

FINDINGS OF THE
1989 SCENIC RIVERS WATER QUALITY
MONITORING PROGRAM

REPORT NO. 12 DRBC/NPS
COOPERATIVE MONITORING PROGRAM

DELAWARE RIVER BASIN COMMISSION
IN COOPERATION WITH THE NATIONAL PARK SERVICE

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Report prepared by the Delaware River Basin Commission staff, Gerald M. Hansler, Executive Director. Todd W. Kratzer was the principal author. Warren R. Huff managed data entry and retrieval with the EPA BIOS (STORET) system. Pauline A. Ditmars performed data entry for BIOS (STORET).

The 1989 Scenic Rivers Monitoring program was a cooperative effort between DRBC and two units of the National Park Service. Overall design and management of the program was performed by Todd W. Kratzer with assistance from Richard C. Albert of the Delaware River Basin Commission and Elizabeth A. Johnson and Malcolm Ross, Jr. of the Delaware Water Gap National Recreation Area and Upper Delaware Scenic and Recreation Area, respectively.

Persons who conducted field sampling or participated in special studies included Don Miller, Chris Halloran, Cyndie Faunce, Richard Albert, Todd Kratzer, and Warren Huff of DRBC; Laurie Richardson, Ann Baughman, and Linda Lohner of the DWGNRA; Paul Eriksson, Sam Fielding, and Joachim Hertle - Student Conservation Association volunteers; Johnna Johnson, Ruth Hartman, Kitt Groesbeck, Connie Lloyd, and Wanda Tibbett of the UDSRR; Cindy Rice of the U.S. Fish and Wildlife Service; Jim and Mary Rogers of the Delaware Valley Job Corps Center; and volunteers: Dick Gross, Barbara Yeaman, Tim Baltch, and Tammy Perkins. Interstitial water and water column nutrient analyses were performed by Hess Environmental Laboratories. Tom Gross performed the macroinvertebrate analyses.

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INTRODUCTION

This report presents the findings of the 1989 DRBC/NPS Scenic Rivers Water Quality Monitoring Program. The program is carried out cooperatively by the Delaware River Basin Commission (DRBC) and the National Park Service (NPS) in the Upper Delaware Scenic and Recreational River (UDSRR) and the Delaware Water Gap National Recreation Area (DWGNRA). The program monitors 112 miles of the Delaware River classified as National Wild and Scenic Rivers within the UDSRR and DWGNRA, and the intervening 8 miles. Also monitored are the more than 70 tributaries which flow into these reaches of the river.

The 1989 program was the sixth year of the cooperative DRBC/NPS monitoring program. The DRBC portion of the program, formerly the Upper Delaware Summer Limnological Program, has been conducted since 1969. The cooperative program operates under a quality assurance plan approved by the U.S. Environmental Protection Agency. Earlier reports of the program are listed on the back cover of this report.

The 1989 Scenic Rivers Monitoring Program targeted several objectives:

1. continue past baseline monitoring work which screens water quality at numerous Delaware River sites and tributaries;
2. continue the development of a water quality model for the DWGNRA;
 - A. BOD and nutrient transformation rate determinations;
 - B. channel and water surface elevation measurements;
3. conduct special studies including:
 - A. development of biological water quality criteria;
 - B. aquatic-plant density (biomass yield) determinations and nutrient relationships;
 - C. effects of wastewater discharges on macroinvertebrate populations; and
4. continue tributary flow gaging to construct stage/discharge curves for wastewater loading evaluations.

The 1989 DRBC/NPS Scenic Rivers Monitoring Program made approximately 600 station-visits to over 90 sites in the scenic rivers region. Figures 1 and 2 show the locations of these stations and Table 1 provides location descriptions. More than 490 of these station-visits were part of the baseline monitoring effort. In this effort, water quality data were collected at 72 sites for dissolved oxygen, water temperature, conductivity, fecal coliform and other parameters. Macroinvertebrates (aquatic insects) were collected at 10 sites: 5 in the UDSRR, 4 in the DWGNRA, and 1 in the intervening reach of the Delaware River. Macroinvertebrates serve as a surrogate for toxic analyses and an indicator of long-term changes in water quality.

Figure 1

Delaware Water Gap National Recreation Area Sampling Stations

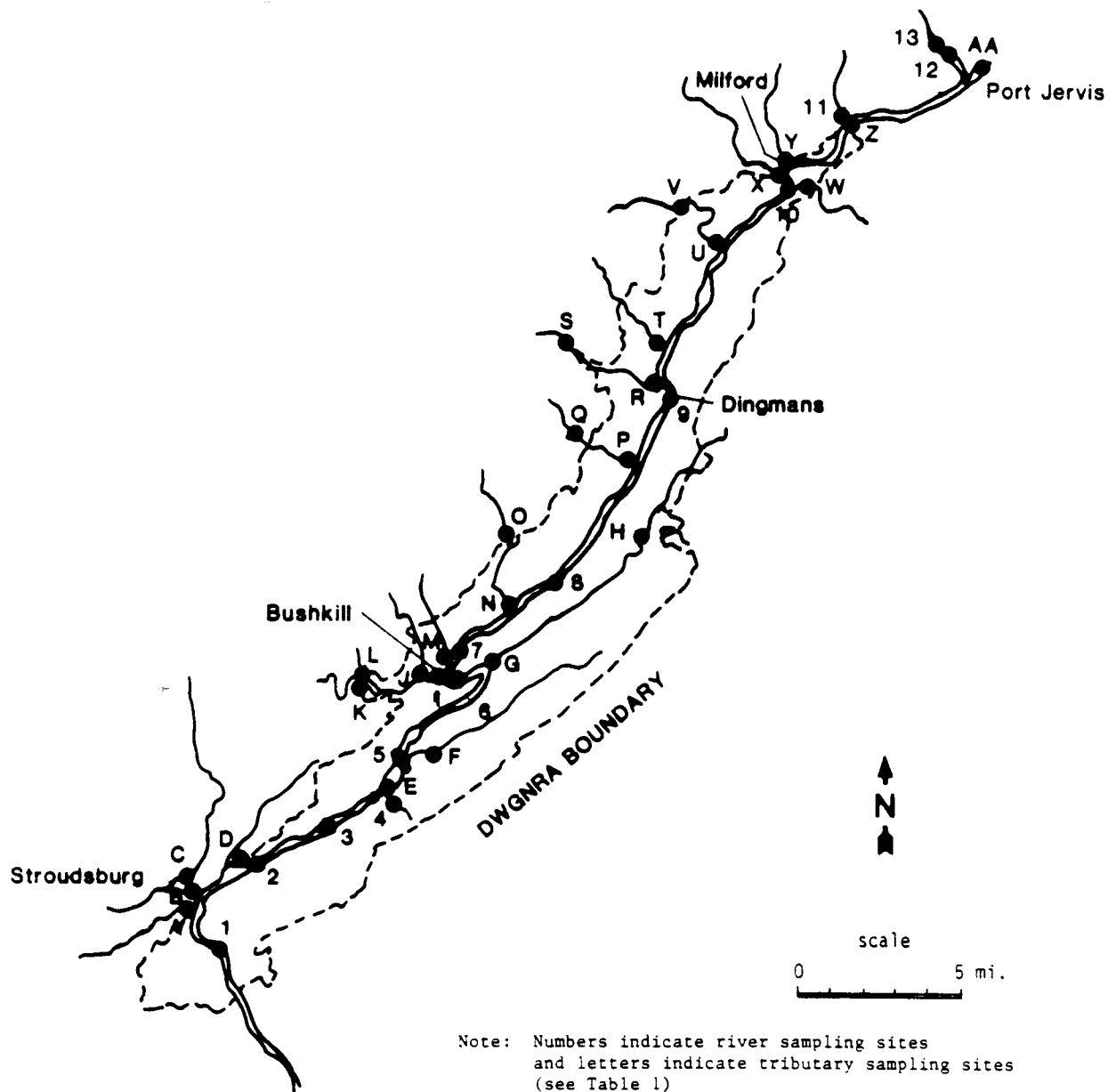
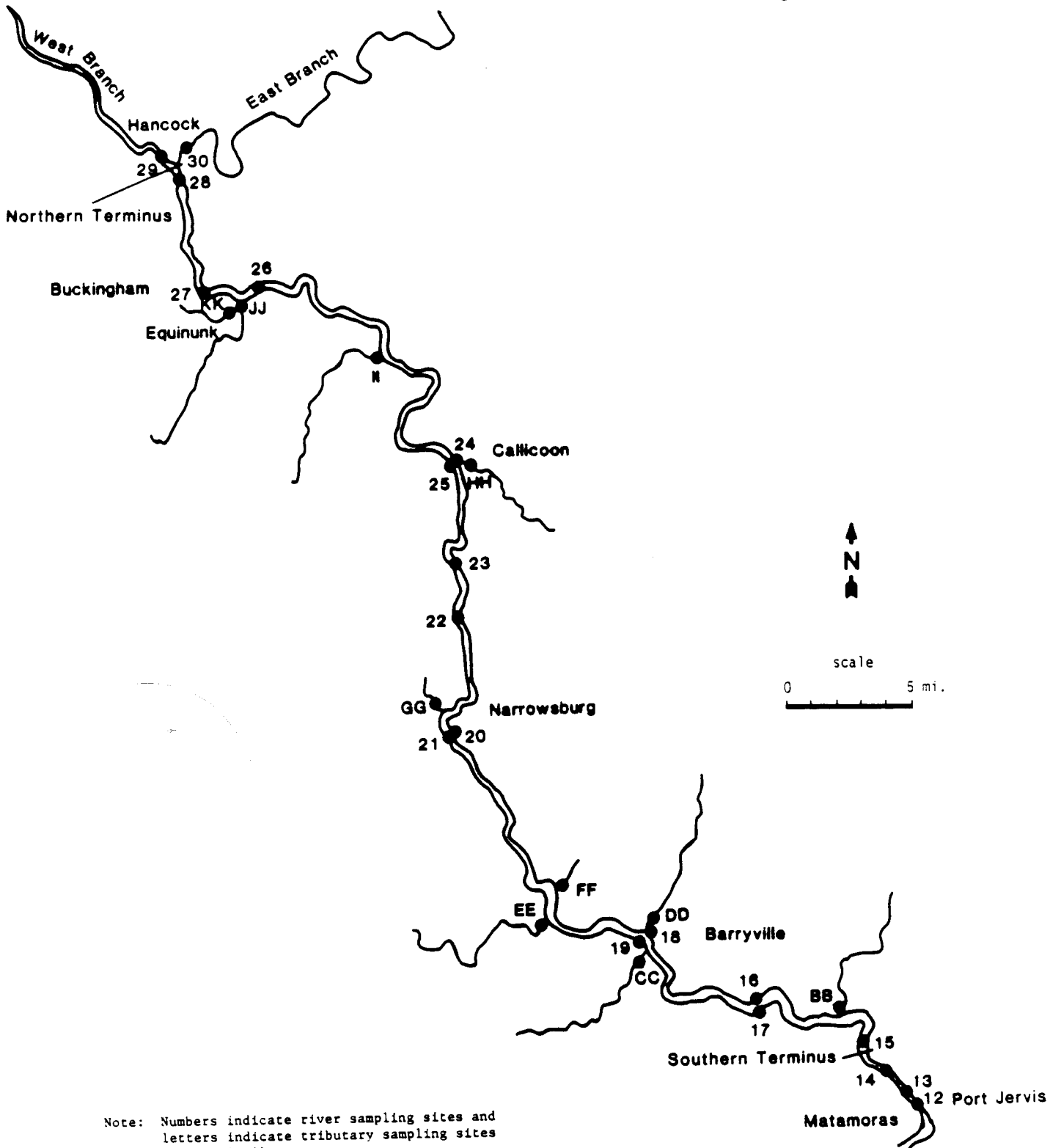


