Delaware River Basin Commission

2004 Delaware River and Bay Integrated List Water Quality Assessment

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Delaware River Basin Commission
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Introduction and Overview

This report provides an assessment of the Delaware River's support of various uses from 2000 through 2002 that are protected by the Delaware River Basin Commission's (DRBC) Water Quality Regulations, or by the federal Clean Water Act of 1972. The uses are: maintenance of aquatic life; providing a raw water source for human consumption; swimming and recreation; fish consumption; and shellfish consumption. The assessment primarily involves comparisons of several key water quality parameters with DRBC water quality standards and stream quality objectives. DRBC Water Quality Regulations also designate agricultural and industrial uses for the Delaware River. However, since these two uses would require less stringent water quality criteria than the other uses discussed, they were not assessed for this report.

In accordance with the U.S. Environmental Protection Agency's (EPA) *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates* (September 1997), as well as their *Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act*, this report assesses designated use support in the mainstem and bay of the Delaware River Basin.

Assessed water bodies (assessment units) are placed into one of five categories. These are based primarily upon the totality of designated use support within those water bodies as well as the availability of data for assessing water quality in those water bodies. For each designated use, in each assessment unit, a number of water quality parameters, relevant to the use, are compared to the existing, applicable water quality criteria. The methodology used to make the assessments is presented in Part 3 of this report.

1. Summary

Table 1.1 shows the levels to which the assessed portions, or assessment units, of the non-tidal Delaware River supported their designated uses during the 2000 through 2002 monitoring seasons. Segments of the River that were assessed as not supporting the aquatic life designated use were 1A1, 1A2, 1B1 and 1E4 due to pH, 1B2 due to Turbidity, 1D2-1D4 and 1D6 due to Total Dissolved Solids. Additionally, the recreation designated use was considered not supported in 1D6, 1E2 and 1E5 due to fecal coliform and the drinking water designated use was considered not supported in 1B2 due to turbidity. The Fish consumption use was the most widely not supported use, with the entire non-tidal Delaware River falling under one or more state fish consumption advisories.

Table 1.2 provides a summary of the extent of use support for the designated uses, in the different assessment units of the Delaware Estuary. The aquatic life designated use was considered not supported in 3 due to temperature and pH, 4 due to temperature and toxic parameters, 5B due to toxic parameters and 5C due to dissolved oxygen. The drinking water designated use was considered not supported in Zones 2 and 3 due to DRBC's combined human health criteria (for PCBs) for drinking water and fish consumption. The fish consumption designated use was considered to be not supported in any part of the Estuary, due to state fish consumption advisories that are in place.

Table 1.3 provides a summary of the extent of use support for the designated uses, in different assessment units of the Delaware Bay. The aquatic life designated use was considered not supported in 6br2b, 5brA, 6de1, 6de5 and 6nj9 due to dissolved oxygen, in 6nj1 due to temperature and dissolved oxygen and in 6brB due to temperature. Fish consumption was not supported in any portion of the Bay due to the presence of state fish consumption advisories. The shellfish designated use was considered not supported in all areas closed to shellfish harvesting.

Tables 1.4 and 1.5 provide a summary of use support by region (Non-Tidal and Estuary/Bay), expressed in miles or square miles and percent of total miles or total square miles.

Tables 1.6 - 1.8 provide an overview of causes and sources of pollutants or conditions that created the non-support of uses as described in this report. The causes of the non-support are the chemical constituents,

pollutants or conditions that created the criteria violations. The source is the activity that creates the condition or pollutant, or causes the pollutant to enter the stream. In many circumstances, professional judgment was utilized in surmising the most likely sources Table1.1: Use Support in Non-Tidal River Assessment Units from 2004 Integrated Assessment

Table 1.1: Use Support in Non-Tidal River Assessment Units from 2004 Integrated Assessment

AU	River Miles*	DO	pH	Fecal	Turbidity	TDS Aquatic Life	TDS Drinking Water	Alkalinity	Aquatic Life Assessment	Recreation Assessment	Drinking Water Assessment	Fish Consumption Assessment	Final Assessment
1A1	335.54-308.01	+	-	+	+	+	+	NA	Not Supported	Supported	Supported	Not Supported	5
1A2	308.01-299.38	+	-	+	+	ID	ID	NA	Not Supported	Supported	ID	Not Supported	5
1A3	299.38-293.62	ID	ID	ID	ID	ID	ID	NA	Probably Not Supported	Probably Supported	ID	Not Supported	3A
1B1	293.62-281.11	+	-	+	+	ID	ID	NA	Not Supported	Supported	ID	Not Supported	5
1B2	281.11-264.88	+	+	+	-	ID	ID	NA	Not Supported	Supported	Not Supported	Not Supported	5
1B3	264.88-257.67	+	+	+	+	+	+	NA	Supported	Supported	Supported	Not Supported	2
1C1	257.67-256.53	ID	ID	ID	ID	ID	ID	NA	ID	Probably Supported	ID	Not Supported	3B
1C2	256.53-229.85	+	+	+	+	ID	ID	NA	Probably Supported	Supported	ID	Not Supported	5
1C3	229.85-228.13	ID	ID	ID	ID	ID	ID	NA	ID	Probably Supported	ID	Not Supported	5
1C4	228.13-219.35	+	+	+	+	ID	ID	NA	ID	Supported	ID	Not Supported	5
1D1	219.35-214.70	+	+	+	+	ID	ID	NA	ID	Supported	ID	Not Supported	5
1D2	214.70-210.20	+	+	+	+	-	+	NA	Not Supported	Supported	Supported	Not Supported	5
1D3	210.20-200.89	+	+	+	+	-	+	NA	Not Supported	Supported	Supported	Not Supported	5
1D4	200.09-192.71	+	+	ID	ID	-	+	NA	Not Supported	Probably Supported	ID	Not Supported	5
1D5	192.71-185.83	ID	ID	ID	ID	ID	ID	NA	Probably Not Supported	ID	ID	Not Supported	5
1D6	185.83-185.41	+	+	-	+	-	+	NA	Not Supported	Not Supported	Supported	Not Supported	5
1E1	185.41-179.02	ID	ID	ID	ID	ID	ID	ID	ID	Probably Not Supported	Probably Supported	Not Supported	5
1E2	179.02-176.16	+	+	-	+	+	+	+	Supported	Not Supported	Supported	Not Supported	5
1E3	176.16-173.88	ID	ID	ID	ID	ID	ID	ID	ID	ID	Probably Supported	Not Supported	5
1E4	173.88-156.22	+	-	+	+	+	+	+	Not Supported	Supported	Supported	Not Supported	5
1E5	156.22-133.4	+	+	-	+	+	+	+	Supported	Not Supported	Supported	Not Supported	5

Notes:

* River miles reflect National Hydrographic Dataset mileage system, which differs slightly from DRBC river mileage system.
ID: Insufficient data to compare this parameter to current water quality criterion
Aquatic Life Use Support Assessed by: DO, pH, TDS, Alkalinity, Turbidity
Recreation Use Support Assessed by: Fecal Coliform
Drinking Water Use Assessed by: TDS, Turbidity
Fish Consumption Use Assessed by: Presence of Advisories

Table 1.2: Use Support in Estuary Assessment Units from 2004 Integrated Assessment

Parameter	Assessment Unit					
	2	3	4	5A	5B	5C
Dissolved Oxygen	+	-	+	ID	ID	-
Temperature	+	-	-	NA	NA	NA
pH	+	+	+	+	+	+
Fecal Coliform	+	+	+	+	+	+
Enterococcus	+	+	+	+	+	+
Turbidity	+	+	+	+	+	+
Alkalinity	+	+	+	+	+	+
Sodium	NA	+	NA	NA	NA	NA
Chloride	+	+	NA	NA	NA	NA
TDS	+	+	NA	NA	NA	NA
Toxicity	+	+	+	ID	ID	+
Toxic Parameters	+	+	-	+	-	+
Designated Use	**Use Support Level**					
Aquatic Life	Supported	Not Supported	Not Supported	ID	Not Supported	Not Supported
Recreation	Supported	Supported	Supported	Supported	Supported	Supported
Drinking Water	Not Supported	Not Supported	NA	NA	NA	NA
Fish Consumption	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Final Assessment Category	**5**	**5**	**5**	**5**	**5**	**5**

Notes:
NA: Ambient criteria not applied in these zones
+(-): This parameter meets (does not meet) current water quality criterion
ID: Insufficient Data
Aquatic Life Use Support Assessed by: DO, Temperature, pH, TDS, Alkalinity, Turbidity, Toxicity, Toxic Parameters
Recreation Use Support Assessed by: Fecal Coliform
Drinking Water Use Assessed by: TDS, Turbidity, Chloride in Zones 2 and 3, Sodium in Zone 3, Toxic Parameters
Fish Consumption Use Assessed by: Presence of Advisories

Table 1.3: Use Support in Delaware Bay Assessment Units from 2004 Integrated Assessment

Assessment Unit	Miles[2]	DO	pH	Temp.	Fecal	Entero.	Alkalinity	Turbidity	Aquatic Life	Recreation	Fish	Shellfish	Final
6br1a	2.66	ID	ID	ID	ID	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6br1b	20.61	+	+	+	+	+	+	+	Supported	Supported	Not Supported	Supported	5
6br2a	1.09	ID	ID	ID	ID	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6br2b	25.88	-	ID	ID	+	ID	ID	ID	Not Supported	Supported	Not Supported	Supported	5
6br2c	0.31	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6br2d	1.52	ID	ID	ID	ID	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6br3a	16.45	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6br3b	12.63	+	+	+	+	+	+	+	Supported	Supported	Not Supported	Supported	5
6br3c	8.53	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6brA	47.10	-	+	+	+	+	+	+	Not Supported	Supported	Not Supported	Supported	5
6brB	40.82	+	+	-	+	+	+	+	Not Supported	Supported	Not Supported	Supported	5
6brC	22.39	+	+	+	+	+	+	+	Supported	Supported	Not Supported	Supported	5
6de1	187.24	-	+	+	+	+	+	ID	Not Supported	Supported	Not Supported	Supported	5
6de2	0.72	ID	ID	ID	ID	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6de3	5.31	+	+	+	+	+	+	ID	ID	Supported	Not Supported	Not Supported	5
6de4	5.39	ID	ID	ID	ID	ID	ID	ID	ID	ID	Not Supported	Not Supported	5
6de5	5.81	-	+	+	+	+	+	+	Not Supported	Supported	Not Supported	Not Supported	5
6nj1	268.96	-	ID	-	+	ID	ID	ID	Not Supported	ID	Not Supported	Supported	5
6nj2	1.65	+	ID	+	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj3	2.96	+	ID	+	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj4	0.65	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj5	0.82	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj6	0.69	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj7	7.17	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj8	3.23	+	ID	+	+	ID	ID	ID	ID	ID	Not Supported	Supported	5
6nj9	1.32	-	ID	+	ID	ID	ID	ID	Not Supported	ID	Not Supported	Not Supported	5
6nj10	1.00	ID	ID	ID	+	ID	ID	ID	ID	ID	Not Supported	Not Supported	5

Aquatic Life Use Support Assessed by: DO, pH, TDS, Alkalinity, Turbidity

Recreation Use Support Assessed by: Fecal Coliform

Drinking Water Use Assessed by: TDS, Turbidity

Fish Consumption Use Assessed by: Presence of Advisories

Table 1.4: Extent of Use Support of Designated Uses (Non-Tidal River)

Use	Total Miles	Miles Supporting	Miles with Insufficient Data	Miles Not Supporting
Aquatic Life	202	33	64	105
Fish Consumption	202	0	0	202
Primary Contact Recreation	202	144	32	26
Drinking Water	202	93	93	16

Table 1.5: Extent of Use Support of Designated Uses (Estuary and Bay)

Use	Total Area (mi^2)	Area Supporting (mi^2)	Area with Insufficient Data (mi^2)	Area Not Supporting (mi^2)
Aquatic Life	790	64	73	653
Fish Consumption	790	0	0	790
Shellfishing	693	652	0	41
Primary Contact Recreation	769	444	325	0
Secondary Contact Recreation	21	21	0	0
Drinking Water	15	0	0	15

Note: Zone 2 = 8 square miles, Zone 3 = 7 square miles, Zone 4 = 17 square miles, Zone 5 = 65 square miles, Zone 6 = 693 square miles (total area is 790 square miles)

Table 1.6: Overview of Causes and Sources of Impairments in Non-Tidal Delaware River

Assessment Unit	Use Not Supported	Causes	Possible Sources
1A1	Aquatic Life	pH	Excessive Plant Growth*
1A1	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1A2	Aquatic Life	pH	Excessive Plant Growth*
1A2	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1A3	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1B1	Aquatic Life	pH	Excessive Plant Growth*
1B1	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1B2	Aquatic Life	Turbidity	Unknown Sources
1B2	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1B2	Drinking Water	Turbidity	Unknown Sources
1B3	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C1	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C2	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C3	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1C4	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D1	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D2	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D2	Aquatic Life	Total Dissolved Solids	Natural Sources, Unknown Sources
1D3	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D3	Aquatic Life	Total Dissolved Solids	Natural Sources, Unknown Sources
1D4	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D4	Aquatic Life	Total Dissolved Solids	Natural Sources, Unknown Sources
1D5	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D6	Aquatic Life	Total Dissolved Solids	Natural Sources, Unknown Sources
1D6	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1D6	Primary Contact Recreation	Fecal Coliform	Residential Districts, Wet Weather Discharges (Non-Point Source)
1E1	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1E2	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1E2	Primary Contact Recreation	Fecal Coliform	Residential Districts, Wet Weather Discharges (Non-Point Source)
1E3	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1E4	Fish Consumption	Mercury	Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1E4	Aquatic Life	pH	Excessive Plant Growth*
1E5	Fish Consumption	Dioxins, Mercury, PCBs	Brownfield Sites, Contaminated Sediments, Some Industrial Point Sources, Nonpoint Sources, Air Deposition
1E5	Primary Contact Recreation	Fecal Coliform	Residential Districts, Wet Weather Discharges (Non-Point Source)

* Excessive plant growth, if a source of pH criterion exceedence, may be caused by nutrient enrichment

Table 1.7: Overview of Causes and Sources of Impairments in Delaware Estuary

Assessment Unit	Use Not Supported	Causes	Possible Sources
2	Drinking Water	PCBs	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources
2	Fish Consumption	PCBs, Dioxins, Mercury	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources, Air Deposition
3	Drinking Water	PCBs	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources
3	Fish Consumption	PCBs, Dioxins, Mercury	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources, Air Deposition
3	Drinking Water	PCBs	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources
3	Aquatic Life	Temperature	Drought-Related Impacts, Urbanized High Density Areas
3	Aquatic Life	Dissolved Oxygen	Municipal Point Source Discharges, Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Residential Districts
4	Fish Consumption	PCBs, Dioxins, Mercury	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources, Air Deposition
4	Aquatic Life	Temperature	Drought-Related Impacts, Urbanized High Density Areas
4	Aquatic Life	Copper	Unknown Sources
5a	Fish Consumption	PCBs, Dioxins, Mercury, Arsenic, Chlorinated Pesticides	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Air Deposition, Unknown Sources
5b	Aquatic Life	Copper	Unknown Sources
5b	Fish Consumption	PCBs, Dioxins, Mercury, Arsenic, Chlorinated Pesticides	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Air Deposition, Unknown Sources
5c	Aquatic Life	Dissolved Oxygen	Municipal Point Source Discharges, Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Residential Districts
5c	Fish Consumption	PCBs, Dioxins, Mercury	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources, Air Deposition

Table 1.8: Overview of Causes and Sources of Impairments in Delaware Bay

Assessment Unit	Use Not Supported	Causes	Possible Sources
All Units	Fish Consumption	PCBs, Dioxins, Mercury	Brownfield Sites, Contaminated Sediments, Wet Weather Discharges, Unknown Sources, Air Deposition
6br1a	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6br2a	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6br2b	Aquatic Life	Dissolved Oxygen	Municipal Point Source Discharges, Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture
6br2d	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6br3a	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6brA	Aquatic Life	Dissolved Oxygen	Municipal Point Source Discharges, Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture
6brB	Aquatic Life	Temperature	Drought-Related Impacts, Urbanized High Density Areas, Natural Sources
6de1	Aquatic Life	Dissolved Oxygen	Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture, Natural Sources
6de2	Shellfishing	Pathogens	Wet Weather Discharges
6de3	Shellfishing	Pathogens	Wet Weather Discharges
6de4	Shellfishing	Pathogens	Wet Weather Discharges
6de5	Aquatic Life	Dissolved Oxygen	Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture, Natural Sources
6de5	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6nj1	Aquatic Life	Dissolved Oxygen	Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture, Natural Sources
6nj9	Aquatic Life	Dissolved Oxygen	Wet Weather Discharges, Non-Point Sources, Small Flow Discharges, Agriculture, Natural Sources
6nj9	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts
6nj10	Shellfishing	Pathogens	Wet Weather Discharges, Residential Districts

2. Background

This section gives an overview of the Delaware River Basin's water resources and other geographic statistics. A brief discussion of the various aspects of the Delaware River Basin Commission's (DRBC) water pollution control program is also provided, including how it relates to some other regulatory entities in the Basin. Finally, a description of some special issues of concern and recommendations for dealing with them is given.

2.1 An Overview of the Delaware River Basin

The Delaware is the longest un-dammed river east of the Mississippi, extending from the confluence of its East and West branches at Hancock, N.Y. to the mouth of the Delaware Bay. 216 tributaries feed the river, the largest being the Schuylkill and Lehigh Rivers in Pennsylvania. In all, the basin contains approximately 13,500 square miles, draining parts of Pennsylvania (50.3 percent of the basin's total land area); New Jersey (23.3%); New York (18.5%); and Delaware (7.9%). See Figure 2.1 for a map of the Basin. Table 2.1 provides geographical statistics for the Delaware River Basin.

Figure 2.1: Delaware River Basin

Source: 2004 DRBC Integrated List

Over 17 million people rely on the waters of the Delaware River Basin for drinking and industrial use and the Delaware Bay is only a day's drive away for about 40 percent of the people living in the United States. Yet the basin drains only four-tenths of one percent of the total continental U.S. land area.

Three reaches of the Delaware River have been included in the National Wild and Scenic Rivers System. One section extends 73 miles from the confluence of the river's East and West branches at Hancock, N.Y. downstream to Milrift, PA; the second is a 40-mile stretch from just south of Port Jervis, NY downstream to the Delaware Water Gap near Stroudsburg, Pa. The Lower Delaware Wild and Scenic Rivers Act, signed into law on November 1, 2000, adds about 65 miles of the Delaware and selected tributaries to the national system, linking the Delaware Water Gap and Washington Crossing, PA, just upstream of Trenton, N.J. Currently, almost the entire non-tidal Delaware River (the portion north of the "fall line" at Trenton, New Jersey) is included in the National Wild and Scenic Rivers System. The Maurice River in New Jersey (a Delaware Bay tributary) and the White Clay Creek in Pennsylvania and Delaware (which flows into the Christina River, a tributary to the Delaware) also have been included in the national system.

The Delaware Bay and tidal reach of the Delaware River have been included in the National Estuary Program, a project set up to protect estuarine systems of national significance.

As a result of clean-up efforts in the Delaware River, shad and other fish species are increasing in number. A record number of juvenile shad were netted in the Delaware during 1996, a strong indication of exceptionally good spawning runs when these fish return to the river as adults. A recent study of Delaware River shad fishing placed a $3.2 million annual value on this fishery alone.

There are other economic benefits from the river. The Port of Philadelphia, for instance, generated $335 million in business revenue during 1997, according to the Philadelphia Regional Port Authority. State and local taxes from port transactions that year totaled $13 million and there were 3,622 jobs directly stemming from port activities.

The population of the Delaware River Basin increased by approximately 3.7 percent between 1990 and 2000, according to U.S. Census Bureau figures. Large growth spurts occurred in Pennsylvania's Pocono Mountain region and in the Philadelphia suburbs. The Basin's population rose by about 270,000 over the decade with the 1990 figure standing at roughly 7.31 million people. The basin provides water to approximately 10 million people who live outside of its boundaries.

Table 2.1: Delaware River Basin Geographic Statistics (approximate)

Total Basin Land Area (mi^2)[a]	12,700
Population (2000)	7.6 million
Major River Basins (HUC 8)[b]	13
River Miles (Named)[a]	9,080
Border (Shared) River Miles[a]	339
Square Miles of Public Lakes and Reservoirs[b]	140
Square Miles of Estuary/Bay[b]	783
Square Miles of Wetlands[b]	480

[a]DRBC GIS files

[b]National Hydrographic Dataset

2.2 Water Pollution Control Programs

DRBC's water pollution control program is carried out through a series of interdependent steps and provides a rational approach to protecting and restoring water quality in the Basin. The waters of the Basin are protected for designated uses with water quality objectives that specify what levels of individual parameters are appropriate, based upon a review of the current scientific understanding about the needs of those uses. DRBC's monitoring programs provide a mechanism to evaluate how those water quality objectives are being met, and assessment of those monitored data provide the link to how well the designated uses are being protected. The identified impairment of interstate waters in the Basin leads to the development of TMDLs and the issuing of permits to reduce loading of pollutants in order to improve water quality to those levels that meet the objectives. In addition, DRBC has other layers of protection (see Special Protection Waters below) that aim to maintain existing water quality where it is better than the water quality objectives.

2.2.1 Watershed Approach

Because activities that affect the water quality of the Basin's many streams can individually or cumulatively impact the water quality of the main stem River, many of DRBC's regulations and programs are based on a watershed concept and focus on those interrelationships. The following are examples of how the Commission takes a multi-faceted approach to water quality regulation.

