

Table 5. Annual Water Discharge, Calendar Year 2004

Site	Years of Record	Long-term Annual Mean cfs ¹	2004	
			Mean cfs	Percent of LTM ²
Towanda	16	11,635	15,337	131.8
Danville	20	17,091	21,823	127.7
Lewisburg	20	11,356	16,530	145.6
Newport	20	4,773	6,862	143.8
Marietta	18	40,336	56,169	139.3
Conestoga	20	666	1,052	158

¹ Cubic feet per second

² Long-term mean

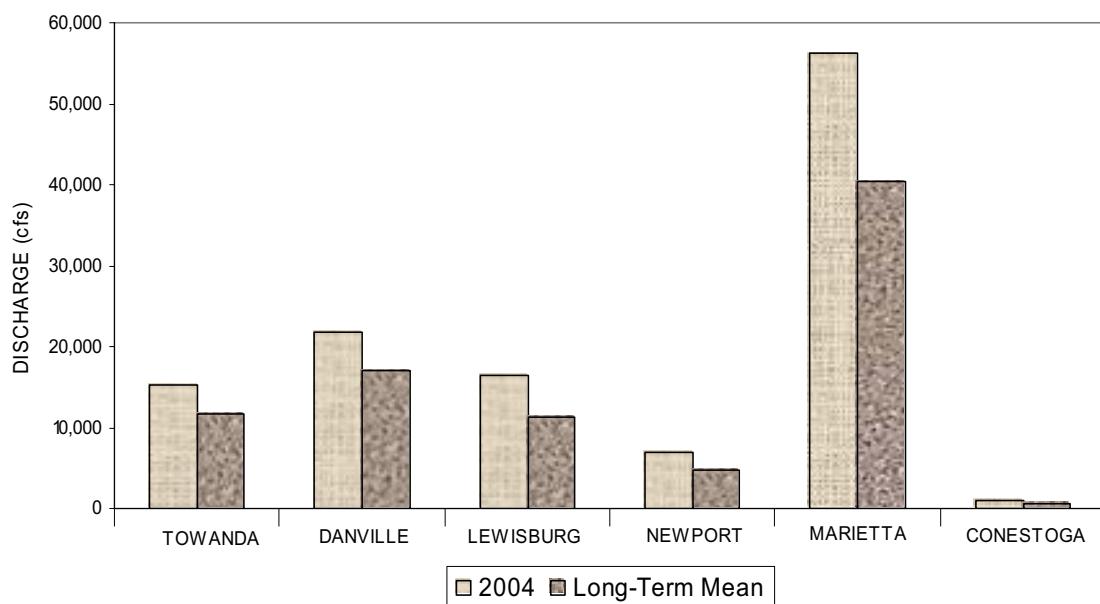


Figure 3. Annual and Long-Term Discharges at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa.

ANNUAL NUTRIENT AND SUSPENDED-SEDIMENT LOADS AND YIELDS

Loads and yields represent two methods for describing nutrient and SS amounts within a basin. Loads refer to the actual amount of the constituent being transported in the water column past a given point over a specific duration of time and are expressed in pounds. Yields compare the transported load with the acreage of the watershed

and are expressed in lbs/acre. This allows for easy watershed comparisons. This project reports loads and yields for the constituents listed in Table 6 as computed by the Minimum Variance Unbiased Estimator (MVUE) described by Cohn and others (1989). This estimator relates the constituent concentration to water discharge, seasonal effects, and long-term trends, and computes the best-fit regression equation. Daily loads of the constituents were then calculated

from the daily mean water discharge records. The loads were reported along with the estimates of accuracy.

Identifying sites where the percentage of LTM for a constituent was higher than the percentage of LTM for discharge may show potential areas where improvements or degradations have occurred for that particular constituent. One item to note is that nutrients and SS increase with increased flow (Ott and others, 1991; Takita, 1996, 1998). In 2004, this became an issue due to Tropical Storm Ivan in September where flows were 528 percent above the LTM at Marietta. During events such as this, sediment and nutrients (mostly phosphorous) that are trapped in the beds of streams and rivers are reintroduced into the water column and transported downstream. The high values that were found in 2004 were mostly due to this scouring process and can be seen when comparing

annual loads to seasonal loads (including monthly loads for September alone).