Figure 2

Upper Delaware Scenic and Recreational River Sampling Stations



Note: Numbers indicate river sampling sites and letters indicate tributary sampling sites (see Table 1)

Table 1

Map Key For Figure 1 and Figure 2

River Stations

Code Location

1	Delaware River at Kittatinny Access Area
2	Delaware River at Worthington Access Area
3	Delaware River at Smithfield Access Area
4	Delaware River at Poxono Access Area
5	Delaware River at Depew Access Area
6	Delaware River at Walpack Bend
7	Delaware River at Bushkill Access Area
8	Delaware River at Eshback Access Area
9	Delaware River at Dingmans Access Area
10	Delaware River at Milford Access Area
11	Delaware River at Northern DEWA (DNGNRA) Boundary
12	Delaware River at Port Jervis/Matamoras Bridge
13	Delaware River at Port Jervis Beach
14	Delaware River at Matamoras Access Area
15	Delaware River at Millrift
16	Delaware River at Pond Eddy (N.Y.)
17	Delaware River at Pond Eddy (PA)
18	Delaware River at Sholola/Barryville Bridge (N.Y.)
19	Delaware River at Sholola/Barryville Bridge (PA)
20	Delaware River at Narrowsburg Access Area (PA)
21	Delaware River at Narrowsburg Access Area (N.Y.)
22	Delaware River at Skinners Falls Access Area
23	Delaware River at Damascus Access Area
24	Delaware River at Callicoon Access Area (PA)
25	Delaware River at Callicoon Access Area (N.Y.)
26	Delaware River at Equinunk/Lordville Bridge
27	Delaware River at Buckingham Access Area
28	Delaware River Just Below E./W. Branch Confluence
29	E. Branch Delaware River at Hancock
30	W. Branch Delaware River at Hancock

Tributary Stations

Code Location

A	Cherry Creek Near Route 80 Bridge
B	Brodhead Creek at Route 402 Bridge
C	Marshall's Creek at Minisink Hills Bridge
D	Shawnee Creek at Resort Parking Lot
E	Pahaquarry Creek at Old Mine Road Bridge
F	Van Campens Brook at Old Mine Road Bridge
G	Flat Brook at Old Mine Road Bridge
H	Flat Brook at Walpack Center Bridge
I	Bush Kill at Route 209 Bridge
J	Little Bush Kill Near Bush Kill Confluence
K	Bush Kill at DEWA (DNGNRA) Boundary
L	Saw Creek Near Bush Kill Confluence
M	Denmark Creek at Route 209 Bridge
N	Toms Creek at Route 209 Bridge
O	Toms Creek at DEWA (DNGNRA) Boundary
P	Hornbeck Creek at Route 209 Bridge
Q	Hornbeck Creek at DEWA (DNGNRA) Boundary
R	Dingmans Creek at Route 209 Bridge
S	Dingmans Creek at DEWA (DNGNRA) Boundary
T	Adams Creek at Route 209 Bridge
U	Raymondskill Creek at Route 209 Bridge
V	Raymondskill Creek at DEWA (DNGNRA) Boundary
W	Shiners Brook at Route 521 Bridge
X	Sawkill Creek at Route 209 Bridge
Y	Vandermark Creek at Route 209 Bridge
Z	Cummins Creek
AA	Neversink River at Route 6 Bridge
BB	Mongaup River at Route 97 Bridge
CC	Sholola Creek at Railroad Bridge Near Delaware River Confluence
DD	Halfway Brook at Route 97 Bridge
EE	Lackawaxen River at Route 590 Bridge
FF	York Lake Falls at Route 97 Bridge
GG	Atco Creek at Route 652 Bridge
HH	Callicoon Creek at Route 97 Bridge
II	Little Equinunk Creek Near Delaware River Confluence
JJ	Equinunk Creek at Route 191 Bridge
KK	Factory Creek at Route 191 Bridge

FINDINGS

The 1989 monitoring program revealed satisfactory water quality at nearly all monitoring sites. Overall river and tributary water quality within the UDSRR and DWGNRA indicated good aquatic "health" conditions. There are, however, sites at which water quality had been previously degraded and are continuing to show lowered water quality at either the same or a lesser extent as was presented in the 1988 DRBC/NPS Scenic Rivers Monitoring Program. The majority of the 1988 water quality problems appear to have been reduced as evident in the 1989 data.

Baseline Monitoring

Water column samples were collected at 30 stations on the Delaware River and at 42 tributary stations. Samples were analyzed for air and water temperature, dissolved oxygen, pH, conductivity, and fecal coliform. Selected samples were also analyzed for fecal streptococcus, $\text{NO}_3 + \text{NO}_4$ nitrogen, $\text{NH}_3 + \text{NH}_4$ nitrogen, total orthophosphate, total phosphorus, and BOD_5 (5-day Biochemical Oxygen Demand). Air and water temperature, dissolved oxygen, pH, and conductivity were measured in the field. Fecal coliform, fecal streptococcus, $\text{NO}_3 + \text{NO}_4$ nitrogen, total orthophosphate, and BOD analyses were performed by DRBC and NPS personnel at the National Park Service laboratory in Milford, PA. Water column and interstitial water (water in sediment pore spaces) nitrogen and phosphorus concentrations from selected river sites were analyzed by Hess Environmental Laboratories as part of a special nutrient study (see Sediment Pore-Water and Water Column Nutrients section). Baseline monitoring data are entered into the Environmental Protection Agency (EPA) STORET computer system. Appendices A, B, C, and D present the data from the 1989 baseline monitoring.

Three river and 7 tributary stations showed variation from previous background water quality. These sites include Kittatinny Access (N.J.), Dingmans Access (PA), Milford Beach (PA), Northern DWGNRA Boundary (PA), Port Jervis/Matamoras Bridge (N.Y.), Narrowsburg Access (N.Y.), and Callicoon Access (N.Y.).

Nutrient and/or BOD values were uncommonly high at the Kittatinny, Dingmans, Milford, and Northern DWGNRA Boundary stations. Kittatinny Access showed a $\text{NH}_3 + \text{NH}_4$ (ammonia plus ammonium) nitrogen value of 0.69 milligrams per liter (mg/l), the highest value for this parameter at any station. Milford Beach also showed an elevated $\text{NH}_3 + \text{NH}_4$ nitrogen value of 0.65 mg/l. Ammonia becomes increasingly toxic to aquatic organisms as the concentration, pH, and water temperature increase. For example, based on the Environmental Protection Agency's (EPA) ammonia toxicity criteria, ammonia-nitrogen concentrations become toxic at levels exceeding 0.67 mg/l when the stream pH is 9.0 and the water temperature is 30 C. These pH and water temperature values are periodically attained during the summer months within the DWGNRA. However, these conditions were not concurrent when the ammonia-nitrogen samples were collected.

Dingmans Access and Milford Beach showed elevated values for BOD_5 : 1.72 and 1.50 mg/l, respectively. The Northern DWGNRA Boundary station exhibited the highest river values, of those stations sampled, for total phosphorus and $\text{NO}_3 + \text{NO}_4$ (nitrite plus nitrate) nitrogen. Respective values were 0.07 and 0.29 mg/l.

Geometric averages for fecal coliform levels (colonies/100 milliliters) sampled during dry weather at the Port Jervis/Matamoras Bridge and Callicoon Access sites were 197 and 167, respectively. These values present a respective 31 percent increase and 14 percent decrease for dry weather compared to 1988 values. Wet-weather fecal coliform data present a geometric average of 183 at the Port Jervis/Matamoras Bridge and a single value of 326 at the Callicoon Access station. Daily precipitation data were used to determine wet-weather conditions. These data for May thru September are presented in Appendix E. The Port Jervis/Matamoras Bridge wet weather data presents a 3 percent decrease compared to 1988. Fecal coliform standards for these sections of the Delaware River allow a geometric mean of 200 colonies/100 ml.

The factor(s) attributing to the lower fecal coliform levels at Callicoon Access is(are) uncertain, since no wastewater treatment facilities have been installed. The higher values found on the New York side of the Port Jervis/Matamoras Bridge arise from an apparent sewage discharge from a storm sewer pipe approximately 100 feet upstream of the bridge.

Narrowsburg Access (N.Y.) showed an average percent saturation of dissolved oxygen of 80.4 percent. The minimum dissolved oxygen value was 6.5 mg/l which is also the lowest daytime dissolved oxygen value recorded in 1989. Narrowsburg Access (PA side), by comparison, showed an average percent saturation of 95. All other river stations showed percent saturations above 90. Pre-1988 monitoring findings at this station (Upper Delaware Summer Limnological Program, Reports 1-10) show average percent saturations of dissolved oxygen above 90 percent. This indicates a local, ongoing, organic or nitrogen loading to the river from an undetermined source(s). Further investigation will be carried out in the 1990 monitoring program to determine the cause(s) of the lowered dissolved oxygen concentration at the Narrowsburg, NY sampling station.

Seven Delaware River tributaries showed elevated fecal coliform levels when compared to levels at other stations. Waterways that showed higher fecal coliform concentrations included Cherry Creek near the Route 80 bridge, Brodhead Creek at the Route 402 bridge, Shawnee Creek within the Shawnee Resort complex, Bushkill Creek at the Route 209 bridge, Saw Creek near the Bushkill confluence, Halfway Brook at the Route 97 bridge, and Callicoon Creek at the Route 97 bridge. The geometric means for Cherry Creek, Brodhead Creek, Shawnee Creek, and Saw Creek dry-weather fecal coliform results were 273, 406, 164, and 115 colonies per 100 milliliters, respectively. The Cherry Creek, Brodhead Creek, and Shawnee Creek values represent 81, 85, and 17 percent reductions compared to 1988 values. Geometric means for wet-weather fecal coliform values for Cherry Creek, Brodhead Creek, and Saw Creek were 317, 436, and 204, respectively. Compared to 1988 values, these represent 84 and 56 percent reductions for Cherry Creek and Brodhead Creek and a 16 percent increase for Saw Creek. Rain storms produced higher counts of fecal coliforms in many of the tributaries from runoff and sediment resuspension.

