

3. Surface Water Assessment

This section begins with a discussion of the monitoring programs utilized by DRBC and the data they provide. Those data can, among other purposes, be used to assess attainment of designated uses as described in section 2. Following this discussion are the actual assessments of use attainments for the years 2000 through 2002.

3.1 Current Monitoring Programs

The surface water quality monitoring program utilized by the Delaware River Basin Commission actually consists of three programs:

- The upper and middle non-tidal portions of the River (RM 330.7 to 209.5) are monitored through the *Scenic Rivers Monitoring Program*, a joint National Park Service and DRBC effort.
- The lower non-tidal portions (RM 209.5 to 133.4) are monitored through the *Lower Delaware Monitoring Program*.
- The Estuary, or tidal portion of the Delaware River (RM 133.4 to the mouth of the Delaware Bay), is monitored through the *Delaware River Boat Run Monitoring Program*.
- In addition, data obtained from other agencies, as available, are used to supplement data obtained through the above-mentioned monitoring efforts.

3.1.1 Overview of the Monitoring Programs and Program Goals

Scenic Rivers Monitoring Program (SRMP)

In 1984, The SRMP, a joint NPS/DRBC effort, began monitoring approximately a 121 mile reach of the Delaware River, from RM 330.7 to RM 209.5, which contains two portions of the National Wild and Scenic Rivers System and numerous high quality tributaries that drain portions of New York, New Jersey and Pennsylvania.

The Delaware River Basin Commission and National Park Service (DRBC/NPS) Scenic Rivers Monitoring Program (SRMP) conducts water quality assessment activities in the northern portion of the Delaware River Basin from the lower reaches of the East and West Branches of the Delaware River downstream to the Delaware Water Gap (see Figure 3.1 in Section 3.3, Assessment Methodology). Participating in the program are the Delaware River Basin Commission, the NPS Upper Delaware National Scenic and Recreational River (UDSRR), and the NPS Delaware Water Gap National Recreation Area (DWGNRA).

The monitoring program consists of three elements: baseline monitoring, ecosystem monitoring and special studies. The goals of the program are to:

- Assess whether existing water quality is measurably changing;
- Expand the scope of monitoring to provide an ecosystem monitoring strategy that complements baseline monitoring; and
- Provide scientific information for management decisions.

Lower Delaware Monitoring Program (LDMP)

In 1998, DRBC began monitoring to characterize water quality of the Lower Delaware River, extending from Trenton, NJ (RM 133.4) to the Delaware Water Gap (RM 209.5). See Figure 3.1 in Section 3.3 Assessment Methodology for a location map. The monitoring network was established because little data existed to characterize water quality in the reach, which has been included in the National Wild and Scenic Rivers system. The 1998 pilot study led to establishment of a fixed network for the year 2000, monitored bi-weekly through the May-September season for the purpose of defining existing water quality over a five-year period. The year 2000 results led to the 2001 program, the first of a five-year effort to develop a water quality management strategy that protects and improves the water quality of the Lower Delaware region.

The monitoring program consists of two components: routine baseline monitoring, including water chemistry and physical parameters, and biological monitoring. The chemical/physical component has been established. The biological component is in development.

The Goals of the Program are to:

- Expand and augment baseline water quality, physical, and biological data collection efforts of various federal, state, local, and citizen monitoring agencies
- Allow statistical definition of existing water quality within five years, so that criteria may be established for development of an anti-degradation protection strategy for the Lower Delaware River corridor
- Enable reporting of water quality status and trends, biological response to natural and anthropogenic stressors, quantitative long and short-term changes to channel morphology of the river and its tributaries, and identification of key factors controlling maintenance and improvement of the ecological integrity of the river;
- Support determination of abatement priorities for point and non-point sources of pollution;
- Allow prioritization of tributaries for monitoring and watershed planning purposes;
- Expand ecological knowledge of the Lower Non-Tidal Delaware River; and
- Help to safeguard the health and safety of the river-using public.

