

NUTRIENT LOADS IN BIG CREEK UP AND DOWNSTREAM OF C&H FARM

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Summary

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2. Over the 5 years of monitoring, two large storms on May 11 and December 26, 2015 dominated nutrient loads at the sites up- (BC6) and downstream (BC7) of the C&H Farm. The months during which these two storms occurred comprised 72, 84, 51, and 70% of the total 5-year load of dissolved P, total P, nitrate-N, and total N, respectively.
3. These two months accounted for only 17% of total discharge at BC7 during this period. This reflects a greater erosive power of larger storms and predominance of surface runoff pathways transporting nutrients to Big Creek, than via subsurface flow paths. Supporting this observation is that 86 and 74% of particulate or sediment-bound P and N was delivered during the months of May and December 2015.

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Nutrient Loading of Big Creek

Water discharge and nutrient load in Big Creek was monitored continuously starting in May, 2014, when USGS installed a gaging station at BC7; USGS 07055790 Big Creek near Mt. Judea, AR (see 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). Discharge and loads are determined on a water year basis of May 1 to April 30.

The monthly discharge and nutrient flux varied dramatically over the 5-year monitoring period (see Supplemental Table S1). Two large storms on May 11 and December 26, 2015 dominated nutrient loads at the sites up- (BC6) and downstream (BC7) of the C&H Farm (Figure 1). On an annual basis, the variance in rainfall and Big Creek flow led to a wide variation in annual dissolved P, total P, nitrate-N, and total N flux at both the up and downstream sites BC6 and BC7 (Figure 2).

Tabulated on a monthly basis, discharge and loads varied with season, but the dominance of the large storm events on May 11 and December 26, 2015 are clear (Table 2). The May 11 storm comprised 34% of the total annual discharge at BC7 (on a water year basis; i.e., May 1 to April 30) and over 50% of nutrient discharge (53% dissolved P, 58% total P, 50% nitrate-N, and 54% total N, respectively). Similarly, the December 26 storm event comprised 25% of annual discharge and 50% of nutrient discharge (51% dissolved P, 45% total P, 49% nitrate-N, and 51% total N, respectively).

Dominance of one or several large rainfall and thus, flow events over extended periods of monitoring is found in many watersheds across the U.S. and overseas and is certainly not unique to the Big Creek or Buffalo River Watershed. During these storm events for instance, the monitored application fields BC5a and BC12 were mostly flooded as Big Creek breached its banks. Thus, the effectiveness of conservation practices such as buffer strips or no-application zones for slurry would have little impact on the conservation of nutrients or limiting their movement to Big Creek, under such extreme flow events.

Supplementary Tables S2 and S3 present monthly and annual discharge and nutrient fluxes in metric units, while the range in monthly fluxes at up and downstream sites are more clearly depicted in Figures S1 to S3. Stream discharge and percent water year loss of nutrients on a monthly basis are depicted in Figures S4 and S5.

Cumulative flows and P and N loads at the up and downstream sites are presented in Supplementary Figures S6 to S8 with the extreme storm events of May and December 2015 excluded. Figures S9 to S11 depict cumulative discharge and P and N loads with extreme 2015 storms included.

BCRET Site BC7: USGS 07055790 Big Creek near Mt. Judea, AR

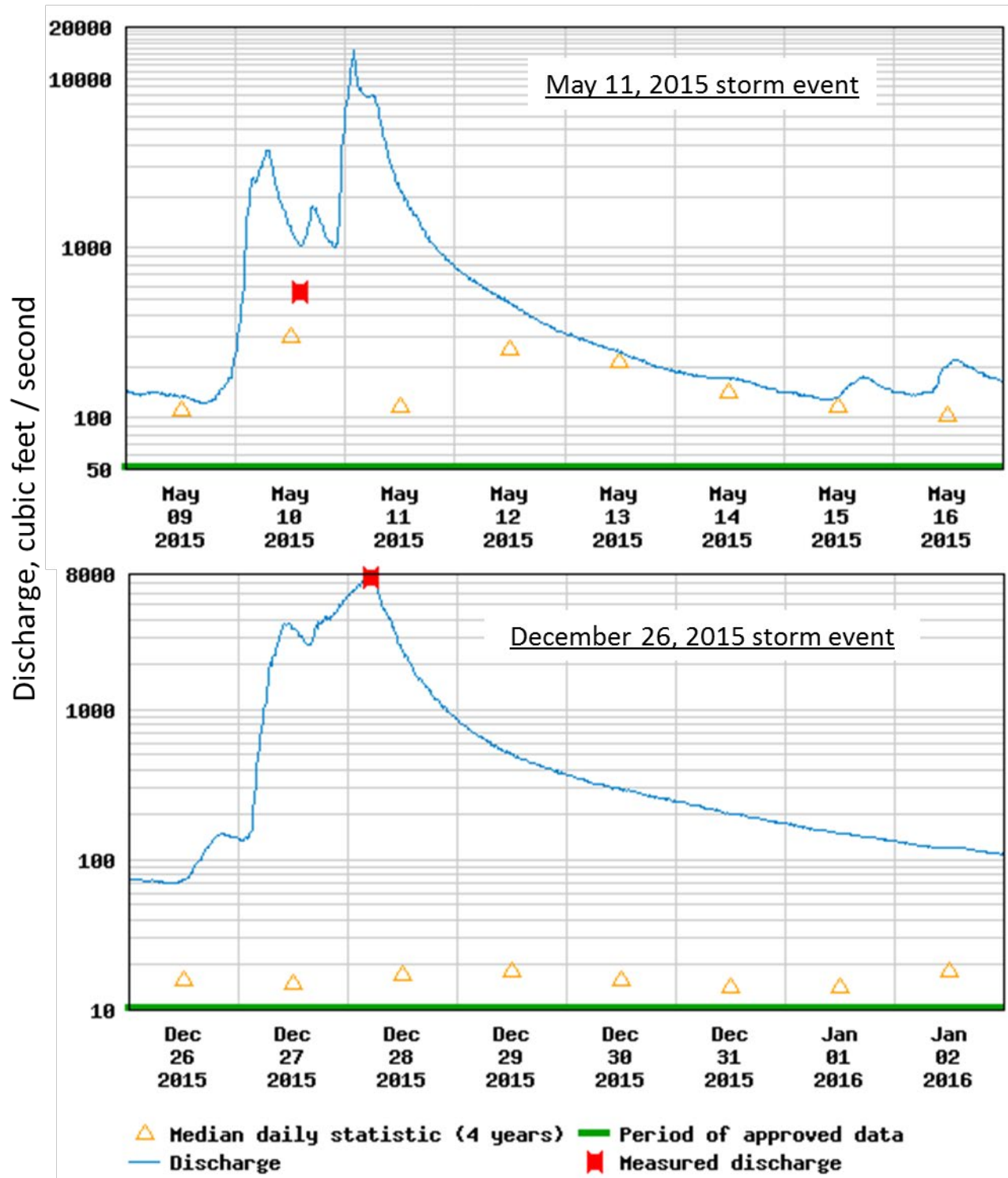


Figure 1. Discharge at BC7 (USGS 07055790 Big Creek near Mt. Judea, AR) downstream of the C&H Farm for the May 11 and December 26, 2015 storm events.