The dry- and wet-weather fecal coliform reductions in the tributaries may be partially or wholly attributable to new or modified wastewater treatment facilities that discharge to these streams. These facilities are now treating wastes that were historically untreated or treated to a lesser extent before being discharged. The Manwalamink Water Company Sewage Treatment Plant began the operation of a new unit in 1989 to serve the Shawnee Inn Development. This wastewater is now rerouted from Shawnee Creek to Brodhead Creek. Since September 1988, the new Delaware Water Gap Borough Council Sewage Treatment Plant has been operational and is treating sewage that had previously been untreated prior to discharge to Cherry Creek. Also, Brodhead Creek may now be receiving a higher quality effluent from the East Stroudsburg Borough Sewage Treatment Plant

since the plant has undergone an upgrade and expansion that was scheduled for completion in February 1989.

Halfway Brook and Callicoon Creek both showed elevated wet-weather fecal coliform values in the single samples collected at these sites: 690 and 1398 colonies per 100 milliliters, respectively. Past data show that both creeks receive wastewater discharges that contribute most of the fecal coliform.

Highest BOD₅ values were found at Cherry Creek (1.67 mg/l) and Shawnee Creek (1.55 mg/l). Although these values are higher than the single BOD₅ values from each of these sites in 1988, additional monitoring is warranted to determine the significance of these data.

Macroinvertebrates

Macroinvertebrates were collected at 10 Delaware River sites using a kick net. Macroinvertebrate data were entered into the EPA BIOS (STORET) computer system. Table 2 summarizes these 1989 macroinvertebrate data.

Macroinvertebrate population "health" was evaluated using three indices: the Shannon-Weiner diversity index, equitability, and the EPT index. These indices have been recommended as biological criteria for water quality in the Middle Delaware Scenic and Recreational River¹ and are expected to be applicable for the Upper Delaware Scenic and Recreational River as well. Proposed criteria for these indices within the DWGNRA are as follows:

1. a reach-wide mean Shannon-Weiner index of 3.6 with no more than 10 percent of the values below 3.0;
2. a reach-wide mean equitability of 0.8 with no more than 15 percent of the values below 0.6; and
3. a reach-wide mean EPT value of 13 with no more than 15 percent of the values below 10.0.

Individual site means should be at least 3.0, 0.6, and 10 for the Shannon-Weiner, equitability, and EPT indices, respectively.

Two of the 10 samples showed signs of degraded water quality. Kittatinny Access showed lower-than-normal values for the Shannon-Weiner and equitability indices, and Buckingham Access showed a below normal Shannon-Weiner index and low equitability and EPT values. Although

¹ See Recommended Biological Criteria For The Middle Delaware Scenic and Recreational River. Prepared by the Delaware River Basin Commission as part of the cooperative Commission/National Park Service Monitoring and Planning Program. January 1990.

Table 2

Summary: 1989 Macroinvertebrate Data

Station	Date	No. of Taxa	No. of Organisms	* SDI	Equitability	** EPT
1	8/14	20	1220	3.18	0.60	15
2	7/31	24	1072	3.67	0.75	16
3	7/31	26	1776	3.96	0.85	15
4	7/28	30	2096	3.85	0.70	21
5	7/28	27	1320	4.14	0.93	20
6	7/14	36	2312	4.16	0.72	24
7	7/27	25	1096	4.15	1.04	18
8	7/27	24	800	4.23	1.12	18
9	7/27	25	992	4.24	1.08	15
10	7/13	17	372	3.47	0.88	14
1	Delaware River at Kittatinny Access Area (N.J.)					
2	Delaware River at Smithfield Access Area (PA)					
3	Delaware River at Bushkill Access Area (PA)					
4	Delaware River at Milford Beach (PA)					
5	Delaware River at Matamoras Access Area (PA)					
6	Delaware River at Barryville Bridge (N.Y.)					
7	Delaware River at Narrowsburg Access Area (PA)					
8	Delaware River at Callicoon Access Area (N.Y.)					
9	Delaware River at Callicoon Access Area (PA)					
10	Delaware River at Buckingham Access Area (PA)					

* Shannon-Weiner Diversity Index

** Ephemeroptera, Plecoptera, and Trichoptera richness

Minimum index values representative of good water quality are 3.0, 0.6, and 10 for the Shannon-Weiner, Equitability, and EPT indices, respectively.

Kittatinny Access showed higher index values in 1988, prior years showed values similar to 1989. The Buckingham data are consistent with the 1988 findings. It is noted that both the New York and Pennsylvania sides of the Delaware River at Callicoon show improved biological populations over past years.

Tributary Flow Gaging

In 1989 the DRBC/NPS Scenic Rivers Monitoring Program performed 21 flow measurements at 13 flow gaging stations that were established on ungaged tributaries within the DWGNRA. Tributary flow data are presented in Appendix D. Flow measurements are required at these sites to construct stage/discharge relationships (also known as rating curves). The stage/discharge relationships will be used to determine wasteload allocations for each watershed during various flows and as inputs for the QUAL2EU water quality model hydraulics.

Special Investigations

During 1988 and 1989, several river and tributary sites revealed potential pollution problem areas and were evaluated with special investigations. Problem areas in 1988 that were again revisited in 1989 were the Masthope Development's sewage outfall into Falling Waters Creek and the raw sewage discharge from a multi-business complex that flows into Halfway Brook in the Town of Highland near Barryville, N.Y.. During the 1989 Scenic Rivers Monitoring Program a special investigation was conducted to determine the source(s) of high bacteria levels in the Delaware River just downstream of the Port Jervis/Matamoras Bridge.

Masthope Sewage Outfall

Falling Waters Creek is the discharge stream for the Masthope Development. The creek and the Delaware River upstream and downstream of the confluence were sampled twice in 1989, once on July 14 and once on August 16. Results show that the creek is continuing to be impacted by effluent with high fecal coliform counts. The July 14 creek sample had 4,900 fecal coliform colonies per 100 milliliters (colonies/100 ml) and the August 16 sample had 1,320 colonies/100 ml. These levels are less than 25 percent of the fecal coliform levels in 1988. River samples taken upstream and downstream of the creek confluence on these dates showed 25 and 33 colonies/100 ml, and 27 and 42 colonies/100 ml, respectively. Although the impact to the river is minimal due to its large dilution capacity, discharges to Falling Waters Creek require disinfection to reduce fecal coliform levels.

Halfway Brook Discharge

A follow-up sampling this year for a sewage discharge problem in Halfway Brook showed continued high levels of fecal coliform. This problem was initially encountered in 1987 and persisted through 1988. A sample taken at the outfall pipe from the multi-business complex on July 20 contained 9,600 fecal coliform colonies/100 ml and had a raw sewage odor. The New York Department of Environmental Conservation has been requested to investigate the problem.

Port Jervis Storm Sewer Discharge

The 1988 DRBC/NPS Scenic Rivers Monitoring Program added a new monitoring station on the New York side of the Route 209 (Port Jervis/Matamoras) bridge. Fecal coliform levels at this station during both the 1988 and 1989 monitoring programs showed high geometric means of 189 and 190 colonies/100 ml, respectively, with more than 54 percent of the values greater than or equal to 200 colonies/100 ml. Investigation of the contamination source in 1989 revealed an apparent sewage discharge from a storm sewer outfall pipe approximately 100 feet upstream of the Route 209 bridge on the Port Jervis shore. The pipe was continuously discharging debris and sewage during dry weather, unlike a storm sewer which is designed to drain runoff during wet weather. Dry-weather wastewater discharges, from storm or combined sewers, are in violation of the Delaware River Basin Commission's water quality regulations. The problem has been reported to the New York Department of Environmental Conservation.

SPECIAL SCENIC RIVERS PLANNING STUDIES

Several special studies were conducted to determine water quality impacts from nutrient-enriched and biologically-toxic loadings from wastewater treatment plant discharges. These studies incorporated water chemistry, hydraulics, aquatic plant density, and aquatic insect population measurements.

Sediment Pore-Water and Water Column Nutrients

Nutrient sources, especially phosphorus and nitrogen, are limited in natural waters. As the adjacent land use changes due to growth and development, point and nonpoint source discharges of nutrients increase. Aquatic plants absorb these chemicals and metabolize them for energy, growth, and reproduction. As nutrients become increasingly available, plant growth increases. In many cases these plant growths become very dense and can restrict water recreation and become detrimental to aquatic organisms due to the associated variations in dissolved oxygen and pH (see next section).

On August 9 and 10, five river transects were sampled for sediment pore-water (interstitial-water) and water column nutrients. The river sampling was conducted at Kittatinny, Smithfield, Dingmans, Milford, and the Northern DWGNRA boundary. Eight to 10 sediment samples were composited at each transect. These samples were collected with a cylindrical sampler that measured 8.25 centimeters in diameter by 4.13 centimeters in depth. Two water column samples were also composited at each transect. All samples were analyzed by Hess Environmental Laboratories for total phosphorus, total orthophosphate, $\text{NO}_3 + \text{NO}_4$ nitrogen, and $\text{NH}_3 + \text{NH}_4$ nitrogen. Interstitial water was centrifuged from the sediment samples and analyzed for unfiltered nutrients. All analytical methods were approved by the Environmental Protection Agency (EPA).

Water-column phosphorus levels were highest at the Northern DWGNRA boundary while water-column nitrogen concentrations were highest at the Kittatinny and Milford sites (as presented in the previous Baseline Monitoring section). Interstitial-water phosphorus was highest at the Milford site and interstitial-water nitrogen was higher at the Smithfield, Dingmans, and Milford sites. These data are presented in Table 3.

