



Delaware River
STATE OF THE BASIN REPORT
2008



A scenic view of the Delaware River. In the foreground, a person is kayaking on the water. In the middle ground, a long bridge spans across the river. The background is a dense forest of green trees under a blue sky with some clouds.

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Message from the Executive Director



The water resources of the Delaware River Basin are vital to the long term health of our citizens and the stability of our economy. These resources supply our drinking water, support our industries, transport our products, provide habitat to a wide array of living resources and contribute to overall quality of life. Management of these resources is a complex task involving all levels of government, public-private partnerships, and a multitude of laws, regulations, and competing interests.

Policy makers and citizens alike often ask me if the health of the system is “getting better.” My answer is both “Yes” and “No”. While we have made great strides in water quality improvement, we still have a long way to go in many respects. To truly assess issues of ecosystem health and sustainable use, we need to answer a series of questions spanning multiple dimensions of resource management. Examples include:

How clean are the water resources of the Delaware River, its tributaries and Bay?

Do we have enough water for drinking and commerce? Is it safe to drink?

Are our waters “swimmable”?

Are fish abundant and safe to eat? How are other living resources faring?

Is critical habitat being protected?

Are years of management and stewardship yielding good results?

Are we prepared to meet the issues we might face in the future?

Responding to these questions requires environmental managers to set goals for the protection and improvement of resources, to efficiently assess issues and trends, and to monitor the success of implemented management strategies—all of which require high-quality data, scientific information, and an effective feedback system. You can’t manage what you don’t measure.

This State of the Basin Report 2008 is designed to serve as a benchmark of current conditions and a point of reference for gauging progress toward management goals. It also provides a platform for measuring and reporting future progress in water resource management, and a guide for adjusting monitoring and assessment programs. Finally, it is intended to communicate our understanding of the health of the Basin, to increase public involvement in Delaware River Basin and Estuary Program activities, and to build consensus on a broad array of actions that can be taken to continue to improve water quality, water availability, and enhance the living resources of the Delaware River Basin.

Carol R. Collier
December 2008

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- Partnership for the Delaware Estuary
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In addition to DRBC publications and in-house data, major sources of information for this report include USEPA Storet, USGS NWIS, and an array of environmental quality information from NJDEP, PADEP, DE DNREC, NYDEC, US Fish and Wildlife Service, US Forest Service, and the Nature Conservancy. In 1998, as part of the National Water Quality Assessment Program (NAWQA), the US Geological Survey undertook a four year study (1998–2002) of water quality issues in the Delaware River Basin. This Report draws on some of the results of that study.¹ The introduction to Category II: Water Quality relies significantly on Richard C. Albert's seminal article on the history of water resource management in the basin.² Much of the background and conditions reported in Category III: Living Resources was published in the State of the Delaware Estuary 2008.³ References to DRBC's 1981 Level B Study have been used where appropriate to bridge the past and present. A Technical Summary of data underpinning this Report has been published separately by the Water Resources Agency at the University of Delaware.⁴

DRBC staff are also grateful to the many members of state agencies and the

1 Fischer et al. *Water Quality in the Delaware River Basin, Pennsylvania, New York, and Delaware, 1998-2001*. Circular 1227. Reston VA: USGS, 2004.

2 Albert, R.C. "The Historical Context of Water Quality Management for the Delaware Estuary", *Estuaries* 11 no. 2 (1988): 99-107.

3 Partnership for the Delaware Estuary. "State of the Delaware Estuary 2008", Report no. 08-01. *Estuary News* 18 no.3 (Summer 2008).

4 Kauffman, G. et al. *Technical Summary: State of the Delaware Basin Report*. Water Resources Agency, Institute for Public Administration, University of Delaware. Newark DE: July 2008.

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In addition to identifying desired environmental end states, the *Water Resources Plan for the Delaware River Basin* includes goals for the development of partnerships; the exchange of data, information and technology; and the improvement of coordination and cooperation among basin institutions, agencies and organizations. The *State of the Basin Report 2008*, product of a extensive collaborative effort, fulfills those goals.

