When looking at constituent loads, it can be difficult to determine whether improvements are being made due to the variations in flow. Because of this, it is useful to compare the loads from years that had similar amounts of flow. Table 20 lists the flow and TN, TP, and SS loads for 1992 and 2002. Newport was not sampled during 1992 and has been excluded from the table. The fact that constituent loads tend to be higher during higher flow years suggests that the loads for TN, TP, and SS should be higher for all sites during 1992. This was in fact the case for TN. TP, however, was higher during 2002 for all sites except Lewisburg, with a dramatic increase at Marietta. SS loads were higher for all sites in 2002 except for Danville.

SEASONAL WATER DISCHARGES AND NUTRIENT AND SUSPENDED-SEDIMENT LOADS AND YIELDS

Seasonal loads for all parameters and all sites are listed in Table 21 (high values in boldface type). For the purposes of this project, January–March is winter, April–June is spring, July–September is summer, and October–December is fall. As a general note, nutrient and SS levels increase with increases in flow. This is very apparent with regard to the seasonal results for Conestoga. Fall was by far the highest flow season for Conestoga, and, due to this, all parameters also were highest during that timeframe. All other sites had highest flow during the spring months. Most parameters followed the general rule of higher discharges resulting in higher nutrient loads, except for TNH_3, DNH_3, DP, and DOP. These parameters were highest during the fall for nearly all sites, leading to the possible conclusion that these constituents are not as flow dependent.

Newport had some variation from the other sites with TN, DN, total nitrate plus nitrite (TNOx), and dissolved nitrate plus nitrite (DNOx) showing highest values during the fall. The values were only slightly below those for spring and were easily explained, given that the flow difference between spring and fall at Newport was small.

Seasonal highs in TP loads corresponded with seasonal highs in SS for all sites, backing the idea that phosphorus can be reduced by reducing SS concentrations. The dissolved fraction, however, is beginning to be dominated by DOP. Figures 7-12 show graphs of discharge, TN, TP, and SS as compared to the long-term means. Discharge values at Towanda and Danville were above the long-term mean for both spring and fall. Corresponding SS values for both sites are dramatically lower than their respective long-term means leading to the conclusion that SS concentrations were improving at these sites. Similar circumstances existed at Lewisburg for 2002. Above average flows at Marietta during the spring and fall seasons led to TP loads well above long-term means for the same months. Conestoga had slightly above average flows for the fall season, producing well above average loads of TP and SS. This was coupled with extremely low loads of these constituents during the winter and summer months.

Figures 13-15 show the seasonal yields for each site. When comparing land uses Lewisburg, (2 percent urban, 15 percent Agricultural, 81 percent forest, 2 percent other) and Newport (2 percent urban, 28 percent Agricultural, 69 percent forest, 1 percent other) are good sites to examine for differences due to forest versus agriculture, since this constitutes the only significant different between the two. When looking at the yields of TN, TP, and SS for these sites, Newport recorded higher yield values for all seasons except winter. By looking at the seasonal discharges for winter, Newport recorded values that were 31.6 percent of the long-term mean for the site, while Lewisburg recorded discharge values that were 67.5 percent of the long-term mean. This could easily account for higher yield values for Lewisburg for the winter season. When looking at the long-term yields, Newport recorded the highest values for all four seasons for TN and TP and highest SS yields for spring and summer. Given the land uses for these two sites, it becomes clear that higher yield values were generally found in watersheds where forested land had been lost to agriculture. It was not possible to determine which factor had more effect on yields;

the loss of forestland or the addition of agricultural land.

There were no consistent seasonal patterns between the mainstem Susquehanna sites at Towanda, Danville, and Marietta. This makes sense considering that the land use percentages for these sites were very comparable. Long-term yield values at Conestoga were highest of all sites for all seasons. Phosphorus and SS yields at Conestoga were not the highest during the winter months for 2002. This was likely due to flows for the season being 23.6 percent of the long-term mean. Figure 16 shows the load percent breakdowns for each season at each site. As a general note, spring was the time of the highest loads of nutrient and SS at all sites while summer was the lowest. This corresponds with the flows for 2002. The exception was at Conestoga where the highest values for flow, nutrients, and SS were during the fall. This emphasizes the significant impact that discharge has on constituent loads.

Table 20. Comparison of 2002 Loads with 1992 Loads for Flow, Total Nitrogen, Total Phosphorus, and Suspended Sediment

Site	Discharge cfs		TN thousands lbs		TP thousand lbs		SS thousands lbs	
	1992	2002	1992	2002	1992	2002	1992	2002
Towanda	11,700	10,936	31,600	22,933	1,600	1,747	879,000	1,011,773
Danville	16,000	15,756	46,100	36,081	2,710	2,794	1,310,000	1,071,789
Lewisburg	10,500	9,615	21,700	18,844	999	943	337,000	400,870
Marietta	34,100	33,407	118,000	105,516	5,070	7,789	2,280,000	4,158,875
Conestoga	417	382	6,710	5,123	277	432	57,500	153,336

Table 21. Seasonal Mean Water Discharges and Loads of Nutrients and Suspended Sediment, Calendar Year 2002