Special Protection Waters

Currently, portions of the Delaware River are designated by DRBC as "Special Protection Waters" (differentiated as either Outstanding Basin Waters or Significant Resource Waters) and have associated with them a variety of specific pollution prevention and reduction requirements. Designated reaches are comprised of (see Figure 2.2):

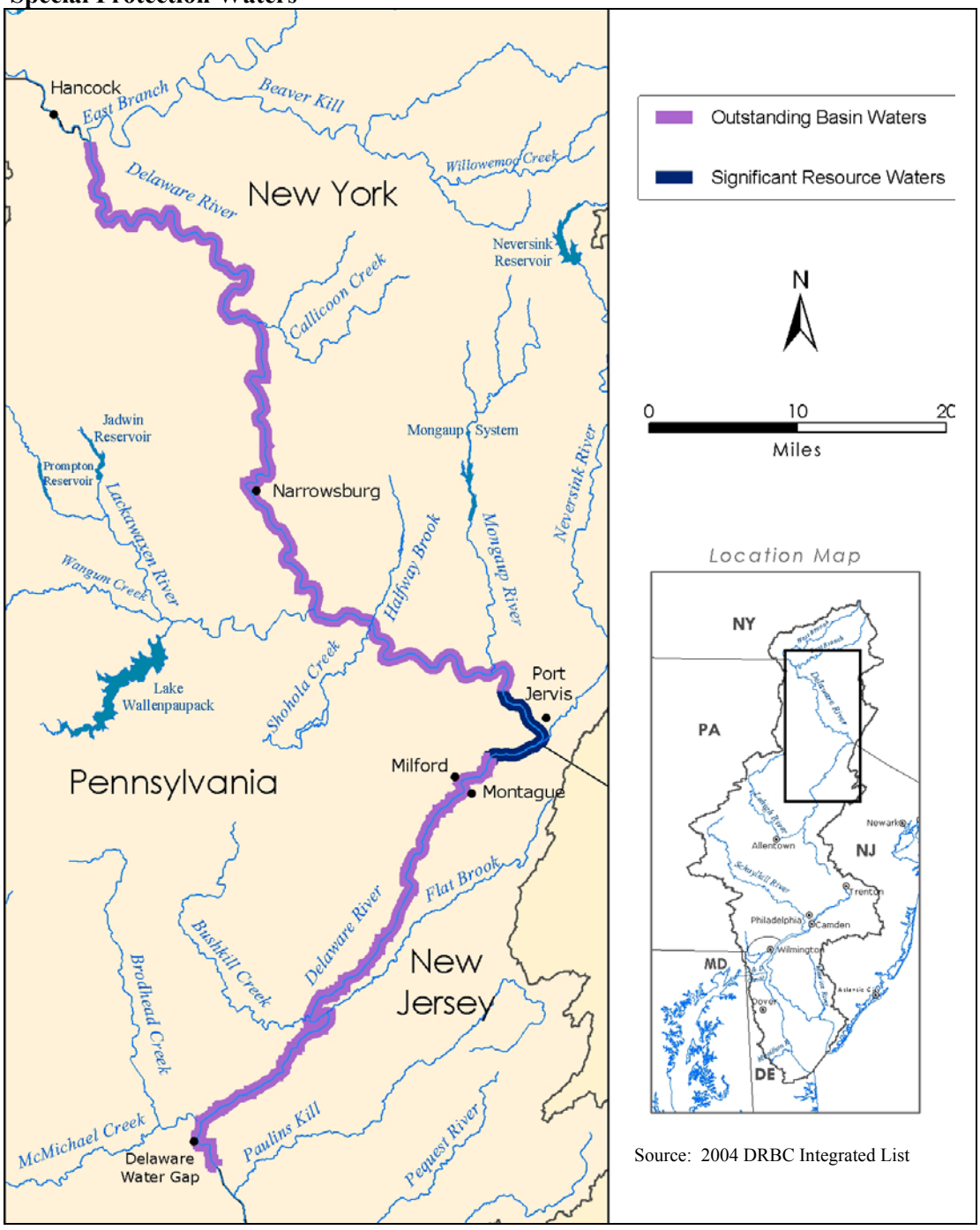
Outstanding Basin Waters

- The Upper Delaware Scenic and Recreational River from Hancock, NY to Milrift, NY (Delaware River between River Miles 330.7 and 258.4)
- Portions of intrastate tributaries located within the established boundary of the Upper Delaware Scenic and Recreational River Corridor
- The Middle Delaware Scenic and Recreational River from Milrift, NY to the Delaware Water Gap (Delaware River between River Miles 250.1 and 209.5)
- Portions of tributaries located within the established boundaries of the Delaware Water Gap National Recreation Area

Significant Resource Waters

- The Delaware River between River Miles from Milrift, NY to Milford, PA 258.4 and 250.1

Figure 2.2: Special Protection Waters



Source: 2004 DRBC Integrated List

Special Protection Waters regulations take a watershed approach to antidegradation of water quality. The regulations apply to the drainage area of the designated waters. Policies provide an up-front approach to reducing or eliminating new pollutant loadings, through requirements made in the docket (permit) review process, for the purpose of maintaining "Existing Water Quality" (EWQ) in designated waters. This is accomplished, in part, by looking at the cumulative impacts of point and nonpoint sources as they may affect the designated waters, either through direct discharge or through tributary loading. EWQ is defined (in DRBC Water Quality Regulations) as "the actual concentration of a water constituent at an in-stream site or sites, as determined through field measurements and laboratory analysis of data collected over a time period determined by the Commission to adequately reflect the

natural range of the hydraulic and climatologic factors which affect water quality". Numerical criteria for Special Protection Waters EWQ are defined as "(a) an annual or seasonal mean of the available water quality data, (b) two-tailed upper and lower 95 percent confidence limits around the mean, and (c) the 10^{th} and 90^{th} percentiles of the dataset from which the mean was calculated." EWQ was defined for the above-mentioned portions of the River in 1992.

Estuary CBOD Allocations

DRBC allocates loading of carbonaceous biological oxygen demand (CBOD) among dischargers in the Delaware Estuary. Allowable loads are apportioned through the permit review process by utilizing steady-state modeling to estimate the cumulative impacts of discharges. As the assimilative capacity of a zone is reached, or when allocations existing at that time are no longer equitable, the capacity in the zone, minus a reserve, is reallocated among the waste dischargers in that zone.

Integrated Resource Planning

In 1998, DRBC amended its Southeast Pennsylvania Ground Water Protected Area (SPGWA) Regulations (adopted 1980) to include watershed-based ground water withdrawal limits for sub-basins that lie entirely or partially within the SPGWA. As required by the Regulations, those withdrawal limits may be revised by the Commission to be more protective of streams designated by the State of Pennsylvania as either "high quality" or "exceptional value", or "wild" or "scenic", or "pastoral", or to correspond to more stringent requirements in "integrated resource plans" adopted and implemented by all municipalities in the sub-basin. Integrated Resource Plans (IRPs) must assess water resources and existing uses of water; estimate future water demands and resource requirements; evaluate supply-side and demand-side alternatives to meet water withdrawal needs; assess options for wastewater discharge to subsurface formations and streams; consider storm water and floodplain management; assess the capacity of the sub-basin to meet present and future demands for withdrawal and non-withdrawal uses such as instream flows; identify potential conflicts and problems; incorporate public participation; and outline plans and programs including land use ordinances to resolve conflicts and meet needs. The development of IRPs helps focus and coordinate planning tools to consider the multiple uses of water resources and the interrelationships of water quality and quantity to meet various needs.

Basin Planning Process

DRBC is currently heading a process to develop a "forward-looking" Water Resources Plan for the Delaware River Basin. This plan outlines numerous mechanisms for protecting, preserving and enhancing the water resources of the Basin, on a watershed basis, through the development of desired outcomes, goals, objectives, indicators and management strategies. The plan is multi-faceted in its approach and calls for the active involvement of a broad range of governmental and non-governmental entities in addition to DRBC.

The Plan includes such concepts as the integration of water resources considerations into land use planning and management, the development of analytical tools to evaluate water resources impacts of municipal land use plans, the preparation of all necessary TMDLs by the dates required by states, and the use of regulatory and non-regulatory approaches to maintaining and improving water quality where it is better than criteria.

2.2.2 Water Quality Standards Program

Water quality standards provide a description of water body uses to be protected as well as water quality objectives necessary to protect those uses. DRBC's water quality standards program derives its authority from Section 3.2 of the Delaware River Basin Compact (1961) which directs the Commission to adopt "a comprehensive plan…for the immediate and long range development and uses of the water resources of the basin" and to adopt "a water resources program, based upon the comprehensive plan, which shall include a systematic presentation of the quantity and quality of water resources needs of the area…"; and Section 5.2 which allows the Commission to "assume jurisdiction to control future pollution and abate existing pollution in the waters of the basin, whenever it determines…that the effectuation of the comprehensive plan so requires."

Designated Uses

Water uses are paramount in determining stream quality objectives, which, in turn, are the basis for determining discharge effluent quality requirements. Water quality standards require that all surface waters of the Basin be maintained in a safe and satisfactory condition for the following uses:

- Agricultural, industrial and public water supplies after reasonable treatment, except where natural salinity precludes such uses;
- Wildlife, fish and other aquatic life;
- Recreation;
- Navigation;
- Controlled and regulated waste assimilation to the extent that such use is compatible with other uses;
- Such other uses as may be provided by the Commission's Comprehensive Plan

Designated uses have been established specifically for the interstate zones of the Delaware River, as described in Tables 2.2 and 2.3. Figure 2.3 depicts the main-stem zones in the Basin and Table 2.4 shows the application of designated uses to specific zones. Zones 1A-E (assessed for this report) and Zones E, W1, W2, N1 and N2 (not assessed for this report) represent the non-tidal portions of the Delaware River. Zones 2-6 (assessed in this report) and C1-8 (not assessed in this report) represent the Estuary, or tidal portions of the River, including the tidal portions of the tributaries to the River.

Figure 2.3: Main Stem Water Quality Zones for the Delaware River

Source: 2004 DRBC Integrated List

Table 2.2: Main Stem, Shared Delaware River Water Quality Zones

Zone	Location
1A	RM 330.7 - 289.9
1B	RM 289.9 - 254.75
1C	RM 254.75 - 217.0
1D	RM 217.0 - 183.66
1E	RM 183.66 - 133.4
2	RM 133.4 - 108.4
3	RM108.4 - 95.0
4	RM 95. 0 - 78.8
5	RM 78.8 - 48.2
6	RM 48.2 - 0.0

Note: Zones 1A to 1D (RM 209.5) are currently Special Protection Waters. 1D (from RM209.5) to 1E has been proposed as Special Protection Waters.

Table 2.3: Other Interstate Delaware River Zones (not assessed in this report)

Zone	Location
E	E. Branch to RM 330.7
W1	W. Branch to RM 330.7
W2	RM 1.8 on Sand Pond Ck. to RM 10.1 on W. Branch; Cat Hollow Bk. to RM 1.05 on Sand Pond Ck.; Sherman Ck. to RM 1.8 on Sand Pond Ck.; unnamed Sherman Ck. trib. to RM 1.6 on Sherman Ck.; Starboard Ck. to RM 1.81 on Sand Pond Ck.
N1	RM 0.5 on Neversink R. to RM 253.64
N2	Clove Bk. to RM 0.5 on Neversink R.; unnamed Clove Bk. trib. to RM 1.0 on Clove Bk.; unnamed trib. to Clove Bk. trib. to RM 0.7 on Clove Bk. trib.
C1	Source to RM 16.3 on Christina River
C2	W. Branch Christina R. to RM 25.7 on Christina R.; Persimmon Run to RM 0.8 on W. Branch Christina R.; E. Branch Christina R. to RM 30.2 on Christina R.
C3	White Clay Ck. to RM 14.7 at PA-DE line
C4	RM 14.7 on White Clay Ck. to RM 10.0 on Christina R.
C5	RM 13.4 on Red Clay Ck. to RM 12.6 at PA-DE line; W. Branch Red Clay Ck. to RM 13.4 on Red Clay Ck.
C6	RM 12.6 on Red Clay Ck. at PA-DE line to RM 2.6 on White Clay Ck.
C7	RM 20.0 on Brandywine Ck. to head of tide at RM 2.0 on Brandywine Ck.; W. Branch Brandywine Ck. to RM 20.0 on Brandywine Ck.
C8	Naaman Ck. to head of tide in DE

Table 2.4: Assignment of Designated Uses to the Mainstem Delaware River

Designated Uses	Applicable Zones
Agricultural water supplies	Zones 1,2 and 3
Industrial water supplies after reasonable treatment	All Zones
Maintenance and propagation of resident fish and other aquatic life	Zones 2 and 6
Maintenance and propagation of resident game fish and other aquatic life	Zone 1
Maintenance and propagation of shellfish	Zone 6
Maintenance and propagation of trout	Zone 1A
Maintenance of resident fish and other aquatic life	Zones 3-5
Navigation	Zones 2-6
Passage of anadromous fish	Zones 2-6
Propagation of resident fish	Zone 5 (RM 70.0-48.2)
Public water supplies after reasonable treatment	Zones 1,2 and 3
Recreation	Zones 1, 2, 4 (below RM 81.8), 5 and 6
Secondary contact recreation	Zones 3 and 4 (above RM 81.8)
Spawning and nursery habitat for anadromous fish	Zones 1A-1E
Wildlife	All Zones

Ambient Water Quality Standards

Sections 3.20, 3.30, and 3.40 of DRBC's Water Quality Regulations define the "Water Quality Objectives", or ambient water quality standards for the non-tidal river, tidal river and Basin ground water, respectively. Objectives are zone-based and define the water quality necessary to protect the designated uses in those zones. For the water quality assessments in Part 3, monitored data are compared against the zone standards for determining use attainment. Table 2.5 shows the water quality objectives for the non-tidal main stem and Table 2.6 shows the objectives for the tidal portions of the Delaware River main stem and tributaries.

Table 2.5: Water Quality Objectives for Non-tidal Delaware River Zones

Parameter	Zones																	
	1A	1B	1C	1D	1E	E	W1	W2	N1	N2	C1	C2	C3	C4	C5	C6	C7	C8
BACTERIA–FECAL COLIFORM--Not to exceed 200 per 100 ml as a geometric average; samples shall be taken at such frequency and location as to permit valid interpretation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ALKALINITY--Not less than 20 mg/l					X													
DISSOLVED OXYGEN																		
Not less than 4.0 mg/l at any time		X	X	X	X				X		X	X		X		X	X	X
Not less than 5.0 mg/l at any time	X					X	X	X		X			X		X			
Not less than 7.0 mg/l in spawning areas whenever temperatures are suitable for trout spawning	X					X	X	X		X			X		X			
Minimum 24 hour average of 5.0 mg/l		X	X	X	X				X		X	X		X		X	X	X
Minimum 24 hour average of 6.0 mg/l	X					X	X	X		X			X		X			
PHENOLS --Not to exceed 0.005 mg/l unless due to natural conditions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PH																		
Between 6.0 and 8.5	X	X	X	X	X	X	X	X			X	X	X	X	X	X		X
Between 6.5 and 8.5									X	X							X	
RADIOACTIVITY--Alpha emitters not to exceed 3 pc/l (picocuries per liter); Beta emitters not to exceed 1000 pc/l	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SYNTHETIC DETERGENTS (Methylene Blue Active Substances (M.B.A.S.))--Not to exceed 0.5 mg/l	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2.5 Continued

Parameter	Zones																	
	1A	1B	1C	1D	1E	E	W1	W2	N1	N2	C1	C2	C3	C4	C5	C6	C7	C8
TEMPERATURE																		
Not to exceed 5 degrees F (2.8 degrees C) rise above ambient temperature until stream temperature reaches 50 degrees F (10 degrees C)	X					X	X	X		X			X		X			
Not to exceed 2 degrees F (1.1 degrees C) rise above ambient temperature when stream temperature is between 50 degrees F (10 degrees C) and 58 degrees F (14.4 degrees C)	X					X	X	X		X			X		X			
Natural temperature will prevail above 58 degrees F (14.4 degrees C)	X					X	X	X		X			X		X			
Not to exceed 5 degrees F (2.8 degrees C) rise above ambient temperature until stream temperature reaches 87 degrees F (30.6 degrees C)		X	X	X	X				X		X	X		X		X	X	X
Natural temperature will prevail above 87 degrees F (30.6 degrees C)		X	X	X	X				X		X	X		X		X	X	X
TOTAL DISSOLVED SOLIDS--Not to exceed 133 percent of background, or 500 mg/l, whichever is less	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TURBIDITY																		
Unless exceeded due to natural conditions: maximum 30 day average 10 units, maximum 150 units	X	X																
Not to exceed the natural background by 10 units, or a maximum of 25 units, whichever is less											X	X	X	X	X	X	X	
Unless exceeded due to natural conditions: maximum 30 day average 20 units, maximum 150 units			X	X														
Unless exceeded due to natural conditions: maximum 30 day average 30 units, maximum 150 units					X													
Increases not to be attributable to industrial waste discharges											X	X	X	X	X	X	X	
THRESHOLD ODOR NUMBER--Not to exceed 24 units at 60 degrees C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2.6: Water Quality Objectives for the Tidal Delaware River Zones (Estuary)

Parameter	Zone				
	2	3	4	5	6
BACTERIA–FECAL COLIFORM					
Maximum geometric average 200 per 100 ml	X			X	X
Maximum geometric average 770 per 100 ml		X			
Above R.M. 81.8 maximum geometric average 770 per 100 ml			X		
Below R.M. 81.8 maximum geometric average 200 per 100 ml			X		
BACTERIA–ENTEROCOCCUS					
Maximum geometric average 33 per 100 ml	X				
Maximum geometric average 88 per 100 ml		X			
Above R.M. 81.8 maximum geometric average 88 per 100 ml			X		
Below R.M. 81.8 maximum geometric average 33 per 100 ml			X		
Maximum geometric average 35 per 100 ml				X	X
BACTERIA--COLIFORM, TOTAL--MPN (most probable number) not to exceed Federal shellfish standards in designated shellfish areas					X
ALKALINITY					
Maintain between 20-100 mg/l	X				
Maintain between 20-120 mg/l		X	X	X	X
DISSOLVED OXYGEN					
Not less than 5.0 mg/l at any time unless due to natural conditions					X
Minimum 24 hour average of 3.5 mg/l		X	X		
Minimum 24 hour average of 5.0 mg/l	X				
Minimum 24 hour average of 6.0 mg/l					X
Minimum 24 hour average concentration: At R.M. 78.8: 3.5 mg/l At R.M. 70.0: 4.5 mg/l At R.M. 59.5: 6.0 mg/l				X	
During the periods from April 1 to June 15 and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l	X	X	X	X	

Table 2.6 Continued

Parameter	Zone				
	2	3	4	5	6
CHLORIDE					
Maximum 15-day average concentration of 50 mg/l	X				
Maximum 30-day average concentration of 180 mg/l at R.M. 98		X			
PHENOLS					
Not to exceed 0.005 mg/l unless due to natural conditions	X	X			
Maximum 0.02 mg/l, unless exceeded due to natural conditions			X		
Maximum 0.01 mg/l, unless exceeded due to natural conditions				X	X
PH --Between 6.5 and 8.5	X	X	X	X	X
HARDNESS					
Maximum 30 day average of 95 mg/l	X				
Maximum 30 day average of 150 mg/l		X			
RADIOACTIVITY					
Alpha emitters not to exceed 3 pc/l (picocuries per liter)	X	X	X	X	X
Beta emitters not to exceed 1000 pc/l	X	X	X	X	X
SODIUM–Maximum 30 day average concentration of 100 mg/l at R.M. 98		X			
SYNTHETIC DETERGENTS (Methylene Blue Active Substances (M.B.A.S.)					
Maximum 30 day average of 0.5 mg/l	X				
Maximum 30 day average of 1.0 mg/l		X	X	X	X

Table 2.6 Continued

Parameter	Zone				
	2	3	4	5	6
TEMPERATURE					
Shall not exceed 5 degrees F (2.8 degrees C) above the average 24-hour temperature gradient displayed during the 1961-66 period, or a maximum of 86 degrees F (30 degrees C), whichever is less	X	X	X		
Shall not be raised above ambient by more than: 1) 4 degrees F (2.2 degrees C) during September through May, nor 2) 1.5 degrees F (0.8 degrees C) during June through August;				X	X
The maximum temperatures shall not exceed 86 degrees F (30.0 degrees C)				X	
The maximum temperatures shall not exceed 85 degrees F (29.4 degrees C)					X
TOTAL DISSOLVED SOLIDS					
Not to exceed 133 percent of background, or 500 mg/l, whichever is less	X	X			
Not to exceed 133 percent of background			X		
TURBIDITY					
Unless exceeded due to natural conditions: maximum 30 day average 40 units, maximum 150 units	X	X	X	X	X
Unless exceeded due to natural conditions above R.M. 117.81 during the period May 30 to September 15, maximum 30 units	X				
THRESHOLD ODOR NUMBER --Not to exceed 24 units at 60 degrees C	X	X	X	X	X

Ambient Standards for Drinking Water Sources

Zones 1, 2 and 3 of the Delaware River are given the designated use of "public water supplies after reasonable treatment". It is the general policy of DRBC that all ground water of the Basin, as well as surface sources of drinking water, should not exceed maximum contaminant levels (MCL) given in the National Primary Drinking Water Standards. In Zones 2 and 3, there is additional definition of the permissible levels of specific toxicants in waters designated for both drinking water as well as fish consumption (due to the bioaccumulation of certain substances even at very low ambient levels). Appendix A includes tables from DRBC's Water Quality Regulations that show the toxics criteria for Zones 2 and 3.

Changes to Water Quality Standards

Ongoing Review of Water Quality Regulations

The last amendment of the Water Quality Regulations occurred in 1996. Currently, DRBC, through its Water Quality Advisory Committee, is developing recommendations to revise its standards under authority of Section 5.2 of the Compact which states that the Commission "may adopt and from time to time amend and repeal rules, regulations and standards" to control future pollution and abate existing pollution. A final, approved version of those rules, amended with any proposed changes, is not available at the time of this report and all water quality assessments presented here are based upon the Water Quality Regulations, as they existed during the 2000 through 2002 monitoring seasons.

Progress Toward Implementing Biocriteria

The Commission does not currently use biological criteria for 305(b) assessments or determinations of impairment, other than reports arising from fish-tissue toxics analyses and inference of aquatic life use support based upon water chemistry. Macroinvertebrate biocriteria were developed for DRBC's Special Protection Waters rules issued in 1992, and have been undergoing review as part of DRBC's anti-degradation policy.

With the launch of DRBC's Lower Delaware Monitoring Program in 1999, declaration of most of the non-tidal Delaware River as Wild and Scenic in 2000, and major efforts to update DRBC's comprehensive plan and water quality standards, there has been renewed interest in DRBC's biomonitoring program. Meetings with state and local partners resulted in the decision that DRBC should take a lead role in biological monitoring of the Delaware River, and near the mouth of select tributaries. With technical support and advice from NJDEP, PADEP, USGS, US EPA Region 3, the National Park Service, and the Academy of Natural Sciences, DRBC set out to define goals, objectives, and methods for improvement of its biological assessment program for the river.

DRBC investigated large-river methods and decided to wait for the issuance of EPA's large-rivers guidance before launching large-scale monitoring in difficult habitats such as pools, rapids, and upper-estuarine reaches. In 2001, DRBC initiated an annual benthic survey of wadeable riffle, run, and island margin habitats, to develop a benthic index of biological integrity for the non-tidal river. The annual August/September low-flow survey is narrowly defined to eliminate spatial and temporal variability, enabling site-to-site, reach-to-reach, and year-to-year comparison of results. By 2005, DRBC hopes to have enough data to create a low-flow B-IBI (benthic index of biotic integrity, a metric used to assess the quality of a macroinvertebrate community) for wadeable portions of the Delaware River.

There is current interest in monitoring other assemblages in order to gain a more complete picture of the ecological integrity of the Delaware River, and to measure progress toward objectives defined by the Commission's Comprehensive Plan. Methods under investigation would assess submerged aquatic vegetation, fish, mussels, plankton, invasive exotic species, and ecological characterization of over 50 unique microhabitats observed in the river. These investigations have been scheduled on a rotating basis as special studies.

2.2.3 Point Source Control Program

DRBC uses a variety of programs to regulate point source pollutant loadings that would impact the Delaware River. These consist of Docket Review, Special Protection Waters Regulations and Basin-wide minimum treatment standards and interstate cooperative agreements.

Section 3.8 of the Compact states that "No project having substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the Commission". All discharges to waters of the Basin with a design capacity greater than or equal to 50,000 gallons per day are subject to review by the Commission. In Special Protection Waters, the review threshold is 10,000 gallons per day. Projects are reviewed for potential impacts to the waters of the Basin and for consistency with the Comprehensive Plan, which consists of the statements of policies and programs that the Commission determines are necessary to govern the proper development and use of the River Basin *(DRBC Rules of Practice and Procedure, 1997)*.