Tables 7-19 show the loads and yields for the six monitoring stations in Group A, as well as an associated error value. They also show the average annual concentration for each constituent. Comparisons have been made to the LTMs for all constituents. Figures 4A-6B show graphs of 2004 loads and yields versus LTMs. Table 20 shows summary statistics for the Group B sites consisting of average concentrations of the various parameters for the 3-month period that the sites were sampled. Table 21 shows monthly loads for TN, TP, and SS and monthly flow for Group A sites. As a general note, nutrient and SS loads increase with increasing discharge. Many of the values are high due to unusually high flows during September, specifically from Tropical Storm Ivan.

Table 6. List of Analyzed Parameters, Abbreviations, and STORET Codes

Parameter	Abbreviation	STORET Code
Total Nitrogen as N	TN	00600
Dissolved Nitrogen as N	DN	00602
Total Organic Nitrogen as N	TON	00605
Dissolved Organic Nitrogen as N	DON	00607
Total Ammonia as N	TNH ₃	00610
Dissolved Ammonia as N	DNH ₃	00608
Total Nitrate + Nitrite as N	TNOx	00630
Dissolved Nitrate + Nitrite as N	DNOx	00631
Total Phosphorus as P	TP	00665
Dissolved Phosphorus as P	DP	00666
Dissolved Orthophosphate as P	DOP	00671
Total Organic Carbon	TOC	00680
Suspended Sediment	SS	80154

Table 7. Annual Water Discharges, Annual Loads, Yields, and Average Concentration of Total Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	31,220	107.7	5.6	1.03	1.27	6.26	5.81
Danville	21,823	127.7	45,613	100.3	6.0	1.06	1.35	6.35	6.33
Lewisburg	16,530	145.6	33,427	136.7	7.4	1.03	1.09	7.63	5.58
Newport	6,862	143.8	26,608	160.2	5.4	1.97	1.77	12.40	7.74
Marietta	56,169	139.3	179,472	144.2	6.3	1.62	1.57	10.79	7.48
Conestoga	1,052	158	15,116	143.4	5.5	7.30	8.03	50.25	35.04

Table 8. Annual Water Discharges and Annual Loads and Yields of Total Phosphorus, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	3,233	146.6	24.9	0.1071	0.0963	0.648	0.442
Danville	21,823	127.7	5,623	169.3	26.0	0.1309	0.0987	0.783	0.463
Lewisburg	16,530	145.6	2,164	172.9	31.5	0.0665	0.0560	0.494	0.286
Newport	6,862	143.8	1,575	188.6	23.1	0.1166	0.0888	0.734	0.389
Marietta	56,169	139.3	15,804	206.2	24.8	0.1429	0.0965	0.950	0.461
Conestoga	1,052	158	1,125	164.0	35.4	0.5431	0.5227	3.739	2.280

Table 9. Annual Water Discharges and Annual Loads and Yields of Total Suspended Sediment, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	5,409,886	220.6	62.5	179.17	107.07	1,084.1	491.5
Danville	21,823	127.7	6,004,331	224.8	56.4	139.75	79.38	836.2	372.0
Lewisburg	16,530	145.6	831,642	84.8	78.1	25.56	43.88	189.8	223.9
Newport	6,862	143.8	1,182,830	231.9	61.0	87.56	54.28	551.0	237.6
Marietta	56,169	139.3	15,887,154	285.0	60.6	143.67	70.21	955.1	335.2
Conestoga	1,052	158	537,074	165.6	110	259.32	247.19	1,785.5	1078.0

Table 10. Annual Water Discharges and Annual Loads and Yields of Total Ammonia, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	1,444	94.7	23.52	0.0453	0.0630	0.274	0.289
Danville	21,823	127.7	2,350	81.1	26.15	0.0547	0.0862	0.327	0.404
Lewisburg	16,530	145.6	1,280	122.6	24.60	0.0393	0.0467	0.292	0.238
Newport	6,862	143.8	682	162.9	30.5	0.0505	0.0446	0.318	0.195
Marietta	56,169	139.3	7,222	164.1	28.1	0.0653	0.0554	0.434	0.265
Conestoga	1,052	158	240	85.2	38.0	0.1158	0.2147	0.798	0.936

