

COMPARISON OF THE 2004 LOADS AND YIELDS OF TOTAL NITROGEN, TOTAL PHOSPHORUS, AND SUSPENDED SEDIMENT WITH THE BASELINES

Annual fluctuations of nutrient and SS loads and water discharge create difficulties in determining whether the changes observed were related to land use, nutrient availability, or simply annual water discharge. Ott and others (1991) used the relationship between annual loads and annual water discharge to provide a method to reduce the variability of loadings due to discharge. This was accomplished by plotting the annual yields against the water-discharge ratio. This water-discharge ratio is the ratio of the annual mean discharge to the LTM discharge. Data from the initial 5-year study (1985-89) were used to provide a best-fit linear regression line to be used as the baseline relationship between annual yields and water discharge. It was hypothesized that, as future yields and water-discharge ratios were plotted against the baseline, any significant deviation from the baseline would indicate that some change in the annual yield had occurred, and that further evaluations to determine the reason for the change were warranted. The data collected in 2004 were compared with the 1985-89 baselines, where possible. Monitoring at some of the stations was started after 1987; therefore, a baseline was established for the 5-year period following the start of monitoring. 2004 yield values also were plotted against a baseline

developed with data from the beginning of each dataset (usually 1985) through 2004. Figures 17-28 display the baseline graphs and the 2004 yields.

Susquehanna River at Towanda, Pa.

The baselines for TN, TP, and SS for the Susquehanna River at Towanda are shown in Figures 17 and 18 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 24 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial 5-year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = 0.0642 + 6.6451x \quad R^2 = 0.86$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.1375 + 0.5399x \quad R^2 = 0.53$$

Suspended Sediment (SS)

$$\text{SS Yield} = -620.42 + 1006.5x \quad R^2 = 0.43$$

Where x = water-discharge ratio and R2 = correlation coefficient

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = 0.6019 + 5.2078x \quad R^2 = 0.75$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.1606 + 0.6027x \quad R^2 = 0.70$$

Suspended Sediment (SS)

$$\text{SS Yield} = -701.9 + 1193.4x \quad R^2 = 0.60$$

Table 24. Comparison of 2004 TN, TP, and SS Yields with Baseline Yields at Towanda, Pa.

Parameter	Discharge Ratio	1989 – 1993 Baseline lb/ac/yr	1989 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.427	9.547	8.033	6.256
TP	1.427	0.633	0.699	0.648
SS	1.427	815.856	1000.92	1084.13

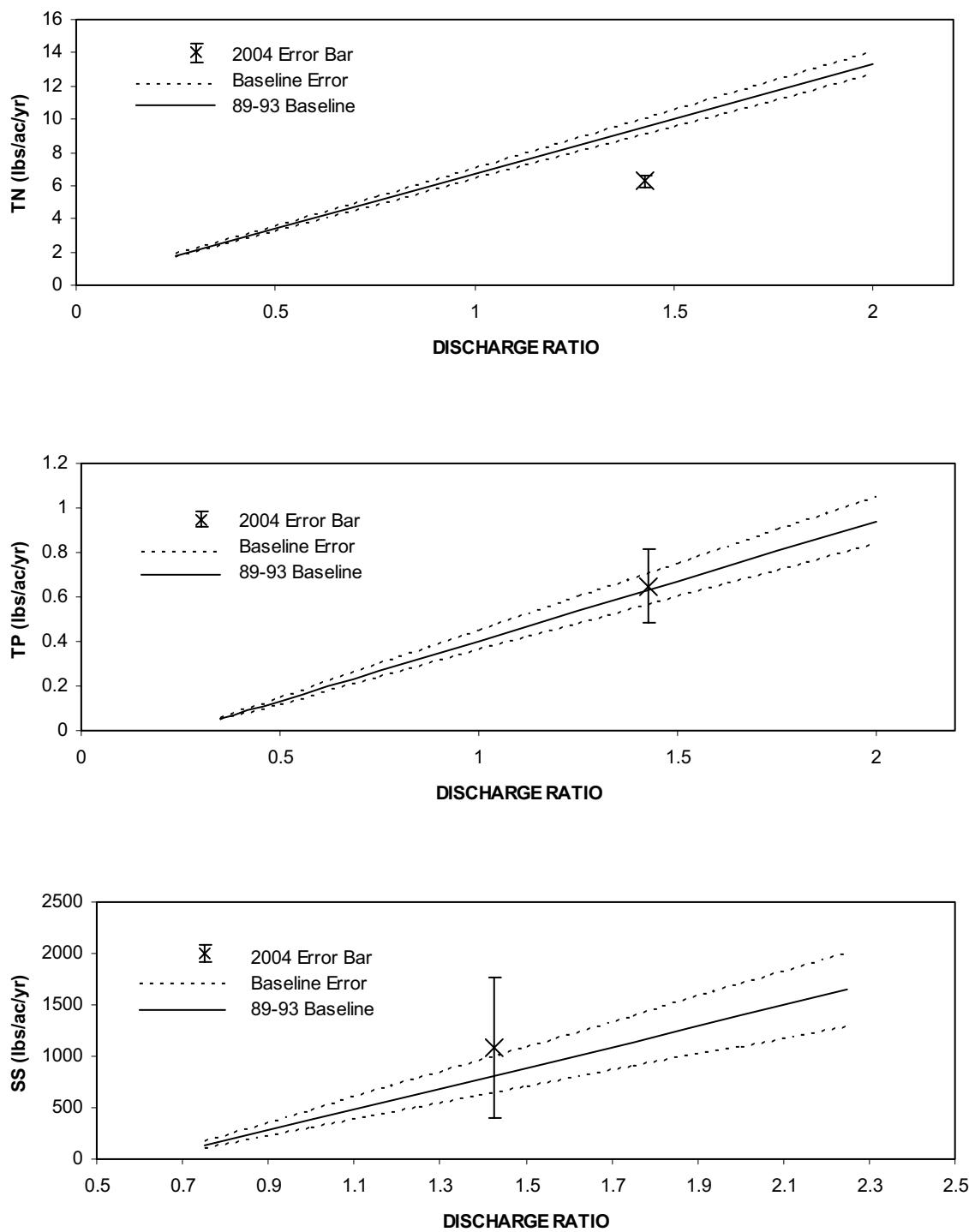


Figure 17. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Towanda, Pa., 2004 Yield Compared to 1989-1993 Baseline