Table 3

Water Column and Interstitial Water Nutrients
For the Delaware River Within the DWGNRA

Location	Date	Total-P as P (mg/l)	Total Ortho-P as P (mg/l)	NO2+NO3 as N (mg/l)	NH3+NH4 as N (mg/l)	Sample Type *
Delaware River @ Northern DWGNRA Boundary, PA & NJ	8/10/89	0.07	0.03	0.29	0.11	WC
	8/10/89	0.04	< 0.01	< 0.01	0.49	Int
Delaware River @ Milford Beach, PA & NJ	8/10/89	< 0.01	< 0.01	0.23	0.65	WC
	8/10/89	0.22	0.09	0.69	0.73	Int
Delaware River @ Dingmans Access, PA & NJ	8/10/89	< 0.01	< 0.01	0.25	0.19	WC
	8/10/89	0.09	< 0.01	0.52	1.14	Int
Delaware River @ Smithfield Access, PA & NJ	8/09/89	< 0.01	< 0.01	0.18	0.39	WC
	8/09/89	0.15	< 0.01	0.33	1.03	Int
Delaware River @ Kittatinny, PA & NJ	8/09/89	< 0.01	< 0.01	0.20	0.69	WC
	8/09/89	0.14	0.01	0.08	1.17	Int

* WC = Water Column sample

Int = Interstitial Water sample

Based on the 1988 diurnal studies, plant productivity is greatest in the river reach from the Northern DWGNRA boundary to Milford and at Kittatinny. Therefore, the 1989 nutrient results indicate either 1) an aquatic plant preference for water column nutrients, and/or 2) phosphorus may be a limiting nutrient for plant growth. A follow-up study is warranted to delineate these possibilities.

Aquatic Plant Biomass Study

Inputs of nutrients, primarily phosphorus and nitrogen, within a waterway yielding low concentrations of nutrients, may increase aquatic plant growth rates and existing plant bed densities several times. Consequently, excessive plant growths may cause large variances in dissolved oxygen concentrations and pH due to plant photosynthesis and respiration. Extreme variances in dissolved oxygen and pH are detrimental to many aquatic organisms. To determine the current aquatic plant densities (biomass yield), a trial biomass measurement study was conducted on August 16 and 17 which is during the period of peak biomass production. The study comprised the reach of the river between the Northern DWGNRA boundary, and the Route 206 bridge near Milford, PA. Plant bed areal coverage and densities were measured for the three dominant rooted aquatic plants: Elodea, Potamogeton, and Vallisneria. Table 4 shows biomass densities, areal coverage, and total biomass for each type of aquatic plant for 4 regions of the study reach. Total biomass increased in a downstream direction. Elodea was the most prevalent of the three plants in each section of the study reach.

Further studies are necessary to determine plant densities in the remainder of the river reach within the DWGNRA. Biomass measurements will be conducted every 3 to 4 years to note changes in plant productivity associated with nutrient loadings. These data will be used to determine limiting nutrient concentrations in both the interstitial water and water column which promote excessive plant blooms.

Lower Bushkill Creek Watershed Macroinvertebrate Study

A special macroinvertebrate study was performed cooperatively by the Delaware River Basin Commission, the National Park Service, and the U.S. Fish and Wildlife Service on the Lower Bushkill Creek Watershed. On August 1 and 2, macroinvertebrate and chemical and physical water analyses were performed upstream and downstream of the Middle Smithfield (formerly Fernwood) and Saw Creek (Stoney Hollow) wastewater treatment plant discharges; at the mouth of Bushkill Creek; and upstream of the Saw Creek confluence in Bushkill Creek. Macroinvertebrate populations, air and water temperature, dissolved oxygen, BOD, pH, conductivity, and fecal coliform levels were analyzed. On site physical measurements included channel width, water depth and velocity, and distance upstream or downstream of discharges. Results will be presented in a separate report.

Water Quality Model Input Studies

Specific input parameters for the QUAL2EU water quality model were defined in 1989 through special studies.

Table 4

Biomass: Northern DWGNRA Boundary To Route 206 Bridge

Reach	Plant Genus	Avg. Density (g/sq ft)	Approximate Bedded Area (sq ft)	Approximate Biomass (grams)
Upstream end of unnamed island at Northern DWGNRA boundary to downstream end Mashipacong Island (River Miles 250.8 to 249.3)	Elodea	15.11	12,158	183,673
	Potamogeton	12.28	3,172	38,946
	Vallisneria	13.21	2,759	36,447
	Total Reach Biomass =			259,066
Downstream end Mashipacong to upstream end Quicks Island (River Miles 249.3 to 248.8)	Elodea	12.77	43,697	557,848
	Potamogeton	4.48	7,593	34,039
	Vallisneria	7.01	14,029	98,295
	Total Reach Biomass =			690,182
Upstream end Quicks Island to Sawkill Cr. confluence (River Miles 248.8 to 247.0)	Elodea	23.11	174,880	4,040,810
	Potamogeton	6.96	113,600	790,592
	Vallisneria	IA	IA	-----
	Total Reach Biomass =			4,831,402
Sawkill Cr. confluence to Route 206 Bridge (River Miles 247.0 to 246.0)	Elodea	23.11	116,640	2,695,106
	Potamogeton	17.39	42,320	736,032
	Vallisneria	IA	IA	-----
	Total Reach Biomass =			3,431,138

IA = Insignificant Amount

Channel and water surface elevations were surveyed to verify U.S.G.S. topographic map and Army Corps of Engineer elevations at several locations in the DWGNRA reach of the Delaware River. Elevations were measured during low flow at the upstream end of Arrow Island, Kittatinny Access, Bushkill Access, Dingmans Access, Milford Beach, Route 84 bridge, and the Route 209 (Port Jervis/Matamoras) bridge. All surveyed water surface elevations were within 1 percent of interpolated topographic map elevations. These water surface elevations are used to determine slopes for the water quality model hydraulics.

Orthophosphate, $\text{NO}_3 + \text{NO}_2$ nitrogen, and $\text{NH}_3 + \text{NH}_4$ nitrogen were sampled from Port Jervis Beach to Bushkill Access on June 27. These same parameters were again sampled from Port Jervis Beach to the Northern DWGNRA boundary on August 30. Changes in concentrations (decreasing from upstream to downstream) allows the computation of decay (or transformation) coefficients for input to the water quality model. However, since the existing concentrations of these parameters in the river are low, the results are invalid due to the limited detection sensitivity of the analytical equipment. Therefore, additional sampling from Port Jervis Beach to Kittatinny Access, with the use of more sensitive analyses, is required to accurately depict the decay coefficients.

Five-day and 20-day BODs were also measured from the Route 209 bridge to Milford Beach and will be used with baseline BOD data to compute decay coefficients for use in the water quality model.

Nutrients and BODs were analyzed during the Lower Bushkill Watershed Macroinvertebrate Study. These results will be included in the study report.

SUMMARY

The 1989 DRBC/NPS Scenic Rivers Monitoring Program evaluated water quality at numerous river locations and various tributaries. In addition, the program conducted several special studies for the development of a DWGNRA water quality model, for the initiation of nutrient/aquatic plant productivity relationships, and for an evaluation of aquatic macroinvertebrate population shifts downstream of wastewater treatment plant discharges. Overall, water quality was found to be good to excellent at most sampling sites with many problem sites showing substantial improvement relative to 1988. Water quality problems were noted, however. These ranged from persistent problems which have been noted in previous years to problems which may be emerging as the result of human activities in the scenic rivers area.

LIST OF ABBREVIATIONS

DEWA - Delaware Water Gap National Recreation Area, more commonly referred to as DWGNRA

K - Actual value is less than value given

L - Actual value is greater than value given

APPENDIX A

**Delaware River Baseline Monitoring Data:
Selected Water Chemistry and Bacterial Parameters
Air Temperature, Water Temperature,
Dissolved Oxygen, pH, Conductivity,
and Fecal Coliform**

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Kittatinny Access Area, NJ - River Mile 211.5								
5/25	1110	23.0	16.0	9.0	91	7.00	59	80
6/12	1230	28.0	20.0	8.6	95	7.00	65	36
6/19	1307	27.0	20.0	8.5	94	7.00	55	52
6/26	1350	27.0	22.0	8.0	92	7.00	71	36
7/03	1125	26.0	22.0	8.5	97	6.75	86	92
7/10	1135	24.0	23.5	8.7	104	7.00	80	55
7/19	0935	21.1	22.0	7.7	88	6.75	93	292
7/25	1237	31.0	25.0	8.4	102	7.00	84	72
8/07	1125	21.0	25.0	6.4	78	7.00	90	152
8/09	1130	19.0	22.5	8.8	102	7.00	110	
8/21	1128	25.5	22.5	7.5	87	7.00	110	56

Delaware River at Worthington Access Area, NJ - River Mile 214.8

5/25	1045	21.0	18.0	9.1	96	6.50	59	
6/12	1250	24.0	19.0	8.8	95	7.00	60	40
6/19	1208	30.0	19.0	8.8	95	7.00	55	40
6/27	0900		21.0	7.9	89	6.75	72	48
7/03	1150	26.0	23.0	9.7	113	7.50	82	36
7/10	1150	25.0	23.5	9.6	113	7.25	80	68
7/19	1010	23.3	22.0	8.8	101	7.00	91	30
7/25	1320	25.0	25.5	8.8	108	7.25	82	148
8/07	1155	22.0	25.0	8.5	103	7.00	88	22
8/21	1147	25.5	23.0	8.4	98	7.50	100	32

Delaware River at Smithfield Access Area, PA - River Mile 217.9

5/25	1315	29.0	18.0	9.0	95	7.00	60	82
6/12	1445	31.0	20.0	9.0	99	7.00	70	52
6/20	1150	25.0	19.0	8.5	92	7.00	71	
6/26	1035	25.0	22.0	7.8	89	6.75	70	52
7/03	0900	19.0	22.5	8.3	96	7.00	89	44
7/12	1030	21.5	23.5	8.0	94	7.00	82	14
7/18	1113	21.1	21.5	8.8	100	7.00	100	108
7/26	0935	25.0	25.0	7.8	95	7.00	90	13
8/08	1000	19.0	24.0	7.9	94	7.00	92	87
8/09	1430	21.0	24.0	9.3	111	7.50	110	
8/24	0909	18.0	24.0	8.0	95	7.00	96	35