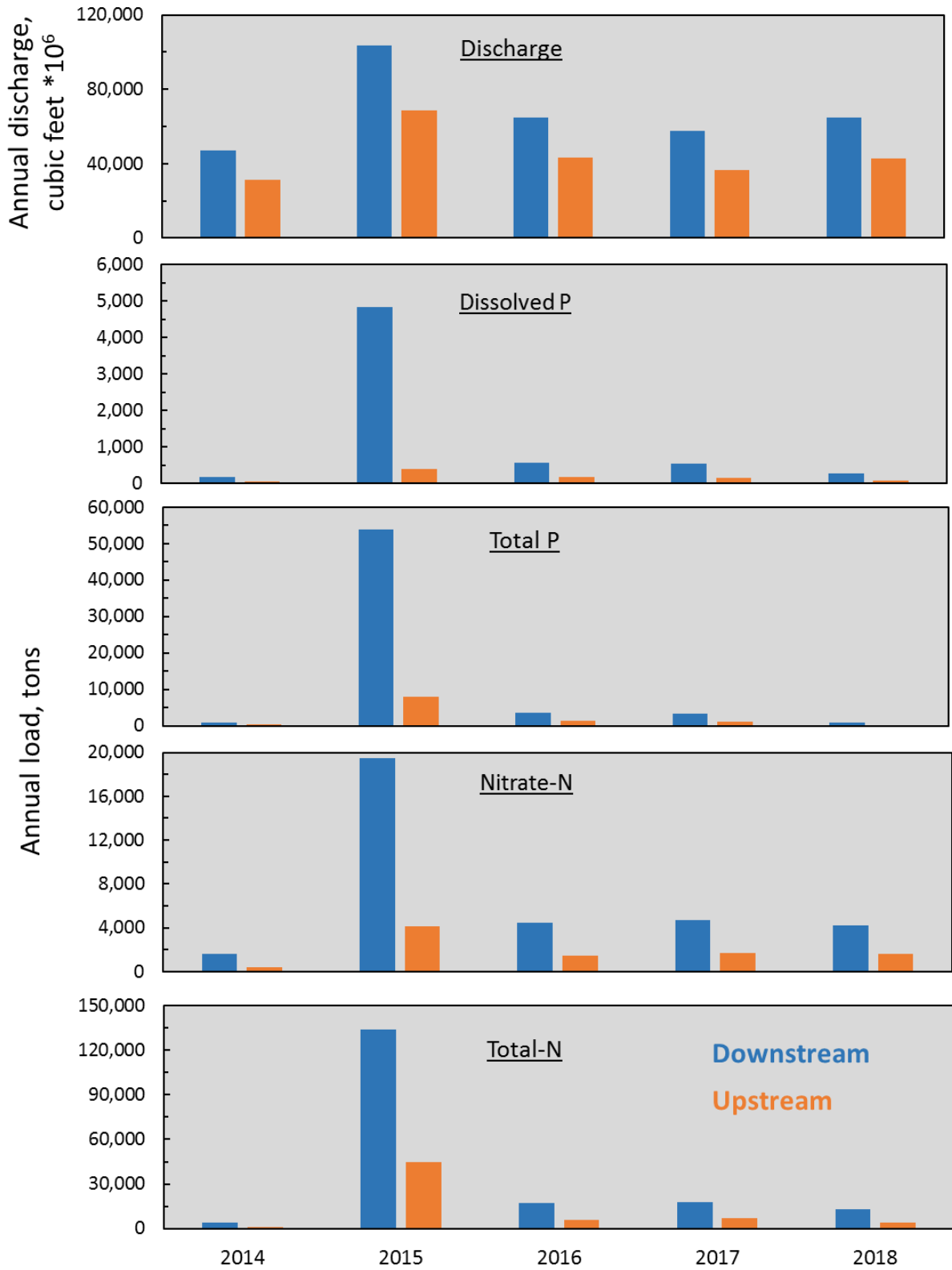


Figure 2. Annual discharge and load of phosphorus and nitrogen up- (BC6) and downstream (BC7) of the C&H Farm (water-year basis; May 1 to April 30).

Table 1. Monthly flow and nutrient loss for the downstream (BC7) sampling site and percent of annual value, based on a water year (i.e., May 1, 2014 to April 30, 2015).

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Volume	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual
	ft ³ *10 ⁶	%	lbs	%	lbs	%	lbs	%	lbs	%
Water Year 2014										
May, 2014	5,505	11.7	30,602	8.5	105,824	6.3	301,281	9.5	652,733	8.2
June, 2014	2,108	4.5	2,217	0.6	5,778	0.3	36,393	1.2	51,854	0.7
July, 2014	4,138	8.8	13,315	3.7	43,515	2.6	151,398	4.8	278,079	3.5
August, 2014	964	2.0	472	0.1	1,167	0.1	9,650	0.3	12,255	0.2
September, 2014	247	0.0%	23	0.0	51	0.0	859	0.0	913	0.0
October, 2014	1,872	4.0	8,007	2.2	26,724	1.6	84,452	2.7	163,457	2.1
November, 2014	480	1.0	93	0.0	200	0.0	2,804	0.1	3,017	0.0
December, 2014	1,845	3.9	1,651	0.5	3,967	0.2	31,166	1.0	40,542	0.5
January, 2015	4,846	10.3	76,009	21.2	365,498	21.7	568,945	18.0	1,644,873	20.7
February, 2015	1,455	3.1	1,449	0.4	3,990	0.2	26,343	0.8	36,056	0.5
March, 2015	15,798	33.5	190,045	53.0	978,067	58.0	1,576,954	49.9	4,285,366	53.9
April, 2015	7,883	16.7	34,646	9.7	150,631	8.9	370,294	11.7	780,156	9.8
Sum	47,142		358,530		1,685,412		3,160,540		7,949,301	

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Volume	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual
	ft ³ *10 ⁶	%	lbs	%	lbs	%	lbs	%	lbs	%
Water Year 2015										
May, 2015	30,314	29.3	4,264,990	44.0	56,546,902	52.4	16,220,827	41.6	118,725,629	44.2
June, 2015	6,610	6.4	47,744	0.5	265,107	0.2	396,532	1.0	1,039,143	0.4
July, 2015	10,236	9.9	206,016	2.1	1,399,025	1.3	1,300,686	3.3	4,464,363	1.7
August, 2015	274	0.3	23	0.0	66	0.0	813	0.0	955	0.0
September, 2015	212	0.2	15	0.0	40	0.0	577	0.0	672	0.0
October, 2015	125	0.1	5	0.0	14	0.0	248	0.0	286	0.0
November, 2015	5,005	4.8	73,225	0.8	333,828	0.3	556,768	1.4	1,604,732	0.6
December, 2015	26,192	25.4	4,919,538	50.7	48,529,036	45.0	18,958,801	48.6	138,058,592	51.4
January, 2016	4,350	4.2	8,472	0.1	24,597	0.0	118,091	0.3	207,047	0.1
February, 2016	1,965	1.9	2,699	0.0	7,840	0.0	40,281	0.1	69,769	0.0
March, 2016	13,564	13.1	160,482	1.7	760,129	0.7	1,270,452	3.3	3,940,900	1.5
April, 2016	4,448	4.3	13,179	0.1	48,186	0.0	146,071	0.4	328,196	0.1
Sum	103,296		9,696,389		107,914,771		39,010,147		268,440,286	
Water Year 2016										
May, 2016	10,180	15.7	76,877	6.7	356,247	5.1	625,675	7.0	1,878,652	5.4

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Volume	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual
	ft ³ *10 ⁶	%	lbs	%	lbs	%	lbs	%	lbs	%
June, 2016	1,724	2.7	1,650	0.1	4,824	0.1	24,709	0.3	44,407	0.1
July, 2016	541	0.8	127	0.0	302	0.0	2,772	0.0	4,214	0.0
August, 2016	7,365	11.3	51,281	4.5	192,551	2.8	409,961	4.6	1,210,167	3.5
September, 2016	1,244	1.9	1,732	0.2	4,463	0.1	21,285	0.2	44,796	0.1
October	433	0.7	60	0.0	103	0.0	1,730	0.0	2,429	0.0
November, 2016	546	0.8	165	0.0	260	0.0	3,660	0.0	5,600	0.0
December, 2016	827	1.3	197	0.0	273	0.0	4,962	0.1	7,171	0.0
January, 2017	1,507	2.3	969	0.1	1,421	0.0	17,567	0.2	30,416	0.1
February, 2017	2,131	3.3	2,202	0.2	6,032	0.1	44,487	0.5	65,488	0.2
March, 2017	13,260	20.4	195,463	17.0	1,049,540	15.1	1,776,614	19.8	5,841,168	16.8
April, 2017	25,189	38.8	818,007	71.2	5,334,856	76.8	6,038,701	67.3	25,578,962	73.7
Sum	64,947		1,148,731		6,950,869		8,972,123		34,713,470	
Water Year 2017										
May, 2017	15,230	26.4	291,003	26.7	1,879,400	29.5	2,249,845	24.1	9,023,469.10	25.8
June, 2017	10,510	18.2	414,989	38.1	2,954,878	46.4	2,725,090	29.2	12,979,740	37.1
July, 2017	1,874	3.3	1,817	0.2	5,990	0.1	31,115	0.3	55,929	0.2

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Volume	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual
	ft ³ *10 ⁶	%	lbs	%	lbs	%	lbs	%	lbs	%
August, 2017	1,592	2.8	1,791	0.2	5,626	0.1	28,735	0.3	53,257	0.2
September, 2017	291	0.5	38	0.0	86	0.0	1,152	0.0	1,584	0.0
October, 2017	174	0.3	11	0.0	20	0.0	440	0.0	553	0.0
November, 2017	241	0.4	17	0.0	29	0.0	440	0.0	844	0.0
December, 2017	174	0.3	91	0.0	165	0.0	2,946	0.0	3,500	0.0
January, 2018	984	1.7	362	0.0	676	0.0	11,117	0.1	13,375	0.0
February, 2018	11,065	19.2	297,622	27.3	1,247,436	19.6	3,077,333	32.9	10,079,367	28.8
March, 2018	6,190	10.7	39,224	3.6	134,569	2.1	560,317	6.0	1,339,867	3.8
April, 2018	9,285	16.1	42,499	3.9	140,971	2.2	659,175	7.1	1,474,282	4.2
Sum	57,609		1,089,465		6,369,847		9,347,703		35,025,767	
Water Year 2018										
May, 2018	6,664	10.3	53,899	8.1	206,215	11.4	693,903	6.7	1,893,296	7.5
June, 2018	1,545	2.4	2,397	0.4	6,774	0.4	46,077	0.4	85,438	0.3
July, 2018	212	0.3	11	0.0	18	0.0	546	0.0	653	0.0
August, 2018	810	1.3	594	0.1	1,240	0.1	14,285	0.1	22,002	0.1
September, 2018	504	0.8	125	0.0	210	0.0	4,231	0.0	5,449	0.0

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Volume	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual	Loss	Percent of annual
	ft ³ *10 ⁶	%	lbs	%	lbs	%	lbs	%	lbs	%
October, 2018	2,553	3.9	9,012	1.4	21,312	1.2	148,314	1.4	304,214	1.2
November, 2018	5,704	8.8	60,712	9.1	174,082	9.7	770,994	7.4	2,047,997	8.1
December, 2018	9,438	14.6	81,902	12.3	189,379	10.5	1,343,479	13.0	2,940,914	11.6
January, 2019	12,372	19.1	148,319	22.2	391,809	21.7	2,198,415	21.2	5,611,917	22.1
February, 2019	13,554	21.0	193,529	29.0	484,985	26.9	3,195,359	30.8	7,809,540	30.9
March, 2019	5,664	8.8	7,828	1.2	15,566	0.9	226,111	2.2	340,616	1.4
April, 2019	5,632	8.7	108,503	16.3	312,023	17.3	1,727,360	16.7	4,340,386	16.1
Sum	64,654		666,830		1,803,614		10,369,074		25,402,422	

Table 2. Annual flow (million cubic feet) and nutrient loss (lbs) for the upstream (BC6) and downstream (BC7) sampling sites and difference between these two sites, based on a water year (i.e., May 1, 2014 to April 30, 2015).