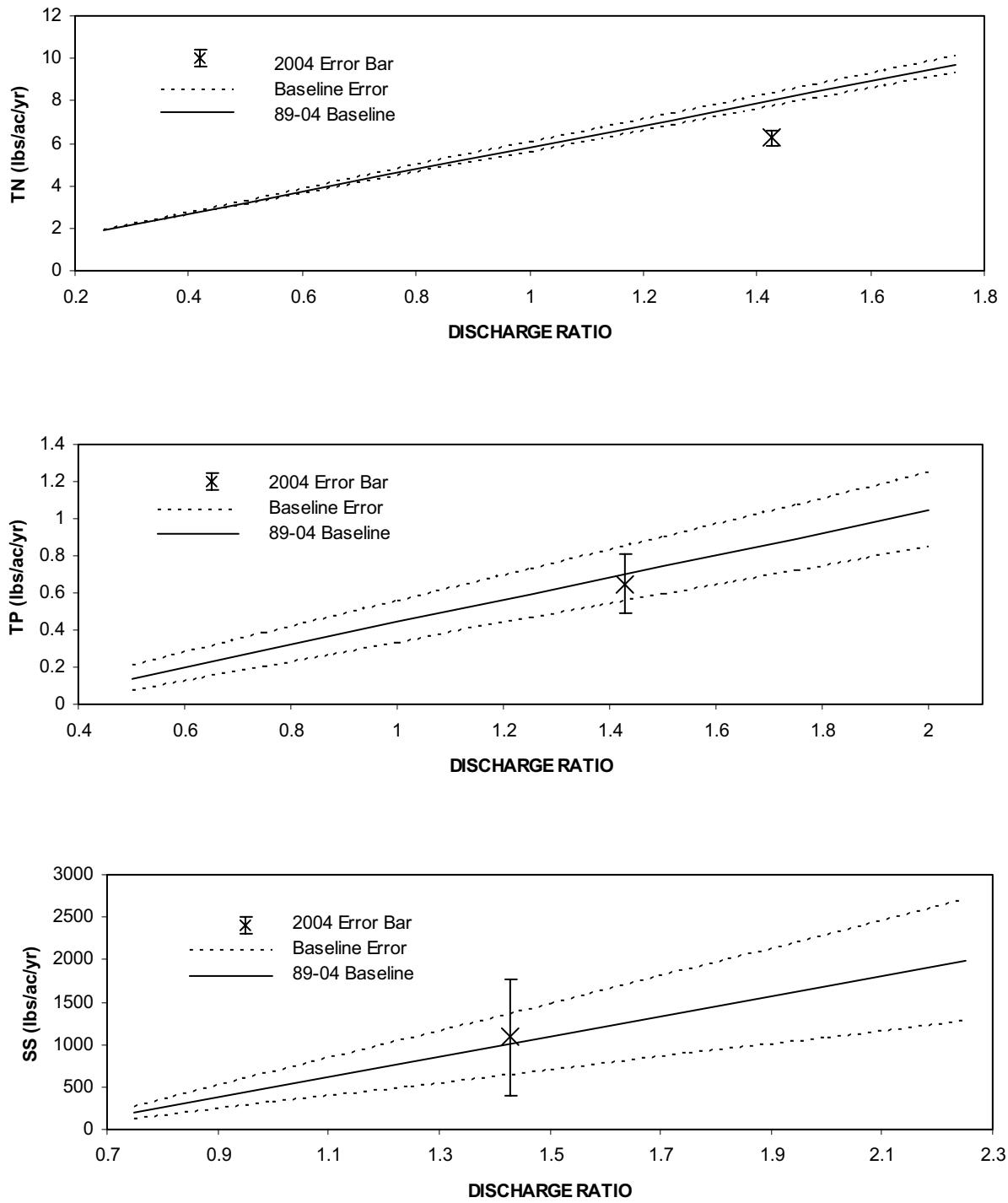


Figure 18. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Towanda, Pa., 2004 Yield Compared to 1989-2004 Baseline

Susquehanna River at Danville, Pa.

The baselines for TN, TP, and SS for the Susquehanna River at Danville are shown in Figures 19 and 20 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 25 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial 5-year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = -0.2303 + 6.4302x \quad R^2 = 0.85$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.1583 + 0.583x \quad R^2 = 0.95$$

Suspended Sediment (SS)

$$\text{SS Yield} = -480.64 + 762.56x \quad R^2 = 0.99$$

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = 1.4799 + 4.8508x \quad R^2 = 0.64$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.1619 + 0.6245x \quad R^2 = 0.75$$

Suspended Sediment (SS)

$$\text{SS Yield} = -461.88 + 833.83x \quad R^2 = 0.66$$

West Branch Susquehanna River at Lewisburg, Pa.

The baselines for TN, TP, and SS for the West Branch of the Susquehanna River at Lewisburg are shown in Figures 21 and 22 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 26 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial-5 year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = -1.4234 + 7.1513x \quad R^2 = 0.73$$

Total Phosphorus (TP)

$$\text{TP Yield} = 0.0255 + 0.2498x \quad R^2 = 0.53$$

Suspended Sediment (SS)

$$\text{SS Yield} = -157.34 + 316.17x \quad R^2 = 0.67$$

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = 0.0207 + 5.5594x \quad R^2 = 0.86$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.1145 + 0.4001x \quad R^2 = 0.74$$

Suspended Sediment (SS)

$$\text{SS Yield} = -284.27 + 508.12x \quad R^2 = 0.43$$

Table 25. Comparison of 2004 TN, TP, and SS Yields with Baseline Yields at Danville, Pa.

Parameter	Discharge Ratio	1985 – 1989 Baseline lb/ac/yr	1985 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.415	8.868	8.344	6.352
TP	1.415	0.667	0.722	0.783
SS	1.415	751.37	717.989	836.165

Table 26. Comparison of 2004 Total Nitrogen, Total Phosphorus, and Suspended-Sediment Yields With Baseline Yields at Lewisburg, Pa.

Parameter	Discharge Ratio	1985 – 1989 Baseline lb/ac/yr	1985 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.501	10.30	8.365	7.22
TP	1.501	0.435	0.486	0.39
SS	1.501	317.231	478.448	189.783

