperature of 22°C (71.5°F) and at the minimum stream flow for that season. At water temperatures of 10°C (50°F), the dissolved oxygen standard is 6.5 mg/L.
B. During March, April and May, when background stream flows are 15 cfs or higher, the dissolved oxygen standard is 6.5 mg/L in all areas except the Delta Ecoregion, where the primary season dissolved oxygen standard will remain at 5 mg/L.
C. The critical season dissolved oxygen standard is to be met at maximum allowable water temperatures and at Q7-10 flows. However, when water temperatures exceed 22°C (71.6°F), a 1 mg/L diurnal depression will be allowed below the applicable critical standard for no more than 8 hours during any 24-hour period.

Field Determination and Methodology

Dissolved oxygen and temperature are determined *in-situ* using a luminescent dissolved oxygen sensor integrated to a Hydrolab HL4 sonde[1]. In-situ measurement entails no holding time for samples, and the act of collecting a sample can change the oxygen level, a direct probe reading is often the preferred method. The probe is air calibrated at monthly intervals when data are downloaded from the sonde data logger. Data quality are assured through recording calibration accuracy and conducting a field duplicate to determine precision. See U.S. EPA Field Measurement of Dissolved Oxygen for details https://www.epa.gov/sites/production/files/2017-07/documents/field_do_measurement106_af.r4.pdf. Sonde readings were recorded every hour for the time they were deployed in Big Creek.

[1] Mention of trade names does not imply endorsement by the Division of Agriculture, University of Arkansas Systems. Information on the Hydrolab HL4 sonde is available at http://www.ott.com/products/water-quality-2/hydrolab-hl4-multiparameter-sonde-54/

Big Creek Dissolved Oxygen

The following tables and Figures detail the dissolved oxygen concentration in Big Creek upstream of the C&H farm October 22 to November 13, 2014 and downstream of the farm from September 9 to November 11, 2014, April 10 to October 16, 2015, and May 16 to December 11, 2017.

Measurements upstream of the farm were not taken after 2014 due to the sonde probe being dislodged and lost during a large storm even in the spring of 2015. It was not replaced until early 2018, when a secure site on the low-water bridge at the upstream site on Big Creek was made available.

Measurements at the downstream site were not taken in 2016, again due to loss of the sonde at that site during an early spring storm event. Loss of the two sonde units are indicative of the significant amount of scouring and stream bed modification that can take place in large storm events. Also, measurements were not recorded between September 16 and October 17, 2017 due the sonde malfunctioning.

Diurnal and seasonal fluctuations in dissolved oxygen concentrations are apparent from measurements in Big Creek. See Figures 1 through 8. The diurnal fluctuations in dissolved oxygen concentration are typically a function of photosynthesis during daylight hours (which releases oxygen); removal of dissolved oxygen by microbial respiration (satisfying microbial and chemical oxygen demands, either in the water column or through interaction with the bed sediments); and exchange of oxygen at the water surface (i.e., reaeration) (O'Connor and Di Toro, 1970[2]; Williams et al., 2000[3]).

The diurnal and seasonal fluctuations of dissolved oxygen concentration are clearly dependent on many factors (Williams et al., 2000[3]). The influence of water column temperature on oxygen solubility can be eliminated by converting dissolved oxygen concentration in mg/L to % saturation. See Figures 9 to 12. Additional breaks in dissolved oxygen concentrations were determined with flow less and greater than 15 cfs for monitoring in 2014, 2015, and 2017 and given in Table 2.

Dissolved oxygen was measured at both upstream and downstream from October 22 to November 13, 2014 and is presented in Figures 13 to 18. Finally, dissolved oxygen at the USGS Carver gaging station is presented in Figure 19 for June 3, 2014 to May 1, 2017.

The information on dissolved oxygen in Big Creek downstream of the C&H Farm at USGS 07055790 Big Creek near Mt. Judea given here is made available to ADEQ and on the BCRET website. Interpretation of dissolved oxygen concentrations in terms of water quality standards is deferred to ADEQ.

[2] O'Connor, D.J., and D.M. Di Toro. 1970. Photosynthesis and oxygen balance in streams. J. Sanit. Eng. Div. ASCE, 98:547-571.

[3] Williams, R.J., C. White, M.L. Harrow, and C. Neal. 2000. Temporal and small-scale spatial variations of dissolved oxygen in the River Thames, Pang and Kennet, UK. Sci. Total. Environ. 251/252:497-510.

Table 18. Big Creek Dissolved Oxygen concentrations.

Metric	Upstream [1]	Downstream [2]				
	10/22/2014 – 11/13/2014	10/22/2014 – 11/13/2014	9/9/2014 – 11/13/2014	4/8/2015 – 10/16/2015	5/16/2017 - 12/11/2017	9/9/2014 – 12/11/2017
Average	9.36	8.92	8.57	8.73	8.63	8.66
Minimum	6.78	6.67	5.73	5.01	5.84	5.01
Maximum	11.58	12.42	12.42	12.92	14.04	14.04
Median	9.49	8.57	8.27	8.53	8.44	8.44
Observations	525		1,557	4,524	4,093	10,175

1. Watershed area is 27.01 miles^2.
2. Watershed area is 40.89 miles^2.

Table 19. Big Creek Dissolved Oxygen concentrations downstream of C&H, as a function of stream temperature.

Metric	9/9/2014 – 11/13/2014		4/10/2015 – 10/16/2015		5/16/2017 - 12/11/2017		9/9/2014 – 12/11/2017	
	Temperature	Dissolved oxygen	Temperature	Dissolved oxygen	Temperature	Dissolved oxygen	Temperature	Dissolved oxygen
	°C	mg/L	°C	mg/L	°C	mg/L	°C	mg/L
All observed water temperatures								
Average	16.87	8.57	17.98	8.73	18.38	8.63	17.97	8.66
Minimum	7.46	5.73	8.53	5.01	8.49	5.84	7.46	5.01
Maximum	26.46	12.42	26.69	12.92	26.42	14.04	26.69	14.04
Median	16.98	8.28	18.50	8.53	18.65	8.44	18.19	8.45
Observations	1,557		4,525		4,093		10,175	
Observations <6 mg/L DO	8		47		21		74	
Observations <6 mg/L DO, %	0.51		1.04		0.51		0.73	
Water temperature > 22 °C								
Average	23.03	10.78	23.32	9.62	23.16	9.40	23.23	9.56
Minimum	22.04	7.68	22.00	6.09	22.00	6.15	22.00	6.09
Maximum	26.46	11.62	26.69	12.26	26.42	13.19	26.69	13.13
Median	22.66	10.85	23.11	9.87	22.85	9.73	22.95	9.86
Observations	48		523		519		1,090	

Metric	9/9/2014 – 11/13/2014		4/10/2015 – 10/16/2015		5/16/2017 - 12/11/2017		9/9/2014 – 12/11/2017	
Observations <6 mg/L DO	0		0		0		0	
	Flow	Dissolved oxygen	Flow	Dissolved oxygen	Flow	Dissolved oxygen	Flow	Dissolved oxygen
	cfs	mg/L	cfs	mg/L	cfs	mg/L	cfs	mg/L
	Stream flow <15 cfs							
Average	5.08	8.54	3.51	8.48	4.80	8.44	4.43	8.48
Minimum	2.41	5.73	1.44	5.74	1.06	5.72	1.06	5.72
Maximum	14.10	12.42	14.10	12.90	14.60	14.04	14.60	14.04
Median	3.62	8.27	2.79	8.20	3.40	8.15	3.19	8.19
Observations	1340		2006		2634		5980	
	Stream flow >15 cfs							
Average	64.40	8.75	190.63	8.92	127.61	8.97	162.18	8.93
Minimum	15.00	6.96	15.00	5.01	15.50	6.61	15.00	5.01
Maximum	369.00	11.67	14600.00	12.92	10600.00	13.75	14600.00	13.75
Median	45.40	8.28	84.00	8.89	44.70	8.86	58.30	8.85
Observations	217		2519		1459		4195	

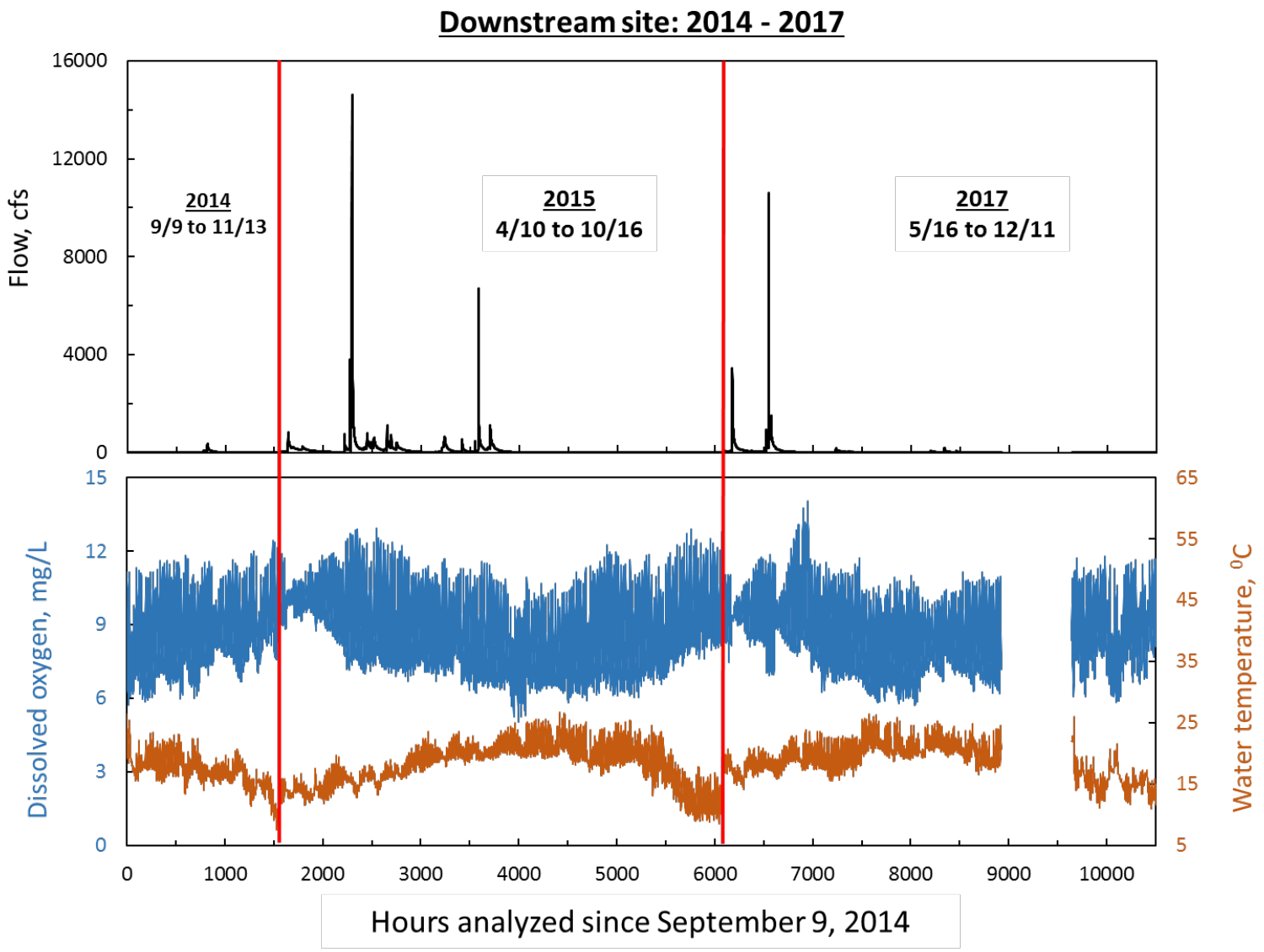

Figure 21. Flow, water temperature, and dissolved oxygen concentration downstream of the C&H Farm between September 9, 2014 and December 11, 2017.