Table 11. Annual Water Discharges and Annual Loads and Yields of Total NO₂₃ Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	31,220	179.9	5.55	1.034	0.7576	6.26	3.48
Danville	21,823	127.7	30,188	114.4	6.69	0.703	0.7844	4.20	3.68
Lewisburg	16,530	145.6	24,918	161.1	6.71	0.766	0.6918	5.69	3.53
Newport	6,862	143.8	22,271	176.8	5.28	1.6485	1.3408	10.38	5.87
Marietta	56,169	139.3	142,935	166.6	6.80	1.293	1.0803	8.59	5.16
Conestoga	1,052	158	13,109	155.0	8.08	6.3293	6.4456	43.58	28.11

Table 12. Annual Water Discharges and Annual Loads and Yields of Total Organic Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	11,067	88.0	11.75	0.229	0.48	1.95	2.22
Danville	21,823	127.7	14,705	84.5	12.58	0.342	0.52	2.05	2.42
Lewisburg	16,530	145.6	8,537	105.7	20.44	0.262	0.36	1.95	1.84
Newport	6,862	143.8	4,280	103.6	19.58	0.317	0.44	1.99	1.92
Marietta	56,169	139.3	33,500	88.7	14.49	0.303	0.476	2.01	2.27
Conestoga	1,052	158	2,294	116.8	24.75	1.108	1.50	7.63	6.53

Table 13. Annual Water Discharges and Annual Loads and Yields of Dissolved Phosphorus, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	929	121.9	18.89	0.0308	0.033	0.186	0.153
Danville	21,823	127.7	1,505	163.3	21.53	0.0350	0.027	0.210	0.128
Lewisburg	16,530	145.6	651	141.1	20.85	0.0200	0.020	0.149	0.105
Newport	6,862	143.8	672	161.0	19.61	0.0498	0.045	0.313	0.195
Marietta	56,169	139.3	3,566	151.1	17.56	0.0323	0.030	0.214	0.142
Conestoga	1,052	158	414	154.0	15.58	0.1997	0.205	1.375	0.893

Table 14. Annual Water Discharges and Annual Loads and Yields of Dissolved Orthophosphate, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	636	160.3	22.88	0.0211	0.017	0.128	0.080
Danville	21,823	127.7	1,067	228.9	24.94	0.0248	0.014	0.149	0.065
Lewisburg	16,530	145.6	433	229.9	31.91	0.0133	0.008	0.099	0.043
Newport	6,862	143.8	553	173.7	26.02	0.0410	0.034	0.258	0.148
Marietta	56,169	139.3	2,757	169.6	23.32	0.0249	0.021	0.166	0.098
Conestoga	1,052	158	383	173.6	21.67	0.1847	0.168	1.272	0.733

Table 15. Annual Water Discharges and Annual Loads and Yields of Dissolved Ammonia, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	1,346	115.8	18.46	0.0446	0.051	0.270	0.233
Danville	21,823	127.7	2,167	123.4	19.43	0.0504	0.052	0.302	0.244
Lewisburg	16,530	145.6	1,299	117.6	17.51	0.0399	0.049	0.296	0.252
Newport	6,862	143.8	619	170.3	19.30	0.0458	0.039	0.288	0.169
Marietta	56,169	139.3	6,113	161.3	19.43	0.0553	0.048	0.368	0.228
Conestoga	1,052	158	219	111.2	33.00	0.1056	0.15	0.727	0.654

Table 16. Annual Water Discharges and Annual Loads and Yields of Dissolved Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	27,868	117.9	5.79	0.923	1.032	5.585	4.739
Danville	21,823	127.7	39,966	107.7	6.12	0.930	1.103	5.566	5.168
Lewisburg	16,530	145.6	28,866	119.1	6.49	0.887	1.084	6.587	5.532
Newport	6,862	143.8	24,264	158.8	4.87	1.796	1.626	11.304	7.117
Marietta	56,169	139.3	161,236	165.8	6.43	1.458	1.225	9.693	5.847
Conestoga	1,052	158	14,573	151.6	6.22	7.037	7.326	48.448	31.949

Table 17. Annual Water Discharges and Annual Loads and Yields of Dissolved NO₂₃ Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	21,023	137.1	6.67	0.697	0.670	4.213	3.074
Danville	21,823	127.7	29,985	119.4	6.76	0.698	0.746	4.176	3.497
Lewisburg	16,530	145.6	24,732	142.6	6.68	0.760	0.776	5.644	3.959
Newport	6,862	143.8	22,142	174.6	5.28	1.639	1.350	10.315	5.907
Marietta	56,169	139.3	140,328	208.8	6.90	1.269	0.846	8.436	4.040
Conestoga	1,052	158	12,944	154.7	7.67	6.250	6.379	43.030	27.820

