9 June 2021

Water Resources Program FY 2022-2024

Report No: 2021-3

Managing, Protecting and Improving the Water Resources of the Delaware River Basin since 1961

60 years 1961–2021

Delaware River Basin Commission

DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

NO. 2021 – 04

A RESOLUTION to adopt the *Water Resources Program FY 2022-2024*.

WHEREAS, Section 13.2 of the *Delaware River Basin Compact* requires the Commission to "annually adopt a water resources program, based upon the comprehensive plan, consisting of the projects and facilities which the commission proposes to be undertaken by the commission and by other authorized governmental and private agencies, organizations and persons during the ensuing six years or such other reasonably foreseeable period as the commission may determine"; and

WHEREAS, the *Water Resources Program FY 2022-2024* was developed by the DRBC staff in consultation with the Commissioners and identifies the projects, including plans, programs, services, and activities, to be undertaken to address the water resources needs of the Basin over the next three fiscal years; and

WHEREAS, the projects, including the plans, programs, services, and activities set forth in the *Water Resources Program FY 2022-2024* guided the development of the FY 2022 budget of the Commission; and

WHEREAS, on May 12, 2021, the Commission held a duly noticed public hearing on the proposed *Water Resources Program FY 2022-2024*; now therefore,

BE IT RESOLVED by the Delaware River Basin Commission:

The *Water Resources Program FY 2022-2024*, including the projects, plans, programs, services, and activities set forth therein, is hereby adopted in satisfaction of Section 13.2 of the *Compact*.

Adopted: June 9, 2021

/s/ Shawn M. Garvin
Shawn M. Garvin, Chairman *pro tem*

/s/ Pamela M. Bush
Pamela M. Bush, J.D., Commission Secretary

AUTHORIZATION

The Delaware River Basin (DRB) Compact states:

The commission shall annually adopt a water resources program, based upon the comprehensive plan, consisting of the projects and facilities which the commission proposes to be undertaken by the commission and other authorized governmental and private agencies, organizations and persons during the ensuing six years or such other reasonably foreseeable period as the commission may determine. (§13.2 DRB Compact, 1961)

According to the Compact, "Project" shall mean any work, service or activity which is separately planned, financed, or identified by the Commission, or any separate facility undertaken or to be undertaken within a specified area, for the conservation, utilization, control, development or management of water resources which can be established and utilized independently or as an addition to an existing facility, and can be considered as a separate entity for purposes of evaluation (§1.2.(g)).

VISION, MISSION, AND VALUES

VISION

The Delaware River Basin Commission (DRBC or Commission) will provide trusted, effective, and coordinated management of our shared water resources.

The vision of the Delaware River Basin Commission is built upon the Compact signed in 1961 by Delaware, New Jersey, New York, Pennsylvania, and the federal government. It is defined in the Delaware River Basin Compact as, “the conservation, utilization, development, management and control of water and related resources of the Delaware River Basin under a comprehensive multipurpose plan will bring the greatest benefits and produce the most efficient service in the public welfare.”

MISSION

The DRBC will “develop and effectuate plans, policies and projects relating to the water resources of the Basin” through:

- Watershed-based planning and management
- Effective, efficient, and coordinated regulatory programs
- Policies and practices informed by science
- Collaboration with and among our state and federal signatory partners
- Adaptive and innovative water resource management
- Public education and outreach

- Public and stakeholder input
- Dedicated and engaged staff in a high performing workplace

To accomplish this mission, the Commission will continue to lead and collaborate with the signatory parties to: protect and improve water quality; manage river flows to meet diverse and at times conflicting Basin needs; reduce damage caused by floods; provide for the reasonable and sustainable development and use of surface and ground water; and promote water conservation and efficiency.

VALUES

The DRBC will be guided in its mission by the following core values:

- Service: to the public, the regulated community and our DRBC colleagues.
- Respect: for each other, the public and the Basin's water resources.
- Professionalism: defined by high ethical standards, integrity, continuous improvement, and accountability.

SCOPE AND ORGANIZATION

The Water Resources Program (WRP) covers fiscal years (FY) 2022 through 2024 (July 1, 2021, through June 30, 2024) and is an element of strategic planning for DRBC program direction over the next three years. The architecture is based on the requirements of the Delaware River Basin Compact (Compact) and the goals of the five Key Result Areas of the *Water Resources Plan for the Delaware River Basin* (Basin Plan, 2004).

The WRP is presented in two parts:

- **Part 1: General Statement of Conditions in the Basin** summarizes water resource conditions in the Basin, including hydrologic conditions, water use and sufficiency, overall assessment of water quality, landscape conditions, and emergent issues that could affect long-range water resource planning and management in the Basin.
- **Part 2: Work Resource Management** notes the key issues that focus the Commission's programs and summarizes by Key Result Area the work program initiatives the Commission plans to undertake over the next three years.

LIST OF ACRONYMNS/ABBREVIATIONS

7Q10	7-day average, one-in-ten years
AA	Administrative Agreement
ACCC	Advisory Committee on Climate Change
ACWA	Association of Clean Water Administrators
AEMR	Annual Effluent Monitoring Report
AWRA	American Water Resources Association
AWWA	American Water Works Association
BLM	Biotic Ligand Model
BG	billion gallons
C&D	Chesapeake and Delaware (Canal)
CA2	Critical Area 2
CaCO3	calcium carbonate
CBOD	carbonaceous biochemical oxygen demand
CCMP	Comprehensive Conservation and Management Plan
cfs	cubic feet per second
CWMS	Corps Water Management System
CY	calendar year
CZM	Coastal Zone Management
D & R	Delaware and Raritan
DGS	Delaware Geological Survey
DNREC	Delaware Department of Natural Resources and Environmental Control
DO	dissolved oxygen
DOC	dissolved organic carbon
DRB	Delaware River Basin
DRB-PST	Delaware River Basin Planning Support Tool
DRBC	Delaware River Basin Commission
DRBRP	Delaware River Basin Restoration Program

DWCF	Delaware Watershed Conservation Fund
EFDC	Environmental Fluid Dynamics Code
EIC	Estuary Implementation Committee
EWQ	Existing Water Quality
EWS	Early Warning System
FAC	Flood Advisory Committee
FEMA	Federal Emergency Management Agency
FFMP	Flexible Flow Management Program
FY	fiscal year
GIS	Geographic Information System
GWPA	Groundwater Protected Area
HEC-HMS	Hydrologic Engineering Center - Hydrologic Modeling System
HUC	Hydrologic Unit Code
IBI	Index of Biological Integrity
ICWP	Interstate Council of Water Policy
IWA	International Water Association
IWAAs	Integrated Water Availability Assessments
KRA	Key Result Area
LNG	liquefied natural gas
MACC	Monitoring Advisory and Coordination Committee
mg/L	milligrams per liter
MGD	million gallons per day
mi	mile
MLR	multiple linear regression
mm	millimeters
MWh	megawatt hour
NBOD	nitrogenous biological oxygen demand
NFWF	National Fish and Wildlife Foundation
NGWMN	National Ground-Water Monitoring Network

NJDEP	New Jersey Department of Environmental Protection
NJWSP	New Jersey Water Supply Plan
NOAA	National Oceanic and Atmospheric Administration
NOAA-CSC	National Oceanic and Atmospheric Administration - Coastal Services Center
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
NWS	National Weather Service
NYC	New York City
NYSDEC	New York State Department of Environmental Conservation
ODRM	Office of the Delaware River Master
PADEP	Pennsylvania Department of Environmental Protection
PAFBC	Pennsylvania Fish and Boat Commission
PAS	Planning Assistance to States
PBDE	polybrominated diphenyl ethers
PCB	polychlorinated biphenyls
PEMA	Pennsylvania Emergency Management Agency
PFC	perfluorinated compound
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PMP	Pollution Minimization Plan
ppb	parts per billion
PPL	Pennsylvania Power and Light
PRM	Potomac-Raritan-Magothy (aquifer system)
PWS	Public Water Supply
RFAC	Regulated Flow Advisory Committee
REF-DSS	Riverine Environmental Flow - Decision Support System

RFP	Request for Proposal
RPP	Rules of Practice & Procedure
RSM	Regional Sediment Management
SAN	Schuylkill Action Network
SEF	Subcommittee on Ecological Flows
SEPA GWPA	Southeast Pennsylvania Groundwater Protected Area
SPW	Special Protection Waters
SRMP	Scenic Rivers Monitoring Program
STAC	Science and Technical Advisory Committee
TAC	Toxics Advisory Committee
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAUSP	Water Availability and Use Science Program
WLA	waste load allocation
WMAC	Water Management Advisory Committee
WPF	William Penn Foundation
WQAC	Water Quality Advisory Committee
WQM	Water Quality Management
WRP	Water Resources Program
WRRDA	Water Resources Reform and Development Act
WSCC	Water Supply Coordinating Council
WSSF	Water Supply Storage Fund
WTP	water treatment plant

TABLE OF CONTENTS

1. GENERAL STATEMENT OF CONDITIONS IN THE BASIN

Part I of the Water Resources Program is presented in five sections:

- **Section 1.1: Hydrologic Conditions: Brief Summary** is a summary of the hydrologic conditions in the Basin from July 1, 2019, through June 30, 2020.
- **Section 1.2: Water Use and Sufficiency** is a summary of water and groundwater withdrawal trends as well as surface and groundwater conditions in the Basin.
- **Section 1.3: Surface Water Quality** summarizes the most recent assessments of surface water quality in the Basin.
- **Section 1.4: Population and Land Use** summarizes population and land use trends based upon recent data.
- **Section 1.5: Emergent Issues** briefly describes emerging issues of concern.

1.1 HYDROLOGIC CONDITIONS: BRIEF SUMMARY

1.1.1 Rainfall

Throughout the Delaware River Basin (Basin), rainfall for the period from July 2019 through June 2020 ranged from approximately 33 inches to 58 inches. **Figure 1** presents the rainfall received in the Basin. Localized higher amounts occurred near Reading, Pa. Lower amounts occurred in the southern portion of the Basin near the estuary and in the area surrounding Port Jervis, N.Y., and the Neversink Reservoir.

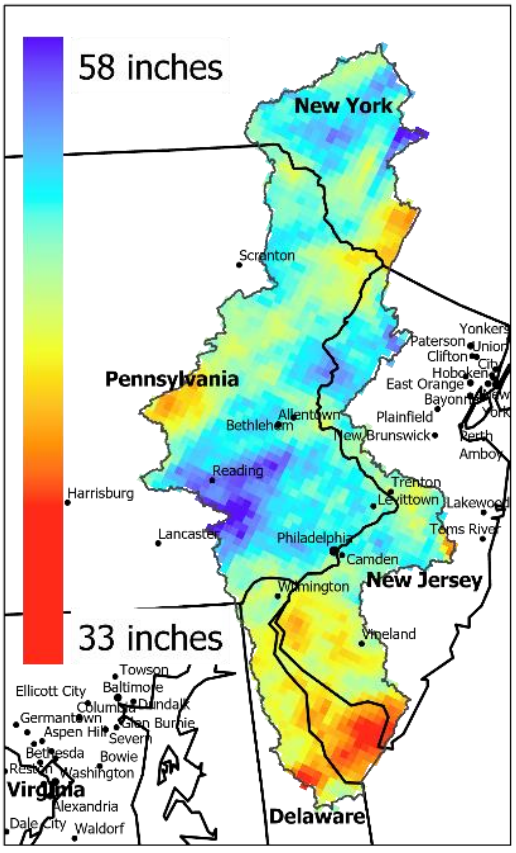


Figure 1

1.1.2 Reservoir Conditions and Management

Combined storage in the three New York City (NYC) reservoirs, located in the upper Basin, is presented in **Figure 2**. In July 2019, the combined storage was above the long term daily median value. The storage steadily decreased, passing below the median value in the middle of September 2019. The storage continued to decrease until October 14, 2019, at which the point the storage was approximately 50 billion gallons (BG) above drought watch levels. The storage then increased through the remainder of October, remained

steady through November 2019, and increased again in December 2019. In the first months of 2020, the storage remained level and then increased to 100 percent storage at the beginning of May 2020, which is typical. The storage then decreased and was below the daily median storage by the end of June 2020.

Releases from the three NYC Delaware River Basin (DRB) Reservoirs were made in accordance with the 2017 Flexible Flow Management Program (FFMP). The River Master directed releases from the NYC reservoirs to meet the Montague flow objective. The volume of water released for Montague was approximately 26 BG and occurred between August 3 and October 13, 2019. Releases for thermal mitigation and rapid flow change mitigation totaled 994 million gallons (MG) and 477 MG, respectively. Thermal mitigation releases were made for six multi-day events (17 days total) in July 2019 and early August 2019. Rapid flow change mitigation releases were made for two events in October 2019. Thermal releases also were made on nine days comprising three events in June 2020 and totaling approximately 254 MG.

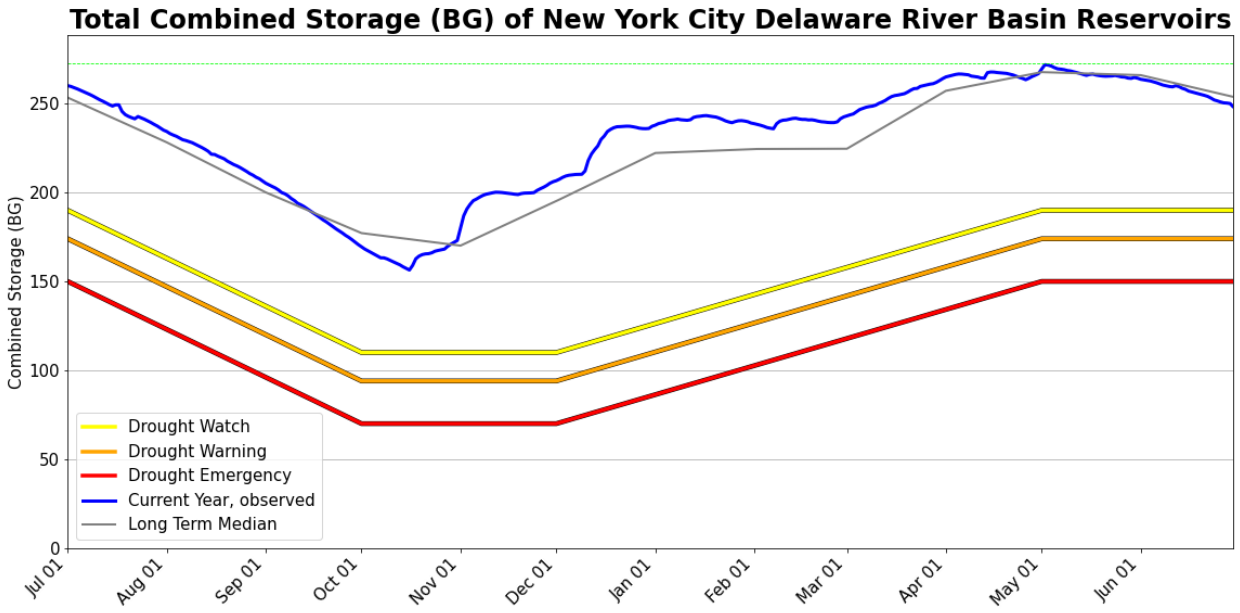


Figure 2

Releases of water from Beltzville Reservoir were made at DRBC's request on September 21 and 22, 2019, to support the Trenton Equivalent Flow Objective, using 0.148 BG of DRBC's Water Supply Storage. The releases were made in advance of requests for water from the Excess Release Quantity, a volume of water in the NYC reservoirs reserved for use by the lower Basin. A total of 1.3 BG was released at DRBC's request from the Excess Release Quantity for the Trenton Equivalent Flow Objective.

1.1.3 Groundwater Conditions

1.1.3.1 PENNSYLVANIA

Groundwater levels in five selected United States Geological Survey (USGS) county observations wells were used to represent Pennsylvania's groundwater conditions during July 2019 through June 2020. The individual wells were selected based on their geographic locations in the Pennsylvania portion of the DRB: Wayne County WN 64 (northern), Schuylkill County SC 296 (western), Lehigh County LE 644 (central), Bucks County BK 1020 (eastern), and Chester County CH 10 (southern).

In Wayne and Schuylkill Counties, the groundwater levels remained mostly within normal conditions for the period (**Figures 3** and **4**). At the end of the period, two large spring rainfall events caused two increases in groundwater levels. The levels were decreasing as the period finished in June 2020.

In Lehigh County, groundwater levels in July 2019 were above normal (**Figure 5**). Levels stayed above normal until March 2020, when levels became normal. At the end of June 2020, levels were decreasing.

In Bucks and Chester Counties, groundwater levels began above normal and decreased to normal conditions at the beginning of September 2019 (**Figures 6** and **7**). Groundwater levels at both wells remained within the normal ranges for the remainder of the period and showed a decreasing trend by the end of June 2020.

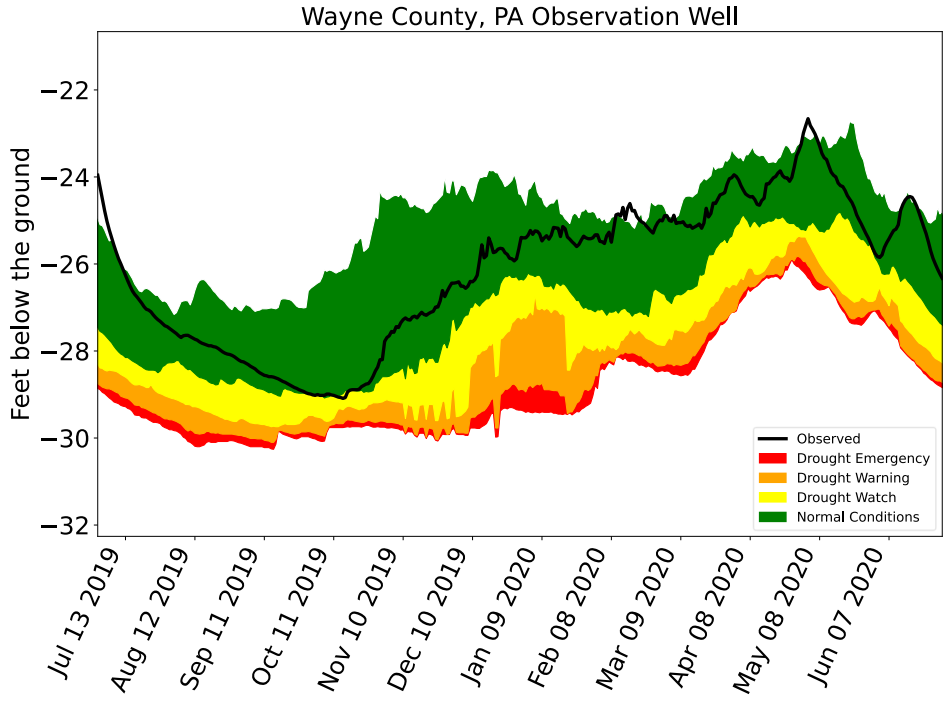


Figure 3

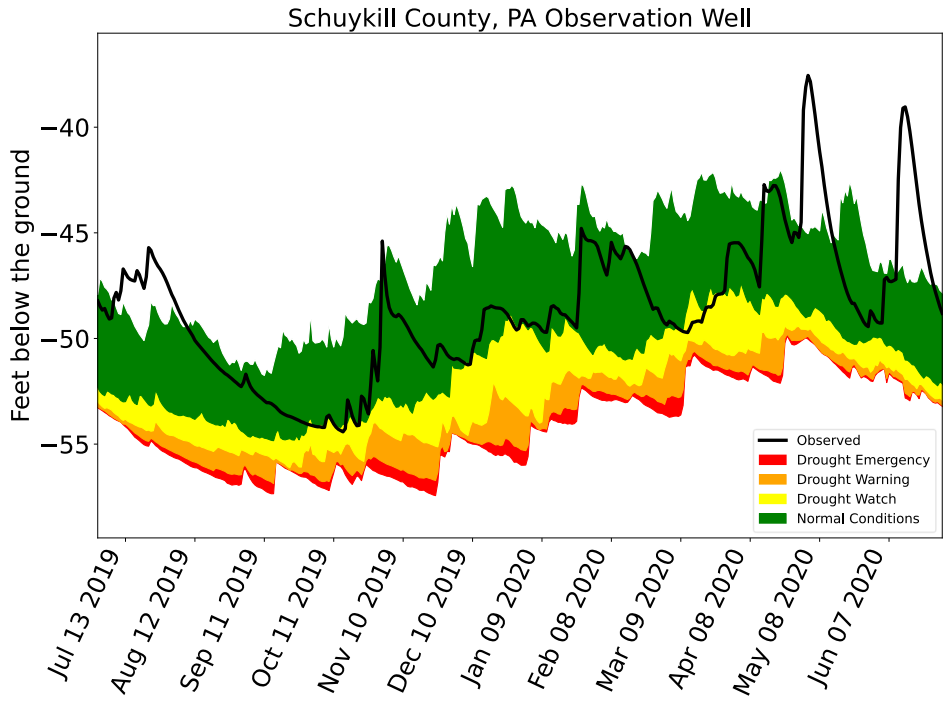


Figure 4

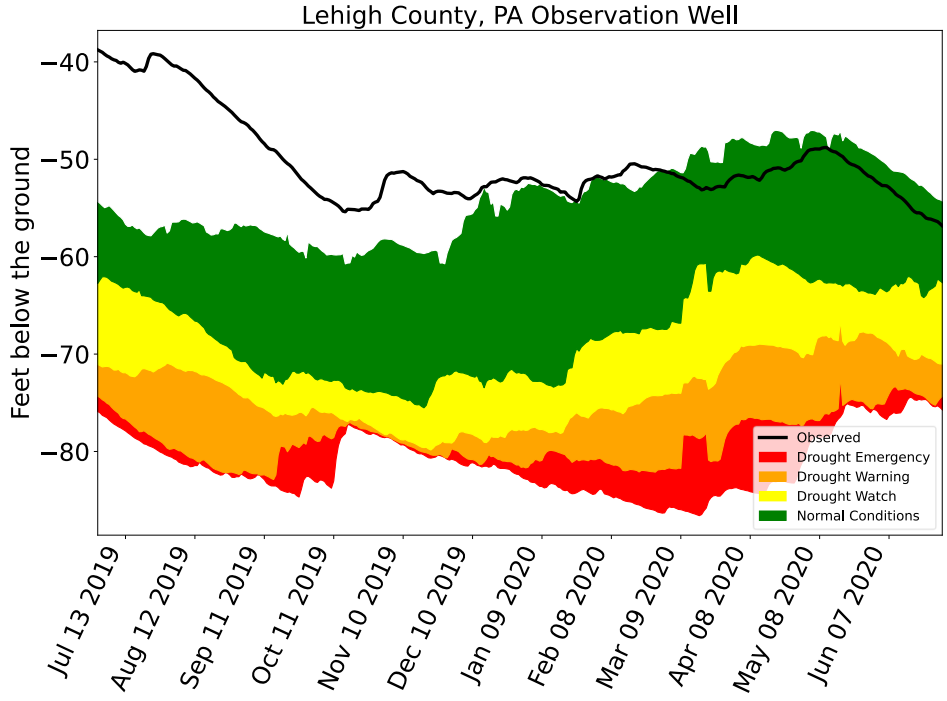


Figure 5

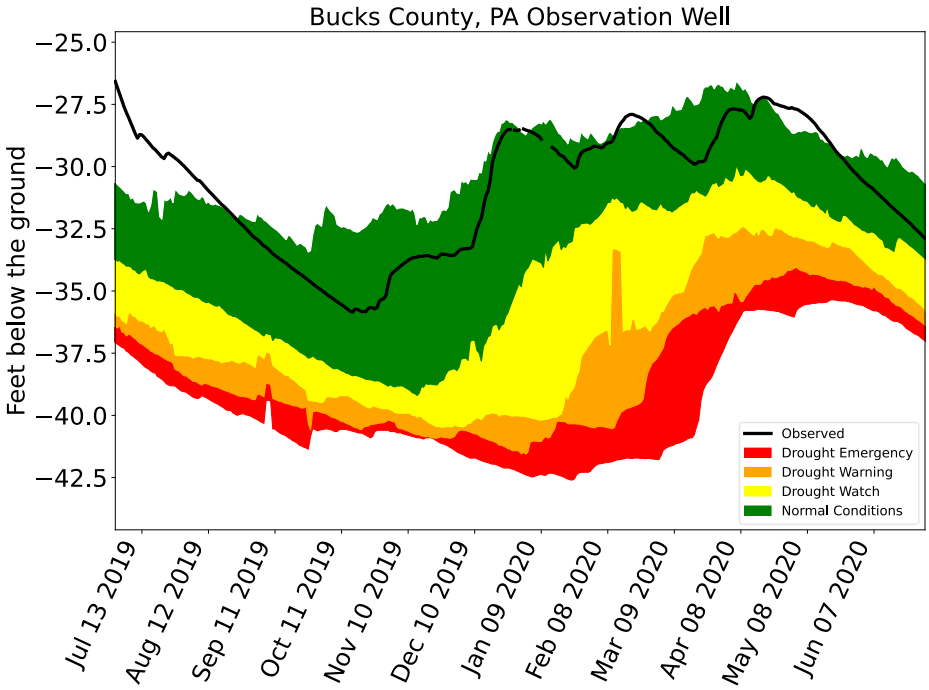


Figure 6

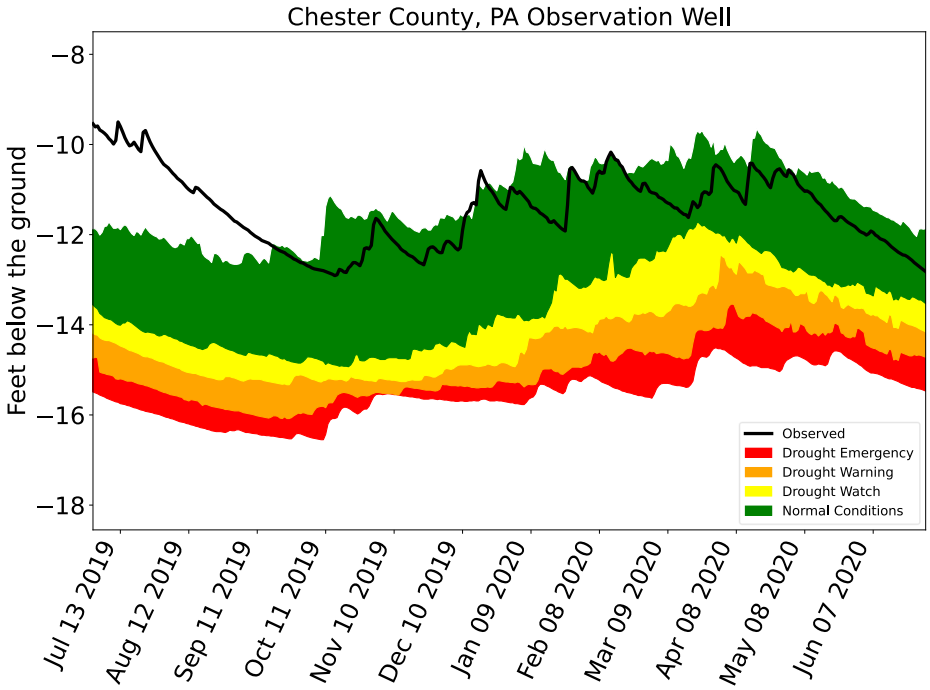


Figure 7

1.1.3.2 NEW JERSEY

The groundwater levels in Cumberland County, N.J., began July 2019 at above normal conditions (**Figure 8**). The levels then decreased into the normal range in the beginning of October 2019 and remained in normal conditions for the remainder of 2019 and the first half of 2020. At the end of June 2020, groundwater levels were decreasing into USGS defined drought watch levels.