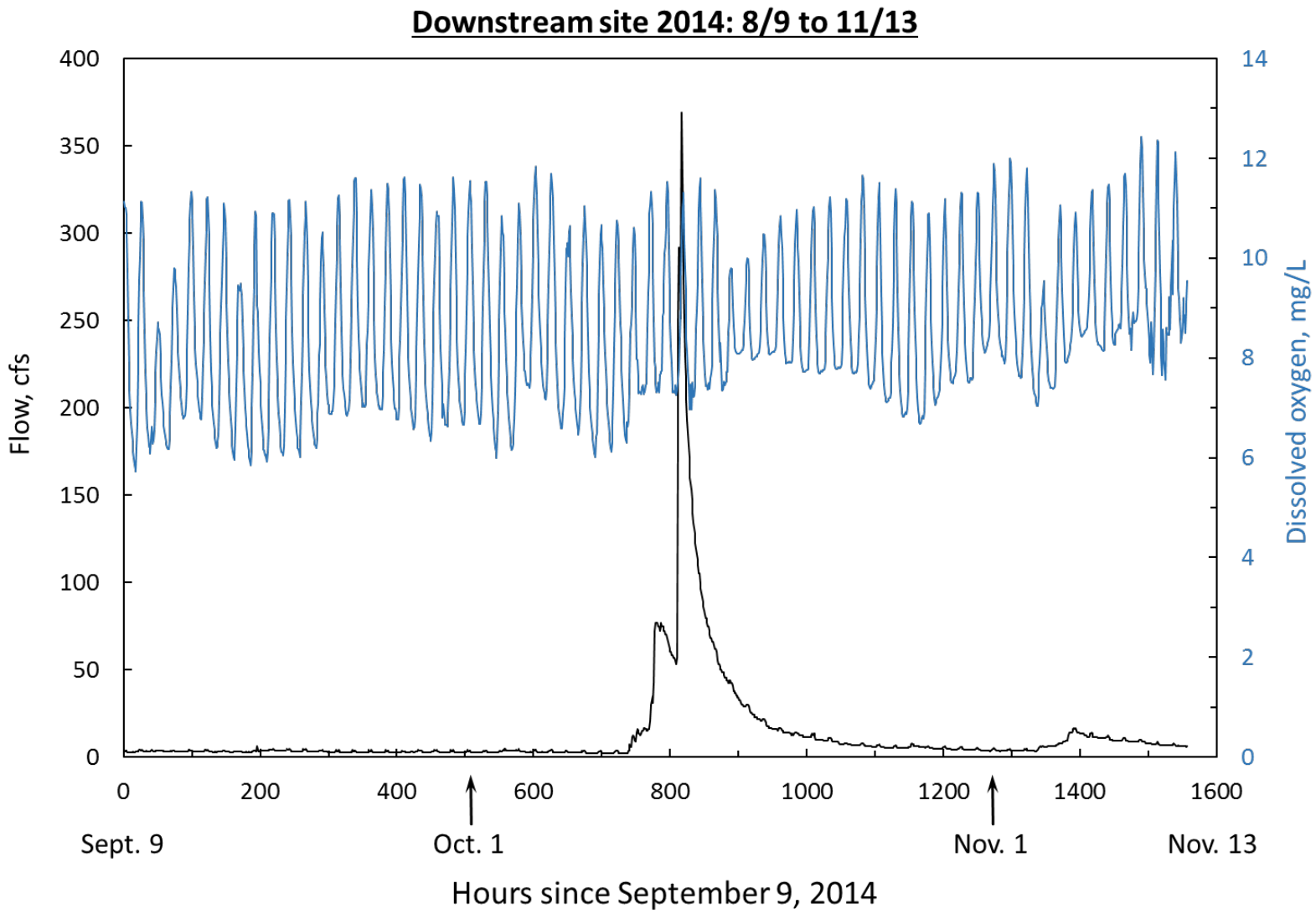

Figure 22. Flow and dissolved oxygen concentration downstream of the C&H Farm between September 9 and November 13, 2014.

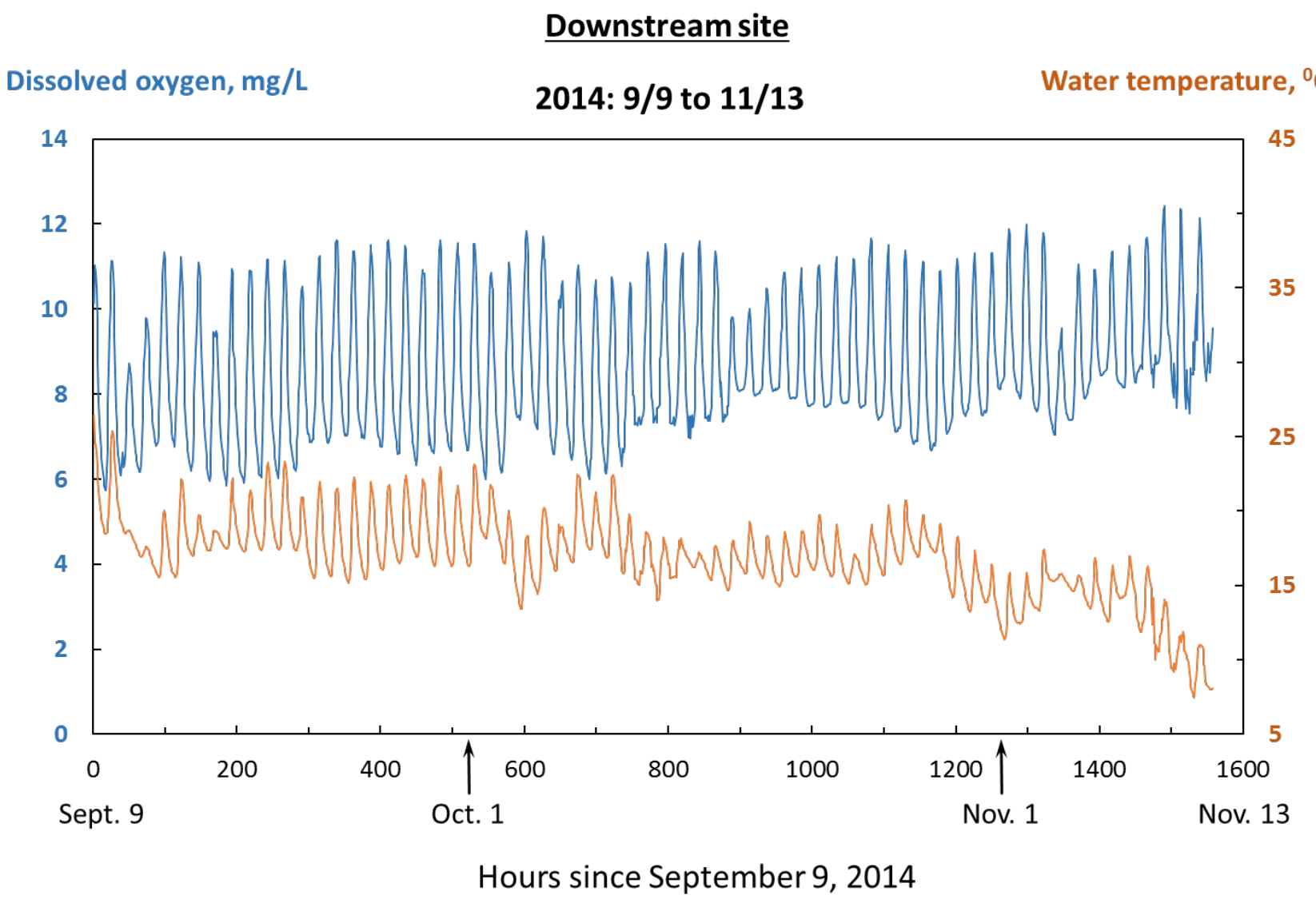

Figure 23. Water temperature and dissolved oxygen concentration downstream of the C&H Farm between September 9 and November 13, 2014.