Station	Season	Mean Water Discharge	Total Nitrogen as N	Dissolved Nitrogen as N	Total Ammonia as N	Dissolved Ammonia as N	Total Organic Nitrogen as N	Dissolved Organic Nitrogen as N	Total Nitrate Plus Nitrite as N	Dissolved Nitrate Plus Nitrite as N	Total Phosphorus as P	Dissolved Phosphorus as P	Dissolved Ortho-Phosphate as P	Total Organic Carbon	Suspended Sediment
		cfs	thousands of pounds												
Towanda	Winter	12,521	7,271	7,084	468	394	2,295	2,006	4,730	4,693	453	212	206	16,710	243,789
	Spring	**18,834**	**9,153**	**8,351**	383	384	**3,873**	**3,112**	**4,985**	**4,917**	**738**	241	208	**33,850**	**634,061**
	Summer	1,875	810	689	30	29	430	328	382	380	72	39	44	3,432	8,864
	Fall	10,378	5,699	5,541	**530**	**439**	1,896	1,745	3,540	3,424	484	**264**	**289**	18,311	125,059
Danville	Winter	16,498	10,604	10,292	707	570	3,006	2,513	7,280	7,337	624	251	273	21,171	238,824
	Spring	**26,190**	**13,389**	**11,837**	560	470	**5,531**	**3,956**	**7,586**	**7,546**	**1,108**	304	298	**44,721**	**585,363**
	Summer	2,977	1,248	1,018	43	37	701	476	610	606	89	37	35	5,246	10,556
	Fall	17,228	10,840	10,385	**843**	**769**	3,588	2,995	6,677	6,596	973	**408**	**405**	31,399	237,048
Lewisburg	Winter	10,383	5,381	5,018	**376**	**376**	1,568	1,193	3,541	3,508	261	114	**100**	8,989	86,948
	Spring	**18,094**	**7,965**	**7,035**	353	300	**2,685**	**1,776**	**4,926**	**4,828**	**438**	**133**	96	**20,563**	**282,162**
	Summer	1,884	957	892	36	33	280	220	644	627	32	21	19	2,172	2,419
	Fall	8,129	4,541	4,317	332	332	1,118	894	3,180	3,100	213	121	98	9,311	29,340
Newport	Winter	2,071	1,700	1,627	42	38	396	310	1,284	1,278	82	52	47	2,795	22,788
	Spring	**5,234**	4,480	4,071	123	107	**1,137**	**796**	3,214	3,180	**310**	145	140	**8,574**	**188,828**
	Summer	949	668	609	21	19	220	163	434	427	55	36	30	1,787	8,114
	Fall	4,026	**4,522**	**4,281**	**148**	**139**	886	671	**3,506**	**3,466**	272	**162**	**156**	7,958	85,952
Marietta	Winter	32,066	25,855	24,057	1,202	124	6,340	4,145	18,547	18,373	1,388	703	823	40,294	625,280
	Spring	**57,335**	**39,719**	**34,279**	1,230	1,101	**10,091**	**6,193**	**25,696**	**25,256**	**3,581**	**1,285**	1,534	**92,412**	**2,632,050**
	Summer	6,839	4,118	3,641	117	114	1,012	687	2,344	2,324	286	165	161	12,164	62,232
	Fall	37,381	35,824	32,627	**1,907**	**2,004**	5,668	3,422	25,175	24,961	2,533	1,183	**1,634**	66,503	839,312
Conestoga	Winter	202	783	763	7	7	115	100	669	661	26	18	15	402	2,771
	Spring	432	1,443	1,370	24	26	252	167	1,219	1,209	111	45	51	1,072	57,687
	Summer	124	421	407	3	4	54	43	367	365	31	24	28	311	1,800
	Fall	**773**	**2,477**	**2,288**	**89**	**102**	**495**	**261**	**2,032**	**2,025**	**265**	**121**	**131**	**2,484**	**91,078**

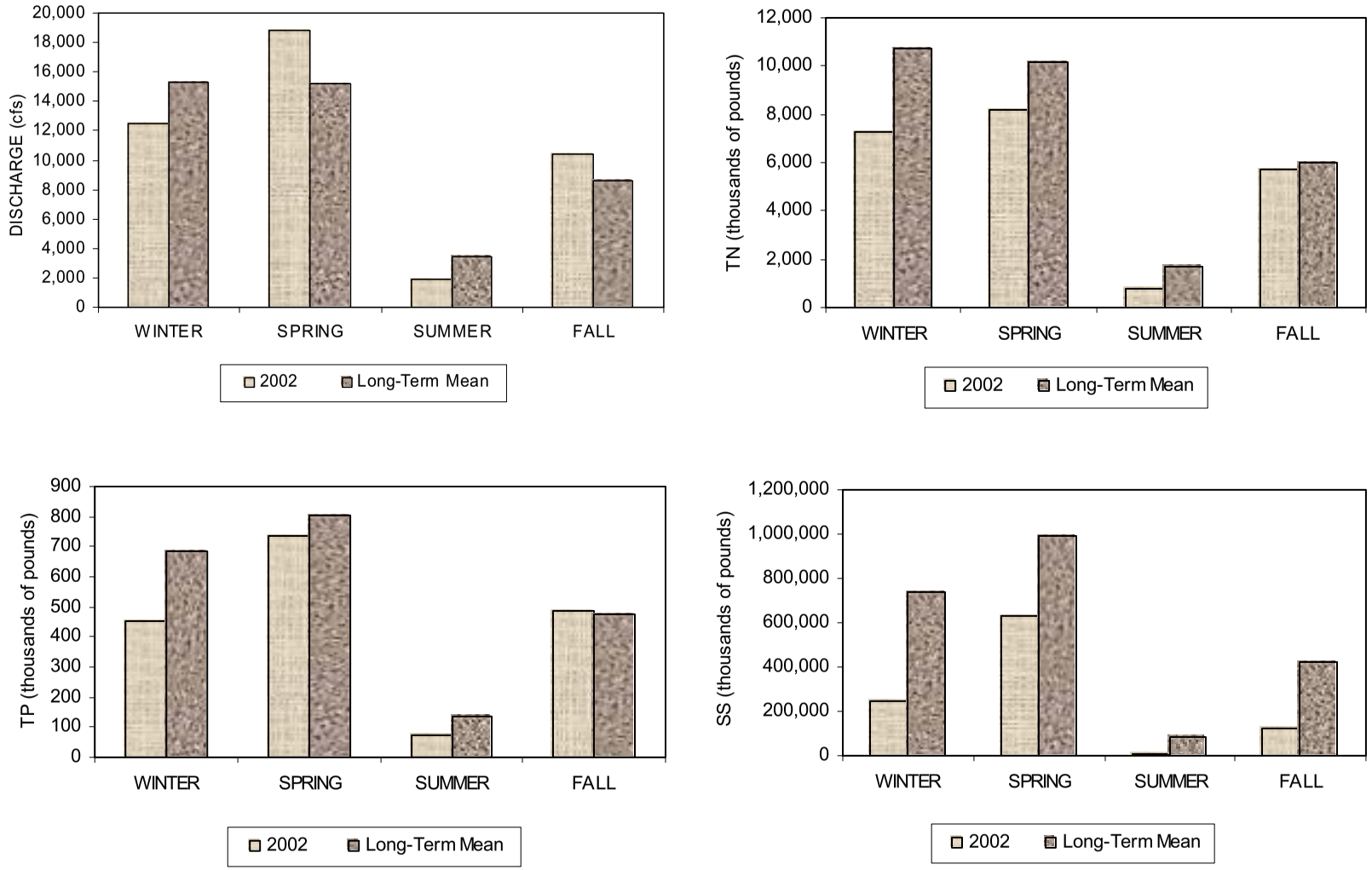


Figure 7. Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Towanda, Pa., Calendar Year 2002