Parameter	2014	2015	2016	2017	2018
Flow, cubic feet * 10⁶					
Upstream	31,312	68,611	43,199	36,379	42,944
Downstream	47,142	103,296	64,947	57,609	64,654
Difference	15,829	34,685	21,808	36,379	21,710
Dissolved P, lbs					
Upstream	92,217	760,790	321,835	306,602	200,460
Downstream	358,530	9,696,389	1,148,731	1,089,465	666,830
Difference	267,314	8,935,600	826,896	782,862	466,370
Particulate P, lbs ¹					
Upstream	413,949	15,056,004	2,239,594	5,011,094	448,531
Downstream	1,326,881	98,218,382	5,802,138	5,280,383	1,136,784
Difference	912,932	83,162,377	3,562,544	269,289	688,253
Total P, lbs					
Upstream	505,166	15,816,794	2,561,429	2,317,696	648,991
Downstream	1,685,412	107,914,771	6,950,869	6,369,847	1,803,614
Difference	1,180,246	92,097,977	4,369,441	4,052,151	1,154,623
Nitrate-N, lbs					
Upstream	825,208	8,274,072	2,956,073	3,345,303	4,021,493

Parameter	2014	2015	2016	2017	2018
Downstream	3,160,540	39,010,147	8,972,123	9,347,703	10,369,074
Difference	2,335,332	30,736,076	6,016,050	6,002,400	6,347,581
Particulate N, lbs ²					
Upstream	1,433,040	81,416,726	7,986,252	10,536,632	3,848,011
Downstream	4,788,761	229,430,138	25,741,347	25,678,064	15,033,348
Difference	3,355,720	148,013,412	17,755,094	15,141,432	11,185,337
Total N, lbs					
Upstream	2,258,248	89,690,798	10,942,326	13,881,935	7,869,504
Downstream	7,949,301	268,440,286	34,713,470	35,025,767	25,402,422
Difference	5,691,053	178,749,488	23,771,144	21,143,832	17,532,918

¹ Particulate P is estimated as the difference between dissolved P and Total P.

² Particulate N is estimated as the difference between nitrate-N and Total N. Monitoring shows ammonium-N to be negligible in Big Creek.

Supplementary Tables and Figures

Table S 1. Monthly and annual flow (million cubic feet) and nutrient loss (lbs) for the upstream (BC6) and downstream (BC7) sampling sites, based on a water year (i.e., May 1, 2014 to April 30, 2015).

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
	ft ³ *10 ⁶		----- lbs -----							
Water Year 2014										
May, 2014	3,656	5,505	8,759	30,602	33,707	105,824	85,998	301,281	217,202	652,733
June, 2014	1,400	2,108	871	2,217	2,833	5,778	9,089	36,393	16,271	51,854
July, 2014	2,749	4,138	3,857	13,315	17,218	43,515	37,020	151,398	90,995	278,079
August, 2014	641	964	164	472	648	1,167	1,886	9,650	3,651	12,255
September, 2014	164	247	6	23	35	51	108	859	247	913
October, 2014	1,244	1,872	1,830	8,007	8,907	26,724	16,893	84,452	45,576	163,457
November, 2014	319	480	30	93	116	200	410	2,804	707	3,017
December, 2014	1,226	1,845	622	1,651	1,829	3,967	6,167	31,166	9,248	40,542
January, 2015	3,219	4,846	13,490	76,009	87,699	365,498	125,411	568,945	439,209	1,644,873
February, 2015	966	1,455	693	1,449	1,972	3,990	6,463	26,343	8,485	36,056
March, 2015	10,493	15,798	48,426	190,045	291,036	978,067	429,513	1,576,954	1,206,539	4,285,366
April, 2015	5,236	7,883	12,468	34,646	59,165	150,631	106,249	370,294	220,119	780,156
Sum	31,312	47,142	91,217	358,530	505,166	1,685,412	825,208	3,160,540	2,258,248	7,949,301

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
	ft ³ *10 ⁶		----- lbs -----							
Water Year 2015										
May, 2015	20,135	30,314	319,748	4,264,990	9,257,789	56,546,902	3,840,365	16,220,827	45,272,409	118,725,629
June, 2015	4,391	6,610	12,552	47,744	93,339	265,107	105,533	396,532	333,777	1,039,143
July, 2015	6,799	10,236	37,908	206,016	405,010	1,399,025	326,121	1,300,686	1,514,233	4,464,363
August, 2015	182	274	8	23	49	66	115	813	255	955
September, 2015	141	212	4	15	28	40	69	577	168	672
October, 2015	83	125	1	5	9	14	25	248	68	286
November, 2015	3,324	5,005	14,460	73,225	80,070	333,828	113,395	556,768	408,336	1,604,732
December, 2015	17,397	26,192	320,648	4,919,538	5,769,452	48,529,036	3,466,785	18,958,801	40,951,526	138,058,592
January, 2016	2,889	4,350	3,344	8,472	8,539	24,597	26,128	118,091	45,773	207,047
February, 2016	1,305	1,965	1,306	2,699	2,882	7,840	10,117	40,281	15,997	69,769
March, 2016	9,010	13,564	45,218	160,482	184,233	760,129	344,283	1,270,452	1,061,362	3,940,900
April, 2016	2,954	4,448	5,592	13,179	15,394	48,186	41,135	146,071	86,893	328,196
Sum	68,611	103,296	760,790	9,696,389	15,816,794	107,914,771	8,274,072	39,010,147	89,690,798	268,440,286
Water Year 2016										
May, 2016	6,762	10,180	23,956	76,877	92,959	356,247	175,160	625,675	562,767	1,878,652
June, 2016	1,145	1,724	836	1,650	1,932	4,824	6,372	24,709	12,219	44,407

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
	ft ³ *10 ⁶		----- lbs -----							
July, 2016	360	541	57	127	131	302	521	2,772	1,131	4,214
August, 2016	4,892	7,365	13,266	51,281	42,932	192,551	92,082	409,961	360,903	1,210,167
September, 2016	826	1,244	566	1,732	1,131	4,463	4,124	21,285	11,737	44,796
October	287	433	22	60	36	103	238	1,730	556	2,429
November, 2016	363	546	72	165	70	260	605	3,660	1,200	5,600
December, 2016	550	827	92	197	76	273	814	4,962	1,496	7,171
January, 2017	1,001	1,507	530	969	314	1,421	3,783	17,567	6,497	30,416
February, 2017	1,415	2,131	900	2,202	2,455	6,032	8,795	44,487	14,663	65,488
March, 2017	8,807	13,260	57,832	195,463	396,080	1,049,540	537,344	1,776,614	1,680,454	5,841,168
April, 2017	16,731	25,189	223,706	818,007	2,023,313	5,334,856	2,126,235	6,038,701	8,288,702	25,578,962
Sum	43,139	64,947	321,835	1,148,731	2,561,429	6,950,869	2,956,073	8,972,123	10,942,326	34,713,470
Water Year 2017										
May, 2017	10,116	15,230	84,260	291,003	701,315	1,879,400	798,220	2,249,845	3,011,895	9,023,469.10
June, 2017	6,981	10,510	110,412	414,989	1,066,598	2,954,878	1,054,290	2,725,090	4,569,686	12,979,740
July, 2017	1,245	1,874	796	1,817	2,318	5,990	8,078	31,115	16,142	55,929
August, 2017	1,057	1,592	703	1,791	1,907	5,626	7,317	28,735	14,903	53,257
September, 2017	193	291	14	38	38	86	208	1,152	409	1,584

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
	ft ³ *10 ⁶		----- lbs -----							
October, 2017	116	174	3	11	10	20	65	440	130	553
November, 2017	160	241	5	17	38	29	208	440	189	844
December, 2017	286	174	34	91	68	165	523	2,946	761	3,500
January, 2018	653	984	147	362	282	676	2,204	11,117	2,967	13,375
February, 2018	7,349	11,065	80,549	297,622	438,920	1,247,436	1,065,491	3,077,333	2,912,749	10,079,367
March, 2018	4,111	6,190	13,707	39,224	51,233	134,569	186,507	560,317	2,912,749	1,339,867
April, 2018	4,111	9,285	15,972	42,499	54,969	140,971	222,192	659,175	439,357	1,474,282
Sum	36,379	57,609	306,602	1,089,465	2,317,696	6,369,847	3,345,303	9,347,703	13,881,935	35,025,767
Water Year 2018										
May, 2018	4,427	6,664	18,891	53,899	78,851	206,215	265,824	693,903	615,794	1,893,296
June, 2018	1,026	1,545	1,044	2,397	2,678	6,774	15,519	46,077	26,768	85,438
July, 2018	141	212	4	11	11	18	112	546	192	653
August, 2018	538	810	244	594	443	1,240	4,284	14,285	6,569	22,002
September, 2018	335	504	48	125	83	210	1,046	4,231	1,517	5,449
October, 2018	1,696	2,553	2,826	9,012	6,189	21,312	50,761	148,314	87,766	304,214
November, 2018	3,789	5,704	16,486	60,712	48,680	174,082	294,450	770,994	622,213	2,047,997
December, 2018	6,269	9,438	24,078	81,902	58,531	189,379	489,089	1,343,479	830,343	2,940,914