Table 18. Annual Water Discharges and Annual Loads and Yields of Dissolved Organic Nitrogen, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	6,910	85.4	10.94	0.229	0.353	1.385	1.621
Danville	21,823	127.7	9,676	88.4	10.74	0.225	0.326	1.347	1.525
Lewisburg	16,530	145.6	4,838	91.7	15.73	0.149	0.236	1.104	1.204
Newport	6,862	143.8	2,699	96.0	11.15	0.200	0.299	1.257	1.310
Marietta	56,169	139.3	19,979	75.1	16.73	0.181	0.335	1.201	1.599
Conestoga	1,052	158	1,804	170.5	24.34	0.871	0.806	5.997	3.517

Table 19. Annual Water Discharges and Annual Loads and Yields of Total Organic Carbon, Calendar Year 2004

Site	2004 Discharge cfs	Discharge % of LTM	2004 Load thousands of lbs	Load % of LTM	Prediction Error Percent	2004 Avg. Conc. mg/l	LTM Conc. mg/l	2004 Yield lbs/ac/yr	LTM Yield lb/ac/yr
Towanda	15,337	131.8	111,601	135.6	4.90	3.696	3.594	22.365	16.498
Danville	21,823	127.7	157,771	143.7	4.54	3.672	3.262	21.971	15.285
Lewisburg	16,530	145.6	76,688	168.1	7.95	2.357	2.041	17.500	10.412
Newport	6,862	143.8	40,436	129.9	7.27	2.993	3.312	18.838	14.497
Marietta	56,169	139.3	335,726	148.6	5.74	3.036	2.846	20.184	13.585
Conestoga	1,052	158	10,296	124.3	10.47	4.971	6.316	34.229	27.546

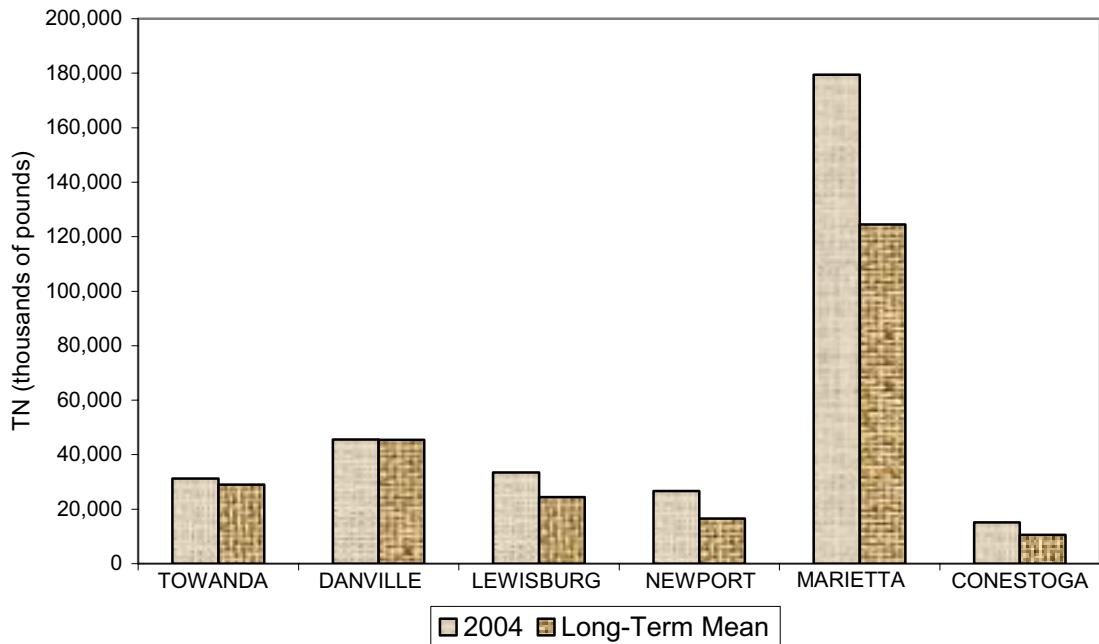


Figure 4A. *Annual Loads of Total Nitrogen (TN) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