DRBC also implements point source controls through its Special Protection Waters Regulations. All new or expanded discharges, for which DRBC has review authority, in Significant Resource Waters must undertake a non-discharge alternatives analysis and provide a Social and Economic Justification for a locally degrading discharge to be approved. In the case of Outstanding Basin Waters, no degrading discharge is permissible. The regulations state, "Point sources of pollutants discharged to Outstanding Basin Waters shall be treated as required and then dispersed in such a manner that complete mixing of effluent with the receiving stream is, for all practical intents and purposes, instantaneous."

Article 4 of DRBC's Water Quality Regulations identifies Basin-wide minimum treatment standards for wastewater discharges. These include:

- Removal of total suspended solids
- Minimum secondary treatment for biodegradable wastes
- BOD treatment requirements
- Disinfection requirements
- Color standards
- Dissolved substance standards
- pH standards
- Ammonia standards
- Temperature standards

DRBC maintains cooperative agreements with all four Basin States, which provide that all NPDES permits for projects that lie within the Basin must comply with these DRBC standards as well as State standards.

2.2.4 Nonpoint Source Control Program

DRBC regulates non-point pollution as part of the anti-degradation requirements of Special Protection Waters. Under DRBC's Special Protection Water regulations, all new or expanded discharges to the drainage areas of Special Protection Waters must submit for approval a Non-point Source Pollution Control Plan with their application. The plan must control the new or increased non-point source loads generated within the portion of the project's service area that is also located within the drainage area of Special Protection Waters. The plans must document the Best Management Practices to be applied to the project site. Non-point pollution from runoff of developed areas in Special Protection Waters may not be susceptible to antidegradation constraints if they are associated with an existing, non-expanding facility, such as a wastewater treatment plant that is not expanding its service area.

2.2.5 Coordination With Other Agencies

The nature of DRBC's water quality management activities relies on interstate coordination and cooperation. For instance, the agency maintains agreements with all four Basin states regarding permit review, as previously described. Additionally, all new or amended DRBC regulations are ruled on by the Commission, which has representation by the four states and federal government. The SRMP and Estuary Boat Run also rely on cooperation between DRBC and other agencies. The Scenic Rivers Monitoring Program is a partnership between DRBC and the National Park Service, while the Boat Run uses data from Delaware Department of Natural Resources and Environmental Conservation's monitoring programs. See Part 3 for more information on these programs.

2.2.6 Special Concerns and Recommendations

- Data Availability – Working to ensure adequate data for assessing the water quality of the Delaware River and for implementing DRBC's many water quality management programs is an ongoing issue.
- Fish Consumption Advisory Consistency – There are discussions ongoing among the Basin States to find a mechanism for ensuring that fish consumption advisories are consistent between states that share common water bodies.
- Lower Delaware River – Efforts to define "Existing Water Quality" for this area have been underway since 2000. In addition, this portion of the River potentially stands to be designated as Special Protection Waters by the DRBC, and subject to the regulatory approaches outlined in section 2.2.1 of this report.
- Maintaining Existing Water Quality – With growth and development pressures increasing in many parts of the Basin, preventing degradation of high quality waters is an important issue. A related issue is trying to identify the links between water quality issues in the main stem and the potential sources of pollution throughout the Basin. To that end, DRBC is evaluating alternatives for partnering with the Basin States to address watershed issues that impact main stem water quality at boundary control points.
- Identifying Natural Background Conditions – Attempting to better characterize natural conditions along the Delaware River continues to be an important topic of discussion, particularly as it applies to setting appropriate water quality goals for the River.

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 121mile 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.

3.2 Plan for Achieving Comprehensive Assessment

Because DRBC's water quality use standards are currently based on chemical constituents and because DRBC's monitoring programs are primarily based upon fixed networks rather than a probabilistic or rotating basin design, comprehensive assessment could potentially rely on three factors:

- Creating a denser network of monitoring locations (including the use of outside sources of data)
- Collecting sufficient data on all parameters for which there are standards
- Identifying sources of any mainstem river pollution that occurs through tributary loadings

A lack of resources has hampered the ability to implement some of these aspects of a more comprehensive monitoring program. As noted in the case of the SRMP, a number of parameters have not been monitored and in the LDMP, locations set aside as boundary control points have not been monitored. However, with a greater availability of resources, it would be more feasible to augment and enhance the programs to provide more comprehensive data coverage.

3.3 DRBC Integrated List Assessment Methodology

This assessment methodology discusses how the main stem of the Delaware River and the Delaware Bay are broken up into Assessment Units (AU) and how data collected from within those AUs are used to evaluate designated use support. The designated uses that are assessed are Aquatic Life, Recreation (primary and secondary contact), Fish Consumption, Shellfish Consumption, and Drinking Water. This section discusses the general and parameter-specific data requirements for making use support decisions, the method used for defining AUs in the River, the tidal River, and the Bay, the sources of data used for assessments, and the method of assigning AUs to one of five general categories for developing the Integrated List. These categories are defined under "Method For Assigning Assessment Units to Integrated List Categories" below.

3.3.1 General Data Requirements

In order to maintain accuracy and reliability in the assessments used for the Integrated Report and for other environmental decisions and regulatory programs, DRBC ensures that Quality Assurance Project Plans (QAPP) are approved annually prior to the initiation of its routine monitoring programs. Subsequently, any data used for assessment purposes must be accompanied by a QAPP that meets DRBC's requirements for monitoring data. It is assumed that data collected by State and Federal agencies have met the appropriate quality assurance requirements to be used in water quality assessments.

Data submitted to DRBC for use in water quality assessments should be in an electronic format to avoid an undue burden associated with entering large amounts of monitored data into such a format. In particular, data entered into US EPA's STORET system provides an appropriate example upon which to base the formatting of such data. Generally, spreadsheets and databases provide an appropriate format as well.

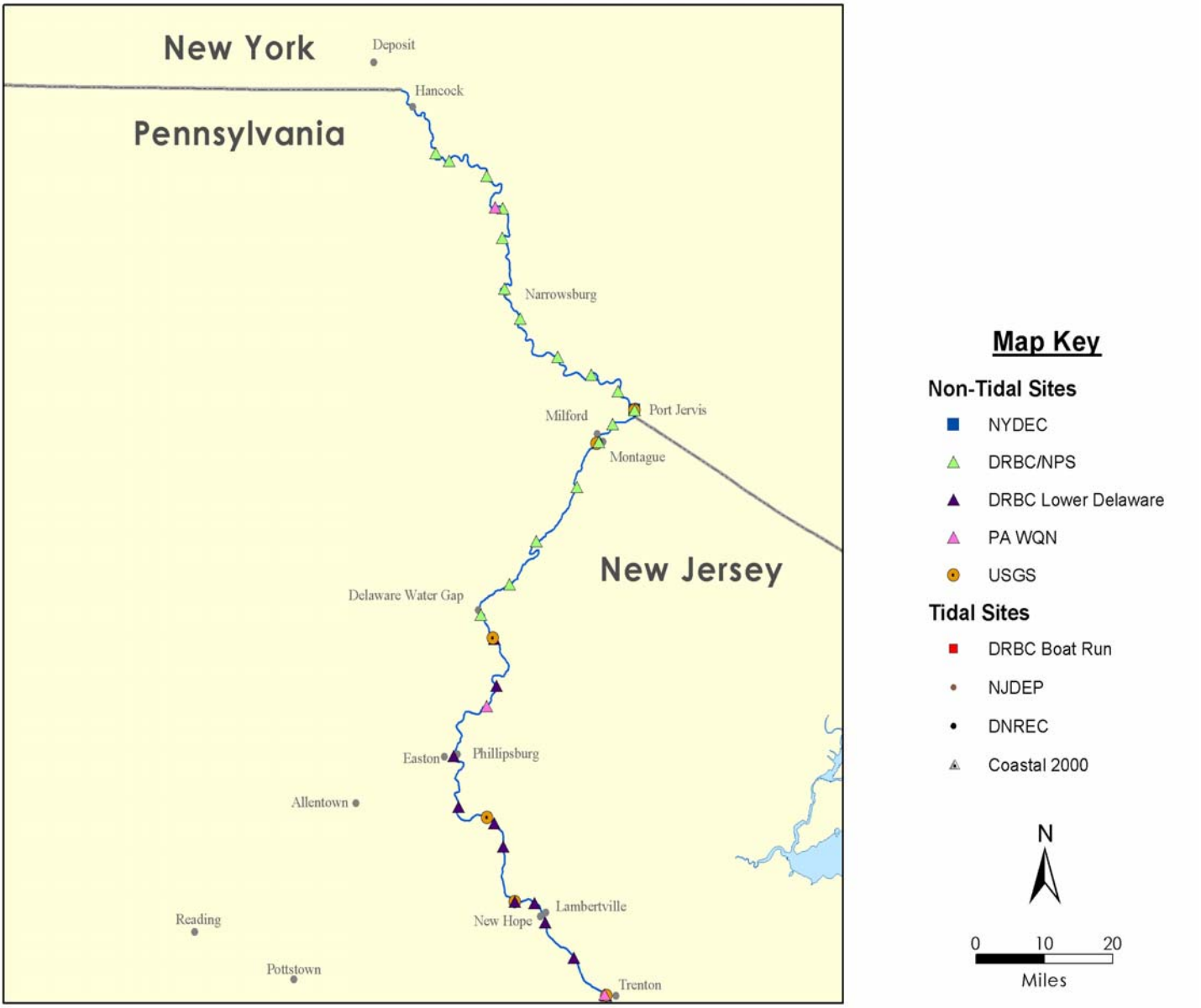
Data and Information Sources

DRBC collects a variety of water quality data from its own monitoring programs and also solicits available data from the Basin States in order to assess water quality in the Delaware River and Bay. The water quality assessments provided in this report are based upon data from the following sources:

- The National Park Service/DRBC Scenic Rivers Monitoring Program (SRMP)
- The Lower Delaware River Monitoring Program (LDMP)
- The Delaware Estuary Boat Run Program
- The Pennsylvania DEP Stream and Wastewater Treatment Plant Water Quality Monitoring
- The Pennsylvania DEP Water Quality Network (WQN)
- The Delaware DNREC Ambient Surface Water Quality Monitoring Program
- The New Jersey DEP Ambient Surface Water Monitoring Network
- The New York State DEC Ambient Monitoring Network
- United States Geological Survey (USGS) National Water Quality Assessment Program (NAWQA) and National Water Information System (NWIS)
- DRBC/USGS Cooperative Monitoring Program (Continuous Monitors)
- Environmental Protection Agency Coastal 2000 Program

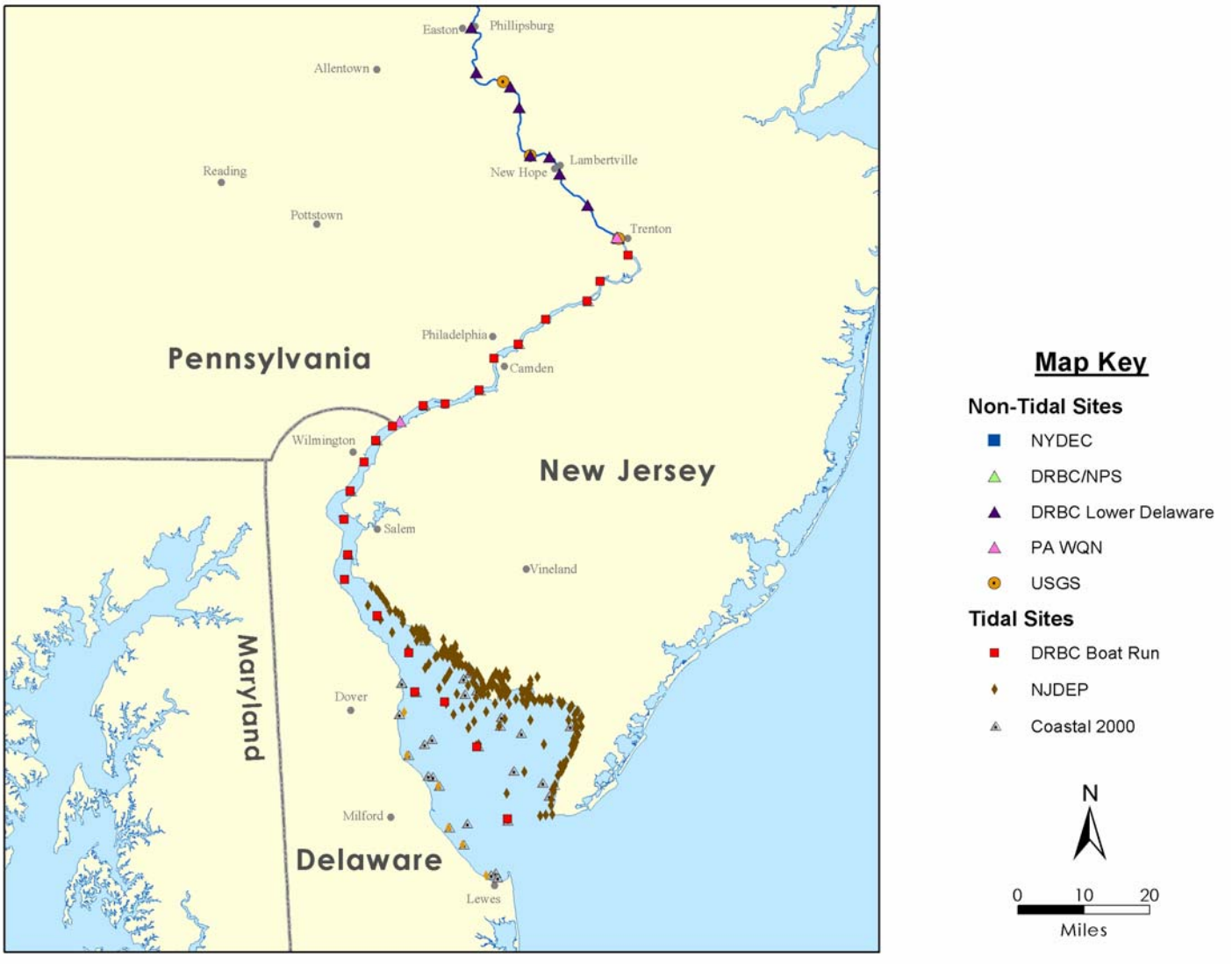
Figures 3.1 & 3.2 show the locations of the sites used in the monitoring programs listed above.

Figure 3.1: Monitoring Locations Non-Tidal



Source: DRBC

Figure 3.2: Monitoring Locations Tidal



Source: DRBC

3.3.2 Coordination with Basin States

Because DRBC's role is to assess shared waters in the Basin (the main stem Delaware River and the tidal portions of its tributaries), coordination with the Basin States is important. The Integrated Listing process defines a list of waters for which Total Maximum Daily Loads (TMDLs) must be prepared (a 303(d) list). However, the regulatory responsibility for preparing a 303(d) list, represented in the Integrated List by category 5, rests with the States. DRBC does not produce a 303(d) list of its own, and thus does not require the public noticing process for publishing a 303(d) list. Further, the programmatic knowledge necessary to sub-categorize waters within Category 4 (what pollution control activities are planned for tributaries to the River, for example) also requires significant input from the states.

In order to avoid potential discrepancies between the DRBC's and States' Integrated Lists, and to ensure that the States have adequate time for their public noticing processes, DRBC provides a preliminary Integrated List to the States in advance of their administrative deadlines to begin the 303(d) list public noticing process. In that way, DRBC and the States have an opportunity to coordinate and come to agreement on any outstanding data or assessment issues, and to arrive at a final list of impaired waters (Categories 4 and 5). Working within this schedule, the most recent monitoring season of data (typically May through October) that DRBC can effectively use for its assessment is the one that occurs two calendar years prior to the April 1 Integrated Report submittal date required by U.S. EPA. The assessment utilizes data from that monitoring season and the two prior monitoring seasons. In the case of this Integrated List report, that includes monitoring seasons in 2000, 2001, and 2002.

3.3.3 Definition of AUs in Main Stem Delaware River, Delaware Estuary and Delaware Bay

Non-Tidal River Assessments

For River assessments (river miles 330.7 to 133.4), the definition of AUs is based upon DRBC Water Quality Zones (Figure 3.3), as specified in its Water Quality Regulations, but also takes into account that water quality in the main stem river is primarily a result of, and may be significantly affected by, tributary inputs. The aggregation of data in a water quality zone for assessment purposes presumes that differences in water quality, among distinct monitoring stations within the zone, are fairly small. However, in the case where a tributary supplies large inputs of one or more pollutants to the River, water quality upstream and downstream of that tributary's confluence with the River may be significantly different, with monitoring stations exhibiting higher water quality upstream of the confluence. Likewise, where a tributary provides higher quality water to a zone, monitoring stations downstream of the confluence may exhibit better water quality than those upstream of the confluence. Aggregating the data within a Water Quality Zone, without regard to this potentiality, may mask locations of either impaired water quality or water quality that is better than criteria. Therefore, AUs have been chosen to reflect the potential for water quality to change due to tributary loadings. The determination of which tributaries should be used to break up existing, programmatically defined water quality zones into more refined, hydrologically-based AUs is based upon capturing those tributaries that supply the majority of the watershed area to the main stem of the Delaware River. Those direct tributaries to the River that comprise 85% of the drainage area (each being roughly 30 square miles or greater in area) have been used to define AUs in the non-tidal portion of the River. The result is a larger, more refined set of AUs that is set up to account for the potential longitudinal changes in water quality that are likely to occur due to tributary influences.

In the relatively less-developed upper portions of the Basin, reservoir releases exert important influences on both flow and water quality in the River. This influence begins at Hancock, NY (River Mile 330.7), where the East and West Branches of the Delaware River converge. Both tributaries are regulated by reservoir releases. The 2004 Assessment focuses on the main stem River, downstream of this location. Within the assessed portion of the main stem Delaware River, those tributaries (from among those used to define AUs, as described above) that contribute reservoir releases are represented by The Lackawaxen River (Lake Waulenpaupack), Mongaup River (Rio Reservoir) and Neversink River (Neversink Reservoir).

Table 3.1 shows the AUs in the non-tidal River that are defined by the tributaries that constitute eighty-five percent of the drainage area of the non-tidal Delaware River. Also shown are the Water Quality Zone boundaries, defined in DRBC's Water Quality Regulations.

Table 3.1: Non-Tidal Assessment Units (Based on Tributary Watershed Area)

Tributary or Boundary	At RM	To RM	Assessment Unit	Tributary or Boundary	At RM	To RM	Assessment Unit
WQ1A	330.7	322.5	1A1	WQ1C/D	217.0	213.0	1D1
Equinunk Ck.	322.5	303.6	1A2	Brodhead Ck.	213.0	207.0	1D2
Callicoon Ck.	303.6	295.6	1A3	Paulins Kill	207.0	197.8	1D3
Calkins Ck.	295.6	289.9	1A4	Pequest R.	197.8	190.7	1D4
WQ1A/B	289.9	285.6	1B1	Martins Ck.	190.7	184.1	1D5
Tenmile R.	285.6	284.22	1B2	Bushkill Ck.	184.1	183.66	1D6
Masthope Ck.	284.22	277.7	1B3	WQ1D/E (Lehigh R.)	183.66	177.4	1E1
Lackawaxen R.	277.7	274.19	1B4	Pohatcong Ck.	177.4	174.6	1E2
Shohola Ck.	274.19	261.84	1B5	Musconetcong R.	174.6	173.7	1E3
Mongaup R.	261.84	254.75	1B6	Cooks Ck.	173.7	157.0	1E4
WQ1B/C	254.75	253.64	1C1	Tohickon Ck.	157.0	133.4	1E5
Neversink R.	253.64	226.9	1C2	WQ1E/WQ2	133.4		
Bush Kill	226.9	225.3	1C3				
Flat Brook	225.3	217.0	1C4				

Figure 3.3: DRBC Water Quality Zones

Source: DRBC

Table 3.2 shows a modification of the AUs in Table 3.1 to account for reservoir releases as described above. Note that this table reflects assessment units, reported to EPA, that are consistent with USGS's National Hydrographic Dataset. This system is slightly different than the DRBC river mileage system (reflected in Table 3.1), upon which its Water Quality Regulations (including water quality zones) are based. These NHD-related assessment units provide the basis for the discussion of assessment results presented in section 3.4 of this report. Figure 3.4 depicts how the river AUs for this water quality assessment are delineated.

Table 3.2: Modification of Non-Tidal Assessment Units (To Factor In Reservoir Release Influences)

Tributary or Boundary	At RM*	To RM*	Assessment Unit	Tributary or Boundary	At RM*	To RM*	Assessment Unit
WQ1A	335.54	308.01	1A1	WQ1C/D	219.35	214.70	1D1
Callicoon Ck.	308.01	299.38	1A2	Brodhead Ck.	214.70	210.20	1D2
Calkins Ck.	299.38	293.62	1A3	Paulins Kill	210.20	200.89	1D3
WQ1A/B	293.62	281.11	1B1	Pequest R.	200.09	192.71	1D4
Lackawaxen R.	281.11	264.88	1B2	Martins Ck.	192.71	185.83	1D5
Mongaup R.	264.88	257.67	1B3	Bushkill Ck.	185.83	185.41	1D6
WQ1B/C	257.67	256.53	1C1	WQ1D/E (Lehigh R.)	185.41	179.02	1E1
Neversink R.	256.53	229.85	1C2	Pohatcong Ck.	179.02	176.16	1E2
Bush Kill	229.85	228.13	1C3	Musconetcong R.	176.16	173.88	1E3
Flat Brook	228.13	219.35	1C4	Cooks Ck.	173.88	156.22	1E4
				Tohickon Ck.	156.22	133.4	1E5
				WQ1E/WQ2	133.4		

* River miles reflect National Hydrographic Dataset mileage system, which differs slightly from DRBC river mileage system.

Figure 3.4: Assessment Units - Nontidal

Source: DRBC

Delaware Estuary Assessments

Table 3.3 indicates the extent of AUs within the Estuary. Assessment units for the tidal waters of the Estuary (river miles 133.4 to 48.2) have been selected on the basis of programmatically defined water quality zones in the DRBC Water Quality Regulations. Due to tidal action in the Estuary, water from the main stem river regularly moves up into the tributaries and water downstream of a tributary's confluence with the River regularly moves upstream of that confluence. While tributary loadings to these zones are an important determinant of water quality, the different hydrology in these zones, as compared to the river zones above river mile 133.4 at Trenton, makes using significant tributaries for the delineation of AUs less effective than in non-tidal river waters. As with AUs in the non-tidal Delaware River, data are aggregated within AUs. See Figure 3.5 for a depiction of AUs in the Estuary.