Month and year	Flow		Dissolved P		Total P		Nitrate-N		Total N	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
	ft ³ *10 ⁶		----- lbs -----							
January, 2019	8,218	12,372	39,936	148,319	124,334	391,809	855,032	2,198,415	1,660,450	5,611,917
February, 2019	9,003	13,554	57,065	193,529	171,396	484,985	1,325,766	3,195,359	2,394,301	7,809,540
March, 2019	3,762	5,664	3,470	7,828	7,468	15,566	65,427	226,111	98,149	340,616
April, 2019	3,741	5,632	36,365	108,503	150,326	312,023	654,182	1,727,360	1,525,442	4,340,386
Sum	42,944	64,654	200,460	666,830	648,991	1,803,614	4,021,493	10,369,074	7,869,504	25,402,422

Table S 2. Annual flow (million cubic feet) and nutrient loss (tons) for the upstream (BC6), downstream (BC7) sampling sites and difference between these two sites, based on a water year (i.e., May 1, 2014 to April 30, 2015).

Parameter	2014	2015	2016	2017	2018
Flow, cubic feet * 10⁶					
Upstream	31,312	68,611	43,199	36,379	42,944
Downstream	47,142	103,296	64,947	57,609	64,654
Difference	15,829	34,685	21,808	36,379	21,710
Dissolved P, tons					
Upstream	46.1	380.4	160.9	153.3	100.2
Downstream	179.3	4,848.2	574.4	544.7	333.4
Difference	133.7	4,467.8	413.4	391.4	233.2
Particulate P, tons ¹					
Upstream	207.0	7,528.0	1,119.8	2,505.5	224.3
Downstream	663.4	49,109.2	2,901.1	2,640.2	568.4
Difference	456.5	41,581.2	1,781.3	134.7	344.1
Total P, tons					
Upstream	252.6	7,908.4	1,280.7	1,158.8	324.5
Downstream	842.7	53,957.4	3,475.4	3,184.9	901.8
Difference	590.1	46,049.0	2,184.7	2,026.1	577.3
Nitrate-N, tons					
Upstream	412.6	4,137.0	1,478.0	1,672.7	2,010.7
Downstream	1,580.3	19,505.1	4,486.1	4,673.9	5,184.5
Difference	1,167.7	15,368.0	3,008.0	3,001.2	3,173.8

Parameter	2014	2015	2016	2017	2018
Particulate N, tons ²					
Upstream	716.5	40,708.4	3,993.1	5,268.3	1,924.0
Downstream	2,394.4	114,715.1	12,870.7	12,839.0	7,516.7
Difference	1,677.9	74,006.7	8,877.5	7,570.7	5,592.7
Total N, tons					
Upstream	1,129.1	44,845.4	5,471.2	6,941.0	3,934.8
Downstream	3,974.7	134,220.1	17,356.7	17,512.9	12,701.2
Difference	2,845.5	89,374.7	11,885.6	10,571.9	7,237.8

¹ Particulate P is estimated as the difference between dissolved P and Total P.

² Particulate N is estimated as the difference between nitrate-N and Total N. Monitoring shows ammonium-N to be negligible in Big Creek.

Table S 3. Annual flow (million cubic feet) and nutrient loss (Mg) for the upstream (BC6), downstream (BC7) sampling sites and difference between these two sites, based on a water year of May 1 to April 31 (i.e., May 1, 2014 to April 30, 2015).

Parameter	2014	2015	2016	2017	2018
Flow, cubic feet * 10⁶					
Upstream	31,312	68,611	43,199	36,379	42,944
Downstream	47,142	103,296	64,947	57,609	64,654
Difference	15,829	34,685	21,808	21,230	21,710
Dissolved P, Mg					
Upstream	41.8	345.0	146.0	139.0	110.5
Downstream	162.6	4,397.3	520.9	494.1	367.5
Difference	121.2	4,052.3	375.0	355.0	257.1
Particulate P, Mg¹					
Upstream	187.7	6,827.9	1,015.7	2,272.5	247.2
Downstream	601.7	44,542.0	2,631.3	2,394.7	626.6
Difference	414.0	37,714.1	1,615.6	122.2	379.3
Total P, Mg					
Upstream	229.1	7,172.9	1,161.6	1,051.1	357.7
Downstream	764.3	48,939.3	3,152.2	2,888.7	994.1
Difference	535.2	41,766.4	1,981.5	1,837.7	636.4
Nitrate-N, Mg					
Upstream	374.2	3,752.3	1,340.6	1,517.1	2,216.4

Parameter	2014	2015	2016	2017	2018
Downstream	1,433.3	17,691.1	4,068.9	4,239.2	5,714.9
Difference	1,059.1	13,938.8	2,728.3	2,722.1	3,498.5
Particulate N, Mg²					
Upstream	649.9	36,922.5	3,621.8	4,778.4	2,120.8
Downstream	2,171.7	104,046.6	11,673.7	11,645.0	8,285.7
Difference	1,521.8	67,124.1	8,051.9	6,866.6	6,164.9
Total N, Mg					
Upstream	1,024.1	40,674.8	4,962.3	6,295.5	3,569.6
Downstream	3,605.0	121,737.7	15,742.6	15,884.2	11,522.3
Difference	2,580.9	81,062.9	10,780.2	9,588.7	6,566.0

¹ Particulate P is estimated as the difference between dissolved P and Total P.

² Particulate N is estimated as the difference between nitrate-N and Total N. Monitoring shows ammonium-N to be negligible in Big Creek.

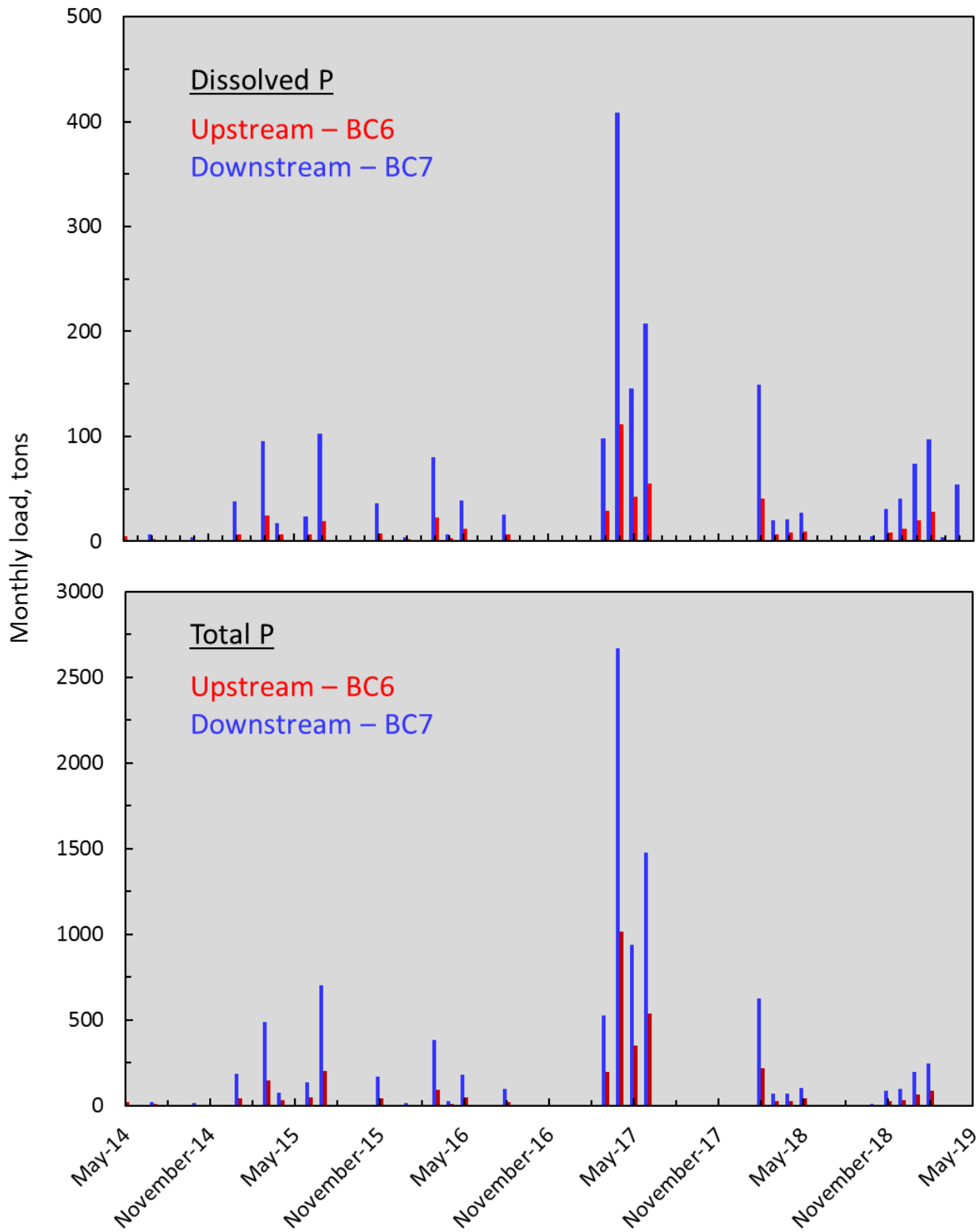


Figure S 1. Monthly dissolved and total P load at BC6 upstream and BC7 downstream of the C&H Farm, excluding the May 11 and December 26, 2015 storms.

