

# Delaware River Basin Commission

## 2008 Delaware River and Bay Integrated List Water Quality Assessment



April 2008



This report provides an assessment of waters in the Delaware River and Bay for support of various designated uses in accordance with Section 305(b) of the Clean Water Act and identifies impaired waters, which consist of waters that do not meet Delaware River Basin Commission's (DRBC) Water Quality Regulations (18 CFR 410). It assesses data compiled from 2004 through 2006 into the 2008 Delaware River and Bay Integrated List Water Quality Assessment (2008 Assessment). The assessment methodology used to develop the 2008 Assessment closely tracks the methodology used for the most recent assessment, completed in 2006. The number of assessment units used in the 2008 Assessment has been reduced by consolidating the units into DRBC's Water Quality Management zones 1A, 1B, 1C, 1D, 1E, 2, 3, 4 and 5, the boundaries of which are defined in the DRBC's Water Quality Regulations. The 2008 Assessment continues, however, to include subunits within zone 6 that are defined in part by shellfish management directives issued by the states of Delaware and New Jersey.

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## 1 Abbreviations and List of Figures and Tables

2006 Assessment	2008 Delaware River and Bay Integrated List Water Quality Assessment
2008 Assessment	2008 Delaware River and Bay Integrated List Water Quality Assessment
AU	Assessment Unit
Basin Plan	Water Resources Plan for the Delaware River Basin
Boat Run	Delaware Estuary Boat Run Monitoring Program
CBOD	Carbonaceous Biological Oxygen Demand
CWA	Clean Water Act
DNREC	Delaware Department of Natural Resources and Environmental Control
DO	Dissolved Oxygen
DRBC	Delaware River Basin Commission
DxF	Dioxins/Furans
EPA	United States Environmental Protection Agency
EWQ	Existing Water Quality
FDA	United States Food and Drug Administration
ICP	Interstate Control Points
IRP	Integrated Resource Plan
LDMP	Lower Delaware River Monitoring Program
MCL	Maximum Contaminant Level
Na	Sodium
NAWQA	National Water Quality Assessment Program
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department of Health and Senior Services
NOAA	National Oceanic Atmospheric Administration
NPS	National Park Service
NSSP	National Shellfish Sanitation Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
PADEP	Pennsylvania Department of Environmental Protection
PCB	Polychlorinated Biphenyls
PORTS	Physical Oceanographic Real-Time System
PMP	Pollutant Minimization Plans
RM	River Mile
SPGWA	Southeast Pennsylvania Ground Water Protected Area
SPW	Special Protection Waters
SRMP	Scenic Rivers Monitoring Program
STORET	STORage and RETrieval

TDS	Total Dissolved Solids
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalency
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WHO	World Health Organization
WQM	Water Quality Management
WQN	Water Quality Network
WQR	Water Quality Regulations

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## 2 Overview

The 2008 Delaware River and Bay Integrated List Water Quality Assessment (2008 Assessment) reports the extent to which waters of the Delaware River and Bay are attaining designated uses in accordance with Delaware River Basin Commission's [Water Quality Regulations](#) (18 CFR 410) (DRBC WQR), or the federal Clean Water Act (CWA) section 305(b) (40 CFR 130.8) for the period 2004 to 2006. The designated water uses to be protected within the Delaware Basin are as follows:

- 1) Agricultural, industrial, and public water supplies after reasonable treatment, except where natural salinity precludes such uses;
- 2) Wildlife, fish and other aquatic life;
- 3) Recreation;
- 4) Navigation;
- 5) Controlled and regulated waste assimilation to the extent that such use is compatible with other uses; and
- 6) Such other uses as may be provided by the Commission's Comprehensive Plan (2001).

The assessment involves comparison of several key water quality parameters with applicable DRBC water quality criteria. DRBC WQR designate drinking water, agricultural, and industrial uses for the Delaware River. Since drinking water use is assessed and protective of the other uses, agricultural and industrial uses are not assessed separately for this report. The assessment for drinking water requires more stringent water quality criteria than the other uses.

Assessed water bodies (assessment units, AU) are placed into one or more of the six designated water use 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.

Table 3-1 summarizes the designated uses that are supported in the main stem Delaware River (AUs 1A-1E and 2-5). Table 3-2 provides a summary of the extent of use support for the designated uses, in the different assessment units of the Delaware Bay (AU 6).

## 3 Introduction

### 3.1 Background

The 2008 Assessment closely follows the format and methodology of the [2006 Delaware River and Bay Integrated List Water Quality Assessment](#). The main stem of the Delaware River only is assessed in this report. Intrastate streams (tributaries) feeding the Delaware River are included in the Basin States integrated assessments.

**Table 3-1. Extent of Use Support for the Delaware River**

<b>AU</b>	<b>Aquatic Life</b>	<b>Drinking Water</b>	<b>Recreation</b>	<b>Fish Consumption</b>	<b>Shellfish Consumption</b>
<b>1A</b>	NS	S	S	NS	NA
<b>1B</b>	ID	S	S	NS	NA
<b>1C</b>	ID	S	S	NS	NA
<b>1D</b>	ID	S	S	NS	NA
<b>1E</b>	NS	S	S	NS	NA
<b>2</b>	NS	S	S	NS	NA
<b>3</b>	S	S	S	NS	NA
<b>4</b>	NS	NA	ID (below RM 81.8)/S	NS	NA
<b>5</b>	NS	NA	S	NS	NA

S: The assessment unit supports the designated use.

NS: The assessment does not support the designated use.

NA: Designated use is not applicable to the assessment unit.

ID: Insufficient or unreliable data is present.

**Table 3-2. Extent of Use Support for the Delaware Bay**

AU	Aquatic Life	Drinking Water	Recreation (Primary)	Fish Consumption	Shellfish Consumption
6brA	The criteria for this use was assessed as a whole zone and is supported (S).	NA	The criteria for this use was assessed as a whole zone and is supported (S).	The criteria for this use was assessed as a whole unit using Basin state fish advisories and is not supported (NS).	S
6brB		NA			S
6brC		NA			S
6br1a		NA			NS
6br1b		NA			S
6br2a		NA			NS
6br2b		NA			S
6br2c		NA			ID
6br2d		NA			ID
6br3a		NA			NS
6br3b		NA			SS
6br3c		NA			S
6de1		NA			S
6de2		NA			ID
6de3		NA			ID
6de4		NA			ID
6de5		NA			NS
6nj1		NA			S
6nj2		NA			SS
6nj3		NA			SS
6nj4	NA	SS			
6nj5	NA	SS			
6nj6	NA	SS			
6nj7	NA	SS			
6nj8	NA	SS			
6nj9	NA	NS			
6nj10	NA	NS			

S: The assessment unit supports the designated use.

SS: The assessment unit supports the designated use, but with special conditions.

NS: The assessment does not support the designated use.

NA: Designated use is not applicable to assessment unit.

ID: Insufficient or unreliable data is present.

### 3.2 Delaware River Basin

The Delaware River 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. The Delaware River is fed by 216 tributaries, 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%) (Figure 3-1).

Approximately 15 million people, or about 5% of the U.S. population, rely on the waters of the Delaware River Basin for drinking and industrial use, and the Delaware Bay is only

a one to two hour drive away for about 20 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. The population of the Delaware River Basin in 2000 stood at approximately 7.8 million people. Table 3-3 provides additional geographical statistics for the Delaware River Basin. 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.

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, NY, 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. Almost the entire non-tidal Delaware River (the portion north of the “fall line” at Trenton, NJ) is included in the National Wild and Scenic Rivers System. In addition, 35.4 miles of the Maurice River and its tributaries in New Jersey and approximately 190 miles of the White Clay Creek and its tributaries in Pennsylvania and Delaware have been included in the national system. Most recently, on December 22, 2006, President George W. Bush signed into law the Musconetcong Wild and Scenic Rivers Act, which designates 24.2 miles of the [Musconetcong River](#) (a tributary of the Delaware River located in New Jersey) as a component of the National Wild and Scenic Rivers System.

There are other economic benefits from the river. According to the Coast Guard, the Delaware River Port Complex generates \$19 billion in business revenue annually, is home to the third largest east coast petrochemical port and five of the largest east coast refineries, and receives over 65% of fruit imported to the U.S. from South America. It is also the largest North American port complex for steel, paper, and meat imports.

**Figure 3-1. Delaware River Basin**



**Table 3-3. Approximate Geographical Statistics for the Delaware River Basin**

Total Basin Land Area (mi <sup>2</sup> ) <sup>a,b</sup>	12,700
Population (2000)	7.8 million
Major River Basins (HUC 8) <sup>c</sup>	13
River Miles (Named) <sup>a</sup>	9,080
Border (Shared) River Miles <sup>a</sup>	339
Square Miles of Public Lakes and Reservoirs <sup>c</sup>	140
Square Miles of Estuary/Bay <sup>c</sup>	783
Square Miles of Wetlands <sup>c</sup>	480

<sup>a</sup>DRBC GIS files

<sup>b</sup>Total Basin area minus area of Estuary and Bay

<sup>c</sup>National Hydrographic Dataset

### **3.3 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 criteria 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 WQC 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 total maximum daily loads (TMDLs), issuing of permits and other mechanisms to reduce loading of pollutants in order to improve water quality to levels that meet the criteria. In addition, DRBC has other layers of protection (i.e., Special Protection Waters) that aim to maintain existing water quality where it is better than the water quality criteria.

#### **3.3.1 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” (SPW) and have associated with them a variety of specific pollution

prevention and reduction requirements driven by a “no measurable change” policy toward water quality. Designated reaches of SPW fall into two categories:

(1) Outstanding Basin Waters

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

(2) Significant Resource Waters

- The Delaware River from Milrift, NY, to Milford, PA (RM 258.4 to 250.1)
- The Delaware River from the Delaware Water Gap to Trenton, NJ (RM 209.5 to 133.4). Note that this designation has been made on an interim basis.

SPW 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 non-point sources as they may affect the designated waters, either through direct discharge or through tributary loading. EWQ is defined 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” (DRBC WQR 2007). Numerical criteria for SPW 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<sup>th</sup> and 90<sup>th</sup> percentiles of the dataset from which the mean was calculated.”

### Estuary CBOD Allocations

The Commission determined that the 1964 carbonaceous biochemical oxygen demand (CBOD<sub>20</sub>) of the effluent load to Zones 2, 3, 4, and 5 exceeded the waste assimilative capacity of those zones to meet the stream quality objectives based upon numerical modeling study conducted in the late 1960s. In accordance with the regulations, the assimilative capacity of each Delaware Estuary zone minus a reserve was originally allocated in 1968 among the individual dischargers based upon the concept of uniform reduction of raw waste in a Zone (Zones 2, 3, 4, and 5). Since 1968, the wasteload allocations for individual dischargers have been updated and documented by the Commission (DRBC, 2001).

### Pollutant Minimization Plans

In 2005, DRBC established requirements for the development of [Pollutant Minimization Plans](#) (PMP) for selected toxic pollutants. These plans are currently being required for point and non-point discharges of polychlorinated biphenyls (PCB) in the Delaware Estuary. The goal of this program is to work toward meeting water quality standards and to eliminate fish consumption advisories due to PCBs. Because of the limited ability of dischargers to reduce their PCB loadings quickly enough to fully comply in the short term with the numeric limits that are based on water quality standards, this non-numeric approach allows the Commission to require concrete reduction steps before permits are re-issued by the states containing these requirements. DRBC may also require PMPs for contaminated sites to further reduce non-point sources of PCB loadings to the Estuary.

### Integrated Resource Plans

In 1998, DRBC amended its [Ground Water Protected Area Regulations Southeastern Pennsylvania](#) to include watershed-based ground water withdrawal limits for sub-basins that lie entirely or partially within the protected area. 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,” “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.

### Integrated Resource Management

In 2001, DRBC began a multi-stakeholder process to develop a “forward-looking” [Water Resources Plan for the Delaware River Basin](#) (Basin Plan). In September 2004, the Governors of the Basin States and representatives of six federal agencies, signed a resolution showing their support for the Basin Plan. The Basin Plan is a unified framework of desired outcomes, goals, objectives, and milestones for protecting, preserving, and enhancing water resources. The central theme of the Basin Plan is a watershed-based approach to the achievement of integrated resource management. The Basin Plan sets a direction for water resource policy and management through 2030 and calls for the active involvement of a broad range of governmental and non-governmental entities in addition to DRBC.