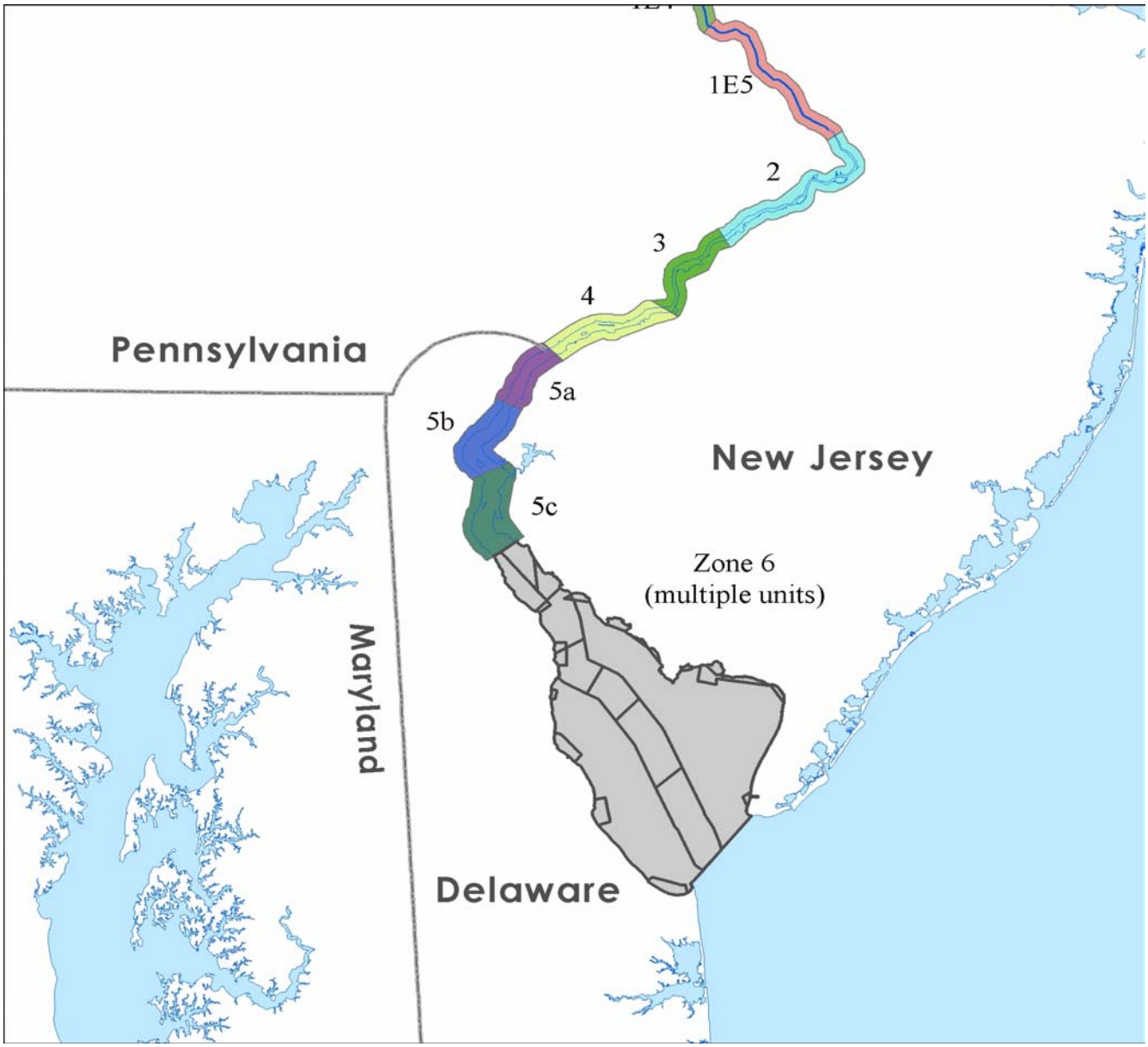
In addition to the AUs based on Water Quality Zones, note that Zone 5 has been subdivided for assessment purposes based upon changes criteria, by river mile, within the Zone itself. The Zone (RM 78.8 – RM 48.2, with an area of 65 square miles) is subdivided into three AUs, based upon changes in the dissolved oxygen criteria within the Zone. The subdivisions are 5A (RM 78.8-RM70.0, with an area of 13 square miles or approximately 20% of the Zone), 5B (RM 70.0-RM59.5, with an area of 21 square miles or approximately 32% of the Zone) and 5C (RM59.5-RM48.2, with an area of 31 square miles or approximately 48% of the Zone). These subdivisions

enable a more effective assessment. Averaging data from a group of sampling locations, for which the water quality criteria differ, could mask issues of non-attainment of those criteria.

Table 3.3: Assessment Units in Tidal River

Programmatic Boundary	At RM	To RM	Area	Assessment Unit
WQ1/WQ2	133.4	108.4	8 sq. miles	2
WQ2/WQ3	108.4	95.0	7 sq. miles	3
WQ3/WQ4	95.0	78.8	17 sq. miles	4
WQ4/WQ5	78.8	70.0	13 sq. miles	5a
	70.0	59.5	21 sq. miles	5b
	59.5	48.2	31 sq. miles	5c

Figure 3.5: Assessment Units - Tidal



Source: DRBC

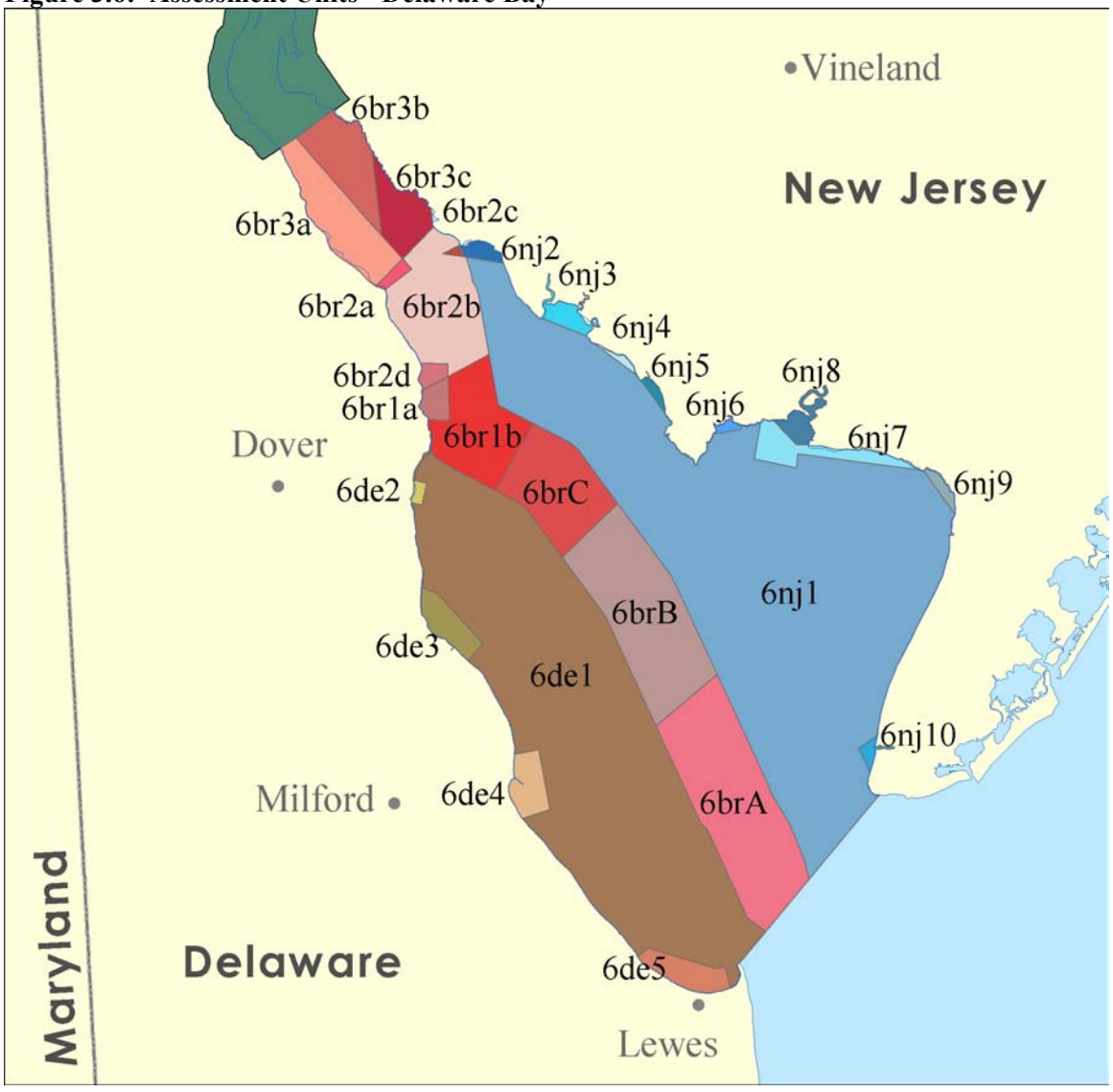
Delaware Bay Assessments

Due to the spatial nature of the Delaware Bay (686 square miles, from River Mile 48.2 to the mouth of the Bay), individual monitoring locations were, for this report, assessed individually and were aggregated by AUs that are based upon areas defined by the shellfish water classifications of the States of Delaware and New Jersey and upon the Delaware Estuary Boat Run program. This method was chosen to remain consistent with water body area boundaries that have already been defined for a particular designated use, namely Shellfish Consumption.

AUs are assessed by looking at the use support or non-support exhibited by the monitoring locations present in those AUs. For example, if all sites in an AU are supporting the Aquatic Life designated use, then the AU is supporting the use. Figure 3.6 shows how the Bay was partitioned into assessment units.

If more than 10% of the assessable sites, where ten or more assessable sites are present in an AU, do not support a use, the AU does not support that use. Where less than 10 assessable sites are present in an AU, all assessable sites must support the use for the AU to support the use. In this second case, non-support of any use will cause the entire AU to be considered impaired for that use, and therefore a Category 4 or 5 water.

Figure 3.6: Assessment Units - Delaware Bay



Source: DRBC

3.3.4 Data Requirements

Tables 3.4-3.6 describe the general criteria for each parameter assessed and how that parameter is assessed relative to DRBC's Water Quality Regulations. The tables also describe the parameter-specific data requirements that are needed to enable assessments that have a higher degree of confidence associated with them. It should be noted, however, that assessments might also be made using data that is less robust than what the Data Requirements indicate.

Aquatic Life

The assessment of the Aquatic Life Designated Use is based upon the monitoring of chemical water quality data. The parameters used for determining use support are dissolved oxygen, temperature, pH, alkalinity, turbidity, total dissolved solids (TDS) and toxics data and information.

Table 3.4: Aquatic Life Designated Use

Parameter	Criterion	Assessment Method	Data Requirements
Dissolved Oxygen	Not less than numerical criterion at any time	Percent of samples in the AU less than criterion	At least 20 samples per AU (or Bay site) over a three-year period
	24-hour average not less than numerical criterion	Percent of 24-hour averages in the AU less than criterion	At least 20 24-hour averages per AU (or Bay site) over a three-year period; 24-hour average requires at least one daytime and one nighttime sample at a site in a 24-hour period, and samples should not be heavily weighted toward daytime or nighttime measurements.
	Seasonal average not less than numerical criterion	Departure (of seasonally relevant sample average) below criterion	In each AU (or Bay site), over a three-year period, at least 20 evenly- distributed (temporally[a]) samples per regulation-defined season.
Temperature	Except in designated heat dissipation areas[b], not to exceed specified increase above ambient temperature. Natural temperatures prevail where ambient temperature exceeds specified level.	Comparison of sampled 24-hour average temperature to date-specific ambient average temperature defined in Water Quality Regulations. Percent of 24-hour averages that exceed criterion.	At least 20 samples[c] per AU (or Bay site) over a three-year period. Samples should be evenly distributed over the calendar year.
pH	Not to depart from specified range	Percent of samples in each AU that depart from specified range	At least 20 samples per AU (or Bay site) over a three-year period
Total Dissolved Solids	Not to exceed 133% of background[d]	In each AU where background is specified in DRBC Water Quality Regulations, percent of samples in AU that exceed 133% of background level	At least 20 samples per AU over a three-year period
Alkalinity	Not less than specified criterion value, or not to depart from specified range.	Percent of samples in each AU less than specified criterion value or outside specified range, as applicable.	At least 20 samples per AU over a three-year period
Turbidity	Unless exceeded by natural conditions, not to exceed maximum 30-day average and not to exceed maximum turbidity criterion	Average turbidity of samples in an AU Percent of samples in an AU that exceed maximum turbidity criterion	At least three samples, on different days, in a 30-day period per AU (or Bay site) At least 20 samples per AU (or Bay site) over a three-year period
Toxics Data and Information[e]	Chronic Toxicity: 1.0 Toxic Units (chronic) Acute Toxicity: 0.3 Toxic Units (acute) Ambient toxic parameters not to exceed criterion	Number of exceedences in an AU over a three-year period	At least 10 samples per AU over a three-year period[f]

[a]Using best professional judgment
[b]See DRBC Water Quality Standards (1996) 4.30.6.F.1
[c]Sample consists of 24-hour average temperature calculated from field measurements within an AU
[d]Criterion not applied below river mile 78.8
[e]Toxics criteria apply between river miles 133.4 and 48.2
[f]Based upon EPA guidelines

Drinking Water

The parameters used for determining the Drinking Water Use are total dissolved solids (TDS), turbidity, chlorides and toxic substances. Because this particular use so closely relates to human health, the assessment takes into account both the ambient chemical monitored data, which provide an indication of the suitability of the source of drinking water, as well as information on actual impacts to the use such as closures of drinking water facilities due to water quality concerns.

Table 3.5: Drinking Water Designated Use

Parameter	Criterion	Assessment Method	Data Requirements
Total Dissolved Solids	Not to exceed 500 mg/l	Percent of samples in an AU that exceed 500 mg/l	At least 20 samples per AU over a three-year period
Turbidity	Unless exceeded by natural conditions, not to exceed maximum 30-day average and not to exceed maximum turbidity criterion	Average turbidity of samples in an AU Percent of samples in an AU that exceed maximum turbidity criterion	At least three samples, on different days, in a 30-day period At least 20 samples per AU over a three-year period
Chlorides	Maximum 30-day average concentration Maximum 15-day average concentration	Average concentration of samples in an AU Percent of samples in an AU that exceed maximum chloride criterion	At least three samples in a 30-day period At least two samples in a 15-day period At least 20 samples per AU over a three-year period
Toxic Substances[a]	Ambient toxic parameters not to exceed criterion	Number of samples in an AU that exceed criterion	At least 10 samples per AU over a three-year period[b]

[a]Toxics criteria, in waters designated for the Drinking Water use, apply between River Miles 133.4 and 95.0
[b]Based upon EPA guidelines

Primary and Secondary Contact Recreation

The parameters used for determining the Primary and Secondary Contact Recreation Uses are fecal coliform and enterococcus bacteria. Note that the criteria call for calculating a geometric mean of bacterial sample results, which, according to EPA's 1997 *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates*, should include at least five samples in a thirty-day period. However, the monitoring programs in place on the Delaware River rarely use this intensity of bacterial sampling. In that case, for fecal coliform bacteria, the EPA-recommended criterion of 400 colonies/100 ml is used as a single-sample criterion not to be exceeded in ten percent or more of the samples collected in an AU. For enterococcus bacteria, where a geometric mean cannot be adequately calculated, EPA's 1986 guidance document titled "*Ambient Water Quality Criteria for Bacteria*" (EPA 440/5-84-002) to determine the applicable single-sample criterion against which to assess. The applicable criterion must not be exceeded in ten percent or more of samples in order for a given AU to be considered meeting the Recreation Designated Use.

Table 3.6: Primary and Secondary Contact Recreation

Parameter	Primary Contact Criterion	Secondary Contact Criterion	Assessment Method	Data Requirements
Fecal Coliform Bacteria	Geometric Mean Not to Exceed 200/100ml or Instantaneous Maximum of 400/100ml, per EPA guidance[a]	Geometric Mean Not to Exceed 770/100ml	Geometric mean of samples in an AU. Percent of samples in an AU above EPA-recommended instantaneous maximum	At least five samples per AU (or Bay site) over a thirty-day period during each monitoring season. Otherwise, at least 20 samples per AU (or Bay site) over a three-year period.
Enterococcus Bacteria	Geometric Mean Not to Exceed 33/100ml or Instantaneous Maximum of 61/100ml (primary contact freshwater) and 104/100ml (primary contact marine), per EPA guidance[a]	Geometric Mean Not to Exceed 88/100ml or Instantaneous Maximum of 151/100ml (freshwater), per EPA guidance[a]	Geometric Mean of Samples in an AU Percent of samples in an AU above EPA-recommended instantaneous maximum	For Geometric Mean, at least five samples per AU (or Bay site) over a thirty-day period during each monitoring season. Otherwise, at least 20 samples per AU (or Bay site) over a three-year period.

[a] Ambient Water Quality Criteria for Bacteria – 1986 (EPA440/5-84-002), using "infrequently used full body contact" for secondary contact.

Fish Consumption

The categorization of AUs for the Fish Consumption use is based upon the presence of State fish consumption advisories in the main stem or tidal tributary portions of the River at the time of the assessment. Where no fish consumption advisories exist, the water body is supporting the use. Where limits on the number of fish meals or "do not eat" advisories exist for one or more fish species, the water body is impaired for the fish consumption use.

While all state fish consumption advisories aim to provide a high level of protection to the public with regard to the consumption of fish caught from state waters, there may be situations in which two or more states that share a water body do not post the same advisories in that water body. This may be due to a variety of causes, including different approaches to calculating the risks associated with particular contaminants or different assumptions about the amount of contaminant contained in a fish meal. This water quality assessment report categorizes AUs based upon the presence of fish consumption advisories, wherever posted.

In some cases, statewide advisories for one or more fish species may exist for one or more specific contaminants. In some cases, these advisories are based upon the presumption of a high prevalence of that contaminant in state waters, and not upon specific monitored data. Any AUs affected solely by this type of advisory are considered to have insufficient data for an assessment and will be placed in category 3. See the 2004 305(b) water quality assessment reports or Integrated Listing methodologies of Delaware, New Jersey, New York and Pennsylvania for more information about the posting of fish consumption advisories in state waters. The Web pages at the following Internet addresses provide more information:

For Delaware: http://www.dnrec.state.de.us/fw/advisory.htm
For New Jersey: http://www.nj.gov/dep/dsr/njmainfish.htm
For New York: http://www.dec.state.ny.us/website/dfwmr/fish/fishregs/fishhealthadv.html
For Pennsylvania: http://sites.state.pa.us/PA_Exec/Fish_Boat/fishpub/summary/sumconsumption.pdf

Shellfish Consumption

Zone 6 (river mile 48.2 to the mouth of the Delaware Bay) is designated for the Shellfish Consumption use in DRBC's Water Quality Regulations. Both the states of Delaware and New Jersey assess for this use in their coastal waters, using procedures developed by the National Shellfish Sanitation Program (NSSP). In both states, waters classified for shellfishing may be not be open for that use at all times. In some cases, waters are open seasonally (typically in winter). In other cases, harvesting may be prohibited due to administrative closures that are based upon resource protection, upon the proximity of the water to sewer outfalls or upon land uses abutting those coastal waters. In still other cases, waters may be open to harvesting but with special treatment of the shellfish required, such as transplantation to cleaner waters, for a period of time, prior to harvest. Finally, some waters are closed to shellfish harvesting due to existing water quality concerns, as shown by monitoring.

Where sufficient water quality data exist for the States to determine if the Shellfish Consumption use is supported, only those data determine the support of the use. All other waters are considered to have insufficient data. Areas prohibited from harvesting shellfish but not based upon sufficient, recent data, are considered to be Probably Not Supporting the use. Areas that are open to harvesting or seasonally open to harvesting are considered to be Probably Supporting the use. This does not necessarily mean that collecting more data would enable those areas to be reclassified, as many of the areas are classified based upon agreements or precautions.

3.3.5 Method For Assigning Assessment Units to Integrated List Categories

When an AU is assessed against the relevant criteria for determining if all designated uses have been met, that water body is then placed into one of five categories that describe both the level of use support and the degree to which the available data can be used to accurately assess use support. The five categories into which an AU can be placed are as follows, according to the 2004 Integrated List Guidance provided by U.S. EPA:

Integrated Listing Categories (2004 Integrated List Guidance)

1: Water body is attaining the water quality standard and no use is threatened
2: Water body is attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened
3: Insufficient or no data and information to determine if any designated use is attained
4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL
   A. TMDL has been completed
   B. Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future
   C. Impairment is not caused by a pollutant
5: The water quality standard is not attained. The AU is impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL.

Tables 3.7-3.10 below explain, for each of the various designated uses assessed, how an AU is considered to be supporting that use. Table 3.11 explains how an AU is assigned to Categories 2-5. Note that, for Bay assessments, each site is assessed individually for support of each use and then all sites in an AU are evaluated in concert to determine the final assessment category into which that AU should be placed.

Table 3.7: Aquatic Life Designated Use – Supporting

Category	Parameter	Explanation
1	Dissolved Oxygen	• Data requirements met for at least half the applicable component criteria. • Less than 10% of samples in AU (or Bay site) violate "not less than" criterion. • Less than 10% of 24-hour averages in AU (or Bay site) violate "24-hour average" criterion. • No seasonal average violates "seasonal average" criterion.
	Temperature	Data requirements met. Less than 10% of samples in AU (or Bay site) violate criterion
	pH	Data requirements met. Less than 10% of samples in AU (or Bay site) violate criterion
	Total Dissolved Solids	Data requirements met. Less than 10% of samples in AU violate criterion
	Alkalinity	Data requirements met. Less than 10% of samples in AU violate criterion
	Toxics Data or Information	Data requirements met. For each parameter assessed, no more than one exceedence each of acute and chronic toxicity criteria over a three-year period. No more than one exceedence of ambient parameter criteria over a three-year period.
	Turbidity	• Data Requirements met • No more than one 30-day average exceeds maximum level criterion per year • Less than 10% of all samples in an AU (or Bay site) exceed maximum level criterion over the three-year assessment period

Table 3.8: Primary and Secondary Contact Recreation Use – Supporting

Category	Parameter	Explanation
1	Fecal Coliform or Enterococcus Bacteria	• Data requirements met. • In a given AU (or Bay site), no violations of the geometric mean criterion exist for any 30-day period in which at least five samples have been collected. • The results of less than 10% of samples in an AU (or Bay site) exceed the relevant criterion over a three-year period.

Table 3.9: Fish Consumption Use – Supporting

Category	Parameter	Explanation
1	Fish Consumption Advisories	In a given AU, no fish consumption advisories are present that are based upon monitored water quality or fish tissue data or other water body-specific information.

Table 3.10: Drinking Water Use – Supporting

Category	Parameter	Explanation
1	Drinking Water Supply Closures	In a given AU, no waters affected by administrative closures for drinking water supply, due to water quality concerns, over the three-year assessment period
	Chlorides	• Data Requirements met • No more than one 30-day or 15-day average (as applicable) exceeds maximum level criterion over the three-year assessment period • Less than 10% of all samples in an AU exceed maximum level criterion over the three-year assessment period
	Turbidity	• Data Requirements met • No more than one 30-day average exceeds maximum level criterion per year • Less than 10% of all samples in an AU exceed maximum level criterion over the three-year assessment period
	Total Dissolved Solids	• Data Requirements met • Less than 10% of all samples in an AU exceed maximum level criterion over the three-year assessment period
	Toxic Substances	• Data Requirements met • For each parameter assessed, no more than one exceedence of criteria over the three-year assessment period

Table 3.11: Explanation of AU Assignment to Categories 2-5

Category	Explanation
2	• Data requirements met for assessing at least one but not all uses. • No parameters for which data requirements are met indicate nonattainment of criteria. • AU is "probably supporting"[a] one or more uses and is supporting all other uses. • No parameters, for which Data Requirements are not met, indicate a high likelihood of criteria nonattainment. [b]
3	• No designated use has sufficient data for all its relevant parameters. • In the case of Fish Consumption, AUs affected by statewide or other advisories that are based upon the presumption of contaminant presence, but not based upon water quality data, are listed in this category. • In the case of Shellfish Consumption, areas affected by administrative or precautionary closures, and for which water quality data are not sufficient to determine the presence or absence of water quality concerns relating to this use, are listed in this category.
3A Waters of Concern	• One or more parameters, for which insufficient data exist, indicate a high likelihood of impairment[b] • AU is "probably not supporting" one or more designated uses[a]
3B	• AU is "probably supporting" one or more designated uses[a]. There is insufficient data to determine if the remaining uses (if any) are supported. No uses are "probably not supported".
4	• One or more water quality criteria not met, additional data or information indicate a likelihood of one or more water quality criteria not being met by the next reporting cycle. • In the case of Drinking Water use, AU is has been affected by an administrative closure due to monitored water quality data. • A TMDL is not required due to 4A, 4B or 4C.
4A	TMDL has been completed
4B	Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future
4C	Impairment is not caused by a pollutant
5	• One or more water quality criteria not met, additional data or information indicate a likelihood of one or more water quality criteria not being met by the next reporting cycle. • In the case of Drinking Water, AU has been affected by an administrative closure due to monitored water quality data during the three-year assessment period. • In the case of Fish Consumption, AU is affected by a fish consumption advisory for one or more species, based upon monitored water quality or fish tissue data. • In the case of Shellfish Consumption, area is affected by a shellfishing restriction or closure based upon recent monitored water quality or shellfish tissue data.

a*:* AU, for which insufficient data exist to assess a given use, is bounded by two AUs that have sufficient data for assessment. See below.
b: Twenty-five percent or more of samples in an AU exceed the criterion or seasonal average exceeds criterion by 25 percent or more of the criterion value. See below.