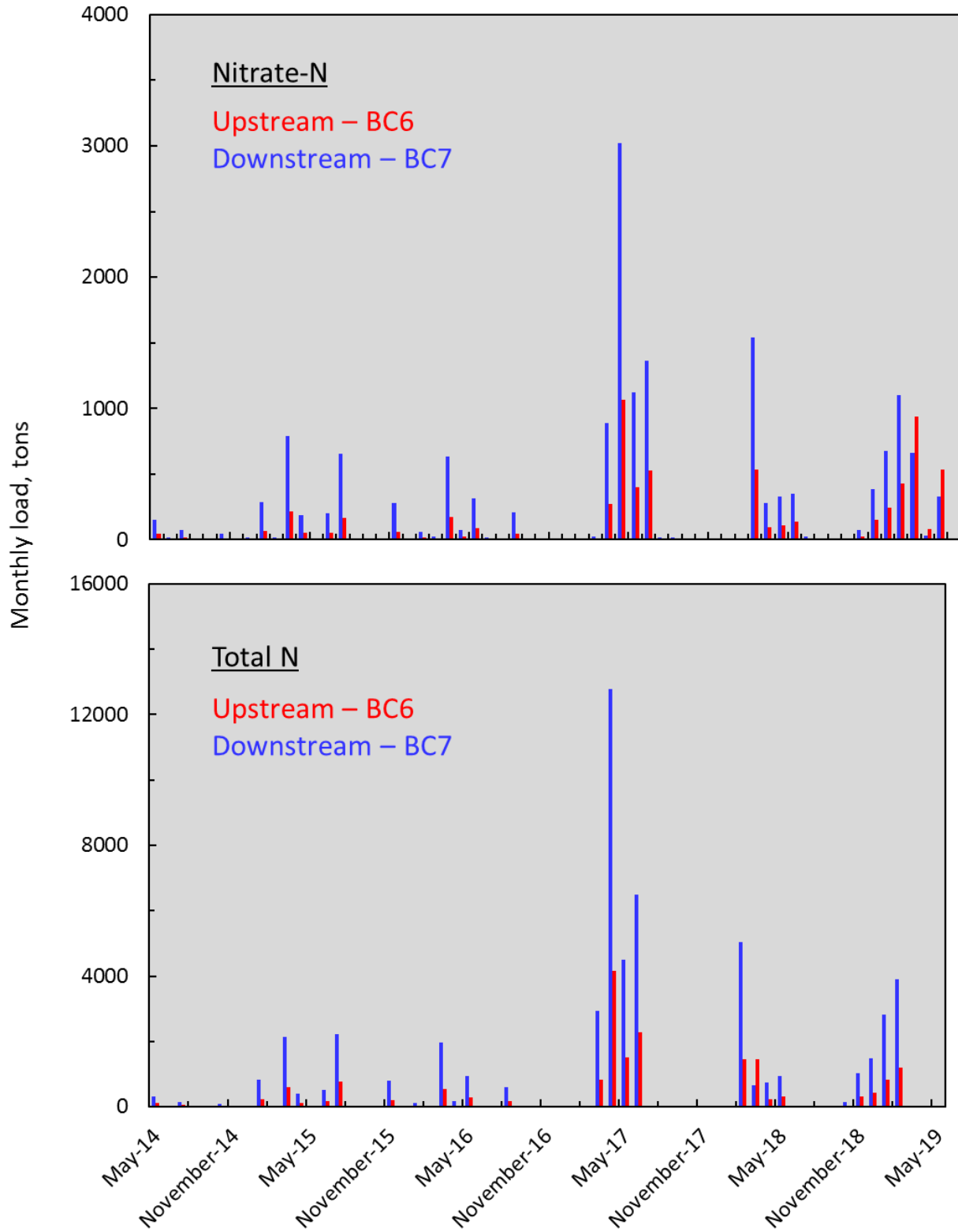


Figure S 2. Monthly nitrate-N and total N load at BC6 upstream and BC7 downstream of the C&H Farm, excluding the May 11 and December 26, 2015 storms.

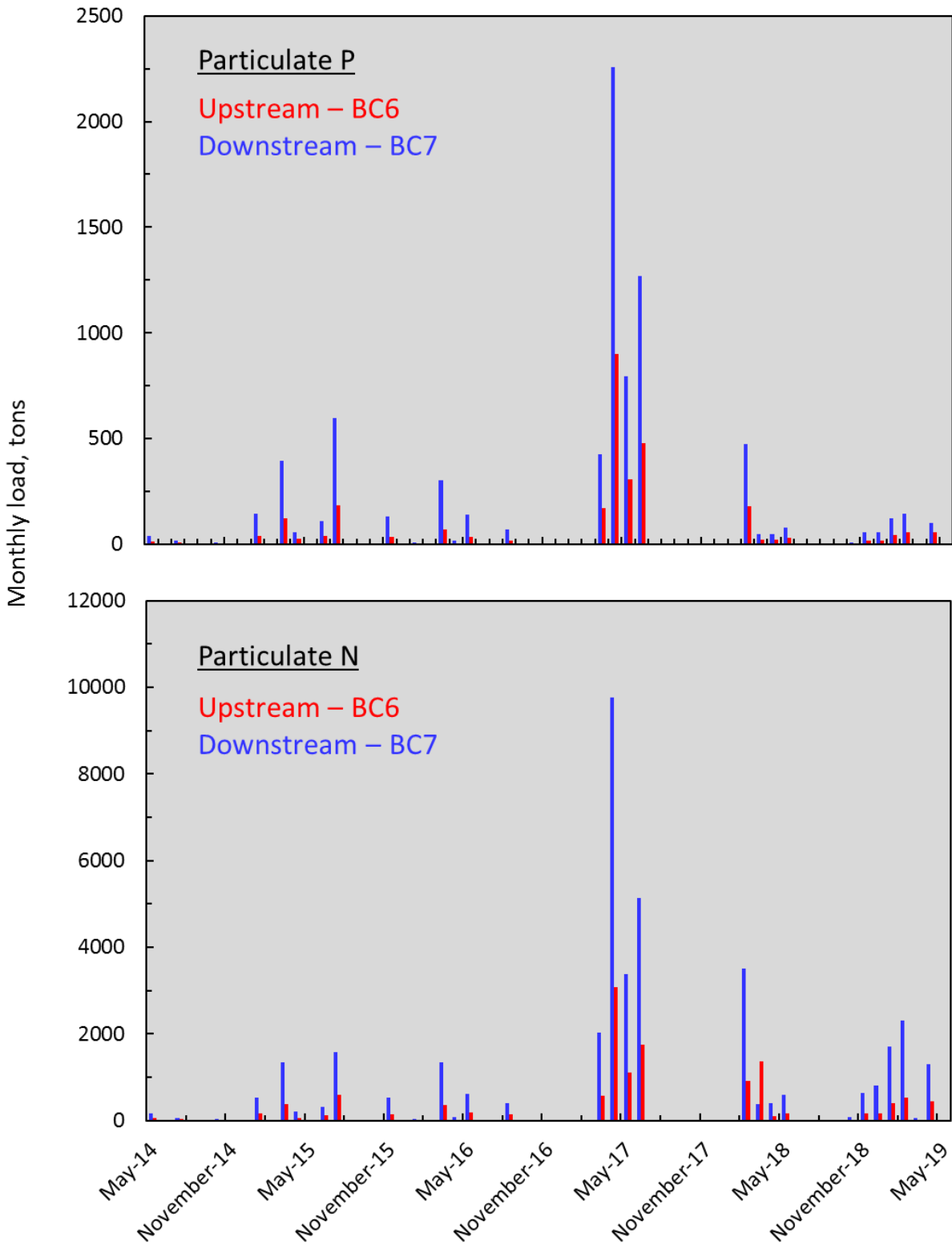


Figure S 3. Monthly particulate N and P load at BC6 upstream and BC7 downstream of the C&H Farm, excluding the May 11 and December 26, 2015 storms.