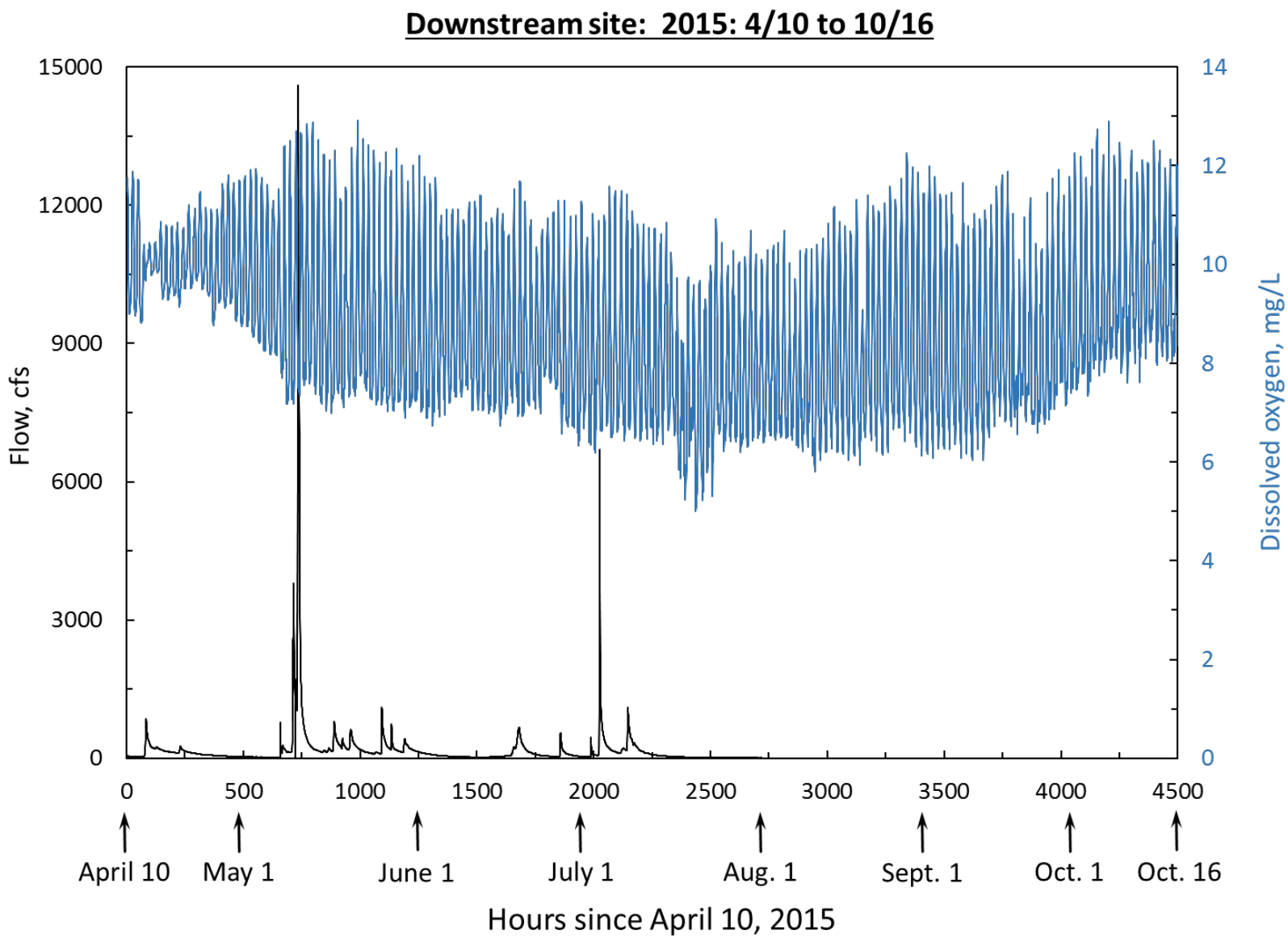

Figure 24. Flow and dissolved oxygen concentration downstream of the C&H Farm between S April 10 and October 16, 2015.

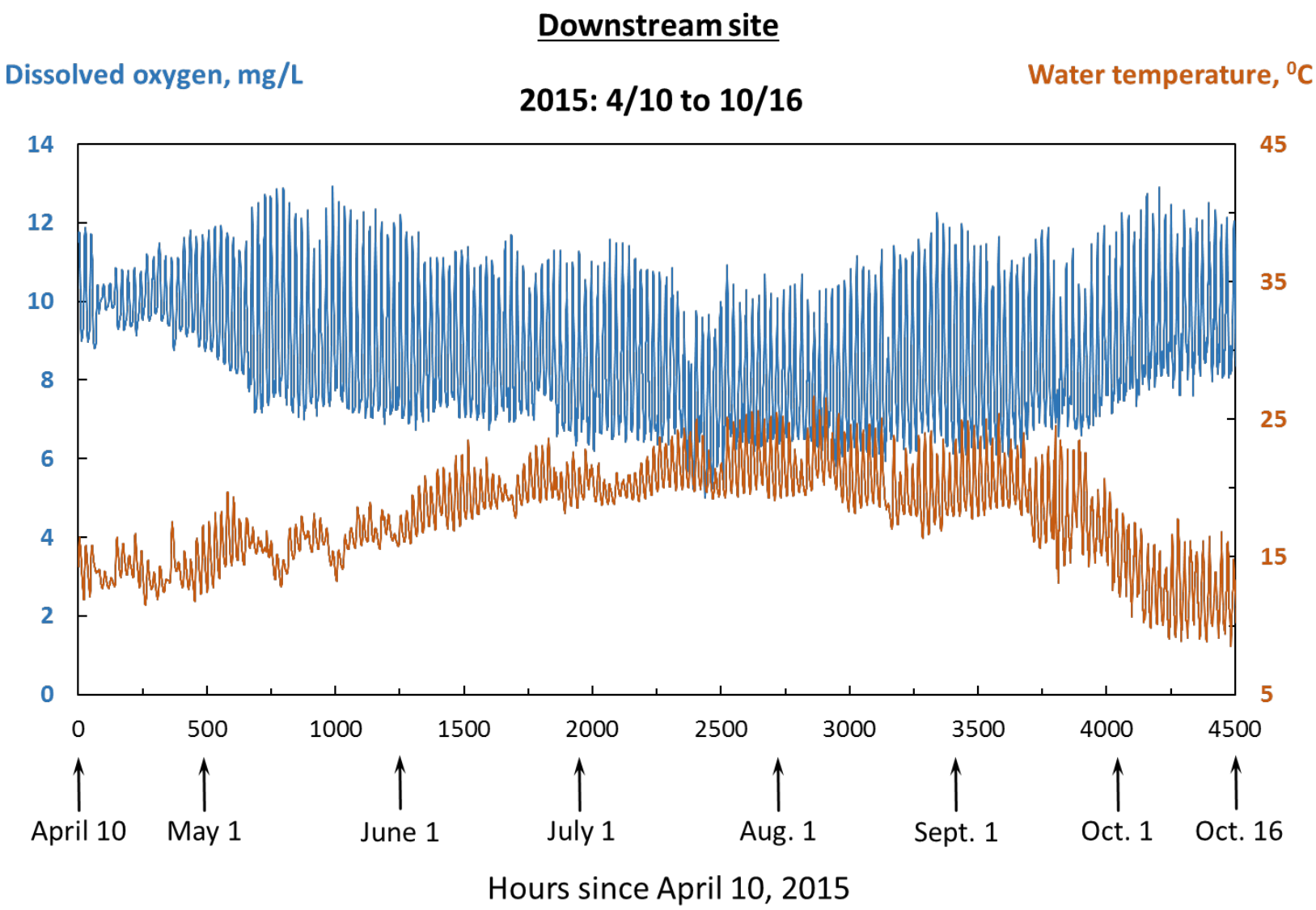

Figure 25. Water temperature and dissolved oxygen concentration downstream of the C&H Farm between April 10 and October 16, 2015.

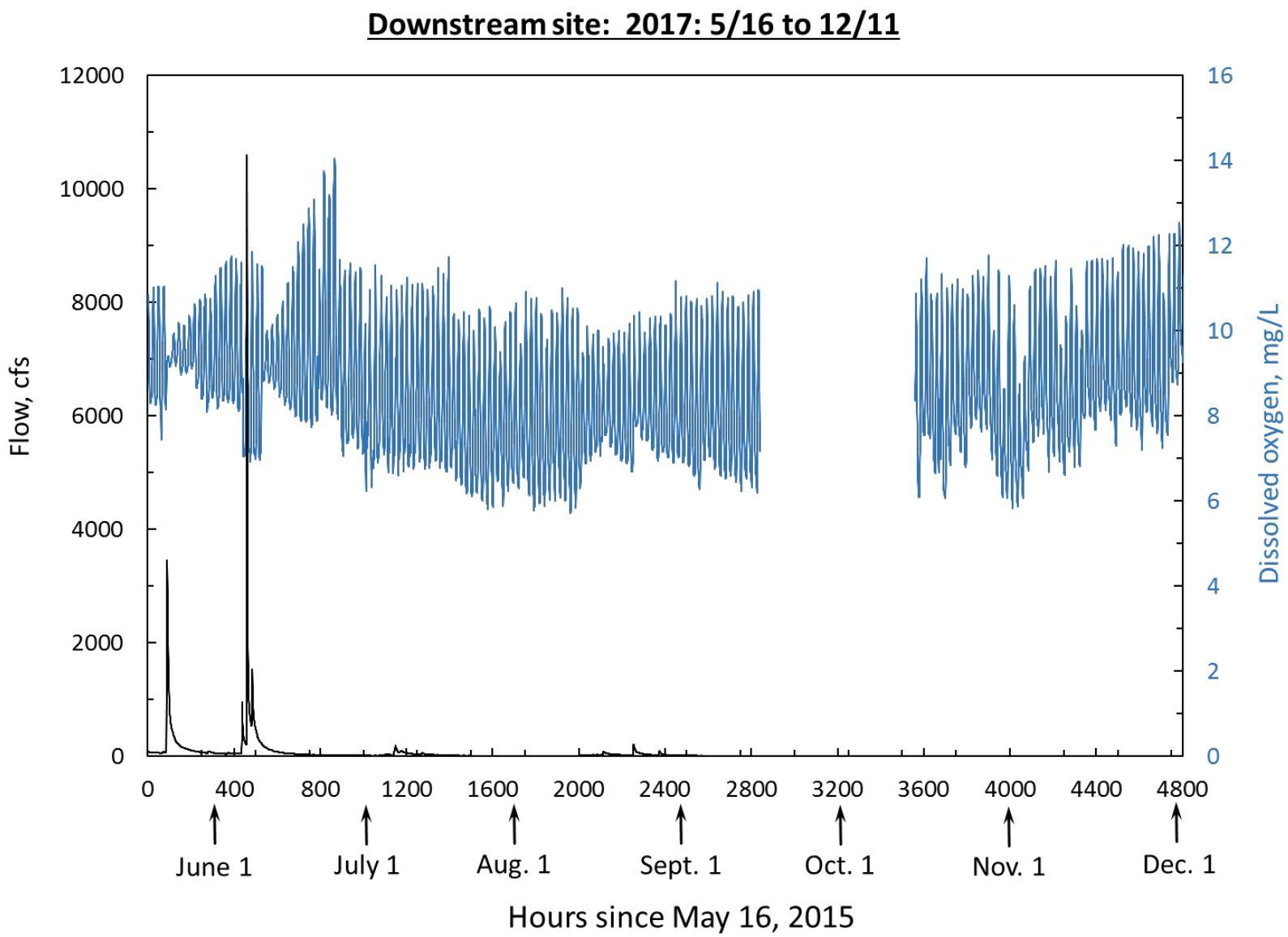

Figure 26. Flow and dissolved oxygen concentration downstream of the C&H Farm between May 16 and December 11, 2017.