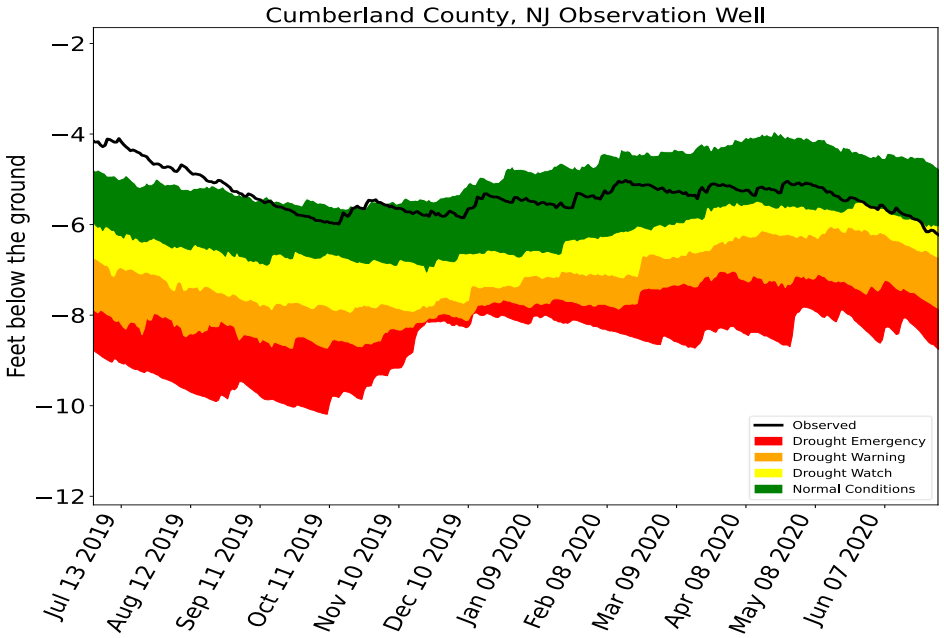


Figure 8

1.1.3.3 DELAWARE

Groundwater levels in New Castle County, Del., remained above the normal range until the middle of September 2019 (**Figure 9**). The groundwater then continued within the normal range for the remainder of the year. The levels were below the monthly median values between December 2019 and May 2020. In June 2020, the groundwater levels were beginning to decrease below the normal range.

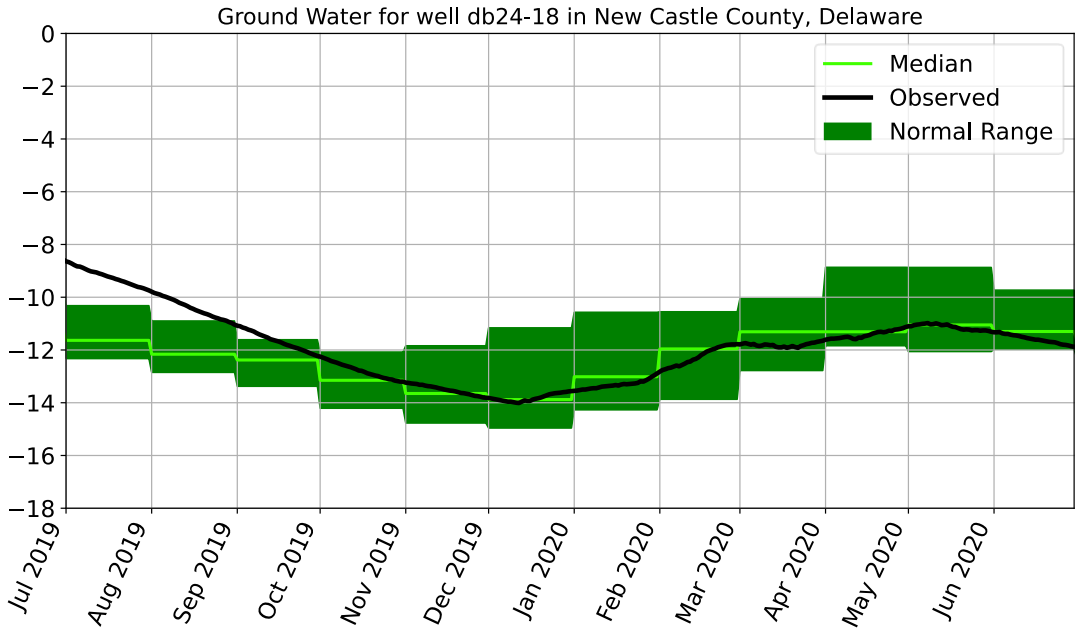


Figure 9

1.1.3.4 NEW YORK

The groundwater well at Woodbourne, N.Y., was chosen to represent the upper Basin (**Figure 10**). In July 2019, levels were decreasing below the median value but stayed within the normal range. In November 2019, the levels increased above the daily median but again stayed within the normal range. The groundwater levels rose above normal twice in 2020: once in February and again in April through the middle of May. In June 2020, levels decreased below the normal range and continued to trend downward at the end of the month.

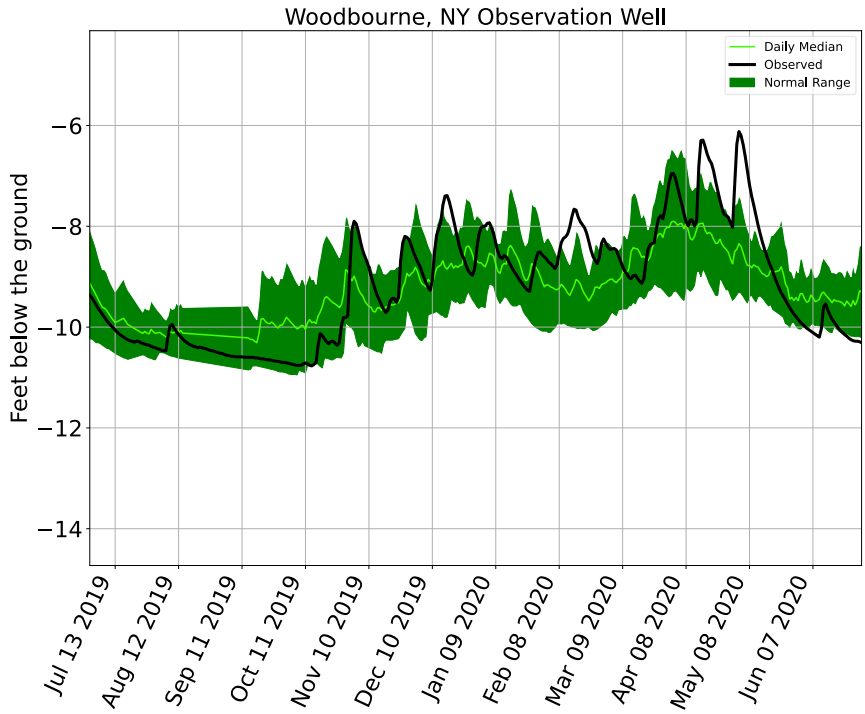


Figure 10

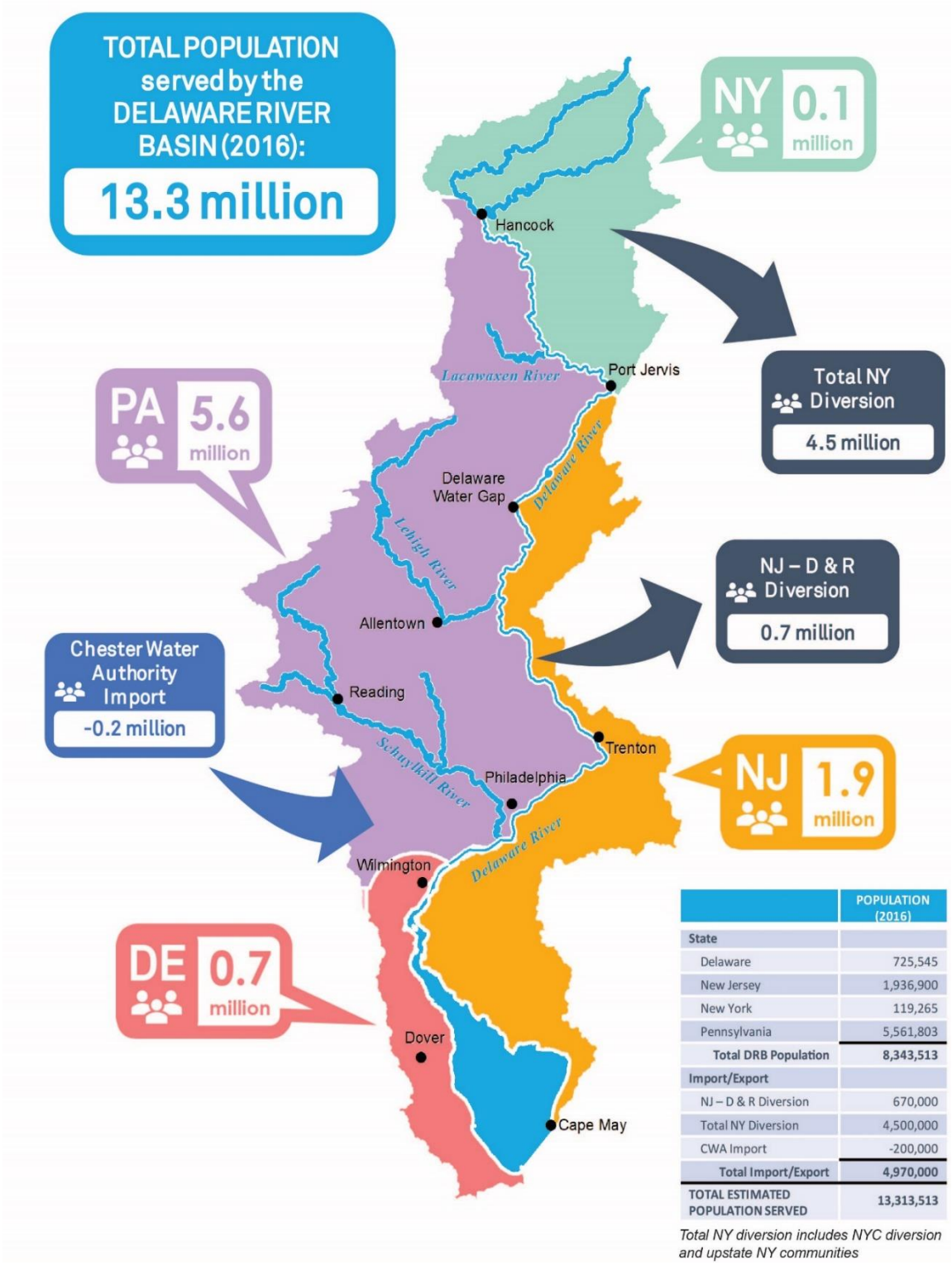
Daily, weekly, quarterly, and annual summaries of hydrologic conditions[1] in the Basin – including precipitation, streamflow, reservoir storage, groundwater levels, and the river mile location of the 7-day average 250 mg/l chloride concentration – are provided on the DRBC website.

1.2 WATER USE AND SUFFICIENCY

1.2.1 Population Served

The Delaware River Basin (DRB) provides water to portions of the four states located in the Basin: New York, New Jersey, Pennsylvania, and Delaware. As of 2016, the total population served by DRB water is estimated at 13.3 million. The total population served includes those within the Basin boundaries as well as populations of the Basin states located outside of the DRB, which are served through exports. Estimates of population served through exports are based on daily use by "equivalent" populations outside the Basin. Although water from the Basin is mixed with other sources for New York City, the "equivalent" population served for New York City is estimated by multiplying the DRB portion of the water supply by the 2016 population. A summary of the data below is presented graphically in **Figure 11**.

[1] https://www.nj.gov/drbc/programs/flow/hydrologic-reports.html



	POPULATION (2016)
State	
Delaware	725,545
New Jersey	1,936,900
New York	119,265
Pennsylvania	5,561,803
Total DRB Population	**8,343,513**
Import/Export	
NJ – D & R Diversion	670,000
Total NY Diversion	4,500,000
CWA Import	-200,000
Total Import/Export	**4,970,000**
TOTAL ESTIMATED POPULATION SERVED	**13,313,513**

Figure 11. Population estimates for 2016 in the Delaware River Basin by state.

1.2.2 Water Withdrawals and Trends

Understanding water withdrawals, water use, and supply is integral to the management of water resources. In recent years, our understanding of the ways in which water is withdrawn and used has improved greatly, as have the underlying systems in place to manage the data, meaning that more timely and comprehensive assessments can be made. **Figure 12** shows the Basin-wide picture of water withdrawals, exports, and consumptive use, by sector, based on 2018 calendar year water use data; the data shown represent daily average withdrawals.

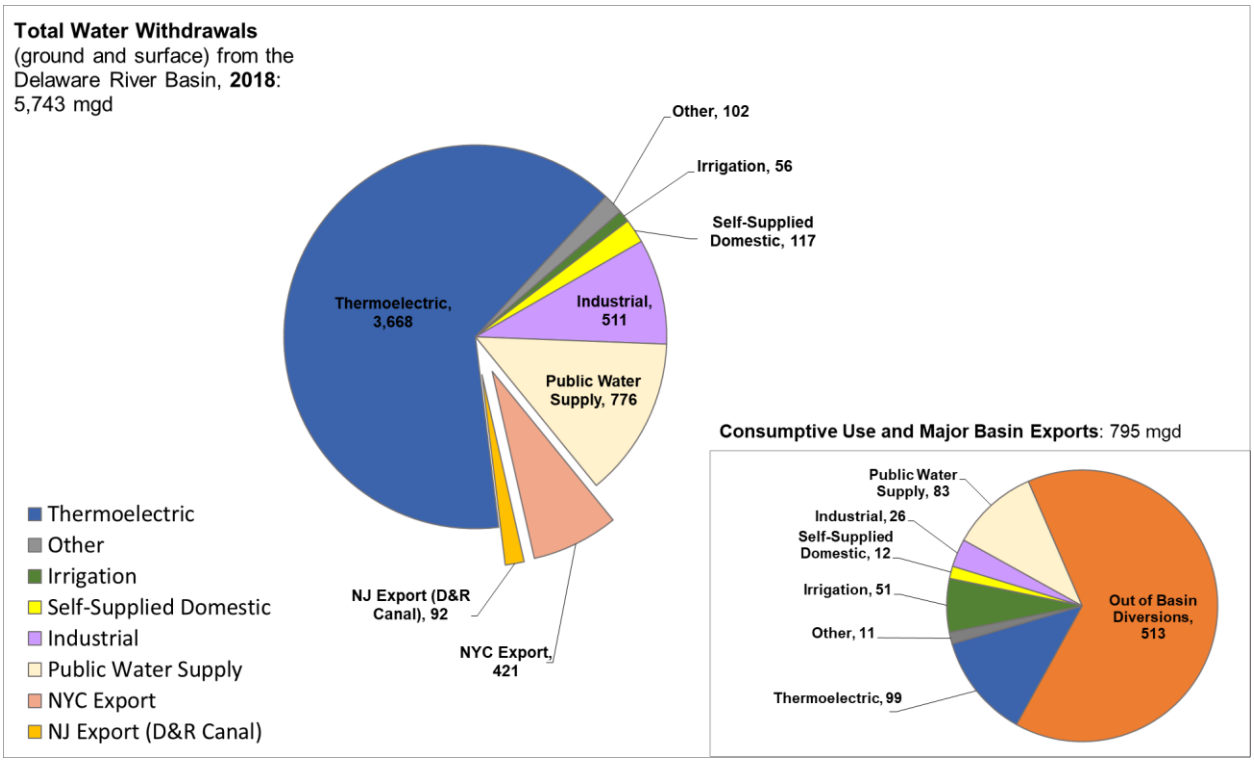


Figure 12. Total Water Withdrawals and Consumptive Use / Major Exports from the Basin in 2018. Note that self-supplied domestic estimates from other reporting years have been used as more recent data were not readily available Additionally, data from the hydroelectric power sector is not presented as it is known to be incomplete.

Key Delaware River Basin Water Use Facts:

- Based on 2016 data, an estimated 13.3 million people rely on water from the Basin for their daily water needs (see Part I - Section 1.2.1). Approximately 8.3 million people live in the Basin, and the volume of exports to New York City and northeastern New Jersey is sufficient to supply water to an additional 5 million people;
- Based on 2018 data, ground and surface water withdrawals from the Basin total 5,743MGD (excluding data from the hydroelectric power generation sector);
- Major Exports from the Basin total 513 MGD;

- Consumptive Use in the Basin is 282 MGD;
- Approximately 95% of all water used in the Basin is obtained from surface waters; and
- Three dominant use sectors account for over 80% of total water withdrawals; these sectors are thermoelectric power generation ("Thermo," 64%), public water supply ("PWS," 13.5%), and industrial use ("Industrial," 9%).

DRBC closely tracks withdrawals and water use in the three, dominant water-using sectors. Current data for these key sectors extends through calendar year 2018 and provides a monthly time series of data spanning a period of over 20 years. Although **Figures 13** and **14** contain data gaps, an overall pattern and trend in water withdrawals and consumptive use is apparent. The public water supply sector displays a slight decreasing trend in total water withdrawn as well as water consumptively used; this is primarily attributed to the influence of conservation practices neutralizing population increases. The industrial sector displays a historically decreasing trend with some fluctuations, likely the result of facilities entering or exiting the industrial sector. The thermoelectric sector displays an overall decreasing trend in total water withdrawals with an increasing trend in consumptive use.

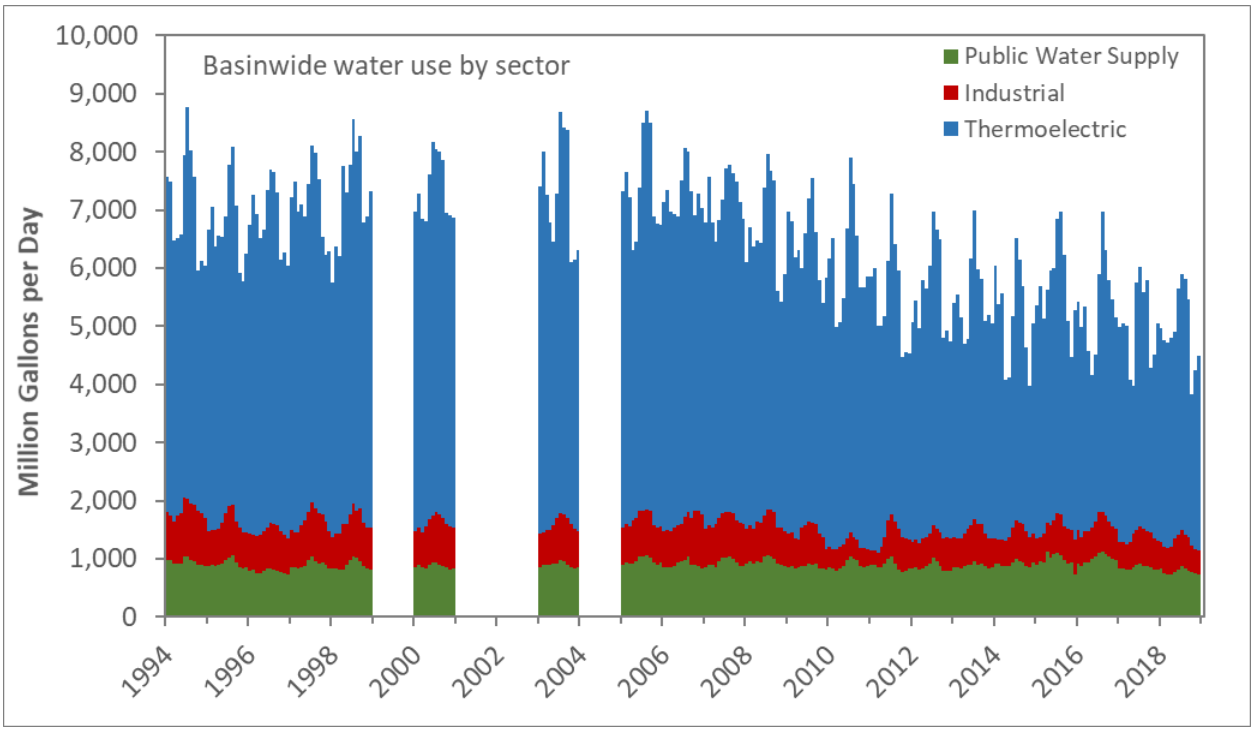


Figure 13. Monthly water withdrawals for three key sectors in the Delaware River Basin. No data are shown for months where data were incomplete to avoid visually skewing trends.

1.2.3 Cumulative Thermoelectric Withdrawals and Consumptive Use

Water withdrawals for thermoelectric power generation are primarily used for cooling purposes. The cooling process is typically achieved by either highly evaporative cooling towers or a once-through cooling (OTC) process that uses a condenser to absorb heat. The two types of cooling use water in different ways. Evaporative cooling towers require a smaller volume of withdrawal but consume most of the water (typically >90% consumptive use). Once-through cooling requires much greater volumes of water at the intake, but the rate of loss to evaporation is very small (typically <1%). A decline in withdrawals for thermoelectric power generation over the past several years is evident in **Figure 13** and is a result of plant closings, or decreased production, at facilities with OTC systems.