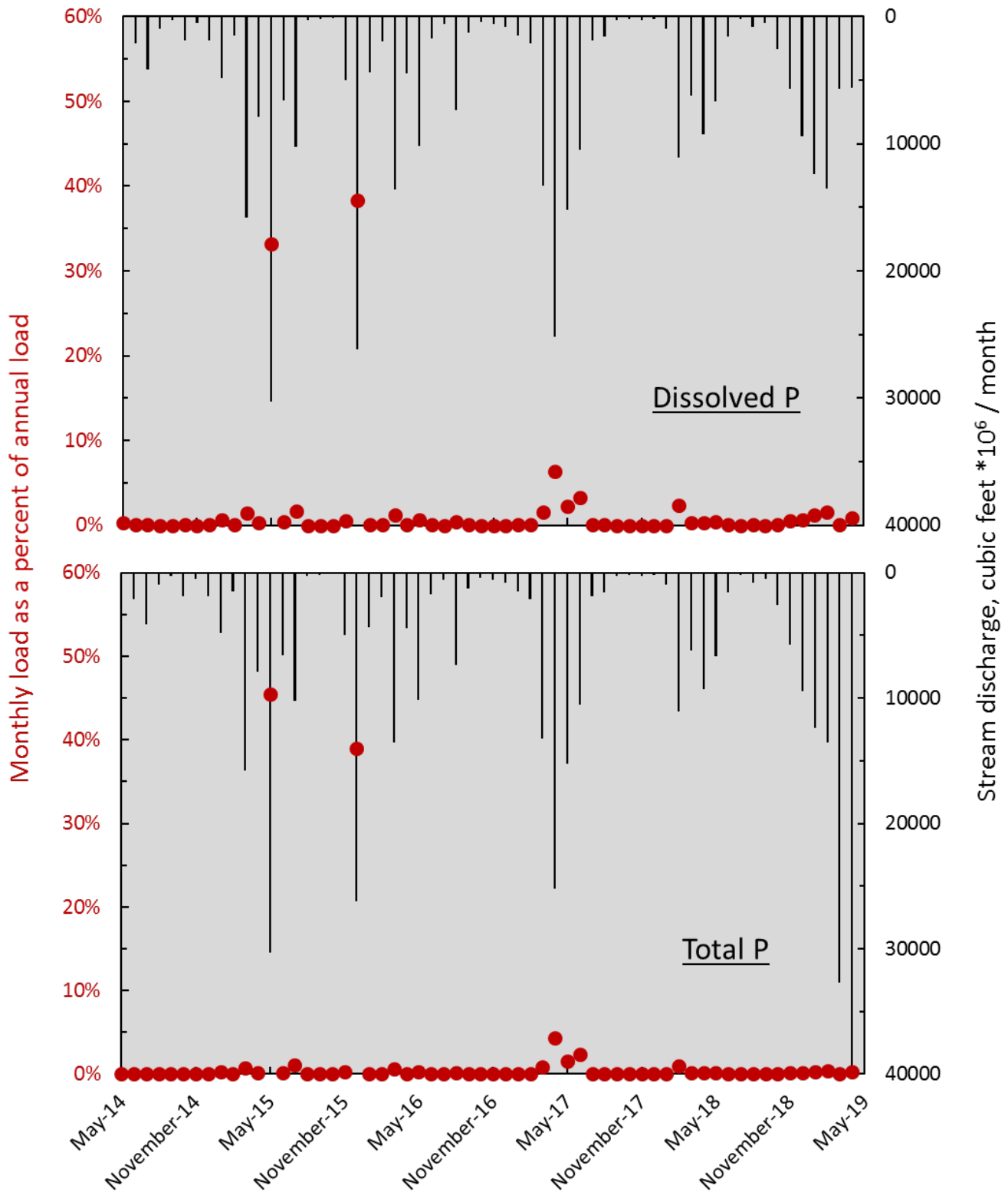


Figure S 4. Monthly dissolved and total P load and discharge at BC7 downstream of the C&H Farm.

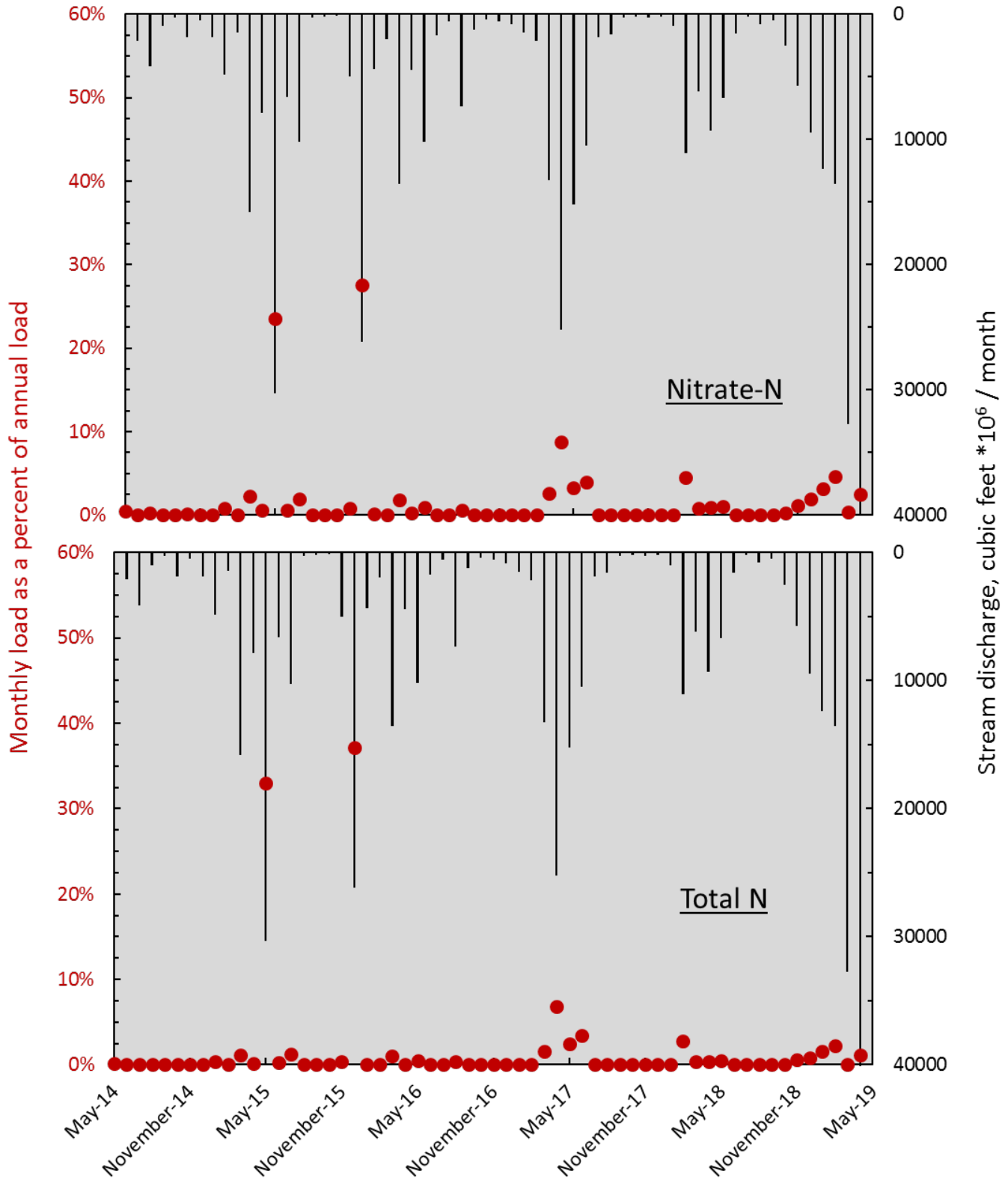


Figure S 5. Monthly nitrate-N and total N load and discharge at BC7 downstream of the C&H Farm.

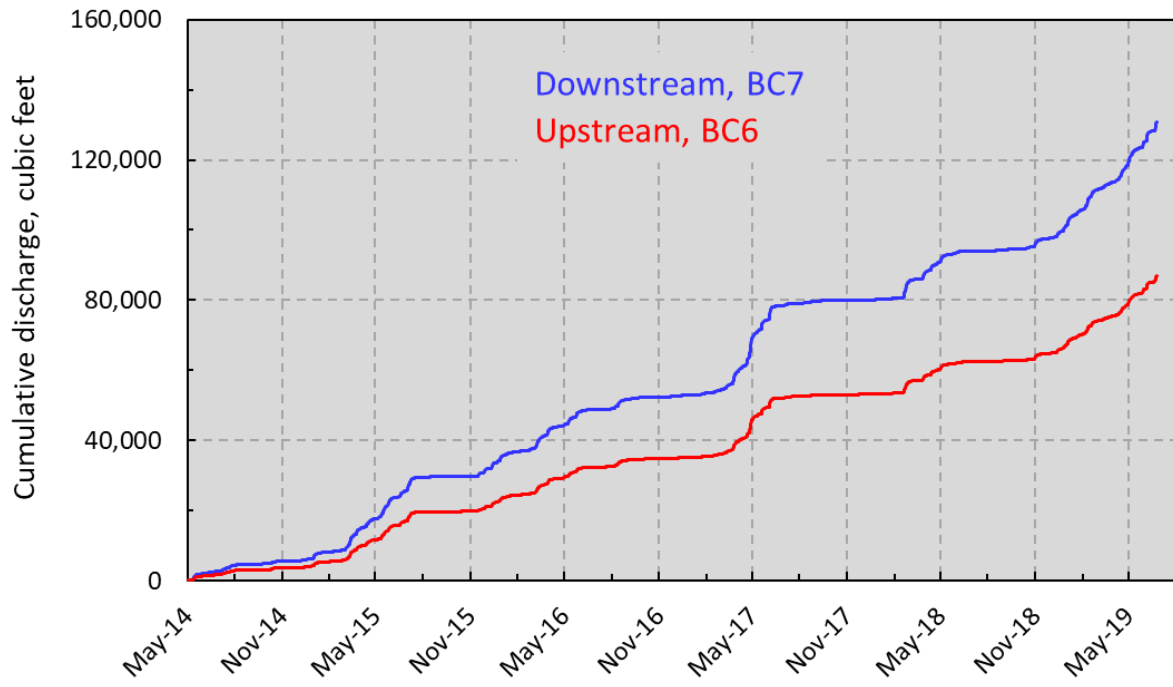


Figure S 6. Cumulative discharge up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms excluded.