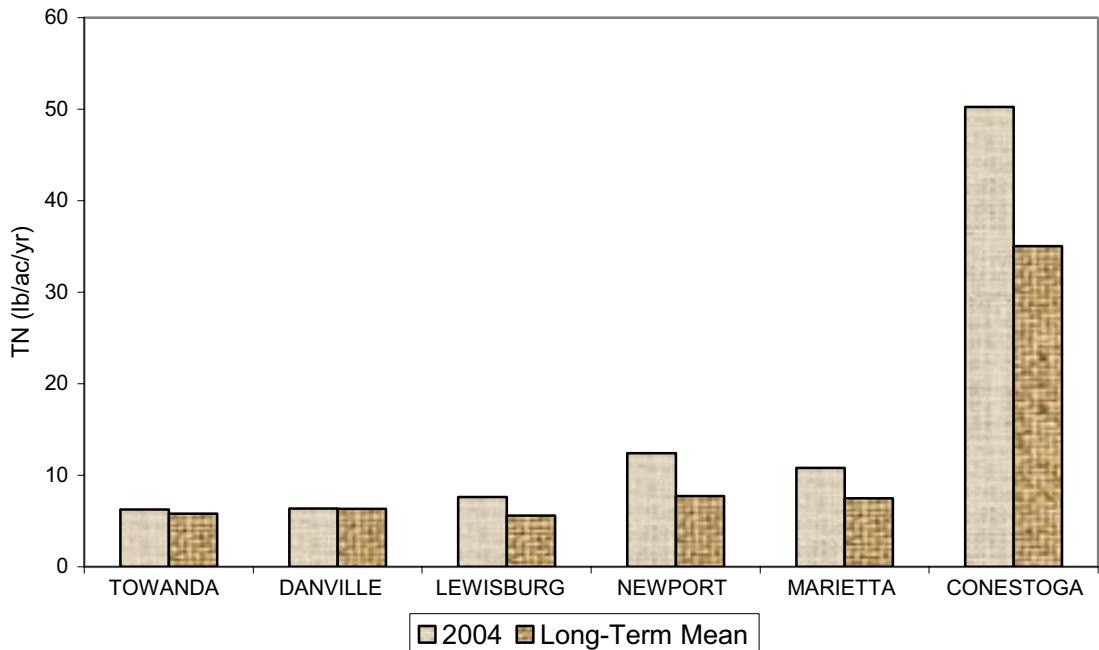


Figure 4B. *Total Nitrogen (TN) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

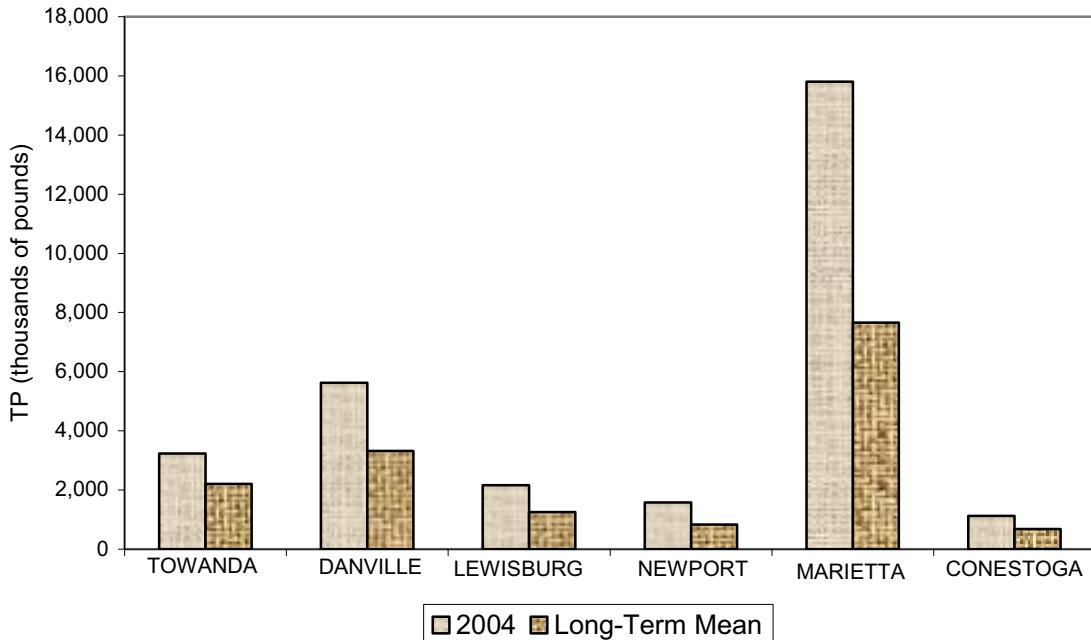


Figure 5A. *Annual Loads of Total Phosphorus (TP) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