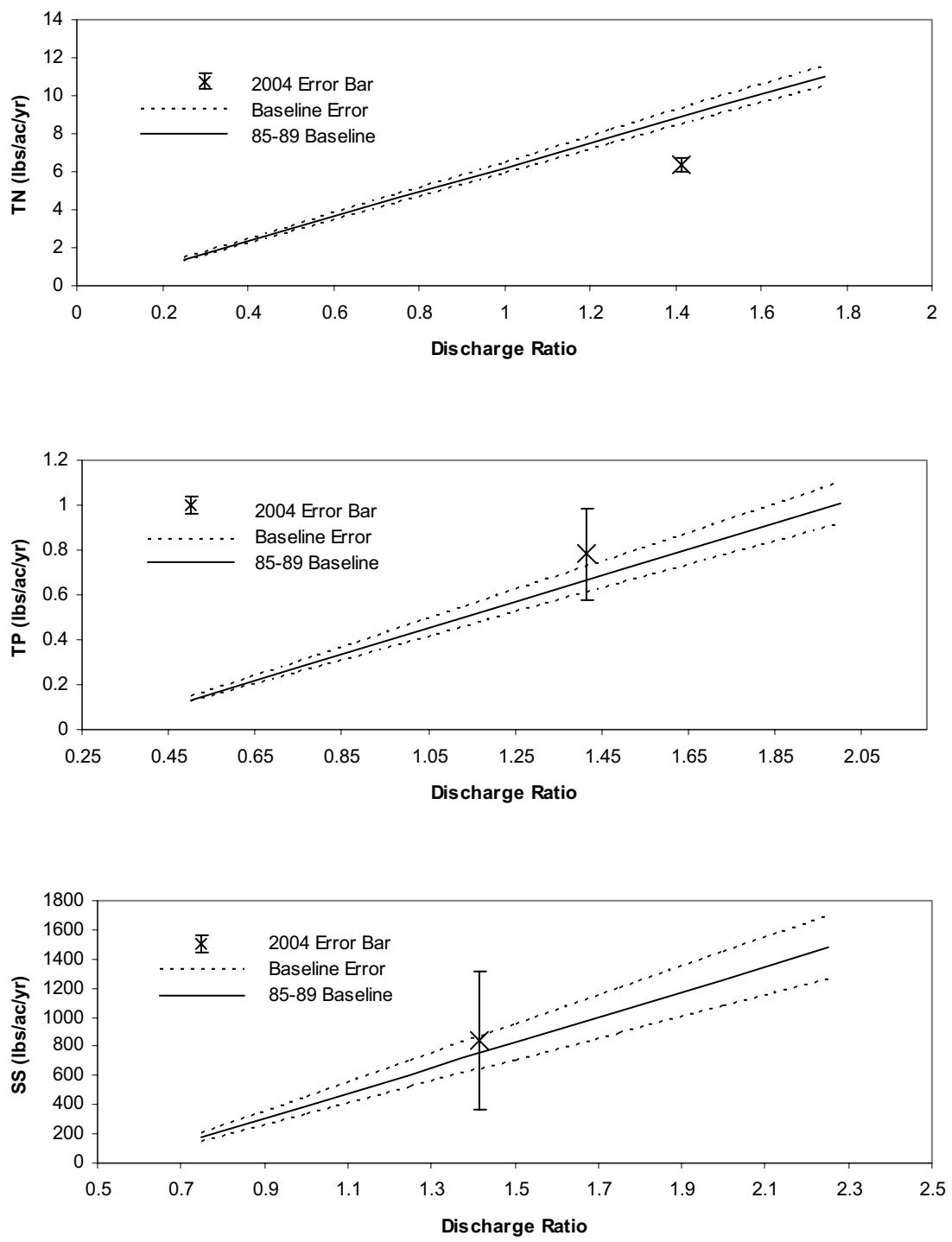


Figure 19. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Danville, Pa., 2004 Yield Compared to 1985-1989 Baseline

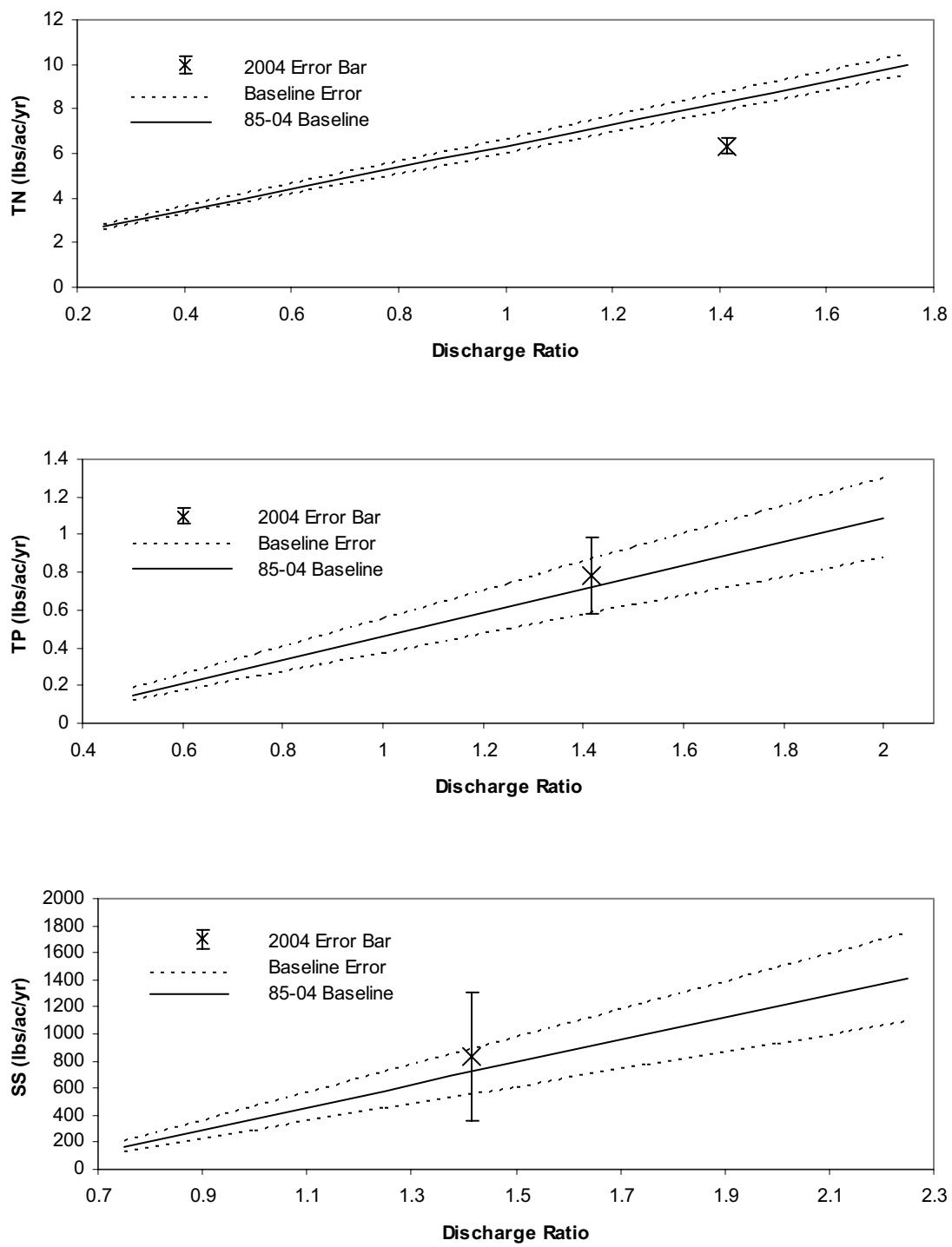


Figure 20. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Danville, Pa., 2004 Yield Compared to 1985-2004 Baseline