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Poxono Access Area, NJ - River Mile 219.4								
5/25	1006	20.0	15.0	9.0	89	7.00	60	
6/19	1139	29.0	20.0	8.3	92	7.00	55	68
6/27	1045	28.0	21.5	8.0	91	6.75	68	20
7/03	1210		23.0	8.6	100	7.00	82	60
7/10	1220	27.0	23.5	8.7	103	7.00	76	10
7/19	1039	24.4	22.0	8.7	100	7.00	91	14
7/25	1350	28.0	25.0	8.5	103	7.00	83	80
8/07	1215	21.0	26.0	8.0	99	7.00	88	89
8/21	1209	25.5	23.0	7.9	97	7.25	100	29
Delaware River at Depew Access Area, NJ - River Mile 221.2								
7/19	1136	26.7						12
Delaware River at Walpack Bend, PA - River Mile 226.6								
6/29	1010	19.0	21.0	8.4	94	7.00	70	48
7/18	1033	24.0	21.0	8.7	98	7.50	85	9
Delaware River at Bushkill Access Area, PA - River Mile 227.9								
5/25	1049	26.0	15.0	9.0	89	6.50	55	30
6/20	1200	25.0	19.0	8.9	96	7.00	60	
6/23	0835	23.0	21.0	8.2	92	6.75	68	57
7/04	1410	25.0	24.0	8.2	98	7.00	78	38
7/12	1315	22.0	23.0	8.3	97	7.00	80	22
7/18	1244	25.0	21.5	8.6	98	7.00	88	20
7/26	1215	30.0	26.0	7.7	95	7.00	82	21
8/08	1325	24.0	24.0	7.7	92	7.00	98	11
8/24	1151	24.0	24.0	8.0	95	7.00	98	12
Delaware River at Eshback Access Area, PA - River Mile 232.1								
5/25	1114	30.0	15.0	9.1	90	6.50	60	23
6/20	1251	27.0	19.0	9.0	97	6.50	60	34
6/29	0913	19.0	21.0	8.4	94	7.00	70	42
7/04	1430	24.0	24.0	8.2	98	6.75	80	60
7/12	1330	22.0	23.0	8.5	99	7.25	82	16
7/18	1300	27.2	22.0	9.0	103	7.25	89	14
7/26	1230	31.0	26.5	8.2	102	7.25	80	20
8/03	1340	24.0	24.0	8.8	105	7.50	100	17
8/24	1222	24.0	24.0	9.0	107	7.50	100	35

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Dingmans Access Area, PA - River Mile 238.7								
5/25	1257	30.0	15.0	9.8	97	6.50	52	36
6/20	1407	28.0	19.0	9.0	97	7.00	60	
6/23	1010	25.0	20.0	8.0	88	6.75	70	79
7/03	0915	19.0	23.0	7.7	90	7.00	80	16
7/11	0917	28.0	24.0	7.4	84	7.00	80	56
7/18	0935	22.0	21.0	8.9	100	7.00	82	24
7/25	0940	25.0	25.0	7.8	95	7.00	88	49
8/07	1030	23.0	27.0	7.7	97	7.00	95	40
8/10	1130		22.5	8.9	103	7.00	88	
8/21	1055	25.0	22.0	8.4	96	7.30	88	21

Delaware River at Milford Beach, PA - River Mile 246.8

5/26	1040	25.0	18.0	8.9	94	7.00	60	26
6/14	1435	16.0	18.0	9.2	97	6.50	65	40
6/23	1100	27.0	20.0	8.4	93	6.75	70	50
7/07	1104	29.0	22.0	8.2	94	7.00	70	108
7/12	1049	24.0	23.0	8.1	95	7.00	80	16
7/26	1251	35.0	27.0	8.3	104	7.00	90	
8/08	1148	21.0	23.0	8.0	93	7.50	90	46
8/10	1500	24.0	22.5	9.4	109	7.00	100	20
8/22	1105	26.0	23.0	8.7	102	7.00	80	42

Delaware River at Northern DEWA Boundary, PA - River Mile 250.2

5/26	0850	23.0	13.0	9.4	89	6.50	35	31
6/23	0832	27.0	20.0	8.5	94	7.00	65	67
6/27	1500	30.0	22.5	9.0	104	6.75	68	32
7/07	0900	24.0	21.0	8.4	94	7.00	70	158
7/12	0915	23.0	22.0	9.0	103	7.00	80	32
7/26	1030	31.0	25.0	8.3	101	7.00	90	28
8/08	0923	20.0	22.0	8.4	96	7.00	90	47
8/10	1300	27.0	23.0	10.1	118	7.50	85	10
8/22	1000	24.0	23.0	9.2	107	7.50	80	42
8/30	0855	23.0	22.0	8.0	92	7.00	80	37

Delaware River at Route 84 Bridge, PA - River Mile 253.6

7/24	1615	30.0	27.0	8.8	111	7.00	88	12
7/26	1047	31.0	25.0	8.0	97	7.00	90	22
8/30	0415	26.0	22.0	7.6	87	6.75	80	76

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Port Jervis/Matamoras Bridge, NY - River Mile 254.8								
5/26	0915	25.0	17.0	9.0	93	6.50	60	64
6/23	0849	28.0	20.0	8.6	95	7.00	65	142
6/27	1445	32.0	22.0	9.2	106	7.00	72	64
7/07	0951	27.0	22.0	8.2	94	7.00	70	346
7/12	0935	22.0	22.0	9.4	108	7.00	80	348
7/24	1555	29.0	27.0	9.4	118	7.50	80	360
7/26	1105	31.0	25.0	8.2	100	6.50	90	508
7/28	1129	29.0	26.0	8.6	106	7.00	90	278
8/03	1350	28.0	25.0	9.0	109	7.50	82	100
8/08	1049	21.0	22.0	8.3	95	7.00	90	200
8/22	1020	24.0	23.0	9.2	107	7.00	80	184
8/30	1042	27.0	22.0	8.9	102	7.00	80	216

Delaware River just south of Port Jervis Beach, NY - River Mile 255.0

8/03	1325	26.0	25.5	9.5	116	7.50	80	32
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Delaware River at Port Jervis Beach, NY - River Mile 255.3

7/07	0937	27.0	21.0	8.3	93	7.00	70	216
7/24	1145	28.5	24.0	9.0	107	7.25	82	68
7/28	1112	29.0	26.0	8.7	108	7.00	88	136
8/03	1300	30.0	25.0	9.4	114	7.00	80	38
8/30	1019	25.0	22.0	8.4	96	7.25	78	10

Delaware River at Matamoras Access Area, PA - River Mile 256.2

7/07	0920	27.0	21.0	8.3	93	7.00	70	82
7/24	1230	28.5	24.5	8.9	107	7.25	76	7
7/28	1053	28.0	27.0	9.2	116	7.50	85	55

Delaware River at North Port Jervis, NY - River Mile 256.3

7/24	1055	28.5	24.0	8.3	99	7.00	82	0
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Delaware River at Millrift, PA - River Mile 258.4

5/22	1430		20.0	8.7	96	7.00	50	0
6/29	1150		20.5	8.6	96	7.00	61	6
7/07	0949	25.0	20.0	8.3	92	6.75	70	56
7/31	1130	23.0	23.0	8.1	95	7.00	80	10
8/24	1135	25.0	21.0	8.3	93	6.50	00	22

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Pond Eddy, NY - River Mile 265.7								
5/22	1250	30.0	20.0	8.9	98	7.00	55	8
6/29	1115	19.0	20.0	8.7	96	7.00	60	26
7/07	1119	26.0	21.0	8.6	97	6.70	78	56
7/31	1100	20.0	22.0	7.9	91	6.50	80	6
8/24	1110	23.0	21.0	8.0	90	6.50	70	36

Delaware River at Pond Eddy, PA - River Mile 265.8

6/22	1215	25.0	21.0	8.4	94	6.50	55	46
7/07	1056	24.0	20.5	8.3	92	6.75	74	88
7/13	1130	19.0	21.0	7.9	89	7.00	63	7
8/16	1150	30.0	26.0	8.2	101	7.00	60	38

Delaware River at Shohola/Barryville Bridge, NY - River Mile 273.5

5/22	1220	38.0	20.0	8.2	90	7.00	55	6
6/29	1105	20.0	21.0	8.5	96	7.00	60	28
7/14	1140	23.0	22.0	9.8	112	7.50	84	12
7/31	1035	20.0	22.0	8.4	96	7.00	80	7
8/24	1055	19.0	20.0	8.5	94	7.00	80	19

Delaware River at Shohola/Barryville Bridge, PA - River Mile 273.5

6/22	1120	25.0	21.0	9.3	104	7.00	60	82
7/13	1100	18.0	21.0	8.3	93	7.00	60	8
7/14	1250	23.0	22.5	9.8	113	8.00	80	0
8/16	1130	30.0	26.0	8.8	109	7.50	80	8

Delaware River at Narrowsburg Access Area, PA - River Mile 289.8

6/22	0950	25.0	20.0	7.8	86	7.00	60	348
7/13	0910	18.0	22.0	8.5	97	7.00	70	16
7/17	1112	22.0	21.0	7.9	89	6.75	86	10
7/27	1630	33.0	28.0	8.3	106	7.00	92	4
8/16	0920	27.0	25.0	8.0	97	7.50	70	16

Delaware River at Narrowsburg Access Area, NY - River Mile 290.0

5/22	1125	28.0	20.0	8.2	90	6.50	69	64
6/29	1005	17.5	19.5	7.5	82	6.50	75	56
7/17	1136	23.0	20.5	7.5	83	6.75	90	4
7/31	1000	20.0	19.0	6.5	70	6.50	75	14
8/24	0950	24.0	20.0	7.0	77	6.50	70	27

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Skinners Falls Access Area, NY - River Mile 295.4								
5/22	1045	28.0	17.0	9.2	95	7.00	55	14
6/29	0930	15.0	19.0	8.3	90	6.50	63	18
7/17	1202	22.8	20.5	10.3	115	8.00	90	6
7/31	0930	19.0	20.0	8.0	88	7.00	80	26
8/24	0920	20.0	19.0	8.2	89	7.00	60	21

Delaware River at Danascus Access Area, PA - River Mile 298.4

6/22	0915	25.0	20.0	8.0	88	6.50	60	44
7/13	0845	18.0	20.0	8.3	92	6.50	63	8
7/17	1325	23.0	20.5	9.6	107	7.50	89	10
8/16	0850	23.0	24.0	7.0	83	7.00	80	15

Delaware River at Callicoon Access Area, PA - River Mile 303.2

6/22	0905	24.0	20.0	8.3	92	7.00	53	56
7/13	0835	17.0	19.0	8.3	90	6.50	65	16
7/20	1011	19.0	21.0	7.2	81	7.00	92	54
7/27	1140	33.0	26.5	8.6	107	7.00	82	22
8/16	0830	23.0	23.0	6.8	79	6.50	80	14

Delaware River at Callicoon Access Area, NY - River Mile 303.5

5/22	1015	28.0	15.0	10.5	104	7.00	63	100
6/29	0915	16.0	17.0	8.6	89	7.00	84	220
7/20	1110	18.0	21.0	8.3	93	7.00	92	326
7/27	1310	35.0	26.5	10.2	127	8.50	100	44
7/31	0915	19.0	19.0	9.5	103	7.00	110	268
8/24	0900	17.0	17.0	9.0	93	7.00	120	508

Delaware River at Equinunk/Lordville Bridge, NY - River Mile 321.6

5/22	0930	28.0	15.0	9.5	94	7.00	45	42
6/29	0835	14.0	17.0	8.4	87	6.50	59	28
7/31	0825	20.0	19.0	8.4	91	6.50	75	18
8/24	0825	17.0	16.0	8.3	84	7.00	65	21