Among the concepts included in the Basin Plan are 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 implementation of TMDLs to meet water quality standards for the protection of designated uses, and the use of regulatory and non-regulatory approaches to maintaining and improving water quality where it is better than criteria.

### **3.3.2 Water Quality Standards Program**

Water quality standards provide a description of water body uses to be protected, as well as, water quality criteria 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 criteria, 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 six (6) uses:

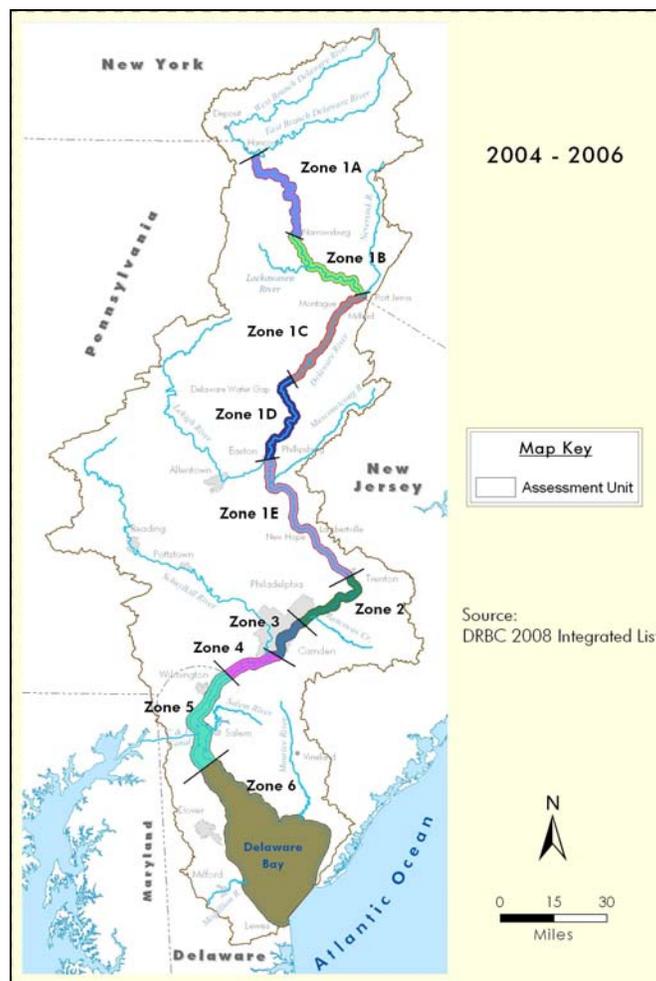
- 1) Agricultural, industrial and public water supplies after reasonable treatment, except where natural salinity precludes such uses;
- 2) Wildlife, fish and other aquatic life;
- 3) Recreation;
- 4) Navigation;
- 5) Controlled and regulated waste assimilation to the extent that such use is compatible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

The Delaware River and Bay consists of a non-tidal and tidal zone. Zone C1-8 and intrastate streams (zones E, W1, W2, N1 and N2) are not assessed in this report as they are assessed in the Integrated Reports of the Basin States. The non-tidal main stem consists of five Water Quality Management (WQM) zones: 1A, 1B, 1C, 1D, and 1E (Figure 3-2). These zones form the boundaries for the DRBC's assessment units (AUs) in the non-tidal zone. The zones as defined by river mile (RM) are included in Table 3-4.

These zones are no longer subdivided as in the 2006 Assessment, but are assessed as a whole unit. The designated uses applicable to the non-tidal AUs include aquatic life, fish consumption, primary contact recreation, and drinking water (Table 3-1).

The tidal Delaware River consists of AU 2, 3, 4, and 5 (Figure 3-2) and extends from RM 133.4 to RM 48.2 (Table 3-4). Assessment unit 5 is no longer subdivided as in the 2006 Assessment, but is assessed as a whole unit. Assessment unit 6 (Delaware Bay) includes multiple units that are defined in part by shellfish management areas issued by the states of Delaware and New Jersey (Figure 3-3). The designated uses supported in the estuary and bay are indicated in Table 3-2. Shellfish consumption only applies to WQM zone 6.

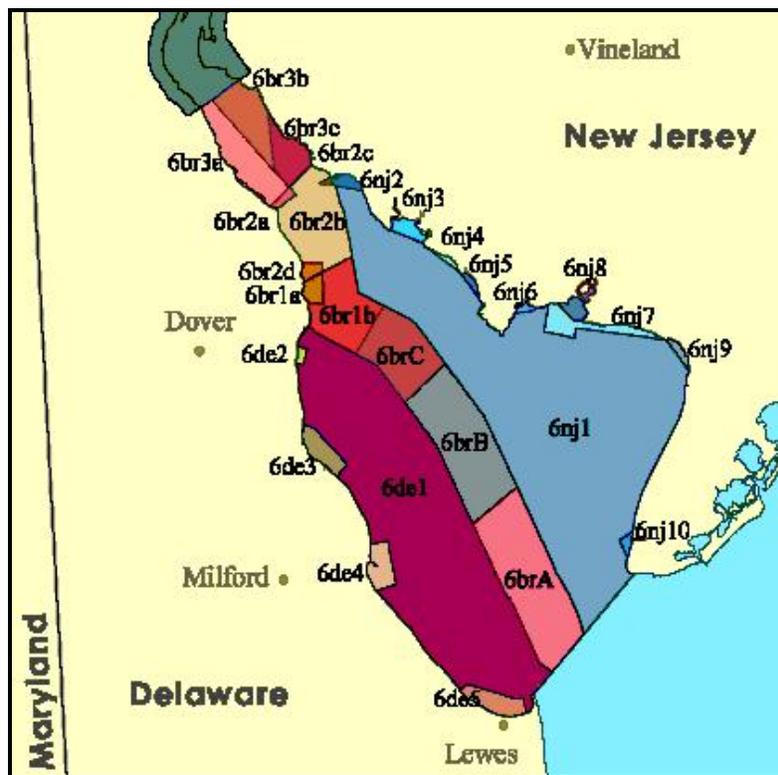
**Figure 3-2. Delaware River Water Quality Management zones/Assessment Units**



**Table 3-4. Delaware River Water Quality Management (WQM) zones**

WQM zone	Location (as River Mile)
1A	330.7 – 289.9
1B	289.9 – 254.75
1C	254.75 – 217.0
1D	217.0 – 183.66
1E	183.66 – 133.4
2	133.4 – 108.4
3	108.4 – 95.0
4	95.0 – 78.8
5	78.8 – 48.2
6	48.2 – 0.0

**Figure 3-3. Zone 6 Shellfish Management Assessment Units**



**Table 3-5. Designated Uses by DRBC Water Quality Management zones**

Designated Water Use	Water Quality Management Zone									
	1A	1B	1C	1D	1E	2	3	4 <sup>A</sup>	5	6
Aquatic Life	X	X	X	X	X	X	X	X	X	X
Drinking Water	X	X	X	X	X	X	X			
Recreation										
Primary & Secondary	X	X	X	X	X	X		X	X	X
Secondary only							X	X		
Fish Consumption	X	X	X	X	X	X	X	X	X	X
Shellfish Consumption										X

<sup>A</sup> Primary recreation below RM 81.8; Secondary recreation above RM 81.8

### *Ambient Water Quality Standards*

Sections 3.20, 3.30, and 3.40 of DRBC’s [Water Quality Regulations](#) define the “Water Quality Objectives.” From this point on, the objectives will be referred to as “Water Quality Criteria” (WQC) for the non-tidal river, tidal river, and basin ground water. Criteria are zone-based and define the water quality necessary to protect the designated uses in those zones. For the water quality assessments, monitored data are compared against the zone standards for determining use attainment. Table 3-6 shows the water quality objectives for the non-tidal main stem. Table 3-7 shows the water quality criteria for the tidal portions of the Delaware River main stem and tributaries. Tables 3-8, 3-9, and 3-10 contain the WQC for toxic pollutants, carcinogens, and systemic toxicants in the Delaware River Estuary. The DRBC does not monitor for every parameter listed in Tables 3-6 through 3-10. These parameters are in italics in the tables.

### *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 and fish consumption (due to the bioaccumulation of certain substances even at very low ambient levels).

## *Changes to Water Quality Standards*

### Ongoing Review of Water Quality Regulations

The last updates of water quality criteria in DRBC [Water Quality Regulations](#) (WQR) 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 available on the DRBC website with amendments through September 26, 2007. All water quality assessments presented here are based upon the WQR, as they existed during the 2004 through 2006 monitoring seasons.

### Progress Toward Implementing Biocriteria

The Commission does not currently use biological criteria for the 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. However, DRBC is currently in the process of developing data, through a biomonitoring program, to establish biocriteria for the non-tidal Delaware River.

**Table 3-6. DRBC Water Quality Criteria for non-tidal zones**

Water Quality Criteria for Parameter of Interest	WQM Zone				
	1A	1B	1C	1D	1E
<b>DISSOLVED OXYGEN</b>					
Not less than 4.0 mg/l at any time		X	X	X	X
Not less than 5.0 mg/l at any time	X				
Not less than 7.0 mg/l in spawning areas whenever temperatures are suitable for trout spawning	X				
Minimum 24 hour average of 5.0 mg/l		X	X	X	X
Minimum 24 hour average of 6.0 mg/l	X				
<b>TEMPERATURE<sup>A</sup></b>					
Not to exceed 5 °F (2.8 °C) rise above ambient temperature until stream temperature reaches 50 °F (10 °C)	X				
Not to exceed 2 degrees F (1.1 °C) rise above ambient temperature when stream temperature is between 50 °F (10 °C) and 58 °F (14.4 °C)	X				
Natural temperature will prevail above 58 °F (14.4 °C)	X				
Not to exceed 5 °F (2.8 °C) rise above ambient temperature until stream temperature reaches 87 °F (30.6 °C)		X	X	X	X
Natural temperature will prevail above 87 °F (30.6 °C)		X	X	X	X
<b>pH</b>					
Between 6.0 and 8.5	X	X	X	X	X
<b>PHENOLS</b>					
Not to exceed 0.005 mg/l unless due to natural conditions	X	X	X	X	X
<b>THRESHOLD ODOR NUMBER</b>					
Not to exceed 24 units at 60 °C	X	X	X	X	X
<b>SYNTHETIC DETERGENTS (Methylene Blue Active Substances – MBAS)</b>					
Not to exceed 0.5 mg/l	X	X	X	X	X
<b>RADIOACTIVITY</b>					
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
<b>FECAL COLIFORM</b>					
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
<b>TOTAL DISSOLVED SOLIDS</b>					
Not to exceed 133 percent of background, or 500 mg/l, whichever is less	X	X	X	X	X
<b>TURBIDITY</b>					
Unless exceeded due to natural conditions: maximum 30 day average 10 units, maximum 150 units	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
<b>ALKALINITY</b>					
Not less than 20 mg/l					X
<b>TOXIC SUBSTANCES</b>					
Shall not exceed one-twentieth of the TL <sub>50</sub> value at 90 hours or the specified limits (in mg/l) listed below:					
<i>Arsenic</i> 0.05	X	X	X	X	X
<i>Barium</i> 1.0	X	X	X	X	X
<i>Cadmium</i> 0.01	X	X	X	X	X
<i>Chromium (Hexavalent)</i> 0.05	X	X	X	X	X
<i>Lead</i> 0.05	X	X	X	X	X
<i>Mercury</i> 0.005	X	X	X	X	X
<i>Selenium</i> 0.01	X	X	X	X	X
<i>Silver</i> 0.05	X	X	X	X	X

<sup>A</sup> The DRBC WQR do not define “ambient” and “natural” temperature.