Table of Contents

INTRODUCTION

The Basin – Then and Now	2
Welcome to the Delaware River Basin	5

CATEGORY I • HYDROLOGY 8

Indicators:

Flows at Trenton	12
Salt Line Location	14
Water Use Efficiency	15
Water Use	16
Water Supply Sources	18
Areas of Ground Water Stress	20
Flood Damage	22

Feature:

Climate Change	24
--------------------------	----

CATEGORY II • WATER QUALITY 28

Indicators:

Nutrients	31
Dissolved Oxygen	32
Water Clarity	34
Metals: Copper	36
Fish Consumption Advisories	37
Pesticides	38
Toxics: PCBs	40
Support of Designated Use: Tributaries	42
Trends in Tributary Water Quality	43
Support of Designated Use: Delaware River & Bay	44

Feature:

Contaminants of Emerging Concern	46
--	----

CATEGORY III • LIVING RESOURCES 48

Indicators:

Macroinvertebrates	50
Freshwater Mussels	52
Oysters	53
Horseshoe Crabs	54
Shorebirds – Red knot	55
Louisiana Waterthrush	56
Bald Eagle	57
Striped Bass and Weakfish	58
Atlantic Sturgeon	59
Shad	60
Brook Trout	61

Feature:

Invasive Species	62
----------------------------	----

CATEGORY IV • LANDSCAPE 64

Indicators:

Population Growth and Distribution	66
Population Density	68
Land Use 2001	70
Land Consumption	72
Dams	73
Forests	74
Wetlands	76
Tidal Wetland Buffers	77

Feature:

Valuing Natural Landscapes	78
--------------------------------------	----

SUMMARY & RECOMMENDATIONS 80

ILLUSTRATIONS 84

ACRONYMS

Introduction

The Basin ~ Then and Now

THEN -... the activities of man vastly affect the behavior of water and ecology of the Delaware River Basin. The Estuary and Bay have been dredged to accommodate deeper draft ships, thereby altering the tidal prism; dredge spoil has been deposited on lowlands previously available to accept flood flows; people have settled where supplies of fresh water are periodically inadequate; waste products have been discharged into the stream system without regard to effect on aquatic habitat; much of the watershed land use has been modified by agriculture and urbanization, altering the erosion, surface runoff, and the delicate balance between land and water in the rivers, bays and marshes; major ground water reservoirs have been pumped to a point where water now flows from surface streams to the aquifer instead of from the aquifer to the streams; and surface storage reservoirs have been constructed to conserve water during periods of high flow for release during periods of low flow to meet the ever-increasing demands of man.

The Final Report & Environmental Impact Statement
of the Level B Study, May 1981
Delaware River Basin Commission

How clean are the water resources of the Delaware River,
its tributaries and Bay?

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Is it safe to drink?

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Is critical habitat being protected?
Are our years of management and stewardship yielding
good results?

Are we prepared to meet the issues we might face
in the future?

Starting in 1976, a comprehensive study was conducted to identify and resolve water resource problems in the Basin. The resulting "Level B Study" issued in 1981 by the Delaware River Basin

Commission (DRBC) reported the findings of that study, including resource conditions and recommendations for management. Since then, many excellent specialized studies have been published on a

variety of water resource issues, but the *Level B Study* remains the last comprehensive assessment of the Basin – including water supply, water quality and flow management issues – published in one volume.

30-50 Million years ago

The Delaware River and valley are formed.

1610

Delaware Bay is named in honor of Lord De La Warre (Thomas West), governor of Jamestown.

1769

The Delaware River at Philadelphia is described as a "mess" by a visiting Englishman.

1776

The Declaration of Independence is signed in Philadelphia. George Washington crosses the Delaware River above Trenton, NJ on Christmas Eve.

1790

John Fitch operates the 1st successful steamboat on the Delaware River.

1799

1st government pollution survey notes contamination entering the river from ships and sewers.