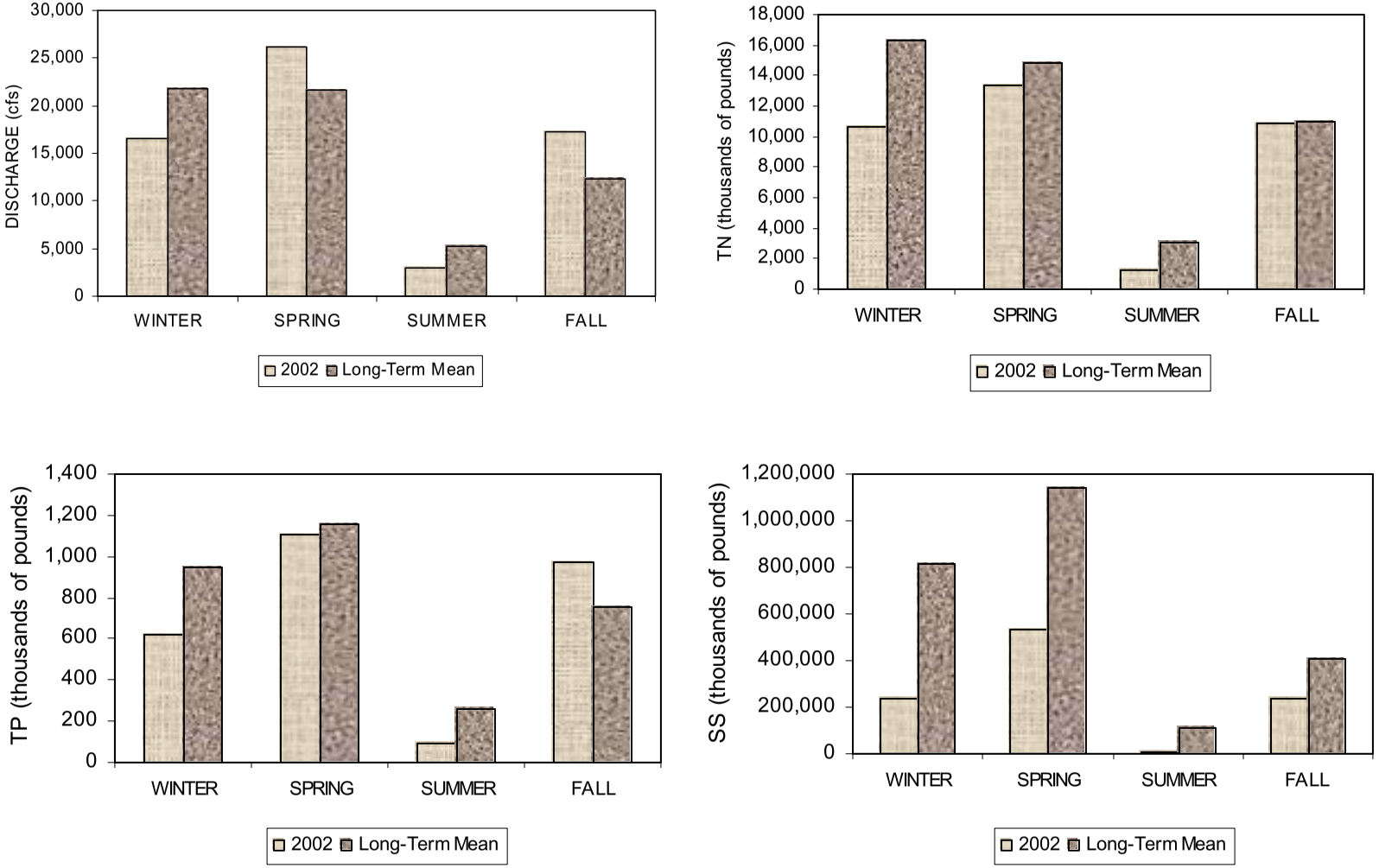


Figure 8. Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Danville, Pa., Calendar Year 2002

