SUSQUEHANNA RIVER BASIN COMMISSION

Nutrients and Sediment Monitoring Program

2009 Summary Report

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About the Program

From 1984 to 1989, SRBC conducted an initial 5-year nutrient monitoring program involving 14 sampling sites to establish a database for estimating nutrient (nitrogen and phosphorus) and suspended sediment loads in the Susquehanna basin. This initial effort, funded by the Pennsylvania Department of Environmental Protection and conducted as part of the Chesapeake Bay Restoration Program, consisted of monthly base flow sampling and periodic sampling during high flows.

The sampling network — consisting of sites on the mainstem Susquehanna, major tributaries and smaller watersheds to represent different land uses — was established to: collect the data needed to enable accurate allocation of nutrient and suspended sediment loads to the mainstem Susquehanna River reaches and to the major subbasins; and to provide a long-term nutrient and suspended-sediment database and loading data in sufficient detail to track and better define nutrient loading dynamics.

After the initial effort, the monitoring sites were reduced to the following six sites to continue evaluating trends from the major subbasins: Susquehanna River at Towanda, Pa. (to estimate loads from New York State); Susquehanna River at Danville, Pa.; Susquehanna River at Marietta, Pa.; West Branch Susquehanna River at Lewisburg, Pa.; Juniata River at Newport, Pa.; and Conestoga River at Conestoga, Pa. (to provide data from a major tributary watershed with intensive agricultural activity and increasing development).

The long-term monitoring at these six sites has allowed SRBC to determine whether conditions were improving (decreasing trends), staying the same, or becoming worse (increasing trends) over the years for nitrogen, phosphorus and suspended sediment loads. SRBC releases its findings annually.

Between 2004 and 2005, the U.S. Environmental Protection Agency provided funding to significantly expand SRBC's overall monitoring network to 23 sites in the basin (see map on page 2). These additional sites were added as part of the Chesapeake Bay Program's Non-tidal Monitoring Network. Additionally, the U.S. Geological Survey (USGS) conducts sampling at three other sites in the Susquehanna basin (see Figure 1).

This report summarizes the findings of the technical report *Nutrients and Suspended Sediment Transported in the Susquehanna River Basin, 2009, and Trends, January 1985 through December 2009*. Detailed information on monitoring sites, data collection and data analysis can be found in the full report and on the SRBC web site at *www.srbc.net/programs/CBP/nutrientprogram.htm*.

This summary report provides an overview of the following report findings:

Nutrient and Suspended Sediment Loads and Yields

— basic information on annual and seasonal loads and yields of nutrients and suspended sediment (SS) measured during calendar year 2009 at SRBC's six long-term monitoring sites;

Data Comparisons

— data comparisons with Long-Term Means (averages) and historical baseline datasets. Significant deviations from baselines indicate a change in annual yields that warrant further evaluation; and

Nutrient and Suspended Sediment Trends

— changes over time in the concentrations of nutrients and sediment found in waterways, taking into account the effects of flow.

Matthew Shank, SRBC Aquatic Biologist, reads and records water quality data from a portable sonde.

"The water quality improvements resulting from the implementation of best management practices throughout the Chesapeake Bay Watershed will appear first in the tributary streams and then ultimately be reflected in water quality and living resource improvements to the bay itself."