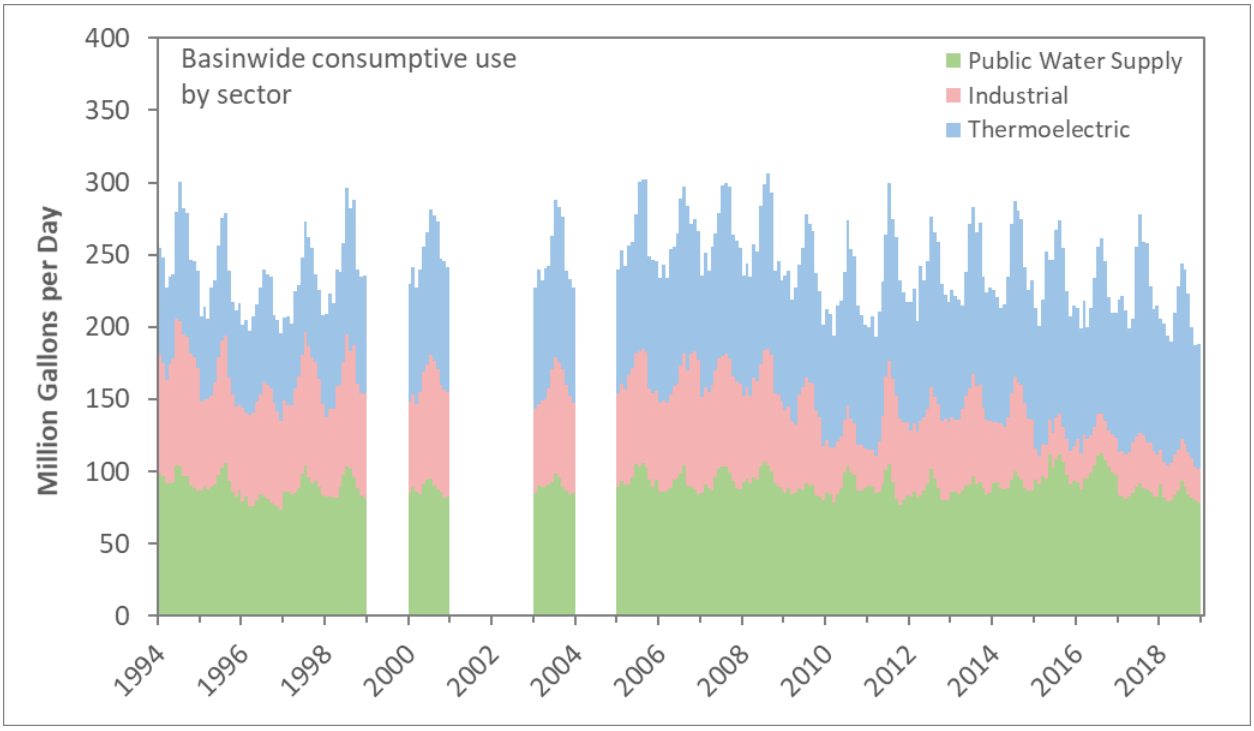


Figure 14. Monthly consumptive water use for three key sectors in the Delaware River Basin. No data are shown for months where data were incomplete to avoid visually skewing trends. Public water supply uses a standard consumptive use factor, whereas the thermoelectric sector uses site-specific calculated consumptive use factors. The industrial sector uses site-specific consumptive use factors starting in CY2015.

However, the need for energy production in the Basin continues and other (smaller) facilities have come online. New facilities largely use evaporative cooling, which withdraws a lesser volume of water but evaporates a greater percentage of the withdrawal. **Figure 15** shows the resulting increasing trend in consumptive water use, despite a decrease in overall water withdrawn for the thermoelectric power generating sector.

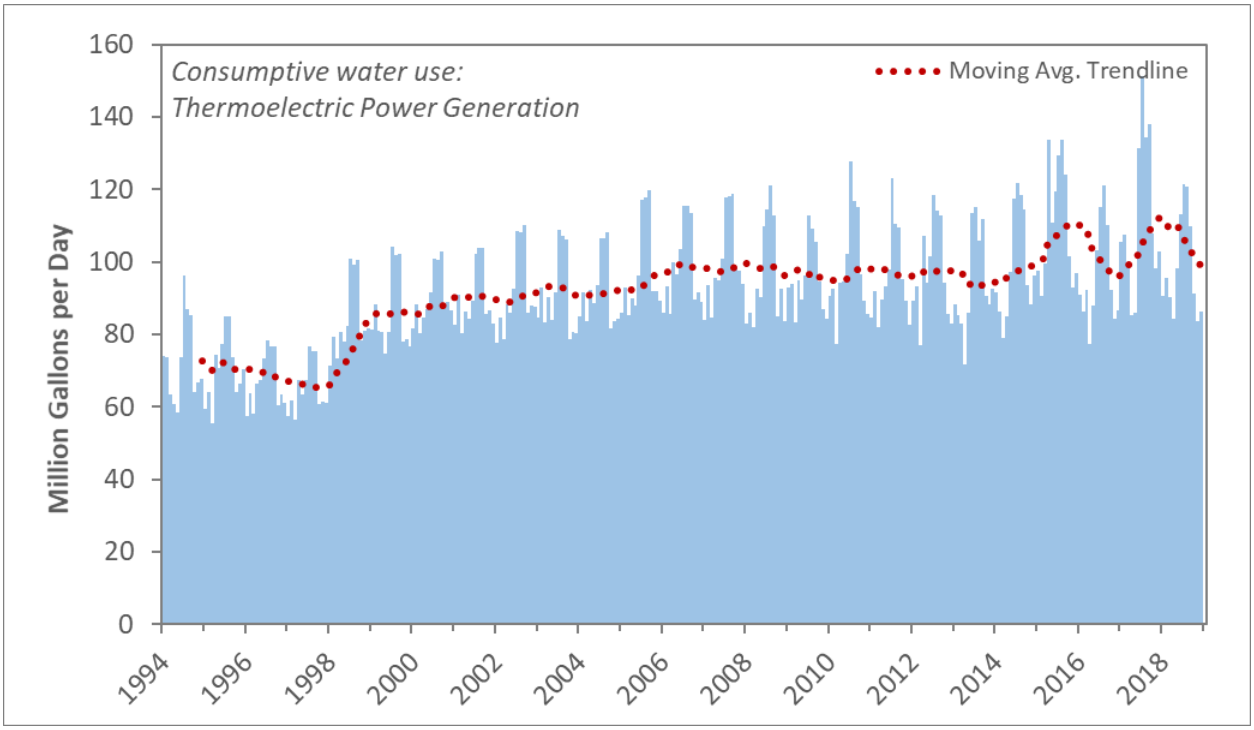


Figure 15. Trend in monthly consumptive use for thermoelectric power generation in 1994-2018. The trendline is calculated as a 12-month moving average.

1.2.4 Public Water Supply Withdrawals

Historic data for public water supply (PWS) withdrawals show a slightly decreasing trend (see **Figure 16**) largely driven by water conservation measures in the form of changes in plumbing codes, enacted in the early 1990s, which require use of more efficient plumbing fixtures and fittings. In addition, education and awareness of water conservation practices have played a role in decreasing water use for this sector despite increases in population (shown by the red line in **Figure 16**). While slightly decreasing in the aggregate, withdrawals have increased in several systems where there are population growth regions (*i.e.*, where water conservation practices cannot offset the more rapid increase in population). Over the past 30 years, DRBC has been a leader in enacting regulations to promote water conservation in the areas of source and service metering, leak detection and repair, plumbing fixtures and fittings, and water rate structures. The trend shown in **Figure 16** indicates that these regulations have been successful and have contributed to the trends in PWS water withdrawals. **Figure 16** also shows the consumptive use portion (light green) of the total withdrawals; the non-consumptive portion (dark green) reflects those volumes returned to the Basin after withdrawal. (Note that DRBC does not track

consumptive use data for the public water sector, but rather uses a Basin-wide “consumptive use factor” of 10% for public water supply systems.)

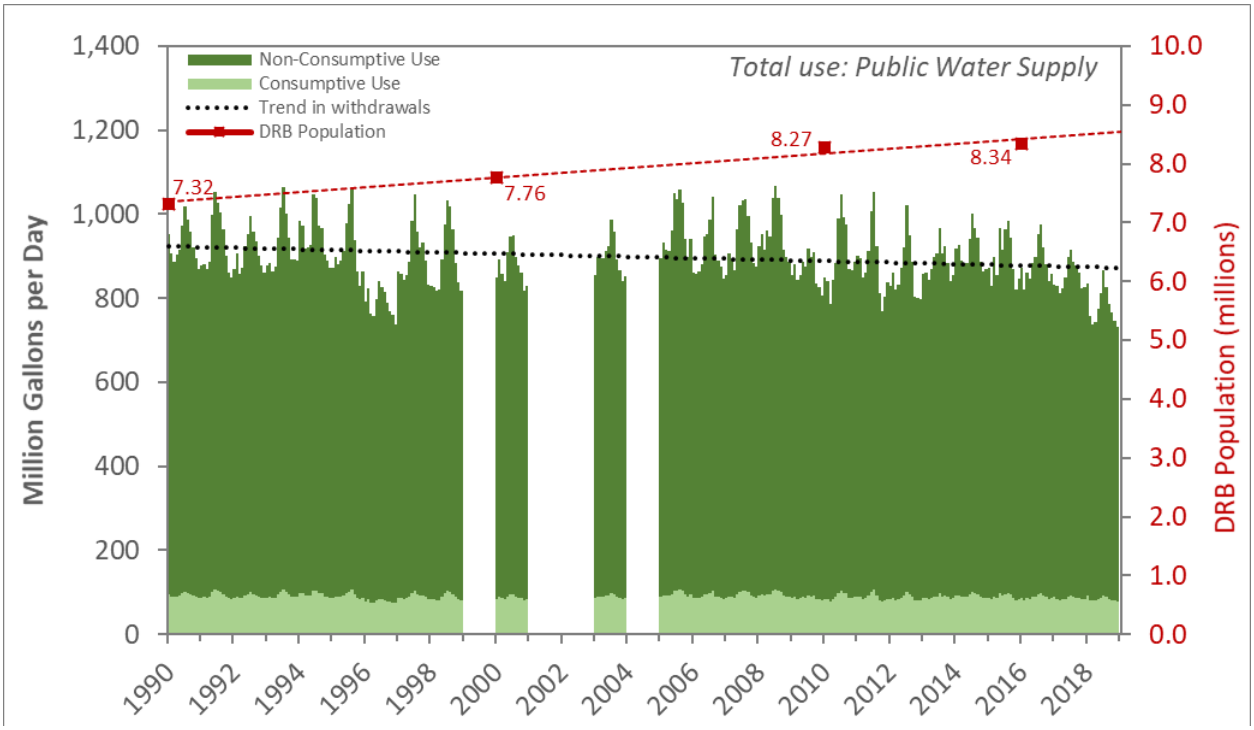


Figure 16 Monthly withdrawals of public water systems in the Delaware River Basin 1990-2018. No data are shown for months where data were incomplete to avoid skewing trends. The population values are reflective of the population residing within the Basin boundary, not the population served.

In 2009, as part of DRBC’s effort to ensure its regulations reflect the latest thinking in the field of water efficiency, the Commission amended its Comprehensive Plan and Water Code to implement an updated water audit approach to identify and manage water loss in the Basin, in partnership with Basin water purveyors. The approach is consistent with the International Water Association (IWA) and American Water Works Association (AWWA) Water Audit Methodology and is considered a best management practice in water loss control. The revised regulations require PWS systems to conduct an annual water audit to help identify water losses, particularly water lost due to leaky infrastructure. DRBC performed multiple outreach efforts, and the audit became a mandatory requirement in 2012. Nearly three hundred water audits were available for analysis for Calendar Year (CY) 2018. Collectively, the audit data indicate that approximately 798 MGD of water was put into distribution systems in the Delaware River Basin. *Non-revenue water* is a key term used in the AWWA water audit methodology to quantify water losses and unbilled water consumption. Non-revenue water is water that has been treated and pressurized and enters the distribution system but generates no revenue for the water purveyor. Water losses can be real losses (through leaks, also referred to as physical losses) or apparent losses (for example, through theft or metering inaccuracies). Based on the CY2018 reported data, an estimated 164 MGD was reported as physically lost from distribution systems in the DRB along with an estimated 28 MGD reported as apparent losses and 21 MGD of unbilled authorized consumption for a total

of 213 MGD of non-revenue water reported in CY2018. This non-revenue water has an estimated annual value of $126 million to water utilities in the DRB and represents a significant opportunity to improve the efficiency of public water supply in the Basin. **Figure 17** shows a summary of the 2018 results of data collection under the DRBC water audit program.

Data collection under the DRBC's water audit program marks a significant step in a long-term effort to improve water efficiency and promote best practices in water loss control for Basin water purveyors. As the program progresses, continued emphasis will be placed on ensuring that water purveyors build confidence in the data submitted in the water audit. Developing and providing accurate data to the water audit process will result in a clearer understanding of the causes of water loss and is a vital first step in the process. Furthermore, the water audit emphasizes the importance of calibrating source meters to ensure accurate measurement of water withdrawn. This also helps improve the accuracy of reported withdrawals of water to state agencies and DRBC for use in other water use studies and assessments. It is anticipated that a focus on this issue will result in an improved efficiency of public water supply systems, saving both water resources and money.

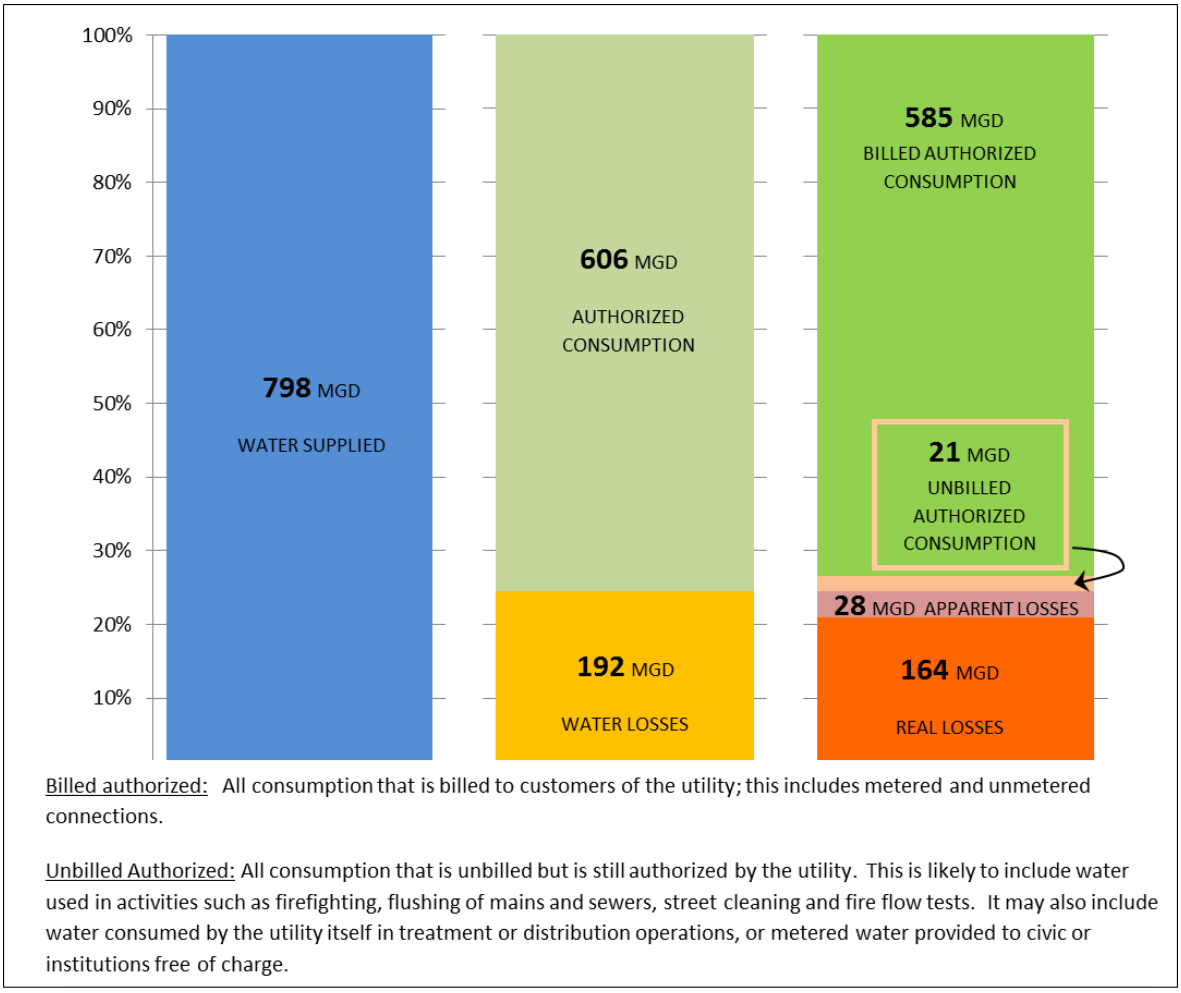


Figure 17. DRBC water audit program summary (CY2018); aggregate of 294 individual water system audits.

1.2.5 Industrial Withdrawals

Historic data for industrial withdrawals show a decline from levels in the early 1990's (**Figure 18**). The closing of the Bethlehem Steel plant in Bethlehem, Pa., in 1995 contributed significantly to the overall decline in water use for this sector as it was the Basin's largest industrial water user. Over the past decade, industrial water use has declined slightly despite numerous facilities changing hands. Several large refineries in the Basin have experienced ownership turnover in recent years. Refineries that were idle are once again in production and have returned to more normal operations with water withdrawal data returning to previous levels. As an example, the large drop in water use observed near 2010 is primarily attributed to a period of temporary closure of a major refinery.

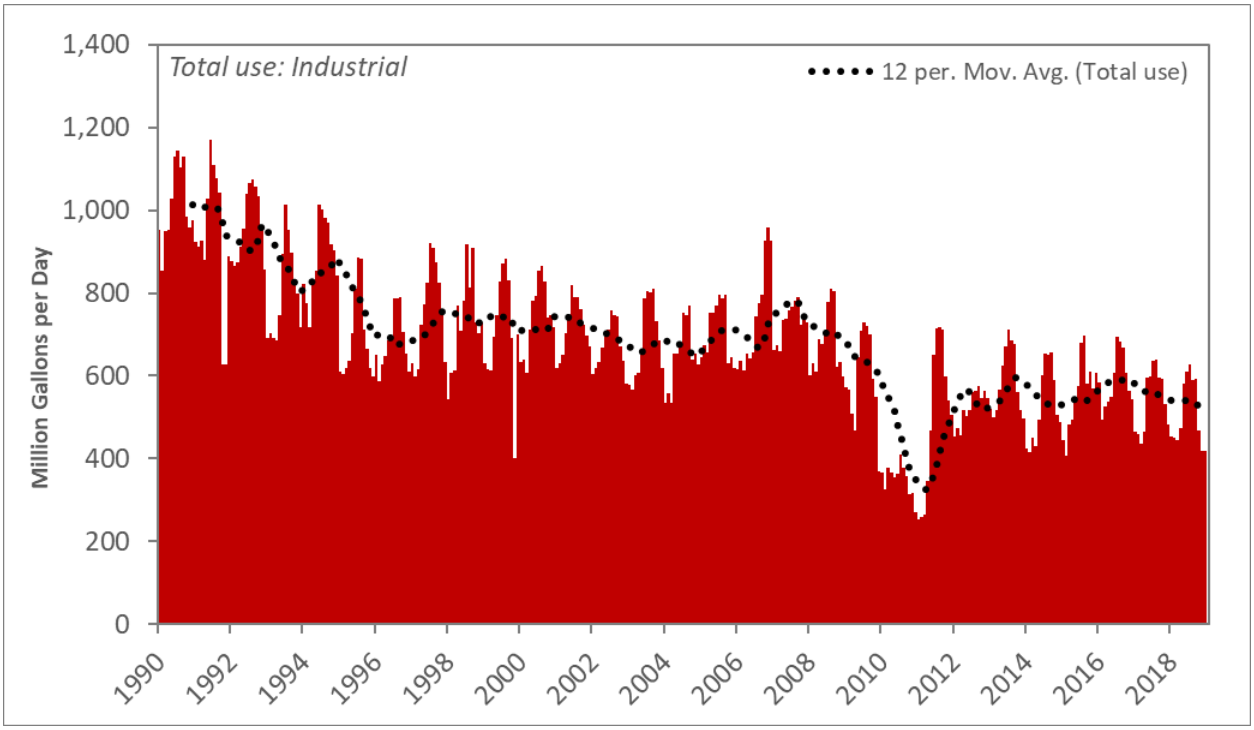


Figure 18. Monthly industrial water withdrawals 1990 – 2018. The trendline is calculated as a 12-month moving average.

1.2.6 Seasonal Variation in Withdrawals and Consumptive Use

The monthly data, shown in **Figures 13**, **14**, **15**, **16**, and **18**, highlight the extent to which water withdrawals and consumptive uses vary seasonally. Thermoelectric power generation experiences peaks in the summer months as a consequence of increased power demand for residential and commercial cooling. Simultaneously, public water suppliers experience peak demands in the summer months when lawn-watering and other outside uses are greatest. This highlights the need for including accurate seasonal (peak) considerations—including ecological (instream) needs—in long-range supply sufficiency assessments.

1.2.7 Ecological (Instream) Flow Needs

Water supply planning in the Basin generally has not taken into account the instream flow needs of aquatic communities principally due to a scarcity of specific quantitative information, especially regarding the relationship of flow to ecological needs. Understanding instream flow needs is important to protect key ecological communities for the range of habitats in the Delaware River Basin and may be informative for the Commission to plan to meet future water needs for all uses. In December 2013, the Commission and The Nature Conservancy (TNC) completed a year-long study[2] on Basin-wide ecosystem flow recommendations for subwatersheds of the Delaware River (DRBC, 2013a). The resultant recommendations may be an important component in future policy development.

1.2.8 Conditions in Special Groundwater Management Area

Two areas of the Basin are included in special management programs to mitigate historical groundwater supply issues and prevent future stress. The Commission manages the Southeast Pennsylvania Groundwater Protected Area (SEPA GWPA) on behalf of the Commonwealth of Pennsylvania, and New Jersey manages Critical Area 2 in the Potomac-Raritan-Magothy (PRM) aquifer system in southwestern New Jersey (**Figure 19**).

[2] https://www.nj.gov/drbc/library/documents/TNC_DRBFlowRpt_dec2013.pdf

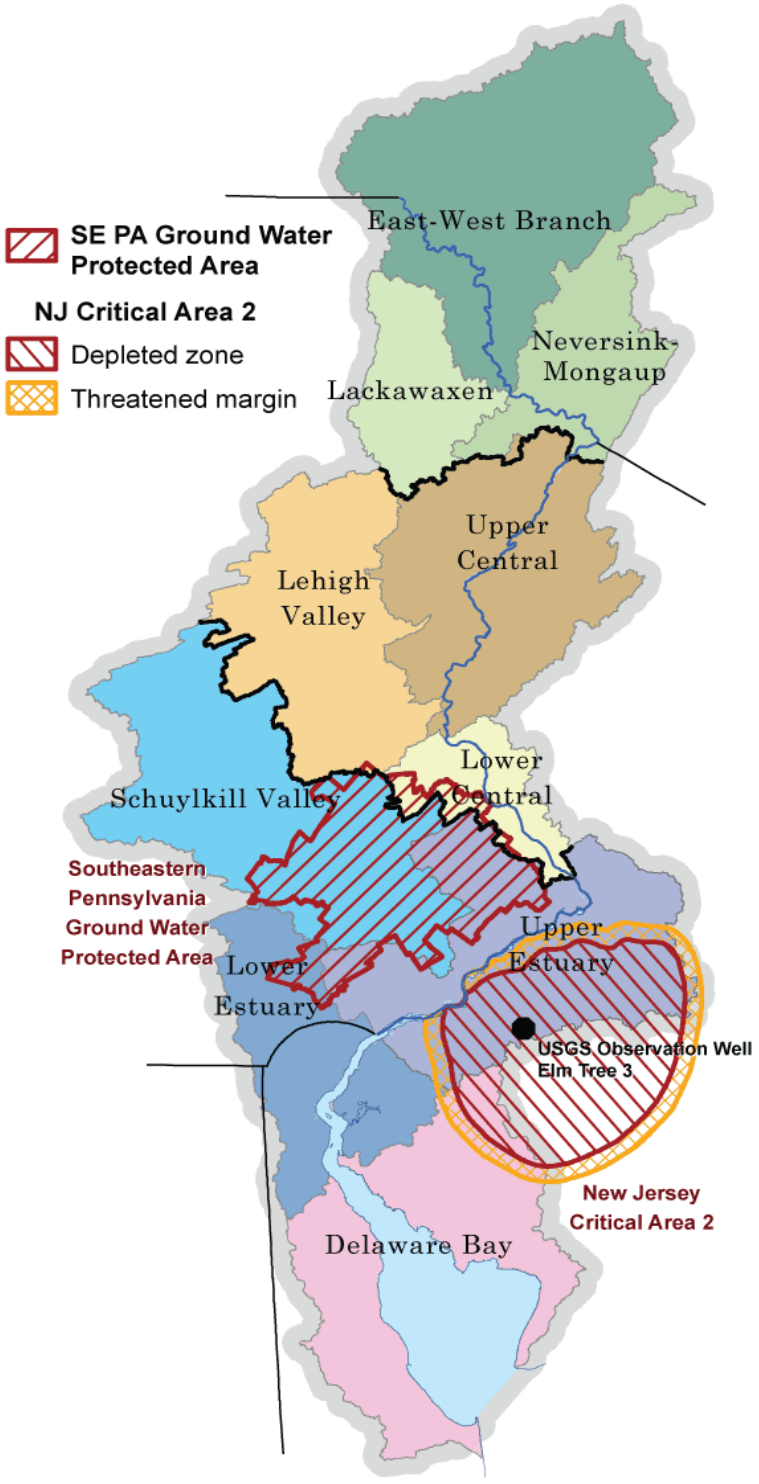


Figure 19. Groundwater Management Areas in the Delaware River Basin.