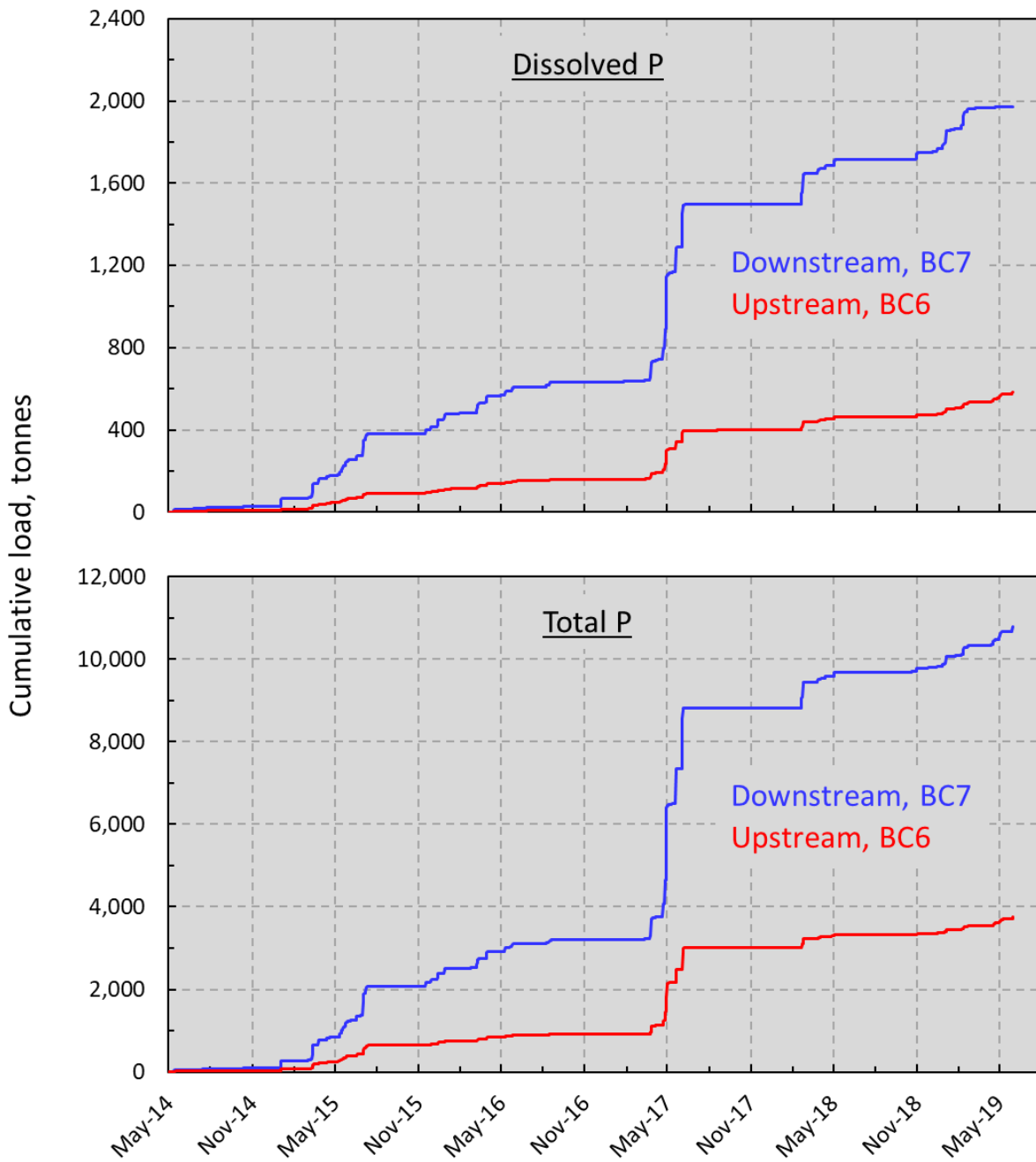


Figure S 7. Cumulative dissolved and total P load up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms excluded.

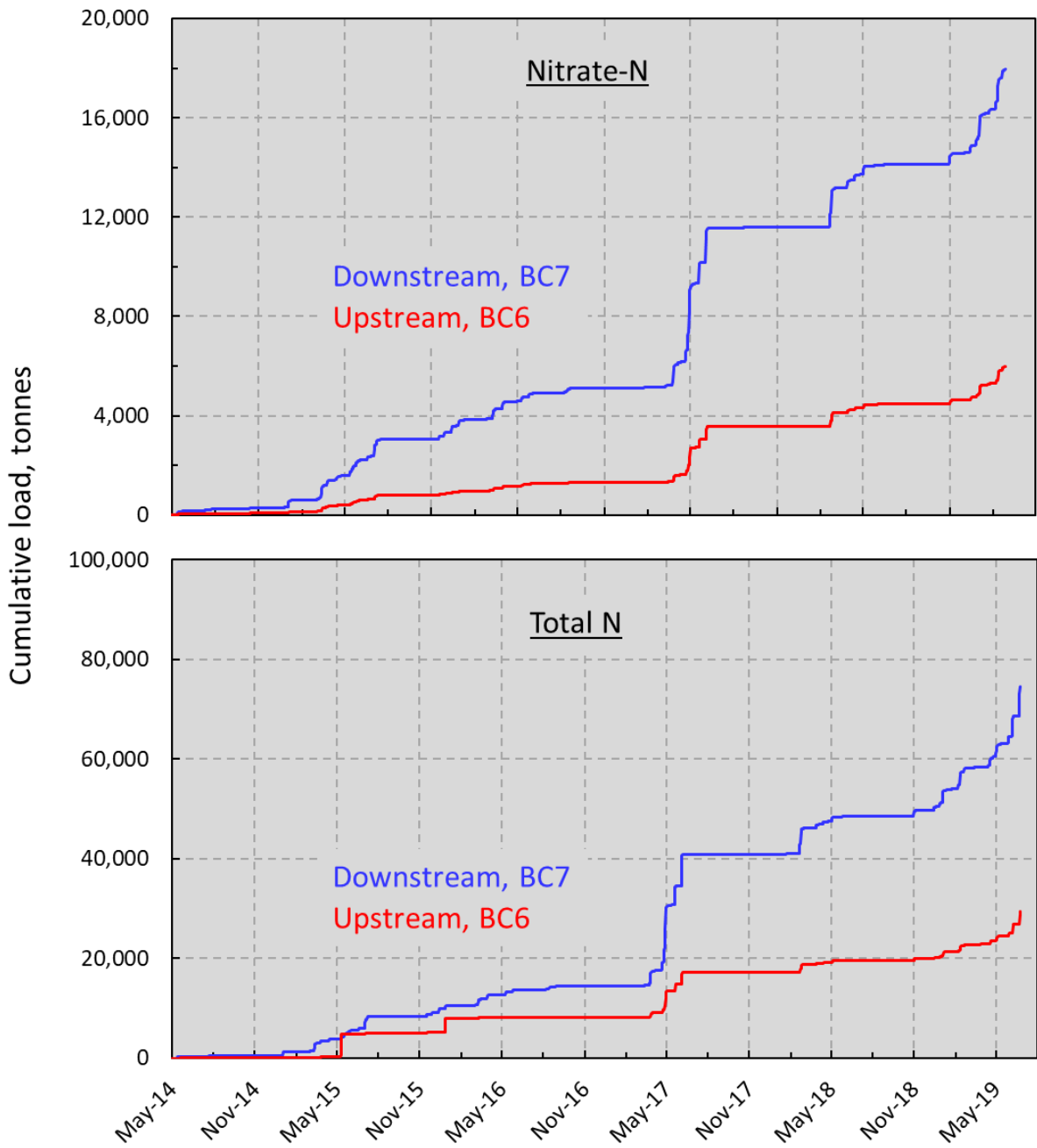


Figure S 8. Cumulative nitrate-N and total N load up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms excluded.