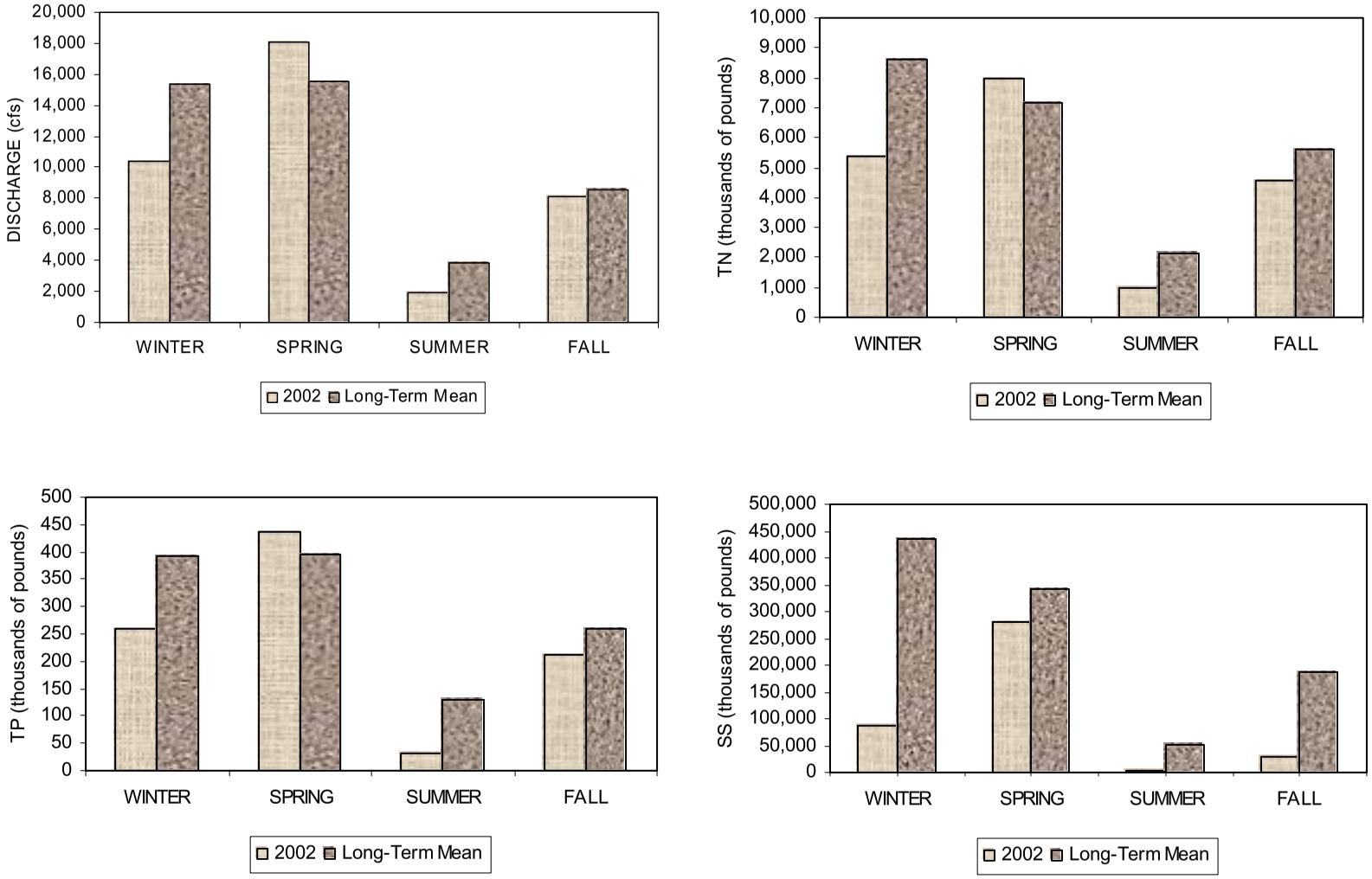


Figure 9. ***Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Lewisburg, Pa., Calendar Year 2002***