Use of Continuously Monitored Data

Data on temperature, dissolved oxygen and pH are collected continuously at a number of locations on the Delaware River. These data represent the most accurate reflection of water quality at those locations, given that all three of those parameters normally exhibit diurnal fluctuations that cannot be captured by once-daily monitoring. Continuously monitored dissolved oxygen, for instance, provides a reliable twenty-four hour average that can be used to assess that component of the DRBC water quality criteria for dissolved oxygen. In AUs where continuous data exist for temperature, dissolved oxygen and/or pH, those data are used to represent water quality conditions, for those parameters, in that AU.

Waters of Concern

The Data Requirements presented in Tables 3.4-3.6 are goals and are not used to preclude a water body from being assessed. For example, where one or more parameters, for which the data requirements have not been met, indicate that an AU exhibits a high likelihood of criteria non-attainment, the AU will be placed in Sub-Category 3 as a "Water of Concern". A high likelihood of non-attainment is considered to be:

- 25 percent or more samples not meeting the criterion for a particular parameter
- A seasonal average that does not meet the relevant criterion by at least 25 percent of the value of the criterion

Assessment Units Probably Supporting or Not Supporting a Designated Use Based Upon Adjacent Units

Where an AU, for which there are no or insufficient data for determining its support of a particular designated use, is bounded by two AUs supporting that designated use, the unit with no or insufficient data is considered to be *probably* supporting the designated use. Likewise, if bounded by AUs that are impaired for a particular use, then the unit with no or insufficient data is considered to be *probably not* supporting the use. An AU that is probably supporting one or more uses and is supporting all other uses is placed in Category 2. An AU that is probably not supporting one or more uses, but is not impaired for any use, is placed in Category 3 as a "water of concern".

If an AU, for which there are no data on a particular use, is bounded by two AUs that differ in their support for that use, then the use is considered to have no supporting information and the AU will be placed in the appropriate category, depending on the support level of the remaining uses:

- Category 2 if at least one use is supported and all other uses are supported or have insufficient data or information, with no uses "probably not supported".
- Category 3 if no uses have sufficient data or information for assessment and no uses are either Probably Supported or Probably Not Supported
- Category 3A (Waters of Concern) if any parameters indicate a high likelihood of impairment (see above) or if any uses are Probably Not Supported
- Category 3B (Probably Supporting one or more uses) if one or more uses is Probably Supported but there are insufficient or no data or information on the other uses and no uses are "probably not supported"
- Category 4 or 5 if one or more other uses are impaired based upon sufficient data for assessment.

Insufficient Data to Assess Criteria Based on 30-Day Averages or Geometric Means

Where less than three samples are collected in a 30-day period (for 30-day averages) or, in the case of bacteria, less than five samples are collected in a 30-day period (for geometric mean), the percent of all samples collected in the AU that exceed the numeric criterion will be used. In the case of fecal coliform bacteria, the EPA-recommended 400 colonies per 100 ml will be used as a single-sample criterion not to be exceeded ten percent of the time or more. Similarly, for Enterococcus, the EPA-recommended method (Guidance Document EPA440/5-84-002, January 1986) is used to determine single sample criteria. If there are less than 20 samples for a parameter in the three-year period assessed, then the AU has insufficient data for that parameter.

Multi-Component Criteria

Some parameters have two or more component criteria, as with the "not-less-than", "24-hour average", and "seasonal average" components of the Dissolved Oxygen criteria. If at least one-half of the components can be assessed with sufficient data, then the parameter can be assessed, using the results of the assessed components. If less than one-half the components have sufficient data for assessment, then the parameter is considered to have insufficient data for assessment.

Assessing Data from Different Sources

All assessed data within an AU are considered to carry equal importance and relevance, as all sources of data used for an assessment must have been collected, analyzed and documented using the appropriate, recognized state and/or EPA quality assurance and control procedures. Therefore, data that come from different sources are assessed in aggregate by AU.

3.4 Delaware River and Bay Surface Water Quality Assessment for Years 2000-2002

The following section of the report presents the results of assessing the Delaware River and the tidal portions of its tributaries.

3.4.1 Assessment of Designated Uses for Surface Waters

Aquatic Life Designated Use

The water quality parameters used in this assessment of the Aquatic Life Designated Use are pH, Temperature, Dissolved Oxygen, Alkalinity, Total Dissolved Solids or TDS (Ambient water quality should not exceed 133% of background levels for this use), Turbidity, and toxic parameter data (along with Chronic Toxicity) that were collected in Water Quality Zones 2-5. DRBC standards include temperature criteria for all portions of the River; however only in Zones 2, 3 and 4 do ambient criteria exist. In other portions of the River, criteria are based upon the regulation of temperature increases, caused by effluent discharges, above background conditions. Those background conditions are not defined in Zones 1, 5 and 6. However, DRBC, through its Water Quality Advisory Committee, is working to establish temperature criteria for all portions of the River and Bay.

The Aquatic Life designated use was assessed along the length of the Delaware River from Hancock, NY to the bottom of Zone 1 (202 miles), in Zones 2-5 of the Delaware Estuary (97 square miles), and in the Delaware Bay (693 square miles). Figure 3.7 depicts the level of Aquatic Life Use support in the Delaware River and Bay.

Non-Tidal River

The use was supported in 33 miles of the non-tidal river, or 16.3 %. The remaining 169 miles either had insufficient data or did not support the Use. The following table explains the rationale behind the assessment decisions in those assessment units.

Table 3.12: Use Support Level Explained for Non-Tidal River AUs Not Supporting Aquatic Life Use

AU	Use Support Level	Explanation
1A1	Not Supported	High pH (greater than 8.5) in 12.5% of samples
1A2	Not Supported	High pH (greater than 8.5) in 11.4% of samples
1A3	Insufficient Data	No readily available data
1B1	Not Supported	High pH (greater than 8.5) in 16.7% of samples
1B2	Not Supported	Turbidity criterion exceeded in 11% of samples with one 30-day average of 18.25
1C1	Insufficient Data	No readily available data
1C2	Probably Supported	All criteria met except insufficient TDS data. TDS criteria are likely being met.
1C3	Insufficient Data	No readily available data
1C4	Insufficient Data	No readily available TDS data
1D1	Insufficient Data	No readily available TDS data
1D2	Not Supported	TDS criterion exceeded in 13.2% of samples
1D3	Not Supported	TDS criterion exceeded in 18.5% of samples
1D4	Not Supported	TDS criterion exceeded in 18.2% of samples
1D5	Probably Not Supported	No readily available data, but TDS criterion not met in 1D4 and 1D6
1D6	Not Supported	TDS criterion exceeded in 67% of samples
1E1	Insufficient Data	No readily available data
1E3	Insufficient Data	No readily available data
1E4	Not Supported	High pH (greater than 8.5) in 10.2% of samples

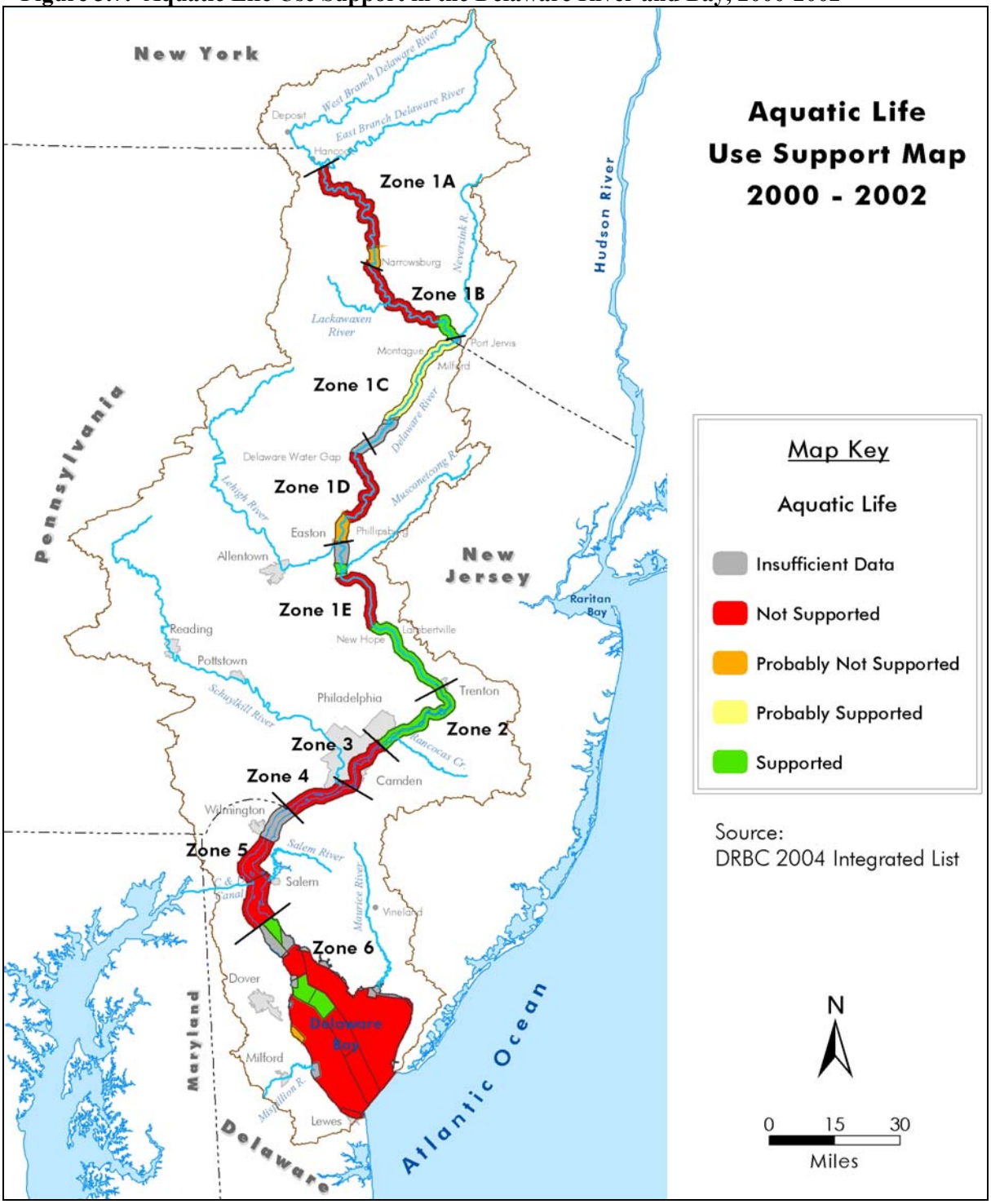
Estuary

The use was supported in Zone 2 of the Estuary (8 square miles) and in 56 square miles of the Bay. The remaining 726 square miles either had insufficient data or did not support the use. The following table explains the rationale behind the assessment decisions in those assessment units.

Table 3.13: Use Support Level Explained for Estuary and Bay AUs Not Supporting Aquatic Life Use

AU	Use Support Level	Explanation
3	Not Supported	Seasonal DO criterion not met in one season (6.4 mg/L average) Temperature criterion not met in 11.8% of 24-hour averages
4	Not Supported	Temperature criterion not met in 12.5% of 24-hour averages Copper exceedences
5a	Insufficient Data	Insufficient DO data for 24-hour averages and seasons not well-represented
5b	Not Supported	Insufficient DO data for 24-hour averages and seasons not well-represented Copper exceedances
5c	Not Supported	DO criterion not met in 14.1% of 24-hour averages
6br1a	Insufficient Data	No readily available data
6br2a	Insufficient Data	No readily available data
6br2b	Not Supported	DO criterion not met
6br2c	Insufficient Data	No readily available data
6br3a	Insufficient Data	No readily available data
6br3c	Insufficient Data	No readily available data
6brA	Not Supported	DO criterion not met
6brB	Not Supported	Temperature criterion not met
6de1	Not Supported	DO criterion not met
6de3	Probably Not Supported	Turbidity data show a “high likelihood” of impairment
6de4	Insufficient Data	No readily available data
6de5	Not Supported	DO criterion not met
6nj1	Not Supported	Temperature criterion not met DO criterion not met
6nj2-6nj8	Insufficient Data	No readily available pH, Alkalinity or Turbidity data
6nj9	Not Supported	DO criterion not met
6nj10	Insufficient Data	No readily available data

Figure 3.7: Aquatic Life Use Support in the Delaware River and Bay, 2000-2002



Fish Consumption Designated Use

The assessment of Fish Consumption is not based on zones, but rather is based upon the presence of fish consumption advisories for the main stem Delaware River and the tidal portions of its tributaries. Tables 3.14 – 3.16 below indicate the portions of the River for which such advisories exist. Figure 3.8 shows how those advisories translate into use support for fish consumption in the Delaware River. All portions of the Delaware River and Bay were found to have fish consumption advisories in place and so were assessed as not supporting the Fish Consumption use.

Where no advisories are in effect, the water body is supporting the Fish Consumption use. Where restrictions exist on the amount of fish consumed in a given time period, or consumption advisories exist for susceptible populations, the water body is not supporting the use. Since the 2002 report, New Jersey has developed a new methodology for making these advisories that has resulted in a two-tiered approach based upon risk level. For the purposes of this assessment, however, any advisory, regardless of risk level utilized, was used to indicate non-support of the use.

In total, all 202 miles of the mainstem Delaware River, all 97 square miles of the Estuary and 686 square miles of the Bay were assessed for fish consumption. As described in the Assessment Methodology (see Section 3.3), only water-body specific advisories for particular contaminants are used for determining use support. Statewide advisories require more information.

Table 3.14: Fish Consumption Advisories for the Delaware River : Delaware, New York and Pennsylvania (Main Stem and Tidal Portions)

Issuing State	From RM	To RM	Locations	Species	Advisory	High Risk Advisory	Contaminant
NY[a]	330.71	253.6	Statewide (i.e., NY portion of mainstem Delaware River)	All Species	no more than 1/2 lb/week	do not eat[b]	Various
PA[c]	330.71	137.60	Source to Yardley	American Eel	2 meals/month		Mercury
PA	137.60	78.74	Yardley to PA/DE line	American Eel	Do Not Eat		PCBs
				White Perch, Striped Bass, Carp, Flathead Catfish	1 meal/month		PCBs
				Channel Catfish	6 meals/year		PCBs
				Smallmouth Bass	2 meals/month		Mercury
DE[d]	78.74	58.90	Delaware State Line to C&D Canal	All Finfish	do not eat		PCBs, Arsenic, Dioxin, Mercury, Chlorinated Pesticides
DE	58.90	0.00	C&D Canal to mouth of Delaware Bay	Striped Bass, Channel Catfish, White Catfish, American Eel, White Perch	no more than 1 8-oz. meal/year		PCBs, Mercury, Dioxin
DE			Red Lion Creek, Rt. 13 to Delaware R.	All Finfish	no more than 3 8-oz. meals/year		PCBs, Dioxin
DE			Tidal Brandywine R., mouth to Baynard Blvd.	All Finfish	do not eat		PCBs
DE			Tidal Christina R., mouth to Smalley's Dam	All Finfish	do not eat		PCBs, Dieldrin
DE			Tidal White Clay Creek, mouth to Route 4	All Finfish	do not eat		PCBs
DE			C&D Canal, entire Canal in DE	All Finfish	do not eat		PCBs
DE			Shellpot Creek, Rt.13 to Delaware River	All Finfish	do not eat		PCBs, Chlordane
DE			Appoquinimink River, Tidal Portions	All Finfish	no more than 1 8-oz. meal/year		PCBs, Dioxin
DE			Drawyers Creek, Tidal Portions	All Finfish	no more than 1 8-oz. meal/year		PCBs, DDT

[a] NYS DEC 2003-2004 Health Advisories - Chemicals in Sportfish and Game

[b] in NY, high risk individuals are women of childbearing age, infants and children under 15

[c] Commonwealth of Pennsylvania Fish Consumption Advisories-2003

[d] Delaware Division of Fish and Wildlife, Fish Health Advisories as of February, 2002

Table 3.15: Fish Consumption Advisories for the Delaware River : New Jersey (For PCBs and Dioxins, Main Stem and Tidal Portions) [a]

From RM	To RM	Locations	Species	Advisory for 1 in 10,000 Lifetime Cancer Risk Level	Advisory for 1 in 100,000 Lifetime Cancer Risk Level	High Risk Advisory[b]
253.60	0.00	Statewide	American Eel	4 meals/year	Do Not Eat	Do Not Eat
			Striped Bass	1 meal/month	1 meal/year	Do Not Eat
137.60	78.74	Delaware River, Easton/Phillipsburg to PA/DE border, including tributaries to head of tide	American Eel	4 meals/year	Do Not Eat	Do not eat
			Striped Bass	4 meals/year	Do Not Eat	Do Not Eat
			Channel Catfish	1 meal every 2 months	1 meal every 2 months	Do Not Eat
78.74	58.90	Delaware River, DE/PA line to C&D Canal	All Finfish	Do Not Eat	Do Not Eat	Do Not Eat
58.90	0.00	Delaware River, C&D Canal to mouth of Delaware Bay	Striped Bass, Channel Catfish, White Catfish, American Eel, White Perch	no more than one 8-oz. meal per year	no more than one 8-oz. meal per year	no more than one 8-oz. meal per year
48.20	0.00	Delaware Bay Tributaries	American Eel	1 meal/month	4 meals/year	4 meals/year

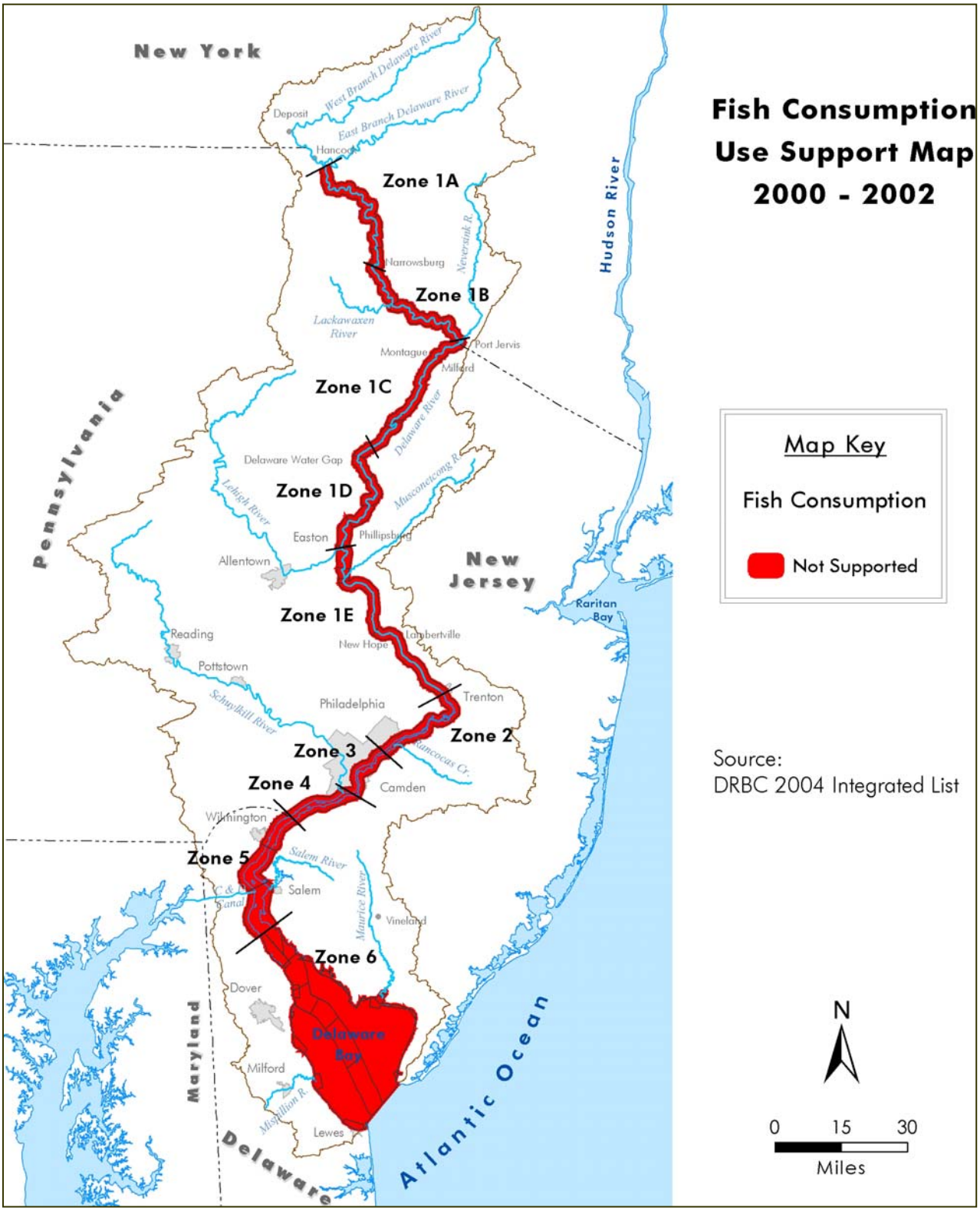
[a] Public Health Advisories And Guidance on Fish Consumption for Recreational Fishing - 2003 PCBs and Dioxin
[b] in NJ, high risk individuals include infants, children under 15, pregnant women, nursing mothers and women of childbearing age.