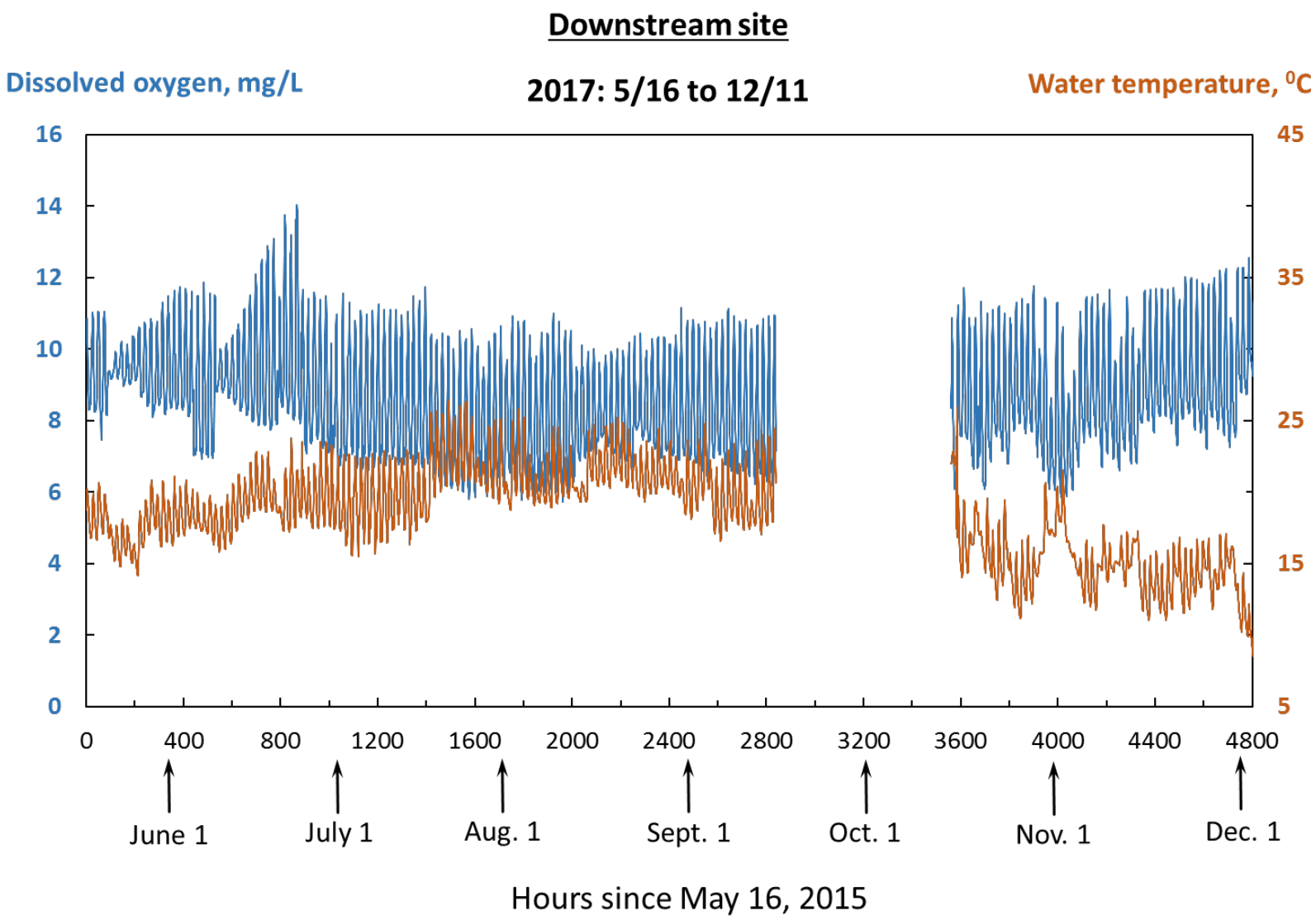

Figure 27. Water temperature and dissolved oxygen concentration downstream of the C&H Farm between May 16 and December 11, 2017.

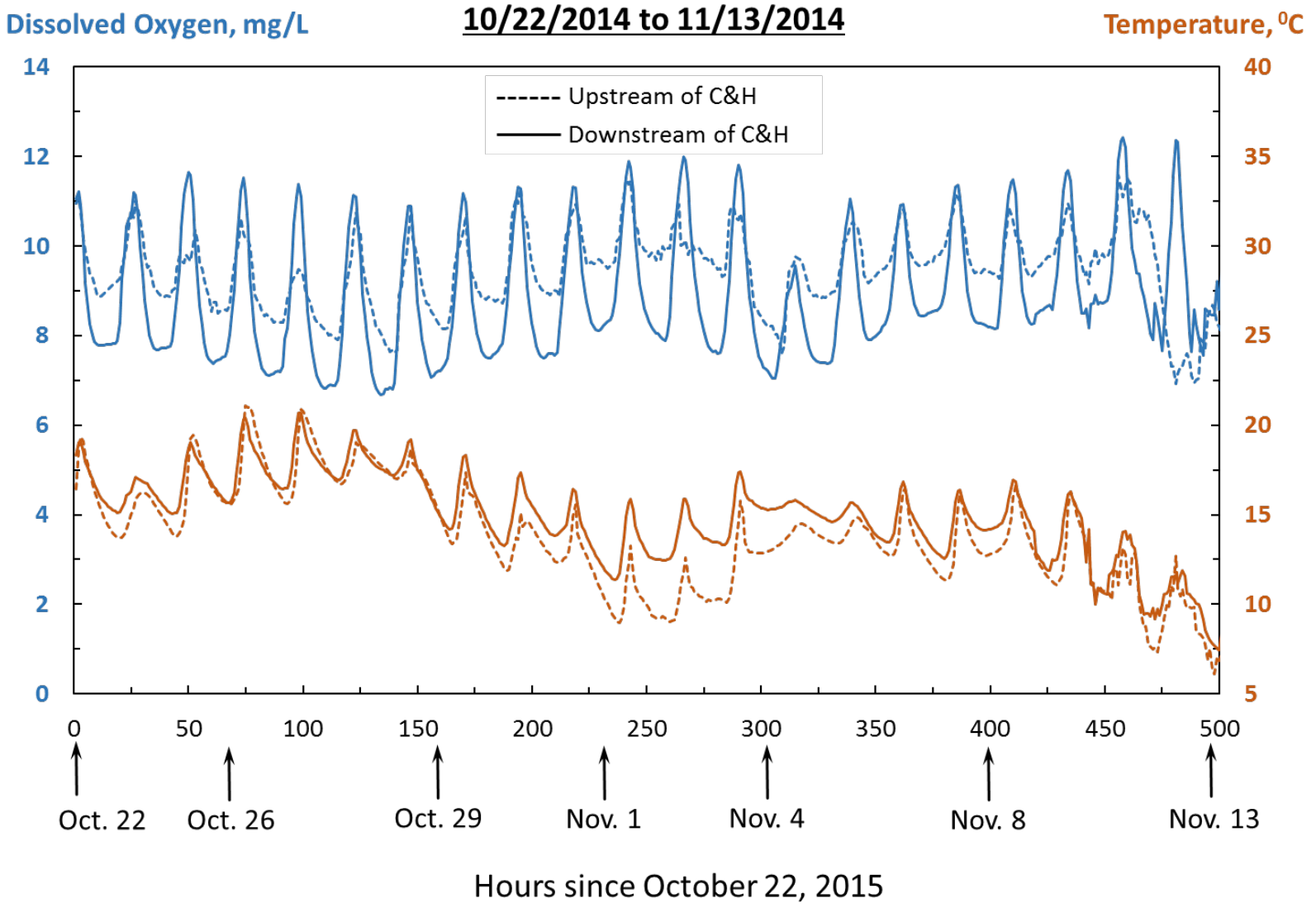

Figure 28. Water temperature and dissolved oxygen concentration upstream and downstream of the C&H Farm between October 22 and November 13, 2014.