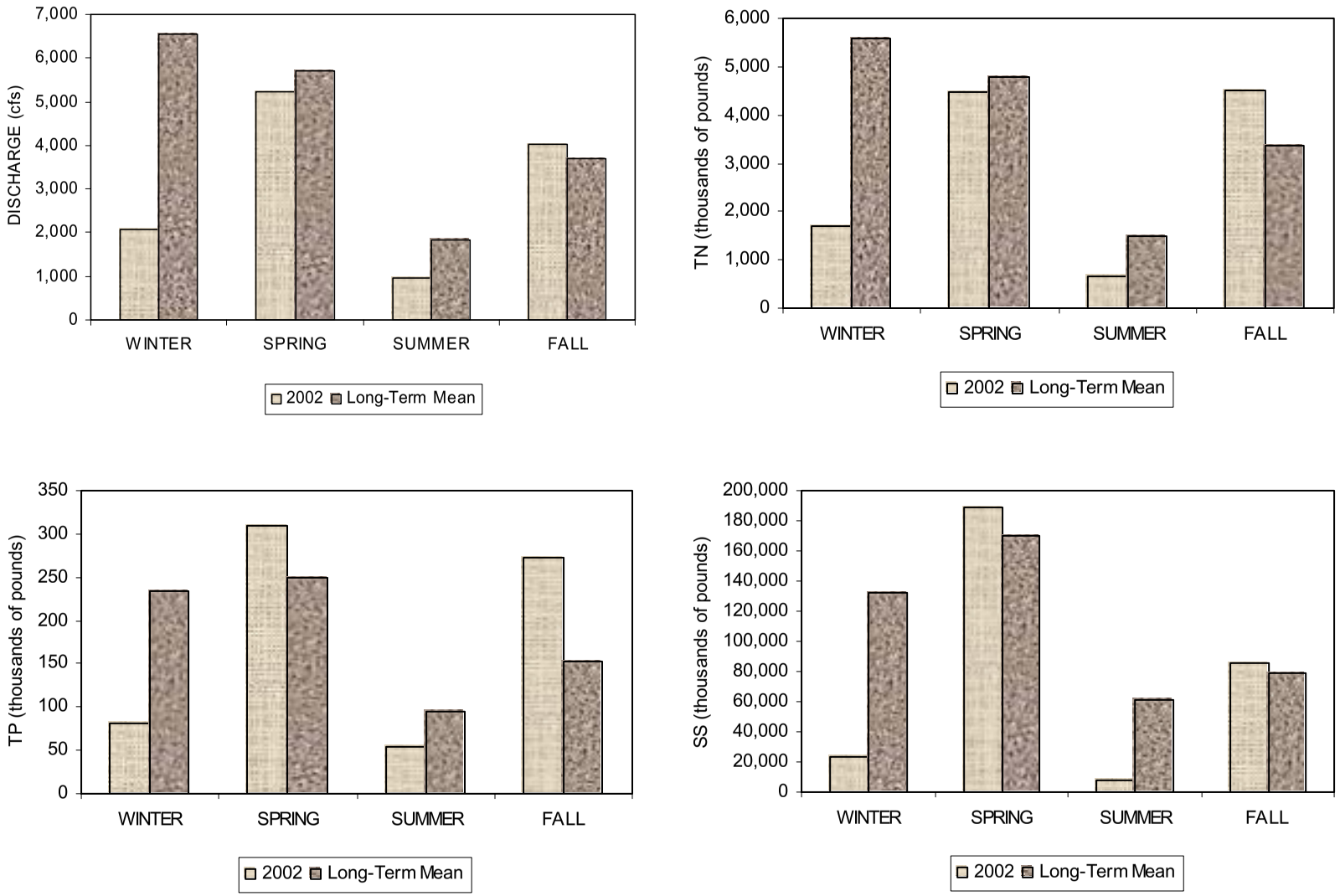
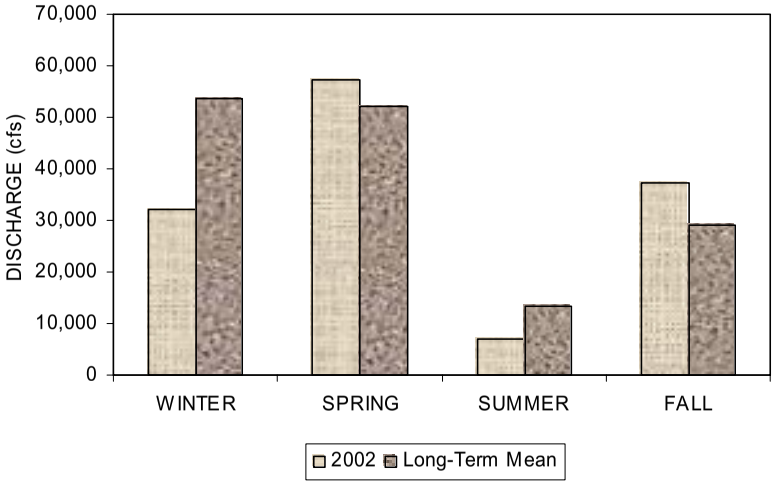
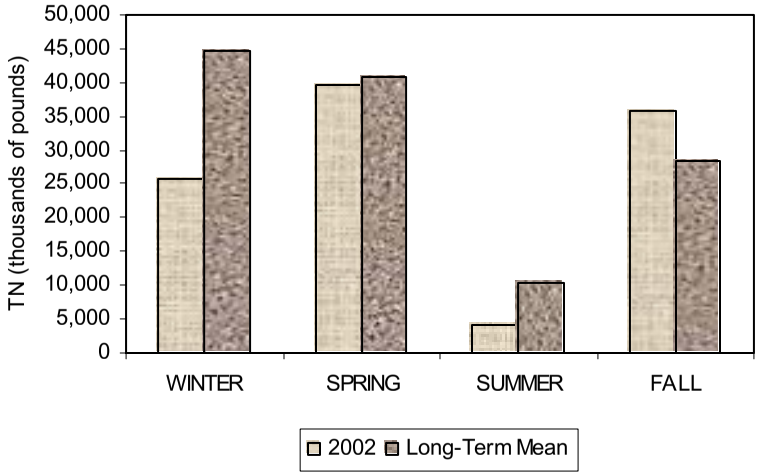
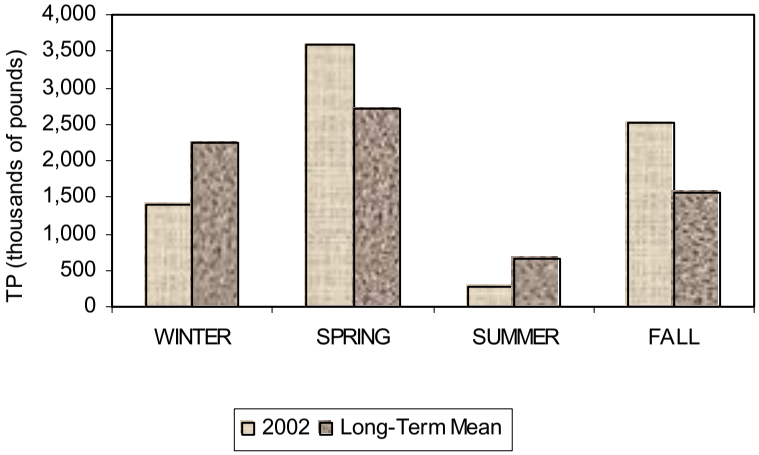