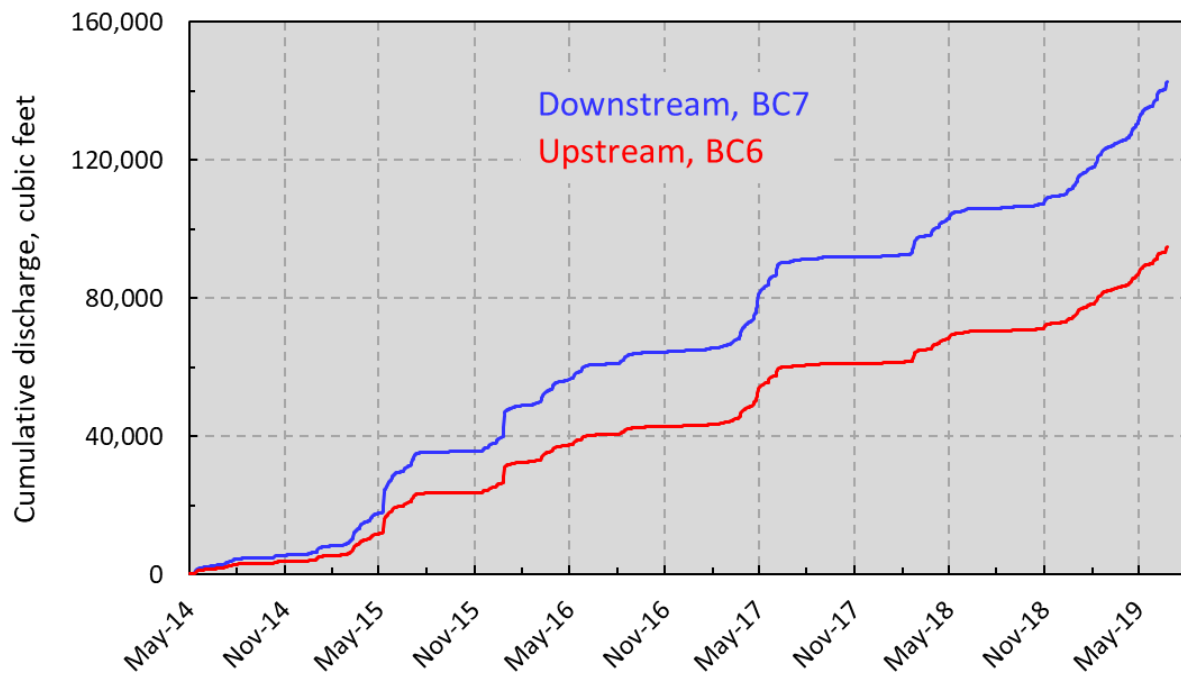


Figure S 9. Cumulative discharge up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms included.

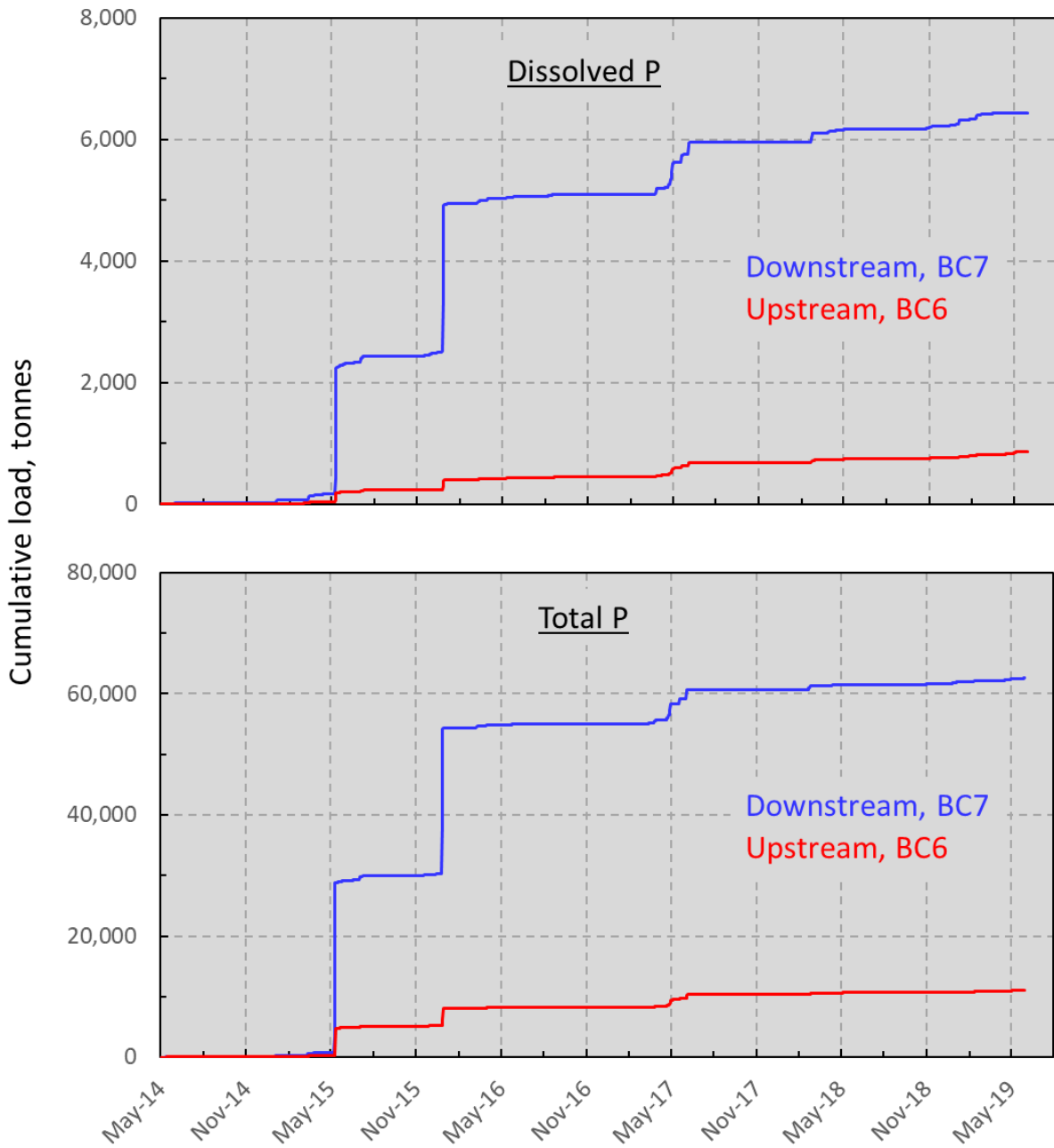


Figure S 10. Cumulative dissolved and total P load up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms included.

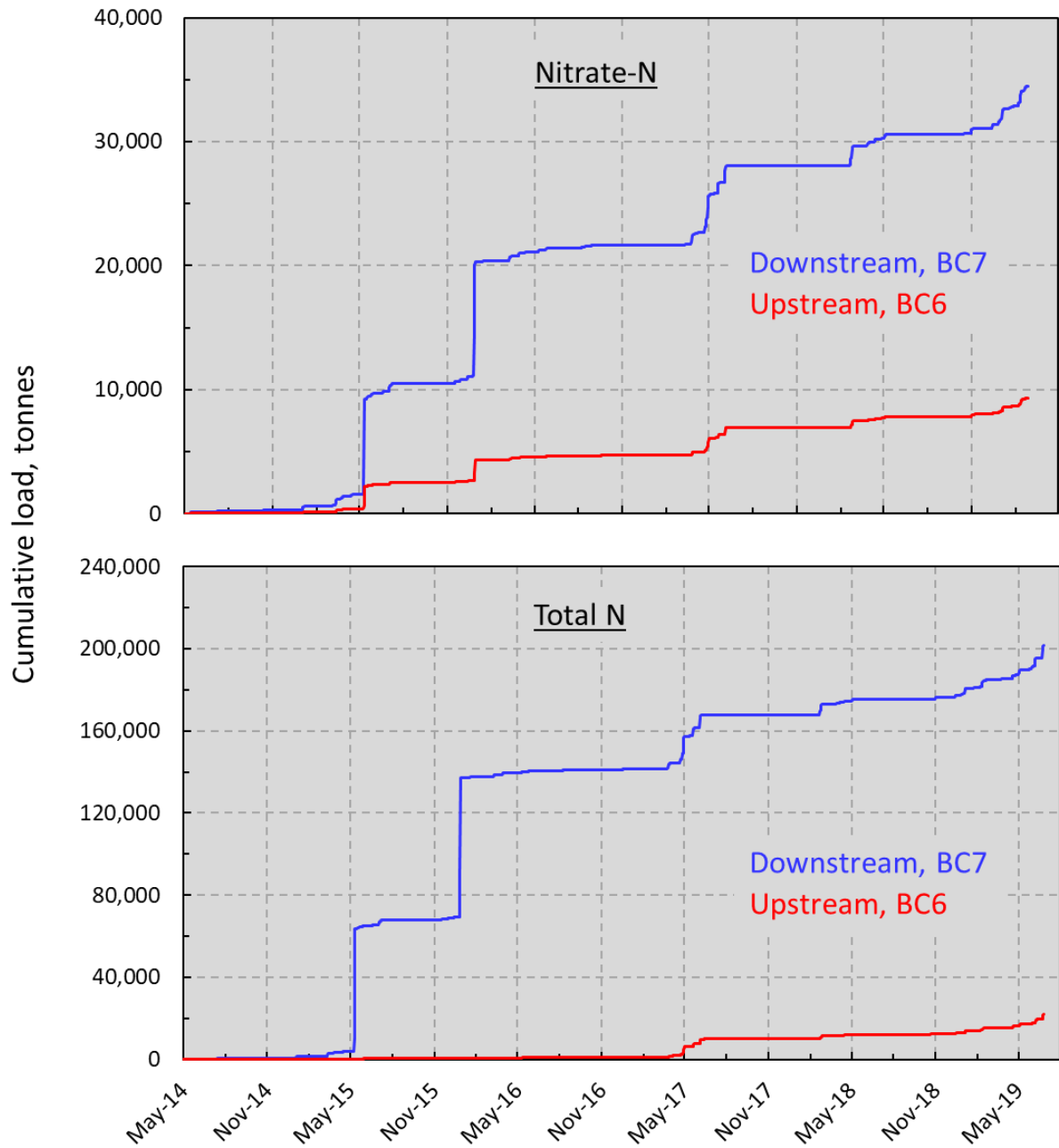


Figure S 11. Cumulative nitrate-N and total N load up (BC6) and downstream (BC7) of the C&H Farm on Big Creek with extreme May and December 2015 storms included.