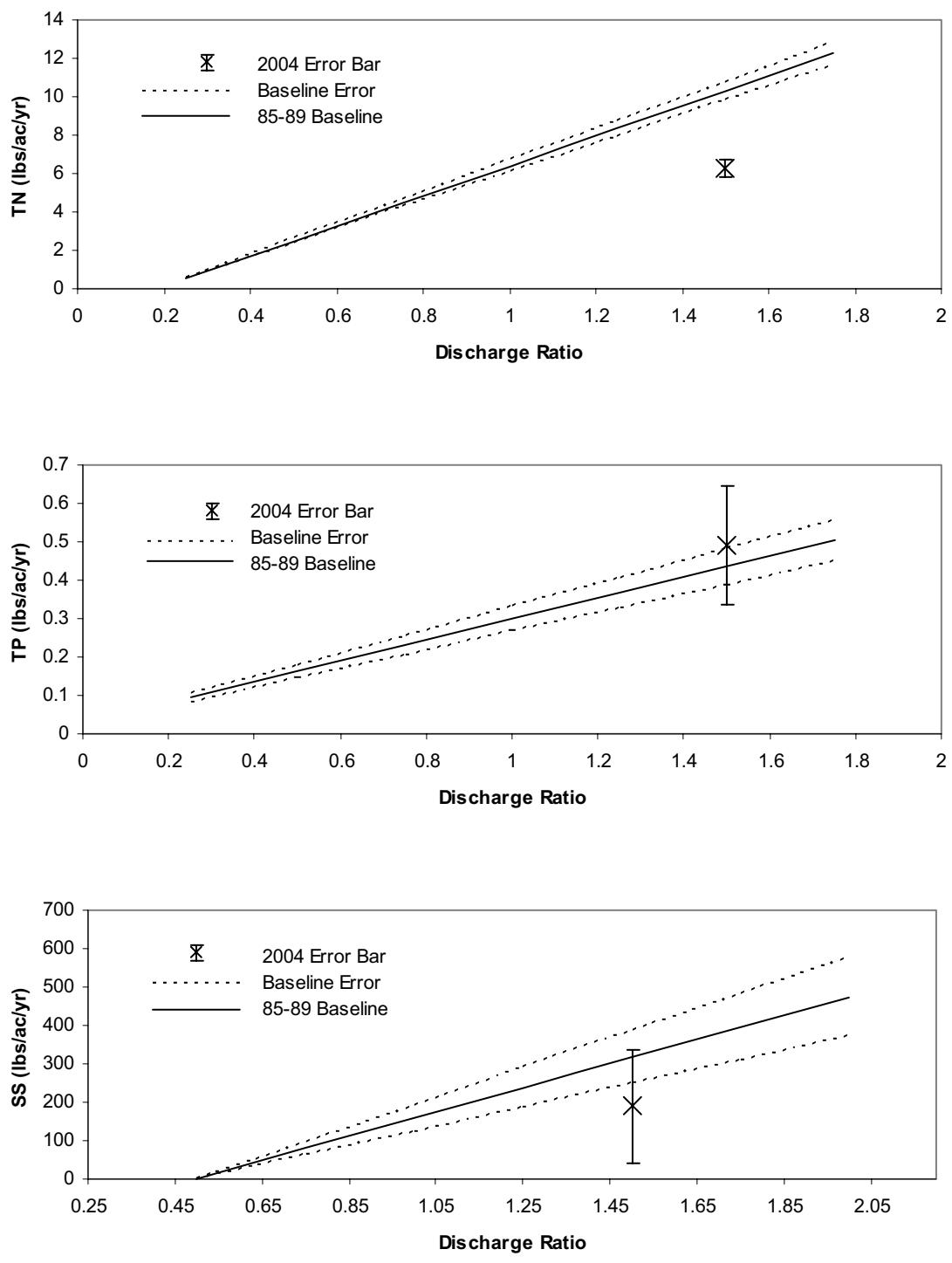


Figure 21. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, West Branch Susquehanna River at Lewisburg, Pa., 2004 Yield Compared to 1985-1989 Baseline

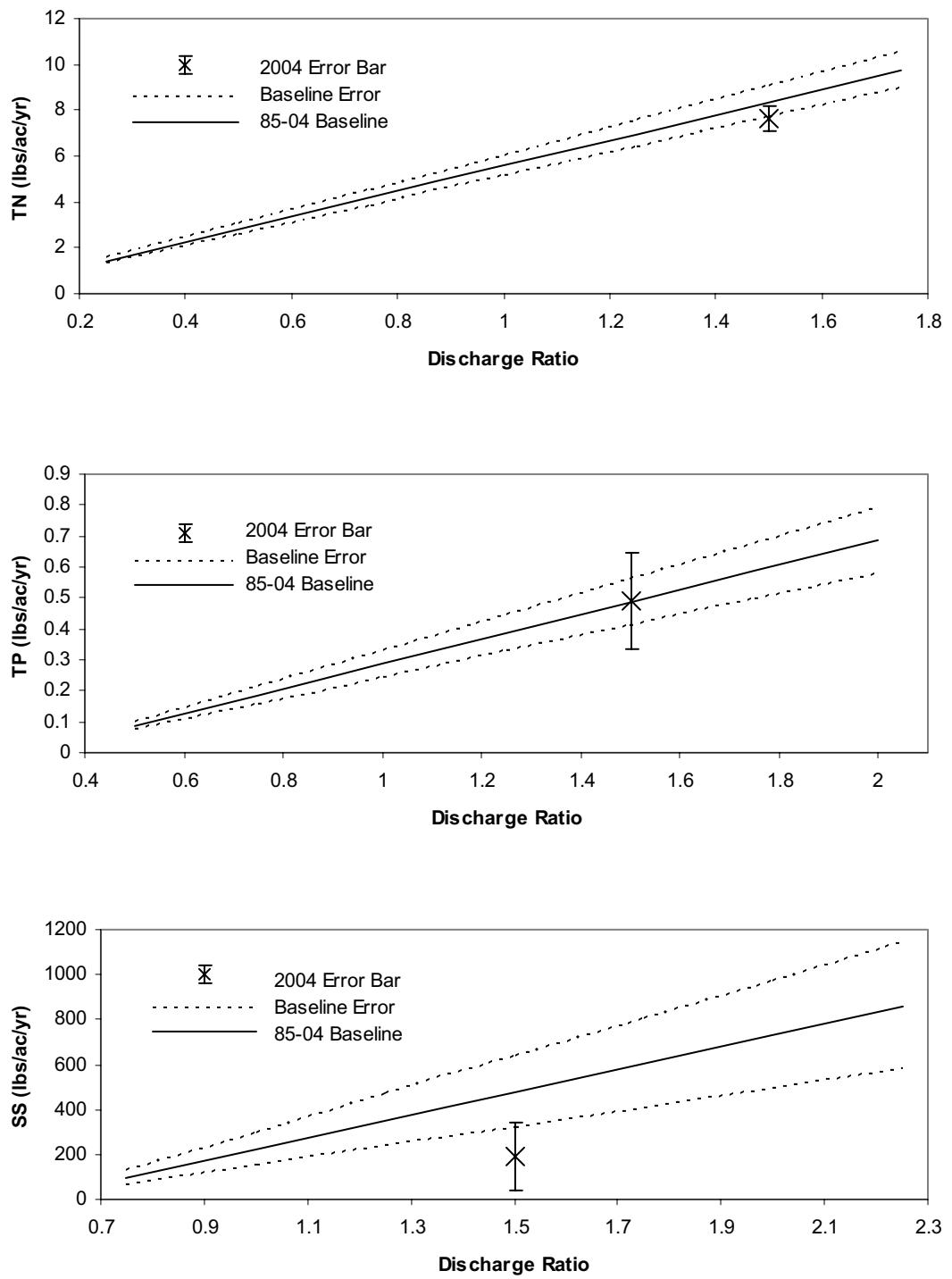


Figure 22. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, West Branch Susquehanna River at Lewisburg, Pa., 2004 Yield Compared to 1985-2004 Baseline

Juniata River at Newport, Pa.