Figure 10. Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Newport, Pa., Calendar Year 2002







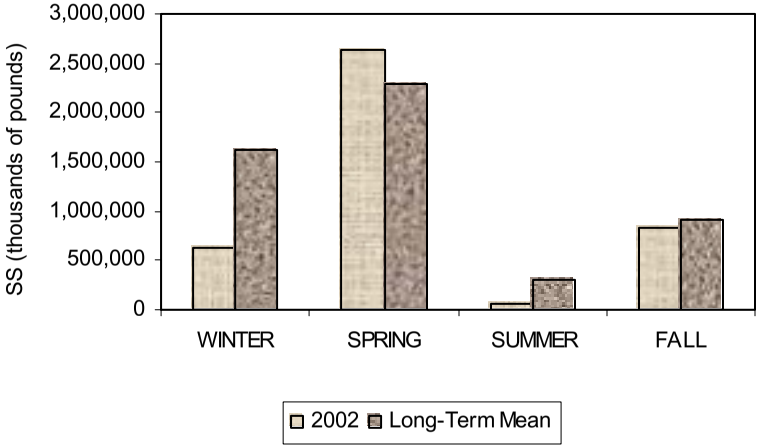


Figure 11. Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Marietta, Pa., Calendar Year 2002

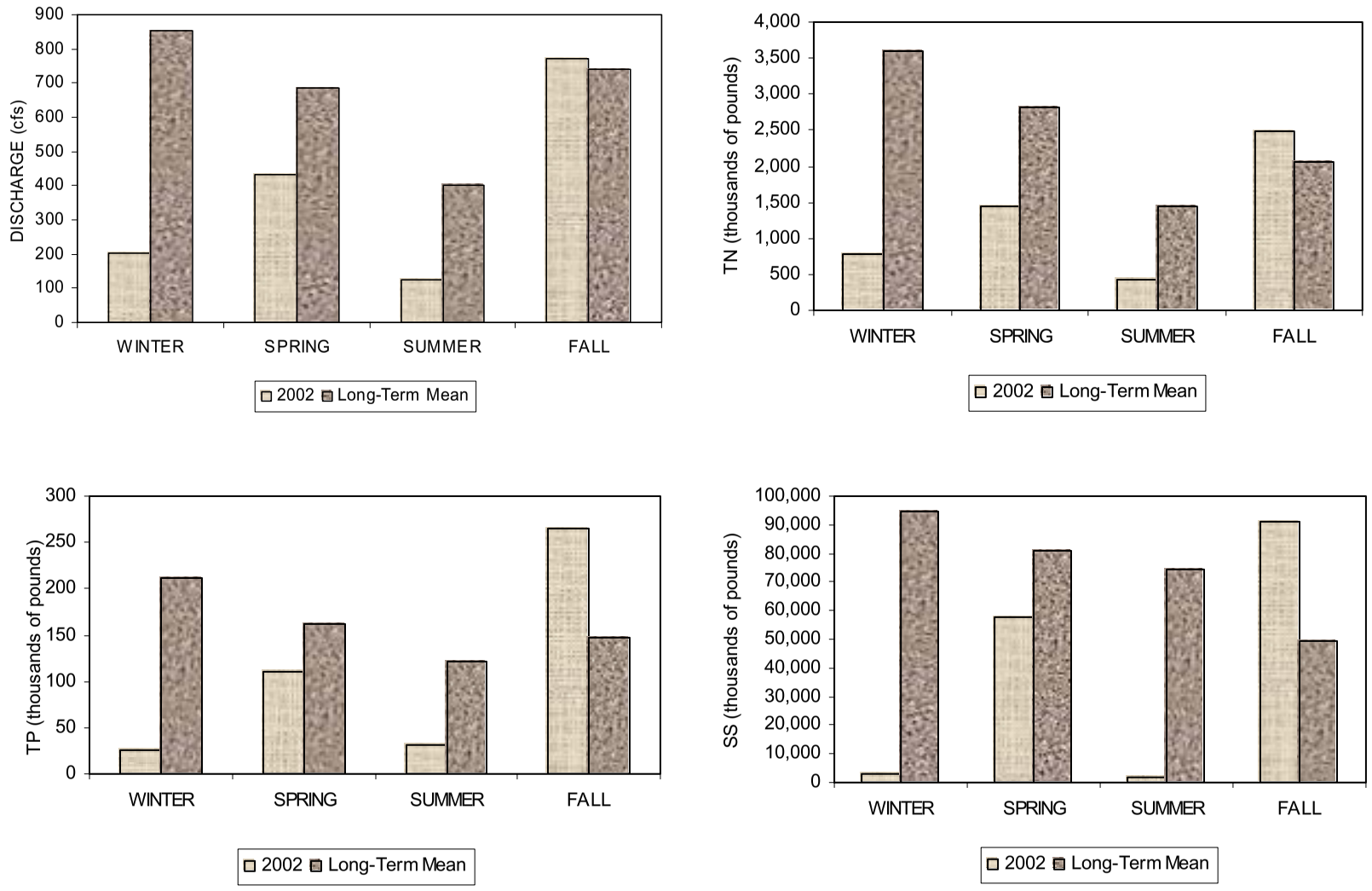


Figure 12. Season Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Conestoga, Pa., Calendar Year 2002

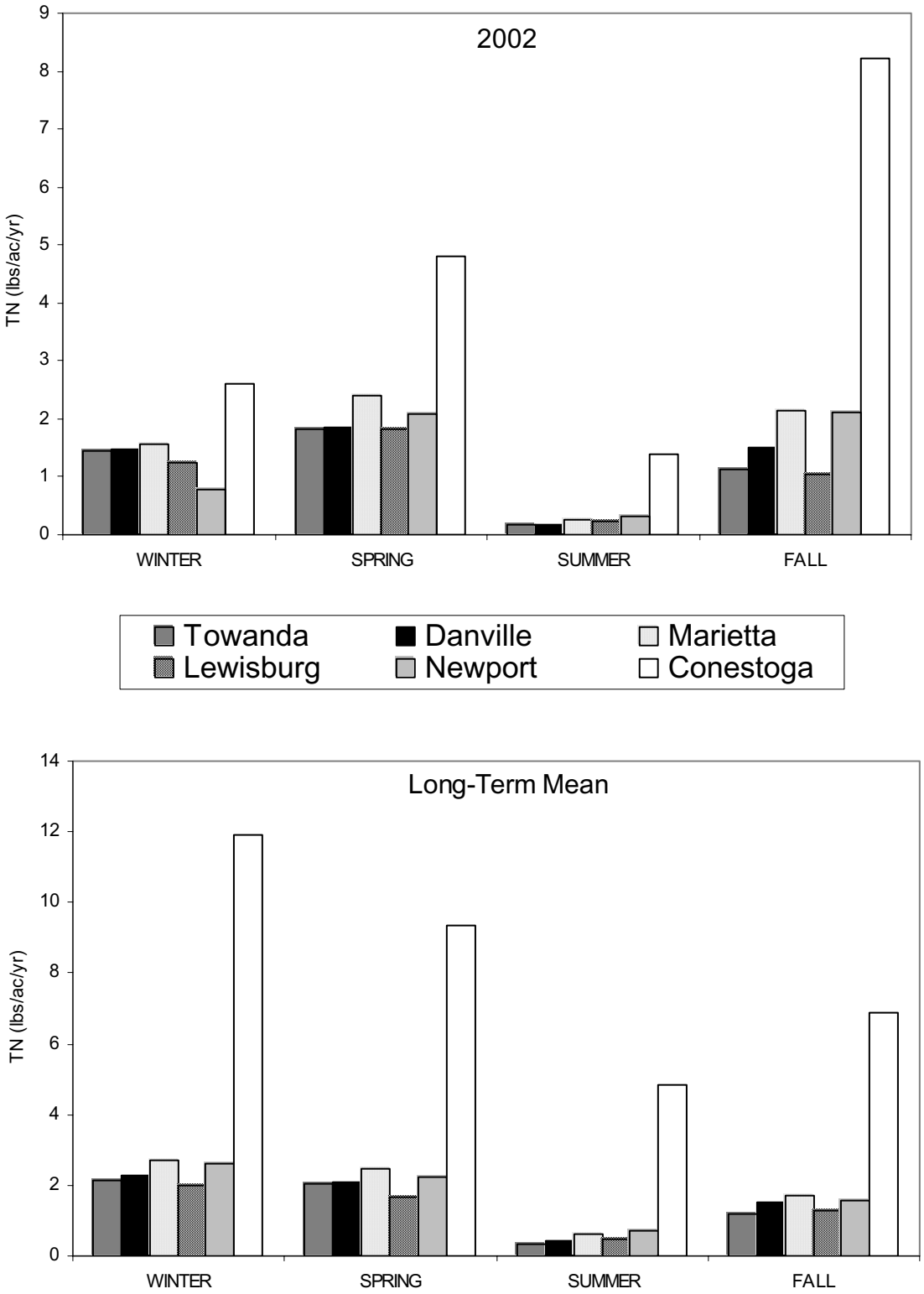


Figure 13. ***Comparison of Seasonal Yields of Total Nitrogen (TN) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.***