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)
Delaware River at Buckingham Access Area, PA - River Mile 325.0								
5/22	0900	16.0	14.0	10.5	102	7.00	45	68
6/22	0825	24.0	18.0	7.2	76	7.00	55	276
6/29	0810	14.0	17.0	8.3	86	7.00	60	36
7/13	0800	16.5	18.0	7.8	83	6.50	48	20
7/13	1245	22.5	19.0	10.6	114	8.00	80	4
7/31	0755	17.0	18.0	7.3	77	7.00	69	14
8/16	0800	24.0	22.0	6.8	78	7.00	65	12
8/24	0745	17.0	16.0	8.4	85	6.50	60	38

APPENDIX B

Delaware River Baseline Monitoring Data:

Nutrients and BOD

Total Orthophosphate, Total P,
NO₂+NO₃, NH₃+NH₄,
BOD₅, and BOD₅-inhibited

Date	Time of Day	Total Ortho-P as P (mg/l)	Total P as P (mg/l)	NO2+NO3 N-Total (mg/l)	NH3+NH4 N-Total (mg/l)	BOD5 (mg/l)	BOD5 Inh (mg/l)
Delaware River at Kittatinny Access Area, NJ - River Mile 211.5							
5/25	1110					0.7	0.5
8/09	1130	0.01 K	0.01 K	0.20	0.69		
Delaware River at Smithfield Access Area, PA - River Mile 217.9							
8/09	1430	0.01 K	0.01 K	0.18	0.39		
Delaware River at Dingmans Access Area, PA - River Mile 238.7							
8/10	1130	0.01 K	0.01 K	0.25	0.19		
8/31						1.72	
Delaware River at Milford Beach, PA - River Mile 246.8							
5/25						1.50	0.70
8/10	1500	0.01 K	0.01 K	0.23	0.65		
Delaware River at Northern DEWA Boundary, PA - River Mile 250.2							
6/21						0.10	0.00
8/10	1300	0.03	0.07	0.29	0.11		
8/30	0855					0.84	
Delaware River at Route 84 Bridge, PA - River Mile 253.6							
8/30	0935					0.43	
Delaware River at Port Jervis/Matamoras Bridge, NY - River Mile 254.8							
6/21						0.40	0.00

APPENDIX C

**Tributary Baseline Monitoring Data:
Selected Water Chemistry and Bacterial Parameters
Air Temperature, Water Temperature,
Dissolved Oxygen, pH, Conductivity,
Fecal Coliform, and Fecal Streptococcus**

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Cherry Creek Near Route 80 Bridge, PA - River Mile 212.6/0.2										
5/25	1153	26.5	16.0	9.9	101	7.50	130	100		
6/12	1335	28.0	17.0	9.6	99	7.50	164	340		
6/19	1328	28.0	17.0	10.0	104	7.50	150	200		
6/26	1205	31.0	18.0	9.1	96	7.50	200	400		
7/03	1055	25.0	17.5	9.5	99	7.75	100	270		
7/10	1115	24.0	19.0	9.1	98	7.25	220	190		
7/18	1000	21.1	17.0	9.1	94	8.00	220	224		
7/25	1148	29.0	20.0	8.6	95	7.50	240	284		
8/07	1015	22.0	21.0	8.1	91	7.50	200	1008		
8/21	1048	25.0	18.0	8.7	92	7.50	230	352		

Brodhead Creek at Route 402 Bridge, PA - River Mile 213.0/0.8

5/25	1215	28.0	15.0	9.8	97	7.00	79	500		
6/12	1355	30.0	18.0	9.4	99	7.00	98	1600		
6/19	1343	29.0	18.0	9.1	96	7.50	90	200		
6/26	1110	29.0	18.0	7.8	83	7.25	135	500		
7/03	1040	25.0	18.0	9.5	101	7.50	130	200		
7/10	1045	24.0	19.0	8.8	95	7.25	110	320		
7/18	1034	22.2	18.0	9.7	103	7.00	140	370		
7/25	1130	30.0	21.5	9.2	104	7.50	130	530		
8/07	1000	22.0	21.0	8.2	92	7.00	140	380		
8/21	1024	24.0	19.0	8.6	93	7.00	140	370		

Marshall's Creek at Minisink Hills Bridge, PA - River Mile 213.0/0.7/0.2

5/25	1230	33.0	18.0	9.5	101	7.00	80	114		
6/12	1405	30.0	17.0	9.7	101	7.50	102	94		
6/20	1105		16.0	9.2	93	7.25	90	92		
6/28	0925	23.0	18.5	8.9	95	7.25	130	68		
7/03	1023	25.0	17.5	9.5	99	7.50	140	24		
7/10	1020	23.0	19.0	8.9	96	7.50	130	54		
7/18	1044	20.6	17.5	9.6	101	7.50	150	54		
7/25	1105	30.0	21.0	9.2	103	7.50	140	20		
8/07	0920	23.0	21.0	8.4	94	7.50	180	86		
8/21	0943	24.0	19.0	8.6	93	7.50	170	36		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Shawnee Creek at Resort Parking Lot, PA - River Mile 214.4/0.2										
5/25	1252	33.0	20.0	9.0	99	8.00	180	36		
6/12	1425	31.0	21.0	8.5	96	8.00	210	250		
6/20	1115	25.0	19.0	8.5	92	8.00	210	296		
6/28	1000	24.0	21.0	8.1	91	7.50	220	150		
7/03	0948	26.0	19.5	8.6	94	8.25	240	250		
7/10	0930	24.0	22.0	8.2	94	8.00	210	150		
7/18	1100	22.0	18.0	8.9	94	8.00	300	116		
7/25	1020	29.0	21.5	8.2	93	8.50	200	128		
8/08	0930	17.0	17.0	9.0	93	8.00	240	60		
8/21	0908	24.0	19.0	8.5	92	8.00	280	200		
Pahaquarry Creek at Old Mine Road Bridge, NJ - River Mile 219.4/0.1										
6/19	1153	25.0	13.0	10.2	97	6.50	25	8		
Van Campens Brook at Old Mine Road Bridge, NJ - River Mile 220.1/0.2/2.3										
7/19	1111	25.6	17.5	9.1	95	7.00	90	25		
Flat Brook at Old Mine Road Bridge, NJ - River Mile 225.3/0.5										
5/25	0940	19.0	15.0	9.1	90	7.50	80	150		
6/12	1103	23.0	16.0	9.6	97	7.50	120	64		
6/19	1105	28.0	17.0	9.3	96	7.00	105	76		
6/27	1145	27.0	20.0	10.2	112	8.50	180	68		
7/03	1340	30.0	20.0	10.6	117	9.00	230	22		
7/10	1340	29.0	21.0	9.8	110	8.00	220	24		
7/19	1209	25.6	19.5	10.2	111	8.50	250	12	160	0.08
7/25	1420	31.0	22.0	9.7	111	8.50	230	32		
8/07	1340	22.0	21.0	8.6	97	8.00	240	33		
8/21	1348	28.0	21.0	9.7	109	9.00	260	14		
8/23	1130	25.0	21.0	9.7	109	8.00	215	34	108	0.31

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Flat Brook at Walpack Center Bridge, NJ - River Mile 225.3/7.2										
5/25	0910	15.0	13.0	9.2	87	7.00	50	108		
6/12	1020		14.0	9.6	93	7.00	100	144		
6/19	1027	26.0	15.0	9.2	91	7.00	85	60		
6/27	1300	30.0	18.0	9.4	99	7.00	110	138		
7/03	1405	26.0	19.0	11.9	129	8.50	240	66		
7/10	1400	28.0	21.0	10.4	117	8.00	122	74		
7/19	1230	27.2	19.0	10.2	110	8.60	215	116	36	3.22
7/25	1445	26.0	21.0	9.9	111	8.50	250	62		
8/07	1400	20.0	20.0	9.0	99	8.00	210	146		
8/21	1412	28.0	21.0	11.2	126	9.00	250	58		
8/23	1058	27.0	19.0	9.6	104	8.00	220	76	68	1.12

Bushkill Creek at Route 209 Bridge, PA - River Mile 226.9/0.7

5/25	1038	24.0	14.0	9.8	95	6.50	35			
6/20	1410	26.0	20.0	9.1	100	7.00	54	37		
6/28	1140	23.0	21.0	8.8	99	7.00	50	64		
7/04	1354	25.0	22.0	8.5	97	6.75	52	800 L		
7/12	1300	22.0	20.5	9.2	102	7.00	50	46		
7/18	1229	23.9	19.0	9.6	104	7.00	57	27		
7/26	1200	29.0	23.5	8.2	97	6.75	42	9		
8/08	1315		20.0	8.6	95	6.75	52	1300		
8/24	1137	21.5	20.0	8.7	96	7.00	60	20		
8/31	1200	25.0	20.0	9.1	100	7.00	40	37		

Little Bushkill Creek Near Bushkill Creek Confluence, PA - River Mile 226.9/0.8/0.1

5/25	1027	22.0	15.0	9.3	92	6.00	25	13		
6/20	1315	26.0	20.0	9.0	99	6.50	37	9		
6/28	1030	22.0	20.5	8.0	89	6.50	39	11		
7/04	1230	26.0	20.0	8.5	94	6.50	42			
7/12	1145	23.0	18.5	8.8	94	6.75	40	9		
7/18	1218	23.9	18.0	9.6	102	6.50	42	4		
7/26	1050	28.0	23.0	8.0	93	6.50	39			
8/08	1120	22.0	17.0	9.5	98	6.50	39	6		
8/24	1128	21.5	19.0	8.6	93	6.75	47	23		
8/31	1150	25.0	17.0	9.2	95	6.50	30	25		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
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Bushkill Creek at DEWA Boundary, PA - River Mile 226.9/3.2

5/25	0953	20.0	15.0	9.7	96	6.50	28	3		
6/20	1356	27.0	20.0	9.0	99	6.50	34	8		
6/28	1115	23.0	21.0	8.3	93	6.50	48	18		
7/04	1320	26.0	22.0	8.4	96	6.75	38	86		
7/12	1235	22.0	20.5	8.8	98	6.75	40	32		
7/18	1137	25.6	19.0	9.1	98	6.75	40	135		
7/26	1130	28.0	22.0	8.1	93	6.75	37	11		
8/08	1150	20.0	19.0	8.9	96	6.75	39	113		
8/24	1111	25.5	20.0	8.8	97	6.50	42	17		