**Table 3-7. DRBC Water Quality Criteria for tidal zones**

Water Quality Criteria for Parameter of Interest	WQM Zone				
	2	3	4	5	6
<b>DISSOLVED OXYGEN</b>					
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 RM 78.8: 3.5 mg/l At RM 70.0: 4.5 mg/l At RM 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	
<b>TEMPERATURE<sup>A</sup></b>					
Shall not exceed 5 °F (2.8 °C) above the average 24-hour temperature gradient displayed during the 1961-66 period, or a maximum of 86 °F (30 °C), whichever is less	X	X	X		
Shall not be raised above ambient by more than: 1) 4 °F (2.2 °C) during September through May, nor 2) 1.5 °F (0.8 °C) during June through August				X	X
The maximum temperatures shall not exceed 86 °F (30.0 °C)				X	
The maximum temperatures shall not exceed 85 °F (29.4 °C)					X
<b>pH</b>					
Between 6.5 and 8.5	X	X	X	X	X
<b>PHENOLS</b>					
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
<b>SYNTHETIC DETERGENTS (Methylene Blue Active Substances – MBAS)</b>					
Maximum 30 day average of 0.5 mg/l	X				
Maximum 30 day average of 1.0 mg/l		X	X	X	X
<b>RADIOACTIVITY</b>					
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
<b>FECAL COLIFORM</b>					
Maximum geometric average 200 per 100 ml	X			X	X
Maximum geometric average 770 per 100 ml		X			
Above RM 81.8 maximum geometric average 770 per 100 ml			X		
Below RM 81.8 maximum geometric average 200 per 100 ml			X		
<b>ENTEROCOCCUS</b>					
Maximum geometric average 33 per 100 ml	X				
Maximum geometric average 88 per 100 ml		X			
Above RM 81.8 maximum geometric average 88 per 100 ml			X		
Below RM 81.8 maximum geometric average 33 per 100 ml			X		
Maximum geometric average 35 per 100 ml				X	X
<b>TOTAL COLIFORM</b>					
MPN (most probable number) not to exceed Federal shellfish standards in designated shellfish areas					X
<b>TOTAL DISSOLVED SOLIDS</b>					
Not to exceed 133 percent of background, or 500 mg/l, whichever is less	X	X			
Not to exceed 133 percent of background			X		
<b>Water Quality Criteria for Parameter of Interest</b>	<b>WQM Zone</b>				

	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>THRESHOLD ODOR NUMBER</b>					
<i>Not to exceed 24 units at 60 degrees C</i>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>TURBIDITY</b>					
Unless exceeded due to natural conditions: maximum 30 day average 40 units, maximum 150 units	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Unless exceeded due to natural conditions above RM 117.81 during the period May 30 to September 15, maximum 30 units	<b>X</b>				
<b>ALKALINITY</b>					
Maintain between 20-100 mg/l	<b>X</b>				
Maintain between 20-120 mg/l		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>CHLORIDES</b>					
Maximum 15-day average concentration of 50 mg/l	<b>X</b>				
Maximum 30-day average concentration of 180 mg/l at RM 98		<b>X</b>			
<b>HARDNESS</b>					
Maximum 30 day average of 95 mg/l	<b>X</b>				
Maximum 30 day average of 150 mg/l		<b>X</b>			
<b>SODIUM</b>					
Maximum 30 day average of 100 mg/l at RM 98		<b>X</b>			
<b>TOXIC SUBSTANCES</b>					
Shall not exceed one-twentieth of the TL <sub>50</sub> value at 90 hours or the specified limits (in mg/l) listed below:					
<i>Arsenic</i>	<i>0.05</i>				<b>X</b>
<i>Barium</i>	<i>1.0</i>				<b>X</b>
<i>Cadmium</i>	<i>0.01</i>				<b>X</b>
<i>Chromium (Hexavalent)</i>	<i>0.05</i>				<b>X</b>
<i>Lead</i>	<i>0.05</i>				<b>X</b>
<i>Mercury</i>	<i>0.005</i>				<b>X</b>
<i>Selenium</i>	<i>0.01</i>				<b>X</b>
<i>Silver</i>	<i>0.05</i>				<b>X</b>

<sup>A</sup> The DRBC WQR do not define “ambient” and “natural” temperature.

**Table 3-8. DRBC Estuary Toxics Criteria (Zones 2 through 5)**

Parameter	Freshwater Objectives (µg/l)		Marine Objectives (µg/l)	
	Acute	Chronic	Acute	Chronic
<b>Metals (Values indicated are total recoverable; see Section 3.10.3.C.2. for form of metal)</b>				
<i>Aluminum</i>	750	87	-	-
<i>Arsenic (trivalent)</i>	360	190	69	36
<i>Cadmium</i>	$e^{(1.128 \cdot \text{LN}(\text{Hardness}) - 3.828)}$	$e^{(0.7852 \cdot \text{LN}(\text{Hardness}) - 3.49)}$	43	9.3
<i>Chromium (trivalent)</i>	$e^{(0.8190 \cdot \text{LN}(\text{Hardness}) + 3.688)}$	$e^{(0.8190 \cdot \text{LN}(\text{Hardness}) + 1.561)}$	-	-
<i>Chromium (hexavalent)</i>	16	11	1,100	50
<i>Copper</i>	$e^{(0.9422 \cdot \text{LN}(\text{Hardness}) - 1.464)}$	$e^{(0.8545 \cdot \text{LN}(\text{Hardness}) - 1.465)}$	5.3	3.4
<i>Cyanide (total)</i>	22	5.2	1.0	-
<i>Lead</i>	48	16	220	8.5
<i>Mercury</i>	2.4	0.012	2.1	0.025
<i>Nickel</i>	$e^{(0.846 \cdot \text{LN}(\text{Hardness}) + 3.3612)}$	$e^{(0.846 \cdot \text{LN}(\text{Hardness}) + 1.1645)}$	75	8.3
<i>Selenium</i>	20	5.0	300	71
<i>Silver</i>	$e^{(1.72 \cdot \text{LN}(\text{Hardness}) - 6.52)}$	-	2.3	-
<i>Zinc</i>	$e^{(0.8473 \cdot \text{LN}(\text{Hardness}) + 0.8604)}$	$e^{(0.8473 \cdot \text{LN}(\text{Hardness}) + 0.7614)}$	95	86
<b>Pesticides/PCBs</b>				
<i>Aldrin</i>	1.5	-	0.65	-
<i>gamma - BHC (Lindane)</i>	1.0	0.08	0.08	-
<i>Chlordane</i>	1.2	0.0043	0.045	0.004
<i>Chlorpyrifos (Dursban)</i>	0.083	0.041	0.011	0.0056
<i>DDT and metabolites (DDE &amp; DDD)</i>	0.55	0.001	0.065	0.001
<i>Dieldrin</i>	1.25	0.0019	0.355	0.0019
<i>Endosulfan</i>	0.11	0.056	0.017	0.0087
<i>Endrin</i>	0.09	0.0023	0.019	0.0023
<i>Heptachlor</i>	0.26	0.0038	0.027	0.0036
<i>PCBs (Total)</i>	1.0	0.014	5.0	0.03
<i>Parathion</i>	0.065	0.013	-	-
<i>Toxaphene</i>	0.73	0.0002	0.21	0.0002
<b>Acid Extractable Organics</b>				
<i>Pentachlorophenol</i>	$e^{(1.005 \cdot \text{pH} - 4.83)}$	$e^{(1.005 \cdot \text{pH} - 5.29)}$	13	7.9
<b>Indicator Parameters</b>				
<b>Whole Effluent Toxicity</b>	0.3 Toxic Units <sub>acute</sub>	1.0 Toxic Units <sub>chronic</sub>	0.3 TU <sub>a</sub>	1.0 TU <sub>c</sub>

**Table 3-9. DRBC Estuary Carcinogen Criteria (Zones 2 through 5)**

PARAMETER	EPA CLASS.	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2&3)	FISH INGESTION ONLY	FISH INGESTION ONLY
<b>Beryllium</b>	B2	0.00767	0.132	0.0232
<i>Aldrin</i>	B2	0.00189	0.0226	0.00397
<i>alpha - BHC</i>	B2	0.00391	0.0132	0.00231
<i>Chlordane</i>	B2	0.000575	0.000588	0.000104
<i>DDT</i>	B2	0.000588	0.000591	0.000104
<i>DDE</i>	B2	0.00554	0.00585	0.00103
<i>DDD</i>	B2	0.00423	0.00436	0.000765
<i>Dieldrin</i>	B2	0.000135	0.000144	0.0000253
<i>Heptachlor</i>	B2	0.000208	0.000214	0.0000375
<i>Heptachlor epoxide</i>	B2	0.000198	0.000208	0.0000366
<b>PCBs (Total)</b>	B2	0.0000444	0.0000448	0.0000079
<i>Toxaphene</i>	B2	0.000730	0.000747	0.000131
<i>Acrylonitrile</i>	B1	0.0591	0.665	0.117
<b>Benzene</b>	A	1.19	71.3	12.5
<b>Bromoform</b>	B2	4.31	164.0	28.9
<b>Bromodichloromethane</b>	B2	0.559	55.7	9.78
<b>Carbon tetrachloride</b>	B2	0.254	4.42	0.776
<b>Chlorodibromomethane</b>	C	0.411	27.8	4.88
<b>Chloroform</b>	B2	5.67	471.0	82.7
<b>1,2 - Dichloroethane</b>	B2	0.383	98.6	17.3
<b>1,1 - Dichloroethene</b>	C	0.0573	3.20	0.562
<b>1,3 - Dichloropropene</b>	B2	87.0	14.1	2.48
<b>Methylene chloride</b>	B2	4.65	1,580	277
<b>Tetrachloroethene</b>	B2	0.80	8.85	1.55
<i>1,1,1,2 - Tetrachloroethane</i>	C	1.29	29.3	5.15
<i>1,1,2,2 - Tetrachloroethane</i>	C	0.172	10.8	1.89
<b>1,1,2 - Trichloroethane</b>	C	0.605	41.6	7.31
<b>Trichloroethene</b>	B2	2.70	80.7	14.2
<b>Vinyl chloride</b>	A	2.00	525.0	92.9
<i>Benzidine</i>	A	0.000118	0.000535	0.000094
<i>3,3 - Dichlorobenzidine</i>	B2	0.0386	0.0767	0.0135
<b>PAHs</b>				
<i>Benz[a]anthracene</i>	B2	0.00171	0.00177	0.00031
<i>Benzo[b]fluoranthene</i>	B2	0.000455	0.000460	0.000081
<i>Benzo[k]fluoranthene</i>	B2	0.000280	0.000282	0.000049
<i>Benzo[a]pyrene</i>	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
<i>Chrysene</i>	B2	0.0214	0.0224	0.00394
<i>Dibenz[a,h]anthracene</i>	B2	0.0000552	0.0000559	0.0000098
<i>Indeno[1,2,3-cd]pyrene</i>	B2	0.0000576	0.0000576	0.0000101
<i>Bis (2-chloroethyl) ether</i>	B2	0.0311	1.42	0.249
<i>Bis (2-ethylhexyl) phthalate</i>	B2	1.76	5.92	1.04
<i>Dinitrotoluene mixture (2,4 &amp; 2,6)</i>	B2	17.3	1420	249
<i>1,2 - Diphenylhydrazine</i>	B2	0.0405	0.541	0.095
<i>Hexachlorobenzene</i>	B2	0.000748	0.000775	0.000136
<i>Hexachlorobutadiene</i>	C	0.445	49.7	8.72
<i>Hexachloroethane</i>	C	1.95	8.85	1.56
<i>Isophorone</i>	C	36.3	2590	455
<i>N-Nitrosodi-N-methylamine</i>	B2	0.000686	8.12	1.43
<i>N-Nitrosodi-N-phenylamine</i>	B2	4.95	16.2	2.84
<i>N-Nitrosodi-N-propylamine</i>	B2	0.00498	1.51	0.265
<i>Pentachlorophenol</i>	B2	0.282	8.16	1.43
<i>2,4,6 - Trichlorophenol</i>	B2	2.14	6.53	1.15
<i>Dioxin (2,3,7,8 - TCDD)</i>	-	$1.3 \times 10^{-8}$	$1.4 \times 10^{-8}$	$2.4 \times 10^{-9}$

