

---

**NUTRIENTS AND SUSPENDED  
SEDIMENT TRANSPORTED IN THE  
SUSQUEHANNA RIVER BASIN, 2003,  
AND TRENDS, JANUARY 1985  
THROUGH DECEMBER 2003**

*Publication No. 234*

*December 2004*

---

*Kevin H. McGonigal  
Water Quality Program Specialist*



Printed on recycled paper.

This report is prepared in cooperation with the Pennsylvania Department of Environmental Protection, Bureau of Water Quality Protection, Division of Conservation Districts and Nutrient Management, under Grant ME3521227.

# SUSQUEHANNA RIVER BASIN COMMISSION



Paul O. Swartz, Executive Director

Erin M. Crotty, N.Y. Commissioner  
Kenneth P. Lynch, N.Y. Alternate  
Scott J. Foti, N.Y. Alternate/Advisor

Kathleen A. McGinty, Pa. Commissioner  
Cathy Curran Myers, Pa. Alternate  
William A. Gast, Pa. Alternate/Advisor

Kendl Philbrick, Md. Commissioner  
Doctor Robert M. Summers, Md. Alternate  
Matthew G. Pajerowski, Md. Alternate/Advisor

Brigadier General Meredith W.B. Temple, U.S. Commissioner  
Colonel Robert J. Davis, Jr., U.S. Alternate  
Colonel Francis X. Kosich, U.S. Alternate  
Stacey E. Brown, U.S. Advisor

The Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact\* among the states of Maryland, New York, Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to coordinate the planning, conservation, management, utilization, development and control of basin water resources among the public and private sectors.

\*Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).

## TABLE OF CONTENTS

ABSTRACT .....	1
INTRODUCTION .....	1
Background.....	1
Objective of the Study .....	2
Purpose of Report.....	2
DESCRIPTION OF THE SUSQUEHANNA RIVER BASIN.....	2
NUTRIENT MONITORING SITES .....	4
SAMPLE COLLECTION AND ANALYSIS .....	6
PRECIPITATION.....	6
WATER DISCHARGE .....	7
ANNUAL NUTRIENT AND SUSPENDED-SEDIMENT LOADS AND YIELDS .....	7
SEASONAL WATER DISCHARGES AND NUTRIENT AND SUSPENDED-SEDIMENT LOADS AND YIELDS .....	16
COMPARISON OF THE 2003 LOADS AND YIELDS OF TOTAL NITROGEN, TOTAL PHOSPHORUS, AND SUSPENDED SEDIMENT WITH THE BASELINES .....	31
 Susquehanna River at Towanda, Pa. ....	31
Susquehanna River at Danville, Pa.....	34
West Branch Susquehanna River at Lewisburg, Pa.....	34
Juniata River at Newport, Pa. ....	39
Susquehanna River at Marietta, Pa.....	39
Conestoga River at Conestoga, Pa.....	44
 DISCHARGE, NUTRIENT, AND SUSPENDED-SEDIMENT TRENDS .....	47
SUMMARY .....	51
REFERENCES .....	53

## FIGURES

Figure 1. The Susquehanna River Basin, Subbasins, and Population Centers .....	3
Figure 2. Locations of Sampling Sites within the Susquehanna River Basin.....	5
Figure 3. Annual and Long-Term Discharges at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa. ....	8
Figure 4A. Annual Loads of Total Nitrogen (TN) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	13
Figure 4B. Total Nitrogen (TN) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	13
Figure 5A. Annual Loads of Total Phosphorus (TP) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	14
Figure 5B. Total Phosphorus (TP) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	14
Figure 6A. Annual Loads of Suspended Sediment (SS) at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	15