SRBC Contact: Kevin McGonigal
Environmental Scientist
kmcgonigal@srbc.net

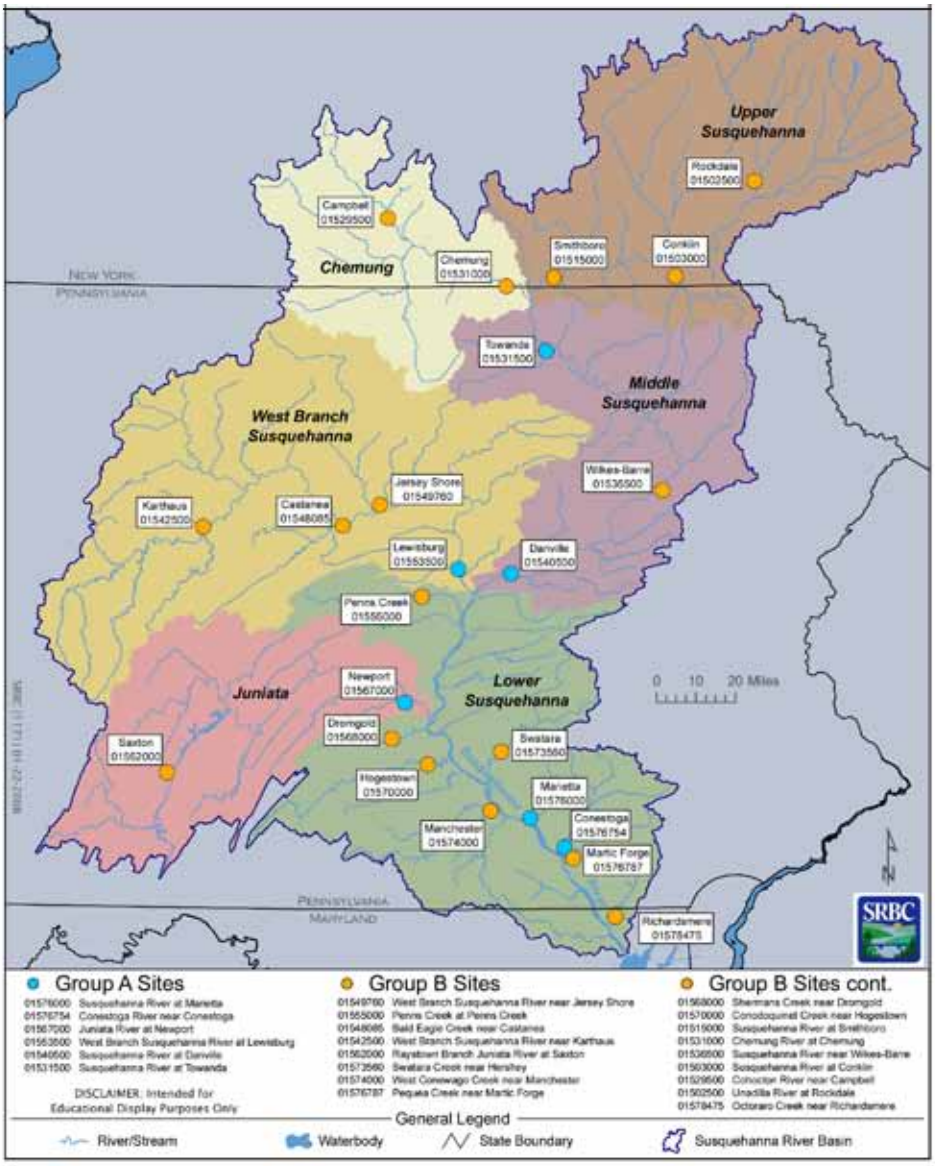
Susquehanna River Basin Commission
1721 N. Front St.
Harrisburg, PA 17102
Phone: (717) 238-0423
Fax: (717) 238-2436
www.srbc.net

SRBC's Nutrient and Sediment Monitoring Program is funded largely through grants from the U.S. Environmental Protection Agency and Pennsylvania Department of Environmental Protection.

Monitoring Locations

Data were collected from six sites on the Susquehanna River, three sites on the West Branch Susquehanna River and 14 sites on smaller tributaries in the basin. These 23 sites, selected for long-term monitoring of nutrient and SS transport in the basin, are shown in Figure 1. All sites have been co-located with USGS stream gaging stations to obtain discharge data.

Figure 1. Location of Sampling Sites within the Susquehanna River Basin



2009 Precipitation & Discharge Stats

- Precipitation for 2009 was above average at all Group A sites (except Lewisburg).
- Although precipitation rates were mostly above long-term mean (LTM) values, 2009 flow values were below the LTM (i.e., average) at all sites. This may be the result of lower rainfall during frozen ground months coupled with higher flows during spring and summer when ground infiltration and plant uptake are higher.

Terms to Know

Long-Term Mean (LTM) — the average of a set of numbers over a defined number of years

Water Discharge — volume rate of water flow which is transported through a given cross-sectional area, measured as cubic feet per second (cfs)

Flow-Adjusted Concentration (FAC) — concentration of a parameter in a waterway after the effects of flow are removed

Parameters Monitored

All water samples were analyzed for various species of Total Nitrogen (TN) and Total Phosphorus (TP), Total Organic Carbon (TOC) and Suspended Sediment (SS).

For Group A sites, two samples were taken each month: a fixed-date sample and a base flow sample. Samples were also drawn during high flow events, targeting one per season. At Group B sites, fixed-date samples were taken monthly in addition to two storm samples collected each quarter.