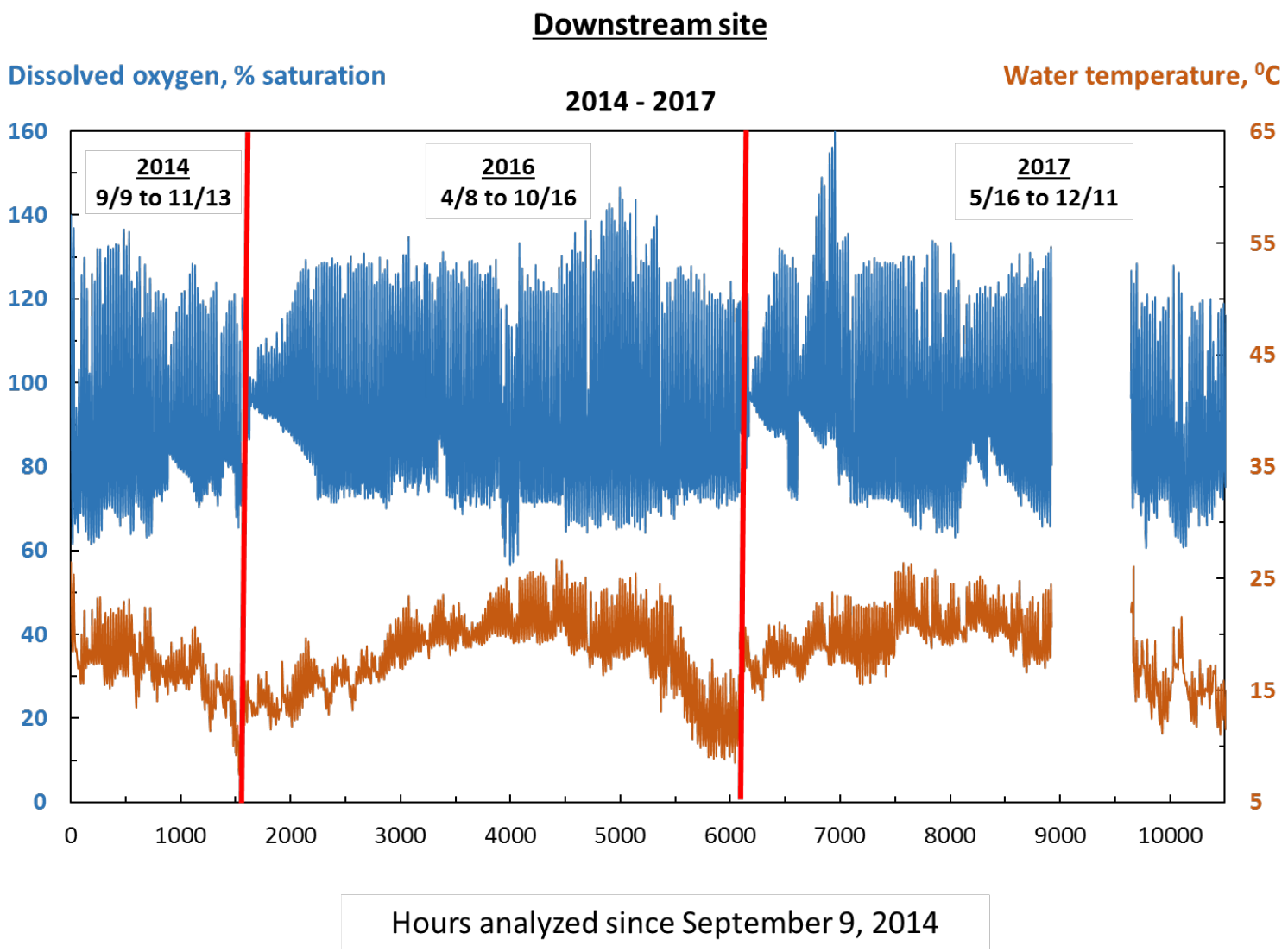

Figure 29. Water temperature and dissolved oxygen saturation downstream of the C&H Farm between September 9 and December 11, 2017.

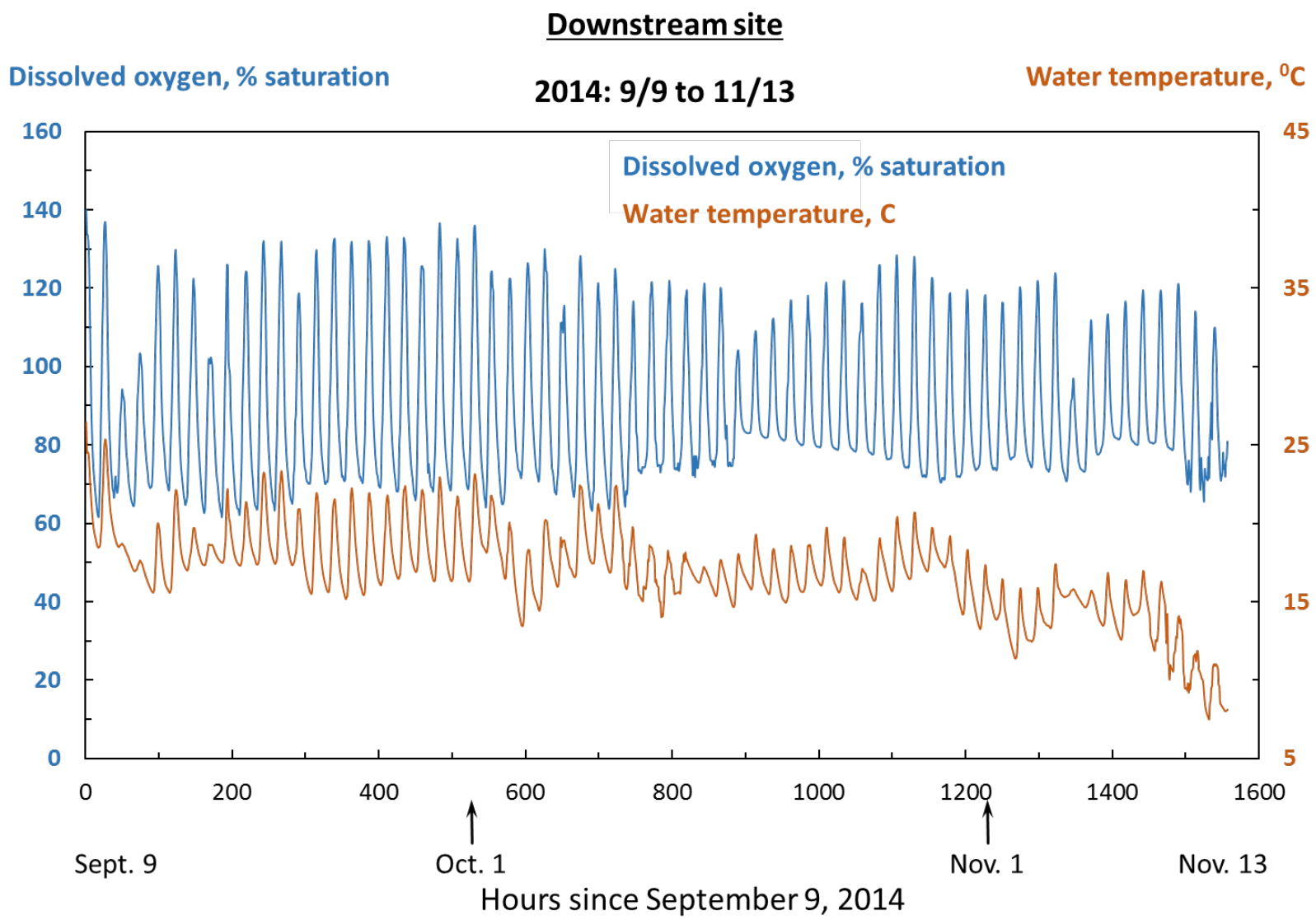

Figure 30. Water temperature and dissolved oxygen saturation downstream of the C&H Farm between September 9 and November 13, 2014.

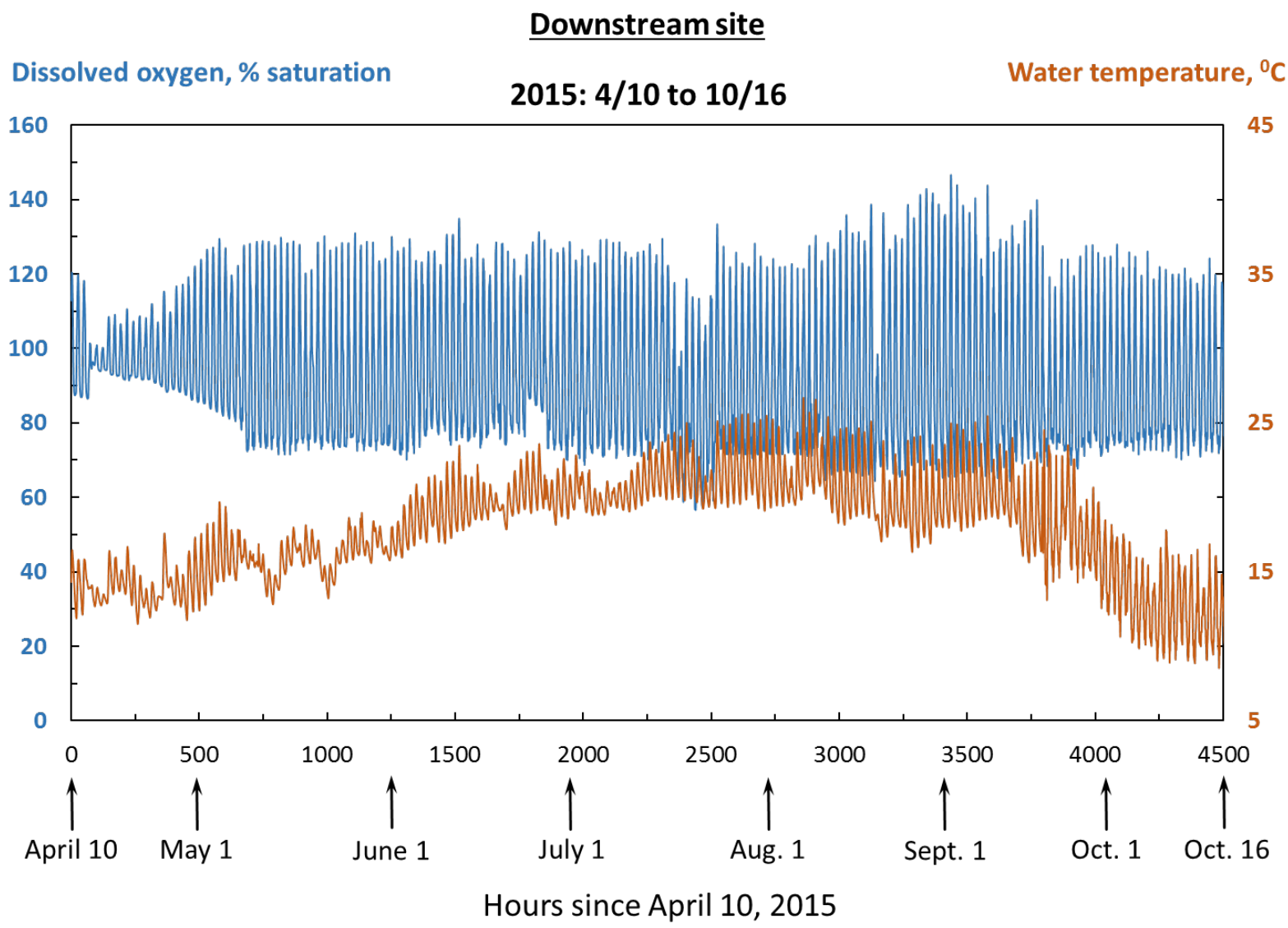

Figure 31. Water temperature and dissolved oxygen saturation downstream of the C&H Farm between April 10 and October 16, 2015.