The baselines for TN, TP, and SS for the Juniata River at Newport are shown in Figures 23 and 24 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 27 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial 5-year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = -0.2997 + 7.7349x \quad R^2 = 0.80$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.0762 + 0.4462x \quad R^2 = 0.96$$

Suspended Sediment (SS)

$$\text{SS Yield} = -294.17 + 490.39x \quad R^2 = 0.89$$

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = -0.2985 + 8.0374x \quad R^2 = 0.95$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.0064 + 0.3953x \quad R^2 = 0.67$$

Suspended Sediment (SS)

$$\text{SS Yield} = -149.52 + 387.12x \quad R^2 = 0.81$$

Susquehanna River at Marietta, Pa.

The baselines for TN, TP, and SS for the Susquehanna River at Marietta are shown in Figures 25 and 26 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 28 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial 5-year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = -0.8251 + 8.3195x \quad R^2 = 0.99$$

Total Phosphorus (TP)

$$\text{TP Yield} = 0.1393 + 0.2102x \quad R^2 = 0.27$$

Suspended Sediment (SS)

$$\text{SS Yield} = -97.695 + 344.91x \quad R^2 = 0.48$$

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = -0.3534 + 8.2514x \quad R^2 = 0.92$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.2151 + 0.7015x \quad R^2 = 0.78$$

Suspended Sediment (SS)

$$\text{SS Yield} = -328.92 + 682.71x \quad R^2 = 0.76$$

Table 27. Comparison of 2004 TN, TP, and SS Yields With Baseline Yields at Newport, Pa.

Parameter	Discharge Ratio	1985 – 1989 Baseline lb/ac/yr	1985 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.48	11.148	11.597	12.4
TP	1.48	0.584	0.579	0.73
SS	1.48	431.607	423.418	551.04

Table 28. Comparison of 2004 TN, TP, and SS Yields With Baseline Yields at Marietta, Pa.

Parameter	Discharge Ratio	1987 – 1991 Baseline lb/ac/yr	1987 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.497	11.629	12.0	10.79
TP	1.497	0.454	0.835	0.95
SS	1.497	418.635	693.097	955.12

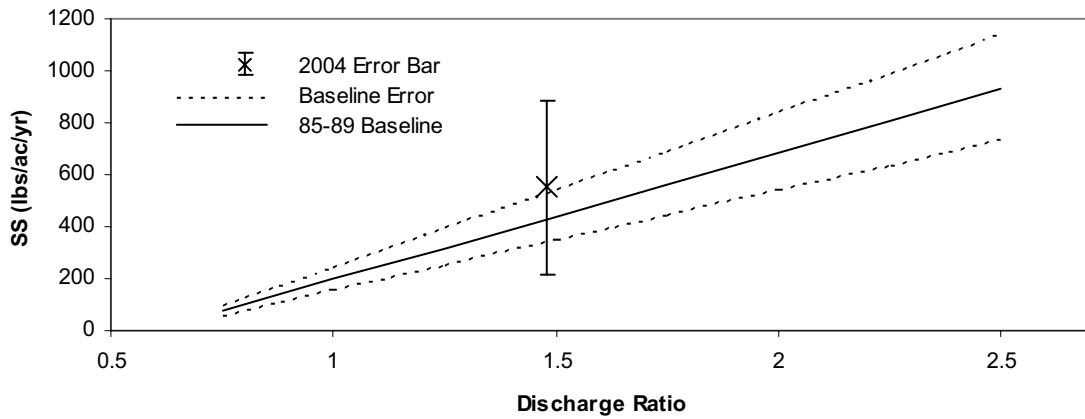
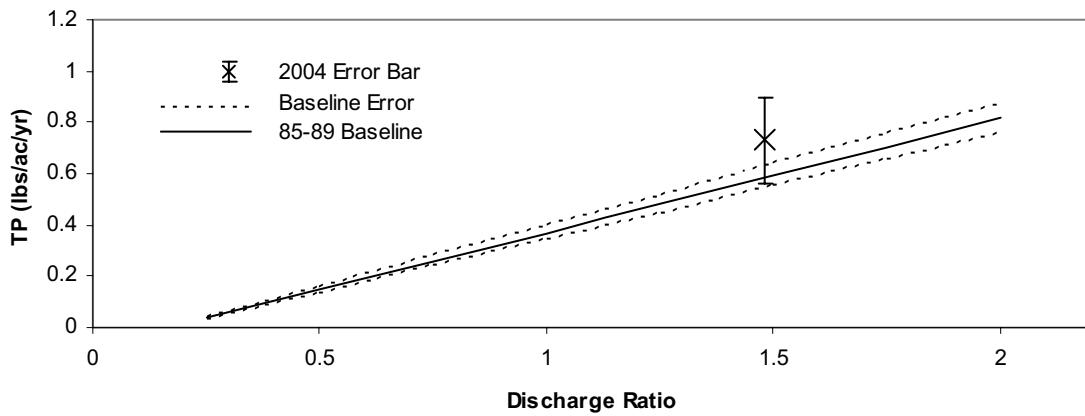
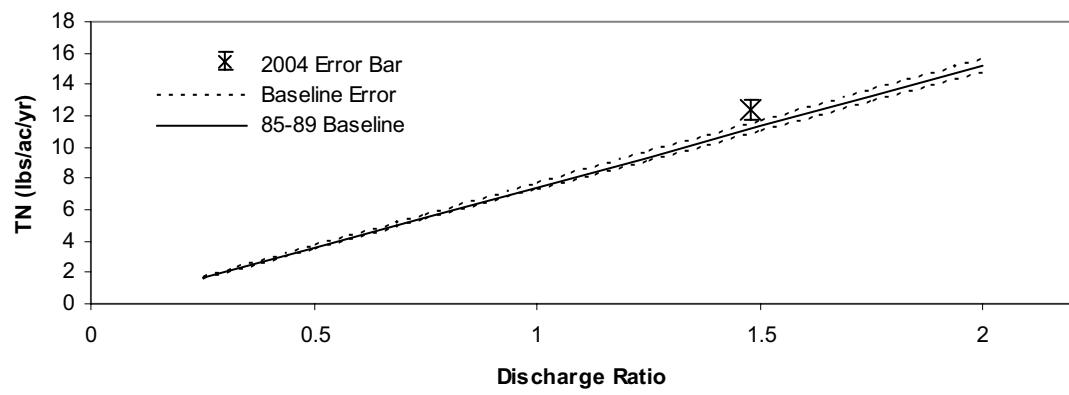


Figure 23. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Juniata River at Newport, Pa., 2004 Yield Compared to 1985-1989 Baseline