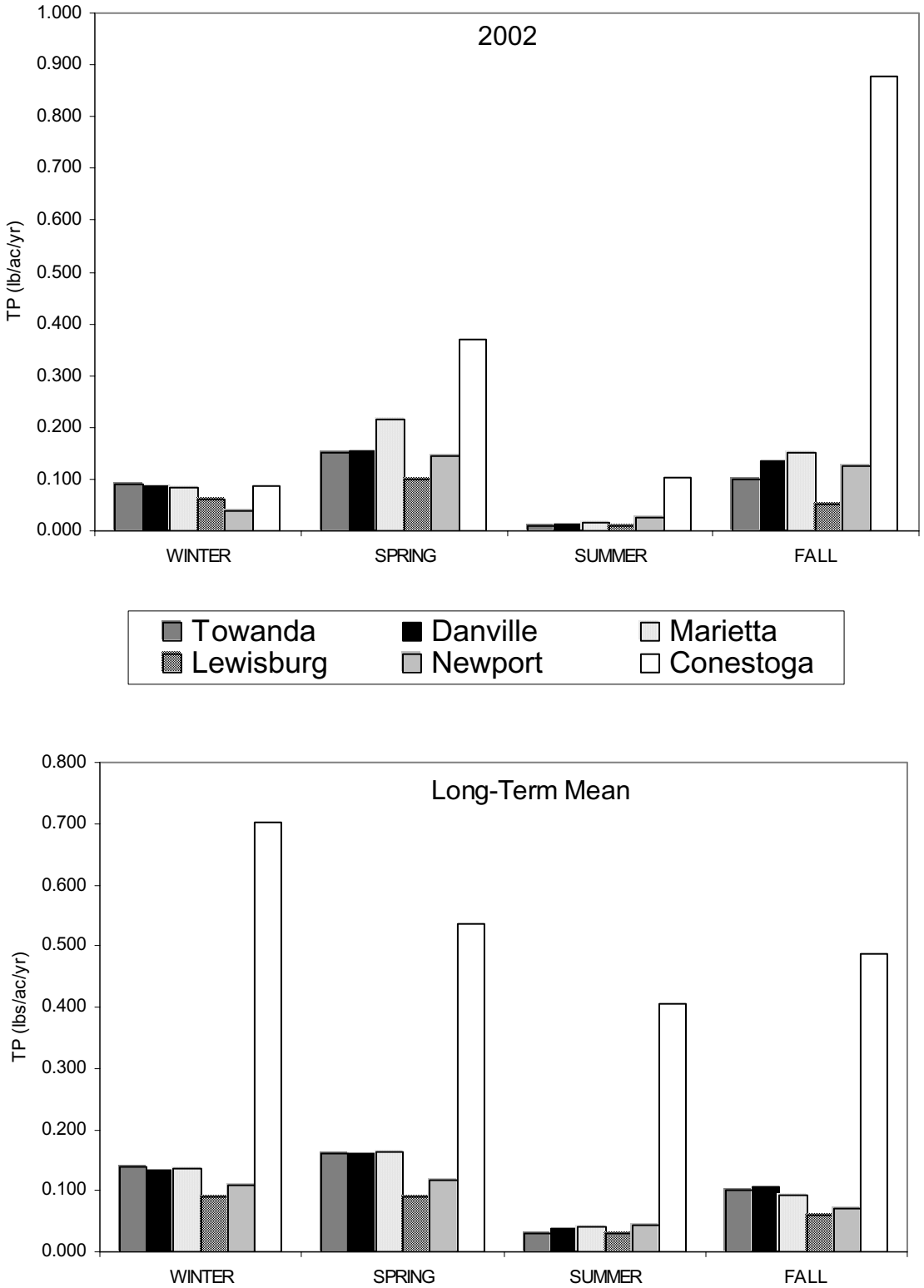


Figure 14. ***Comparison of Seasonal Yields of Total Phosphorus (TP) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.***