**Table 3-10. DRBC Estuary Systemic Toxicant Criteria (Zones 2 through 5)**

PARAMETER	EPA CLASS	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 and 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
<i>Aldrin</i>	B2	0.96	11.5	2.03
<i>gamma - BHC (Lindane)</i>		7.38	24.9	4.37
<i>Chlordane</i>	B2	0.0448	0.0458	0.00805
<i>DDT</i>	B2	0.100	0.100	0.0176
<i>Dieldrin</i>	B2	0.108	0.115	0.020
<i>Endosulfan</i>		111	239	42.0
<i>Endrin</i>	D	0.755	0.814	0.143
<i>Heptachlor</i>	B2	0.337	0.344	0.060
<i>Heptachlor epoxide</i>	B2	0.0234	0.0246	0.00433
Total PCBs	B2	0.00839	0.00849	0.00149
<i>Acrolein</i>		320	780	137
Ethylbenzene		3,120	28,700	5,050
Bromoform	B2	682	25,900	4,560
Bromodichloromethane	B2	693	69,000	12,100
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

PARAMETER	EPA CLASS	FRESHWATER OBJECTIVES (µg/l)		MARINE OBJECTIVES (µg/l)
		FISH & WATER INGESTION (Zones 2 and 3)	FISH INGESTION ONLY	FISH INGESTION ONLY
<b>Tetrachloroethene</b>		318	3,520	618
<b>1,1,1,2 - Tetrachloroethane</b>	C	1,000	22,400	3,940
<b>Toluene</b>		6,760	201,000	35,400
<i>Acenaphthene</i>		1,180	2,670	469
<i>Anthracene</i>	D	4,110	6,760	1,190
<i>Benzidine</i>	A	81.8	369	64.9
<i>Bis (2-chloroisopropyl) ether</i>		1,390	174,000	30,600
<i>Bis (2-ethylhexyl) phthalate</i>	B2	492	1,660	291
<i>Butylbenzyl phthalate</i>	C	298	520	91.4
<i>Diethyl phthalate</i>	D	22,600	118,000	20,700
<i>Dimethyl phthalate</i>	D	313,000	2,990,000	526,000
<i>Dibutyl phthalate</i>	D	2,710	12,100	2,130
<b>1,2 - Dichlorobenzene</b>	D	2,670	17,400	3,060
<b>1,3 - Dichlorobenzene</b>	D	414	3,510	617
<b>1,4 - Dichlorobenzene</b>		419	3,870	677
<i>2,4 - Dinitrotoluene</i>		69.2	5670	996
<i>Fluoranthene</i>		296	375	65.8
<i>Fluorene</i>	D	730	1,530	268
<i>Hexachlorobenzene</i>	B2	0.958	0.991	0.174
<i>Hexachlorobutadiene</i>	C	69.4	7,750	1,360
<i>Hexachlorocyclopentadiene</i>		242	17,400	3,050
<i>Hexachloroethane</i>	C	27.3	124	21.7
<i>Isophorone</i>	C	6,900	492,000	86,400
<i>Nitrobenzene</i>	D	17.3	1,860	327
<i>Pyrene</i>	D	228	291	51.1
<i>1,2,4 - Trichlorobenzene</i>	D	255	945	166
<i>2 - Chlorophenol</i>		122	402	70.6
<i>2,4 - Dichlorophenol</i>		92.7	794	139
<i>2,4 - Dimethylphenol</i>		536	2,300	403
<i>2,4 - Dinitrophenol</i>		70	14,300	2,500
<i>Pentachlorophenol</i>	B2	1,010	29,400	5,160
<b>Phenol</b>		20,900	4,620,000	811,000

### 3.3.3 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, pollutant allocations (including Pollutant Minimization Plans, PMPs), SPW 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”. 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 Delaware River Basin ([DRBC Rules of Practice and Procedure](#), 2002).

DRBC also implements point source controls through its SPW 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 DRBC standards, as well as, state standards.

### **3.3.4 Nonpoint Source Control Program**

DRBC regulates non-point pollution as part of the anti-degradation requirements of SPW. Under DRBC SPW regulations, all new or expanded discharges to the drainage areas of SPW 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 SPW. The plans must document the Best Management Practices to be applied to the project site. Non-point pollution from runoff of developed areas in SPW may not be subject 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.

Non-point sources of PCBs may also be regulated, on a project-specific basis, by PMPs that the DRBC has begun requiring assistance in reducing PCB loadings into the Delaware River.

### **3.3.5 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. Additionally, all new or amended DRBC regulations are ruled on by the Commission, which has representation by the four states and federal government. The Scenic Rivers Monitoring Program (SRMP) and Estuary Boat Run also rely on cooperation between DRBC and other agencies. The SRMP is a partnership between DRBC and the National Park Service (NPS), while the Boat Run is a partnership between DRBC and the Delaware Department of Natural Resources and Environmental Conservation (DNREC).

## **3.4 Special Concerns and Recommendations**

After each assessment cycle, DRBC evaluates potential changes to assessment methodologies and criteria identified through the integrated assessment process. After the completion of the 2008 assessment, DRBC will coordinate with its state and federal partners on several potential changes, including but not limited to the following:

- Review of DRBC WQ regulations;
- Development of an assessment methodology that would include consideration of the Delaware River Biomonitoring Program;
- Clarify linkages between parameters and designated use;
- Proposals for collection of supplementary data to strengthen our ability to assess various parameters, including copper;
- Revision of the deadline for data submission that would allow consideration of current available data collected after the end of the 3 year assessment period;

- Develop consensus on DRBC's role and methodology in assessing parameters for which DRBC has no criteria, but for which state criteria exist;
- Review of monitoring programs to ensure that monitoring supports assessment; and
- Identification of continuous real-time monitoring needs.

## 4 Surface Water Monitoring and Assessment

DRBC collects a variety of water quality data from its own monitoring programs and solicits available data from the Basin states in order to assess the water quality in the Delaware River and Bay. The compiled data for the 2008 Assessment covers a three-year period from 2004 through 2006. Those data are used to assess attainment of designated uses as described in Section 2.

### 4.1 Monitoring Programs

The surface water quality monitoring program utilized by the DRBC consists of the following 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 NPS 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*, a joint effort between the DNREC and DRBC; and
- DRBC Ambient Water Monitoring of the Delaware River for Chronic Toxicity, which is included as an additional study under the Boat Run Monitoring Program.

In addition, data obtained from other agencies' monitoring efforts are used to supplement data obtained through the DRBC sampling efforts. The other data sources include:

- DNREC Dioxins and Furans in Fish from the Delaware River Study,
- Pennsylvania Department of Environmental Protection (PADEP) Water Quality Network (WQN),
- New Jersey Department of Environmental Protection (NJDEP) Ambient Surface Water Monitoring Network (from STORET),
- New York State Department of Environmental Conservation (NYSDEC) Ambient Water Quality Monitoring Program (from STORET),
- United States Geological Survey (USGS) National Water Information System (NWIS),

- DRBC/USGS Cooperative Monitoring Program (continuous monitors),
- National Oceanic Atmospheric Administration (NOAA) Physical Oceanographic Real-Time System (PORTS) data, and
- EPA National Coastal Assessment Programs.

The DRBC water quality monitoring programs and the DNREC dioxin and furan study are described below. For information on quality objectives and criteria and sample design, refer to the following DRBC Quality Assurance Project Plans (QAPPs):

- Scenic Rivers Monitoring Program QAPP, Revision 1 (2006)
- Ambient Water Monitoring of the Delaware River for Chronic Toxicity Freshwater Species, QAPP, Revision 3 (2005)
- Ambient Water Monitoring of the Delaware River for Chronic Toxicity Low Salinity Tolerant Species, QAPP, Revision 4 (2005)
- Lower Delaware Water Quality Monitoring Program QAPP (2004)
- Delaware River Boat Run Monitoring Program QAPP (2004)

#### **4.1.1 Scenic Rivers Monitoring Program (SRMP)**

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

1. To convert reach-wide EWQ targets to ICP and BCP targets;
2. To support water quality models for SPW implementation; and
3. To gather sufficient water quality information to implement DRBC SPW regulations using a site-specific statistical approach to define and assess possible changes to existing water quality.

Sampling sites for the SRMP are listed in Appendix A, Table A-1. There are 47 sampling locations; however, for the 2008 Assessment, only data from Interstate Control Points (ICP) along the main stem Delaware River are utilized. Tributary boundary sites are not used. Parameters monitored under the program are listed in Appendix A, Table A-2.

#### **4.1.2 Lower Delaware Monitoring Program (LDMP)**

In 1999, DRBC began monitoring to characterize the existing water quality of the Lower Non-tidal Delaware River; the reach extending from Trenton, NJ, (RM 134) to the Delaware Water Gap (RM 210). This monitoring network was established because little data existed to characterize water quality in this reach, portions of which have been included in the National Wild and Scenic Rivers System. In 2004, DRBC completed a five-year effort to define existing water quality and to develop a water quality

management strategy that protects and improves the water quality of the Lower Delaware region. Based on LDMP monitoring results, the Lower Delaware was declared by DRBC in 2005 as “Significant Resource Waters” on an interim basis until implementation issues are resolved for full SPW designation and rulemaking.

Program objectives include:

- Establishing EWQ for future comparison;
- Assessing attainment of water quality standards;
- Setting geographic and water quality priorities to maintain or improve EWQ; and
- Long-term monitoring so that DRBC can consistently perform its 305b assessment, evaluate trends, prioritize agency management activities, and assess effectiveness of strategy implementation.

Sampling is conducted at 9 Delaware River ICP sites and 15 tributary sites (Appendix A, Table A-1). Only the results for the ICP sites are used in the assessment. A list of parameters, measured or calculated, for the program is shown in Appendix A, Table A-2.

#### **4.1.3 Estuary Boat Run Program (Boat Run)**

The Boat Run consists of monitoring of the tidal portion of the Delaware River from the head of tide at Trenton, NJ, (RM 133.4) to the mouth of the Delaware Bay, delineated as a line from Cape May, NJ, to Lewes, DE. The goals of the program are to provide accurate, precise, and defensible estimates of the surface water quality of the Delaware Estuary and to allow assessment of water quality standards compliance.

Sampling occurs 12 times per year at 22 locations (Appendix A, Table A-1). The samples are analyzed for routine, bacterial, and nutrient parameters, as well as, radioactivity (Appendix A, Table A-2).

#### **4.1.4 Delaware River Chronic Toxicity Study**

The Toxic Advisory Committee (TAC) for the DRBC recommended and the DRBC Commissioners asked the DRBC staff to study and characterize the nature and extent of cumulative chronic toxicity in the Delaware Estuary (zone 2 through 5). Two studies were initiated under the Boat Run program. The first one involved testing ambient water to measure potential chronic toxicity in the tidal Delaware River (RM 50 to RM 80), using low salinity tolerant species. The criteria used to select the test species were as follows: 1) the species is tolerant of low salinity conditions of 1 to 15 ppt (For the purposes of this study, a species that met the test acceptability requirements at ambient salinities (1 to 15 ppt) demonstrates tolerance of the low salinity conditions); 2) the species has been used in standard toxicity tests; and 3) the species is commercially available. Although it is not a criteria to be a resident species, one of the test species, *Menidia beryllina* is resident in the Delaware Estuary (Delaware Estuary Program, 1995).

Sampling is conducted at 7 Delaware River sites (Appendix A, Table A-1). A list of parameters measured for the study is included in Appendix A, Table A-3.

The second study addressed questions identified in previous toxicity studies undertaken in the tidal Delaware River (RM 63 to RM 115) between 1990 and 2001. The tidal Delaware River area sampled was extended to RM 131.5. Chronic toxicity tests were run on receiving (ambient) water composites samples with three freshwater organisms: the fathead minnow, *Pimephales promelas*; the water flea, *Ceriodaphnia dubia*; and a green alga, *Selenastrum capricornutum* (*Raphidocelis subcapitata*). The definition of freshwater varies among the states adjacent to the Delaware River. For the purposes of this project, freshwater is ambient water with conductivity of 1,750  $\mu\text{S}/\text{cm}$  (1.0 ppt salinity at 25°C). Sampling is conducted at 15 Delaware River sites (Appendix A, Table A-1). A list of parameters measured for the study is included in Appendix A, Table A-3.

#### **4.1.5 Dioxins and Furans in Fish from the Delaware River Study**

Recent DRBC fish tissue data on dioxins and furans (DxF) was compiled with EPA and DNREC DxF fish tissue data. The purpose of the study was two-fold: (1) to better understand the extent and magnitude of DxFs in the main stem Delaware River and (2) to help support regulatory decisions (i.e., fish consumption advisories) in some parts of the Delaware Estuary. The data was presented by DNREC's Rick Greene at a Co-Regulators Meeting on January 25, 2008, at the Delaware River Basin Commission headquarters.