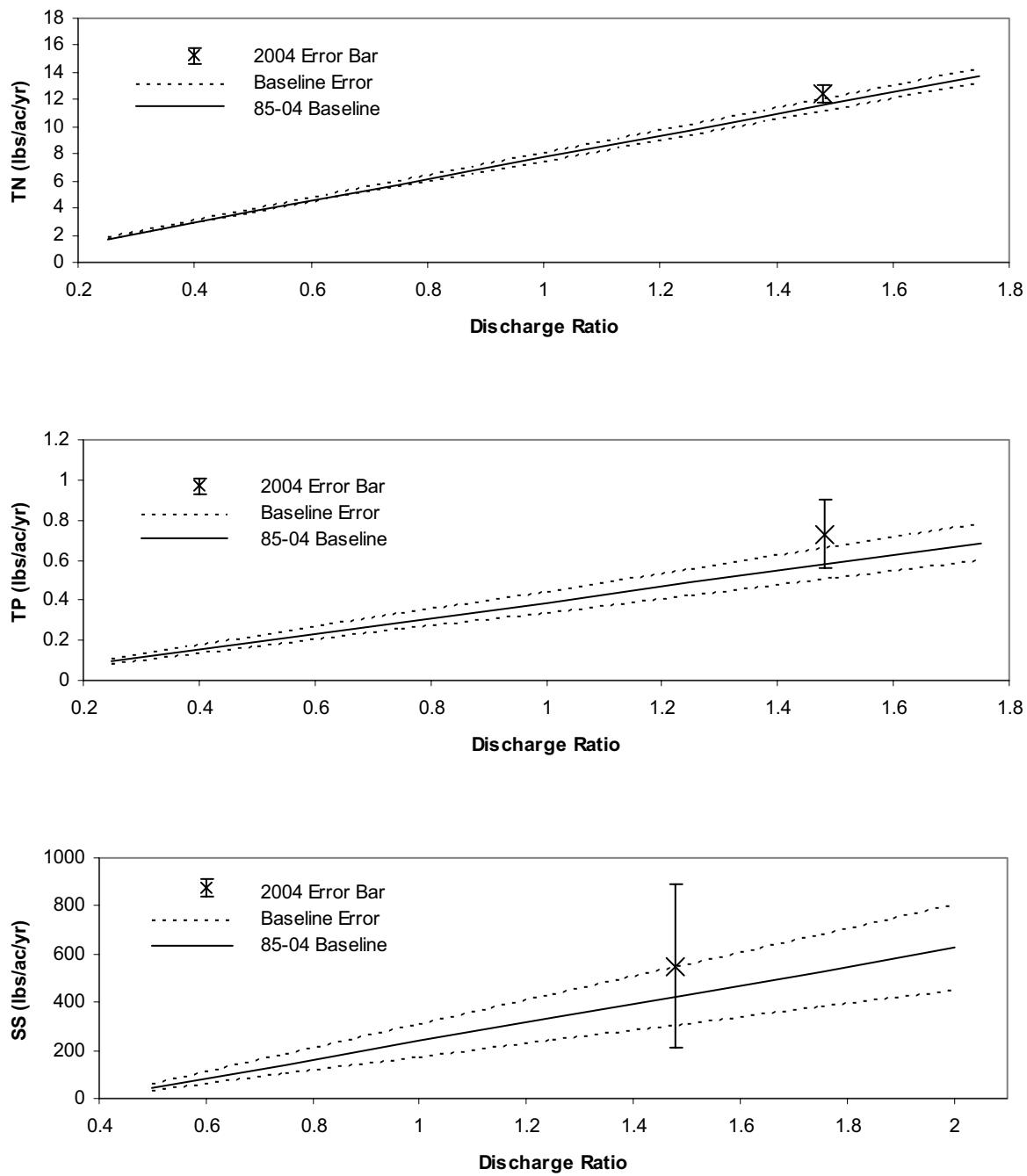


Figure 24. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Juniata River at Newport, Pa., 2004 Yield Compared to 1985-2004 Baseline

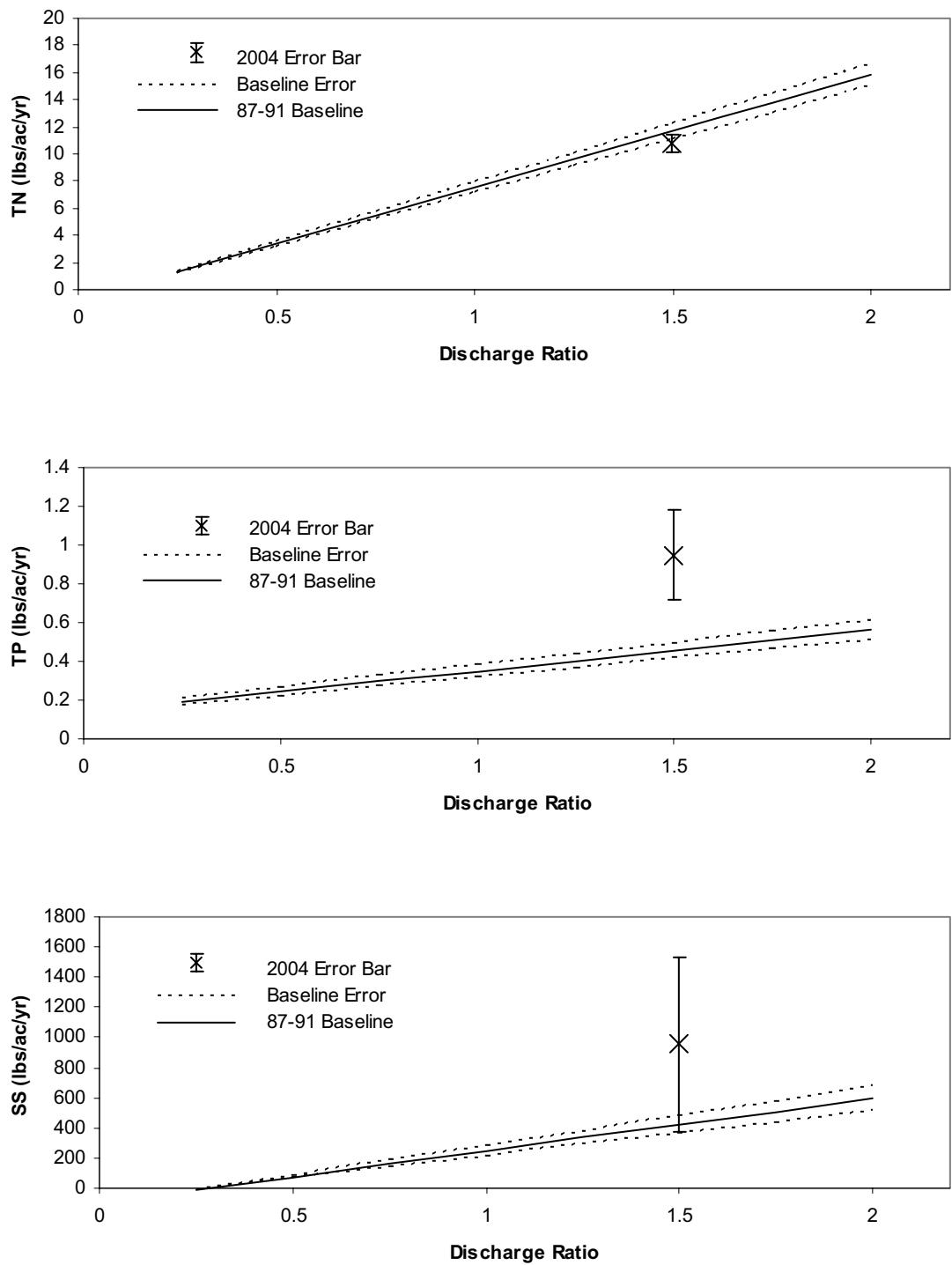


Figure 25. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Marietta, Pa., 2004 Yield Compared to 1987-1991 Baseline