Figure 6B.	Suspended Sediment (SS) Yields at Towanda, Danville, Lewisburg, Newport, Marietta, and Conestoga, Pa., Calendar Year 2003 .....	15
Figure 7.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Towanda, Pa., Calendar Year 2003 .....	21
Figure 8.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Danville, Pa., Calendar Year 2003 .....	22
Figure 9.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Lewisburg, Pa., Calendar Year 2003 .....	23
Figure 10.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Newport, Pa., Calendar Year 2003 .....	24
Figure 11.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Marietta, Pa., Calendar Year 2003 .....	25
Figure 12.	Seasonal Discharges and Loads of Total Nitrogen (TN), Total Phosphorus (TP), Suspended Sediment (SS) at Conestoga, Pa., Calendar Year 2003 .....	26
Figure 13.	Comparison of Seasonal Yields of Total Nitrogen (TN) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa. ....	27
Figure 14.	Comparison of Seasonal Yields of Total Phosphorus (TP) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa. ....	28
Figure 15.	Comparison of Seasonal Yields of Suspended Sediment (SS) at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa. ....	29
Figure 16.	Seasonal Percent of Annual Load of Total Nitrogen, Total Phosphorus, and Suspended Sediment at Towanda, Danville, Marietta, Lewisburg, Newport, and Conestoga, Pa. ....	30
Figure 17.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Towanda, Pa., 1989-1993 and 2003 .....	32
Figure 18.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Towanda, Pa., 1989-2002 and 2003 .....	33
Figure 19.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Danville, Pa., 1985-1989 and 2003 .....	35
Figure 20.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Danville, Pa., 1985-2002 and 2003 .....	36
Figure 21.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, West Branch Susquehanna River at Lewisburg, Pa., 1985-1989 and 2003.....	37
Figure 22.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, West Branch Susquehanna River at Lewisburg, Pa., 1985-2002 and 2003.....	38
Figure 23.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Juniata River at Newport, Pa., 1985-1989 and 2003 .....	40
Figure 24.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Juniata River at Newport, Pa., 1985-2002 and 2003 .....	41
Figure 25.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Marietta, Pa., 1987-1991 and 2003.....	42
Figure 26.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Susquehanna River at Marietta, Pa., 1987-2002 and 2003.....	43
Figure 27.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Conestoga River at Conestoga, Pa., 1985-1989 and 2003.....	45
Figure 28.	Total Nitrogen (TN), Total Phosphorus (TP), and Suspended-Sediment (SS) Yields, Conestoga River at Conestoga, Pa., 1985-2002 and 2003.....	46

## TABLES

Table 1.	Land Use Percentages for the Susquehanna River Basin and Selected Tributaries .....	4
----------	---	---