The *Final Report and Environmental Impact Statement* is commonly referred to as the *Level B Study*, since it conformed to guidelines established by the now defunct US Water Resource Council for a study of its magnitude, or Level B.

In 1999, a process was begun to develop a new and unifying vision for water resource management. The *Water Resources Plan for the Delaware River Basin* (Basin Plan), unveiled in 2004, presents a direction for integrated water resource management, acknowledging the connection between land and water and valuing aquatic habitat protection in the course of ensuring adequate flows and supplies for human needs. In accepting the new Basin Plan, the Governors directed the preparation of a periodic environmental condition report. This *Delaware River: State of the Basin Report 2008* fulfills that mandate.

In 1980 when the Level B Study was under

development, the population of the basin was slightly greater than 7 million; the Clean Water Act was not yet a decade old; and industrial and municipal wastewater did not receive the level of treatment that it does today. There are now more than half a million additional people living in the River Basin and 25 years of advanced water treatment and remediation technology have been applied to water resource problems.

Have conditions improved? Has the *imbalance* noted in the 1981 Study been restored in the intervening 25 years? As we will see, the answer is both yes, and no. There have been improvements in resource condition, especially water quality, because of important changes in management policies. For example, required improvements in wastewater treatment have raised the levels of dissolved oxygen and restored shad runs to the River. However, the presence of toxic compounds and our ever-increasing ability to



Hawk's Nest, NY

detect them in more minute quantities still leads to consumption advisories for many fish species in spite of site clean ups and cleaner water. Nutrients are holding steady, but concerns about pharmaceuticals and other compounds are growing. A trio of floods ravaged portions of the Basin in 2004, 2005 and 2006, re-focusing interest in flood mitigation. And international panels are preparing reports on

1801

Philadelphia's water department is the first in America to supply an entire city with drinking water; Fairmount Water Works on the Schuylkill River serve as a model for other American water delivery systems.

1931

The US Supreme Court grants NYC the right to withdraw 440 mgd from two reservoirs to be built on the headwater tributaries of the Delaware.

1936

The states of NJ, NY, and PA create the Interstate Commission on the Delaware River Basin to clean up pollution. DE joins three years later in 1939.

1954

US Supreme Court amends 1931 decree to increase NYC diversion to 800 mgd, specify flows at Montague NY, and approve 3rd reservoir.

1961

The Delaware River Basin Commission is formed, 1st interstate-federal agreement for comprehensive river basin management.

a changing climate, predicting more rapid changes that challenge our planning and management.

Based on 25 additional years of investigation and assessment, we know more about many issues, from toxic compounds to the effects of landscape changes, than we did in 1981. Yet our knowledge remains incomplete. We are still learning about the relationships among the natural elements of the system – such as soil, geology, slope, rainfall, temperature and chemistry – and of the effects of human influence on parts of this complex system. Changes occur even as we examine and calculate.

This *State of the Basin Report 2008* offers a view of conditions of the Basin's landscapes and waters based on available information on a set of discrete indicators.

Indicators

An *indicator* is a measure of condition; an environmental indicator is a measurement, value or statistic that provides an approximate gauge of the state of the environment and may help evaluate the effectiveness of an environmental management program. Ideally, an indicator is relevant, sensitive to change, easy to measure with low measurement error, and cost effective. For this report, indicators were chosen in part because information on them was readily available.

For each indicator, we include a **Description** and a statement of **Desired Condition** linked to a goal from the 2004 *Water Resources Plan for the Delaware River Basin* (BP), an Action item from the 1997 *Comprehensive Conservation Management Plan for the Delaware Estuary* (CCMP), and, when appropriate, to regulatory standards. There is also a report of condition **Status** and, if relevant, of historic or recent **Trends**. A **status bar** resembling a horizontal thermometer with a red-to-green color gradient accompanies each indicator, where green represents a good condition, and red an unfavorable condition. The placement of an icon indicates the condition status along the continuum, and its style reflects a stable, improving or worsening trend.