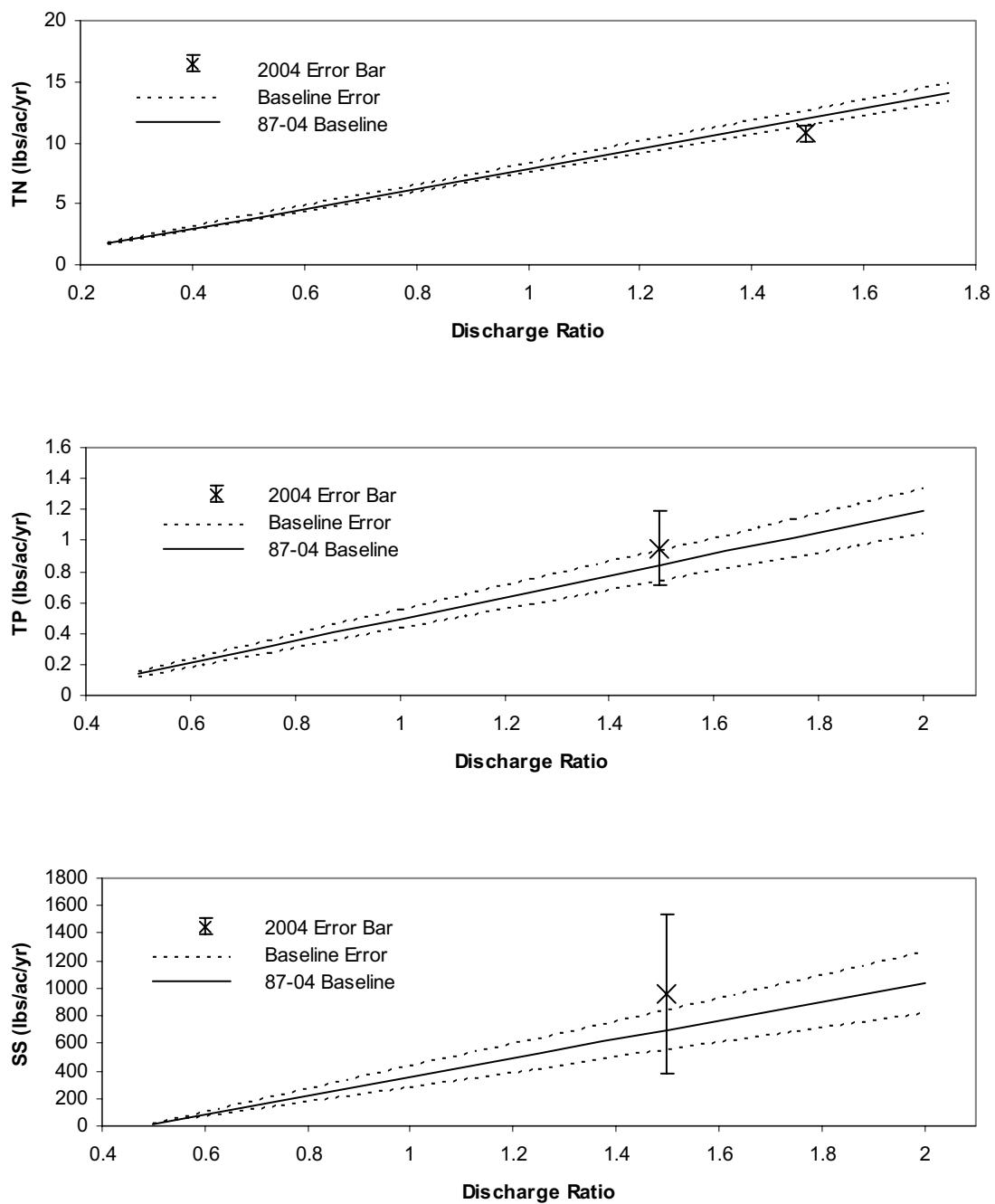


Figure 26. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Marietta, Pa., 2004 Yield Compared to 1987-2004 Baseline

Conestoga River at Conestoga, Pa.

The baselines for TN, TP, and SS for the Susquehanna River at Towanda are shown in Figures 27 and 28 with the 2004 annual yield. Actual 2004 and baseline yields are listed in Table 29 along with the discharge ratio. Best-fit lines were drawn through the data sets using the following equations:

Initial 5-year Baseline;

Total Nitrogen (TN)

$$\text{TN Yield} = 2.1988 + 33.479x \quad R^2 = 0.97$$

Total Phosphorus (TP)

$$\text{TP Yield} = 0.4272 + 1.9976x \quad R^2 = 0.67$$

Suspended Sediment (SS)

$$\text{SS Yield} = -614.08 + 1864.17x \quad R^2 = 0.72$$

2004 Baselines;

Total Nitrogen (TN)

$$\text{TN Yield} = 3.594 + 31.44x \quad R^2 = 0.96$$

Total Phosphorus (TP)

$$\text{TP Yield} = -0.6628 + 2.9425x \quad R^2 = 0.80$$

Suspended Sediment (SS)

$$\text{SS Yield} = -604.68 + 1682.7x \quad R^2 = 0.76$$

Table 29. Comparison of 2004 TN, TP, and SS Yields With Baseline Yields at Conestoga, Pa.

Parameter	Discharge Ratio	1985 – 1989 Baseline lb/ac/yr	1985 - 2004 Baseline lb/ac/yr	2004 lb/ac/yr
TN	1.761	61.155	58.959	56.98
TP	1.761	3.945	4.519	3.51
SS	1.761	2,451.29	2,358.56	1,868.2