Table 3.16: Fish Consumption Advisories for the Delaware River: New Jersey (for Mercury) [a]

From RM	To RM	Locations	Species	General Advisory	High Risk Advisory[b]
253.60	0.00	Statewide	Largemouth & Smallmouth Bass, Chain Pickerel	1 meal/week	1 meal/month
			Brown Bullhead	No Restrictions	1 meal/month
			Yellow Bullhead & Sunfish	No Restrictions	1 meal/month
253.60	209.50	Delaware River upstream of Water Gap	Smallmouth Bass	1 meal/week	1 meal/month
			Channel Catfish Muskellunge	No Restrictions	1 meal/month
209.50	184.60	Delaware River from Water Gap to Phillipsburg	White Catfish	1 meal/week	Do Not Eat
			Channel Catfish	No Restrictions	1 meal/month
			Smallmouth Bass		
			Walleye	No Restrictions	1 meal/week
184.60	131.96	Delaware River, Phillipsburg to Trenton	Channel Catfish	1 meal/week	1 meal/month
			Largemouth Bass	No Restrictions	1 meal/month
			Smallmouth Bass	No Restrictions	1 meal/week
131.96	100.12	Delaware River Trenton to Camden	Largemouth Bass & White Catfish	No Restrictions	1 meal/week
100.12	78.74	Delaware River Camden to Delaware State Line	Hybrid Striped Bass	No Restrictions	1 meal/week

[a] Guide to Mercury Health Advisories for Eating Fish from New Jersey Freshwaters - 2002 Update
[b] High-risk individuals are pregnant women, women planning pregnancy within one year, nursing mothers and children under five years old

Figure 3.8: Fish Consumption Use Support in the Delaware River and Bay, 2000-2002



Shellfish Consumption Designated Use

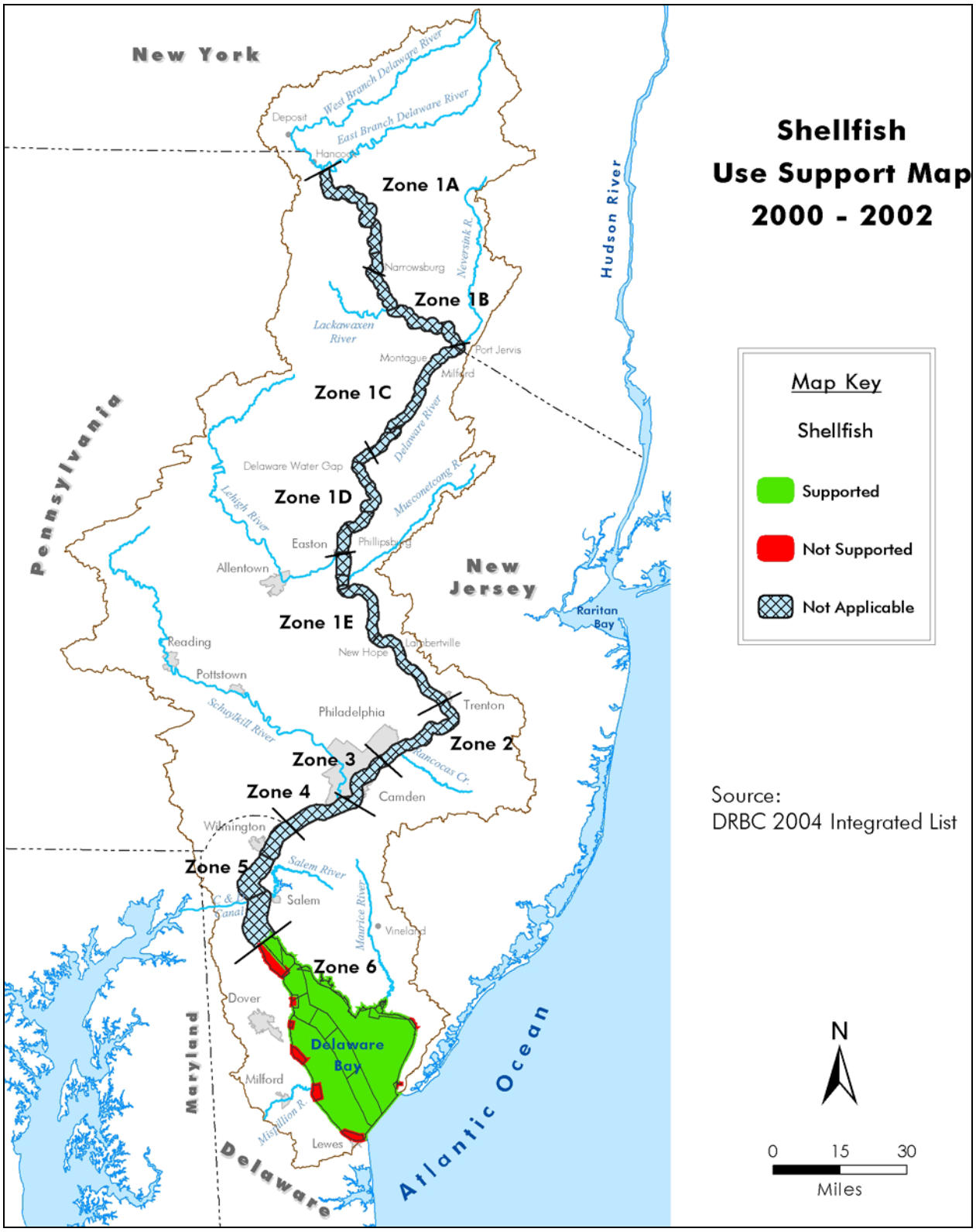
DRBC classifies only Zone 6 for the shellfish consumption use. In Zone 6, a criterion is set such that Total Coliform (Most Probable Number, or MPN) is not to exceed federal shellfish standards in designated shellfish areas. Because both the states of Delaware and New Jersey monitor and assess water quality for suitability for shell fishing based upon the same set of federal guidelines, the reader is referred to the most recent water quality assessment reports of those states for an assessment of the shellfish consumption use.

The State of Delaware classifies its designated shellfish waters as falling into the following categories; Approved, Seasonally Approved, Prohibited Shellfish Harvesting and Resource Protection Area, or Prohibited. New Jersey classifies shellfish waters as falling into the following categories; Unrestricted, Special Restricted, Seasonal, and Prohibited (either due to water quality or to administrative closures).

For this assessment, Prohibited waters were considered to be Not Supporting the use, while all other harvesting areas were considered to be Supporting the use. Figure 3.9 indicates the use support for shellfishing in Zone 6. In total, 652 square miles (94% of Zone 6) were in Full Support and 41 square miles (6% of Zone 6) were Not Supporting the use. For Shellfish Consumption, the entirety of Zone 6 (693 square miles) was assessed.

It is important to note that both the States of Delaware and New Jersey do not list all prohibited or provisionally approved waters as impaired waters, as not all restrictions on shellfish harvesting are due to water quality issues. According to DNREC, there were no closures of shellfishing waters during the 2000-2002 seasons due to water quality concerns. Please see Delaware's and New Jersey's 2004 Integrated List Reports for more information.

Figure 3.9: Shellfish Consumption Use Support in Delaware Bay, 2000-2002



Recreational Designated Use

The determination of Recreational Use support in this assessment is based upon bacterial data. DRBC standards for bacteria are based upon a geometric mean such that, for areas where Fecal Coliform bacteria are used as indicators, a maximum geometric mean of 200 colonies per 100 ml is permitted. Some exceptions to this criterion are present in the standards, however. In Zone 3 and Zone 4 (above RM 81.8) the limit is 770 colonies per 100 ml and secondary contact recreation is the designated use. In sections of the River where Enterococcus is another indicator (Zones 2-6), a maximum geometric mean of 33 colonies per 100 ml is the criterion for primary contact recreation in fresh waters. In marine waters (Zones 5 and 6), the Enterococcus criterion is 35 colonies per 100 ml for primary contact recreation. Secondary contact recreation in fresh waters requires no more than 88 colonies per 100ml.

Fecal Coliform samples should be taken at such a frequency and location as to permit valid interpretation. In a review of the available data used for this report, it is uncommon for there to be at least five samples (sampling dates) represented in any 30-day period. The one exception in the data was in AU 1E5, where it was possible to calculate two 30-day geometric means with at least five samples in a 30-day period each.

Since spikes in Fecal Coliform concentrations are likely to be event-driven (high flow events would tend to increase levels of these bacteria in the streams), it seems inappropriate to analyze the data based on 30-day periods, when only one or two days may be represented. Therefore, for this analysis, single-sample criteria were used. EPA recommends, in their 1997 *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates,* 400 colonies per 100 milliliters be used for fecal coliform. For enteroccoci, the most stringent EPA guidelines were used. These were 61 colonies/100mL for freshwater and 104 colonies/100mL for marine water (Zones 5 and 6). Those allowable densities are based upon EPA's *Consolidated Assessment and Listing Methodology – Toward a Compendium of Best Practices* (July, 2002).

Figure 3.10 shows the level of use support for Recreation, which was assessed along the length of the Delaware River from Hancock, NY to the bottom of Zone 1 (202 miles), in Zones 2-5 of the Delaware Estuary (97 square miles), and in Delaware Bay (686 square miles). It should be noted that this assessment does not account for tributary use support. Bacteria data collected in tributaries may indicate a level of use support that is not consistent with that of the main stem and Bay.

Non-Tidal River

The use was supported in all non-tidal Assessment Units except those in Table 3.17.

Table 3.17: Non-Tidal Assessment Units Not Supporting the Recreation Designated Use

AU	Use Support Level	Rationale
1A3	Probably Supporting	insufficient data but the use is supported in the upstream and downstream AUs.
1D4	Probably Supporting	only 16 samples available for analysis, but maximum density was 100 colonies/100mL
1D5	Insufficient Data	no readily available data
1D6	Not Supporting	17% of samples exceed 400 colonies/ 100mL
1E1	Insufficient Data	no readily available data
1E2	Not Supported	12% of samples exceed 400 colonies/ 100mL
1E3	Insufficient Data	no readily available data
1E5*	Not Supported	two 30-day geometric means did not meet 200 colonies/ 100mL criterion.

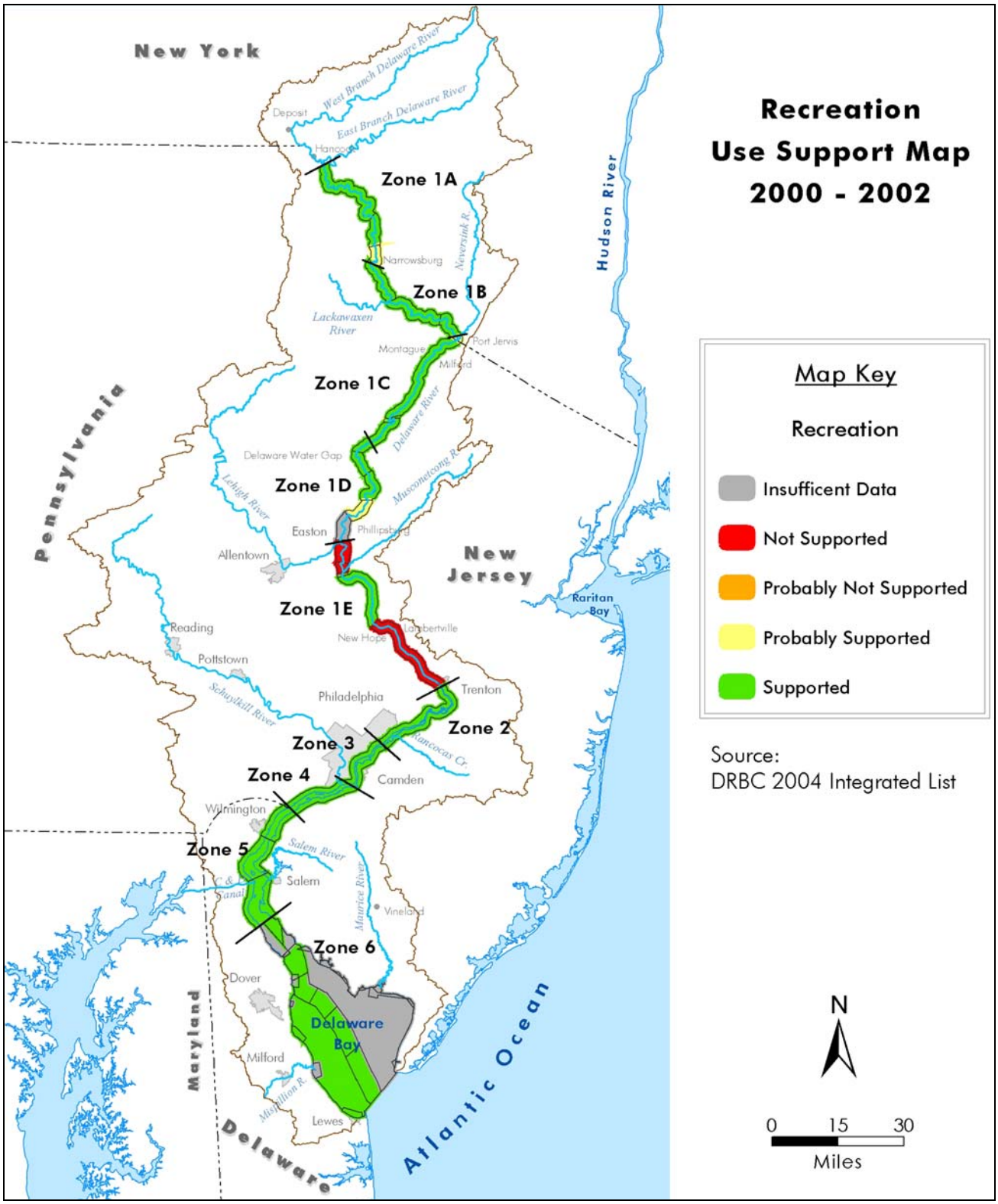
* sufficient data exist for calculating 30-day geometric means

Estuary

The use was supported in Estuary zones 2-5 (97 square miles, or 100% of the Estuary, excluding the Bay) and in the assessable portion of the Bay (368 square miles, or 53% of the Bay). All other Bay assessment units could not be assessed for recreation, according to DRBC water quality standards, because of a lack of readily available enterococcus data.

The assessment process could be improved with more frequent bacteriological sampling overall, as well as a more comprehensive coverage of enterococcus sampling.

Figure 3.10: Recreation Use Support in Delaware River and Bay, 2000-2002



Drinking Water Designated Use

The assessment of the Drinking Water designated use, in this assessment, is based upon levels of toxic substances, Total Dissolved Solids or TDS (secondary drinking water standards, or maximum of 500 mg/L applies for this use), Turbidity, Hardness and Chlorides. Zones 1A-E, 2 and 3 are designated for drinking water use, or a total of 197 main stem river miles and 14 square miles of Estuary.

Historical monitoring data show that levels of PCBs, 1,2 Dichloroethane (DCE) and Tetrachloroethene (PCE) exceed drinking water criteria in Zones 2 and 3 of the Delaware River. There is currently a TMDL in place for PCBs. Further, a 2000 DRBC resolution was passed by the Commissioners that noted that wasteload allocations were necessary in Zones 2 and 3, for DCE and PCE, in order to maintain the stream quality objectives. Discharge monitoring for these substances has occurred. Monitoring is underway to determine if the assimilative capacity of the Delaware River has in fact been exceeded for DCE and PCE. Modeling of the River has indicated that this is the case.

Figure 3.11 shows the level of drinking water use attainment for the various segments of the main stem Delaware River based upon an analysis of the parameters mentioned above. Note that Alkalinity, Chlorides, and Hardness criteria are not set for Zones 1A-E in the River. Note also that for Turbidity, which carries a "30-day average" criterion as well as a maximum value criterion, averages were calculated for the entire dataset. This was because the temporal nature of the data was not sufficient to calculate 30-day averages that would be useful for this analysis. It is recommended that, in the future, turbidity be measured with a greater frequency to improve assessment of the Drinking Water designated use.

The Drinking Water designated use was assessed along the length of the Delaware River from Hancock, NY (RM 335.5) down to the bottom of Zone 1 (202 miles) and in Zones 2 and 3 (14 square miles). This is equal to 100% of the main stem River and Estuary that are designated for that use.

Non-Tidal River

In Zones 1A-E, use support was based upon Turbidity and Total Dissolved Solids data. The use was supported in all Zones except those in Table 3.18.

Table 3.18: Non-Tidal Assessment Units Not Supporting the Drinking Water Designated Use

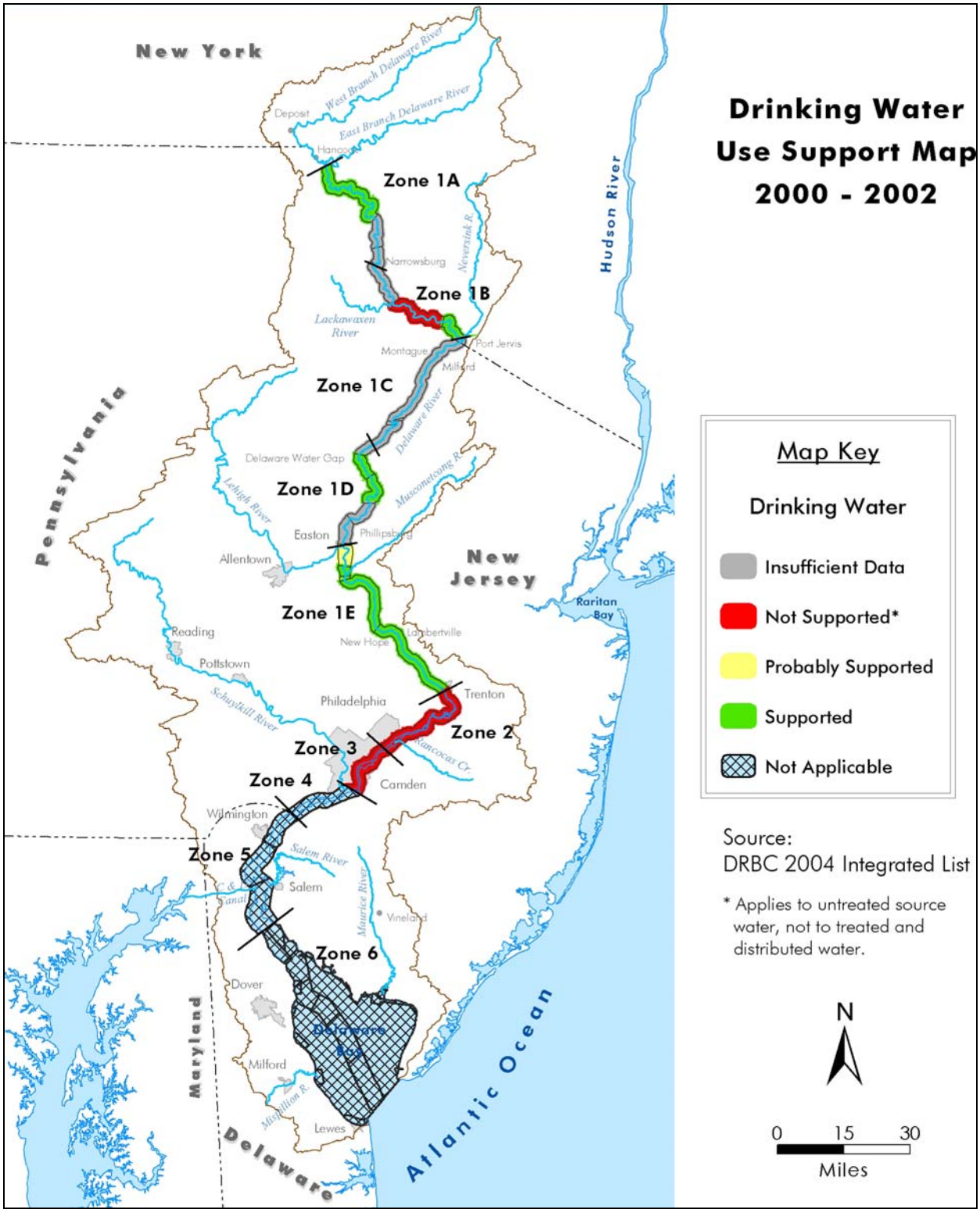
AU	Use Support Level	Rationale
1A2-1A3	Insufficient Data	No readily available Total Dissolved Solids data
1B1	Insufficient Data	No readily available Total Dissolved Solids data
1B2	Not Supported	Turbidity does not meet criteria
1C1-1C4	Insufficient Data	No readily available Total Dissolved Solids data, no readily available data in 1C1 and 1C3
1D1	Insufficient Data	No readily available Total Dissolved Solids data
1D4	Probably Supported	No readily available Turbidity data
1D5	Insufficient Data	No readily available data
1E1	Probably Supported	No readily available data but upstream and downstream AUs support the use
1E3	Probably Supported	No readily available data but upstream and downstream AUs support the use

Estuary

In Zones 2 and 3 (15 square miles, or 100% of the designated area in the Estuary) the drinking water use was assessed as Not Supported. The ambient quality of the water in those zones does not meet the water quality criteria for fish and water ingestion. According to Section 3.10.3.D of DRBC's Water Quality Regulations (1996), "It is the policy of the Commission to designate numerical stream quality objectives for the protection of human health for the Delaware River Estuary (Zones 2 through 5) which correspond to the designated uses of each zone." It is those stream quality objectives, corresponding to the drinking water and fish consumption uses in Zones 2 and 3, that are not being attained and therefore those uses are considered not to be supported in this assessment. This does not, however, indicate that the quality of water treated and distributed for public use is not meeting the applicable drinking water criteria. Only ambient (in-stream) criteria were considered in this assessment.

Monitoring is underway to determine if the assimilative capacity of Zones 2 and 3 has been exceeded for DCE and PCE, as modeling of the system indicates. A TMDL for PCBs is in place for this portion of the River. Both the 2000 305(b) report (1998-1999 assessed) and 2002 305(b) report (2000-2001 assessed) indicated non-support in these zones This assessment continues that characterization, until further data are collected and analyzed.

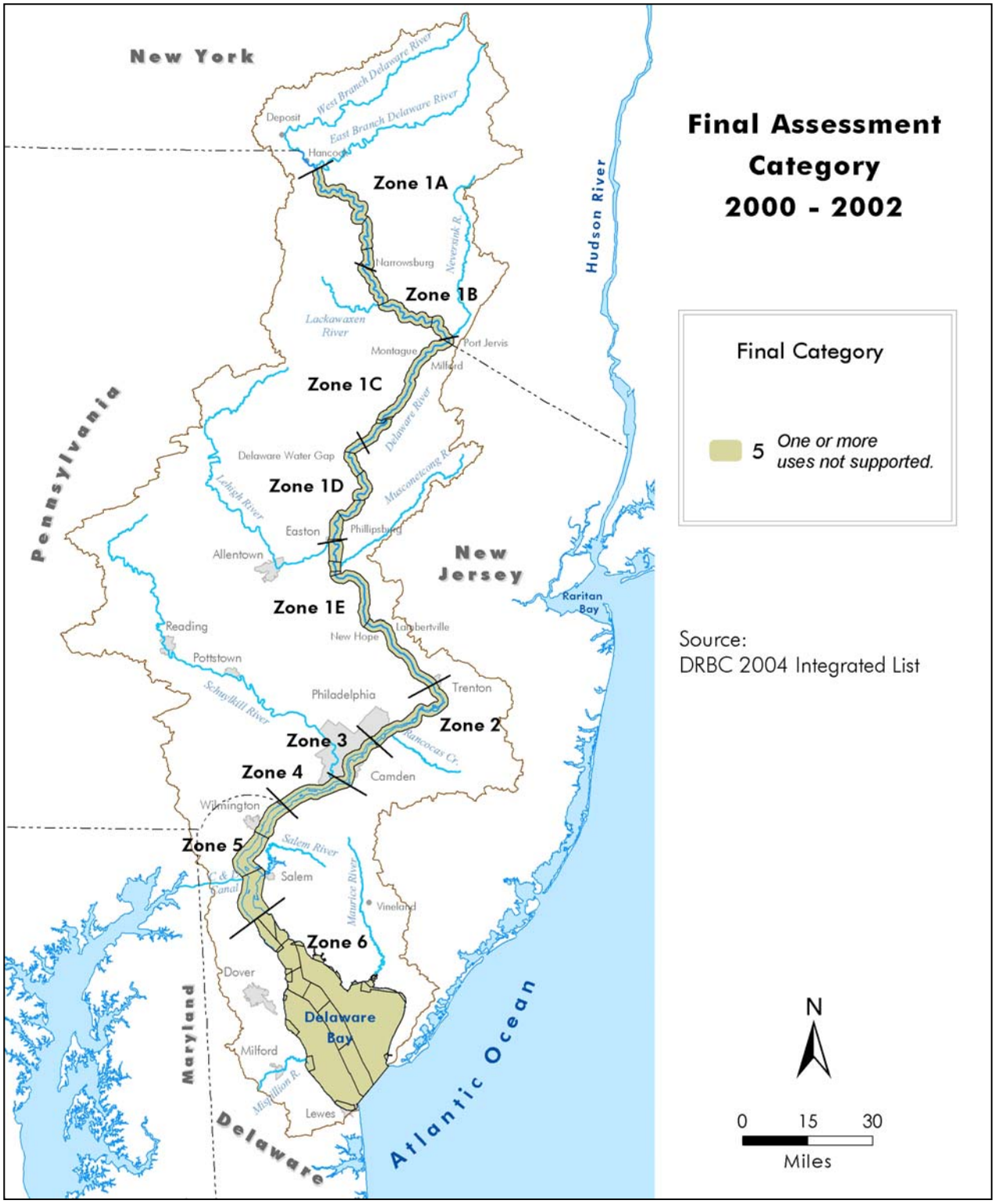
Figure 3.11: Drinking Water Use Support in Delaware River and Estuary, 2000-2002



Final Categorization of Assessment Units

Figure 3.12 represents the Integrated List categories into which each of the AUs belongs. The results of this assessment indicate that the vast majority of the Delaware River and Bay is in Category 5, not supporting one or more uses and requiring a TMDL. In some cases, non-support of the Fish Consumption designated use was the only cause of a water body being placed in Category 5. All parts of the River and Bay are affected by fish consumption advisories.