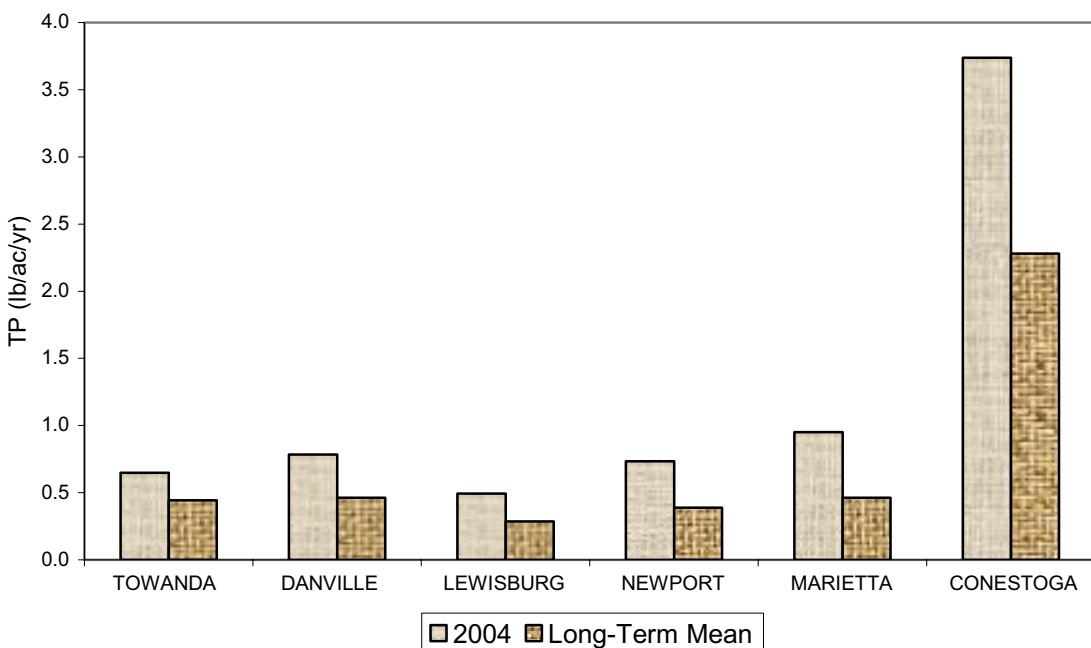


Figure 5B. *Total Phosphorus (TP) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