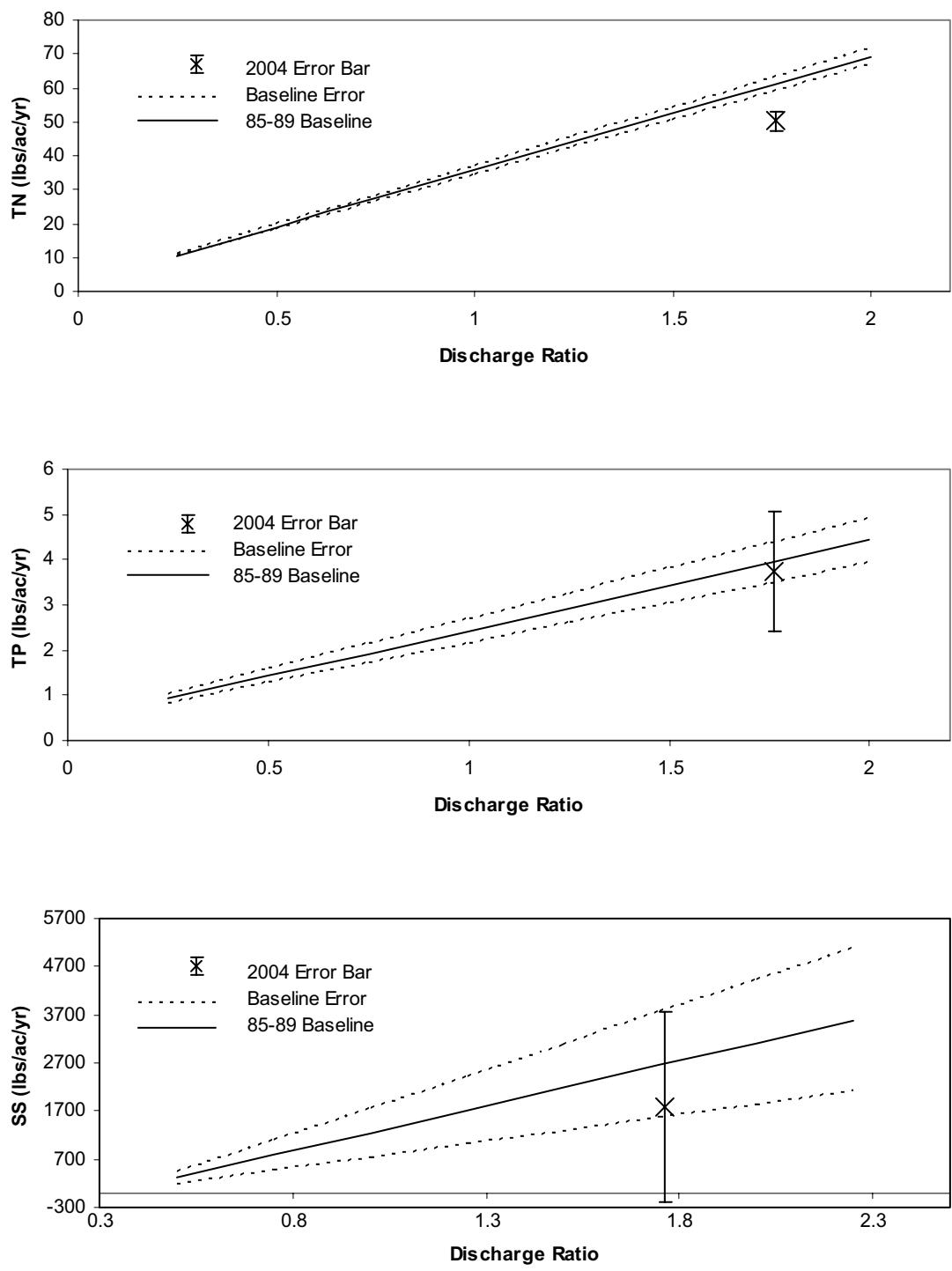


Figure 27. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Conestoga River at Conestoga, Pa., 2004 Yield Compared to 1985-1989 Baseline

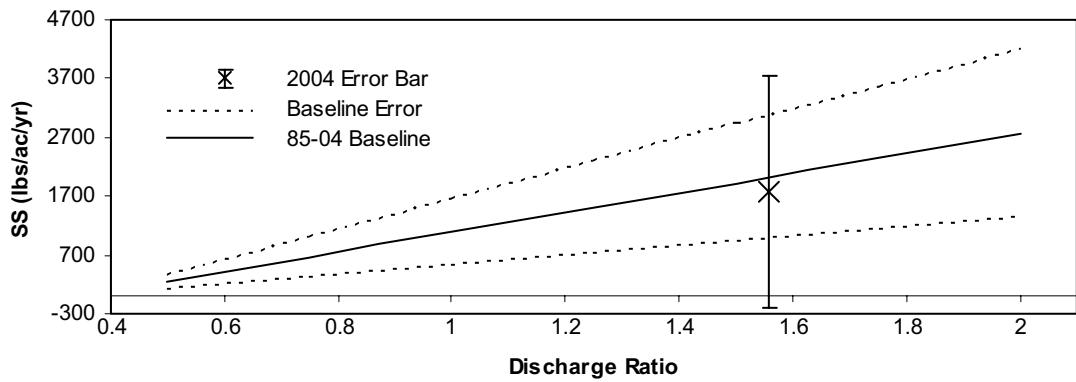
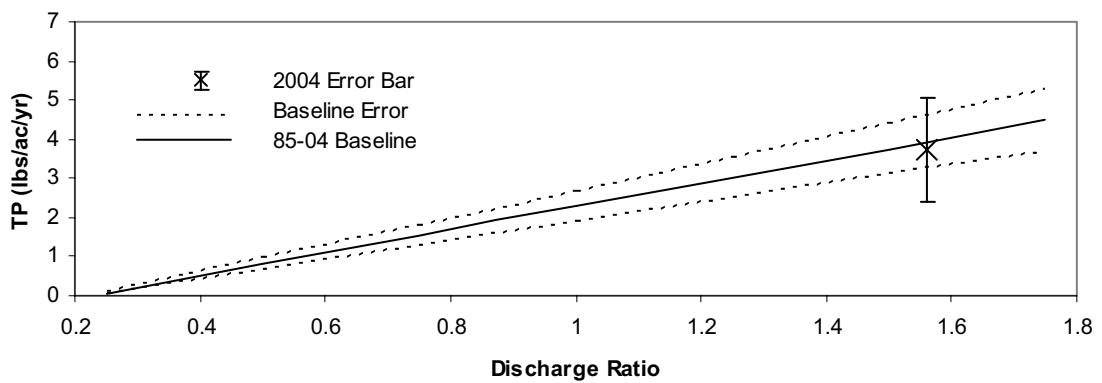
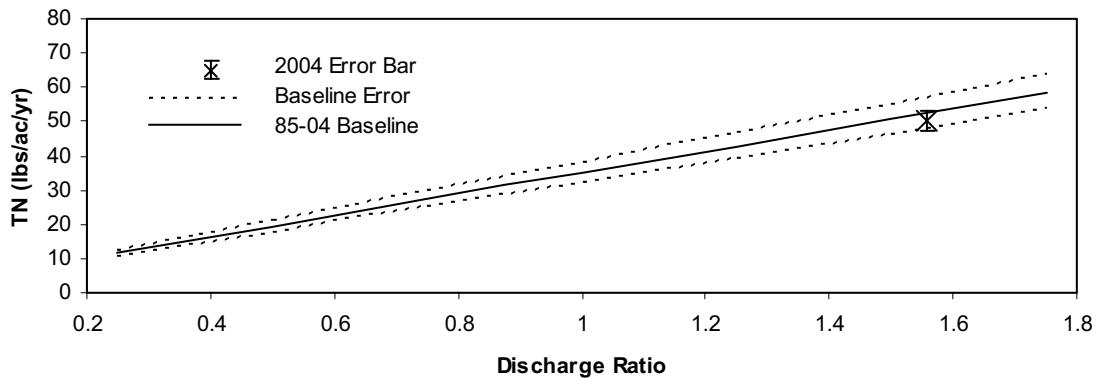


Figure 28. Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Conestoga River at Conestoga, Pa., 2004 Yield Compared to 1985-2004 Baseline