Concluding each indicator page is a statement of **Actions and Needs**, advising on improvements or changes that should be considered to enhance reporting capabilities and environmental conditions.

Reporting

Indicators are assembled into four categories:

- Category I: Hydrology
- Category II: Water Quality
- Category III: Living Resources
- Category IV: Landscape

The *State of the Basin Report 2008* offers a view of conditions of the Basin's landscapes and waters based on available information. It serves as a benchmark of current conditions, as a companion to the 1981 *Level B Study*, and as a point of reference for gauging progress towards the goals of the 2004 *Water Resources Plan for the Delaware River Basin*.

Each category section begins with an introduction and event timeline, and ends with a special feature on emerging issues to suggest ideas for future reporting. The final section of the Report summarizes conditions and recommendations.

The *State of the Basin Report 2008* is designed to serve as a benchmark of current conditions, and as a point of reference for gauging progress towards management goals. It also provides a platform for measuring and reporting future progress in water resource management, and a guide for adjusting monitoring and assessment programs.

1970

1st US Earth Day celebrated; the federal Environmental Protection Agency is established.

1972

FWPCA amendments establish construction grant program and permit discharge process for discharges; subsequently known as the Clean Water Act.

1978

Sections of the upper and middle Delaware River are added to the National Wild and Scenic Rivers System.

1981

Good Faith Agreement advances equitable allocation of basin waters.

1990s

Striped bass and American shad return to the Delaware River in large numbers.

2000

Sections of the lower Delaware River are added to the National Wild and Scenic Rivers System.

Welcome to the Delaware River Basin

Introduction

Basin Overview

Welcome to the Delaware River Basin

Lying in the densely populated corridor of the northeastern US, the 13,600 square mile Delaware River basin stretches approximately 330 miles from headwaters in New York State to its confluence with the Atlantic Ocean. The basin includes approximately 12,800 square miles of land area, nearly 800 square miles of Bay and over 2,000 tributaries, including many that are rivers in their own right. The Delaware River's condition is very much a product of the cumulative flows from its many tributaries, which in turn take their character from the underlying geology, topography, microclimates and land uses of their watersheds.

The northernmost tributaries to the Delaware River originate in the forested western slopes of the Catskill Mountains that reach elevations of up to 4,000 feet. The East and West Branches meet at Hancock NY where the Delaware River officially begins. The River descends about 800 feet on its journey to the sea.

Political Setting

The drainage area encompasses extensive landscapes in New York, New Jersey, Pennsylvania and Delaware and 8 square miles in Maryland, which are not included in this Report. All or portions of 42 counties and 838 municipalities within four states contribute to and benefit from the resources of the Delaware River Basin. Water resources are also exported to cities in NJ and NY outside of the Basin boundary. While the states retain autonomy, the Delaware River Basin is unique in governance. It is the only river basin with both an interstate-federal Commission and a national estuary program in place. The 1961 Compact establishing the Delaware River Basin Commission (DRBC) was the first federal-interstate agreement for basin-scale water resources management. The DRBC pre-dates the first Earth Day, the establishment of the Environmental Protection Agency and the passage of the Clean Water Act. The national significance of the Delaware Estuary was acknowledged in 1988 when it became part of the National Estuary Program.

How old is the Delaware River?

It is thought that the formation of the Delaware River valley began during cycles of erosion and uplift approximately 30 to 50 million years ago. From Port Jervis to the Water Gap, the Delaware follows a strike (or valley) eroded in shales and limestones. The S-shaped curve at Wallpack Bend is a meander of a tributary stream eroded in this time period. From the Water Gap to Trenton the Delaware flows in a southeast course and this is thought to be the original flow direction of the River.

Below Trenton the River closely follows its contact with the bedrock formations of the Piedmont. Why and how the Delaware River was diverted in a right-angle turn at Trenton by softer sediments—when it had eroded through the harder strata of diabase, argillite, sandstone and shale up stream—is not in accord with normal river development and remains somewhat of a mystery. One possible explanation is that the ancestral Delaware flowed southeastward through its entire length across NJ, as did the ancestral Schuylkill River. Both rivers eventually became the product of stream capture by smaller streams flowing parallel to the southwest strike and created the existing context of the Delaware River and Bay.