Estuary Boat Run Program

The Boat Run Program monitors the tidal portion of the Delaware River from the head of tide at Trenton (RM133.4) to the mouth of the Delaware Bay, delineated as a line from Cape May, New Jersey to Lewes, Delaware. See Figure 3.2 in Section 3.3 (Assessment Methodology) for a graphical depiction of the monitored area.

The goals of the Program are to:

- Provide accurate, precise, and defensible estimates of the surface water quality of the Delaware Estuary
- Allow assessment of water quality standards compliance

3.1.2 Quality Assurance and Control

See Appendices B through D for information on quality assurance and control procedures for the Scenic Rivers Monitoring Program, Lower Delaware Monitoring Program, and Estuary Boat Run Program.

3.1.3 Networks and Programs

Scenic Rivers Monitoring Program

Design Methodology

The design of the Scenic Rivers Monitoring Program is based on:

- A fixed network of monitoring locations
- The number of samples that is needed for data comparison for reach-wide average assessments as well as Boundary Control Point assessments. Boundary Control Points refer to sampling locations, at the mouths of tributaries that flow into the Delaware River, in order to determine their contributions of pollutant loads.
- The frequency of sampling is based on the ability to perform statistically valid assessments for showing measurable changes to existing water quality, using a 95 percent confidence interval about the average.

- The “redesign” of the program in 1995 was in part based on an analysis of past data and its applicability to performing statistically sound analyses.
- Protocols outlined in “Estimation of Pollutant Loads in Rivers and Streams: A Guidance Document for NPS Programs”, Progress Report to EPA Region VIII, 1999, prepared under grant #998397-01-0.
- Other literature

Number and Location of Sites

See Appendix B for a listing of monitoring sites used in the Scenic Rivers Monitoring Program:

- Baseline Scenic Rivers Monitoring Sites
- Flow Measurement Monitoring Locations

Sampled Parameters and Sampling Methods

Detailed field and laboratory procedures are contained in the DRBC/NPS Cooperative Water Quality Monitoring Program Manual (1994). Table 3 in Appendix B Contains a summary of the parameters sampled in the 2000-2001 monitoring programs. Note in the table that not all parameters listed have been monitored during the 2000-2001 programs. Baseline Monitoring Locations are monitored monthly unless ice or safety considerations prevent sample collections.

Use of Reference Conditions

The Scenic Rivers Monitoring Program utilizes “boundary control points” to establish baseline reference conditions at the mouths of tributaries to the main stem Delaware River in this region. These monitoring locations are very useful in determining changes in water quality derived from inputs to the main stem from the adjoining watersheds. Boundary control point locations are listed in Table 1 in Appendix B as “Upper Delaware River Tributaries and Middle Delaware River Tributaries”.

Biological Monitoring

Since the end of a 3-year macroinvertebrate study, biological monitoring of Upper Delaware and Middle Delaware tributaries is being discussed. DRBC surveyed Delaware River macroinvertebrates from Hancock, NY, to Trenton, NJ, in August and September 2001. The ultimate purpose of this survey was to develop narrative and numeric biological criteria for reaches of the entire non-tidal Delaware River.

Fish Tissue Monitoring

During the 2001 monitoring season, one fish tissue sample was taken from the Middle Delaware River, at Montague, New Jersey, as part of a larger effort to sample fish tissue for toxicity. Seven fish were sampled, and included both White Perch and Channel Catfish. Parameters sampled for were PCB congeners, chlorinated pesticides, and metals. The results of this sampling effort are still pending. Other samples were taken from the Lower Delaware River and from the Delaware Estuary.

Lower Delaware Monitoring Program

Design Methodology

Delaware River Water Quality Monitoring Sites (9 bridges) were chosen based on accessibility; equidistance along the river corridor; physiographic regional location, coordination/comparison with other agencies; and location relative to major tributaries or known problem areas. In 2000, two monitoring sites were located at each bridge, one-third of the flow width in from each side of the flowing section. In 2001, three monitoring sites were located at each bridge, at one-quarter of the flow width in from the Pennsylvania side of the River, one-quarter of the flow width in from the New Jersey side of the River, and at center channel site. Composite samples were combined from these sites across the transect.