1.2.8.1 SOUTHEAST PENNSYLVANIA GROUNDWATER PROTECTED AREA

The SEPA GWPA is an area of 1200 square miles that includes 76 basins closely managed by DRBC regarding groundwater withdrawals, well interferences, and municipal water supply planning. Withdrawal limits have been established for each of the basins. The following summary of conditions is based on an analysis by DRBC using groundwater withdrawal data provided by the PADEP.

Presently, cumulative allocations in some SEPA GWPA basins exceed the recommended basin withdrawal limit (**Figure 20**). In order to plan for future development and an increased demand on groundwater resources, basin stress determinations will be made based on docket and SEPA GWPA permit allocations. The Commission will continue to update basin usage with current PADEP water withdrawal data and continue to lower cumulative docket/permit allocations to below their respective basin withdrawal limits.

As highlighted in **Figure 20**, use in five (5) basins is currently between 50.1% and 75% of their subbasin withdrawal limits. One (1) basin is between 75.1% and 100% of its withdrawal limit. One (1) basin is above its withdrawal limit, that is greater than 100.1%. Basin 29 (Schuylkill-Crow Creek) has historically been above its withdrawal limit because a major withdrawal from a quarry reservoir is counted as a groundwater withdrawal by PADEP. Additionally, a second basin (Basin 4; Doylestown Subbasin Neshaminy Creek) has historically vacillated between non-stressed, potentially stressed and above the withdrawal limit. Most of the change in water use in Basin 4 is attributable to the Eureka Stone Quarry. For any new withdrawal in a “potentially stressed” basin, SEPA GWPA regulations provide alternative programs geared toward increasing the groundwater recharge to the underlying formation or that conserve overall groundwater use.

Over the period from 2000 to 2018, cumulative groundwater use in the SEPA GWPA has decreased (**Figure 21**). This is likely partially attributable to improved water conservation, as noted above, and due to infrastructure changes, notably the Point Pleasant, Pa., diversion of surface water from the Delaware River to offset groundwater use by communities in Bucks and Montgomery counties. **Figure 21** shows groundwater withdrawal data provided by the PADEP covering the years 1987 through 2018. The groundwater withdrawal data reported in the graph are from facilities that submitted data to the PADEP.

DRBC has an automated dashboard[3] of groundwater surface elevations in the SEPA GWPA which is available on the DRBC website.

[3] https://www.drbc.net/Sky/sepagwpa.htm

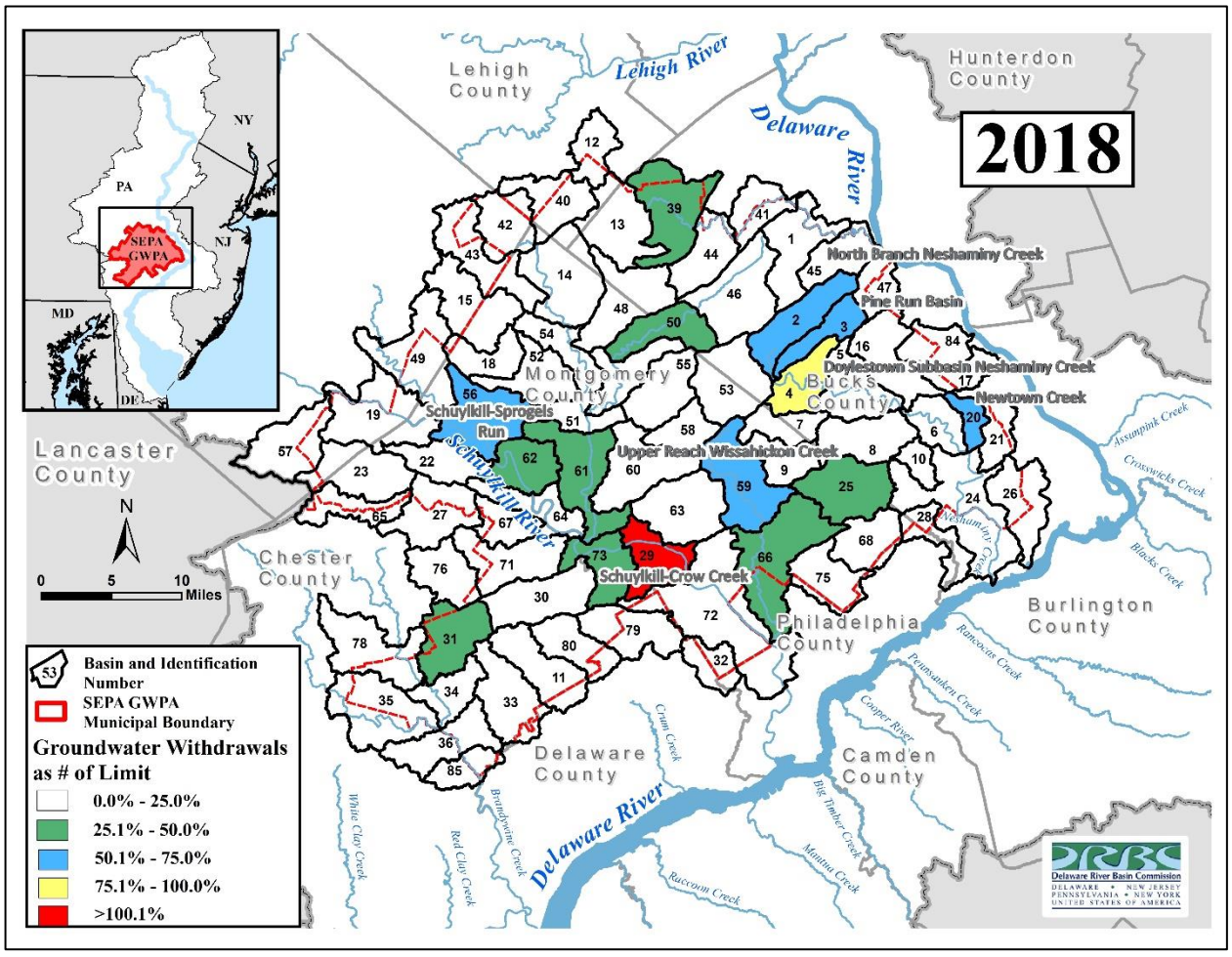


Figure 20. Five (blue) basins are currently between 50.1% and 75% of their annual withdrawal limits; one (yellow) basin is currently between 75.1% and 100.0% of its withdrawal limit; and one basin (red) is greater than 100.1% of its withdrawal limit, where a major withdrawal from a quarry reservoir is counted as a groundwater withdrawal by PADEP.

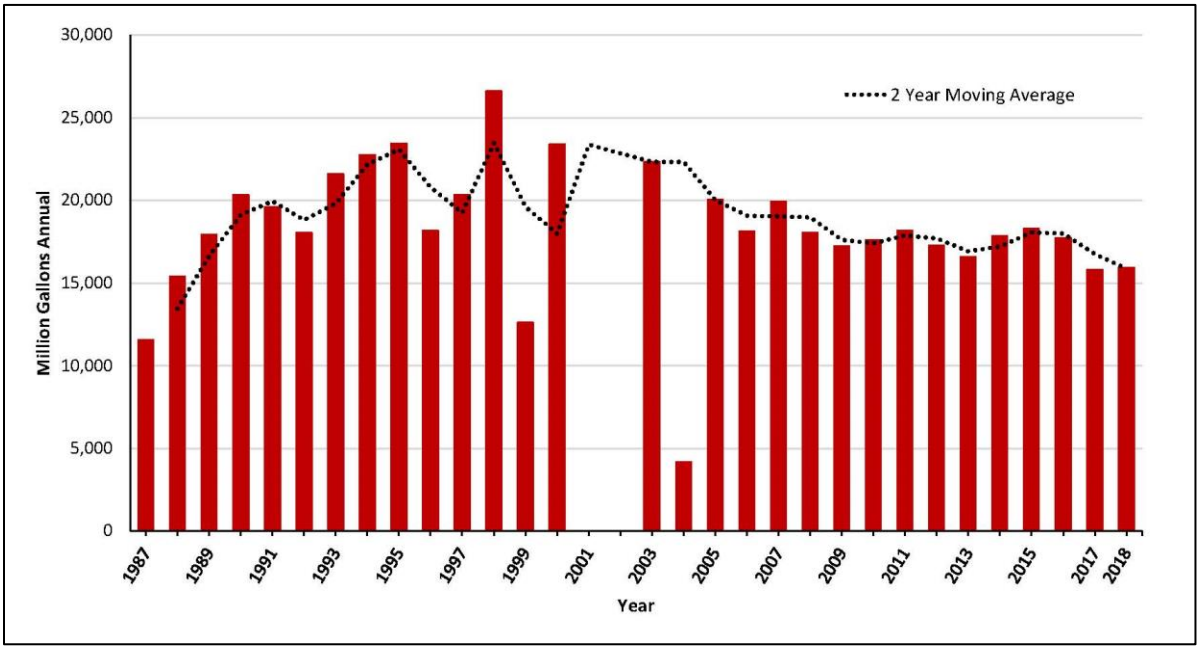


Figure 21. Withdrawals in the SEPA GWPA from 1987-2018 show slight reductions in the period from the late-1990s to 2018.

1.2.8.2 NEW JERSEY CRITICAL AREA 2

The New Jersey Department of Environmental Protection (NJDEP) and USGS regularly monitor groundwater levels in the affected aquifers of Critical Area 2 (CA2) in southern New Jersey, and assessments indicate that withdrawals have significantly decreased beginning with the program's inception in 1996 (**Figure 22**), resulting in concurrent rebounding of groundwater levels in most monitoring wells (**Figure 23**). The surface water diversion/treatment facility on the Delaware River in Delran, Burlington County, N.J., owned and operated by the New Jersey American Water Company, was chosen as the regional water supply alternative for Critical Area 2. The Tri-County Water Supply Project remains the primary water source to meet growing water demands in the region. The downward trend that is visible in **Figure 22** is primarily the result of major infrastructure improvements to allow areas that were previously solely reliable on local Potomac-Raritan-Magothy (PRM) withdrawals to tap into the regional solution of the Delaware River Tri-County project, which is primarily a surface water withdrawal. In addition, water conservation and indoor plumbing efficiencies, as well as economic and business trends, add to the overall downward trend in water withdrawals.

DRBC has an automated dashboard[4] of groundwater surface elevations in Critical Area 2 which is available on the DRBC website.

[4] https://www.drbc.net/Sky/nj2.htm

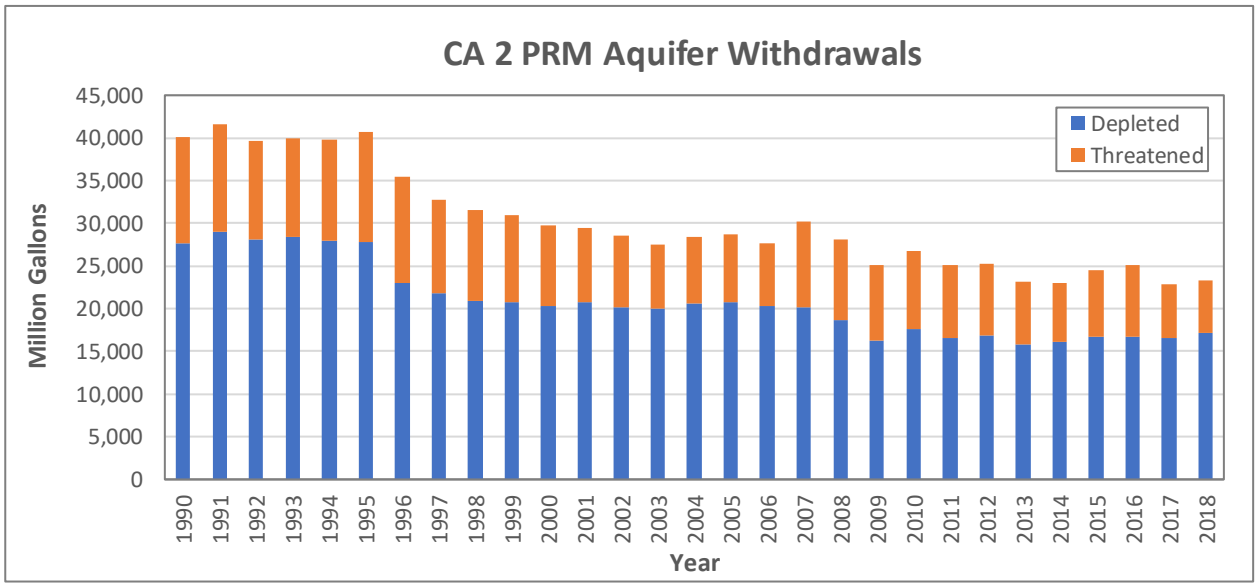


Figure 23. Withdrawals from the PRM 1990-2018 show significant reductions since the inception of Critical Area 2 management in 1996. Source: I. Snook, NJDEP, March 2021.

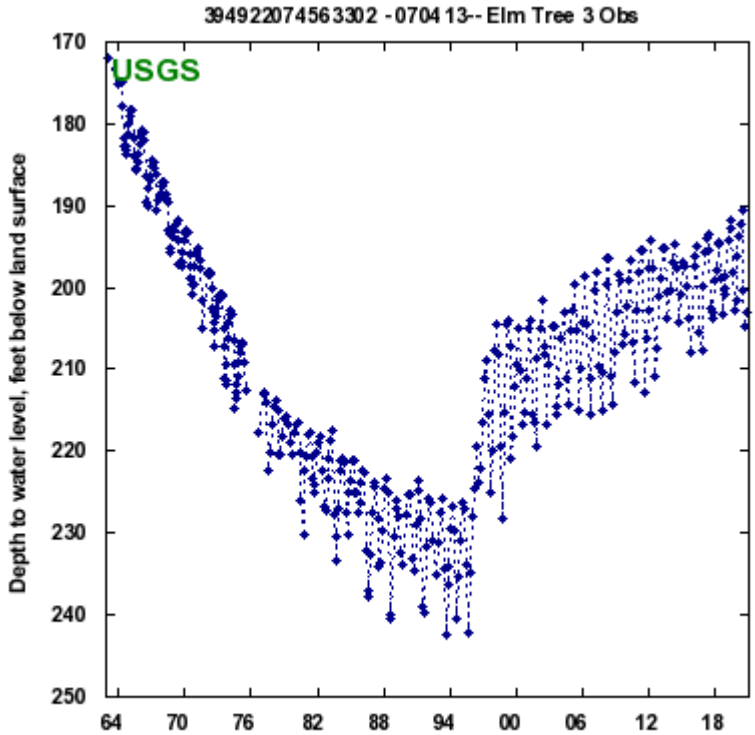


Figure 22. Example of rebounding groundwater levels in the upper PRM of NJ Critical Area 2 since program inception in 1996. Elm Tree 3 observation well Burlington Co., NJ. Period of record shown (02/22/1963 – 09/29/2020). Source: USGS, March 2021.
(https://groundwaterwatch.usgs.gov/awlSites.asp?S=394922074563302)

1.2.9 Areas of Concern: PRM and Bayshore Watersheds

The 2007 report of a multi-year investigation by the U.S. Army Corps of Engineers (USACE or Corps) concluded that groundwater withdrawals in northern New Castle County, Del., were reducing local stream base flows and forming cones of depression. Pumping in Delaware is increasing groundwater flow from Maryland and decreasing flow into New Jersey by about 10% each, and regional pumping has created overlapping cones of depression across the study area of the three states (USACE, 2007).

1.2.9.1 DELAWARE

Critical water resource issues in the Rancocas, Piney Point, Cheswold, Federalsburg, Frederica, and Columbia aquifers of Kent County, Del., have driven state capital funding for a multi-year program in Delaware. The program's goal is to improve groundwater monitoring and includes the collection of detailed, baseline hydrologic information to inform near-term (*e.g.*, 10 year) management options (see **Figure 24**). Monitoring wells were installed and equipped with water level sensors in multiple aquifers at 10 sites, and two rounds of groundwater quality sampling of these wells have been completed. Two USGS stream gaging stations have been re-activated. In 2019 initial results of this effort were published[5] by the Delaware Geological Survey (DGS, 2019). A focused monitoring effort is underway to study the Columbia aquifer in the east Dover area where increased pumping for irrigation and the City of Dover are causing concerns for increased drawdown and saltwater intrusion. In this area, salinity sensors were installed in 14 wells, five streams, and two groundwater fed irrigation ponds and are providing information on the duration, intensity and frequency of saline water incursion. The project is a collaborative effort of the DGS, Delaware Department of Natural Resources and Environmental Control (DNREC), the Governor's Water Supply Coordinating Council (WSCC), and the USGS. It is providing critical information on salt-water intrusion and groundwater quality conditions, yields, and pumping interactions to improve planning and provide options for managing growing water demand and sea-level rise in this region.

1.2.9.2 NEW JERSEY CRITICAL AREA 2

NJDEP released the New Jersey Water Supply Plan (NJWSP) 2017-2022[6] in October 2017, which improves the management and protection of the state's water supplies. The plan is a critical document which emphasizes the need to balance traditional water use with water resource protection, while outlining a range of policy options to achieve that balance amid an array of competing interests and issues. The 2017-2022 NJWSP differs from preceding plans as it is designed to allow for continuous technical and policy updates, as ongoing water resource evaluations, water use data, and more refined water demand projections become available. Using the NJWaTr Database, which is used to determine water budgets for the 151 HUC11 watersheds existing throughout New Jersey and to evaluate confined aquifer and surface water reservoir diversion rates, the state's future water supply planning efforts will be streamlined. In coordination

[5] https://www.dgs.udel.edu/publications/ofr53-kent-county-groundwater-monitoring-project-results-subsurface-exploration

[6] https://www.state.nj.us/dep/watersupply/pdf/wsp.pdf

with the extensive surface water, groundwater and drought monitoring systems and assessment tools, water supply planning at this scale represents significant advancements from those provided in previous frameworks. NJDEP signed a 10-year Flexible Flow Management Program in October 2017 which allows New Jersey to maintain and allocate a Delaware and Raritan Canal diversion of 80 mgd during declared drought emergency. Additionally, the agreement called for a study to be conducted to evaluate the further increase in the diversion during drought. This diversion plays a critical role in meeting New Jersey's current and future water supply needs, while enhancing water system resiliency in the Central, Coastal North, and Northeast drought regions of New Jersey. NJDEP reports that saltwater intrusion is currently being observed in several observation wells located along the Delaware Bay in the Cohansey and Estuarine Sand Aquifers in Lower and Middle Townships in Cape May County. In response to increasing chloride concentrations in a public supply well located approximately 2 miles to the east of the Delaware Bay and completed in the Cohansey Aquifer, NJDEP reduced allowable withdrawal rates in the well and initiated an investigation into the saltwater intrusion in the area. Recent hydrogeologic and water quality data suggest eastward migration of salty water from the Delaware Bay towards pumping centers, thus threatening the ability of those wells to meet demands. A slight increase in chloride concentrations over time was noticed in two other production wells located in the vicinity of the abovementioned production well. The New Jersey Geologic and Water Survey (NJGWS), in cooperation with local water purveyors, has collected hydrogeologic and water quality data to help clarify the saltwater intrusion issue in the area. Although the zone of saltwater contamination in the Cohansey and Estuarine sand aquifers is delineated along the Delaware Bay, it is difficult to trace the movement of saltwater inland at this time, and more studies are needed. Local water purveyors have been collecting monthly groundwater elevations and quarterly water-quality data (sodium and chloride concentrations) in the established network of observation and production wells for the past five years. These data have been used as part of NJDEP's efforts to effectively manage the water supplies of Cape May County.

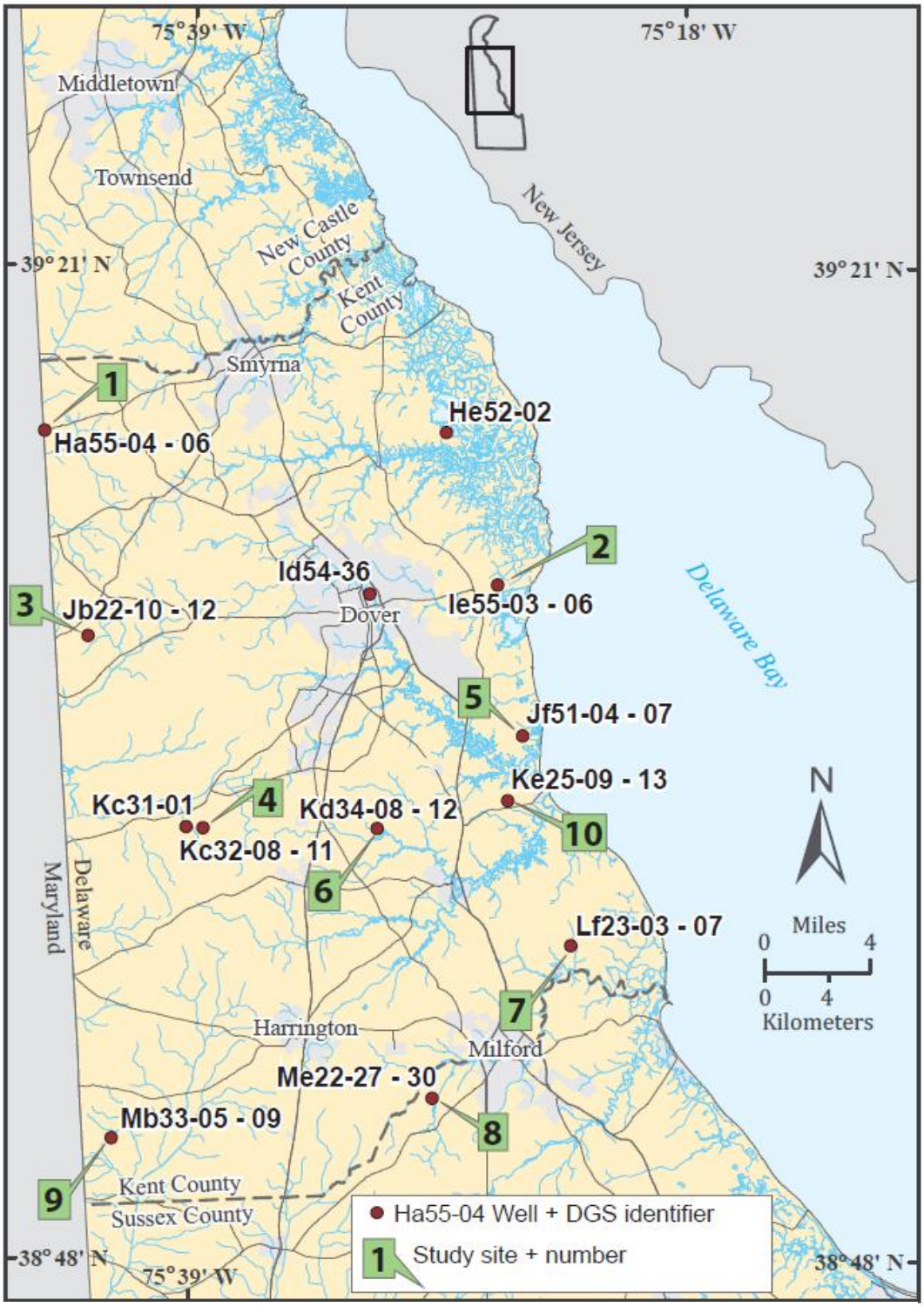


Figure 24. Monitoring sites for Groundwater and Saline Water Intrusion Monitoring Network Infrastructure Improvements: Kent County, Delaware. Source: S. Andres, DGS, Nov. 2019.

1.2.9.3 BAYSHORE SUPPLY ALTERNATIVES

A limited number of water supply alternatives are available for this area. Non-critical, confined aquifers are one option, but these may be limited depending on the magnitude of the diversion (*e.g.*, Piney Point, Mt. Laurel-Wenonah) or by water quality problems (*e.g.*, salt water in the Mt. Laurel-Wenonah). New Jersey American Water's tri-county pipeline, originally developed as an alternative source of water for the stressed municipalities in Critical Area 2, has now been extended through much of Gloucester County, including Logan, Harrison, East Greenwich, Woolwich, Pitman, and Elk Townships.

1.2.10 National Groundwater Monitoring Network

The National Ground-Water Monitoring Network (NGWMN) is a consortium of state and local agencies and the USGS that was established to create a single point of access for scientists, engineers, policy makers, and the public to view and acquire important physical and chemical data on the nation's groundwater resources. NJDEP has contributed data to the NGWMN since 2011. Its network consists of 150 shallow wells designed to provide information on three land uses (urban, agricultural, and undeveloped) and are monitored for 177 analytes on a three-year cycle. DGS became a data provider in early 2016. The network will ultimately allow users to view groundwater data across state lines to observe trends in groundwater quality and availability in a local, regional or national context. NGWMN[7] resources are managed by the USGS Center for Integrated Data Analytics and can be accessed online.