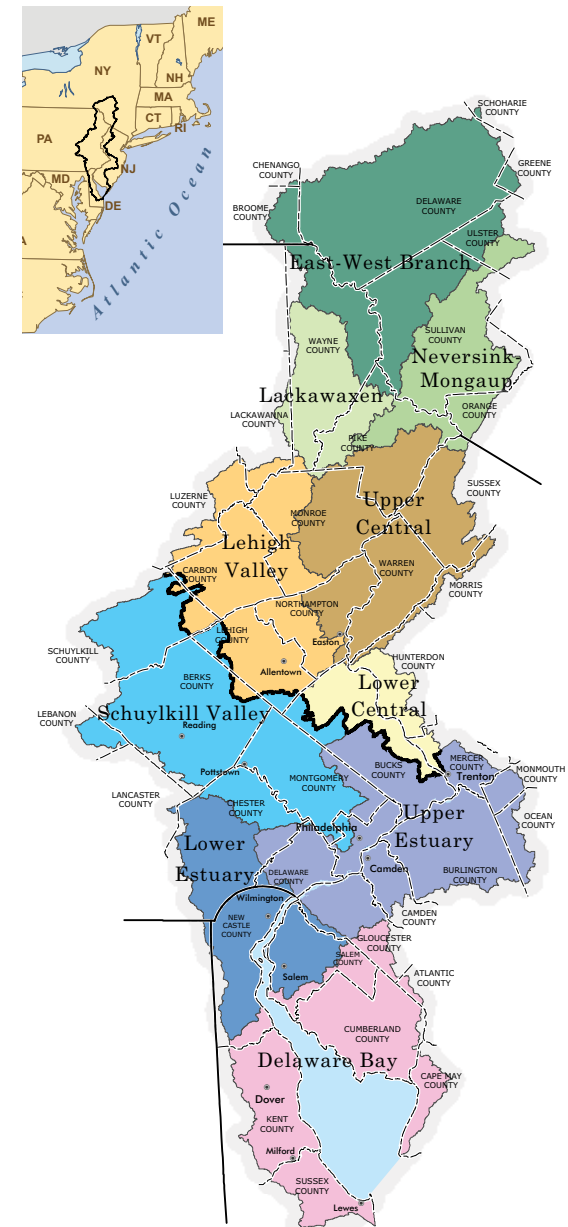


Fig. A.1. Watershed Regions.

What's in a name?

The Delaware River Basin straddles two very different hydrologic provinces corresponding to major physiographic divisions: the Appalachian Highlands and the Atlantic Coastal Plain (Figure 1.1 on the next page). The *fall line* is the natural division between these provinces, running southwest to northeast along the western edge of the River and crossing it near Trenton NJ. Above the fall line freshwater riverine conditions exist. Below the fall line the River is subject to tidal influences and, with increased proximity to the Bay, estuarine conditions exist.

This report honors the Basin as a whole system of functioning parts, and the majority of reporting is on the basin scale. There is also reporting on the regional scale, referencing four regions of the basin. In the context of this Report:

- The **Upper Region** covers the Delaware River headwaters and contributing watersheds to just below Port Jervis NY.
- The **Central Region** is the remaining freshwater river and contributing watersheds between the Upper Region and Trenton NJ.
- The **Lower Region** is the area of tidal flux from Trenton to the head of the Bay and all contributing watersheds.
- The **Bay Region** includes the Bay and the surrounding watersheds.

Combined, the Lower and Bay Regions may also be referred to as the Estuary Region. It is the same area that is included in the National Estuary Program.

Within each region watersheds are grouped together based on the segment of river or bay to which they drain, irrespective of political divisions. For example, in the Upper Region, the Neversink and Mongaup watershed in New York are grouped together with smaller tributaries in Pennsylvania because they all flow into the same stretch of Delaware.