Figure 3.12: Categorization of AUs of the Delaware River and Bay, 2000-2002



4. Ground Water Assessment

As described in Part 2, it is the general policy of DRBC that all ground water of the Basin, as well as surface sources of drinking water, should not exceed maximum contaminant levels (MCL) given in the National Primary Drinking Water Standards. Because this report focuses on the mainstem of the Delaware River, the reader is directed to the 2004 water quality assessment reports of each of the four Delaware River Basin States for an update on groundwater quality management programs and any ground water-related issues.

Some general ground water issues that are occurring in the Basin, as of the writing of this report, are as follows:

- Superfund sites - A number of these sites exist in the Basin and contribute to localized groundwater contamination. Remediation activities are ongoing throughout the Basin.
- Mercury - Natural sources exist in some geologic formations in the Basin. More importantly, air deposition of mercury from combustion activities is an issue.
- Saltwater intrusion - In areas near the Delaware Bay, pumping of groundwater leads to migration of saltwater into the aquifers that supply water for drinking and other needs.
- Naturally occurring substances - Some areas have naturally high levels (due to local geology) of radioactivity, arsenic or other substances that may require additional treatment or preclude them from serving as drinking water sources

Appendix A
DRBC Water Quality Standards for Drinking Water Sources

Table A1: Maximum Contaminant Levels to be Applied as Human Health Stream Quality Objectives in Zones 2 and 3 of the Delaware River Estuary

Parameter	Maximum Contaminant Level (µg/l)
Antimony	6
Arsenic	50
Barium	2.0 mg/l
Cadmium	5
Chromium (total)	100
Nickel	100
Selenium	50
1,2 - trans - Dichloroethene	100
1,2 - Dichloropropane	5
Ethylbenzene	700
gamma - BHC (Lindane)	0.2
1,2,4 - Trichlorobenzene	70
Total Trihalomethanes	100

Table A2: Stream Quality Objectives for Carcinogens for The Delaware River Estuary

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Beryllium	B2	0.00767	0.132	0.0232
Aldrin	B2	0.00189	0.0226	0.00397
alpha - BHC	B2	0.00391	0.0132	0.00231
Chlordane	B2	0.000575	0.000588	0.000104
DDT	B2	0.000588	0.000591	0.000104
DDE	B2	0.00554	0.00585	0.00103
DDD	B2	0.00423	0.00436	0.000765
Dieldrin	B2	0.000135	0.000144	0.0000253
Heptachlor	B2	0.000208	0.000214	0.0000375

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Heptachlor epoxide	B2	0.000198	0.000208	0.0000366
PCBs (Total)	B2	0.0000444	0.0000448	0.0000079
Toxaphene	B2	0.000730	0.000747	0.000131
Acrylonitrile	B1	0.0591	0.665	0.117
Benzene	A	1.19	71.3	12.5
Bromoform	B2	4.31	164.0	28.9
Bromodichloromethane	B2	0.559	55.7	9.78
Carbon tetrachloride	B2	0.254	4.42	0.776
Chlorodibromomethane	C	0.411	27.8	4.88
Chloroform	B2	5.67	471.0	82.7
1,2 - Dichloroethane	B2	0.383	98.6	17.3
1,1 - Dichloroethene	C	0.0573	3.20	0.562
1,3 - Dichloropropene	B2	87.0	14.1	2.48
Methylene chloride	B2	4.65	1,580	277
Tetrachloroethene	B2	0.80	8.85	1.55
1,1,1,2 - Tetrachloroethane	C	1.29	29.3	5.15
1,1,2,2 - Tetrachloroethane	C	0.172	10.8	1.89
1,1,2 - Trichloroethane	C	0.605	41.6	7.31
Trichloroethene	B2	2.70	80.7	14.2
Vinyl chloride	A	2.00	525.0	92.9
Benzidine	A	0.000118	0.000535	0.000094
3,3 - Dichlorobenzidine	B2	0.0386	0.0767	0.0135
PAHs				
Benz[a]anthracene	B2	0.00171	0.00177	0.00031
Benzo[b]fluoranthene	B2	0.000455	0.000460	0.000081
Benzo[k]fluoranthene	B2	0.000280	0.000282	0.000049
Benzo[a]pyrene	B2	0.0000644	0.0000653	0.0000115

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Chrysene	B2	0.0214	0.0224	0.00394
Dibenz[a,h]anthracene	B2	0.0000552	0.0000559	0.0000098
Indeno[1,2,3-cd]pyrene	B2	0.0000576	0.0000576	0.0000101
Bis (2-chloroethyl) ether	B2	0.0311	1.42	0.249
Bis (2-ethylhexyl) phthalate	B2	1.76	5.92	1.04
Dinitrotoluene mixture (2,4 & 2,6)	B2	17.3	1420	249
1,2 - Diphenylhydrazine	B2	0.0405	0.541	0.095
Hexachlorobenzene	B2	0.000748	0.000775	0.000136
Hexachlorobutadiene	C	0.445	49.7	8.72
Hexachloroethane	C	1.95	8.85	1.56
Isophorone	C	36.3	2590	455
N-Nitrosodi-N-methylamine	B2	0.000686	8.12	1.43
N-Nitrosodi-N-phenylamine	B2	4.95	16.2	2.84
N-Nitrosodi-N-propylamine	B2	0.00498	1.51	0.265
Pentachlorophenol	B2	0.282	8.16	1.43
2,4,6 - Trichlorophenol	B2	2.14	6.53	1.15
Dioxin (2,3,7,8 - TCDD)	-	1.3×10^{-8}	1.4×10^{-8}	2.4×10^{-9}

Table A3: Stream Quality Objectives for Systemic Toxicants for the Delaware River Estuary.

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 & 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Antimony		14.0	4,310	757
Arsenic	A	9.19	73.4	12.9
Beryllium	B2	165	2,830	498
Cadmium		14.5	84.1	14.8
Chromium (Trivalent)		33,000	673,000	118,000
Hexavalent chromium	A	166	3,370	591
Mercury	D	0.144	0.144	0.144
Nickel		607	4,580	805
Selenium	D	100	2,020	355
Silver	D	175	108,000	18,900
Thallium		1.70	6.20	1.10
Zinc		9110	68700	12100
Aldrin	B2	0.96	11.5	2.03
gamma - BHC (Lindane)		7.38	24.9	4.37
Chlordane	B2	0.0448	0.0458	0.00805
DDT	B2	0.100	0.100	0.0176
Dieldrin	B2	0.108	0.115	0.020
Endosulfan		111	239	42.0
Endrin	D	0.755	0.814	0.143
Heptachlor	B2	0.337	0.344	0.060
Heptachlor epoxide	B2	0.0234	0.0246	0.00433
Total PCBs	B2	0.00839	0.00849	0.00149
Acrolein		320	780	137
Ethylbenzene		3,120	28,700	5,050
Bromoform	B2	682	25,900	4,560
Bromodichloromethane	B2	693	69,000	12,100

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 & 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Dibromochloromethane	C	690	46,600	8,190
Carbon tetrachloride	B2	23.1	402	70.6
Chloroform	B2	346	28,700	5,050
Chlorobenzene	D	677	20,900	3,670
1,1 - Dichloroethene	C	309	17,300	3,040
1,2 - trans - Dichloroethene		696	136,000	23,900
1,3 - Dichloropropene	B2	10.4	1,690	297
Methyl bromide		49.0	N/A	N/A
Methylene chloride	B2	2,090	710,000	125,000
1,1,2 - Trichloroethane	C	138	9,490	1,670
Tetrachloroethene		318	3,520	618
1,1,1,2 - Tetrachloroethane	C	1,000	22,400	3,940
Toluene		6,760	201,000	35,400
Acenaphthene		1,180	2,670	469
Anthracene	D	4,110	6,760	1,190
Benzidine	A	81.8	369	64.9
Bis (2-chloroisopropyl) ether		1,390	174,000	30,600
Bis (2-ethylhexyl) phthalate	B2	492	1,660	291
Butylbenzl phthalate	C	298	520	91.4
Diethyl phthalate	D	22,600	118,000	20,700
Dimethyl phthalate	D	313,000	2,990,000	526,000
Dibutyl phthalate	D	2,710	12,100	2,130
1,2 - Dichlorobenzene	D	2,670	17,400	3,060
1,3 - Dichlorobenzene	D	414	3,510	617
1,4 - Dichlorobenzene		419	3,870	677
2,4 - Dinitrotoluene		69.2	5670	996
Fluoranthene		296	375	65.8

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 & 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
Fluorene	D	730	1,530	268
Hexachlorobenzene	B2	0.958	0.991	0.174
Hexachlorobutadiene	C	69.4	7,750	1,360
Hexachlorocyclopentadiene		242	17,400	3,050
Hexachloroethane	C	27.3	124	21.7
Isophorone	C	6,900	492,000	86,400
Nitrobenzene	D	17.3	1,860	327
Pyrene	D	228	291	51.1
1,2,4 - Trichlorobenzene	D	255	945	166
2 - Chlorophenol		122	402	70.6
2,4 - Dichlorophenol		92.7	794	139
2,4 - Dimethylphenol		536	2,300	403
2,4 - Dinitrophenol		70	14,300	2,500
Pentachlorophenol	B2	1,010	29,400	5,160
Phenol		20,900	4,620,000	811,000

Appendix B
Scenic Rivers Monitoring Program
Site Information and Quality Assurance and Control

Table B1: Locations for Baseline Scenic Rivers Monitoring (43 Sites)

UPPER DELAWARE RIVER MONITORING LOCATIONS (9)	
Buckingham Access Area (2001)	Ten-Mile River NYSDEC Access Area
Lordville Bridge	Barryville Bridge
Callicoon Bridge	Pond Eddy Bridge
Callicoon NYSDEC Access Area	Millrift
Cochecton Bridge	
MIDDLE DELAWARE RIVER MONITORING LOCATIONS (7)	
Port Jervis	Bushkill Access
Northern DEWA boundary	Smithfield Beach
Milford Beach	Delaware Water Gap
Dingmans Access	
UPPER DELAWARE TRIBUTARIES (14)	
West Branch Delaware	Masthope Creek
East Branch Delaware	Beaver Brook
Equinunk Creek	Lackawaxen River
Little Equinunk Creek	Halfway Brook
Callicoon Creek	Shohola Creek
Calkins Creek	Mongaup River
Ten Mile River	Shingle Kill
MIDDLE DELAWARE TRIBUTARIES (13)	
Neversink River	Flat Brook
Vandermark Creek	Little Flat Brook
Shimers Brook	Van Campens Brook
Sawkill Creek	Shawnee Creek
Raymondskill Creek	Brodhead Creek
Bushkill Creek	Cherry Creek
Little Bushkill	

Table B2: Flow Measurement Monitoring Locations

LOCATION	**AGENCY**	**TYPE**
DELAWARE RIVER FLOW MONITORING LOCATIONS		
Callicoon Access Area	U.S.G.S.	Continuous
North of Lackawaxen	U.S.G.S.	Continuous
Port Jervis	U.S.G.S.	Continuous
Milford	U.S.G.S.	Continuous
Tocks Island	U.S.G.S.	Discontinued
UPPER DELAWARE TRIBUTARY FLOW MONITORING LOCATIONS		
West Branch Delaware	U.S.G.S.	Continuous
East Branch Delaware	U.S.G.S.	Continuous
Equinunk Creek	DRBC/NPS	Instantaneous
Little Equinunk Creek	DRBC/NPS	Instantaneous
Calkins Creek	DRBC/NPS	Instantaneous
Callicoon Creek	DRBC/NPS	Instantaneous
Tenmile River	DRBC/NPS	Instantaneous
Masthope Creek	DRBC/NPS	Instantaneous
Beaver Brook	DRBC/NPS	Instantaneous
Halfway Brook	DRBC/NPS	Instantaneous
Shohola Creek	DRBC/NPS	Instantaneous
Shingle Kill	DRBC/NPS	Instantaneous

Table B2 continued

MIDDLE DELAWARE TRIBUTARY FLOW MONITORING LOCATIONS		
Neversink River	U.S.G.S.	Continuous
Cummins Creek	DRBC/NPS	Instantaneous
Vandermark Creek	DRBC/NPS	Instantaneous
Shimers Brook	DRBC/NPS	Instantaneous
Sawkill Creek	DRBC/NPS	Instantaneous
Raymondskill Creek	DRBC/NPS	Instantaneous
Dingmans Creek	DRBC/NPS	Instantaneous
Hornbecks Creek	DRBC/NPS	Instantaneous
Toms Creek	DRBC/NPS	Instantaneous
Saw Creek	DRBC/NPS	Instantaneous
Little Bushkill Creek	DRBC/NPS	Instantaneous
Bushkill Creek	U.S.G.S.	Continuous
Flat Brook	U.S.G.S.	Continuous
Little Flat Brook	DRBC/NPS	Instantaneous
Big Flat Brook	DRBC/NPS	Instantaneous
Van Campens Brook	DRBC/NPS	Instantaneous
Shawnee Creek	DRBC/NPS	Instantaneous
Marshalls Creek	DRBC/NPS	Instantaneous
Brodhead Creek	U.S.G.S.	Continuous
Adams Creek	DRBC/NPS	Instantaneous
Dunnfield Creek	DRBC/NPS	Instantaneous
Slateford Creek	DRBC/NPS	Instantaneous
Cherry Creek	DRBC/NPS	Instantaneous

Table B3: Parameters for Scenic Rivers Monitoring Program

Parameter	Standard Methods – Number	Equipment	Min – Max	Accuracy(±)
BASELINE PARAMETERS - MONTHLY SAMPLING FREQUENCY				
Flow	See TABLE B2 for locations	Pygmy meter	0.07-3.00 fps	
Air temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
Water temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
		Thermistor probe (DO meter)	-5-45 °C	0.7 °C
		Thermistor probe (conductivity meter)	-2-50 °C	0.6 °C
Dissolved oxygen	4500-O C. - azide modification of Winkler titration method	Kit	0-20 mg/l	20-60 µg/l
	4500-O G. – membrane electrode	Meter	0-20 mg/l	1 % of scale
Specific conductance	2510 - platinum electrode conductivity cell	Meter	0-19,999 µmhos /cm	2 µmhos/cm
PH	4500-H+	Oakton pH meter	4-10 units	0.25 units
Turbidity	2130 B. Nephelometric	LaMotte colorimeter	5-400 NTU	.1-10 NTU
Fecal coliform	9222 D. m-FC media	Membrane filtration	> 0 colonies/100 ml	NA
Total Suspended Solids	2540 D. TSS dried at 103-105°C	Glass fiber filter system, oven, dessicator, analytical balance to 0.1 mg	2.5 -200 mg residue weight	5% of avg. weight 2.8 mg/L SD

Table B3 continued

Parameters **Not** Analyzed in 2000 and 2001 Programs *Some were used to define existing water quality in DRBC's Special Protection Waters rules, others form the basis of DRBC's Stream Quality Objectives for Zones 1A, 1B, 1C, and 1D of the Delaware River. Resource constraints during the 2000 and 2001 monitoring seasons prevented assessment of these against water quality standards and Special Protection Waters stream quality targets.*	
Alkalinity	2320 B. Titration. No criteria for this parameter. Deemed useful, but not funded.
Ammonia N	4500-NH3 F. Phenate Method. Special Protection Waters rules define existing water quality for this parameter. Replacement equipment has not been funded.
Biocriteria: Macroinvertebrate Shannon Diversity	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
Biocriteria: Macroinvertebrate Equitability	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
Biocriteria: Macroinvertebrate EPT Richness	Special Protection Waters rules defined existing water quality using this benthic macroinvertebrate metric as a numeric standard. Methods under development to assess this parameter's sensitivity to "measurable change", no resources allocated.
BOD5	5210 B. 5-Day BOD Test. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Hardness	2340 B. Calculation or 2340C – EDTA Titrimetric. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Nitrate+nitrite N	4500-NO3. No method decided. Special Protection Waters rules defined existing water quality for this parameter. Staff are averse to Cadmium Reduction method due to health and cost concerns regarding waste disposal. Alternative Zinc Reduction method not approved by U.S. EPA. Replacement equipment is not funded.
Ortho-phosphate	4500-P E. Ascorbic acid reduction. Special Protection Waters rules define existing water quality for this parameter. Replacement equipment has not been funded.
Total Dissolved Solids	2540 C. TDS dried at 180 °C. Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.
Total Kjeldahl Nitrogen	4500-Norg A. Macro-Kjeldahl. . Special Protection Waters rules define existing water quality for this parameter. Analysis of this parameter is not funded.

DRBC BIOMONITORING – Macroinvertebrates and habitat for tributaries and Delaware River.	
Habitat Assessment (wadeable tributaries)	RBP 2nd Edition 1999, Habitat Protocols for High Gradient Streams (tributaries). Sampled as needed.
Habitat Assessment (Delaware River – special project)	USGS NAWQA Protocols (Fitzpatrick et al. 1998) in Delaware River OR Adaptation of RBP Habitat (2nd Ed., Barbour et al. 1999) to Delaware River. This is used to identify & quantify extent of riverine microhabitats for macroinvertebrates.
Macroinvertebrates (Rapid Assessment in Tributaries)	Indicator-organism field-level assessment w/ 10 point scoring system. Adapted from NYSDEC screening procedure developed by Bode et al. 1996. Assess 100 m reach upstream of fixed water quality sampling site. Sample as needed. If score < 5, call state for further investigation.
Macroinvertebrates (Delaware River Metric Development)	Best habitat (riffle, run, or island head), 33 sites, 3 replicates, 200-organism subsample of Delaware River from East & West Branches to Trenton, NJ. Index period is August-September, flow must be less than 6,000 cfs @ Trenton for access. Sampled annually.

Quality Assurance and Control

The data collection quality objectives of the SRMP are:

- To accurately describe the water quality conditions in the study area. The water quality parameters should be sufficient to:

1. define and evaluate the quality of the waters within the Scenic Rivers region;
2. determine if numerical standards of Special Protection Waters are maintained
3. categorize tributaries and river locations as point source or non-point source-impacted;
4. support management actions such as follow-up monitoring and directing intensive surveys by state enforcement agencies;
5. determine if water quality meets or exceeds primary contact recreation standards.

- To obtain data so that sound, scientifically-based management decisions involving the ecosystem can be made. The level of precision and accuracy should be sufficient to characterize:

1. the chemical, biological, and physical characteristics of the ecosystem;
2. the aquatic and riparian habitats of the ecosystem;
3. the natural variability of the biological communities of each habitat;
4. the sensitivity of biological communities to natural and anthropogenic impacts;
5. the interrelationship of chemical, physical, and biological components; and
6. measures of the ecosystem's general integrity and health.

Quality Assurance Practices and Procedures

Attainment of quality assurance objectives is achieved by maintaining a running check of precision and accuracy of analyses throughout the sampling program. Instrument variations are controlled by calibration of equipment and use of standard solutions. These are recorded on Calibration Quality Assurance forms.

SRMP staff is required to maintain a daily log of activities. Separate notebooks are also kept for each individual program element. These notebooks are used to record observations, describe sampling station locations, and to present results. The SRMP has also developed three data record/analyses sheets for recording results. These are used routinely for water quality, flow and macroinvertebrate/habitat.

Separate notebooks are also maintained for all quality control checks for bacteriological samples. Examples of information recorded include tests using sample blanks, parallel tests (external and internal) and replicate samples. QA report forms have been developed for use by the SRMP staff for their monthly and other QA reporting activities.

Sample Custody

Samples are generally in the custody of the same individuals from initial collection through analysis and recording of data. One individual has designated responsibility for record-keeping, which includes the preparation of sample labels, laboratory logging procedures and the maintenance of reports as described above. In cases where a laboratory is contracted for analyses (e.g., the Academy of Natural Sciences contracted from 1995-1997), sample custody procedures of the contract lab are followed by the sampling personnel.

Performance and System Audits

Before the initiation of the SRMP, the DRBC/NPS Co-Managers should prepare the program by checking all equipment, making repairs, and by purchasing equipment and chemicals. This activity is coordinated and shared with National Park Service lab personnel. A Co-manager or QA Officer from both DRBC and NPS performs training and field/laboratory audits prior to and during the monitoring season, checking sampling and analytical methods for proper quality controls and other activities related to program administration.

Field audits evaluate sampling technique, sample handling, and preservation to insure representative results. Personnel safety measures are highlighted. Laboratory audits review analytical techniques, sample preparation, and data reporting procedures. Also, laboratory cleanliness and safety are emphasized.

Corrective Actions

Corrective actions are initiated during routine internal and external quality control checks. The Quality Assurance Officer orders corrective actions after consultation with the program co-managers when periodic quality assurance inspections turn up unacceptable variations in data sets obtained during implementation of quality control procedures. If the problems noted by the Quality Assurance Officer are not corrected to his/her satisfaction, a memo report is prepared by the Quality Assurance Officer and sent to each Co-manager.

Quality Assurance Records to Management

The SRMP uses a reporting procedure by which the co-managers prepare quarterly reports to the Quality Assurance Officer before his inspection and institution of performance and system audits. The reports present the results of internal and external quality checks, corrective actions taken and other information such as timing of critical steps in bacterial analyses, sterilization steps taken, incubator temperature monitoring results, etc. The reporting procedures consist of the submittal of logbooks and filling out forms.

Data Storage, Management and Sharing

Data are entered into STORET by DRBC staff as soon as practical after internal review. Dissolved oxygen concentrations and water temperatures are used to calculate percent dissolved oxygen saturation.