Tributary Water Chemistry Monitoring Sites (14) include tributaries selected for Lower Delaware Wild and Scenic Rivers (W&S) designation, PA High Quality (HQ) or Exceptional Value (EV) Waters, NJ Trout Maintenance (TM) or Trout Production (TP) Waters, or are streams which contribute a significant flow to the Delaware and are important hydrologic or pollutant loading influences. Some sites were chosen as comparison sites with other monitoring programs such as the Pennsylvania DEP's Water Quality Network (WQN) and New Jersey DEP's Ambient Surface Water network (ASW). Additional criteria for selection of a tributary included known problems, development pressure, and local interest or existence of a volunteer watershed group. Data are collected from other agencies to supplement DRBC's database for the Lower Delaware, and to verify the accuracy of each agency's data.

Number and Location of Sites

See Appendix C for a listing of the sites utilized in the Lower Delaware Monitoring Program:

- Continuous-Recording Water Quality and Flow Measurement Monitoring Locations
- Flow Monitoring Locations for Developing Flow-Rating Curves for Loadings
- Water Chemistry Monitoring Sites-Mainstem
- Water Chemistry Monitoring Sites-Tributary
- Sites Not Monitored in 2001-Established Sites for Establishing Existing Water Quality

For the 2000-2001 monitoring seasons, twenty-three long-term monitoring sites were sampled biweekly.

Sampled Parameters and Sampling Methods

Table 5 in Appendix C describes the parameters sampled for the Lower Delaware Monitoring Program in 2000 and 2001 as well as the methods and equipment used. Sampling consists of bi-monthly chemical/physical sampling at 9 bridges over the Delaware River and on 14 tributaries to the Delaware River between the Delaware Water Gap and Trenton, NJ. This results in 10 samples per site collected from 23 sites, from May through September.

Use of Reference Conditions

Table 6 in Appendix C lists ten Delaware River tributary sites that were not monitored in the 2000-2001 monitoring season but which were selected as boundary control points or reference sites for future monitoring. These locations are intended to establish "existing water quality" in the Lower Delaware River and thus will be used to indicate changes in water quality over time.

Biological Monitoring/Intensive Studies

During 1999 and 2000, DRBC staff met with monitoring counterparts representing the Pennsylvania DEP, New Jersey DEP, and the USGS National Water Quality Assessment (NAWQA) Delaware Basin Study Unit team members. All agencies expressed the need for biological monitoring of the Delaware River, and expect DRBC to lead main stem Delaware River biological monitoring. A comprehensive biomonitoring program should include examination of multiple assemblages and communities, including fish, macroinvertebrates, periphyton, submerged

aquatic macrophytes, and phyto- and zooplankton. Management priorities, lack of funds, and staff limitations have prevented implementation of such an effort.

However, with existing resources, certain activities have been undertaken to provide a biological monitoring component to Delaware River water quality monitoring. Complementary to DRBC's physical and chemical data gathering, macroinvertebrate monitoring provides a better rounded view of water quality conditions in the Delaware River, and should provide sufficient data for scientifically-based decisions regarding protective and preventive management of a known high-quality resource.

During the summer and fall of 2001, DRBC conducted reconnaissance of the river, basic macroinvertebrate collections, and methods investigations. This activity is expected to continue at least through 2005. By supplementing the traditional water chemistry monitoring with biological and geomorphologic investigations, DRBC intends to gather sufficient information to serve the following needs:

- Develop data sufficient to define Existing Water Quality; protect areas of known high water quality; and improve water quality in impaired areas of the Lower Non-Tidal Delaware River (76 miles). The current chemical monitoring component meets this need only partially. No quantitative biological criteria currently exist for the Lower Non-Tidal Delaware River or near-confluence tributary locations
- Implement Special Protection Waters regulations adopted in the early 1990's for the upper 121 miles of the Delaware River. As of 2001, the current chemistry-only monitoring program does not serve this need. No biological criteria were implemented, though they are a required component of measuring "existing water quality" for the Delaware River and tributary Boundary Control Points (see Section II on Special Protection Waters). A "bio-criteria" program was conducted by the Upper Delaware Scenic and Recreational River and the Delaware Water Gap National Recreation Area units of the National Park Service, in cooperation with the Academy of Natural Sciences in the mid-1990's. This study will provide direction for the development of Special Protection Waters bio-criteria by DRBC and NPS.
- Develop a Benthic Index of Biological Integrity (B-IBI) for the non-tidal Delaware River. This began in 2001 with an intensive 3-year macroinvertebrate survey of accessible river sites, targeting the richest-available habitats (riffles, runs, island margins). A B-IBI will be developed to quantify ecological integrity of the entire 200-mile non-tidal river. Further testing (years 2004-2005) of the most sensitive metrics for detecting 'measurable change' will be refined and incorporated into a B-IBI useful for protecting long-term ecological integrity of the river.

Fish Tissue Monitoring

Fish sampling during the 2000-2001 monitoring seasons occurred at two Lower Delaware River locations. The results of this sampling effort are pending and should provide insights into the condition of water quality as it relates to toxic substances.

Estuary Boat Run Program

Design Methodology

A maximum of 22 locations are sampled, most under slack tide conditions. Staff from Delaware DNREC, under contract with the Commission, perform the work. Samples are collected at a depth of three feet below the water surface at low, or high water slack as designated

Number and Location of Sites

See Appendix D for a listing of the monitoring sites utilized in the Estuary Boat Run Program:

Sampled Parameters and Sampling Methods

Table 1 in Appendix D outlines the parameter categories sampled as part of the Estuary Boat Run Program and the locations at which measurements are taken. Table 2 provides the methods used, and the reporting limits for the parameters sampled.

Sampling Frequency

Samples are collected with the frequency shown in Table 3 in Appendix D. Sampling is generally performed during March through November. High water slack runs are conducted about every third run. Air and water temperature as well as pH and Secchi disk are measured, as indicated in Table 2, at time of sampling.

The period of sampling for the Estuary and River stations is once per month during the months of March, June, July and October and twice per month for the months of April, May, August and September of each calendar year. The period of sampling for the Lower Bay Stations is once per month during the periods of March, April, May, July, Aug, September and October.

Toxics Monitoring

The Estuary Boat Run Program conducts water quality sampling for three heavy metals: Copper, Chromium and Zinc. In addition, special studies have been conducted for Lead as well.

Fish Tissue Monitoring

In years 2000 and 2001, fish tissue samples were collected from five locations in the Delaware Estuary for analysis of organic contaminants (PCBs, DDTs, HCHs, Chlordane-related compounds and pesticides) and trace metals. Sampling locations include Crosswicks Creek (RM 128.4), Tacony Palmyra Bridge (RM 107.9), Paulsboro (RM 87.9), Deepwater (RM 65.5) and The Chesapeake and Delaware Canal (RM 58.6). Fish tissue data are used to determine the ambient concentrations of key toxicants in water bodies by using conversion factors that account for the accumulation of those substances in fish tissue. They do not, however, account for bioaccumulation through the food chain. The water quality assessment presented in this section of the report utilizes these data for the purpose of determining drinking water use attainment.

3.1.4 Coordination and Collaboration with Other Programs

The three programs discussed in this section work in concert to provide complete longitudinal coverage of the shared, interstate waters of the Delaware River. However, there are a number of other sources of data utilized for assessment purposes.

As noted in Table 2 in Appendix B, flow measurement data from the USGS are utilized in the DRBC/NPS program. Relationships between other programs and the Scenic Rivers Monitoring Program include County, US Fish and Wildlife, watershed groups, and the USGS (NAWQA Program). If another monitoring program shows interest for integrating program operations with this program, such proposals would be considered favorably

DRBC has a contract with the Pennsylvania Department of Environmental Protection (PADEP) to provide monitoring information on the tidal portions of its tributaries to the Delaware River. Two sites on the Schuylkill and a site on each of Chester, Crum, Darby, Frankford, Neshaminy, Pennypack, Poquessing and Ridley Creeks make up this network. Data from this monitoring is used in the assessments provided in this report.