The study used DxF data from 112 fish samples taken from 31 main stem locations between 1977 and 2007. The majority of the samples were analyzed using high resolution gas chromatography/high resolution mass spectrometry (EPA Method 1613). DxF toxic equivalencies (TEQs) were calculated using WHO 2005 toxic equivalency factors (TEFs). The results are highlighted in Section 4.3.4.

## **4.2 Assessment Methodologies**

Because DRBC's role is to assess shared waters in the Basin, coordination with the Basin States is important. The Integrated Listing process defines a list of waters for which TMDLs must be prepared (i.e., 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. The DRBC did public notice the methodology for the 2008 Delaware River and Bay Integrated List assessment in the Federal Register on January 14, 2008. Furthermore, the programmatic knowledge necessary to sub-categorize waters within Category 4 requires significant input from the states.

In order to avoid potential discrepancies between the DRBC's 2008 Assessment and the Basin States' Integrated Lists, and to ensure that the Basin States have adequate time for their public noticing processes, it is DRBC's intent to provide a preliminary report to the States in advance of their administrative deadlines. To meet this task, the DRBC

prepares the 305(b) report and coordinates discussions with the Basin States during the year prior to the April 1, 2008, deadline. Therefore, the DRBC only utilizes data from the 2006 monitoring season and the two prior monitoring seasons (2004 and 2005). The 2007 monitoring data will be included in the next assessment.

#### **4.2.1 Assessment Units**

As noted in Section 3.3, the non-tidal assessment units include WQM zones 1A, 1B, 1C, 1D, and 1E (Figure 3-2). The designated uses assessed in zones 1A through 1E include aquatic life, drinking water, primary recreation, and fish consumption (Table 3-1). WQM zones 2, 3, 4, and 5 make up the tidal portion of the Delaware River Basin (Figure 3-2). Fish consumption, aquatic life, and recreation apply to all the tidal zones. Drinking water use is only applicable to WQM zones 2 and 3 (Table 3-1). The Delaware Bay consists of WQM zone 6 (Figure 3-3). The assessed designated uses for the Bay include aquatic life, primary recreation, fish consumption, and shellfish consumption (Table 3-2).

#### **4.2.2 Data Requirements**

This section looks at the general criteria for each parameter assessed and how that parameter is assessed relative to its designated use and DRBC WQR. 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. A designated use could be supported or not supported using less data points. The example below is where an assessment could be made using less data points:

*The data requirement for primary contact recreation is based on fecal coliform where at least five samples per AU is required during each assessment year and a geometric mean of 200/100m is not to be exceeded. If three samples were obtained during one assessment year and failed the geometric mean criteria, and the other two assessment years had at least five samples available for the assessment and passed the criteria; the AU would be considered impaired for that use.*

Listed here are a few cases where insufficient data is available and can not be assessed against DRBC criteria, and fails to support the designated use. The assessment would be identified as “ID” rather than “not supported.”

- a) When the number of samples per AU over an assessment period or season was below data requirements
- b) When background levels was not specified in DRBC WQR for a particular AU
- c) When the parameter was not monitored for in an AU
- d) When the parameter was analyzed in a matrix other than surface water

## *Aquatic Life*

Aquatic life is to be protected in DRBC WQM zones (Table 3-1). The assessment is based upon these water quality parameters: dissolved oxygen (DO), pH, turbidity, temperature, total dissolved solids (TDS), and alkalinity (Table 4-1). In addition, toxic pollutants with criteria based on chronic and freshwater conditions are used to support aquatic life in zones 2 through 5. For protection of aquatic life, zone 6 was assessed as a whole unit.

**Table 4-1. Aquatic Life data requirements and assessment criteria**

<b>Parameter</b>	<b>AU</b>	<b>Criteria</b>	<b>Assessment Method</b>	<b>Data Requirements</b>
<b>DO</b>	1A-1E, 2-6	Meet minimum 24-hour average criteria listed in Table 3-6 and 3-7.	Less than 10% of the samples per AU fail the criteria	At least 20 24-hour averages per AU over a three-year period
	1A-1E, 2-6	Not less than specified criteria in Table 3-6 and Table 3-7	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>Temperature</b>	1A-1E	Not able to assess since DRBC WQR do not define “ambient” and “natural” temperatures		
	2-6	Not to exceed maximum temperature listed in Table 3-7	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>pH</b>	1A-1E	Meet pH criteria range listed in Table 3-6	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
	2-6	Meet pH criteria range listed in Table 3-7	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>TDS</b>	1A-1E, 2-4	Not to exceed 133% of background value listed in the DRBC WQR, or 500 mg/L, whichever is less	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>Alkalinity</b>	1E	Not less than specified criteria in Table 3-6	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
	2-6	Meet criteria range listed in Table 3-7	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>Toxic Pollutants</b>	2-5	Not to exceed criteria noted in Table 3-8 for Freshwater Objectives - Chronic	No more than one (1) exceedence in an AU over a three-year period	At least 10 samples per AU over a three-year period

Water quality data were insufficient to assess turbidity in zones 1A and 1B against the DRBC WQC. The instrument used for monitoring turbidity in these zones was suspect. Temperature data could not be assessed for zones 1A through 1E since the DRBC WQC references ambient waters and “ambient” and “natural” temperatures are not defined in the regulations and could not be determined from the data. TDS in zone 4 could not be assessed against the 133% of the background criteria because DRBC WQR Article 4 Application of Standards (specifically, 4.20.2.A) did not list a background level for TDS in that zone.

### ***Drinking Water***

Drinking water use is designated for WQM zones 1A through 1E, 2, and 3. The parameters used for determining drinking water use in the 2006 Assessment were TDS, chlorides, and toxic substances. For the 2008 Assessment, the aforementioned parameters were assessed, as well as, hardness, odor, phenols, sodium (Na), and turbidity (Table 4-2). Since this particular use closely relates to human health, the assessment also takes into account information on actual impacts to the use such as closures of drinking water facilities due to water quality concerns.

### ***Contact Recreation***

In the DRBC Water Quality Regulations, the "Recreation" designated use includes all water-contact sports, and thus corresponds to "primary contact" recreation. Some waters, however, are designated as "Recreation - secondary contact" which restricts activities to where the probability of significant contact or water ingestion is minimal, encompassing but not limited to:

1. boating,
2. fishing,
3. those other activities involving limited contact with surface waters incident to shoreline recreation.

Criteria protective of the primary contact designated use are also protective of secondary contact uses. Criteria protective of secondary contact uses are not protective of primary contact uses.

#### Primary

With the exception of DRBC WQM zone 3, primary contact recreation applies to zones 1A-1E, 2, and 4-6. The parameter used for determining primary contact recreation in zones 1A-1E is fecal coliform. In addition to fecal coliform, enterococcus bacteria is used to assess primary contact recreation in the tidal zones 2, 4, 5, and 6 (Table 4-3). Zone 4 is only assessed for the parameters below RM 81.8. The criteria are based on a geometric mean, with samples taken at a certain frequency and location as to permit valid interpretation.

#### Secondary

DRBC WQM zones 3 and 4 are restricted to secondary contact recreation. Fecal coliform and enterococcus bacteria are used to assess secondary contact recreation (Table 4-4). Zone 4 is only assessed for the parameters above RM 81.8. The criteria are based on a geometric mean, with samples taken at a certain frequency and location as to permit valid interpretation.

**Table 4-2. Drinking Water data requirements and assessment criteria**

<b>Parameter</b>	<b>AU</b>	<b>Criteria</b>	<b>Assessment Method</b>	<b>Data Requirements</b>
<b>TDS</b>	1A-1E, 2-3	Not to exceed 133% of background level listed in DRBC WQR, or 500 mg/l, whichever is less	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>Hardness</b>	2-3	Not to exceed maximum 30-day average listed in Table 3-7	Less than 10% of the samples per AU fail the criteria	At least three samples in a 30-day period At least 20 samples per AU over a three-year period
<b>Chlorides</b>	2-3	Less than or equal to maximum 15-day (AU 2) or 30-day average (AU 3) listed in Table 3-7	No more than one (1) exceedence of in an AU over a three-year period Less than 10% of the samples per AU fail the criteria	At least two samples in a 15-day period (AU 2) At least three samples in a 30-day period (AU 3) At least 20 samples per AU over a three-year period
<b>Odor</b>	1A-1E, 2-3	Not able to assess since	the parameter was not monitored for in the 2004-2006 period	
<b>Phenols</b>	1A-1E, 2-3	Not to exceed criteria listed in Table 3-6 and 3-7	Less than 10% of the samples per AU fail the criteria	At least 20 samples per AU over a three-year period
<b>Na</b>	3 at RM 98	Not to exceed maximum 30-day average listed in Table 3-8	No more than one (1) exceedence in an AU over a three-year period Less than 10% of the samples per AU fail the criteria	At least three samples in a 30-day period (AU 3) At least 20 samples per AU over a three-year period
<b>Turbidity</b>	1A-1E, 2-3	Not to exceed maximum 30-day average and maximum criteria listed in Table 3-7 and 3-8	No more than one (1) exceedence in an AU over a three-year period Less than 10% of the samples per AU fail the criteria	At least three samples in a 30-day period (AU 3) At least 20 samples per AU over a three-year period
<b>Systemic Toxicants</b>	2-3	Not to exceed criteria noted in Table 3-10 for Freshwater Objectives – Fish & Water Ingestion	No more than one (1) exceedence in an AU over a three-year period	At least 10 samples per AU over a three-year period
<b>Carcinogens</b>	2-3	Not to exceed criteria noted in Table 3-9 for Freshwater Objectives – Fish & Water Ingestion	No more than one (1) exceedence in an AU over a three-year period	At least 10 samples per AU over a three-year period
<b>Drinking Water Closures</b>	1A-1E, 2-3	Not a single event to occur in the three-year period	No closures affecting an AU over the three-year period	Administrative closures for drinking water supply over the three-year period

**Table 4-3. Primary Contact Recreation data requirements and assessment criteria**

Parameter	AU <sup>A</sup>	Criteria	Assessment Method	Data Requirements
<b>Fecal coliform</b>	1A-1E,2,4,5,6	Not a single geometric mean to exceed 200 / 100 ml	Geometric mean of samples per AU during each assessment year	At least 5 samples per AU during each assessment year
<b>Enterococcus</b>	2,4	Not a single geometric mean to exceed 33 / 100 ml	Geometric mean of samples per AU during each assessment year	At least 5 samples per AU during each assessment year
	5,6	Not a single geometric mean to exceed 35 / 100 ml	Geometric mean of samples per AU during each assessment year	At least 5 samples per AU during each assessment year

<sup>A</sup>WQM zone 4 is assessed for the parameters below RM 81.8.

**Table 4-4. Secondary Contact Recreation data requirements and assessment criteria**

Parameter	AU <sup>A</sup>	Criteria	Assessment Method	Data Requirements
<b>Fecal coliform</b>	3,4	Not a single geometric mean to exceed 770 / 100 ml	Geometric mean of samples per AU during each assessment year	At least 5 samples per AU during each assessment year
<b>Enterococcus</b>	3,4	Not a single geometric mean to exceed 88 / 100 ml	Geometric mean of samples per AU during each assessment year	At least 5 samples per AU during each assessment year

<sup>A</sup>WQM zone 4 is assessed for the parameters above RM 81.8.

### ***Fish Consumption***

Fish consumption designated use applies to all DRBC WQM zones. An assessment of “not supporting” the designated use is primarily based upon the presence of the Basin states’ fish consumption advisories in the main stem Delaware River and Estuary. For the purposes of this assessment, advisories related to the general population only are used, rather than advisories for more sensitive subpopulations.

The following fish advisory reports are used:

- 2006-2007 Fish Smart, Eat Smart, A Guide to Health Advisories for eating Fish and Crabs Caught in New Jersey Waters (NJDEP/NJDHSS 2006)
- 2007 Delaware Fish Consumption Advisories (DNREC 2007)
- Fish Consumption Advisories - 2007 (PADEP 2007)
- 2006-2007 Health Advisories: Chemicals in Sportfish and Game (NYSDOH, 2006)

Monitoring data is also used to support listed fish consumption advisories. A recent study (January 25, 2008) by DNREC on DxF in fish from the Delaware River is used to support fish consumption advisories throughout the tidal river.