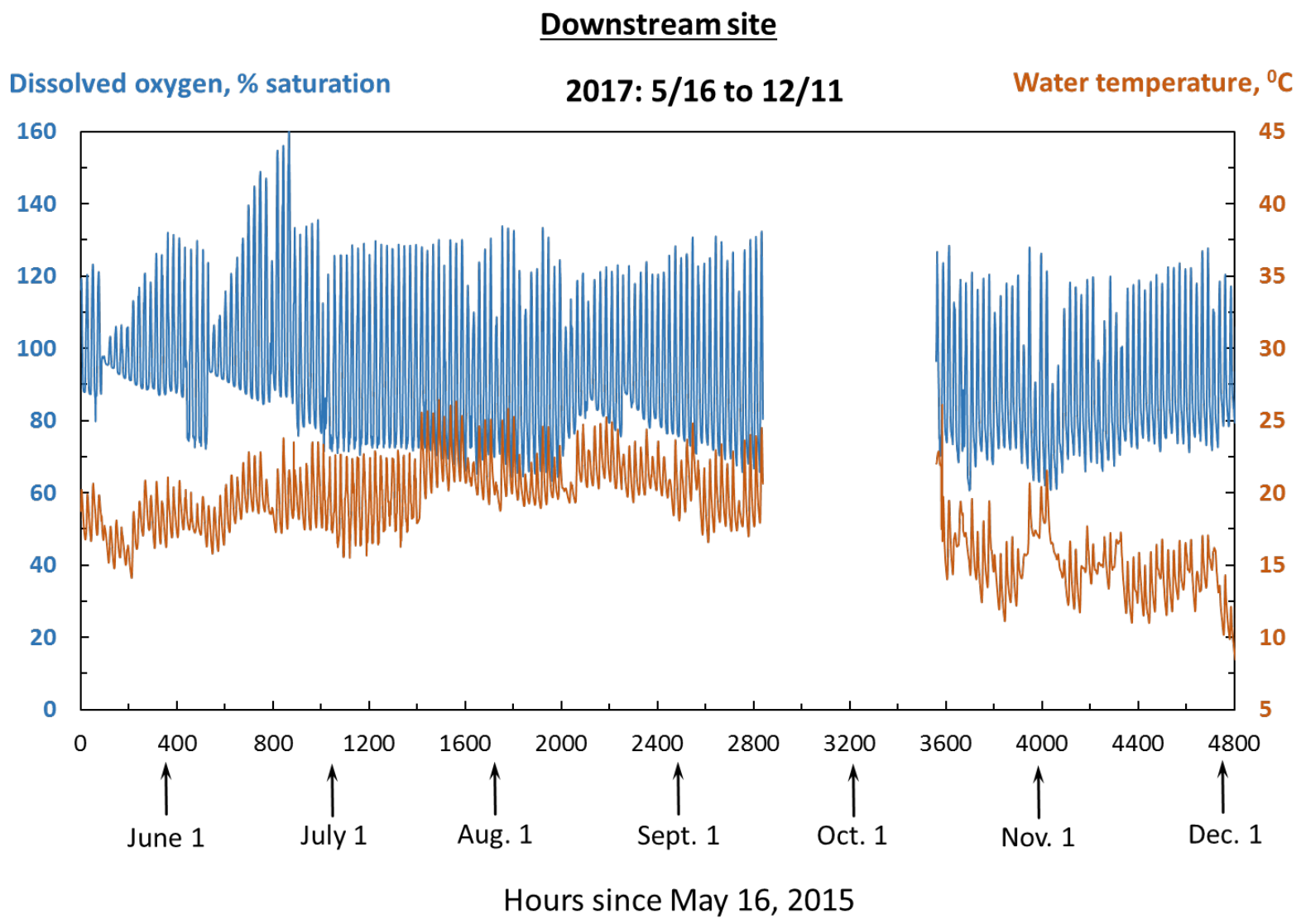

Figure 32. Water temperature and dissolved oxygen saturation downstream of the C&H Farm between May 15 and December 11, 2017.

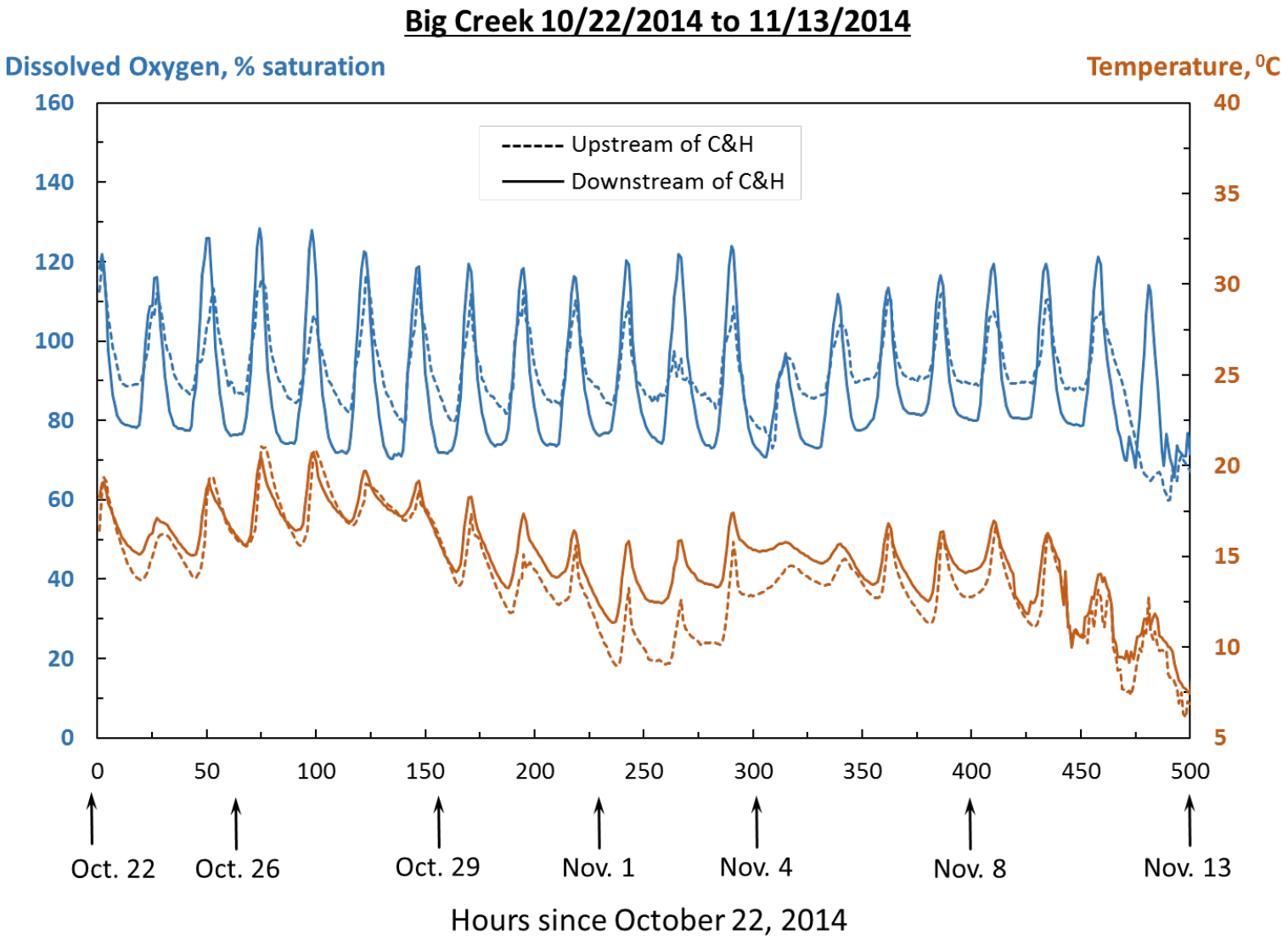

Figure 33. Water temperature and dissolved oxygen saturation upstream and downstream of the C&H Farm between October 22 and November 13, 2014.

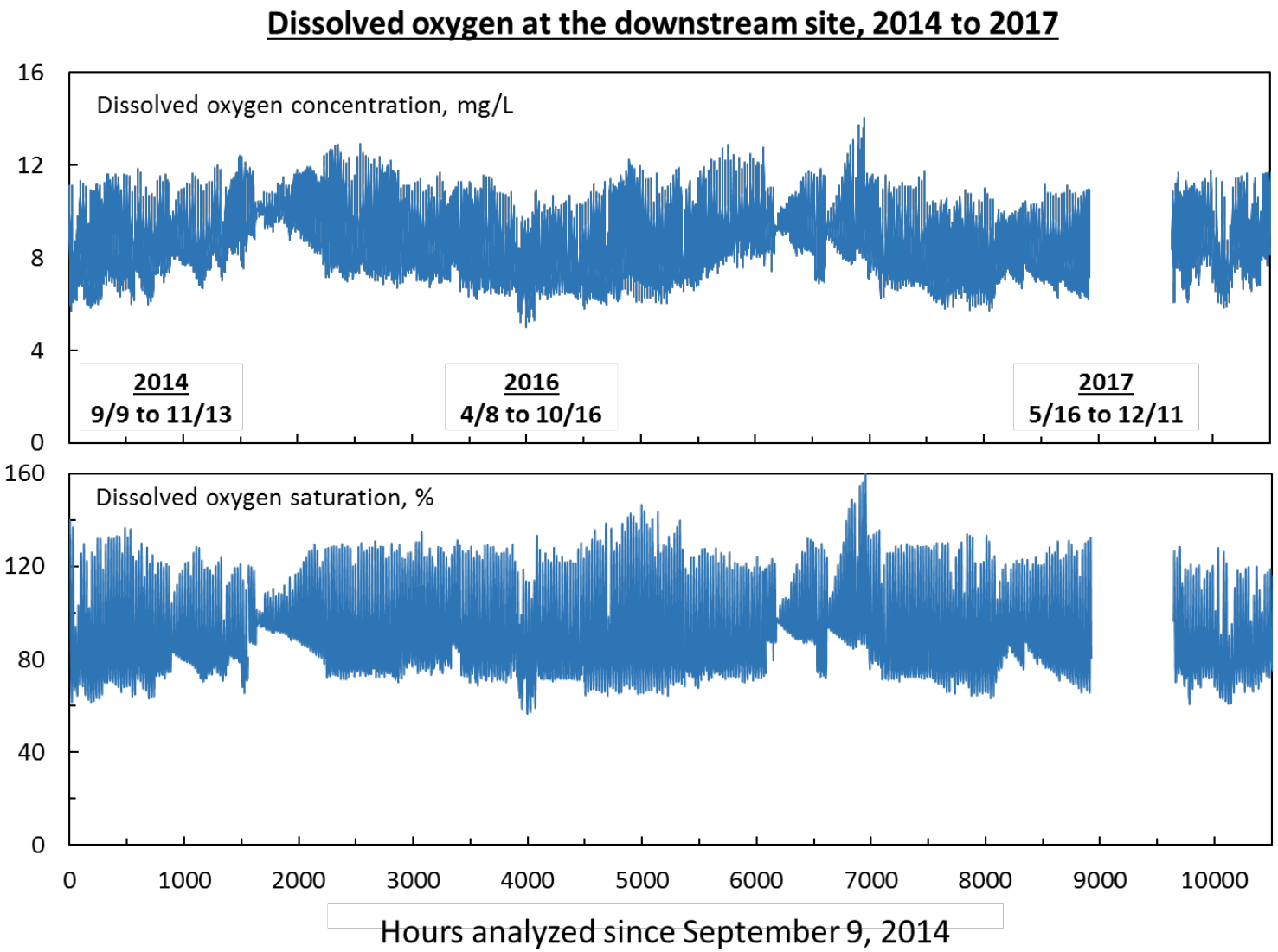

Figure 34. Dissolved oxygen concentration and % saturation downstream of the C&H Farm between 2014 and 2017.