1.2.11 General Statement of Basin Supply Sufficiency

Under normal hydrologic conditions, and in accordance with current DRBC drought management plans and docket requirements (conservation releases, pass-by flows, consumptive use replacement, etc.), there is an adequate supply of water to meet flow objectives, in-Basin water withdrawal demands, and out-of-Basin diversions. Under below normal hydrologic conditions and corresponding low stream flows (*e.g.*, 7-day average, one-in-ten-years (7Q10)), in-Basin water withdrawal demands, flow objectives, and out-of-Basin demands can most likely be met. Under a repeat of the drought of record, analyses indicate that current streamflow objectives at Montague and Trenton, N.J., and current out-of-Basin diversions under the DRBC drought management plans, can most likely be met under existing flow management plans, water demands, and other conditions. Potential changes in in-Basin withdrawal demands and flow objectives, climate change, and sea level rise are currently being evaluated to assess future water supply sustainability.

Furthermore, groundwater in both New Jersey Critical Area 2 and the SEPA Groundwater Protected Area remains under close scrutiny, and conjunctive use of surface water is both recommended and, in some locations, necessary. More in-depth analysis and investigation is needed to provide a detailed forecast of supply adequacy during a repeat of the drought of record, under modified operating restrictions, or under different climatic conditions. The Commission

[7] http://cida.usgs.gov/ngwmn/

proposes over the next three years to prepare a supply assessment under various scenarios and make recommendations for a Sustainable Water Future through 2060.

in 2011, the USACE highlighted potential structural inadequacies in the Blue Marsh and Beltzville Reservoirs. The inadequacy is related to the placement of fill between the impervious core and filter drain, which is no longer aligned with Corps design requirements. The dams are considered safe but in need of rehabilitation when federal funds become available, The DRBC was a sponsor of both projects and pays joint use costs for water and storage in the reservoirs. During low flow and drought conditions, DRBC directs releases in excess of the conservation releases from these reservoirs to support the flow objective in the Delaware River at Trenton. DRBC pays the annual debt service and a portion of operation and maintenance costs. The DRBC funds these costs through revenue generated from the water supply charging program.

1.3 SURFACE WATER QUALITY

1.3.1 Surface Water Quality Assessment

Two major water quality assessments describe the water quality of the Delaware River Basin: the *2019 State of the Basin* and the *2020 Delaware River and Bay Water Quality Assessment Report* (Water Quality Assessment). These two reports complement each other by utilizing different approaches to assess water quality (see **Table 1**). During the second quarter of 2020, DRBC completed the 2020 Water Quality Assessment. That report was finalized and posted on the Commission's web site in November 2020.

Table 1. Comparison of Water Quality Assessment Reports

Comparison	2019 State of the Basin	2020 Delaware River and Bay Water Quality Assessment
Evaluation Method	Use of Indicators	Compare observations to DRBC Criteria
Assessment	Current status, long term trends, future predictions	Supporting or not supporting designated uses
Term	Expanded data window for current status, full period of record for long term trends	5-Year data window
Extent	Entire basin	Mainstem Delaware River only

1.3.2 State of the Basin 2019: Water Quality

The Water Quality chapter of the State of the Basin 2019 report provides an assessment of water quality indicators for the entire Basin, with special emphasis on the estuary. The State of the Basin differs from, and complements, the 2020 Water Quality Assessment, in that it focuses on metrics for which no criteria have been developed and evaluates long term trends. The State of the Basin 2019[8] is available on the DRBC website (DRBC, 2019).

1.3.3 2020 Delaware River and Bay Water Quality Assessment

The Water Quality Assessment (previously called the Integrated Assessment) performed by DRBC focuses on the mainstem Delaware River, comparing observations to water quality criteria to determine whether water quality is sufficient to support designated uses as described in the Water Code. Designated uses for the Delaware River include: Aquatic life, Public Water Supply, Recreation, Fish Consumption, and Shellfish Consumption, although not all uses are designated in all water quality zones (see **Figure 25**). Assessments to determine support of the designated uses of the Delaware River are reported in the 2020 Delaware River and Bay Water Quality Assessment[9], which is available on the DRBC website (DRBC, 2020b).

[8] https://www.nj.gov/drbc/library/documents/SOTBreport_july2019.pdf

[9] https://www.nj.gov/drbc/library/documents/WQAssessmentReport2020.pdf

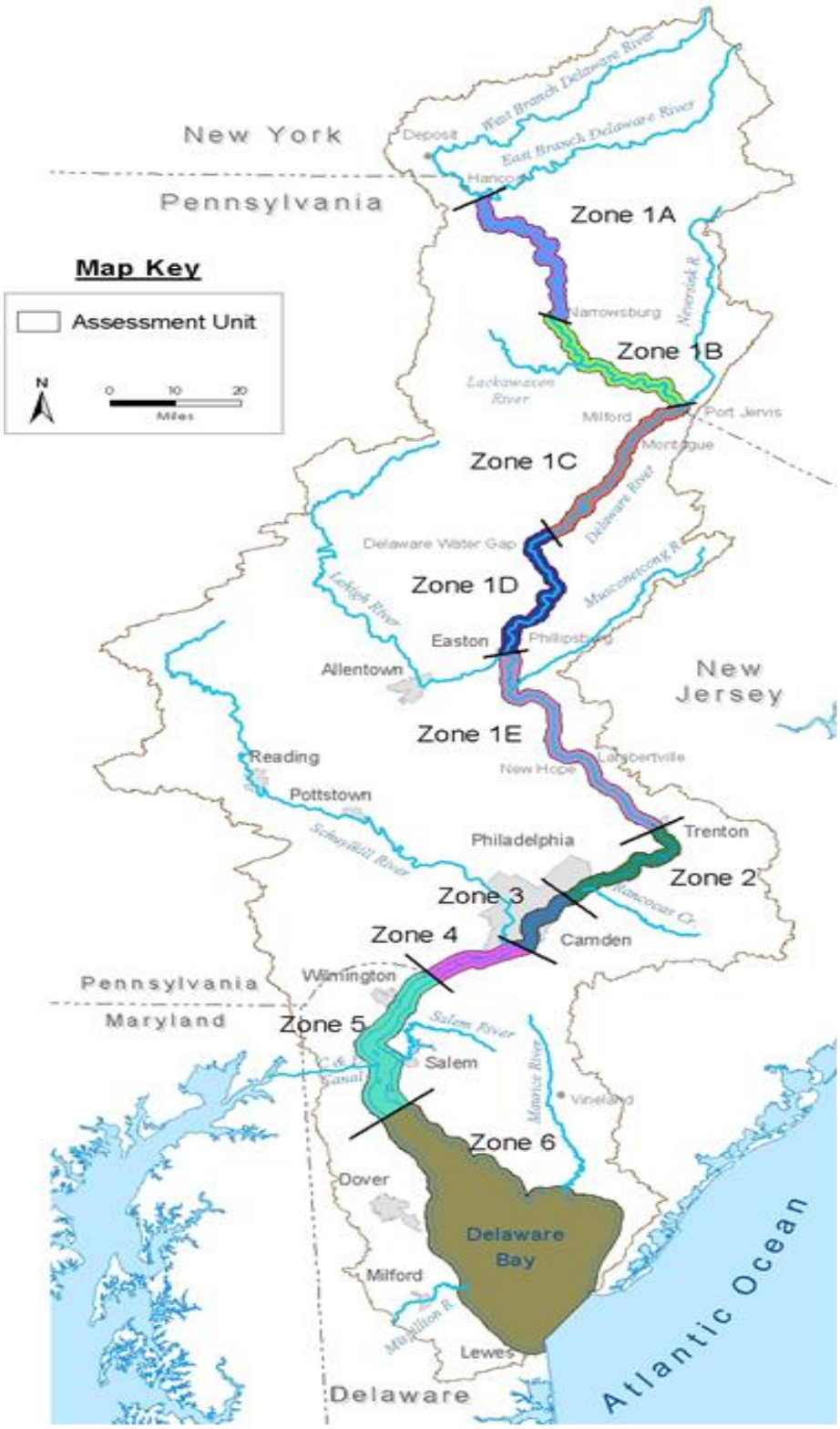


Figure 25. Delaware River Basin Water Quality Zones

1.3.3.1 GENERAL STATEMENT OF BASIN WATER QUALITY

Overall, the majority of observations met water quality criteria in the Delaware River and Bay.

1.3.3.2 AQUATIC LIFE

Support of the aquatic life designated use is assessed by evaluation of dissolved oxygen, pH, turbidity, temperature, total dissolved solids (TDS), alkalinity, toxic pollutants, and biological indicators. The majority of observations met water quality standards. Additional details on select portions of the assessment in support of Aquatic Life are provided below.

1.3.3.2.1 Conventional Pollutants

- **Dissolved Oxygen.** The vast majority of the measurements met criteria. Criteria were met in all zones except Zones 5 and 6. Zone 5 failed to meet the daily mean criteria, and Zone 6 failed to meet both the daily mean and instantaneous minimum criteria.
- **pH.** The majority of discrete pH observations were within the criteria range and therefore met criteria. However, values exceeding the maximum criterion of 8.5 were not uncommon and constituted most criteria violations when they occurred.
- **Turbidity.** The majority of observations met criteria for turbidity in all Zones except Zone 6, which fell just below the 99% threshold for meeting criteria.
- **Temperature**. There are no ambient temperature criteria in Zones 1A through 1E; instead, the temperature criteria could be applicable at the edges of heat dissipation areas for point discharges. In Zones 2 through 5, assessment results failed to meet criteria for temperature. Atmospheric temperatures and meteorological conditions are strong drivers of water temperature.

1.3.3.2.2 Toxic Pollutants

- **Copper.** Multiple exceedances of DRBC acute and chronic marine stream quality objectives were observed for copper in Zone 5. Assessment is complicated by factors such as: field sampling and analytical issues with contamination, a need to assess revisions to current criteria, and the influence of other water quality attributes that influence the partitioning and toxicity of copper. Coordination among Basin states and agencies should continue to ensure the use of the most appropriate methods and procedures for conducting monitoring studies for copper in the Basin and the harmonization of water quality criteria and assessment methodologies in all zones**.**
- **Aluminum.** Data showed numerous exceedances of aluminum acute and chronic freshwater objectives for the support of aquatic life over multiple years. With enhanced monitoring in 2017, the chronic criterion was exceeded in Zones 2, 3 4, and 5, and the acute criterion was exceeded in Zones 4 and 5. Coordination among Basin states and agencies should continue to ensure the use of the most appropriate methods and procedures for conducting monitoring studies in the Basin and the harmonization of water quality criteria and assessment methodologies for aluminum.

1.3.3.3 PUBLIC WATER SUPPLY

Support of the Public Water Supply designated use is assessed by evaluating TDS, Hardness, Chlorides, Odor, Phenols, Sodium, Turbidity, Systemic Toxicants, Carcinogens, and Drinking Water Closures. The majority of observations met water quality standards.

1.3.3.4 RECREATION

Section 101(a)(2) of the Clean Water Act sets as a national goal, "wherever attainable[,]… water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water." For interstate waters in the Delaware River Basin, the regulations that the states use to implement the Clean Water Act defer or refer to DRBC water quality standards. In the Delaware River, primary contact recreation is a designated use for all zones except within a 27-mile long segment that comprises Zone 3 and the portion of Zone 4 above River Mile 81.8 ("upper Zone 4"). Designated recreational uses in the latter reaches include only recreation—secondary contact. The 2020 Water Quality Assessment indicates that primary contact recreation is supported in Zones 2, 5, and 6; and secondary contact recreation is supported in Zone 3 and upper Zone 4. Data were insufficient to assess water quality for recreational uses in Zones 1A, 1B, 1C, 1D, 1E, and the lower portion of Zone 4.

DRBC conducted a special monitoring study in 2019 and 2020 to assess water quality in areas that are currently designated for secondary contact recreation. DRBC collected near-shore samples for bacteria (E. Coli, Fecal Coliform, and Enterococci) from locations in Zone 3 and the upper portion of Zone 4 during the summers of 2019 and 2020, at several locations where primary or secondary contact recreation was observed or anticipated and where access was readily available. All locations sampled are within the portion of the river designated for recreation—secondary contact, where primary contact recreation is not supported by the data and is not recommended for health and safety reasons. A presentation[10] of the results of this monitoring was made to the Water Quality Advisory Committee and is available on the DRBC website.

Results of the monitoring were compared to existing DRBC criteria, which include geometric mean values for Enterococci and Fecal Coliform corresponding to secondary contact recreation. Results of the monitoring were also compared to U.S. Environmental Protection Agency (USEPA) nationally recommended criteria , which include geometric mean values and statistical threshold values (STV) for Enterococci and E. coli corresponding to primary contact recreation. Although 2020 was a drier summer than 2019, results were not substantially improved. Overall, both existing DRBC secondary contact and USEPA nationally recommended primary contact criteria were not met in Zones 3 and upper Zone 4. However, results were highly variable site to site and day to day.

1.3.3.5 FISH CONSUMPTION

While working to reduce toxic pollutants that bioaccumulate, "advisories" containing meal advice for consumers of recreationally caught fish and shellfish are issued to minimize the risk to human health. While the DRBC does not issue fish consumption advisories, DRBC staff work with Basin

[10] https://www.nj.gov/drbc/library/documents/WQAC/120320/Yagecic_Review2020BacteriaData.pdf

states to provide data to use in developing state-issued advisories. The following resources provide detailed information on state-issued fish consumption advisories in the Basin states:

- NJDEP New Jersey Department of Environmental Protection[11]
- Fish Health Advisories - NYS Dept. of Environmental Conservation[12]
- Fish Consumption Advisories (pa.gov)[13]
- Fish Consumption Advisories - DNREC Alpha (delaware.gov)[14]

The fish consumption designated use applies to all DRBC Water Quality Management (WQM) Zones. The assessment criterion is based primarily on the presence of the Basin states' fish consumption advisories in the mainstem Delaware River and Bay for the assessment period. The presence of fish consumption advisories results in an assessment of "not supporting the designated use." Advisories were issued for each assessment unit, so the use is not supported in any zone. However, it is important to note improvements in the advisories. For example: New Jersey and Delaware have revised their advisories in the Delaware Estuary from the Pennsylvania/Delaware border (RM 78.8) to the C&D Canal (RM 58) to allow three meals per year for all fin fish, including white perch and channel catfish. Before 2015, no consumption was advised. Similarly, Pennsylvania revised its advisories from "Do not eat" to "six meals per year" for sections from the Trenton/Morrisville bridge (RM 133) to the Pennsylvania/Delaware border (RM 78.8) for carp in 2016. Those less stringent fish consumption advisories are due to declining levels of polychlorinated biphenyls (PCBs), dioxins and furans, pesticides, and mercury in fish tissue.

Declining levels of PCBs reflect the efforts of the DRBC and the states to reduce PCB loadings through the implementation of Total Maximum Daily Loads (Stage 1 TMDLs) developed by DRBC and established by the U.S. EPA in 2003 and 2006. Polychlorinated biphenyls (PCBs or total PCBs) are a class of man-made compounds that were manufactured and used extensively in electrical equipment such as transformers and capacitors, paints, printing inks, pesticides, hydraulic fluids and lubricants. Individual PCB compounds called congeners can have up to 10 chlorine atoms on a basic structure consisting of two connected rings of carbon atoms. There are 209 such PCB congeners, each with different numbers and locations of chlorine atoms, resulting in distinct chemical characteristics. PCB compounds can be grouped by the number of chlorine atoms attached to the carbon rings; these groups are called homologs. PCB compounds containing five chlorine atoms, for example, belong to the homolog referred to as pentachlorobiphenyl or penta-PCB. PCBs are considered legacy pollutants, since their manufacture and use have generally been banned by federal regulation since 1978. However, mobilization and recycling of legacy PCBs results in ongoing sources of PCBs to the Delaware River Estuary and Bay including: industrial and municipal wastewater treatment plants, combined sewer overflows (CSOs) and municipal separate storm sewer systems (MS4s); contaminated sites; tributaries and boundaries such as the ocean and the C&D Canal; nonpoint source runoff

[11] https://njdep.maps.arcgis.com/apps/MapJournal/index.html?appid=922dff1885394cf19ccf1d9c8d52b4f0&webmap=3bac9ba1ee0a49b6b3e4a11a78fd2fb6#map

[12] https://www.dec.ny.gov/outdoor/7736.html

[13] https://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/FishConsumptionAdvisory/Pages/default.aspx

[14] https://dnrec.alpha.delaware.gov/fish-wildlife/fishing/consumption-advisories/

directly to the estuary; atmospheric deposition and exchange of PCBs between estuary waters and the atmosphere; and sediments contaminated by PCBs. In addition, PCBs may also be incidentally created as a byproduct from certain manufacturing processes, such as dye and pigment production.

PCBs are generally hydrophobic, accumulating in sediments and fatty tissues of aquatic organisms. PCBs have been demonstrated to cause a variety of adverse health effects including both carcinogenic and non-carcinogenic effects. Following a reassessment of the cancer potential by the USEPA in 1996, the agency concluded that PCBs were a probable human carcinogen. Non-cancer health effects of PCBs include effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. Reproductive and developmental effects have also been reported including reduced conception rates and birth weight. Twelve of the 209 PCB congeners have been shown to have dioxin-like effects, including reproductive and developmental problems, cardiovascular disease, increased diabetes, and increased cancer.

On behalf of Delaware, New Jersey, and Pennsylvania, DRBC developed total maximum daily loads (TMDLs) for polychlorinated biphenyls (PCBs or total PCBs) for the tidal Delaware River mainstem (Zones 2-5) and Delaware Bay (Zone 6) in 2003 and 2006, respectively. These TMDLs, established by USEPA Regions II and III, were designed to achieve and maintain the applicable water quality criteria for PCBs in order to protect human health from the carcinogenic effects of eating contaminated fish caught in these waters. As a result of these Stage 1 PCB TMDLs, 94 National Pollutant Discharge Elimination System (NPDES) permittees are each required to develop and implement a PCB Pollutant Minimization Plan (PMP) to reduce PCB loadings to the estuary. DRBC works directly with the co-regulating states to review and improve the minimization efforts, and DRBC manages the PCB effluent database for all dischargers within the tidal drainage portion of the Basin. Between 2005 and 2016, implementation of the Stage 1 PCB TMDLs, through monitoring and pollutant minimization, resulted in a cumulative PCB load reduction of 64% to the estuary from the 94 NPDES permittees that received individual waste load allocations (WLAs) in the Stage 1 PCB TMDLs. DRBC, in close coordination with the co-regulating states in the estuary (DE, PA, and NJ) as well as USEPA Regions II and III, has developed draft Stage 2 PCB TMDLs that incorporate enhanced loading data and implementation requirements as well as revised criteria. These Stage 2 TMDLs are intended to be finalized and established by either USEPA or the individual states. DRBC will continue to manage PCB data for discharges within the tidal drainage portion of the Basin, provide technical support to the minimization program, and work with co-regulating states to extend TMDL implementation to all sources of PCB loads to the estuary.

1.3.3.6 SHELLFISH CONSUMPTION

Shellfish consumption, as a DRBC designated use, only applies to DRBC Zone 6. For the 2020 Water Quality Assessment, approved harvesting areas were considered to be supporting the use. Prohibited waters were considered to be not supporting the use. Assessment units classified as Special Restricted and Seasonally Restricted are considered to be supported but with special conditions. In total for the 2020 assessment, 646 mi^2 are in full support (76% of Zone 6), 5 mi^2 are supporting with special conditions (<1%), and 195 mi^2 are not supporting the shellfish consumption use (23%).

1.3.3.7 ANTI-DEGRADATION: DRBC SPECIAL PROTECTION WATERS

In recent years, three major advancements have been achieved in the Special Protection Waters program:

- The Lower Delaware Measurable Change Assessment 2009-2011[15] (DRBC, 2016a) was completed. This was DRBC's first assessment of measurable change since site-specific existing water quality (EWQ) targets were established in DRBC rules. Methods for determination of measurable change were successfully applied, showing that water quality has not degraded and, in many cases, has improved. Only chlorides and specific conductance exceeded water quality targets at almost all sites, in addition to E. Coli at less than half of the sites, but all are still far better than water quality standards. The cause for the increase in chlorides and specific conductance is believed to be winter road salting. Notable water quality improvements were observed in the Delaware, Lehigh, and Musconetcong Rivers, where nutrient concentrations declined. The publication is also available online as story map[16].
- Site-specific EWQ targets have been developed for all Upper, Middle, and Lower Delaware River sites. There are currently 85 Delaware River and tributary sites. EWQ targets are documented in the Existing Water Quality Atlas of the Delaware River Special Protection Waters[17] (DRBC, 2016b). Data were compiled from the following: DRBC/National Park Service (NPS) Special Protection Waters (SPW) monitoring results; three USGS water quality investigations (Hickman and Fischer, 2008; Siemion and Murdoch, 2010; and Senior in press); and state monitoring results from PADEP, NJDEP and the New York State Department of Environmental Conservation (NYSDEC).
- Water quality models have been developed, calibrated, and are utilized for watershed-wide cumulative evaluations of wastewater projects for four regions: the Lower Delaware, the Lehigh River watershed, the Brodhead Creek watershed, and the Neversink River watershed. These models are regularly updated and used for No Measurable Change (NMC) evaluations of new or expanding wastewater facilities in DRBC's permitting process.

[15] http://www.nj.gov/drbc/library/documents/LowerDel_EWQrpt_2016/LDel_EWQrpt_2016_entire.pdf

[16] http://drbc.maps.arcgis.com/apps/MapSeries/index.html?appid=e63f5f1320794666a7def165ff9ae0e4

[17] http://www.nj.gov/drbc/programs/quality/spw_ewq-atlas.html

1.4 POPULATION AND LANDSCAPE

1.4.1 Population

The following statistics are based on the U.S. Census Bureau, 2000 Census and 2010 Census, as well as 2012-2016 American Community Survey 5-Year Estimates. The county population figures for 2016, discussed below, are adjusted to the Basin boundary.

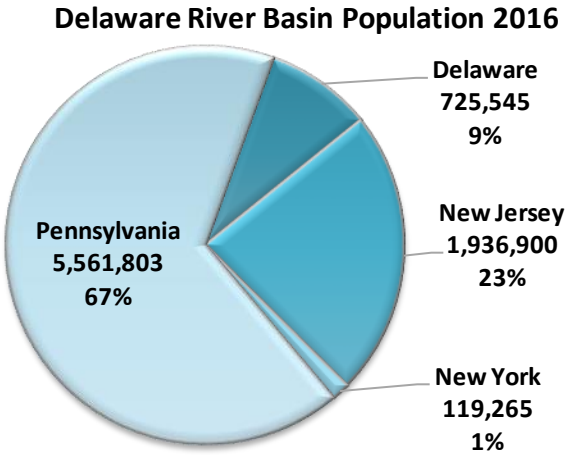


Figure 26. Basin Population 2016. Pennsylvania accounts for approximately two-thirds of the basin's population. (Note: An additional 5 million people outside of the basin who rely on basin water supplies are not included in this figure).

The total 2016 population in the Basin is 8.34 million people. **Figure 26** shows the portion of the Basin population by state.

- The population of the Basin increased by nearly one half million people, from 7.76 million in 2000 to nearly 8.25 million in 2010 (an increase of 6.3%).
- Between 2010 and 2016, the counties within or straddling the Basin added an additional 93,479 people.
- Continued population growth at 6.3% per decade will mean an increase of 35.7% to 11.2 million people by 2060.
- The greatest concentration of developed land (and population density) continues to be in the Lower Region of the Basin, the greater Trenton-Philadelphia-Camden-Wilmington area.

Between 2010 and 2016, the population in four Basin counties increased by 10,000 or more, including Philadelphia, Montgomery, and Chester Counties in Pennsylvania and New Castle County in Delaware (see **Table 2**). Growth in Kent County, Delaware is entirely dependent on groundwater, whereas the other growing counties have greater availability of water supply infrastructure and conjunctive use of source supplies.

Table 2. Portions of DRB Counties with the Largest Population Growth from 2010 to 2016

State	County	2010	2016	Change	% Change
PA	Philadelphia	1,526,006	1,559,938	33,932	2.2%
PA	Montgomery	799,881	815,876	15,995	2.0%
DE	New Castle	517,111	530,081	12,970	2.5%
PA	Chester	454,501	466,616	12,115	2.7%
PA	Lehigh	349,497	358,792	9,295	2.7%
DE	Kent	138,752	147,650	8,897	6.4%

Similarly, between 2010 and 2016, eleven Basin counties decreased in population by more than 1,000 people: five in New Jersey, four in Pennsylvania, and two in New York (see **Table 3**). Pike County, Pa., which in previous years was one of the fastest growing counties in Pennsylvania and the Basin, is now losing population. Unlike their counterparts across the Bay in Delaware, the New Jersey Bayshore counties (Cape May and Salem) are losing population.