Kevin McGonigal, SRBC Environmental Scientist, samples water from the West Conewago Creek at Manchester in York County, Pa. All samples were collected by hand with USGS depth integrating samplers.

Nutrient and Suspended Sediment Loads & 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.

Loads and yields are calculated using the USGS ESTIMATOR model. This tool relates a constituent's concentration to water discharge, seasonal effects and long-term trends.

The full technical report includes tables that show the loads and yields for Group A monitoring sites, as well as the average annual concentrations for each constituent.

The full report also discusses monthly flows for each of the six long-term monitoring stations. Individual loads from historically similar flow months were compared with 2009 data, and seasonal variations at each of the stations are explored.

Key Findings: Loads & Yields

Annual loads for all parameters were below the LTM at all Group A sites except for dissolved phosphorus (DP), dissolved orthophosphate (DOP) and total organic carbon (TOC). DP and DOP were above the LTM at Towanda, Danville and Lewisburg. DOP and TOC were above the LTM at Newport.

Baseline Comparisons

Annual fluctuations in nutrient and suspended sediment loads make it difficult to determine whether the changes were related to land use, nutrient availability or annual water discharge. To make that determination, historical data sets are used to create baseline relationships between annual yields and water discharge.

This report used several different baselines: (1) 1985-1989 data; (2) the 5-year periods following the start of monitoring at stations initiated after 1987; (3) first half of the data set [1985-1996 data]; (4) second half of the data set [usually 1997 - 2009]; and (5) entire data set [1985-2009].

Key Findings: Baseline Comparisons

Using these baseline comparisons, SRBC scientists found lower than predicted yields in TN, TP and SS in 2009 for all sites, except for TP at Towanda and TP at Danville for the second half baseline comparison. Seasonal yields of TP at Towanda were higher than baseline predictions for all seasons. 2009 annual yields were dramatically lower than baseline predictions at Conestoga for TN, TP and SS.

Long-Term Trends

Trends for monthly mean flow and Flow-Adjusted Concentrations (FAC) were computed for the period January 1985 through December 2009 for flow, SS, TOC and several forms of nitrogen and phosphorus.

FAC trends represent the trends after the effects of flow have been removed and represent the concentration that relates to the effects of nutrient-reduction activities and other actions taking place in the watershed.

Load and trend analyses were unable to be completed at Group B sites because samples have not been collected at the stations for a sufficient number of years. Summary statistics for all sites are included in the full report.

Key Findings: Trends

TN, TP and SS trends improved at all sites during 2009, except for TP at Towanda, which had no significant trend (Figure 2 and Table 1). Upward trends were found at Towanda and Newport for DOP. The most southern site, Marietta, showed downward trends for all parameters except DOP, which had no significant trend due to more than 20 percent of the values being below the method detection limit. No significant trends were found for flow for the time period.