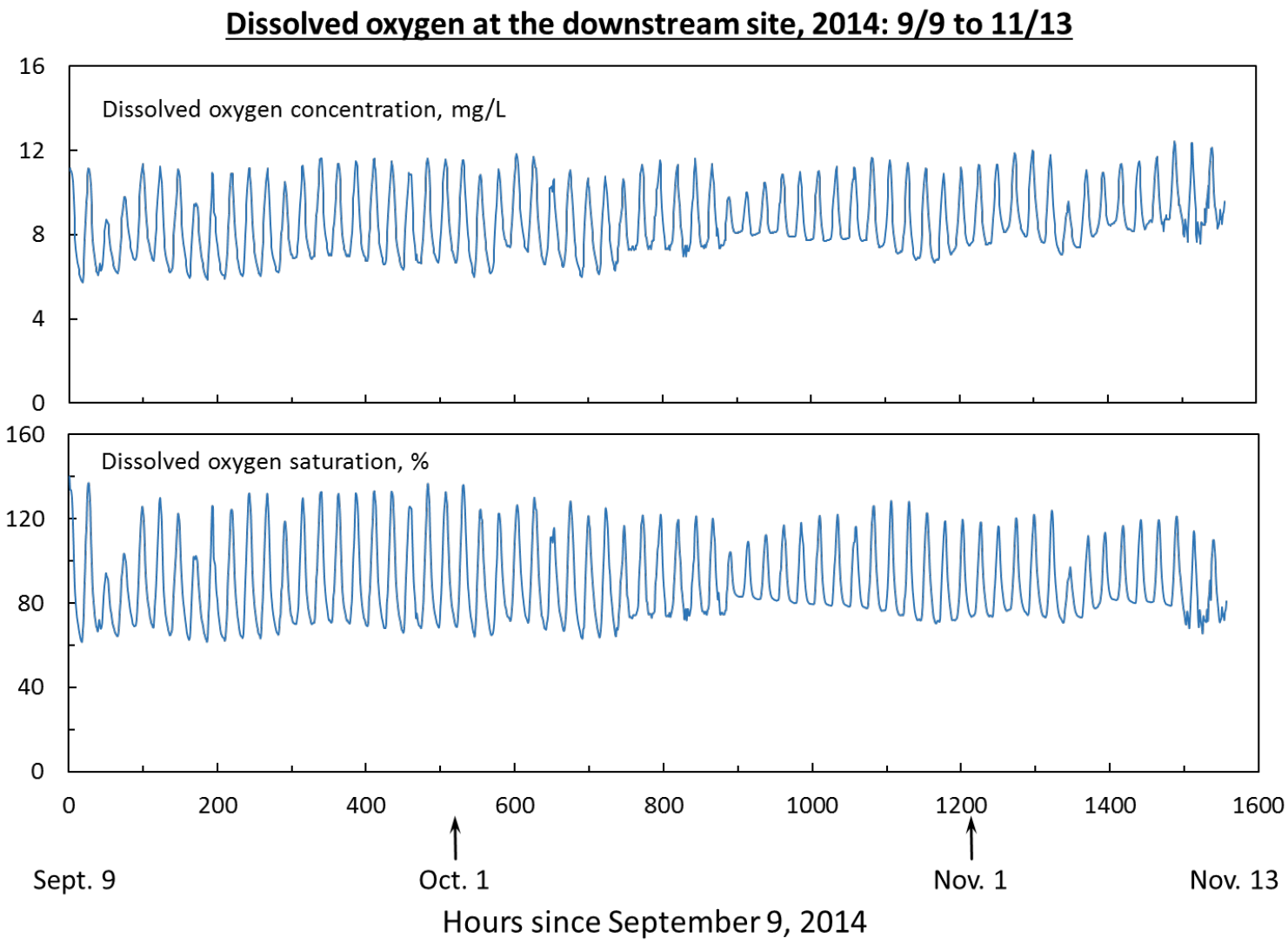

Figure 35. Dissolved oxygen concentration and % saturation downstream of the C&H Farm between September 9 and November 13, 2014.

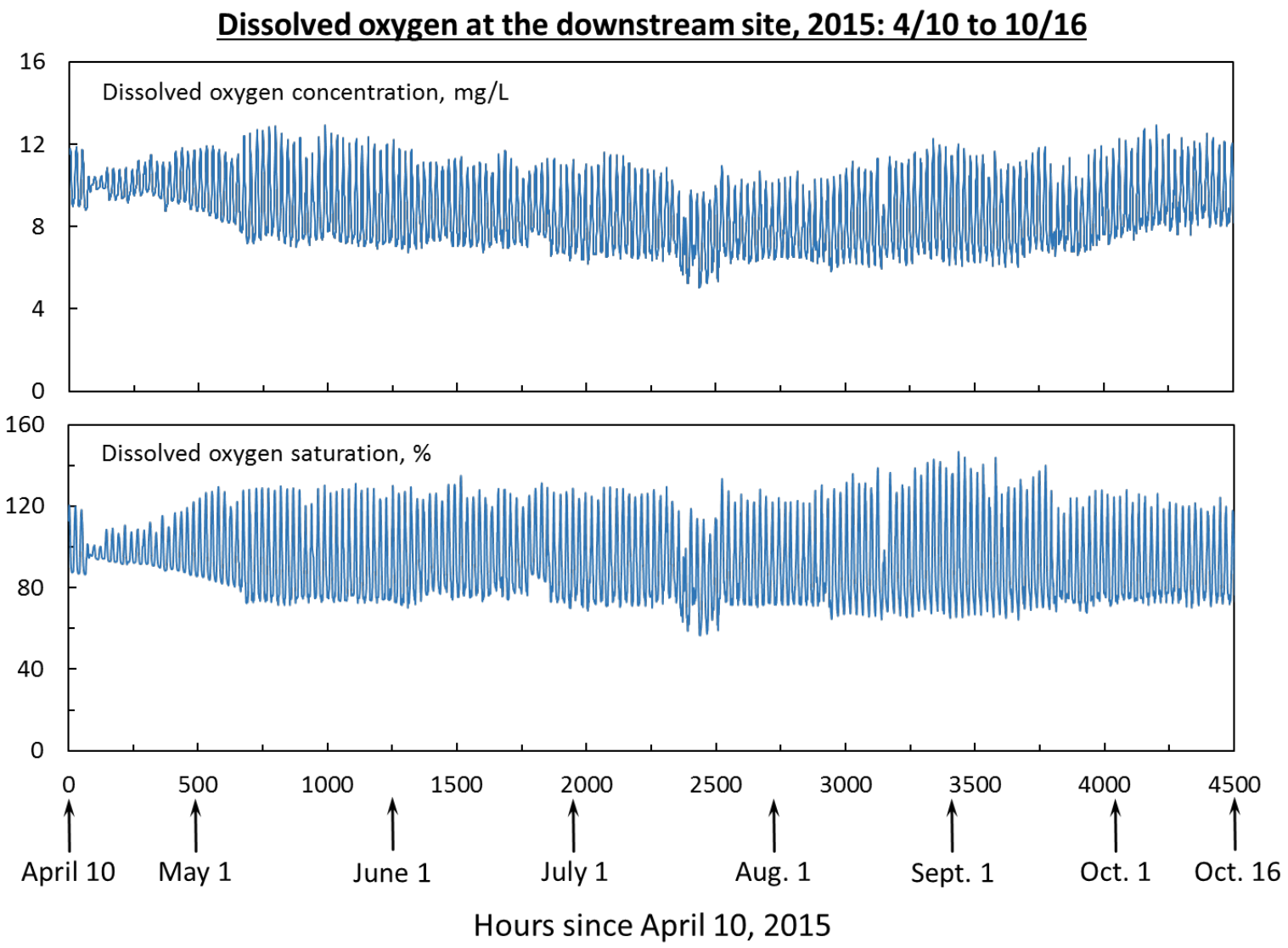

Figure 36. Dissolved oxygen concentration and % saturation downstream of the C&H Farm between April 10 and October 16, 2015.