Table 2.	Data Collection Sites and Their Drainage Areas.....	4
Table 3.	Water Quality Parameters, Laboratory Methods, and Detection Limits .....	6
Table 4.	Summary for Annual Precipitation for Selected Areas in the Susquehanna River Basin, Calendar Year 2003.....	7
Table 5.	Annual Water Discharge, Calendar Year 2003 .....	8
Table 6.	List of Analyzed Parameters, Abbreviations, and Storet Codes.....	9
Table 7.	Annual Water Discharges, Annual Loads, Yields, and Average Concentration of Total Nitrogen, Calendar Year 2003.....	9
Table 8.	Annual Water Discharges and Annual Loads and Yields of Total Phosphorus, Calendar Year 2003 .....	9
Table 9.	Annual Water Discharges and Annual Loads and Yields of Total Suspended Sediment, Calendar Year 2003 .....	9
Table 10.	Annual Water Discharges and Annual Loads and Yields of Total Ammonia, Calendar Year 2003 .....	10
Table 11.	Annual Water Discharges and Annual Loads and Yields of Total NO <sub>23</sub> Nitrogen, Calendar Year 2003.....	10
Table 12.	Annual Water Discharges and Annual Loads and Yields of Total Organic Nitrogen, Calendar Year 2003 .....	10
Table 13.	Annual Water Discharges and Annual Loads and Yields of Dissolved Phosphorus, Calendar Year 2003 .....	10
Table 14.	Annual Water Discharges and Annual Loads and Yields of Dissolved Orthophosphate, Calendar Year 2003 .....	11
Table 15.	Annual Water Discharges and Annual Loads and Yields of Dissolved Ammonia, Calendar Year 2003 .....	11
Table 16.	Annual Water Discharges and Annual Loads and Yields of Dissolved Nitrogen, Calendar Year 2003 .....	11
Table 17.	Annual Water Discharges and Annual Loads and Yields of Dissolved NO <sub>23</sub> Nitrogen, Calendar Year 2003 .....	11
Table 18.	Annual Water Discharges and Annual Loads and Yields of Dissolved Organic Nitrogen, Calendar Year 2003 .....	12
Table 19.	Annual Water Discharges and Annual Loads and Yields of Total Organic Carbon, Calendar Year 2003.....	12
Table 20.	Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS.....	17
Table 21.	Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Winter .....	17
Table 22.	Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Spring.....	17
Table 23.	Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Summer....	18
Table 24.	Comparison of 2003 Loads with 1996 Loads for Flow, TN, TP, and SS During Fall .....	18
Table 25.	Seasonal Mean Water Discharges and Loads of Nutrients and Suspended Sediment, Calendar year 2003.....	19
Table 26.	Seasonal Mean Water Discharge and Load Percentages of Nutrients and Suspended Sediment, Calendar year 2003.....	20
Table 27.	Comparison of 2003 TN, TP, and SS Yields with Baseline Yields at Towanda, Pa.....	31
Table 28.	Comparison of 2003 TN, TP, and SS Yields with Baseline Yields at Danville, Pa.....	34
Table 29.	Comparison of 2003 Total Nitrogen, Total Phosphorus, and Suspended-Sediment Yields With Baseline Yields at Lewisburg, Pa.....	34
Table 30.	Comparison of 2003 TN, TP, and SS Yields with Baseline Yields at Newport, Pa.....	39
Table 31.	Comparison of 2003 TN, TP, and SS Yields with Baseline Yields at Marietta, Pa.....	39
Table 32.	Comparison of 2003 TN, TP, and SS Yields with Baseline Yields at Conestoga, Pa.....	44
Table 33.	Trend Statistics for the Susquehanna River at Towanda, Pa., January 1989 through December 2003.....	48

Table 34.	Trend Statistics for the Susquehanna River at Danville, Pa., January 1985 through December 2003.....	48
Table 35.	Trend Statistics for the West Branch Susquehanna River at Lewisburg, Pa., January 1985 through December 2003 .....	49
Table 36.	Trend Statistics for the Juniata River at Newport, Pa., January 1989 through December 2003 .....	49
Table 37.	Trend Statistics for the Susquehanna River at Marietta, Pa., January 1987 through December 2003.....	50
Table 38.	Trend Statistics for the Conestoga River at Conestoga, Pa., January 1985 through December 2003.....	50
Table 39.	Summary of 2003 Data Comparison to Percentage of LTM, 1996 Loads, Initial 5-Year Baseline, and Full Program Baseline, and Trends in Flow-Adjusted Concentration for TN, TP, and SS.....	52
Table 40.	Summary of 2003 Flow-Adjusted Concentration Trends at all Sites.....	52

## **APPENDICES**

Appendix A:	2003 Storm Sampling Concentrations of Total Nitrogen, Total Phosphorus, and Suspended Sediment .....	55
-------------	--	----

## **ACKNOWLEDGEMENTS**

The author would like to acknowledge those who made important contributions to the completion of this project. Specific thanks to Susquehanna River Basin staff: Dave Heicher, Jen Hoffman, Susan Obleski, and Doreen McCabe for report review, comments, and input; Donna Gavin for GIS support; and Daryl Sitlinger for field support. Also thanks to Mike Langland of the U.S. Geological Survey for assistance with trends analysis. Finally, thanks to the Pa. Department of Environmental Protection for providing funding for the project.