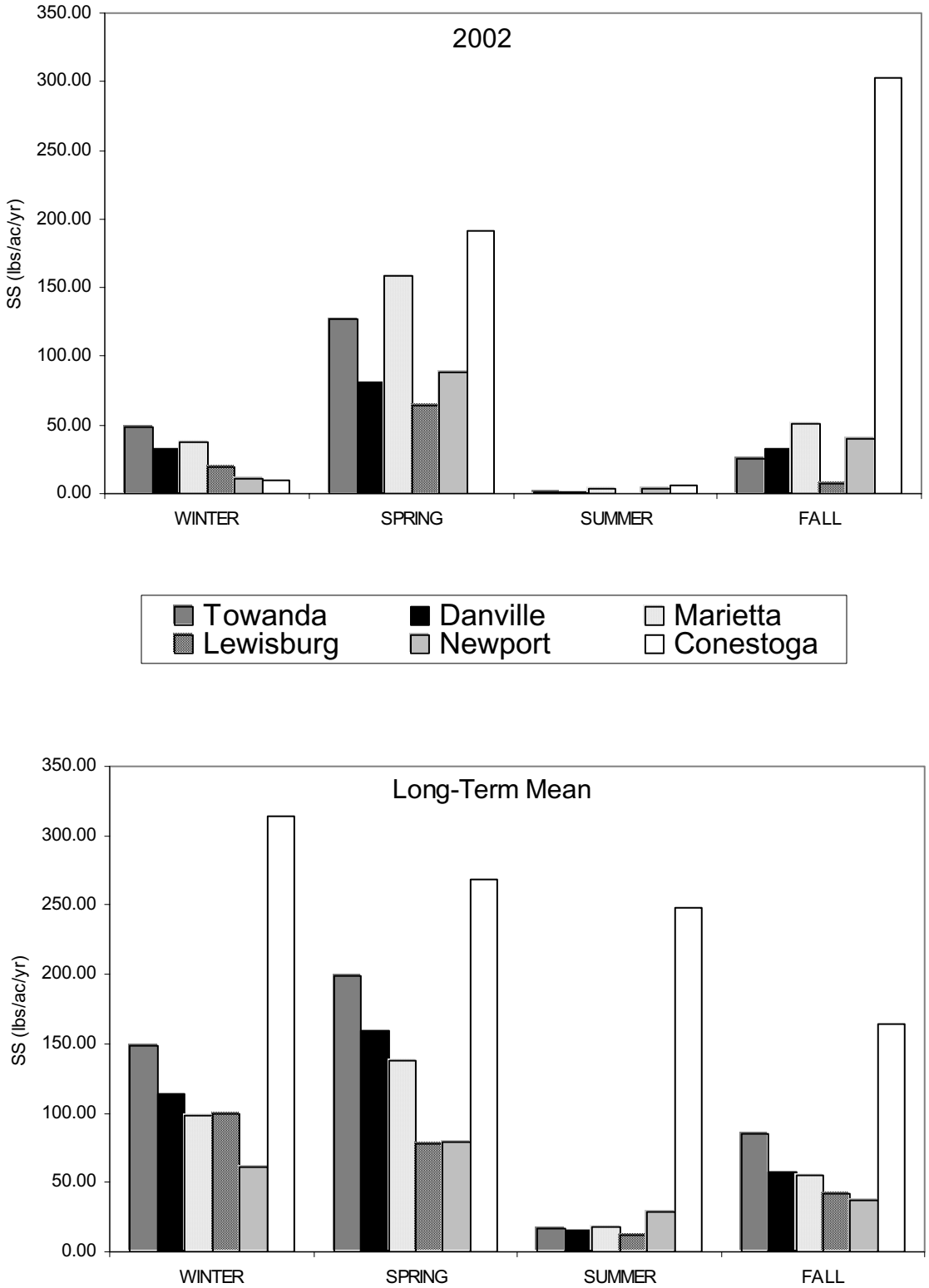


Figure 15. ***Comparison of Seasonal Yields of Suspended Sediment (SS) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.***

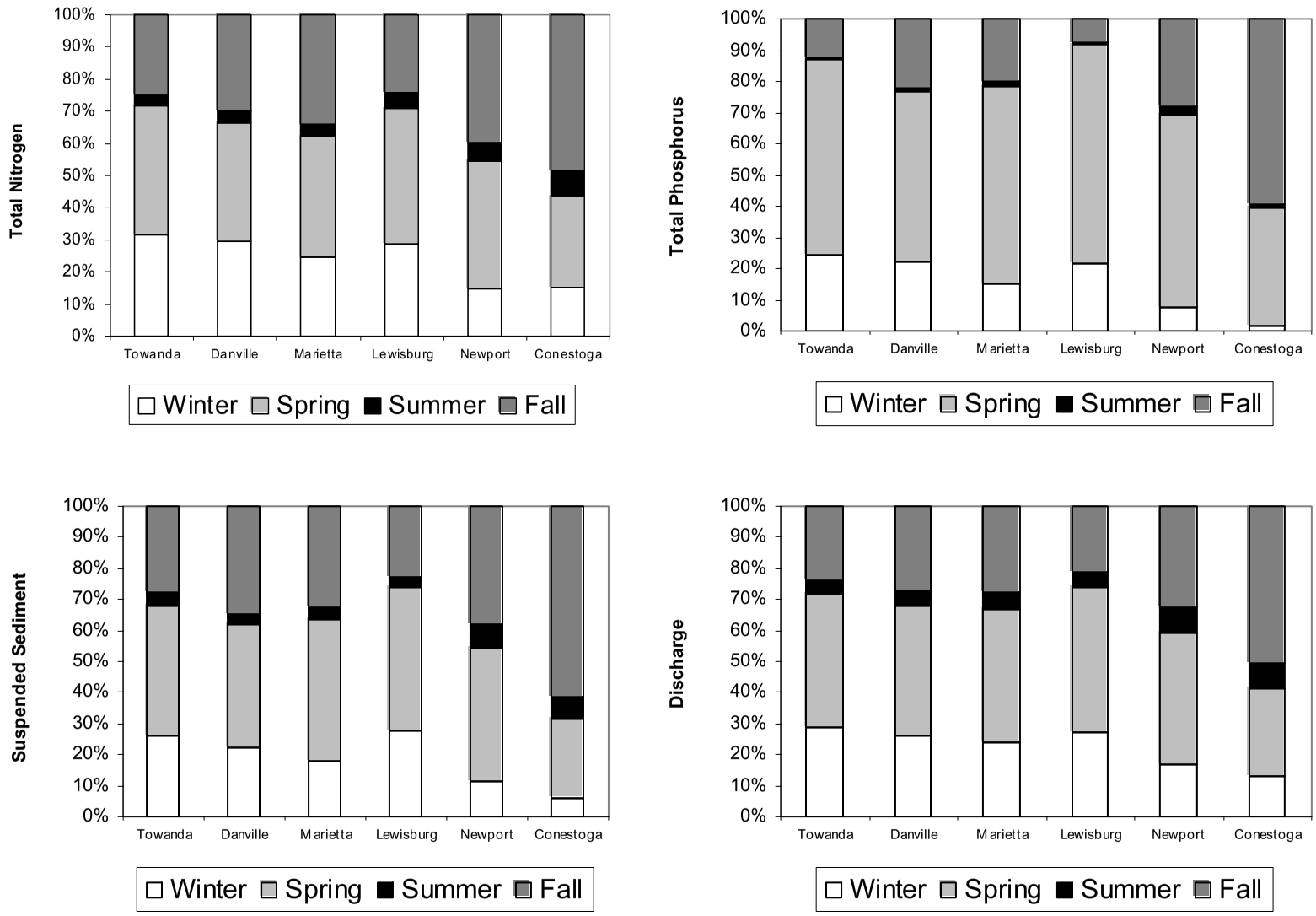


Figure 16. ***Seasonal Percent of Annual Load of Total Nitrogen, Total Phosphorus, and Suspended Sediment at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa.***