Saw Creek Near Bushkill Creek Confluence, PA - River Mile 226.9/3.3/0.1

5/25	1014	21.0	13.0	9.9	94	6.50	30	44		
6/20	1340	26.0	18.0	9.1	96	6.50	39	0		
6/28	1048	23.0	20.0	8.1	89	6.75	50	358		
7/04	1310	28.0	20.0	8.4	93	6.75	54	800 L		
7/12	1215	23.5	19.0	8.7	94	6.75	65	492		
7/18	1149	23.3	19.0	9.1	98	7.00	94	772		
7/26	1120	30.0	22.0	8.1	93	6.75	36	112		
8/08	1135	20.0	17.0	9.4	97	7.00	62	800 L		
8/24	1100	25.5	18.5	8.9	95	7.00	57	56		
8/31	1120	24.0	17.0	9.2	95	6.80	40	52		

Denmark Creek at Route 209 Bridge, PA - River Mile 227.9/0.2

7/25	1119	26.0	17.0	9.2	95	7.00	85	31		
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Toms Creek at Route 209 Bridge, PA - River Mile 230.4/0.3

5/25	1100	25.0	12.0	10.2	95	6.50	35	9		
6/20	1233	24.0	15.0	10.0	99	6.50	40	26		
6/28	1225	21.0	17.0	9.6	99	6.75	48	81		
7/03	0958	22.0	15.0	9.4	93	7.00	50	4		
7/11	1005	29.0	18.0	9.0	95	7.00	52	2		
7/18	1119		15.0	9.6	95	7.00	51	5		
7/25	1134	24.0	18.0	9.1	96	6.50	59	8		
8/07	1110	24.0	17.0	9.1	94	6.80	50	13		
8/21	1145	28.0	17.0	9.4	97	7.00	50	27		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Toms Creek at DEWA Boundary, PA - River Mile 230.4/2.7										
5/25	1200	30.0	13.0	10.0	95	6.50	32	5		
6/20	1307	24.0	15.0	9.7	96	7.00	35	10		
6/28	1250	21.0	16.5	9.6	98	6.75	55	42		
7/03	1035	27.0	16.0	9.2	93	6.50	50	32		
7/11	1113	31.0	20.0	8.7	96	7.00	52	35		
7/18	1140	23.0	16.0	9.8	99	6.50	50	17		
7/25	1148	25.0	19.0	8.8	95	6.50	57	27		
8/07	1140	24.0	19.0	9.1	98	6.80	55	69		
8/21	1155	28.0	18.0	9.2	97	7.00	49	12		

Brodhead/Hellers Creek at Route 209 Bridge, PA - River Mile 233.1/0.4

7/25	1027	25.0	19.0	8.7	94	6.50	55	15		
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Hornbeck Creek at Route 209 Bridge, PA - River Mile 236.4/0.4

5/25	1237	28.0	16.0	9.6	97	6.50	48	31		
6/20	1343	25.0	19.0	8.9	96	7.00	60	23		
6/29	0856	18.0	18.0	9.2	97	7.00	65	5		
7/03	0937	21.0	18.0	8.8	93	7.00	70	26		
7/11	0948	29.0	21.0	8.4	94	7.00	75	10		
7/18	1000	21.0	17.0	9.5	98	7.00	70	36		
7/25	1014	27.0	21.0	8.7	98	7.00	70	11		
8/07	1055	24.0	21.0	8.9	100	7.00	80	25		
8/21	1125	29.0	20.0	9.0	99	7.00	70	13		

Hornbeck Creek at DEWA Boundary, PA - River Mile 236.4/2.1

5/25	1224	30.0	18.0	8.4	89	6.50	50	36		
6/20	1330	28.0	22.0	7.4	85	6.00	60	44		
6/29	1120	20.0	21.0	8.6	97	6.50	75	64		
7/03	1100	28.0	23.0	5.4	63	6.50	90	34		
7/11	1150	28.0	25.0	5.3	64	6.50		56		
7/18	1245	28.0	22.0	6.2	71	6.50	85	20		
7/25	1245	27.0	25.0	5.5	67	6.00	81	14		
8/07	1300	22.0	23.0	5.6	65	6.30	90	14		
8/21	1235	28.0	22.0	6.2	71	6.00	75	30		
8/31	1325	27.0	22.0	6.6	76	6.50	80	12		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Dingmans Creek at Route 209 Bridge, PA - River Mile 239.2/0.5										
5/25	1248	29.0	16.0	9.7	98	6.50	35	6		
6/20	1355	26.0	18.0	9.0	95	6.50	50	37		
6/29	1015	19.0	17.0	8.6	89	6.75	68	16		
7/03	0926	19.0	18.0	8.5	90	6.50	60	19		
7/11	0932	30.0	20.0	8.3	92	7.00	60	23		
7/18	0945	22.0	18.0	8.6	91	6.50	54	9		
7/25	1002	27.0	21.0	8.4	94	6.80	51	27		
8/07	1040	22.0	21.0	8.6	97	6.80	50	11		
8/21	1105	27.0	20.0	8.7	96	6.80	50	3		

Dingmans Creek at DEWA Boundary, PA - River Mile 239.2/3.5

5/25	1313	28.0	17.0	9.6	99	6.50	30	7		
6/20	1424	25.0	21.0	8.6	97	6.50	40	13		
6/29	1145	20.0	21.0	9.0	101	6.50	45	11		
7/03	1135	29.0	23.0	7.7	90	6.50	50	5		
7/11	1210	29.0	24.0	7.5	89	7.00	50	13		
7/18	1315	27.0	21.0	9.5	107	6.50	50	21		
7/25	1306	28.0	25.0	8.1	98	6.50	35			
8/07	1325	21.0	23.0	8.2	96	6.50	45	35		
8/21	1254	28.0	22.0	8.4	96	6.80	40	22		

Adams Creek at Route 209 Bridge, PA - River Mile 240.3/0.2

7/03	0902	17.0	18.0	9.3	98	6.50	50	2		
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Raymondskill Creek at Route 209 Bridge, PA - River Mile 243.9/0.3

5/25	1342	28.0	16.0	9.7	98	6.50	38	24		
6/23	1025	27.0	20.0	8.5	94	6.50	49	77		
6/29	1105	15.0	17.0	8.6	89	6.75	54	24		
7/03	0935	17.0	19.0	9.0	97	6.50	50	27		
7/11	0855	25.0	21.0	8.0	90	7.00	51	6		
7/18	0919	22.0	18.0	9.4	99	7.00	50	9		
7/25	0920	24.0	21.0	8.7	98	6.50	50	10		
8/07	1015	23.0	22.0	8.7	100	6.80	50	14		
8/21	1040	25.0	20.0	8.8	97	6.80	48	11		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
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Raymondskill Creek at DEWA Boundary, PA - River Mile 243.9/3.0

5/25	1332	28.0	16.0	9.8	99	6.00	35	10	
6/23	1046	26.0	20.0	8.1	89	6.50	50	55	
6/29	1230	20.0	20.0	8.9	98	6.50	40	16	
7/03	1210	29.0	22.0	7.9	91	6.50	50	10	
7/11	1235	27.0	23.0	7.5	88	7.00	50	8	
7/18	1345	25.0	21.0	8.5	96	6.50	50	11	
7/25	1319	27.0	23.0	8.4	98	6.50	51	13	
8/07	1000	22.0	23.0	8.1	95	6.50	50	11	
8/21	1030	26.0	20.0	8.8	97	6.50	45	5	

White Brook at Route 521 Bridge, NJ - River Mile 245.8/0.6

6/23	1000	26.0	12.0	10.7	99	8.00	220	22	
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Shiners Brook at Route 521 Bridge, NJ - River Mile 246.6/0.7

5/26	1015	27.0	19.0	8.5	92	7.50	110	28	
6/23	0940	27.0	22.0	8.2	94	8.00	195	22	
6/27	1345	32.0	25.0	7.6	92	8.00	200	8	
7/07	1039	28.0	24.0	7.8	93	8.00	240	15	
7/12	1030	21.0	22.0	8.8	101	8.00	250	8	
7/26	1156	27.0	24.0	8.2	98	8.00	310	5	
8/08	1133	19.0	19.0	8.8	95	8.00	290	3	
8/22	1050	24.0	20.0	9.1	100	8.00	290	7	

Saukill Creek at Route 209 Bridge, PA - River Mile 247.0/0.3

5/26	1045	23.0	16.0	9.5	96	7.00	50	158	
6/23	1110	28.0	19.0	8.8	95	7.00	51	264	
6/29	1311	23.0	18.0	9.8	104	7.00	60	0	
7/07	1124	29.0	20.0	8.8	97	7.00	64	40	
7/12	1102	23.0	17.0	10.0	104	7.00	70	16	
7/26	1306	31.0	22.0	8.6	99	7.00	80	29	
8/08	1200	24.0	17.0	9.3	96	7.00	75	9	
8/22	1113	24.0	18.0	9.7	103	7.00	80	30	

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
Vandermark Creek at Route 209 Bridge, PA - River Mile 247.3/0.1										
5/26	1100	21.5	13.0	9.9	94	6.50	50	70		
6/23	1125	28.0	16.0	9.6	97	6.50	51	130		
6/29	1320	23.0	15.0	10.6	105	7.00	65	156		
7/07	1138	29.0	16.0	9.4	95	7.00	70	240		
7/12	1115	22.0	14.0	10.4	101	7.00	80	68		
7/26	1312	29.0	17.0	9.9	103	7.00	100	62		
8/08	1210	21.0	14.0	10.0	97	7.00	95	20		
Cummins Creek, PA - River Mile 250.1/0.3										
7/12	0850	22.0	14.0	10.6	103	6.50	50	21		
8/08	0923	20.0	14.0	10.1	98	7.00	50	79		
Neversink River at Route 6 Bridge, NY - River Mile 253.6/0.6										
5/26	0940	25.0	17.0	8.1	84	6.50	69	38		
6/23	0912	27.0	21.0	7.5	84	7.00	75	72		
6/27	1420	30.0	22.0	7.8	89	6.75	70	180		
7/07	1009	28.0	21.0	7.7	87	7.00	90	124		
7/12	0956	21.0	22.0	7.4	85	7.00	100	132		
7/26	1122	29.0	25.0	7.3	89	6.50	120	142		
8/08	1105	21.0	20.0	7.7	85	7.00	95	56		
8/22	1030	26.0	22.0	8.1	93	7.00	98	128		
Mongaup River at Route 97 Bridge, NY - River Mile 261.1/0.2										
7/07	1038	27.0	17.0	8.9	92	6.50	80	0		
Shohola Creek at Railroad Bridge Near Delaware River Confluence, PA - River Mile 273.2/0.2										
7/07	1353	27.0	23.0	8.2	96	6.50	42			
7/14	1330	23.0	21.0	8.8	99	6.75	64	20		
Halfway Brook at Route 97 Bridge, NY - River Mile 273.4/0.2										
7/20	1416	22.0	18.0	9.1	96	6.75	100	690		
Lackawaxen River at Route 590 Bridge, PA - River Mile 277.7/0.3										
7/07	1321	26.0	22.0	8.9	102	7.00	72			
7/14	1445	22.0	20.0	9.5	105	7.50	79	12		