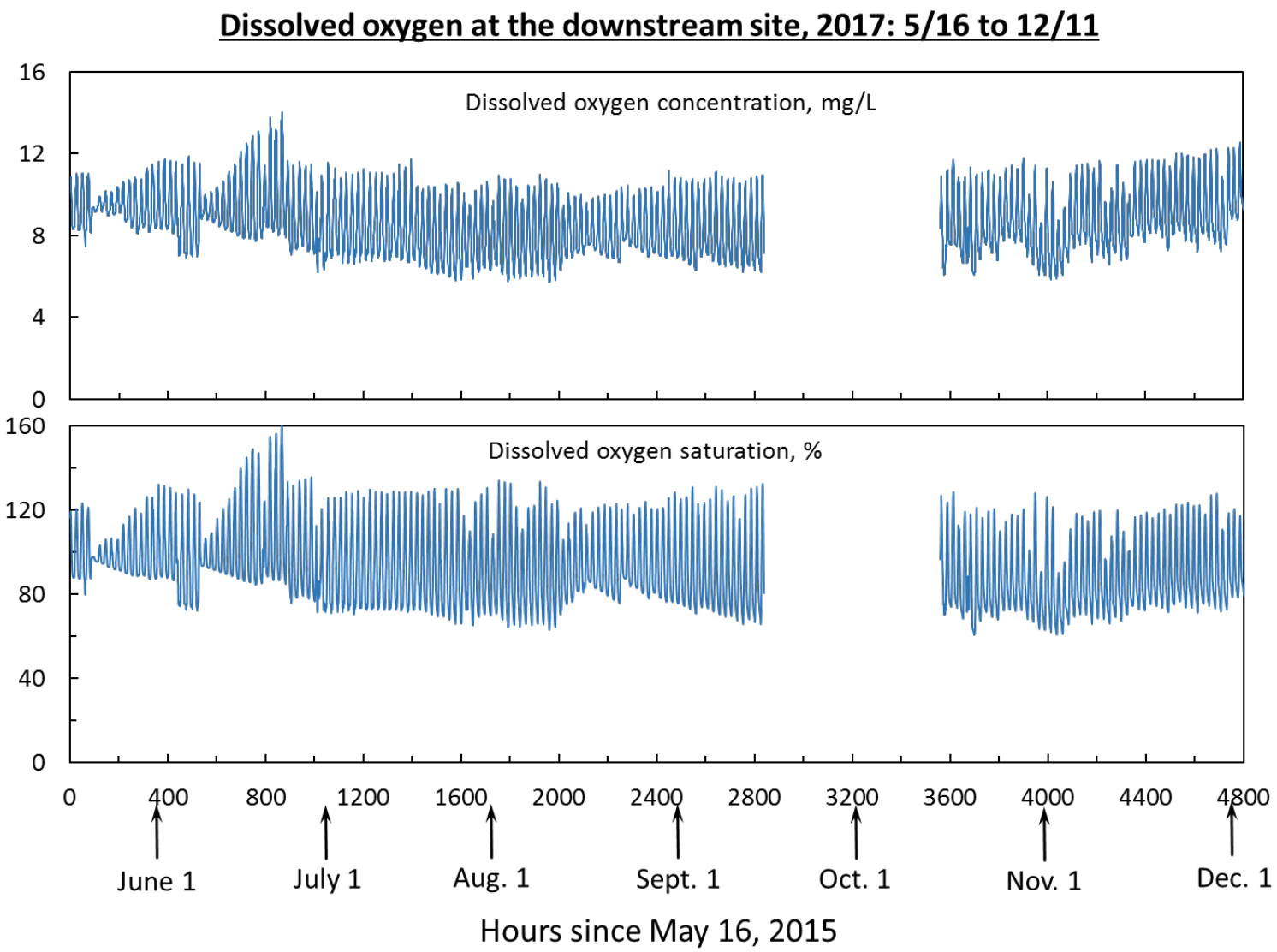

Figure 37. Dissolved oxygen concentration and % saturation downstream of the C&H Farm between May 16 and December 11, 2017.

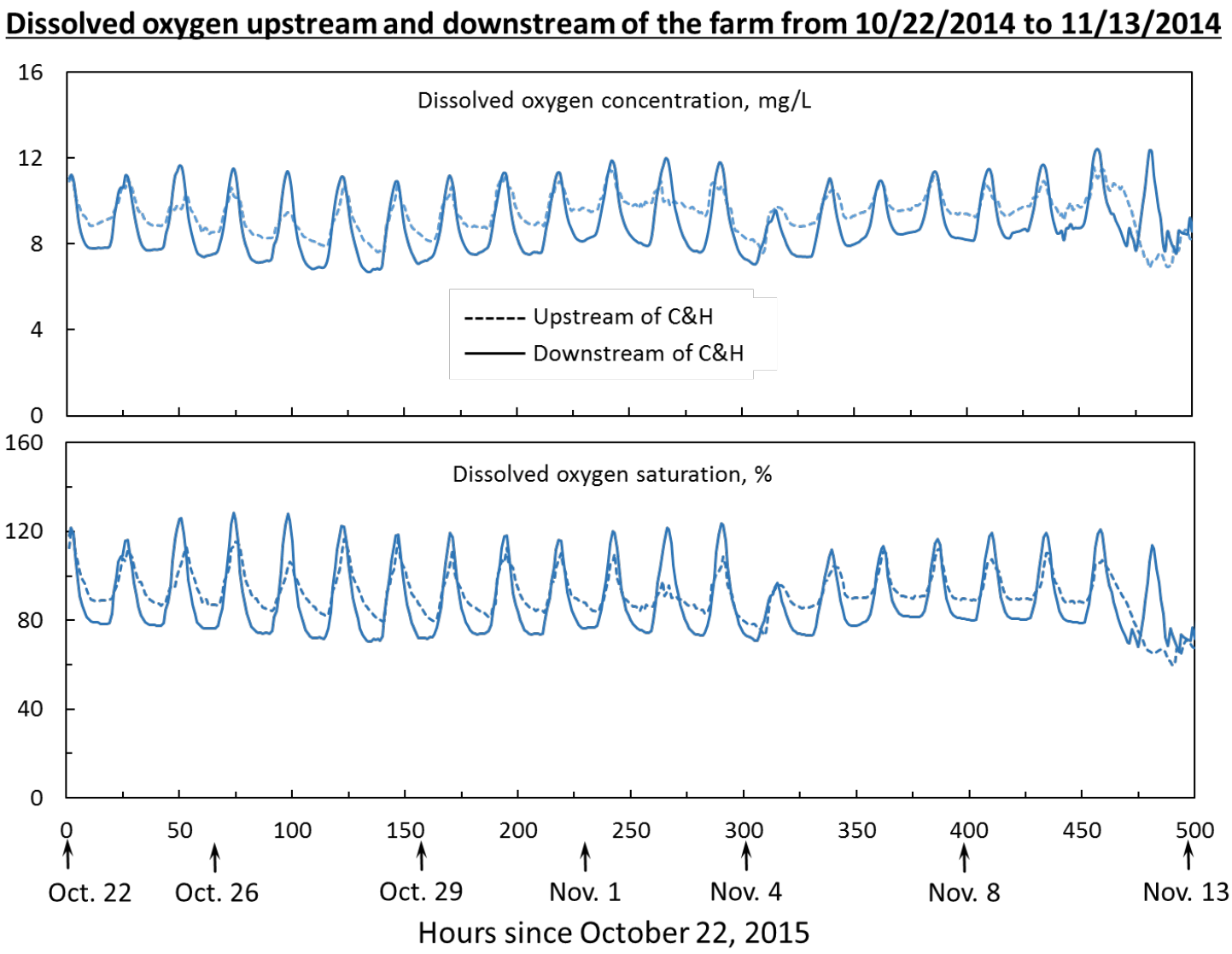

Figure 38. Dissolved oxygen concentration and % saturation upstream and downstream of the C&H Farm between October 22, 2014 and November 13, 2014.

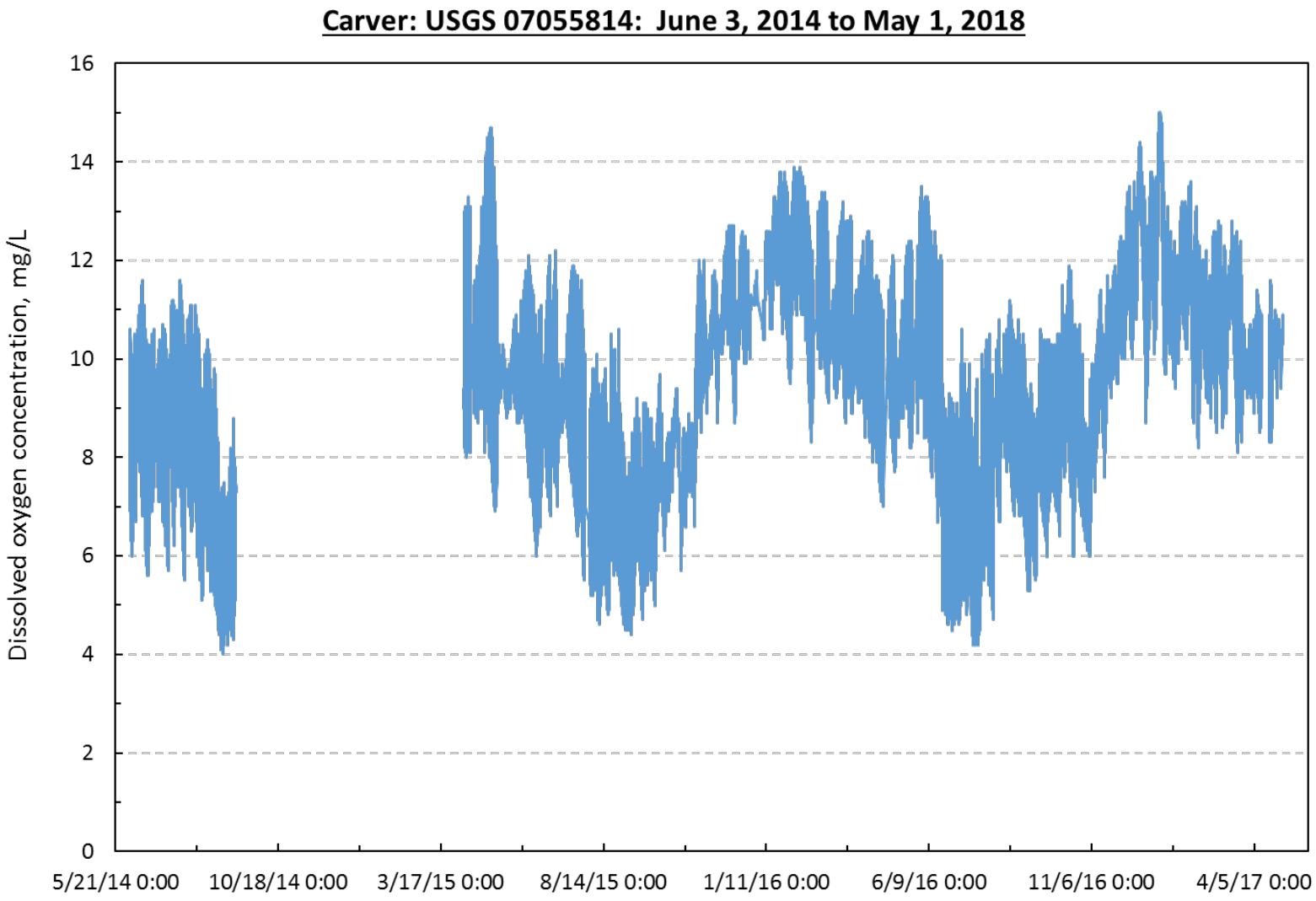

Figure 39. Dissolved oxygen concentration at the USGS Carver site (USGA: 07055814) for June 3 to May 1, 2014.