Table 3. Portions of DRB Counties with the Largest Population Loss from 2010 to 2016

State	County	2010	2016	Change	% Change
PA	Monroe	169,842	167,126	-2,716	-1.6%
NJ	Camden	444,167	441,967	-2,200	-0.5%
NJ	Sussex	76,876	74,903	-1,974	-2.6%
NJ	Warren	108,692	107,095	-1,597	-1.5%
NY	Sullivan	66,398	64,808	-1,590	-2.4%
NJ	Salem	66,083	64,504	-1,579	-2.4%

State	County	2010	2016	Change	% Change
PA	Wayne	50,828	49,363	-1,465	-2.9%
PA	Schuylkill	85,402	84,143	-1,260	-1.5%
PA	Pike	57,369	56,210	-1,159	-2.0%
NJ	Cumberland	156,437	155,348	-1,089	-0.7%
NY	Delaware	33,290	32,237	-1,053	-3.2%

1.4.2 Landscape

Landscape change occurs gradually across the Basin but is nonetheless worth tracking, since landscape conditions can affect water resources. In the years between 1996 and 2010, the landscape changed, although not dramatically in the aggregate. Net changes are summarized below, and regional shifts in land cover are illustrated in **Figure 27**.

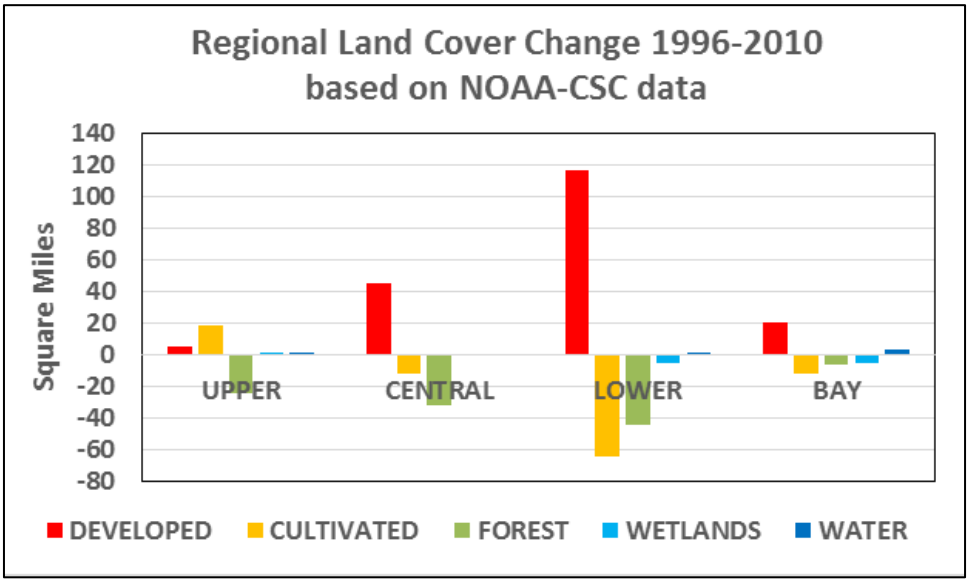


Figure 27. Regional Net Change in Land Cover 1996-2010 illustrates the magnitude of change and the net gains/losses in land cover in the four basin regions. Forest loss was experienced across the basin. Based on analysis of satellite imagery from NOAA Coastal Services Center.

- Developed land now covers nearly 2,100 square miles – more than 16% of the Basin.
- Natural landscapes (*e.g.*, forests and wetlands) cover slightly less than 60% of the landscape.
- Forested land, once a dominant feature, now accounts for less than half of the Basin land cover and decreased by more than 100 square miles (approx. 68,460 acres) between 1996 and 2010. Continued loss of forest, crucial to sustaining water quality and availability, could have a negative impact on the long-term condition of the Basin's water resources.
- Changes in wetlands appear to be less dramatic, since no-net-loss policies have minimized losses from development activity. However, coastal wetlands face the threat of erosion and inundation from rising sea levels, effects exacerbated by their inability to migrate inland when trapped by existing developed land.
- Cultivated land (agricultural and transitional scrub shrub landscapes) experienced a net decrease during the period in all but the Upper region of the Basin.

Changes in species composition can be expected with changes in climatic conditions, including the transitioning of coastal freshwater wetlands to salt marsh and the loss of once-dominant forest species—such as hemlock and oak—from infestation and disease supported by warmer temperatures. The overall effects of these changes on water resources remain to be examined.

Estimates of future population may drive both direct (potable supply) and indirect (energy-related, industrial) needs for water. Future land use/land cover projections and their implications for future water supply needs may be developed as part of the USGS National WaterSMART program and integrated into the Sustainable Water Future 2060 project.

1.5 EMERGENT ISSUES

1.5.1 Hydraulic Fracturing

For a summary of recent rulemaking actions and Work Program tasks related to hydraulic fracturing, see Part II - Section 2.2.6.

1.5.2 Pipelines, Electric Generation and Cogeneration, Electric Transmission Lines

The development of natural gas outside of the Delaware River Basin has resulted in the modification and/or expansion of existing natural gas pipelines in the Basin and the construction of new natural gas transmission pipelines and supporting infrastructure (*e.g.*, compressor stations) across the Basin. The Commission has received, reviewed, and approved several applications for transmission pipelines in recent years, and additional pipelines are proposed. Several transmission lines are proposed to convey the liquid by-products from the gas wells to refineries and markets in the Basin.

In addition to the natural gas transmission pipelines, the Basin has experienced the reconstruction and or expansion of electric transmission lines. The replacement of the existing infrastructure is due to such factors as its age, the need to improve delivery system reliability and redundancy, and the need for increased capacity to meet growing demand in the northeastern U.S. Existing

coal and oil burning electric generating and cogenerating facilities have closed or converted to natural gas as a fuel. New natural gas power plants are being proposed and constructed throughout the northeastern U.S. to take advantage of cheaper, regional sources of natural gas. Electric generating facilities have transitioned from once-through to evaporative cooling as capacity has been added, a shift that is expected to increase the consumptive use of water. At the same time, the emergence of dry cooling as a technology for power generation could reduce water use overall and thereby consumptive use as well. Finally, projects that would convert natural gas from regional or other locations into a liquid form (liquid natural gas or LNG) for local use, and/or for export to other areas of the country or overseas, are being proposed.

1.5.3 Port Development / Dredging

The Delaware River and Estuary supports the largest freshwater port in the world, and the Delaware River port complex comprises numerous facilities in Delaware, Pennsylvania, and New Jersey. The DRBC periodically receives project review applications for port development and dredging projects and is aware of several large projects being planned. The effects of these projects on water quality and aquatic life will be a focus of Commission project review activity.

1.5.4 Changing Climate

Observed precipitation amounts and air temperature have been increasing throughout the Basin. Sea levels in the Delaware Bay and Estuary have been rising due to climate change. Predictions by the scientific community indicate that these trends will persist through this century. However, the rate of change is also a factor affecting water availability. If temperature, precipitation, and sea levels continue to increase, there may be major implications for water resource management in the Basin including impacts to water quality and water quantity.

The effects of climate change are being considered as DRBC plans for future water supply availability and whether new drought or flow management programs are needed in the Basin. Modeling and other analyses are underway to further define the range of risks due to climate change. For example, DRBC is using a three-dimensional hydrodynamic model to look at the potential impacts of sea level rise on salinity in the Delaware Estuary. This model will also be used to study the impacts from sea level rise on estuary wetlands and marshes. Additionally, DRBC is evaluating alternative flow management scenarios to determine what is needed to mitigate the impacts of climate-impacted hydrology on reservoir management and sea level rise on the location of the salt front in the estuary. DRBC is also evaluating how climate change will impact water supply and demand in the Basin. The recently formed Advisory Committee on Climate Change (ACCC) met several times since its formation in December 2019 and held its first Climate Change Forum in March 2021.

1.5.5 Perfluoroalkyl and polyfluoroalkyl substances (PFAS)

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a diverse group of compounds that have varying degrees of persistence, toxicity, and bioaccumulation in the environment. They are found in a variety of industrial and household products such as stain repellant textiles, fire-fighting foams, and paper coatings. They have unique properties to repel both water and oil. While there is still much to be learned about the effects of PFAS on human and ecological health, exposure from drinking water is a concern. In November 2016, USEPA issued a revised health advisory for

Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS), the most extensively produced and studied of the PFAS[18]. NJDEP and NYSDEC have adopted standards for some PFAS. The four states within the Delaware River drainage basin (New Jersey, New York, Pennsylvania and Delaware) have initiatives to manage PFAS exposure. These substances have been detected in drinking water wells in Basin states. PFOS has also been detected in fish tissue in the Basin. Available data for surface water show PFAS levels are below current USEPA and Basin state human health advisory levels in segments of the Delaware River designated as drinking water sources. PFAS levels observed in fish indicate that further evaluation of risk to human health and wildlife is warranted in the Delaware River. DRBC staff and its Toxics Advisory Committee (TAC) continue to review and assess PFAS in the Delaware River. For additional information, see Contaminants of Emerging Concern[19] on the DRBC website.

1.5.6 Atlantic Sturgeon (Acipenser oxyrinchus)

Effective in April 2012, four geographically distinct populations of Atlantic sturgeon—including those of the New York Bight, which includes the Delaware River—were listed as endangered. Mature Atlantic sturgeon migrate from the sea to fresh water in advance of spawning, and juveniles remain in fresh water for several years. Once abundant in the tidal Delaware River, spawning adults are believed to currently number fewer than 300. The Endangered Species Act requires species listed as endangered to receive protection under the Act to prevent extinction, including a prohibition against "take," which includes harassing, harming, pursuing, wounding, killing, trapping, capturing, or collecting. In August 2017, critical habitat for Atlantic sturgeon in the Delaware River was designated as the entire tidal river from the head of the tide at Trenton, N.J., to the head of Delaware Bay. Atlantic sturgeon is one of the key fish species being considered in the aquatic life designated use studies (see Part II – Section 2.2.1.4.2).

1.5.7 Increasing Chloride Trends

Freshwater instream monitoring has shown an upward trend in chloride concentrations of the nontidal Delaware River. This is a trend common to areas of the U.S. with significant roadway de-icing activity. While concentrations are still below criteria for drinking water and aquatic life use, the trend is of concern. Studies[20] in New York, Maryland, and Vermont indicated that chloride concentrations in winter could increase as much as a hundred-fold over summertime levels in unimpacted forest streams; and mean annual levels increase as a function of impervious surface, sometimes exceeding tolerance for freshwater life in suburban and urban streams (Kaushai, 2005). Additional monitoring and investigation into sources, mitigation measures, and de-icing alternatives to salt and brine are needed.

[18] See USEPA Fact Sheet 800-F-16-003 https://www.epa.gov/sites/production/files/201606/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf

[19] http://www.nj.gov/drbc/programs/quality/cecs.html

[20] http://www.pnas.org/content/102/38/13517.long

1.5.8 Microplastics

Plastic is perhaps the most prevalent type of debris found in our oceans and large lakes. Plastic debris can come in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called "microplastics." Eventually larger plastics degrade into microplastics and include originally manufactured products, such as microbeads found in cosmetics and personal care products (such as toothpaste); industrial scrubbers used for abrasive blast cleaning; and resin pellets used in the plastic manufacturing process. "Microfibers" are another type of microplastic that are generated from washing synthetic clothing made of polyester and nylon (petroleum-based materials). These tiny particles easily pass-through water filtration systems and end up in receiving waters, posing a potential threat to aquatic life.

Microbeads are not a recent problem. They probably first appeared in personal care products about fifty years ago, with plastics increasingly replacing natural ingredients. As recently as 2012, this issue was still relatively unknown, with an abundance of products containing plastic microbeads on the market and not a lot of awareness on the part of consumers. On December 28, 2015, President Obama signed the *Microbead-Free Waters Act of 2015*, banning plastic microbeads in cosmetics and personal care products.

As an emerging field of study, not much is known yet about microplastics and their impacts. The National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program is leading efforts within NOAA to research this topic. Standardized field methods for collecting sediment, sand, and surface-water microplastic samples have been developed and continue to undergo testing. Eventually, field and laboratory protocols will allow for global comparisons of the amount of microplastics released into the environment, which is the first step in determining the final distribution, impacts, and fate of this debris. USGS in partnership with National Park Service units in the Basin are conducting a research project that includes sampling in the Delaware River and Bay. The funded project is titled "*Occurrence and Potential Risk of Microplastics in Lake Mead & the Delaware River."*

Funded by Delaware Sea Grant, researchers at the University of Delaware are investigating the abundance and type of microplastics in water collected at five sites along Delaware Bay in Delaware and New Jersey. Preliminary results indicate a higher concentration of filamentous microplastics near industrial areas and higher concentrations of smaller microplastics (0.3–1 mm) near Cherry Island Landfill in Wilmington and Bombay Hook, although microplastics at Cherry Island were three times more likely to be larger (1-5 mm) in size than smaller (0.3-1 mm). Study results will inform project partners at DNREC who are developing a strategy to investigate the extent and implications of microplastics in the Delaware Bay, as well as state water quality regulators concerned about the potential impact for fisheries, including oysters. The impacts on human health are not fully studied or known.

In 2018, DRBC received a grant from the Delaware Watershed Conservation Fund to monitor for microplastics and model loadings of microplastics in the upper Delaware River Estuary. This project will provide greater detail into how microplastics are distributed in this section of the Basin and which source tributaries are introducing the most microplastics. DRBC will collect samples from four sites in the upper Delaware River Estuary and 10 tributary sites. As the non-tidal Delaware River is the largest loading into the estuary, samples will also be collected at the head of tide in Trenton, N.J. Samples will be collected and will be analyzed by Temple University for microplastic concentrations. Data collected during microplastic monitoring efforts will be used to

model microplastic dynamics in the estuary. These models will allow us to identify high plastic-loading tributaries, which will be targeted for cleanup efforts.

1.5.9 Cyanobacteria

During summer 2019, cyanobacteria blooms were noted in several impoundments draining to tributaries, and ultimately, the Delaware River. Fate and degradation of cyanotoxins are not well understood. DRBC will continue to coordinate with advisory committees and other stakeholders to determine what, if any, strategies or follow-up steps are warranted. The NJDEP also has extensive guidance[21] on this topic at their website.

1.5.10 Tracking 1,4-Dioxane

1,4-Dioxane is a synthetic industrial chemical. It is one of the most mobile organic contaminants because of its low absorption potential and miscibility. It was classified as a likely human carcinogen in 2017. 1,4--Dioxane is a likely contaminant at many sites contaminated with certain chlorinated solvents (particularly 1,1,1-trichloroethane [TCA]) because of its widespread use as a stabilizer for chlorinated solvents. 1,4-Dioxane is released into the environment from wastewater discharges, unintended spills, leaks, historical disposal practices of solvents, and unregulated manufacturing waste streams. (USEPA and Interstate Technology & Regulatory Council [ITRC]).

Recent monitoring has quantified 1,4-Dioxane in surface water in the Delaware River and Lehigh River. DRBC has applied for funding under its USEPA 106 Grant and will continue working cooperatively with the Basin states and drinking water utilities to perform additional monitoring to better understand sources of 1,4-Dioxane and to formulate strategies for control.

[21] https://www.state.nj.us/dep/wms/bfbm/CyanoHABHome.html

2. WATER RESOURCE MANAGEMENT

Part II of the Water Resources Program is presented in two sections:

- **Section 2.1: Goals and Priorities** summarizes the primary water resource goals of the DRBC and FY 2022-2024 Commission focus areas.
- **Section 2.2: Water Resource Management Work Program** summarizes the activities and programs constituting the Commission's work plan for FY 2022-2024, organized by the five Key Result Areas of the Basin Plan 2004.

These five Key Results Areas (KRAs) are:

1. Ensuring the Sustainable Supply of Suitable Quality Water
2. Waterway Corridor Management
3. Linking Land and Water Resource Management
4. Institutional Coordination and Cooperation
5. Education and Outreach for Stewardship

See also **Supplemental Table A** in **Appendix A** for a summary of prospective changes to the DRBC Comprehensive Plan, regulations and/or programs.

2.1 GOALS AND PRIORITIES

The primary water resource goals of the DRBC are:

- An adequate and sustainable supply of water for the Basin.
- Clean and healthy water resources throughout the Basin.
- Reduction of losses and impacts in areas prone to flooding within the Basin.

2.1.1 Commission Focus Areas

The Commission Focus Areas for FY 2022-2024 are as follows:

1. Water Quantity
    - Develop water demand projections out to 2060.
    - Analyze surface and groundwater availability for the Basin using demand projections out to 2060.
    - Initiate a study to identify new storage opportunities to meet future needs.
    - Provide technical support (modeling, research, assessments, documentation) to the states and New York City (Decree Parties) for the studies specified in FFMP 2017.
    - Continue the multi-year evaluation of additional storage and/or optimizing operations at F.E. Walter Reservoir with the USACE.

- Work with the USACE to modify the existing HEC-HMS model (hydrologic) for the DRB to better simulate low flow conditions. This project is being performed through a Planning Assistance to States (PAS) Program cost sharing agreement with USACE.
- Manage DRBC storage to support the Trenton Equivalent Flow Objective for salinity repulsion.
- Monitor hydrologic conditions that may require Commission action.
- Coordinate drought management actions with states, reservoir operators, and facilities with consumptive use replacement requirements.
- Use the 3D hydrodynamic model to evaluate effectiveness of flow management goals for salinity repulsion under future sea level rise predictions and flow management alternatives, for both the FFMP 2017 studies and the 2060 study.

2. Water Quality

- Conduct studies to determine the attainable aquatic life designated uses and dissolved oxygen (DO) criteria to support those uses in Zones 3, 4, and the upper portion of Zone 5 as outlined in Resolution 2017-4 and Resolution for the Minutes 2020-9. These include:
    - Fish studies to determine the DO requirements of aquatic species as well as the spatial and temporal distribution of fish communities.
    - Development and calibration of a 3D eutrophication model of the tidal river and estuary, in close coordination with a panel of nationally recognized experts.
    - Application of the eutrophication model to relate nutrient loads to DO targets, and to prepare scenarios to evaluate the attainability of various DO conditions and aquatic life uses.
    - Application of the eutrophication model to determine load and waste load allocations necessary to achieve attainable aquatic life uses.
    - Evaluation of costs to achieve various levels of nutrient reductions through enhanced wastewater treatment.
    - Technical and socioeconomic evaluations of upgrading designated aquatic life uses in the portion of the estuary currently designated for fish maintenance only.
- Implement water quality program (monitoring, assessment, and modeling) supported by USEPA Section 106 grant in the Special Protection Waters (SPW) and Delaware Estuary.
- Collaborate with USEPA and the Basin states to implement Stage 1 PCB TMDLs throughout the tidal system; support establishment of Stage 2 PCB TMDLs and develop revised implementation requirements.
- Coordinate with advisory committees to recommend updates to DRBC water quality regulations for the mainstem for key parameters, such as ammonia.
- Develop and implement a strategy for enhanced recreational designated uses in Zones 3 and upper 4.
- Monitor and report on the location of the salt front.

3. Regulatory Review
    - Review applications and issue dockets/permits for projects under DRBC lead.
    - Develop/update and implement the One Process / One Permit Program and associated administrative agreements (AAs) for collaborative permitting and technical coordination of state NPDES permits and water withdrawals.
    - Enforce conditions of dockets/permits through compliance program.
4. Collaborate with regional, state, and federal watershed partners: Partnership for the Delaware Estuary, Schuylkill Action Network, Christina Basin, Common Waters, Coalition for the Delaware River Watershed, Pennsylvania Emergency Management Agency (PEMA), National Park Service Wild and Scenic Rivers program, Delaware River Basin Restoration Program through U.S. Fish and Wildlife Service (USFWS), USGS, National Weather Service and state and federal committees/councils.
5. Agency Fiscal Management
    - Water Withdrawal and Discharge Project Fees: Continue to evaluate and implement the annual monitoring and coordination fee program. Annually adjust fees for review of project applications and coordination with state permitting programs based upon the Consumer Price Index (CPI).
    - Re-establish and/or maintain signatory party contributions.

2.1.2 Diversity, Equity, Inclusion and Justice

While the DRBC is charged with managing, protecting, and improving the water resources of the Delaware River Basin, the Commission has always been steadfast in its commitment to the following core values:

- Service: to the public, the regulated community and our DRBC colleagues.
- Respect: for each other, the public and the Basin's water resources.
- Professionalism: defined by high ethical standards, integrity, continuous improvement, and accountability.

The DRBC is committed to applying these core values to meet the vital goals of Diversity, Equity, Inclusion and Justice (DEIJ) and to ensure that DEIJ best practices are fully incorporated into the work of all five of its functional branches: Directorate, Finance and Administration, External Affairs and Communications, Water Resource Management, and Science and Water Quality Management. The DRBC's commitment to DEIJ is essential to its mission, and the Commission strives to ensure that our Basin community is one of respect, inclusion, and equality.

DRBC has formed an internal workgroup to help develop a DEIJ strategic plan for the Commission that will translate into policy and practices which support DEIJ goals, as well as create processes and an organizational culture that will ensure DEIJ principles are effectively incorporated. The Strategic Plan goals are to:

- Improve opportunities to increase the diversity of staff, partners, vendors.
- Build partnerships with organizations ahead of DRBC on advancing DEIJ principals from which we can gain knowledge.

- Provide DRBC staff with DEIJ resources.
- Amend the DRBC Vision, Mission and, Values statements to incorporate DEIJ principles.
- Offer resources for DEIJ training and development.
- Implement plans for improved outreach to DEIJ communities in the Basin.
- Incorporate DEIJ principles in rulemaking and project review.
- Ensure DRBC's culture is wholly aligned with DEIJ principles.

The DEIJ workgroup will seek input and feedback from both internal (staff) and external stakeholders (co-regulators, non-governmental organizations, vendors, and legislators) in drafting the strategic plan for review by senior management and ultimately recommending the plan for Commissioner approval.

In addition to the development of the DEIJ strategic plan, DRBC staff are also part of the Coalition for the Delaware River Watershed's (CDRW) workgroup on DEIJ; and training, learning and outreach opportunities for staff have already begun to be researched and implemented.

2.2 WATER RESOURCES MANAGEMENT WORK PROGRAM

2.2.1 Ensuring the Sustainable Supply of Suitable Quality Water (KRA #1)

1.1 Water Supply Strategy: Forecasting and Planning

1.2 Multi-objective Flow Management

1.3 Water Supply Management: Conservation, Special Area Management and Permitting

1.4 Determining Water Quality and Meeting Standards: Criteria-Based Programs, Anti-Degradation and Water Quality Administration

2.2.1.1 WATER SUPPLY STRATEGY: FORECASTING AND PLANNING

2.2.1.1.1 Water Supply Planning for a Sustainable Water Future 2060

Building on the water use and demand evaluation work in past reporting efforts, the Commission will integrate efforts to prepare a detailed and comprehensive analysis of water demand, availability, and sufficiency through 2060. Assessment of surface flows, aquifer conditions, anthropogenic supply needs, permitted allocations, and ecological needs will be compiled to identify long-term sustainability concerns and suggest appropriate action. The work plan includes:

- Develop water demand projections out to 2060.
  - FY 2022: Public Water Supply Sector
  - FY 2022: Thermoelectric and Industrial Sectors
  - FY 2022: Remaining sectors and Final Report

- Assessment of water availability during a repeat of the drought of the 1960s, the Basin's drought planning benchmark.
    - Groundwater availability analyses using current and projected water demand out to 2060.
        - At the 147 Hydrologic Unit Code (HUC) scale at both the 25 and 50-year return intervals.
        - At the 72 HUC scale for the SEPA GWPA at both the 25 and 50-year return intervals.
    - Surface water availability using current and projected water demand out to 2060.
        - Use of Surface Water Estimation and Evaluation Tool (SWEET) in non-tidal watersheds.
- Assessment of water availability with predicted future climate trends.
- Assessment of the efficacy of the Trenton Equivalent Flow Objective for salinity management for different sea level rise scenarios.
- Identification of additional information and tools necessary to forecast future condition (demand, supply, climate) scenarios.
- Review of the adequacy of supply storage facilities to meet future water use and in-stream needs.
- Analysis of the water audits and recommendations for future actions.

While most tasks are included in this Part II - Section 2.2.1.1 of the work program, others (*e.g.*, those related to flow modeling or agency coordination), are described in other sections of the document as appropriate.

In Fiscal Year 2019, Congress provided the Water Availability and Use Science Program (WAUSP) with additional resources to pilot Integrated Water Availability Assessments (IWAAs). In response, the WAUSP selected 10 new projects across the U.S. that will help to support development of National and Regional IWAAs. Multiple USGS Water Science Centers within the Delaware River Basin (DRB) will work with Basin stakeholders to develop a holistic workplan addressing potential impacts of the drought of record under current supply and demand conditions. Additional deliverables include a model to predict daily withdrawal for public supply water use, improved predictions of streamflow during drought periods, improved water-quality modeling processes, and evaluating the utility of National scale models to inform local water management. Commission staff will engage when and where appropriate on this project.