Figure 2. Flow-Adjusted Concentration Trends Through 2009

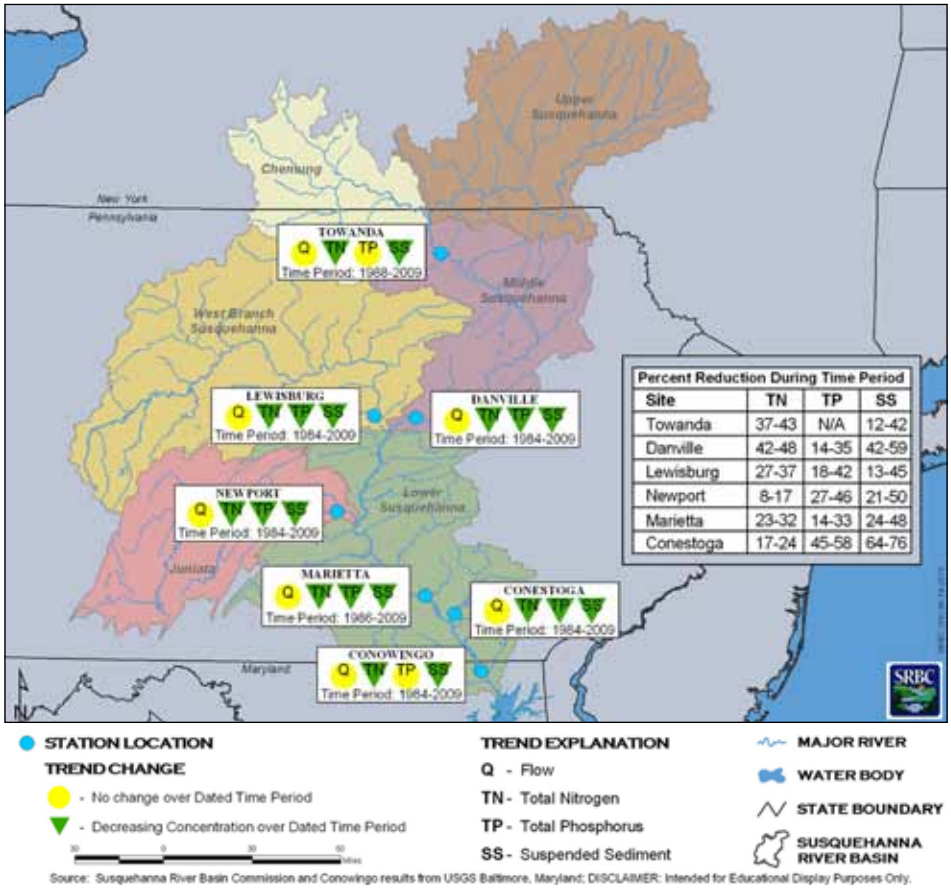


Table 1. 2009 Annual, Seasonal and Annual Long-Term Mean Precipitation (inches), Flow (cfs), Loads (in 1000's of pounds), Yields (lbs/ac/yr), Concentration (mg/L) and Trends for Total Nitrogen (TN), Total Phosphorus (TP) and Suspended Sediment (SS) at Long-Term Monitoring Sites

Parameter		Period	Towanda	Danville	Lewisburg	Newport	Marietta	Conestoga
Precipitation		2009	40.99	41.13	39.68	38.16	41.29	45.56
		LTM	38.41	39.07	41.52	36.49	39.9	42.83
Flow		2009	10,031	14,903	9,247	3,705	34,659	642
		LTM	11,755	16,492	10,785	4,372	38,933	676
Total Nitrogen	Load	Winter	6,838	10,771	5,577	2,560	29,276	1,586
		Spring	4,168	6,910	3,581	4,378	23,938	2,043
		Summer	2,011	3,589	1,864	838	11,603	1,387
		Fall	3,733	6,865	4,425	4,392	28,818	2,675
		2009	16,749	28,134	15,446	12,167	93,634	7,692
		LTM	27,453	43,105	23,280	16,132	128,759	10,288
	Yield	2009	3.36	3.92	3.53	5.67	5.63	25.57
		LTM	5.5	6	5.31	7.52	7.74	34.2
	Conc.+	2009	0.85	0.96	0.85	1.67	1.37	6.09
		LTM	1.19	1.33	1.1	1.86	1.68	7.73
	Trend	*	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Total Phosphorus	Load	Winter	679	872	294	55	1030	28
		Spring	454	640	204	201	1107	65
		Summer	293	423	117	45	640	68
		Fall	405	629	261	209	1391	132
		2009	1831	2564	876	512	4169	295
		LTM	2340	3584	1257	777	7555	656
	Yield	2009	0.367	0.357	0.2	0.238	0.251	0.981
		LTM	0.469	0.499	0.287	0.362	0.454	2.182
	Conc.+	2009	0.093	0.087	0.048	0.07	0.061	0.233
		LTM	0.101	0.11	0.059	0.09	0.099	0.493
	Trend	*	NS	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Suspended Sediment	Load	Winter	358,010	375,641	130,929	14,036	664,247	4,745
		Spring	148,998	233,944	57,176	95,627	627,549	20,523
		Summer	75,094	155,171	32,823	7,061	280,675	15,169
		Fall	105,575	229,083	98,603	97,293	849,782	47,530
		2009	687,675	993,839	319,530	214,017	2,422,253	87,968
		LTM	2,914,955	3,224,133	1,152,555	509,863	6,549,927	349,594
	Yield	2009	137	138	73	100	146	292
		LTM	584	449	263	238	394	1,162
	Conc.+	2009	34.8	33.9	17.6	29.3	35.5	69.6
		LTM	126	99.3	54.3	58.9	85.5	262.6
	Trend	*	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing

** Trend time periods: Towanda 1989-2009; Marietta 1987-2009; Lewisburg, Danville, Newport, and Conestoga 1985-2009.*
+ Concentrations are calculated using total annual discharge and annual load.