**Table 4-5. Fish Consumption Data requirements and assessment criteria**

Parameter	AU	Criteria	Assessment Method	Data Requirements
<b>Fish Consumption Advisory</b>	1A-1E, 2-6	Not a single fish advisory listed for an AU	Count of the number of fish consumption advisories per AU listed over the three-year assessment period	NY, NJ, DE, and PA fish consumption advisories for the general population based upon the Basin states' water quality or fish tissue data

### *Shellfish Consumption*

Shellfish consumption designated use only applies to DRBC WQM zone 6 (RM 48.2 to the mouth of the Delaware Bay). New Jersey and Delaware assess this use in their coastal waters, using procedures developed by the [FDA National Shellfish Sanitation Program](#) (NSSP). Both states use total coliform (as most probable number) as the assessment tool and compare it against federal shellfish standards.

In both states, waters classified for shellfishing may be opened for that use all year round. In some cases, the AU is opened seasonally (typically in winter). In other cases, harvesting may be prohibited due to administrative closures based upon proximity to sewer outfalls. In still other cases, waters may be open to harvesting, but with special treatment of the shellfish, such as transplantation to cleaner waters for a period of time prior to the harvesting. Finally, some waters are closed to shellfish harvesting due to existing water quality concerns.

**Table 4-6. Shellfish Consumption data requirements and assessment criteria**

Parameter	AU <sup>A</sup>	Criterion	Assessment Method	Data Requirements
<b>Shellfish Consumption Classifications</b>	6	Not a single restriction and/or closure in an AU	Count of the number of shellfish harvesting, restrictions and/or closures per AU listed over the three-year assessment period	DE and NJ shellfish consumption and harvesting advisories, restrictions, and/or closures per AU over a three-year assessment period

<sup>A</sup> WQM zone 6 is subdivided into multiple units based on Shellfish Management Directives.

### 4.3 Assessment Results

After an AU is assessed against the relevant criteria for a designated use, the AU is then determined to be “Supporting” or “Not Supporting” for that designated use. In some cases, the AU can not be classified as supporting or non-supporting because there is insufficient data to compare a parameter to current DRBC WQC.

The assessment results are presented in tabular format by designated use. A plus sign (+) indicates that the parameter meets DRBC current water quality criteria. A minus sign (-) signifies that the parameter does not meet DRBC’s current water quality criteria. In order for a designated use to be supported (S) in a zone, it must meet these conditions:

- 1.) All applicable parameters in that row must be assessed and labeled with a + sign.
- 2.) Available data is sufficient to make an assessment for each parameter.

For a zone to be not supported (NS) for a particular use, it must contain at least one minus sign for an applicable parameter, regardless of insufficient data for other parameters. If there is insufficient data present for a parameter that is a primary surrogate for a designated use in a zone, then the AU assessment for the zone is identified as insufficient (ID). The tables follow below. For comparison purposes, the 2006 Assessment results are included.

**Table 4-7. Aquatic Life Designated Use Assessment Results**

AU	DO	pH	Turbidity	Temperature <sup>A</sup>	TDS	Alkalinity	Toxic Pollutants <sup>B</sup>	2008 Assessment	2006 Assessment
1A	+	-	ID	ID	+	NC	NC	NS	NS
1B	+	+	ID	ID	+	NC	NC	ID	ID
1C	+	+	+	ID	+	NC	NC	ID	ID
1D	+	+	+	ID	+	NC	NC	ID	ID
1E	+	-	+	ID	+	+	NC	NS	S
2	+	+	+	-*	+	+	+	NS	S
3	+	+	+	+	+	+	+	S	S
4	+	+	+	-*	ID	+	+	NS	S
5	-	+	+	+	NC	+	+	NS	NS
6	+	+	+	+	NC	+	NC	S	S/ID

<sup>A</sup> DRBC WQR do not define “ambient” and “natural” for zones 1A-1E.

<sup>B</sup> Assessed against parameters and criteria listed in DRBC WQR Table 5 Freshwater Objectives, Chronic or Table 3-8 in this report.

+ (-): The parameter meets (does not meet) DRBC current water quality criteria.

S: The assessment unit supports the designated use.

NS: The assessment does not support the designated use.

NC: DRBC WQR does not contain applicable criteria for a parameter in the AU to be assessed.

ID: Insufficient or unreliable data is present. The parameter could not be assessed against DRBC current water quality criteria.

\*: Review of meteorological data suggests that water column temperatures were influenced by air temperatures. The degree to which water column temperatures are influenced by thermal discharges is unknown.

### **4.3.1 Aquatic Life**

For the 2008 Assessment, aquatic life is supported in DRBC WQM zones 3 and 6 (Table 4-7). Aquatic life is not supported in zones 1A and 1E because of pH not meeting the DRBC WQC for that zone. Zones 2 and 4 do not support aquatic life because of exceedences of temperature criteria. DRBC standards include temperature criteria for all portions of the River; however, in-stream values only exist for Zones 2, 3 and 4. For zones 2, 3, and 4, criteria are also based upon the regulation of temperature increases, caused by effluent discharges, above background conditions. The degree to which thermal discharges contribute to temperature changes is not known. Furthermore, review of meteorological data for the tidal region suggests that water column temperatures were influenced by air temperatures.

In zone 5, the dissolved oxygen criteria are not met. Approximately 17% of the samples assessed in zone 5 for DO do not meet the 24-hour average criteria.

The assessment for copper in lower zone 5 is complicated by the issue of the appropriate hardness value to be used to assess the elevated copper concentrations. There is a need to collect additional data and supplementary parameters in order to determine if the aquatic life use of lower zone 4 and zone 5 is impaired by elevated copper concentrations. In order to further the resolution of this assessment, the DRBC has scheduled supplemental data collection at two additional sampling locations and at an increased frequency in 2008. In addition, major ions and dissolved organic carbon will be measured concurrently for input into the Biotic Ligand Model Windows Interface, Version 2.1.2 (HydroQual Inc., Mahwah, NJ) when monitoring metals in selected river segments.

### **4.3.2 Drinking Water**

Drinking water is supported in zones 1A-1D, 2, and 3 (Table 4-8). The use does not apply to zones 4, 5, and 6.

Zones 1D and 1E were affected by a single human-induced water quality event that occurred during the 2004-2006 assessment period. Between August 23 and 27, 2005, PPL Martins Creek Steam Electric Station released approximately 100 million gallons of fly ash slurry into the Delaware River. Elevated metal concentrations below the PPL discharge were found. In particular, arsenic concentrations briefly exceeded the human health criterion of 50 ug/l set by the PADEP. As a result of the elevated levels, drinking water intakes at Easton, PA, and Point Pleasant, PA, were closed for a period of time, and the spill was remediated. Development of a TMDL for arsenic is not the appropriate action to take. Instead, stronger safeguards should be in place to prevent a similar event, as well as, better coordination between the Basin States and DRBC with respect to response efforts (i.e., monitoring).

One measurement of 17 in zone 1E exceeded DRBC's phenol criteria. However, DRBC's phenol criteria (5 ug/L) is much lower than EPA's recommended human health phenol criteria for consumption of water and organisms (21,000 ug/L).

### **4.3.3 Contact Recreation**

Primary contact recreation is supported in all applicable zones, except zone 4 below RM 81.8 (Table 4-9), where there is insufficient data. Secondary contact recreation is supported in zones 3 and 4. WQM zone 1E and 6 are assessed as whole units for this use. Zone 6 is only subdivided for Shellfish Consumption designated use. Therefore, based on the assessment methodology described earlier, Zone 6 is supporting for primary contact recreation.

### **4.3.4 Fish Consumption**

The assessment of fish consumption is based upon the presence of fish consumption advisories for the main stem Delaware River and Bay. Table 4-10 shows the advisories issued by the Basin states as they apply DRBC WQM zones. The Basin states, with the exception of NJ, indicate the contaminant contributing to the advisory. In most instances, the contaminants are PCBs and mercury. New York did not issue any fish advisories for the Delaware River. However, fish advisories due to mercury are listed for the reservoirs feeding the Delaware River.

Fish consumption is not supported in any WQM zone in the Delaware River and Bay (4-11). Recently compiled DxF data from fish tissue collected in 2004 and 2005 also support fish advisories in the tidal river (Greene 2008). PCBs remain the primary cancer risk driver, followed by dioxin and dioxin-like chemicals (DxF TEQs). Mercury levels in striped bass are moderately elevated and contribute to non-cancer health risks.

### **4.3.5 Shellfish Consumption**

Shellfish consumption only applied to DRBC WQM zone 6. 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).

Figure 4.1 indicates the DE and NJ classifications for shellfishing in zone 6. Table 4-12 lists the DE and NJ classifications and the 2008 and 2006 Assessment results. In the 2006 Assessment, subunits were combined for the assessment (i.e., 6brA-6brC, 6br2c-6br2d, 6de2-6de4, 6nj2-6nj7, and 6nj9-6nj10). In the 2008 Assessment, these subunits are assessed individually.

For this assessment, approved harvesting areas were considered to be supporting (S) the use. Prohibited waters were considered to be not supporting (NS) the use, unless recent, readily available data showed that water quality was sufficient to support the use and that prohibitions on harvesting were based on administrative issues, and not specific, current water quality concerns. A designation of “ID” is given to AUs with limited data not supporting the use. AUs classified as special restricted and seasonally restricted are considered to be supported, but with special conditions (SS).

The states of DE and NJ 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. In total, 641 square miles (93% of zone 6) are in full support, and 51 square miles (7% of zone 6) are not supportive of the use.

**Table 4-8. Drinking Water Designated Use Assessment Results**

AU	TDS	Hardness	Chlorides	Odor	Phenols	Sodium	Turbidity	Systemic Toxicants <sup>A</sup>	Carcinogens <sup>B</sup>	Human-Induced Impact(s)	2008 Assessment	2006 Assessment
<b>1A</b>	+	NC	NC	ID	ID	NC	ID	NC	NC	NC	S	ID
<b>1B</b>	+	NC	NC	ID	ID	NC	ID	NC	NC	NC	S	ID
<b>1C</b>	+	NC	NC	ID	ID	NC	+	NC	NC	NC	S	ID/S
<b>1D</b>	+	NC	NC	ID	ID	NC	+	NC	NC	NC	S	ID/S
<b>1E</b>	+	NC	NC	ID	+*	NC	+	NC	NC	NC	S	ID/S/NS
<b>2</b>	+	+	+	ID	ID	NC	+	+	+	NC	S	S
<b>3</b>	+	+	+	ID	ID	+	+	+	+	NC	S	S
<b>4</b>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>5</b>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>6</b>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

<sup>A</sup> Assessed against parameters and criteria listed in DRBC WQR Table 7 Freshwater Objectives, Fish & Water Ingestion or Table 3-10 in this report.

<sup>B</sup> Assessed against parameters and criteria listed in DRBC WQR Table 6 Freshwater Objectives, Fish & Water Ingestion or Table 3-9 in this report.

+ (-): The parameter meets (does not meet) DRBC current water quality criteria.

S: The assessment unit supports the designated use.

NS: The assessment does not support the designated use.

NA: Designated use is not applicable to the assessment unit.

NC: DRBC WQR does not contain applicable criteria for a parameter in the AU to be assessed.

ID: Insufficient or unreliable data is present. The parameter could not be assessed against DRBC current water quality criteria.

\*: One measurement of 17 in zone 1E exceeded DRBC's phenol criteria. However, DRBC's phenol criteria (5 ug/L) is much lower than EPA's recommended human health phenol criteria for consumption of water and organisms (21,000 ug/L).