2.2.1.1.2 Supporting and Coordinating with State Water Supply Planning and Allocation

DRBC works closely with the states through the DRBC Water Management Advisory Committee (WMAC) and by serving on committees organized by the states for water supply planning and management. Basin states continue to improve their data collection efforts, which are critical for well-informed planning and management.

As reflected in the updated administrative agreements between the Commission and the states of New Jersey (2015) and New York (2016), the Commission is cooperating with the state permitting/allocation programs for the groundwater and surface water withdrawals in those states. DRBC administers a special program for the Southeastern Pennsylvania Groundwater Protected Area (SEPA GWPA, see Part II - Section 2.2.1.3.3) on behalf of the Commonwealth of Pennsylvania. New York's water supply law (see primarily NY Environmental Conservation Law, Article 15, Titles 15, 16 and 33) was amended on August 16, 2011 (Laws of New York, Chapter 401), with most of the statutory amendments effective as of February 15, 2012. The amendments expand the permit program to include withdrawals for purposes beyond public water supply, such as those for commercial, manufacturing, industrial, and other purposes, and limit the permit program to only include systems with capacity to withdraw 100,000 gallons per day or more. Previously, permits were required for any volume of withdrawals for public supply. The revised rule indicates that since the NYSDEC, as a voting member of the DRBC, is integrally involved with the DRBC's water withdrawal approval processes, that if a water withdrawal occurs in the jurisdiction of the DRBC and the water withdrawal is approved by DRBC, as applicable, then the water withdrawal is exempt from the permit requirements of the rule.

2.2.1.1.3 Surface Water Charging Program

DRBC administers an ongoing Surface Water Charging Program, for water withdrawals, which includes on-line registration, reporting and invoicing. Revenue from the program is added to the Water Supply Storage Fund (WSSF). The WSSF is used to fund the cost-share debt service and joint use operations and maintenance of Blue Marsh and Beltzville Reservoirs, facilities where DRBC holds water supply storage. This storage is used to ensure freshwater flows into the estuary during periods of low flow. The WSSF is also used to provide the local cost-sharing support for approximately a dozen USGS streamflow and water quality gages that are used for flow management, water quality assessments, and flood forecasting by the National Weather Service (NWS).

2.2.1.1.4 Facility Planning

The Commission has considerable powers of oversight relating to major facilities and projects affecting water resources in the Basin, and "*…for the determination of project priorities, pursuant to the requirements of the comprehensive plan and [the] water resources program.*"

The Commission will focus on several aspects of facility planning in the next three years:

- Review of Basin-wide storage capacity and ability to meet projected water use and in-stream needs.
- F.E. Walter Re-evaluation Study: The Commission is a non-federal sponsor of this USACE study, along with NYCDEP, to evaluate F.E. Walter Reservoir for additional purposes (drought management, water supply, and additional recreation). DRBC's in-kind services include developing and modeling alternatives to develop the future without project and alternative operations, the storage study, and stakeholder support.
- Development of models and assumptions for future planning exercises and studies.

2.2.1.1.4.1 Beltzville and Blue Marsh Reservoirs

The Commission owns water supply storage in two federal reservoirs, Beltzville (Lehigh River Watershed) and Blue Marsh (Schuylkill River Watershed) and is responsible for their annual debt service and a portion of their operation and maintenance costs. The Commission will continue to use water from these reservoirs for water supply needs, including support of the Trenton Equivalent Flow Objective and to support Western Berks Water Authority (WBWA) in accordance with contracts established prior to construction of Blue Marsh Reservoir.

In FY 2022-2024, the Commission anticipates directing the USACE to provide a recurring daily release of 9 cfs (5.85 MGD) from the water supply pool (DRBC's storage) at Blue Marsh Reservoir for water supply purposes. This is in addition to the applicable daily conservation release, which comes from the USACE water quality pool. The Commission will request additional releases from its water supply pool to satisfy the Trenton Equivalent Flow Objective as necessary.

In FY 2022-2024, the Commission may direct the USACE to provide releases from the water supply pool (DRBC's storage) at Beltzville Reservoir if needed. The Commission will request additional releases from its water supply pool to satisfy the Trenton Equivalent Flow Objective as necessary.

2.2.1.1.4.2 Storage Study

Evaluating future storage needs in relationship to future water demands (both consumptive and non-consumptive uses), climate change (from changes in precipitation and temperature), and sea level rise is part of the Water Supply Planning for a Sustainable Water Future in Part II - Section 2.2.1.1.1. Separate from the F.E. Walter Re-evaluation Study and the FFMP 2017 studies, DRBC is initiating a related study to provide planning, cost estimating and feasibility analysis, and an inventory and evaluation of options for additional storage to meet potential water supply and flow management needs in the Delaware River Basin. A Request for Proposals (RFP) was issued in the first quarter of 2020. The Commission plans to proceed with evaluating RFPs and proceeding with the study in FY 2021-2023.

DRBC WATER RESOURCES PROGRAM
2.2.1.1 Water Supply Strategy

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Sustainable Water Future	Water Demand Projections out to 2060	2021-2022	General Fund
	Groundwater availability analyses for entire DRB and SEPA GWPA	2021-2022	
	Surface water availability analyses	2021-2022	

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
	Strategies for supply sufficiency through 2060	2022-2024	
Support of State Programs	Coordination and support of Basin state water supply programs	On-going	General Fund
Surface Water Charging Program	Program administration, on-line registration and reporting, invoicing	On-going	WSSF
Facility Planning	F.E. Walter Re-evaluation Study	2020-2022	WSSF
	Initiate a contract/study to review and consider options for developing additional or new storage to meet future needs	2021-2023	WSSF
	Explore options for optimizing existing storage for the 2060 and FFMP 2017 studies	2021-2023	General Fund
	HEC-HMS model (calibration for low flow events; use for future hydrologic assessments).	2021-2022	In-kind services For USACE PAS Program

2.2.1.2 MULTI-OBJECTIVE FLOW MANAGEMENT

The mainstem of the Delaware River is the longest un-dammed river east of the Mississippi, 152 miles of which are designated under the Wild and Scenic Rivers Act. However, dams on several large tributaries, which store water in reservoirs, regulate flow to the river through conservation releases. These facilities also provide flood mitigation, water supply, recreational opportunities, and instream flow augmentation. In addition to precipitation, snowmelt and groundwater seeps, activities that affect instream flows include: releases and diversions from water supply and multipurpose reservoirs on tributaries, inter-basin water transfers from tributaries and the river, and water withdrawals from surface waters and interconnected groundwater sources. Low flows may impact habitat and wildlife and reduce the assimilative capacity of the river for wastewater discharges. High flows may cause loss of life and property, but they are also a part of the natural hydrologic cycle. High flows and flooding events move sediment, provide inputs of coarse particulate organic matter that feed organisms at the base of the food chain, and periodically alter the river morphology and riparian corridor, which contribute

to habitat and species diversity. Seasonal high flows also provide environmental cues that trigger spawning and lifecycle events for myriad species dependent on this river (*e.g.*, American shad, oysters, mussels, and Atlantic sturgeon).

2.2.1.2.1 Reservoir Operations

DRBC staff work with and use forecasts from the National Weather Service (Philadelphia and Binghamton, Weather Forecast Offices; Mid-Atlantic River Forecast Center) to determine the amounts of water needed (directed releases) to meet the Trenton Equivalent Flow Objective during low flow conditions. Regular coordination occurs between the DRBC and USACE staff and between DRBC and the Office of the Delaware River Master. DRBC balances the use of 6.09 BG reserved from the Excess Release Quantity for the Trenton Equivalent Flow Objective and its storage in both Blue Marsh and Beltzville Reservoirs.

2.2.1.2.1.1 Flow Management

Releases of water from the three New York City reservoirs (Pepacton, Cannonsville, and Neversink), located in the headwaters of the Delaware River Basin, out-of-Basin diversions, and mainstem flow objectives are managed in accordance with procedures unanimously agreed to by parties to the 1954 Supreme Court Decree (New York State, Pennsylvania, New Jersey, Delaware, and the City of New York).

The Flexible Flow Management Program Agreement, a two-part, 10-year agreement signed by all the Parties, is known as FFMP 2017. The associated operating plan is intended to protect fisheries habitat downstream of the New York City Delaware Basin reservoirs and provide flood mitigation. The Commission's drought management plans, designed to repel the upstream movement of salt water in the Delaware Estuary without increasing the risks to the Basin's water supplies, were also incorporated into the FFMP 2017 operating plan. FFMP 2017 states the intent of the Parties is to study various aspects of flow management over the first five years. They may make adaptive changes to the operating plan as information becomes available and if comparable protection of existing resources is likely to be maintained under new operational programs. Key issues to be studied include salinity repulsion, out-of-Basin diversions, and opportunities to optimize storage. DRBC's Regulated Flow Advisory Committee (RFAC) and its Subcommittee on Ecological Flows (SEF) serve as venues for public input and dialogue with the Decree Parties regarding different aspects of the program (see Part II - Section 2.2.4.4.2). The Commission continues to evaluate salinity management and the proposed alternative operating plans to determine how the Commission's water supply storage in Beltzville and Blue Marsh Reservoirs may be affected. Results from the analyses will provide valuable information for use by the Decree Parties in considering new operating plans. DRBC staff will utilize its existing and developing models for the evaluations (see Part II - Section 2.2.1.2.3).

The Commission will continue to manage and coordinate the replacement of consumptive use for electrical generating or cogenerating facilities who consumptively use more than 100,000 gallons per day during a critical hydrologic condition in accordance with Resolution 2018-5. This is done primarily by requiring releases from Merrill Creek Reservoir, the Mongaup reservoir system, and imports from the Susquehanna River Basin.

2.2.1.2.1.2 Commission Storage (Blue Marsh and Beltzville)

Commission staff is in the process of reviewing the purpose, use and inclusion of Blue Marsh and Beltzville Reservoirs in the Comprehensive Plan. In addition, other related Commission actions, such as dockets and resolutions, will be compiled and reviewed so that their intended use and current status can be evaluated. The findings will be prepared for Commissioner review.

2.2.1.2.1.3 Docket Mandated Storage

Commission staff will conduct reviews for projects where the Commission has required releases from storage. The reviews will focus on the projects' relationship to the Comprehensive Plan. Other related Commission actions, such as dockets and resolutions, will be reviewed and compiled so that their intended use and the current status can be evaluated. The findings will be prepared for Commissioner review.

2.2.1.2.1.4 Consumptive Use Policy for Electric Generating and Cogenerating Facilities

During FY 2018 Commission staff developed, and the Commission approved, a consumptive use policy (Resolution 2018-5) that formalizes the Commission's existing policy as it relates to the consumptive use make-up requirements of electrical generating or cogenerating facilities who consumptively use more than 100,000 gallons per day. Staff is implementing the policy for new electrical generating and cogenerating facility dockets and for existing dockets as they are renewed.

2.2.1.2.2 Ecological Flows

Several initiatives are underway to better identify the ecological flow needs of the Basin. For the Subcommittee on Ecological Flows, DRBC staff will work with stakeholders on use of the Upper Delaware River Riverine Environmental Flow Decision Support System (REF-DSS).

2.2.1.2.2.1 Non-tidal Mainstem and Tributaries

In April 2012, the Commission and The Nature Conservancy (TNC) began a study to develop Basin-wide ecosystem flow recommendations that can be implemented within the sub-watersheds of the Delaware River. The study was completed in December 2013 (DRBC, 2013a). The study area focused on all tributary rivers and streams in the Appalachian Plateau, Ridge and Valley, New England, and Piedmont Physiographic Provinces, but did not include the streams of the Coastal Plain Physiographic Province. The project also summarized information about flow-sensitive species, communities, and ecological processes for the non-tidal mainstem Delaware River as far downstream as Trenton. The resultant recommendations could be an important component in policy development. Such a policy could address pass-by requirements for water withdrawals, conservation release requirements for reservoirs, consumptive use mitigation triggers, and flow targets. The recommendations may also help the Commission and other Basin partners in the planning, design (location and size), and operation of future water supply storage facilities. In FY 2017, the Commission categorized all the existing surface water withdrawals in the DRB. The Commission will continue to consider future policy development that would likely utilize these data relative to the stream setting the withdrawals occur in, the type of water

withdrawal, and the inventory of surface water withdrawals that currently have pass-by requirements.

In 2019, DRBC received a grant from the Delaware Watershed Conservation Fund (DWCF) to *create a web-based habitat model for the Upper Delaware River.* This project will build upon existing models (including REFDSS) that measure habitat changes resulting from regulated flow and temperature mitigation efforts in the upper Delaware River Basin. The updated habitat models resulting from this effort will be used by DRBC's Subcommittee on Ecological Flows (SEF) and other resource stakeholders to evaluate how reservoir releases and flow management protocols affect available habitat. The new models will be expandable, accommodating new research and additional species, and will be able to be used for other parts of the Delaware River. Work is underway and coordination of the draft tool with stakeholders is anticipated in early FY 2022.

2.2.1.2.2.2 Estuary

Freshwater inflow requirements for estuary populations, such as oysters and Atlantic sturgeon spawning, are a part of ongoing research by DRBC partners. For both instream and estuary flow needs, the seasonal components affecting both flow (salinity) and temperature are currently the principal elements of concern. The Trenton Equivalent Flow Objective was set to ensure adequate freshwater flows to protect drinking water intakes in the tidal river. Predictions indicate long-term diminution of snowpack and snowmelt as a regional effect of climate change, which may have implications for flow management alternatives to meet the flow objective. The protection of instream flow needs may require adjustments to allocation and discharge permitting criteria, particularly if flow targets are adjusted. DRBC plans to seek grant support to study salinity and temperature impacts on aquatic life in the Delaware Estuary.

2.2.1.2.3 Flow Management Modeling

An understanding of water supply, storage, and flow regimes is essential for managing the water resources of the Basin. DRBC continues to develop and use modeling tools to aid in the evaluation of water resources management and associated risks in the Basin. The models are used to assess reservoir operations for water supply, flood mitigation, power generation and recreation, the impacts of such operations on Basin resources, the ability of reservoirs to meet intended and multiple objective uses, and the effectiveness of conservation releases. DRBC's Planning Support Tool (DRB-PST) is a daily flow model used to assess flow management options in the Basin. DRBC has updated DRB-PST to fix known issues, add reservoir operations not previously modeled, include components of FFMP 2017, add options to simulate other flow management programs, such as REV1, and add options for calculating the location of the salt front. The impacts to upper Basin habitat related to the flow management programs will be evaluated with REF-DSS. DRBC will be using these models for the 2060 study as well as the FFMP 2017 studies.

DRBC is working with USACE Philadelphia District to recalibrate HEC-HMS, a hydrologic model, with low flow periods. The recalibrated model will be used with output from General Circulation Models (GCMs, or climate models) to generate future hydrology for use with DRB-PST for evaluating future flow management programs and operational goals for multi-objective water resource management.

See also **Supplemental Table B** in **Appendix B** for a summary of all proposed modeling activities.

2.2.1.2.3.1 Hydrologic Reports

A summary of hydrologic conditions in the Basin including precipitation, streamflow, reservoir storage, groundwater levels, and the river mile location of the 7-day average 250 mg/l chloride concentration are prepared daily, weekly, monthly, quarterly, and annually. These reports are posted on the DRBC website. Graphics and information about the salt front, flow, Basin storage (at Blue Marsh, Beltzville, F.E. Walter, Cannonsville, Pepacton, and Neversink Reservoirs) and combined storage of the NYC Reservoirs (foundation of the drought management program) are updated and posted daily on the DRBC hydrologic conditions website[22].

DRBC WATER RESOURCES PROGRAM
2.2.1.2 Multi-objective Flow Management

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Flow Management	Comprehensive study of flow management scenarios/alternatives and their impacts on salinity control and lower Basin storage, under current and future conditions, including sea level rise.	On-going[23]	General Fund
	Collaborative project with USACE (in-kind services) on the modifications to HEC-HMS for use as a planning tool for climate change assessments with DRB-PST and EFDC.	On-going	General Fund
DRB-PST	On-going improvements to DRB-PST in support of comprehensive studies (2060, FFMP 2017)	On-going	General Fund
Salinity Model	Use of the 3D EFDC model for sea level rise analyses	On-going	General Fund / PA Grant
Hydrologic Reports, Event Summaries	Reports; website	On-going	General Fund

[22] hydrosnap.drbc.net

[23] Calibration and validation were completed, and the model is currently being used. However, as new information becomes available (*e.g.*, from different monitoring initiatives), the model may be refined for future analyses.

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Evaluate Reservoir Operations	Blue Marsh, Beltzville, Power sector and Brandywine evaluations	2022-2024	General Fund
	In-kind services for the F.E. Walter Re-evaluation Study	On-going	General Fund
Consumptive Use Replacement	Implementation of the Consumptive Use Policy for electric generating and cogenerating facilities	On-going	General Fund
Reservoir Operations	Directed releases for Trenton as needed	On-going	General Fund
Instream Flow Management	Develop pass-by flow, conservation release, consumptive use mitigation trigger policy (part of Sustainable Water Future 2060)	2024	General Fund

2.2.1.3 WATER SUPPLY MANAGEMENT: CONSERVATION, SPECIAL AREA MANAGEMENT, AND PERMITTING

2.2.1.3.1 Water Conservation and Loss Accounting

DRBC's water conservation program incorporates a wide range of elements, including but not limited to requirements for metering, leak detection and repair programs, water conservation plans, water conservation performance standards for plumbing fixtures, and a water audit requirement to deliver staged improvements in accounting for water loss in distribution systems based on the methodology proposed by the American Water Works Association (AWWA). The rule requires water suppliers to submit water audits annually. This information is used to inform water use analyses and improve water supply planning. Analysis of the results of this program are being used in the development of performance metrics. Staff will prepare a report that evaluates the trends associated with several years of water audits.

2.2.1.3.2 Water Efficiency Standards

Staff will consider reviewing the potential implementation of updated water efficiency standards developed by USEPA WaterSense standards and Energy Star for inclusion in the DRBC Water Conservation Program. WaterSense is a voluntary partnership program sponsored by the USEPA, which provides a label for water-efficient products and a resource for helping you save water. According to USEPA, "*the WaterSense label makes it simple to find water-efficient products, new homes, and programs that meet EPA's criteria for efficiency and performance. WaterSense-labeled products and services are certified to use at least 20 percent less water, save energy, and perform as well as or better than regular models. WaterSense partners with manufacturers, retailers and distributors, homebuilders, irrigation professionals, and utilities to bring WaterSense to your community. Our partnerships encourage innovation in manufacturing and support sustainable jobs for American workers."* Over the next few years staff will review the potential water and cost savings from the WaterSense program as well as the Basin-wide benefits of water use reduction to the public water sector.

2.2.1.3.3 Groundwater Management and Special Management Areas

The Commission will focus efforts on the subbasins of the SEPA GWPA where use assessments indicate subbasins are potentially stressed or near their withdrawal limit. The Commission will continue to monitor conditions and work with docket holders and permittees to find realistic supply solutions and to ensure that allocations support sustainability in the GWPA. The Commission also plans to enhance its tracking of groundwater level conditions and increase its use of annual hydrogeologic reports submitted by docket/permit holders. This information and program status report will be used to provide a more comprehensive analysis of groundwater levels across the GWPA.

2.2.1.3.4 Dockets and Permitting

DRBC's regulatory activities remain important for water supply management and planning. In order to eliminate unnecessary redundancy and to streamline project reviews, updated administrative agreements between the Commission and the states of New Jersey and Delaware were executed in December 2009 (N.J.) and July 2010 (Del.), with minor amendments made to both in May 2013. On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Process / One Permit Program (Rule). The Commission published a draft rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. The Resolution also authorized the Executive Director to enter into an administrative agreement with the NJDEP. In March 2015, an Administrative Agreement (AA) between DRBC and NJDEP was executed. Upon approval of the Rule, the One Process / One Permit Program portion of the AA was activated. In March 2016, an Administrative Agreement (AA) between DRBC and NYSDEC was executed. Initial discussions have occurred between the Commission and PADEP regarding updating its existing AA (executed in 1976). Additional coordination is anticipated during the FY 2022-2024 period covered by this WRP. DRBC will continue to support state partners in their permitting programs through data collection, assessment, and planning, and will issue water supply dockets in accordance with Administrative Agreements and special area management programs. The DRBC database will be updated to incorporate state permit conditions.

2.2.1.3.5 Compliance

Staff will continue annual reviews of DRBC-required data submission, such as the Water Audit Reports. Pre-emptive correspondence and notification systems will continue for docket expiration dates and data/report submittal date reminders.

DRBC WATER RESOURCES PROGRAM
2.2.1.3 Water Supply Management

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Water Conservation and Loss Accounting	Assess data inputs from Water Audit submissions	Ongoing	General Fund
	Prepare trends report on multiple years of water audits.	2022	
	Evaluate and develop updated water efficiency standards using USEPA WaterSense standards and/or Energy Star Certification	2024	General Fund
Southeastern PA Groundwater Protected Area	Evaluate water use in subbasins of SEPA GWPA against allocation and supply limits	Yearly	PA SEPA GWPA
Water Supply Dockets	Review and process water supply dockets in accordance with AAs	Ongoing	Project Review Fees
	Update DRBC database to incorporate state allocation permit conditions	Ongoing	General Fund
Compliance	Track construction start/completion forms, monitoring requirements, docket expirations	Ongoing	General Fund

2.2.1.4 DETERMINING WATER QUALITY AND MEETING STANDARDS: CRITERIA-BASED PROGRAMS, ANTI-DEGRADATION, AND WATER QUALITY ADMINISTRATION

Note: Details on Aquatic Life, including ecosystem needs and restoration, are in Part II – Section 2.2.2.3.

2.2.1.4.1 Special Protection Waters

The Delaware River Basin is unique in having many miles of high-quality waterways in the midst of the densely populated Mid-Atlantic metropolitan area. The river provides multiple benefits to the residents and workers of the Basin. However, it is a water resource management challenge to maintain existing high-water quality in a region that continues to grow. The Commission will continue to work with the states and federal agencies, including the National Park Service (NPS), in the implementation of the Special Protection Waters (SPW) program to maintain no measurable change to existing water quality (EWQ) in the non-tidal river. Program implementation includes management through the DRBC dockets and state NPDES permits (including coordination of programs), and monitoring programs to obtain data to assess any changes to EWQ.

Over the next three years, the following tasks are planned to capitalize upon the achievements described above:

- Data collection / investigation of increasing chloride concentrations in SPW watersheds.
- Initiate discussion on alternative NMC allocation methods for watersheds draining into Special Protection Waters.
- Propose updates of water quality regulations as needed.
- Continue development and publication of SPW outreach and educational materials.

2.2.1.4.2 Criteria Based Program

DRBC's criteria-based program will continue to focus efforts on the assessment of water quality and technical support of project review. Details on the Commission's bacteria monitoring programs and efforts are included in Part II - Section 2.2.2.2.1, Recreational Designated Uses.

2.2.1.4.2.1 Monitoring Programs to Assess Criteria

Long Term Delaware Estuary Water Quality Monitoring

The long-term Delaware Estuary Water Quality monitoring program conducted by the Commission (formerly known as the Boat Run) was extended in 2017 through 2019 to a year-round effort resulting in 12 monthly sampling events at 22 stations. Monitoring in 2020 was temporarily paused due to the COVID-19 pandemic. The Delaware Estuary Water Quality monitoring program will return to a March through October sampling period in 2021. This program provides data to evaluate water quality trends and to assess compliance with Commission water quality criteria. Within available resources, DRBC monitors different analytical parameters each year in all zones of the estuary for a periodic, rotating assessment of criteria.

Dissolved Oxygen Criteria Updates

The dissolved oxygen levels in the tidal waters of the Delaware River and Bay have been the focus of attention for over 50 years. Historically, due to numerous industrial and municipal discharges of oxygen-demanding substances concentrated in urban regions surrounding the tidal river, portions of the estuary commonly exhibited very low oxygen levels from mid-April through October with occasional episodes of anoxia in certain areas. These conditions impaired use by resident fish species and precluded the passage of anadromous fish through the urbanized region between Wilmington (Del.) and Philadelphia (Pa.). In 1967, the Commission established water quality criteria for five water quality management zones based upon the severity of the pollution and geographic boundaries, followed by waste load allocations (WLAs) for carbonaceous biochemical oxygen demand (CBOD) in 1968. The most urbanized portion of the estuary (Zones 3, 4 and the upper portion of Zone 5) was designated for maintenance-only of resident fish populations (not propagation); this designation was aspirational given the water quality conditions at that time, but propagation was not considered an attainable use at that time. Since then, DO levels in the urban portions of the estuary have improved significantly due primarily to upgrades to wastewater treatment plants and consequent decreases in carbonaceous oxygen demand loads.