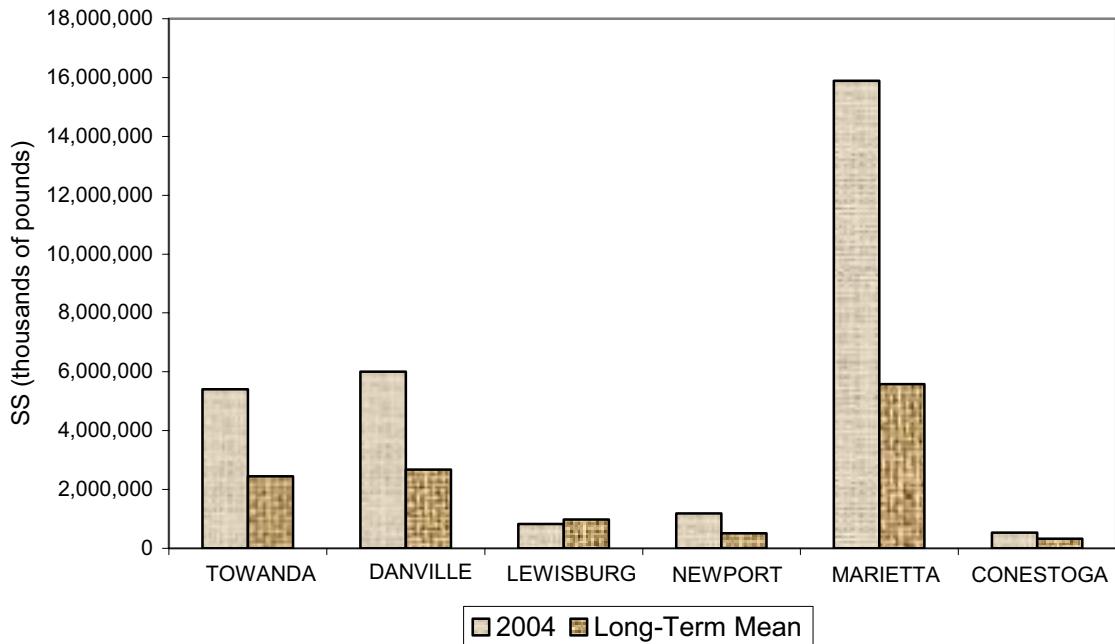


Figure 6A. *Annual Loads of Suspended Sediment (SS) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

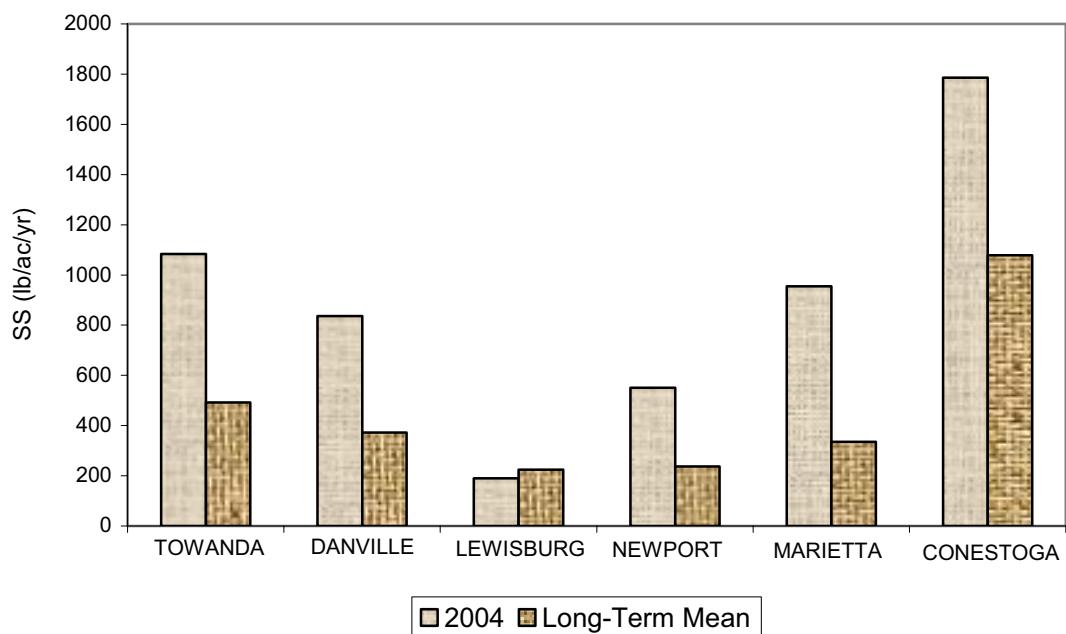


Figure 6B. *Suspended Sediment (SS) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2004*

Table 20. Enhanced Monitoring Station Average Concentration Data for Fall 2004

Station	Avg. Flow	Precip	Temp	Cond	pH	TN	DN	TNH ₄	DNH ₄	TNOx	DNOx	TP	DP	DOP	TOC	TSS
	cfs	inches	C°			mg/l										
Smithboro	16,470	9.71	7.17	181	7.28	1.15	0.90	0.102	0.034	0.628	0.502	0.039	0.025	0.019	3.74	16.1
Chemung	4,553	7.72	7.40	256	7.58	1.55	1.36	0.024	0.023	1.085	0.889	0.039	0.020	0.016	3.77	13.2
Wilkes-Barre	26,570	10.22	8.87	236	7.27	0.92	0.83	0.027	0.027	0.553	0.547	0.052	0.043	0.014	3.07	32.0
Karthaus	2,502	8.40	7.03	387	5.87	0.59	0.56	0.043	0.043	0.400	0.397	0.014	0.012	0.011	1.46	2.0
Castanea	-	8.50	7.27	261	7.35	1.66	1.66	0.037	0.030	1.393	1.393	0.024	0.013	0.013	2.01	4.7
Jersey Shore	9,775	8.74	7.47	214	6.98	0.84	0.80	0.023	0.023	0.677	0.660	0.032	0.025	0.025	1.25	4.0
Penns Creek	633	11.61	7.37	213	8.10	1.59	1.58	0.020	0.020	1.377	1.380	0.044	0.038	0.033	1.74	4.7
Saxton	1,265	7.16	10.97	253	7.57	2.24	2.25	0.020	0.023	2.080	2.077	0.013	0.010	0.010	2.03	8.0
Dromgold	411	9.99	10.57	169	7.03	2.13	2.08	0.030	0.030	1.947	1.883	0.014	0.011	0.011	1.74	4.7
Hogestown	699	8.86	12.00	417	7.77	4.70	4.70	0.020	0.020	4.553	4.307	0.015	0.011	0.011	1.71	2.0
Hershey	931	10.66	11.77	296	7.10	4.94	4.91	0.027	0.027	4.597	4.573	0.030	0.019	0.018	1.65	5.3
Manchester	518	8.64	11.23	269	7.63	2.84	2.81	0.023	0.023	2.540	2.480	0.055	0.042	0.038	3.29	4.0
Martic Forge	-	10.93	12.40	494	7.77	9.56	9.57	0.027	0.027	8.467	7.853	0.062	0.046	0.043	1.82	4.0