**Table 4-9. Contact Recreation Designated Use Assessment Results**

AU <sup>A</sup>	Fecal Coliform		Enterococcus		2008 Assessment	2006 Assessment
	Primary	Secondary	Primary	Secondary		
<b>1A</b>	+	NA	NA	NA	S	S
<b>1B</b>	+	NA	NA	NA	S	S
<b>1C</b>	+	NA	NA	NA	S	S
<b>1D</b>	+	NA	NA	NA	S	S
<b>1E</b>	+	NA	NA	NA	S	S/ID/NS
<b>2</b>	+	NA	+	NA	S	S
<b>3</b>	NA	+	NA	+	S	S
<b>4</b>	ID	+	ID	+	ID/S	S
<b>5</b>	+	NA	+	NA	S	S
<b>6</b>	+	NA	+	NA	S	S/ID/NS

<sup>A</sup> Zones 1E and 6 were assessed as whole units for this use.

+ (-): The parameter meets (does not meet) DRBC current water quality criteria.

S: The assessment unit supports the designated use.

NS: The assessment does not support the designated use.

NA: Designated use is not applicable to the assessment unit.

ID: Insufficient or unreliable data is present. The parameter could not be assessed against DRBC current water quality criteria. In zone 4 below RM 81.8, data was not available for that portion of the river.

**Table 4-10. Fish Consumption Advisories for General Population for the Delaware River and Bay**

Fish Species	Contaminant	Fish Consumption Advisory – General Population										
		1A	1B	1C	1D	1E	2	3	4	5	6	
<b>DELAWARE</b>												
Finfish	PCBs, Dioxins, Mercury, Chlorinated Pesticides										No consumption (state line to C&D canal)	
Weakfish (all sizes), Bluefish (<14 in)	PCBs										1 meal / month	1 meal / month
Striped Bass, White Perch, American Eel, Channel Catfish, Bluefish (>14 in)	PCBs, Mercury										1 meal / year	
<b>NEW JERSEY</b>												
American Eel, Channel Fish	Not listed							1 meal / year	1 meal / year	1 meal / year		
White Catfish	Not listed							1 meal / month	1 meal / month	1 meal / month		
Striped Bass, White Perch	Not listed							4 meals / year	4 meals / year	4 meals / year		
Finfish	Not listed										No consumption (state line to C&D canal)	
<b>NEW YORK<sup>A</sup></b>												
Brown Trout (>24 in), Smallmouth Bass (>15 in), Yellow Perch	Mercury	Pepacton Reservoir – 1 meal / month										
Brown Trout (>24 in), Smallmouth Bass	Mercury	Neversink Reservoir – 1 meal / month										
Smallmouth Bass (>15 in), Yellow Perch	Mercury	Cannonsville Reservoir – 1 meal / month										
<b>PENNSYLVANIA</b>												
American Eel	Mercury	2 meals / month	2 meals / month	2 meals / month	2 meals / month	2 meals / month						
	PCBs						No consumption	No consumption	No consumption			
White Perch, Channel and Flathead Catfish, Striped Bass	PCBs						1 meal / month	1 meal / month	1 meal / month			
<b>Number of Advisories</b>		1	1	1	1	1	5	5	5	5	5	2

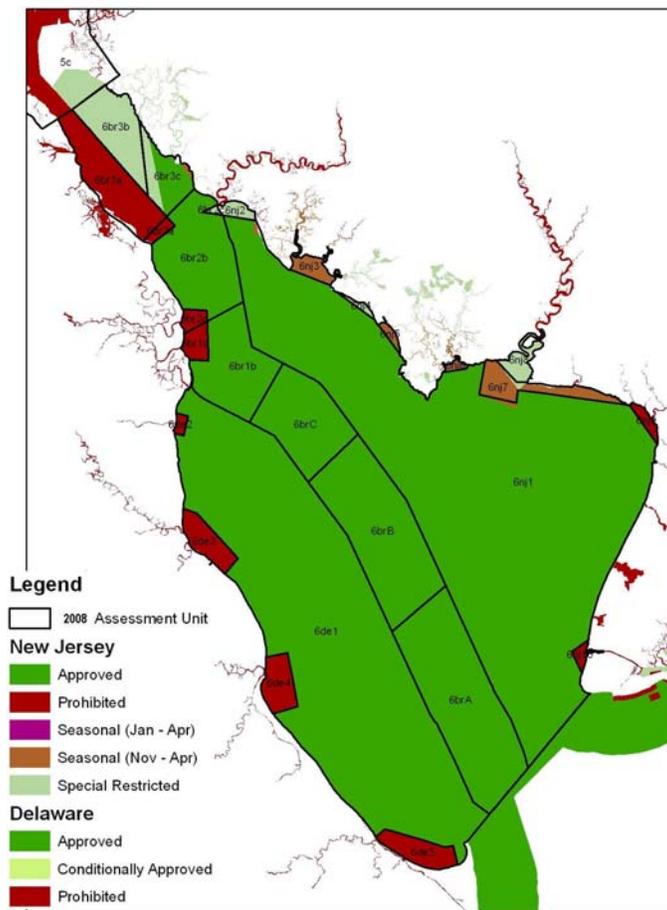
<sup>A</sup> New York did not list any section of the Delaware River in their fish advisory report. However, the reservoirs feeding the Delaware River were included in the report.

Sources: 2007 Delaware Fish Consumption Advisories (DNREC 2007); 2006-2007 Fish Smart, East Smart: Guide to Health Advisories for eating Fish and Crabs caught in New Jersey Waters (NJDEP/NJDHSS 2006); 2006-2007 Health Advisories: Chemicals in Sportfish and Game (NYSDOH 2006); Fish Consumption Advisories (PADEP 2007)

**Table 4-11 Fish Consumption Designated Use Assessment Results**

AU	Fish Consumption Advisories	2008 Assessment	2006 Assessment
1A	-	NS	NS
1B	-	NS	NS
1C	-	NS	NS
1D	-	NS	NS
1E	-	NS	NS
2	-	NS	NS
3	-	NS	NS
4	-	NS	NS
5	-	NS	NS
6	-	NS	NS

+ (-): The parameter meets (does not meet) DRBC current water quality criteria.  
 S: The assessment unit supports the designated use.  
 NS: The assessment does not support the designated use.



**Figure 4-1. Shellfish Consumption Classifications designated by New Jersey and Delaware for the Delaware Bay (DRBC WQM zone 6)**

**Table 4-12. Shellfish Consumption Designated Use Assessment Results**

AU 6	NJ/DE Classification	DRBC Explanation (if applicable)	2008 Assessment	2006 Assessment
6brA	Approved		S	S
6brB	Approved		S	S
6brC	Approved		S	S
6br1a	Prohibited	Limited data not supporting use	NS	ID
6br1b	Approved		S	S
6br2a	Prohibited	Limited data not supporting use	NS	ID
6br2b	Approved		S	S
6br2c	Special restricted		ID	ID
6br2d	Prohibited	Limited data not supporting use	ID	ID
6br3a	Prohibited	Limited data not supporting use	NS	ID
6br3b	Special restricted		SS	S
6br3c	Approved		S	ID
6de1	Approved		S	S
6de2	Prohibited	Limited data not supporting use	ID	ID
6de3	Prohibited	Limited data not supporting use	ID	ID
6de4	Prohibited	Limited data not supporting use	ID	ID
6de5	Prohibited	Limited data not supporting use	NS	S
6nj1	Approved		S	ID
6nj2	Special Restricted		SS	ID
6nj3	Seasonal (Nov-Apr)		SS	ID
6nj4	Special Restricted		SS	ID
6nj5	Seasonal (Nov		SS	ID
6nj6	Seasonal (Nov		SS	ID
6nj7	Seasonal (Nov		SS	ID
6nj8	Special Restricted		SS	ID
6nj9	Prohibited	Limited data not supporting use	NS	ID
6nj10	Prohibited	Limited data not supporting use	NS	ID

S: The assessment unit supports the designated use.

SS: The assessment unit supports the designated use, but with special conditions.

NS: The assessment does not support the designated use.

ID: Insufficient or unreliable data is present.

#### 4.3.6 Categorization of Assessment Units

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. According to the EPA 2006 Integrated List Guidance, the five (5) categories into which an AU can be placed are as follows:

- 1: All designated uses are supported, no use is threatened;
- 2: Available data and/or information indicate that some, but not all of the designated uses are supported;
- 3: There is insufficient available data and/or information to make a use support decision;

- 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed;
- 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

Table 4-13 explains how an AU is placed in one of the five categories listed above.

**Table 4-13. Explanation of AU placement into Categories 1 through 5**

Category	Explanation
<b>1</b>	<b>Data requirements and criteria met for assessing all designated uses.</b>
<b>2</b>	<b>Data requirements and criteria met for assessing at least one, but not all designated uses.</b> No parameters for which data requirements are met indicate non-attainment of criteria. AU is “probably supporting” <sup>A</sup> 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 non-attainment. <sup>B</sup>
<b>3</b>	<b>3</b> <b>Not a single designated use has sufficient data for all its relevant parameters.</b> 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.
	<b>3A</b> <b>Waters of Concern</b> One or more parameters, for which insufficient data exist, indicate a high likelihood of impairment. <sup>B</sup> AU is “probably not supporting” one or more designated uses. <sup>A</sup>
	<b>3B</b> AU is “probably supporting” one or more designated uses. <sup>A</sup> There is insufficient data to determine if the remaining uses (if any) are supported. Not a single use is “probably not supported.”
<b>4</b>	<b>4</b> <b>One or more water quality criteria are not met. Additional data or information indicates a likelihood of one or more water quality criteria not being met by the next reporting cycle.</b> 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.
	<b>4A</b> A TMDL to address a specific segment/pollutant combination has been approved or established.
	<b>4B</b> A use impairment caused by a pollutant is being addressed by the state through other pollution control requirements.
	<b>4C</b> A use is impaired, but the impairment is not caused by a pollutant.
<b>5</b>	<b>One or more water quality criteria are not met. Additional data or information indicates a likelihood of one or more water quality criteria not being met by the next reporting cycle.</b> 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, AU is affected by a shellfishing restriction or closure based upon recent monitored water quality or shellfish tissue data. In the absence of recent, readily available data, restricted areas will be considered impaired.

<sup>A</sup> AU, for which insufficient data exist to assess a given use, is bounded by two AUs that have sufficient data for assessment.

<sup>B</sup> 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.

The results of this assessment list the entire tidal and non-tidal Delaware River and Delaware Bay into Category 5 (Figure 4-2, Table 4-14). In zones 1B, 1C, and 3, the non-support of Fish Consumption designated use is the only cause of the AU being placed into Category 5. Zone 6 is not broken into subunits for the final listing. The zone is listed as category 5 because fish consumption is not supported in all subunits, even if shellfishing is supported in some of the subunits. Zones 1A, 1D, 1E, 4, and 5 are listed into Category 5 because more than the Fish Consumption designated use is not met. In zones 1A, 1E, 2, 4, and 5, Aquatic Life designated use is not supported. Zone 1D and 1E are not supported for Drinking Water designated use.

**Table 4-14. 2008 Integrated Listing Category for DRBC WQM zones**

<b>AU</b>	<b>Aquatic Life</b>	<b>Drinking Water</b>	<b>Recreation</b>	<b>Fish Consumption</b>	<b>Shellfishing</b>	<b>Final 2008 Assessment Category</b>	<b>Final 2006 Assessment Category</b>
<b>1A</b>	NS	S	S	NS	NA	5	5
<b>1B</b>	ID	S	S	NS	NA	5	5
<b>1C</b>	ID	S	S	NS	NA	5	5
<b>1D</b>	ID	S	S	NS	NA	5	5
<b>1E</b>	NS	S	S	NS	NA	5	5
<b>2</b>	NS	S	S	NS	NA	5	5
<b>3</b>	S	S	S	NS	NA	4A	5
<b>4</b>	NS	NA	ID (below RM 81.8)/S	NS	NA	5	5
<b>5</b>	NS	NA	S	NS	NA	4A	5
<b>6</b>	S	NA	S	NS	S/SS/NS/ID	4A	5

S: The assessment unit supports the designated use.