Date	Time of Day	Air Temp (Cent)	H2O Temp (Cent)	D.O. (mg/l)	D.O. Sat. (%)	pH (SU)	Conductance (umhos/cm)	Fecal Coli. (#/100 ml)	Fecal Strep (#/100 ml)	FC/FS
York Lake Falls at Route 97 Bridge, NY - River Mile 278.3/0.1										
5/22	1200	28.0	22.0	9.2	106	6.50	20	0		
6/29	1025	16.5	15.5	9.1	91	6.50	28	1		
Narrow Falls Brook at Route 97 Bridge, NY - River Mile 280.0										
7/27	1700	24.0	20.0	8.5	94	6.75	77	4		
Masthope Creek at Railroad Bridge Near Mouth, PA - River Mile 282.5/0.1										
7/17	1028	23.0	18.0	9.2	97	7.00	60	24		
Tennile River at Route 97 Bridge, NY - River Mile 284.2/1.4/0.1										
7/07	1205		22.0	8.2	94	6.50	64	17		
Atco Creek at Route 652 Bridge, PA - River Mile 289.6/0.5										
6/22	1000	22.0	19.0	8.6	93	6.50	50	70		
7/13	0925	18.5	17.5	9.3	97	6.50	52	12		
8/16	1000	27.0	20.0	8.3	92	6.50	60	9		
Callicoon Creek at Route 97 Bridge, NY - River Mile 303.6/0.3										
7/20	1040	19.0	19.0	8.7	94	7.00	110	1398		
Little Equinunk Creek Near Delaware River Confluence, PA - River Mile 312.7/0.4										
7/13	1530	20.0	19.0	8.3	90	7.00	55	18		
Equinunk Creek at Route 191 Bridge, PA - River Mile 322.5/0.4										
7/13	1445	20.0	19.0	8.1	87	6.75	62	18		
Factory Creek at Route 191 Bridge, PA - River Mile 322.6/0.2										
7/13	1430	20.0	18.0	8.5	90	6.75	44	16		

APPENDIX D

Tributary Baseline Monitoring Data: BOD5 and Flow

Date	Time of Day	BOD5 (mg/l)	Flow (cfs)
Cherry Creek Near Route 80 Bridge, PA - River Mile 212.6/0.2			

5/19			118.4
7/25	1148	1.67	
8/04			26.5

Brodhead Creek at Route 402 Bridge, PA - River Mile 213.0/0.8

7/25	1130	1.22
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Marshall's Creek at Minisink Hills Bridge, PA - River Mile 213.0/0.7/0.2

5/19		167.9
8/04		17.6

Shawnee Creek at Resort Parking Lot, PA - River Mile 214.4/0.2

5/19		43.3
7/25	1020	1.55

Van Campens Brook at Old Mine Road Bridge, NJ - River Mile 220.1/0.2/2.3

5/19		48.5
10/04		22.0

Bushkill Creek at Route 209 Bridge, PA - River Mile 226.9/0.7

8/31	1200	1.24
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Little Bushkill Creek Near Bushkill Creek Confluence, PA - River Mile 226.9/0.8/0.1

8/04		43.0
10/06		69.8

Saw Creek Near Bushkill Creek Confluence, PA - River Mile 226.9/3.3/0.1

8/31	1120	0.49
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Date	Time of Day	BOD5 (mg/l)	Flow (cfs)
Toms Creek at Route 209 Bridge, PA - River Mile 230.4/0.3			

5/05			19.0
8/04			4.3

Hornbeck Creek at Route 209 Bridge, PA - River Mile 236.4/0.4

5/05			19.0
10/05			16.0

Hornbeck Creek at DEWA Boundary, PA - River Mile 236.4/2.1

8/31	1325	1.21	
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Dingmans Creek at Route 209 Bridge, PA - River Mile 239.2/0.5

6/08			38.9
9/29			55.5

Raymondskill Creek at Route 209 Bridge, PA - River Mile 243.9/0.3

5/24			140.0
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Shiners Brook at Route 521 Bridge, PA - River Mile 246.6/0.7

9/29			19.5
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Saukill Creek at Route 209 Bridge, PA - River Mile 247.0/0.3

5/04			60.9
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Vandermark Creek at Route 209 Bridge, PA - River Mile 247.3/0.1

5/08			38.9
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Date	Time of Day	BOD5 (mg/l)	Flow (cfs)
Cummins Creek, PA - River Mile 250.1/0.3			
5/08			42.1
10/05			7.5

Neversink River at Route 6 Bridge, NY - River Mile 253.6/0.6

6/21	0.50
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York Lake Falls at Route 97 Bridge, NY - River Mile 278.3/0.1

7/31	1100	0.0
8/24	1015	0.0

APPENDIX E

**Daily Precipitation Data
For Selected Stations
May Thru September, 1989**

H.

Daily Precipitation Data 1989

Date	***** Equinunk, PA	Precipitation (in.) Matamoras, PA	***** Stroudsburg, PA
5/01	----	----	0.03
5/02	2.04	0.55	1.43
5/03	0.03	0.65	T
5/04	T	----	T
5/05	----	----	0.43
5/06	2.49	1.95	2.56
5/07	0.50	0.15	0.44
5/08	0.10	T	0.01
5/09	----	----	T
5/10	0.23	0.19	1.29
5/11	1.10	1.65	0.30
5/12	0.15	0.04	0.12
5/13	0.02	T	0.06
5/14	----	----	0.02
5/15	0.19	0.06	0.03
5/16	0.04	----	0.85
5/17	0.80	2.25	0.61
5/18	----	0.02	----
5/19	----	----	----
5/20	----	----	----
5/21	0.02	----	----
5/22	T	----	----
5/23	----	----	0.29
5/24	0.35	0.47	0.53
5/25	----	0.70	0.01
5/26	----	T	0.03
5/27	0.09	T	0.12
5/28	T	0.13	----
5/29	----	----	----
5/30	----	----	0.07
5/31	0.02	0.15	0.06
Monthly			
Total =	8.17	8.96	9.29

	***** Precipitation (in.) *****		
Date	Equinunk, PA	Matamoras, PA	Stroudsburg, PA
6/01	0.02	-----	0.06
6/02	0.12	-----	-----
6/03	-----	-----	-----
6/04	0.12	-----	0.02
6/05	0.02	-----	T
6/06	0.51	-----	0.43
6/07	0.28	-----	0.96
6/08	0.28	-----	0.13
6/09	T	-----	0.36
6/10	0.64	-----	0.88
6/11	-----	-----	-----
6/12	-----	-----	-----
6/13	0.45	-----	0.58
6/14	0.02	-----	0.07
6/15	1.05	-----	0.29
6/16	0.21	-----	1.16
6/17	0.44	-----	0.33
6/18	0.02	-----	T
6/19	T	-----	-----
6/20	-----	-----	-----
6/21	0.22	-----	0.17
6/22	0.07	-----	1.16
6/23	-----	-----	0.02
6/24	0.49	-----	0.16
6/25	0.13	-----	-----
6/26	-----	-----	-----
6/27	-----	-----	-----
6/28	0.14	-----	0.08
6/29	0.03	-----	0.45
6/30	-----	-----	-----
Monthly Total =	5.26	-----	7.31

Date	***** Equinunk, PA	Precipitation (in.) * Matamoras, PA	Sti
7/01	----	----	
7/02	----	----	
7/03	----	----	
7/04	----	----	
7/05	1.75	0.52	
7/06	0.07	0.46	
7/07	0.12	----	0.
7/08	0.57	0.13	0.8
7/09	----	----	----
7/10	----	----	----
7/11	0.34	T	T
7/12	----	----	T
7/13	----	T	0.02
7/14	T	----	----
7/15	----	----	----
7/16	----	----	0.44
7/17	0.11	T	0.21
7/18	----	----	----
7/19	----	----	----
7/20	0.06	----	0.76
7/21	1.07	0.44	0.01
7/22	0.01	T	0.33
7/23	0.04	0.18	0.74
7/24	----	----	----
7/25	----	----	0.19
7/26	----	----	0.01
7/27	----	----	T
7/28	0.50	0.15	T
7/29	T	----	----
7/30	----	----	----
7/31	----	0.03	0.11
Monthly Total =	4.64	1.91	5.12

	***** Precipitation (in.) *****		
Date	Equinunk, PA	Matamoras, PA	Stroudsburg, PA
8/01	0.04	1.73	0.18
8/02	----	----	----
8/03	0.28	0.33	0.34
8/04	----	----	----
8/05	0.35	0.04	0.24
8/06	0.50	0.10	1.12
8/07	0.75	----	0.07
8/08	----	T	----
8/09	----	----	----
8/10	----	----	----
8/11	----	0.04	0.07
8/12	0.14	0.65	0.58
8/13	0.82	0.51	1.94
8/14	T	0.16	0.06
8/15	----	----	0.06
8/16	----	----	0.06
8/17	----	0.03	----
8/18	----	----	----
8/19	----	T	0.42
8/20	1.11	0.24	0.10
8/21	0.01	----	0.01
8/22	----	----	----
8/23	----	0.13	0.26
8/24	----	T	----
8/25	----	----	----
8/26	----	----	----
8/27	----	----	----
8/28	----	----	T
8/29	----	----	0.04
8/30	0.34	0.52	T
8/31	----	----	----
Monthly			
Total =	4.34	4.48	5.55

Date	***** Equinunk, PA	Precipitation (in.) Matamoras, PA	***** Stroudsburg, PA
9/01	----	----	T
9/02	0.23	T	T
9/03	----	----	----
9/04	----	----	----
9/05	----	----	----
9/06	----	----	----
9/07	----	----	----
9/08	----	----	----
9/09	----	----	----
9/10	----	----	----
9/11	----	----	----
9/12	----	----	----
9/13	----	----	----
9/14	----	----	----
9/15	0.55	0.11	0.14
9/16	----	0.07	0.22
9/17	0.96	1.97	1.69
9/18	0.01	T	----
9/19	0.09	T	1.63
9/20	1.54	3.72	2.04
9/21	0.01	0.82	0.47
9/22	T	0.22	0.17
9/23	0.24	0.38	0.47
9/24	0.37	0.26	0.11
9/25	----	----	----
9/26	0.33	0.45	1.09
9/27	0.02	0.71	----
9/28	----	----	----
9/29	----	----	----
9/30	----	----	----
Monthly			
Total =	4.35	8.71	8.03

T = Trace, an amount too small to measure.

Daily measurements are based on total precipitation as of
8:00 a.m. for each date listed.

From: National Oceanic and Atmospheric Administration.
Climatological Data, Pennsylvania. May thru Sept. 1989.