The Delaware River Basin is defined by its natural physical characteristics and by the legacies of hundreds of years of human settlement and use. The basin has been traversed by canals and rail lines and, today, an extensive network of roads link population centers within the basin to one another and to major metropolitan centers; New York City, for example, is within a two hour drive of Philadelphia. The natural landscapes of the Delaware that have attracted artists and vacationers for generations are today under increasing pressure to accommodate an expanding population. Conditions within the Basin therefore reflect historic and current circumstances both within the basin and beyond it.

Water resources are also exported outside of the Basin boundaries to cities in NJ and NY.

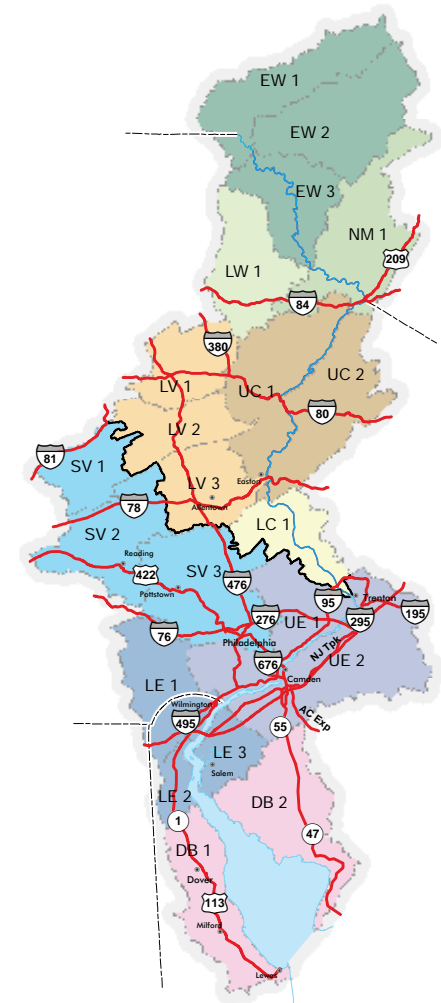
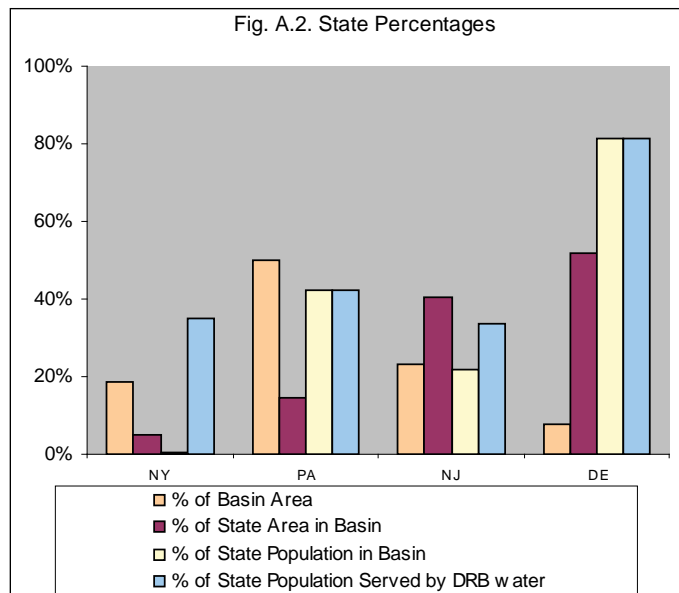


Fig. A.3. Location of Watersheds

- Upper Region**
 EW • East & West Branch;
 LW • Lackawaxen;
 NM • Neversink & Mongaup
- Central Region**
 UC • Upper Central watersheds;
 LV • Lehigh Valley;
 LC • Lower Central
- Lower Region**
 SV • Schuylkill Valley;
 UE • Upper Estuary;
 LE • Lower Estuary
- Bay Region**
 DB1 • Bay watersheds in DE;
 DB2 • Bay watersheds in NJ