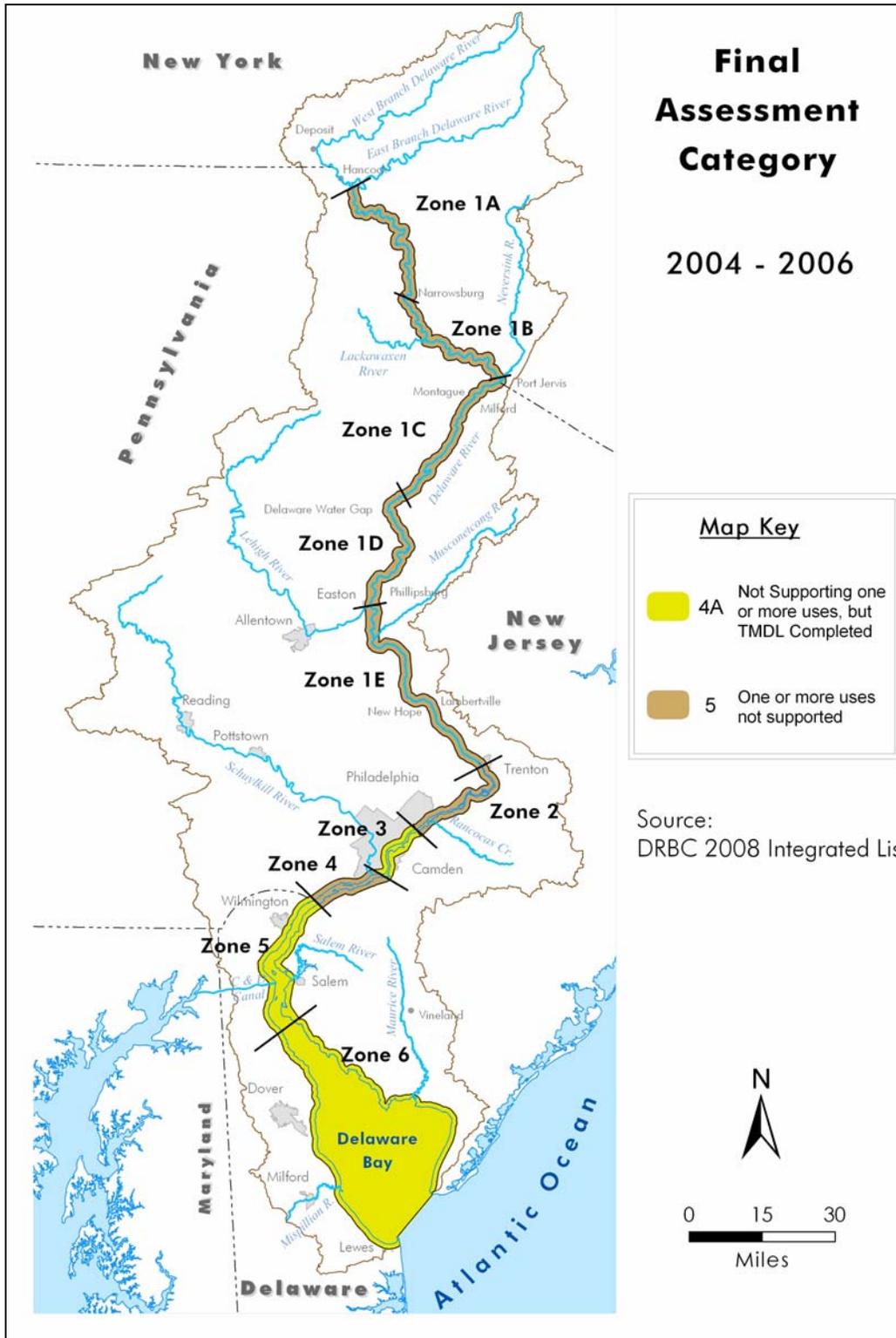
SS: The assessment unit supports the designated use, but with special conditions.

NS: The assessment does not support the designated use.

NA: DRBC WQR does not contain applicable criteria for a parameter in the AU.

ID: Insufficient or unreliable data is present.

**Figure 4-2. Final Assessment Category for Delaware River and Bay**



## 5 Ground Water Monitoring and Assessment

The water quality of ground water for its applicable uses is not assessed in the 2008 Assessment. However, it is the general policy of DRBC that all ground water of the Basin should not exceed MCLs listed in the National Primary Drinking Water Standards. Since this report focuses on the main stem of the Delaware River, the reader is directed to the 2008 water quality assessment reports of each of the Basin States for the status of ground water in that state.

## 6 Public Participation

The DRBC involved public participation in the development of the 2008 Assessment. In early January 2008, a public notice was submitted to the Office of Federal Register, indicating that the number of assessment units used in the 2008 Assessment is reduced by consolidating the units into DRBC's Water Quality Management zones 1A, 1B, 1C, 1D, 1E, 2, 3, 4 and 5, the boundaries of which are defined in the DRBC's Water Quality Regulations. Zone 6 continues to be subdivided as defined in part by shellfish management directives issued by the states of Delaware and New Jersey. No comments were received by close of business on January 28, 2008.

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## **Appendix A. DRBC Monitoring Program Tables**

**Table A-1** Main stem Delaware River sampling sites monitored as part of DRBC's water quality monitoring programs. River miles are in parentheses.

<b>Scenic Rivers Monitoring Program</b>	<b>Lower Delaware Monitoring Program</b>	<b>Estuary Boat Run Program</b>	<b>Delaware Chronic Toxicity Study (Freshwater)</b>	<b>Delaware Chronic Toxicity Study (Low Salinity)</b>
West Branch Delaware River (331.2)	Portland Foot Bridge (207.6)	Trenton-Biles Channel (154.0)	Biles Channel (131.1)	Opposite Mouth of Marcus Hook Creek (80)
Lordville Bridge (321.6)	Belvidere Bridge (197.8)	Florence Bend (123.0)	Florence-Grows Landfill (122)	Opposite Oldman's Point (75.1)
Kellams Bridge (312.6)	Easton Bridge, Northampton St. (183.8)	Burlington Bristol Bridge (117.8)	Beverly (115)	North of Delaware Memorial Bridge (70.8)
Callicoon Bridge (303.7)	Riegelsville Bridge (174.8)	Torresdale (110.7)	Mouth of Rancocas (111.5)	South of Delaware Memorial Bridge (68)
Damascus Bridge (298.4)	Milford-Upper Black Eddy Bridge (167.7)	Betsy Ross Bridge (104.7)	Mouth of Pennsauken Creek (105.4)	North of Pea Patch Island (63)
Narrowsburg Bridge (289.9)	Bulls Island Foot Bridge (155.4)	Benjamin Franklin Bridge (100.2)	Penn's Landing (99.4)	Reedy Island (55)
Del R USGS01428500 (279.2)	Lambertville-New Hope Bridge (148.7)	Navy Yard (93.2)	Opposite the Mouth of Big Timber Creek (95.5)	Liston Point (50)
Barryville Bridge (273.5)	Washington Crossing Bridge (141.8)	Paulsboro, NJ (87.9)	South of Schuylkill River (90)	
Pond Eddy Bridge (265.5)	Calhoun Street Bridge, Trenton (133.5)	Eddystone, PA (84.0)	Paulsboro (85)	
Millrift RR Bridge (258.4)		Marcus Hook (78.1)	Opposite Mouth of Marcus Hook Creek (80)	
Port Jervis Bridge (254.7)		Oldmans Point (74.9)	Opposite Oldman's Point (75.1)	
DEWA Northern Boundary (250.2)		Cherry Island (71.0)	North of Delaware Memorial Bridge (70.8)	
Montague, NJ (246.4)		New Castle (66.0)	South of Delaware Memorial Bridge (68)	
Dingmans Access, PA (238.7)		Pea Patch Island (60.6)	North of Pea Patch Island (63)	
Bushkill Access, PA (228.1)		Reedy Island (54.9)		
Smithfield Access, PA (218.4)		Liston Point-Buoy 8L (48.2)		
Kittatinny Access, NJ (211.5)		Smyrna River (44.0)		
		Ship John Light (36.6)		
		Mahon River (31.0)		
		Elbow of Crossledge Shoal (22.7)		
		South of Joe Flogger Shoal (16.5)		
		South Brown Shoal (6.5)		

**Table A-2** Parameters monitored as part of DRBC's water quality monitoring programs

	SRMP	LDMP	Boat Run
<b>General Water Quality Parameters</b>			
Air Temperature (°F and °C)	x	x	x
Alkalinity (mg/l)	x	x	
Chloride (mg/l)	x	x	x
Conductivity (mS/cm)	x		
Discharge (cfs)		x	
Dissolved Oxygen (% Saturation) calculated		x	
Dissolved Oxygen (mg/l)	x	x	x
Hardness (mg/l)	x	x	x
pH (0.1 units)	x	x	x
Specific Conductance (umhos/cm)		x	x
Total Dissolved Solids (mg/l)	x	x	x
Total Suspended Solids (mg/l)	x	x	x
Turbidity (NTU)		x	x
Water Temperature (°F and °C)	x	x	x
<b>Nutrient and Primary Production Parameters</b>			
Ammonia as NH <sub>3</sub> -N (mg/l)	x	x	x
Carbon, Total Organic (ug/l)			x
Carbon, Total Particulate (mg/l)		x	x
Carbon, Dissolved Organic (ug/l)			x
Chlorophyll A (mg/m <sup>3</sup> )		x	x
Pheophytin A			x
Productivity Carbon 14			x
Nitrate as NO <sub>3</sub> -N (mg/l)	x	x	x
Nitrite as NO <sub>2</sub> -N (mg/l)	x		x
Nitrogen, Total (mg/l) calculated		x	
Nitrogen, Total Kjeldahl (mg/l)	x	x	x
Orthophosphate (mg/l)	x	x	x
Phosphorus, Total (mg/l)	x	x	x
Phytoplankton Biomass (mg/m <sup>3</sup> ) calculated		x	
Secchi Disk/Light Transmission			x
<b>Bacterial Parameters</b>			
Escherichia Coli (col/100 ml)		x	x
Enterococcus (col/100 ml)		x	
Fecal Coliform (col/100 ml)		x	x
<b>Other Parameters</b>			
Copper, Total and Dissolved (ug/l)			x
Chromium, Hexavalent (ug/l)			x
Gage Height (0.01 ft)	x		
Sodium (mg/l)			x
Silica (mg/l)			x
Zinc, Total and Dissolved (ug/l)			x

**Table A-3** Parameters archived and/or monitored as part of DRBC's chronic toxicity studies

	<b>Chronic Toxicity Study Low Salinity</b>	<b>Chronic Toxicity Study Freshwater</b>
<b>Parameters Monitored or Analyzed on Each Sampling Day</b>		
Alkalinity (mg/l)	x	x
Bicarbonate as HCO <sup>3-</sup>	x	
Carbonate as CO <sub>3</sub> <sup>2-</sup>	x	
Chloride (mg/l)	x	x
Dissolved Oxygen (mg/l or % Saturation)	x	x
Hardness		x
pH (0.1 units)	x	x
Salinity (ppt)	x	x
Specific Conductivity (uS/cm)	x	x
Sulfide, Total	x	x
Water Temperature (°C)	x	x
<b>Parameters Monitored or Analyzed on First Sample Day Only</b>		
Ammonia as NH <sub>3</sub> -N (mg/l)	x	x
Chromium, Hexavalent (ug/l)	x	x
Nitrate as NO <sub>3</sub> -N (mg/l)	x	x
Nitrite as NO <sub>2</sub> -N (mg/l)	x	x
Nitrogen, Total Kjeldahl (mg/l)	x	x
Nitrogen, Total as NO <sub>3</sub> -N & NO <sub>2</sub> -N (mg/l)	x	x
Orthophosphate (mg/l)	x	x
Phosphorus, Total (mg/l)	x	x
Total Suspended Solids (mg/l)	x	x
Turbidity (NTU)	x	x
<b>Major Ions and Metals</b>		
Boron (mg/l)	x	
Bromide (mg/l)	x	
Cadmium, Total and Dissolved (ug/l)	x	x
Calcium (ug/l)	x	x
Chromium, Total and Dissolved (ug/l)	x	x
Copper, Total and Dissolved (ug/l)	x	x
Lead, Total and Dissolved (ug/l)	x	x
Magnesium (ug/l)	x	x
Nickel, Total and Dissolved (ug/l)	x	x
Potassium (ug/l)	x	x
Silver, Total and Dissolved (ug/l)	x	x
Sodium (ug/l)	x	x
Sulfate (mg/l)	x	x
Zinc, Total and Dissolved (ug/l)	x	x
Organic Carbon, Total and Dissolved (mg/l)	x	x