Other data are provided by the Delaware Department of Natural Resources and Environmental Conservation (DNREC), from the General Assessment Monitoring component of their Surface Water Quality Monitoring Program.

3.1.5 Program Evaluations

Scenic Rivers Monitoring Program

Updates to Monitoring Strategy

In the 2001 monitoring season, chemical sampling was modified to include a composite of three samples per bridge location, as opposed to two in the 2000 season. Samples are now taken from the center of the bridge, and halfway from the center to the edge of the flow width.

The location of boundary control points in the Middle Delaware River (the Delaware Water Gap National Recreation Area) have been established at the NPS boundaries. Portions of the main stem and tributaries that fall within those boundaries are classified as Outstanding Basin Waters and regulations require no measurable change to existing water quality at the Park Service boundaries. Future monitoring will use these tributary boundary control point locations for this segment of the River.

Effectiveness in Meeting Program Objectives

The ability of the SRMP to assess the status of existing water quality for “measurable change” has been hampered by a lack of financial resources (for example, reduced federal funding, including Section 106 grant money) which has prevented laboratory analysis of water samples (except fecal coliform) since 1993. For the 2000-2002 monitoring program, data are available on temperature, dissolved oxygen, conductivity, pH and fecal coliform. A number of parameters, as listed in Appendix B, Table 3, have not been sampled for during this monitoring period. Some parameters are sampled for determining measurable change and to assist in making waste load allocations when reviewing permit applications for discharges. See Section 2 on Water Quality Standards.

With regard to providing scientific and technical input to management decisions, data collected are useful in making waste load allocations for dischargers to Special Protection Waters in the Basin, where antidegradation policies and more stringent point and non-point pollution control requirements exist. Decisions on how to permit new or expanded regulated discharges are based upon the expected effects on the existing water quality in these areas, and those expectations are driven by the data derived from the SRMP.

Changes Needed to Evaluate New Problems

Currently, an analysis by DRBC and NPS is underway to develop a new monitoring and data assessment protocol for better determining measurable change in the Upper and Middle Delaware River. This update is expected to include a change in monitoring frequency at boundary control points and for determining statistically valid changes to Existing Water Quality.

Additional Monitoring or Data Management Tools Needed

Financial resources remain a concern for the effectiveness of the Scenic Rivers Monitoring Program. As mentioned, not all parameters for which existing water quality has been established are routinely monitored. For data management, currently there is interest in purchasing a STORET pre-processor to facilitate entry of monitoring data into that database.

Lower Delaware Monitoring Program

Changes to the Program

In 2001, the monitoring program has 9 fewer sites than it previously has had, 8 of which were on tributaries and 1 on the main stem of the river. Although the current tributary sites are located on the larger streams, some of the smaller streams that are no longer being monitored may be experiencing water quality degradation which will not show up in the River samples (due to dilution) until the streams become more severely degraded. This impedes the overall effectiveness of the program and would require additional funding in order to provide more comprehensive monitoring coverage.

Changes Needed to Evaluate New Problems

Better coordination with the States for monitoring and long-term water quality/quantity assessments at Boundary Control Points on the tributaries would provide a better evaluation of changes to "existing" water quality. Funding limitations continue to be a concern for maintaining an effective network that not only provides information on current conditions (for such reports as this one) but also would allow the program to meet its other objective of detecting changes to existing water quality.

Additional Monitoring or Data Management Tools Needed

Local municipalities would benefit by having available a locally-based stream model for illustrating present strengths and weaknesses in existing or potential ordinances for water quality/quantity protection. Examples include the effects of mitigating storm water runoff and erosion, proper installation and maintenance of septic systems, pre and post-development ground and surface water evaluations, and protecting water quality and the aquatic ecosystem.

Of additional use would be the tools necessary to model the interaction of the stream and canal networks in the Lower Delaware region. This would allow for a better understanding of the locations, timing and magnitude of pollutant loadings and would help focus limited monitoring resources on identified data needs.