Table 21. 2004 Monthly Flow (*Q*) in Cubic Feet per Second and TN, TP, and SS in Thousands of Pounds

Site	Parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual*
Towanda	Q	11,506	4,708	27,475	20,507	16,106	6,701	12,642	14,384	27,943	6,894	10,413	23,774	15,254
	TN	2,333	866	5,394	3,502	2,549	943	1,805	2,037	4,241	1,104	1,824	4,621	31,219
	TP	115	25	381	206	150	56	283	227	1,170	78	149	393	3,233
	SS	41,183	2,768	359,747	138,529	71,952	17,993	465,651	156,322	3,761,733	18,229	93,254	282,524	5,409,885
Danville	Q	19,152	7,373	34,873	27,973	23,716	10,630	13,784	19,722	40,628	12,380	14,498	35,803	21,711
	TN	4,194	1,388	7,040	4,858	3,793	1,464	1,912	2,810	6,165	2,047	2,629	7,314	45,614
	TP	269	45	550	337	283	101	309	377	2,075	190	274	814	5,624
	SS	97,532	5,299	332,148	160,243	118,811	28,766	282,270	200,197	4,165,133	50,161	135,019	428,752	6,004,331
Lewisburg	Q	17,575	5,183	27,414	20,213	18,735	6,983	12,261	12,513	34,921	8,523	10,614	22,367	16,442
	TN	3,569	1,029	4,948	3,147	2,731	986	1,717	1,781	5,429	1,519	2,030	4,541	33,427
	TP	200	25	267	137	125	34	125	105	730	69	95	252	2,164
	SS	65,611	1,938	92,251	34,376	30,316	4,220	49,281	25,360	452,754	8,562	14,279	52,695	831,643
Newport	Q	7,045	2,798	11,733	12,202	5,873	2,808	2,996	3,532	15,957	3,503	4,928	8,718	6,841
	TN	2,559	801	3,742	3,555	1,686	716	850	1,080	5,246	1,226	1,785	3,362	26,608
	TP	107	25	180	192	83	38	52	66	554	58	77	140	1,572
	SS	44,813	3,525	100,319	115,976	27,791	8,135	14,712	19,046	771,129	11,205	20,313	45,865	1,182,829
Marietta	Q	52,316	25,634	84,797	75,837	58,368	29,360	33,416	46,894	110,893	33,890	35,943	83,871	55,935
	TN	16,765	6,539	22,386	17,549	13,013	5,943	7,506	11,550	29,501	10,023	10,992	27,705	179,472
	TP	879	176	1,414	1,037	745	304	686	938	6,897	522	515	1,693	15,806
	SS	425,658	33,275	868,732	550,453	336,233	98,848	480,247	510,837	11,500,093	159,268	163,702	759,807	15,887,153
Conestoga	Q	724	1,399	676	964	747	804	1,693	1,730	1,222	79	756	1,173	997
	TN	1,024	1,620	913	1,173	930	922	1,775	1,903	1,350	957	975	1,572	15,114
	TP	31	147	26	46	34	48	276	222	149	39	42	64	1,124
	SS	7,117	112,506	6,267	17,666	8,574	16,248	163,924	107,325	64,839	5,911	9,714	16,983	537,074

*Annual flow is average for the year

*Annual loads are total for the year