Appendix C
Lower Delaware Monitoring Program
Site Information and Quality Assurance and Control

Table C1: Continuous-Recording Water Quality and Flow Measurement Monitoring Locations, Delaware Water Gap to Trenton

Location		Agency	Type
01443280	East Branch Paulins Kill near Lafayette, NJ	USGS	Continuous
01443500	Paulins Kill at Blairstown, NJ	USGS	Continuous
01443900	Yards Creek near Blairstown, NJ	USGS	Continuous
01445500	Pequest River at Pequest, NJ	USGS	Continuous
01446500	Delaware R. at Belvidere, NJ	USGS	Continuous**
01447500	Lehigh R. at Stoddartsville, PA	USGS	Continuous**
01447800	Lehigh R blw FE Walter Resv nr White Haven, PA	USGS	Continuous**
01449000	Lehigh R at Lehighton, PA	USGS	Continuous**
01451000	Lehigh R at Walnutport, PA	USGS	Continuous**
01453000	Lehigh R at Bethlehem, PA	USGS	Continuous**
01454700	Lehigh R at Glendon, PA	USGS	Continuous**
01457500	Delaware R. at Riegelsville, NJ	USGS	Continuous**
01457000	Musconetcong River near Bloomsbury, NJ	USGS	Continuous
01460200	Delaware R. at Point Pleasant, PA (QW Site Only)	USGS	DO, pH, Temp, Cond.
01459500	Tohickon Cr near Pipersville, PA	USGS	Continuous**
01463620	Assunpink Creek near Clarksville, NJ	USGS	Continuous
01464000	Assunpink Creek @ Trenton, NJ	USGS	Continuous
01463500	Delaware R. at Trenton, NJ	USGS	Continuous**

** denotes availability of current data on worldwide web at http://waterdata.usgs.gov/nwis-w/

Table C2: DRBC Flow Monitoring - Develop Flow Rating Curves for Loadings (10 Creeks)

Pidcock Creek at Bowmans Hill Wildflower Preserve, Bucks Co, PA	DRBC	Instantaneous
Wickecheoke Creek at Rt 29 near Prahls Mill, Hunterdon Co, NJ	DRBC	Instantaneous
Lockatong Creek at Rosemont-Raven Rock Rd, Hunterdon Co, NJ	DRBC	Instantaneous
Paunacussing Creek near Rt 32, Bucks Co, PA	DRBC	Instantaneous
Tinicum Creek near Rt 32, Bucks Co, PA	DRBC	Instantaneous
Tohickon Creek above Rt 32, Bucks Co, PA (relate to upstr USGS gage)	DRBC	Instantaneous
Nishisakawick Creek, Hunterdon Co, NJ	DRBC	Instantaneous
Cooks Creek above Red Bridge Rd, Bucks Co, PA	DRBC	Instantaneous
Pohatcong Creek above River Rd, Warren Co, NJ	DRBC	Instantaneous
Bushkill Creek above Rt 611, Northampton Co, PA	DRBC	Instantaneous

Table C3: Delaware River Water Chemistry Monitoring Sites

Delaware River Bridge	River Mile	Site # (composite, NJ side, PA side)
Calhoun Street Bridge	134.34	DRBCNJPAC01, DRBCNJ0001, DRBCPA0001
Washington Crossing Bridge	141.80	DRBCNJPAC02, DRBCNJ0004, DRBCPA0006
Lambertville/New Hope Bridge	148.70	DRBCNJPAC11, DRBCNJ0009, DRBCPA0010
Stockton Bridge (not monitored 2001)	151.90	DRBCNJPAC03, DRBCNJ0011, DRBCPA0012
Raven Rock/Lumberville Foot Bridge, Bulls Isl.	155.40	DRBCNJPAC04, DRBCNJ0014, DRBCPA0013

Table C3 continued

Delaware River Bridge	River Mile	Site # (composite, NJ side, PA side)
Frenchtown/Uhlerstown Bridge (closed 2001)	164.30	DRBCNJPAC05, DRBCNJ0021, DRBCPA0018
Milford/Upper Black Eddy Bridge	167.70	DRBCNJPAC06, DRBCNJ0024, DRBCPA0019
Riegelsville Bridge	174.80	DRBCNJPAC07, DRBCNJ0026, DRBCPA0023
Easton/Phillipsburg Bridge, Northampton St.	183.80	DRBCNJPAC08, DRBCNJ0029, DRBCPA0027
Belvidere/Riverton Bridge	197.80	DRBCNJPAC09, DRBCNJ0034, DRBCPA0033
Columbia/Portland Foot Bridge	207.40	DRBCNJPAC10, DRBCNJ0037, DRBCPA0036

Table C4: Tributary Water Chemistry Monitoring Sites

Tributary	Mile	Reason for Selection 2001	Site No.
Pidcock Cr, PA	146.3	Good quality, potential reference site	DRBCPA0008
Wickecheoke Cr, NJ	152.5	W&S, TM, development	DRBCNJ0012
Lockatong Cr, NJ	154.0	W&S, TM, development	DRBCNJ0013
Paunacussing Cr, PA	155.6	W&S, HQ, watershed group	DRBCPA0016
Tohickon Cr, PA 157.0	W&S	EV, regulated, major tributary	DRBCPA0015
Tinicum Cr, PA	161.6	W&S, EV	DRBCPA0017
Nishisakawick Cr, NJ	164.1	ASW	DRBCNJ0020
Cooks Cr, PA	173.7	W&S, EV, infrequent samples, watershed group	DRBCPA0021
Musconetcong R., NJ	174.6	ASW, TM, major tributary, watershed group	DRBCNJ0025
Pohatcong Cr, NJ	177.4	TP, reservoir effects, development, watershed group	DRBCNJ0027
Lehigh River, PA	183.66	WQN, regulated, major tributary, watershed groups	DRBCPA0026
Bushkill Cr, PA	184.1	EV (pt), known problems, watershed group	DRBCPA0028
Pequest River, NJ	197.8	ASW, TM, major tributary, watershed group	DRBCNJ0032
Paulins Kill, NJ	207.0	W&S, TM, ASW, major tributary	DRBCNJ0036

Table C5: Lower Delaware Monitoring Program Sampled Parameters and Procedures

Parameter	Standard Methods Procedure	Equipment	Min – Max	Accuracy(±)
COLLECTED AND ANALYZED BY DRBC:				
Flow Discharge	See TABLE 2 for locations	Pygmy meter	0.07-3.00 fps	
Gage Height	N/A	Surveyor's Tape	N/A	0.01 ft
Air temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
Water temperature	2550 – thermometric	Thermometer	-10-110 °C	1 °C
		Probe (DO meter)	-5-45 °C	0.7 °C
		Probe (cond. meter)	-2-50 °C	0.6 °C
Dissolved oxygen	4500-O C. - azide modification of Winkler titration method	Pre-prepared Hach kit	0-20 mg/l	20-60 µg/l
	4500-O G. – membrane electrode	YSI Meter	0-20 mg/l	1% of scale
Specific conductance	2510 B. Laboratory Method (platinum electrode cond. cell)	YSI Meter	0-19,999 µmhos /cm	2 µmhos/cm
PH	4500-H+	Oakton pH Testr 2	4-10 units	0.25 units
PH	4500-H+	IQ 120 pH meter	2-12 pH	±0.1 units
COLLECTED BY DRBC: Contract with NJ Analytical Labs for analyses (LRL is Lower Reporting Limit)				
Hardness (Total)	EPA 130	1 mg/l CaCO3 LRL	7 d hold time	±1 mg/l
Chloride	EPA 325.3	1 mg/l LRL	7 d hold time	±1 mg/l
Alkalinity, Total	EPA 310	1 mg/l CaCO3 LRL	24 hr hold time	±1 mg/l
Turbidity (NTU)	EPA 180.1	5 NTU LRL	24 hr hold time	±1 units
Enterococcus	9230 C. mE agar enterococci MF	>0 /100ml LRL	6 hr hold time	NA
Fecal coliform	9222 D. m-FC media (MF)	>0 /100ml LRL	6 hr hold time	NA
Nitrate+Nitrite	EPA 353.2, 353.3	0.05 mg/l as N LRL	7 d hold time	0.05 mg/l
Chlorophyll a	SM 10200 H.	0.001 mg/m3 LRL	24 hr hold time	0.001 mg/m3
Ammonia N	EPA 350	0.1 mg/l NH3 as N LRL	7 d hold time	0.1 mg/l NH3 as N
Total Phosphorus	EPA 365.1	0.005 mg/l PO4 as P LRL	7 d hold time	0.005 mg/l PO4 as P
Total Kjeldahl Nitrogen	EPA 351.2	0.1 mg/l TKN LRL	7 d hold time	0.1 mg/l TKN
Orthophosphate P	EPA 365.1	0.005 mg/l PO4 as P LRL	24 hr hold time	0.005 mg/l PO4 as P
Total Suspended Solids	EPA 160.2	4 mg/l LRL	24 hr hold time	4 mg/l

W&S=Wild and Scenic, TM=Trout Maintenance, HQ = High Quality Waters, EV = Exceptional Value Waters, ASW = Ambient Surface Water Network (NJDEP)

Table C6: Sites Not Monitored in 2001, Established for Definition of Existing Water Quality

Tributary	Mile	Reason for Exclusion 2001	Site No.
Assunpink Creek, NJ	133.8	Lack of funds, NJDEP monitors (303D listed)	DRBCNJ1338
Buck/Brock Cr, PA	138.0	Lack of funds, not major tributary	DRBCPA0002
Jacobs Cr, NJ	140.5	Lack of funds, not major tributary	DRBCNJ0003
Aquetong Cr, PA	148.5	Lack of funds, not major tributary (PA HQ stream)	DRBCPA0009
Alexaukin Creek, NJ	149.5	Lack of funds	DRBCNJ0010
Hakihokake Cr, NJ	167.2	Lack of funds, not major tributary (NJ TM waters)	DRBCNJ0023
Fry's Run, PA	176.6	Lack of funds, not major tributary (PA HQ stream)	DRBCPA0024
Lopatcong Cr, NJ	182.0	Lack of funds, not major tributary (NJ TP waters)	DRBCNJ0028
Martins Cr, PA	190.58	Lack of funds, not major tributary	DRBCPA0031
Buckhorn Cr, NJ	192.9	Lack of funds, not major tributary (NJ TP waters)	DRBCNJ0030

Quality Assurance and Control

The QA Objectives of the Lower Delaware Monitoring Program are:

- To accurately describe the water quality and related biological conditions in the study area. The water quality parameters should be sufficient to:

1. Define and assess existing water quality and quantity
2. Evaluate the quality of the waters within the Lower Delaware River region;
3. Categorize tributaries and river locations as point source or non-point source impacted;
4. Rank tributaries and river locations for water quality management actions including follow-up monitoring and intensive surveys by state enforcement agencies;
5. Identify whether water quality meets or exceeds standards related to designated uses; and,
6. Ascertain relative water quality impact on the biological resources of the study area.

Quality Assurance Practices and Procedures

Attainment of quality assurance objectives is achieved by maintaining a running check of precision and accuracy of analyses throughout the sampling program. Before the start of the program, the quality assurance officer and program manager conducted a laboratory audit. During the monitoring season, field sampling protocol audits are conducted monthly. Instrument variations are controlled by calibration of equipment and use of standard solutions. Comparability of data sets is determined by examining data using the Student t-test. All problems are immediately reported to both the program manager and the quality assurance officer, a report is prepared in the form of a DRBC memorandum, and resolution is sought before continuation of the task.

Reports and Forms

The program staff is required to maintain a log of activities. Notebooks and common computer files accessible to all study participants are used to record observations (weather, etc.), to describe sampling station locations, and to present results. Several data record/analyses sheets were developed or adopted from the SRMP and other agencies for recording results. These are used routinely for water quality, flow, habitat, macroinvertebrate, and stream channel condition studies (See Exhibits 2,3 and 4). QA reporting forms have been developed for use by staff for QA recording activities. All forms contained in the Rapid Bioassessment Protocols (Barbour et. al 1999) and USGS NAWQA Protocols (Cuffney et. al 1993; Fitzpatrick et. al 1998) are copied directly from those documents for field use.

Sample Custody

All samples will be logged according to chain of custody procedures. The program manager is responsible for record-keeping, including preparation of sample labels, laboratory logging procedures and maintenance of reports as described above. In cases where a laboratory is contracted for analyses, field personnel follow the contract laboratory's sample custody procedures

Performance and System Audits

Before the initiation of the sampling season, the manager prepares the program by checking all equipment, making repairs, and by purchasing equipment and chemicals. The QA Officer performs an audit of the contract laboratory prior to commencement of the program. The program manager and/or the QA officer observe field and lab procedures, checking data including quality control checks and other activities related to program administration.

The program manager and/or the QA officer will conduct field audits to evaluate sampling technique, sample handling, and preservation to insure representative results. Personnel safety measures are highlighted, and all relevant personnel are required to read and understand the DRBC Field Safety Manual. The laboratory audits review analytical, sample preparation, and data reporting procedures. Also, laboratory cleanliness and safety are

emphasized. DRBC's laboratory must comply with the New Jersey Right-to-Know Act, and all chemical materials must be properly stored and labeled.

Quality Assurance Records to Management

The Project Manager reports to the Quality Assurance Officer for inspection and application of performance and system audits. Reports will present the results of internal and external quality checks, corrective actions taken, and analytical results. The reporting procedures will consist of the submittal of logbooks.

Appendix D
Delaware Estuary Boat Run Program
Site Information and Quality Assurance and Control

Table D1: Sampling Stations Parameter Categories for the Estuary Boat Run Program

STATION	RIVER MILE	SAMPLING STATIONS FOR PARAMETER CATEGORIES			
		ROUTINE, BACTERIAL & RADIOACTIVITY	HEAVY METALS	ALGAL & ORGANIC CARBON	OXYGEN DEMAND
South Brown Shoal[1]	6.5	■	■	■	
South of Joe Flogger Shoal[1]	16.5	■	■	■	
Elbow of Crossledge Shoal[1]	22.75	■	■	■	
Mahon River	31.0	■		■	■
Ship John Light	36.6	■			
Smyrna River	44.0	■			
Liston Point–Buoy 8L	48.2	■			
Reedy Island	54.9	■			
Pea Patch Island	60.6	■	■		
New Castle	66.0	■			
Cherry Island	71.0	■	■	■	■
Oldmans Point	74.9	■			
Marcus Hook	78.1	■	■		
Eddystone, PA	84.0	■	■		
Paulsboro, NJ	87.9	■	■		
Navy Yard	93.2	■	■	■	■
Benjamin Franklin Bridge	100.2	■	■		
Betsy Ross Bridge	104.75	■	■		
Torresdale	110.7	■	■		
Burlington Bristol Bridge	117.8	■	■		
Florence Bend		■		■	■
Trenton (Biles Channel)		■	■	■	■

TABLE D2: METHODS OF ANALYSIS FOR PARAMETERS

CATEGORY OF PARAMETERS	PARAMETER	METHOD REFERENCE	REPORTING LIMIT
ROUTINE	ACIDITY	EPA 305.1/STDMTD 18TH ed. 2310B	1.0 mg/L
	ALKALINITY	EPA 310.1/STDMTD 18TH ed. 2320B	1.0 mg/L
	CHLORIDE	EPA 325.2/STDMTD 18TH ed. 4500-Cl	1.0 mg/L
	DISSOLVED OXYGEN	EPA 360.1/360.2/STDMTD 18TH ed. 4500-O	0.1 mg/L
	PERCENT SATURATION	CALCULATED	1%
	HARDNESS	EPA 130.2	1.0 mg/L
	pH	EPA 150.1	0.1 unit
	DISSOLVED ORTHOPHOSPHATE	EPA 365.1/STDMTD 18TH ed. 4500-P F	0.005 mg/L
	PHOSPHOROUS: TOTAL	EPA 365.1/STDMTD 18TH ED. 4500-P F	0.005 mg/L
	SODIUM	EPA 200.7	5000 ug/L
	SPECIFIC CONDUCTANCE	EPA 120.1	1.0 uS/cm
	TEMPERATURE, AIR & WATER	EPA 170.1/STDMTD 18TH ED. 2550B	N/A
	SUSPENDED SOLIDS, TOTAL & VOLATILE	EPA 160.2- .4/STDMTD 18TH ed. 2540	1.0 mg/L
	TURBIDITY	EPA 180.1	1.0 FTU
	NH_3-N	EPA 350.1/STDMTD 18TH ed. 4500-N	0.005 mg/L
	NO_2-N	EPA 354.1/ STDMTD 18TH ed. 4500-N	0.005 mg/L
	NO_3-N	EPA 353.2, 354.1/ STDMTD 18TH ed. 4500-N	0.005 mg/L
	TOTAL KJELDAHL-N	EPA 351.2	0.05 mg/L
BACTERIAL	E. COLI	EPA 1103.1	N/A
	ENTEROCOCCUS	EPA 1106.1/STDMTD 18TH ed. 9230C	N/A
	FECAL COLIFORM (MTEC)	EPA 825	N/A
ALGAL	CHLOROPHYLL A	(1) STDMTD 18TH ed. 10200H	1.0 ug/L
	PHEOPHYTIN	STDMTD 18TH ed. 10200H	1.0 ug/L
	SILICA	STDMTD 4500-Si E/D	1.0 mg/L
	PRODUCTIVITY, CARBON 14 METHOD	Procedure Developed by University of Delaware	uMC
	SECCHI DISK	N/A	N/A
	LIGHT TRANSMISSION	(2)	0.01 uM

TABLE D2 continued

CATEGORY OF PARAMETERS	PARAMETER	METHOD REFERENCE	REPORTING LIMIT
HEAVY METALS	COPPER, DISSOLVED	EPA 200.7	5 ug/L
	COPPER, TOTAL	EPA 200.7	5 ug/L
	CHROMIUM, HEXAVALENT	STDMTD 18TH ed. 3500-CR	5 ug/L
	ZINC, DISSOLVED	EPA 200.7	10 ug/L
	ZINC, TOTAL	EPA 200.7	10 ug/L
RADIOACTIVITY	ALPHA EMITTERS	(3) EPA 900.0	5 pCi/L
	BETA EMITTERS	(3) EPA 900.0	5 pCi/L
	TRITIUM	(3) EPA 906.0	500 pCi/L
ORGANIC CARBON	DISSOLVED	EPA 415.1/STDMTD 18TH ed. 5310-B	1 mg/L
	TOTAL	EPA 415.1/ STDMTD 18TH ed. 5310-B	1 mg/L
OXYGEN DEMAND	ULTIMATE (60 DAY), DISSOLVED	EPA 405.1/STDMTD 5210-B	2.4 mg/L
	ULTIMATE (60 DAY), TOTAL	EPA 405.1/STDMTD 5210-B	2.4 mg/L

1.For Chlorophyll A, one split sample, for analysis at another laboratory selected by DNREC, was conducted.
2.Light transmission to be conducted as practical to obtain correlation with Secchi Disk readings.
3.Radioactivity analyses outsourced. All laboratory materials provided by the outsourced lab were provided to DRBC.

Table D3: Frequency of Sampling by Parameter Category for the Estuary Boat Run Program

CATEGORY OF PARAMETERS	PARAMETER	FREQUENCY
ROUTINE	ACIDITY	TWO TIMES MONTHLY (1) FOR APRIL, MAY, AUG., & SEPT. & ONCE MONTHLY FOR OCT., MAR., JUNE, JULY & OCT. & ONCE MONTHLY FOR MAR, APRIL, MAY, JULY, AUG., SEPT. & OCT, FOR THE LOWER BAY STATIONS
	ALKALINITY	
	CHLORIDE	
	DISSOLVED OXYGEN	
	HARDNESS	
	pH	
	PHOSPHOROUS: DISSOLVED ORTHOPHOSPHATE & TOTAL	
	SODIUM [1]	
	SPECIFIC CONDUCTANCE	
	TEMPERATURE, AIR & WATER	
	TOTAL SUSPENDED SOLIDS AND DISSOLVED SOLIDS	
	TURBIDITY	
	NH3-N, NO2-N, NO3-N & TOTAL KJELDAHL -N	
BACTERIAL	E. COLI	
	ENTEROCOCCUS	
	FECAL COLIFORM (MTEC)	
ALGAL	CHLOROPHYLL A	
	PHEOPHYTIN A	
	SILICA	
	PRODUCTIVITY, CARBON 14 METHOD	
	SECCHI DISK & LIGHT TRANSMISSION	
HEAVY METALS	COPPER, DISSOLVED & TOTAL	MONTHLY & 7 times per year for Lower Bay Stations
	CHROMIUM, HEXAVALENT	
	ZINC, DISSOLVED & TOTAL	
RADIOACTIVITY	ALPHA EMITTERS	ANNUALLY
	BETA EMITTERS	
	TRITIUM	
ORGANIC CARBON	DISSOLVED	QUARTERLY[2]
	TOTAL	
ULTIMATE OXYGEN DEMAND		

[1] Analyses of sodium are required only for stations above R. M. 78

[2] Not Required for Lower Bay Stations

Quality Assurance and Control

Special Training / Certification

Sample collection is performed by personnel who have experience in the collection of samples for chemical and physical analysis. All members of the sampling team must review and be familiar with the Sampling and Analysis Plan (SAP), the Quality Assurance Project Plan (QAPP), and the references to these documents.

Sample analysis must be performed by personnel who have experience in the analysis of environmental samples. All members of the analytical team must review and be familiar with the QAPP, the laboratory Standard Operating Procedures (SOPs) and the references to these documents.

Quality Control

The minimum requirements consist of an initial demonstration of laboratory capability, analysis of samples spiked with labeled compounds or analysis of quality control samples to evaluate and document data quality, and analysis of standards and blanks as tests of continued performance. Laboratory performance is compared to established performance criteria to determine if the results of analyses meet the performance characteristics of the methods.

Documents and Records

The Project Manager will be responsible for maintaining all documents and records associated with this project. Documents and records associated with this project will be kept and maintained in the project file at the Delaware River Basin Commission (DRBC) offices in West Trenton, New Jersey. Records will be maintained for a minimum of 5 years after completion of sampling and analysis.

Standard Data Reporting Format

The Standard Data Reporting Format requires a signed paper copy of all data along with the supporting quality control information. An electronic data deliverable (EDD) is required of the laboratory.

Field data included in the EDD is taken from the field log books/sheets and submitted in a form specified by DRBC. Laboratory Reports are structured to clearly present all of the items required by the contract. The report shall be organized as follows:

Data is reported by sample or by test. Pertinent information includes, at a minimum, field sample identification, laboratory sample number, date the sample was collected, date the sample was received at the laboratory, date the sample was extracted / prepared, date the sample was analyzed, extraction / preparation / cleanup / analysis procedure(s) used, laboratory preparation batch number(s), dilution factors, all analytes tested for and their associated reporting limits, matrix, units, and sample description including preservation. Any other factors that could affect the sample results are also noted.

Any other information that is pertinent to the samples is also reported. This includes copies of original chain-of-custody forms, copies of any telephone conversation record sheets, and copies of any other forms. The Laboratory shall maintain on file all of the supporting data and documentation for these samples. The Laboratory shall provide, upon request, copies of raw data as the DRBC deems necessary for specific methods and samples.

Sample method and associated quality control information shall be reported in a standard format as a complete packet representing a batch of samples. The method quality control information should be presented as in a standard order following the sample data results. The laboratory should maintain the standard order of reporting to the maximum extent possible.