In 2015, DRBC staff evaluated the existing aquatic life use for Zones 3, 4, and 5 and concluded in a report[24] that, while full attainment of propagation had not been demonstrated, some degree of propagation had been observed (DRBC, 2015). The Commission subsequently adopted Resolution 2017-04 to: a) recognize that evidence supports further study on the inclusion of propagation as a designated use in Zones 3 and 4 and the upper portion of Zone 5 of the Delaware River Estuary; b) authorize such studies to be undertaken in consultation with co-regulators and dischargers; and c) direct the Executive Director to initiate DRBC rulemaking to revise the designated aquatic life uses consistent with the results of the identified studies and the objectives and goals of the federal Clean Water Act. The Resolution identified specific studies to performed by the Commission prior to initiating a rulemaking process, including:

- Evaluation of the dissolved oxygen (DO) requirements of aquatic species;
- Field studies of the occurrence, spatial and temporal distribution of the life stages of estuary fish species;
- Consultation with relevant agencies regarding compliance of potential rulemaking with the Endangered Species Act;
- Development and calibration of a eutrophication model for the Delaware River Estuary and Bay;
- Determination of the nutrient loadings from point and non-point sources, and the reductions that would be necessary to support key aquatic species;
- Evaluation of the capital and operating costs for enhanced wastewater treatment that would achieve higher levels of dissolved oxygen in the estuary; and

[24] https://www.nj.gov/drbc/library/documents/ExistingUseRpt_zones3-5_sept2015.pdf

- Evaluation of the physical, chemical, biological, social, and economic factors affecting the attainment of uses.

The Commission has pursued and has been awarded grants and contracts from multiple public and private sources for DRBC staff and external resources to perform the studies listed above. The Commission has completed or made substantial progress on a majority of the scientific studies and tasks: a study[25] on the DO requirements of aquatic species was completed by a contractor (DRBC, 2018); an intensive two-year nutrient monitoring program for 2018-2019 has been completed to support the eutrophication model development; and treatability and cost evaluations to reduce nitrogen levels from major wastewater treatment facilities were performed by a contractor. The development and calibration of the eutrophication model will be completed in FY 2021-2022, and the model will be applied to help evaluate the cause and effect relationships between nutrient loadings and achievable DO levels in the urban portions of the estuary. A final draft report will be prepared by September 2022 based on results and findings of key studies. Issuance of a final rule and implementation strategy is targeted for completion by March 2025.

DRBC will continue working with co-regulators and the Water Quality Advisory Committee (WQAC) to define the highest attainable aquatic life use and supporting dissolved oxygen criteria in estuary Zones 3 through 5 as outlined in Resolution 2017-4, adopted on September 13, 2017, and Resolution for the Minutes 2020-9 adopted on September 11, 2020.

Nutrient Criteria Development

The Delaware Estuary has both high loadings and high concentrations of nutrients relative to other estuaries in the United States. The effects from these high nutrients are not well understood. However, monitoring in the estuary shows signs of poor ecological health, including a persistent summer DO sag in the urban corridor of the estuary. The DRBC serves as the lead agency for developing nutrient and/or nutrient-related criteria for the Delaware Estuary with close interactions with the WQAC. WQAC members currently recommend deferring development of estuary numeric nutrient criteria to a later time to properly evaluate impacts of high nutrients on aquatic life after low dissolved oxygen impacts have been resolved.

Polychlorinated Biphenyls (PCBs)

Since the establishment of the Stage 1 PCB TMDLs, the water quality criteria for PCBs have been revised to 16 pg/L for Zones 2 – 6, water quality information has been gathered and assessed, and there has been significant progress in the reduction of PCB levels in the Delaware River as described in Part I – General Statement of Conditions in the Basin. At the request of the three estuary states and USEPA, DRBC developed the technical basis for draft Stage 2 PCB TMDLs. DRBC staff worked closely with federal and state co-regulators, the Commission's Toxics Advisory Committee (TAC), and an expert panel of scientists on these efforts. The draft Stage 2 PCB TMDLs also incorporate a more equitable allocation approach than that taken in the Stage 1 PCB TMDLs and include a revised implementation plan for traditional NPDES permittees in the appendix of the document. A draft report for the Stage 2 PCB TMDLs for the Delaware River Estuary and Bay has been developed and shared with estuary states. Although there is no legal

[25] https://www.nj.gov/drbc/library/documents/Review_DOreq_KeySensSpecies_DelEstuary_ANStoDRBCnov2018.pdf

deadline, DRBC is working closely with USEPA and the Basin states on the establishment of the Stage 2 PCB TMDLs.

For FY 2022-2024, the Commission will continue to provide technical support to the estuary states to implement PCB pollutant minimization plans (PMPs) and to manage the effluent PCB database under the Stage 1 PCB TMDLs. DRBC will work closely with USEPA and the Basin states to establish the Stage 2 PCB TMDLs. Once the Stage 2 PCB TMDLs are established, these will supersede the Stage 1 PCB TMDLs established in 2003 and 2006. DRBC will provide technical assistance to the states to implement the Action Level requirement of the Stage 2 PCB TMDLs while providing continued support for PMP reviews and effluent database management.

As resources permit, ambient water samples will be collected in Zones 2 – 6 for analyses of PCBs, dioxin/furans, pesticides, and per- and polyfluoroalkyl substances (PFAS). Collected information will be assessed and compared with previously collected data to identify trends and to assess the effect of PCB reductions already achieved.

Metals

DRBC will be studying areas of elevated concentrations of metals and evidence of criteria exceedances. In addition, the Commission will coordinate with Basin states, USEPA, and stakeholders on criteria development, monitoring, and assessment of metals, focusing attention on bioavailability of the following:

- **Copper.** Copper (Cu) is a naturally occurring trace element found in surface waters and, while essential to virtually all plants and animals, it can be toxic to aquatic life even in low concentrations. DRBC continues to monitor the parameters needed for input to the Biotic Ligand Model (BLM) to assess water chemistry influence on copper toxicity.
- **Aluminum.** Natural sources of aluminum include weathering of rocks. It is the most common metal in the earth's crust. Other sources include mining, industrial processes, and wastewater treatment with alum.

Aluminum is a non-essential metal that can inhibit respiration by binding to ion channels, interfering with essential element uptake, or by accumulating on gills. DRBC will monitor DOC, pH, and hardness for use in Multiple Linear Regression (MLR) to assess water chemistry influence on aluminum toxicity.

Chronic Toxicity

Chronic toxicity is caused by repeated or long-term exposure to low doses of a toxic substance. Most effluent dischargers to the Delaware River are currently monitoring for chronic whole effluent toxicity (WET). Limiting chronic toxicity in effluents decreases the impact of point source discharges on water quality in the Delaware River. WET monitoring in the Delaware River should be coordinated among the Basin states, DRBC and USEPA to generate consistent WET testing and reporting with full compliance by dischargers. Continued efforts should be made to monitor not only effluent from discharges but also the ambient environment to ensure that aquatic life in the Delaware River is protected from toxicity.

2.2.1.4.2.2 Contaminants of Emerging Concern

The DRBC continues to cooperate with Basin states, USEPA and academics on a prioritized list of pharmaceuticals and personal care products, as well as perfluoroalkyl and polyfluoroalkyl substances (PFAS) and polybrominated diphenyl ethers (PBDE), for further evaluation of sources, fate, and effects in water column, sediments, and biota. DRBC compiled the results of a survey on contaminants of emerging concern in a 2013 report[26] (DRBC, 2013b).

In FY 2022-2024, DRBC will collect PFAS occurrence data along 231 miles of the main stem Delaware River, between Narrowsburg, N.Y., and Salem River, N.J., and multiple tributaries (in ambient water concentrations as well as from sediments and fish tissue samples) in order to inform fish consumption advisories. The data may also be used by DRBC and other state and federal government agencies as the scientific basis for the development of future PFAS reduction strategies. This project will provide for the concurrent collection of fish, sediment, and water data to allow for bioaccumulation calculations which have not previously been performed. Supplemental sampling of other aquatic life and food web components will also be performed for occurrence of PFAS. This work complements PFAS monitoring being performed by the Basin states. Input on this research will be sought via presentations to external experts and stakeholders through the DRBC's Water Quality, Toxics, Monitoring and Coordination, and Climate Change advisory committees. The work is being supported with funding from a DWCF 2020 Grant.

2.2.1.4.3 Water Quality Monitoring

2.2.1.4.3.1 Water Quality Modeling for SPW Program

In the non-tidal river, model development will continue with the ongoing calibration and validation of QUAL2K models for the Lower Delaware River, Lehigh River, Neversink River, Brodhead Creek and smaller tributaries throughout FY 2022 to 2024. All models will be continually refined, recalibrated, or validated as more effluent or ambient data and resources are available. Utilization of updated models in no measurable change (NMC) evaluations of new or expanding discharges will reduce uncertainties for maintaining water quality in Special Protection Waters (SPW) from the cumulative impacts from multiple dischargers in a specific watershed.

2.2.1.4.3.2 Water Quality Modeling for Aquatic Life Designated Use

DRBC is continuing its efforts to develop three-dimensional estuary hydrodynamic and eutrophication models under the guidance of a model Expert Panel. The USEPA official version of Environmental Fluid Dynamics Code (EFDC) and Water Quality Simulation Program (WASP8) were selected as the hydrodynamic and water quality models. The hydrodynamic model (EFDC) was developed and calibrated for the 2018-2019 period. A statistical sub-model based on a regional analysis of shared features was developed to estimate hydrologic inputs from unmonitored tributaries and watersheds. Hydrodynamic model performance was evaluated for water surface elevation, current velocity, water temperature and salinity in the estuary. The calibrated hydrodynamic model simulated observed data reasonably well, as will be documented using graphical and statistical tools to evaluate goodness of fit. The Expert Panel unanimously

[26] http://www.state.nj.us/drbc/library/documents/contaminants-of-emerging-concernAug2013rev.pdf

agreed that the calibrated hydrodynamic model is sufficient to be used as the basis of the eutrophication model.

Considerable efforts have been invested to diagnose and enhance the linkages between the hydrodynamic and water quality models. While the combined use of the EFDC hydrodynamic model with the WASP8 water quality model is not novel, the scale and complexity of this application is novel and exposed a number of limitations and inefficiencies. Numerous diagnostic simulations, model grid modifications, sensitivity simulations, code modifications, and optimizations have been performed to allow the models to integrate seamlessly. Model optimization and code enhancements will be continued in FY 2022.

The WASP8 water quality model input file was also developed for the 2018-2019 period. All external nutrients loadings from point source discharges, major tributaries, stormwater runoff, and atmospheric deposition were calculated based on monitored data and estimated where available data were limited. A statistical sub-model based on a regional analysis of shared features was developed to estimate water quality at unmonitored tributaries and watersheds. The light extinction function, which impacts phytoplankton growth/death rates in the model, was evaluated and re-formulated based on 2018-2019 data. Additional data to validate the derived light extinction function was not collected as planned in 2020 due to the COVID-19 pandemic. Model sensitivity simulations for key model coefficients and parameters continue to be performed to guide the model calibration process. Evaluation of the reaeration mechanism for the Delaware River Estuary and development of post processors will be completed in FY 2022. The linked hydrodynamic and water quality model will be completed in FY 2022. Completion and calibration of this linked model will ultimately allow for the development of attainable aquatic life designated uses and associated dissolved oxygen criteria for Zones 3, 4, and upper Zone 5 through load and waste load allocations in the estuary.

See **Supplemental Table B** in **Appendix B** for a summary of ongoing and proposed modeling activities.

2.2.1.4.3.3 Mixing Zone Modeling for Permit and Docket

Near field modeling efforts to support permitting actions (DRBC dockets and/or NPDES permits) for acute mixing zones, heat dissipation areas, and/or TDS mixing zones will continue as needed in FY 2022 – 2024.

2.2.1.4.3.4 Rapid Assessment Dilution Model

DRBC developed a dilution estimation model for rapid assessment of spills and water quality events in the non-tidal Basin. This model delineates the spill path from the point of release to the top of the Delaware estuary, computes the dilution within each HUC12 sub-watershed in the spill path using real-time hydrology data, and identifies intakes in the spill path and the estimated concentration at the intake.

2.2.1.4.4 Water Quality Dockets and Permitting

DRBC's regulatory activities remain important for water quality management. In order to eliminate unnecessary redundancy and to streamline project reviews, updated administrative agreements between the Commission and the states of New Jersey and Delaware were executed in December 2009 (N.J.) and July 2010 (Del.), with minor amendments made to both in May 2013.

On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Process / One Permit Program (Rule). The Commission published a draft rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. Upon approval of the Rule, the One Process / One Permit Program portion of the AA was activated. In March 2016, an Administrative Agreement (AA) between DRBC and NYDEC was executed. Initial discussions have occurred between the Commission and PADEP regarding updating its existing AA (executed in 1976). Additional coordination is anticipated during the FY 2022-2024 period covered by this WRP. DRBC will continue to support state partners in their permitting programs through data collection, assessment, mixing zone analyses, no measurable change evaluations, and other modeling and will issue water quality dockets in accordance with Administrative Agreements and special area management programs, with continued emphasis on cooperative efforts to implement DRBC standards in shared waters. The DRBC database will be updated to incorporate state permit conditions.

2.2.1.4.5 Water Quality Assessment Report

DRBC biennially reports on the conditions of main stem river water quality relative to criteria in accordance with USEPA guidelines for 305 (b) reporting. In 2020, methodological changes were made to help automate the production of the report. The finalized 2020 report[27] is posted on the Commission web site (DRBC, 2020b). Results are described in Part I - Section 1.3.1. The next biennial Water Quality Assessment will be published in 2022.

2.2.1.4.6 Compliance

Staff will continue annual reviews of DRBC-required data submission, such as the annual effluent monitoring reports (AEMRs). Pre-emptive correspondence and notification systems will be continued for docket expiration dates and data/report submittal date reminders.

DRBC WATER RESOURCES PROGRAM
2.2.1.4 Determining Water Quality and Meeting Standards: Criteria-based Programs, Anti-degradation, Water Quality Administration

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Water Quality Standards	Update water quality policy and standards for ammonia	2022-2025	General Fund
	Update designated uses for aquatic life in the estuary to reflect the highest attainable uses.	2022-2025	General Fund, USEPA §106, NJ grant, PA grant

[27] https://www.nj.gov/drbc/library/documents/WQAssessmentReport2020.pdf

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Delaware Estuary Water Quality Monitoring (formerly Boat Run Survey)	Perform rotating monitoring plan to ensure periodic assessment of all parameters (criteria)	Ongoing	USEPA §106
	Data in WQX	Ongoing	USEPA §106
	Perform 305(b) Water Quality Assessment	Ongoing every even numbered year (next 2022)	USEPA §106
	Perform technical assessments in support of State of the Estuary and Basin Reports	Ongoing every 5 years	General Fund
Chronic Toxicity	Ambient surveys and trend analysis of effluent data	2022-2024	USEPA §106
PCBs	Evaluate PMPs and point source monitoring data under Stage 1 PCB TMDLs	Ongoing	USEPA §106
	Support USEPA in establishing Stage 2 TMDLs	Targeted by 2022	USEPA §106
	Continue implementation of Stage 2 TMDLs	After establishment of Stage 2 PCB TMDLs	General Fund, USEPA §106
	PCB monitoring in ambient waters in estuary	2022	USEPA §106
Toxics	Coordination with TAC; recommended criteria revisions	2022-2024	General Fund, DWCF, PACZM, USEPA §106

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
(Ammonia, metals and emerging contaminants)	PFAS study of water, sediment, and fish tissue samples	2021-2022	DWCF 2020 Grant
Water Quality Dockets	Changes to Water Quality regulation and Rules of Practice and Procedure, as required	2022-2024	General Fund
	Review and processing of water quality dockets per AAs	Ongoing	Project Review Fees
Water Quality Assessment Report	Prepare assessment for USEPA and states	2022	USEPA § 106, General Fund
Compliance	Construction start/completion forms, monitoring requirements, annual effluent monitoring reports, docket expirations	Ongoing	General Fund
Eutrophication Model for Delaware Estuary	Development of a 3-D hydrodynamic and eutrophication model.	2022	USEPA §106, PA Grant, NJ Grant, General Fund
	Model calibration and validation for CBOD reallocation, potentially NBOD and/or ammonia allocations, and other nutrient parameters.	2022-2023	

2.2.2 Waterway Corridor Management (KRA #2)

2.2.2.1 Flood Warning and Loss Reduction

2.2.2.2 Enhanced Recreation

2.2.2.3 Aquatic Life and Wildlife Habitat Improvement

2.2.2.1 FLOOD WARNING AND LOSS REDUCTION

Flood loss reduction is a shared responsibility among federal, state, and local agencies and organizations in the Delaware River Basin. DRBC's activities involve coordination, education, planning and permitting. DRBC's Flood Advisory Committee (FAC), which has been inactive, brings together government and non-governmental stakeholders across jurisdictional boundaries and facilitates coordination among agencies to improve the Basin's flood warning system and mitigate flood losses. If resources allow, during calendar year 2022, DRBC may hold one meeting to review the flooding in the lower Basin over the past year and discuss options for adding additional flood forecast locations in the lower Basin (Christina, Red Clay, White Clay Creeks). It is anticipated that new representatives will be needed to fill positions and/or the composition of the FAC reviewed and possibly revised.

2.2.2.1.1 Flood Mitigation Task Force Recommendations

In August 2017, DRBC submitted a proposal under Section 7001 of the Water Resources Reform and Development Act (WRRDA) to the USACE for the development of a Comprehensive Flood Mitigation Study of the Delaware River Basin. The proposed study would further the work of Basin stakeholders in the development and implementation of flood mitigation strategies and result in an Integrated Water Resource Management Program for the Basin that addresses the multiple goals and objectives for the use of water and water resource infrastructure within the Basin, including drought management, habitat protection and flood mitigation.

2.2.2.1.2 Flood Warning and Preparedness

DRBC serves on the Mid-Atlantic River Forecast Center Customer Advisory Board, working to improve NWS products related to flood forecasting and warnings in the DRB and nationwide. As a continuation of previous Education and Outreach Efforts, DRBC created a flood resources portal which makes the information more accessible and focuses on flood warning products, preparedness and DRB flood issues.

2.2.2.1.3 Flood Mitigation

DRBC will be actively engaged with federal entities to monitor the development of robust scientific information to support flood mitigation for the Basin. Up-to-date and regionally relevant information on changes in expected precipitation patterns, climate, and land use patterns, for example, may have a significant impact on how to prepare for storm events and manage floodplains.

During FY 2021-2023, DRBC will assist the Pennsylvania Emergency Management Agency (PEMA) in developing and facilitating viable flood mitigation projects in the Lackawaxen River Watershed for future grant applications. This project is being funded by the Federal Emergency Management Agency (FEMA) 2019 Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM) Grant Programs.

DRBC WATER RESOURCES PROGRAM
2.2.2.1 Flood Warning and Loss Reduction

Program/Projects	Products/Outputs	Fiscal Year	Funding Sources
Flood Warning and Loss Reduction	Assist PEMA with flood mitigation strategies for Lackawaxen Watershed	2021-2023	FEMA FMA/PDM grants
Flood plain dockets	Review and processing of flood plain dockets	Ongoing	Project Review Fees

2.2.2.2 ENHANCED RECREATION

2.2.2.2.1 Recreational Designated Uses

The DRBC supports the Clean Water Act goals, including the goal to achieve "swimmable" waters throughout the Basin. Currently primary contact recreation on the main stem Delaware River is the designated use for all zones except for a 27-mile long segment that comprises Zone 3 and the upper portion of Zone 4. Zone 3 and the upper portion of Zone 4, above River Mile 81.8, are designated as recreation – secondary contact (restricts activities to where the probability of significant contact or water ingestion is minimal), while the lower portion of Zone 4, below River Mile 81.8, is designated for primary contact recreation.

The DRBC assessment criteria[28] for primary contact recreation waters are based on two bacterial parameters, Fecal Coliform and Enterococcus, that are more stringent than in waters designated for recreation – secondary contact (DRBC, 2013c). The DRBC 2020 Water Quality Assessment concluded that the primary contact recreation designated use in Zones 2, 5, and 6 is supported by the monitoring data (DRBC, 2020b). Similarly, the recreation – secondary contact designated use in Zone 3 and the upper portion of Zone 4 is supported by the monitoring data. However, primary contact recreation as a designated use is not yet supported by the data in Zone 3 and the upper portion of Zone 4. Zones 1A, 1B, 1C, 1D, 1E, and the lower portion of Zone 4 had insufficient data for assessment.

The DRBC conducted a two-year, special bacteria monitoring study to assess the likelihood of achieving water quality criteria that would support primary contact recreation in Zones 3 and upper 4. DRBC collected shore-based samples for E. Coli, Fecal Coliform, and Enterococci from locations in Zones 3 and upper 4 in summer 2019 and 2020, at locations where some level of primary (not recommended for health and safety reasons) or secondary contact recreation was

[28] https://www.nj.gov/drbc/library/documents/WQregs.pdf

noted. A presentation[29] of the monitoring results was made to the Water Quality Advisory Committee (WQAC) and is available on the DRBC website. The study results indicated that the water quality criteria for primary contact recreation were not supported by the data. However, some sites could be closer to achieving criteria than others.

The causes of elevated bacteria in Zones 3 and the upper portion of Zone 4 are generally understood to include: 1) discharges of raw sewage from combined sewer overflows (CSOs) following certain wet weather events from the City of Philadelphia, Pa.; the City of Camden, N.J., the City of Gloucester, N.J.; the DELCORA wastewater system in Delaware County, Pa.; and the City of Wilmington, Del.; 2) localized urban runoff during wet weather events (including bacteria from animal sources); 3) overflows of existing sanitary sewer systems during extreme wet weather events; 4) runoff from upstream sources during extreme wet weather events, and 5) unspecified dry weather sources including localized in-situ animal sources such as Canada geese . In terms of addressing discharges from CSOs, the states have worked with their regulated communities to develop and implement CSO Long-Term Control Plans (LTCPs). These plans include significant capital investments over multiple decades to achieve the targeted bacteria load reductions from reductions in CSOs and other infrastructure or operational improvements.

Despite the long-term nature of the infrastructure investment needed to achieve "swimmable" waters by significantly reducing bacteria loadings in the entire area designated for secondary contact recreation, the DRBC, along with other stakeholders, have an aligned interest towards making continued improvements in water quality in the urban estuary and providing additional opportunities for safe and equitable recreational uses. Requests to potentially change water quality standards (designated uses and water quality criteria) for recreational uses have been referred to the DRBC's WQAC for input from diverse stakeholders and for a recommendation to the Commissioners. While that process and the process to implement longer term infrastructure investment continues, this Water Resource Program includes a series of collaborative recommendations and activities, as described below, to continue to examine the potential for enhanced recreational opportunities in the urban Delaware River Estuary. Stakeholders have also raised issues related to instream hazards, such as tidal currents, commercial navigation, and below surface debris, that should be reviewed when considering any revisions to the designated use. Finally, stakeholders have identified equity issues associated with recreational access to the water and affordability impacts associated with infrastructure investment.

The DRBC, along with others, seeks to further increase its understanding of the pollution and water quality and factors that affect bacteria concentrations in Zone 3 and the upper portion of Zone 4, as well as to develop an ability to measure or predict where and when water quality conditions are likely to achieve primary contact recreation criteria. The DRBC will actively engage with the WQAC and its Clean Water Act co-regulators to seek input on development of near-term and long-term activities that improve water quality and increase opportunities for recreational uses in Zones 3 and upper 4. These activities may be considered:

- **New or ongoing water quality monitoring programs** – data and science are foundational for informed decision making either by regulatory agencies or by individuals or groups who may choose to seek recreational opportunities in the urban portion of the Delaware River Estuary. Additional efforts to better understand conditions and trends will be based upon shore-based monitoring, tributary and non-point source monitoring, near-

[29] https://www.nj.gov/drbc/library/documents/WQAC/120320/Yagecic_Review2020BacteriaData.pdf

real-time bacteria indicator (FLUIDION) monitoring, and source assessment monitoring using qPCR to assess human versus non-human bacterial sources.

- **Special studies or analyses** – characterization of sources and loads of bacteria into Zones 3 and upper 4, physical hazard mapping, identification and mapping of existing and potential recreational use areas, research on ingestion and inundation associated with different types of recreational activities, and identification of conservation and restoration activities that could reduce bacteria loads impacting recreational water quality. Some such studies are currently being performed by others including the Roadmap for a Delaware River Upgrade for Recreational Use in Philadelphia and Camden being led by The Water Center at the University of Pennsylvania. These types of studies, or others, can also help inform policy makers, regulatory agencies, stakeholders, and water users.
- **New and innovative assessment tools** – development of a bacteria statistical model (for example, similar to the Philadelphia Water Department RiverCast forecast system for the Schuylkill River) to predict the likelihood of exceedances of applicable criteria based on real-time explanatory variables.
- **Increased coordination and collaboration** – enhanced coordination and advancement of regulatory activities amongst co-regulators (affected Basin states and USEPA Regions II and III) including: a review of aligned regulatory programs that address CSO Long Term Control Plan (LTCP) requirements and limitations; leveraging and building upon the ongoing work of other organizations; and engaging Basin stakeholders through the WQAC and other means.

As noted in Part II – Section 2.1.2 of this Water Resources Program, the Commission is developing a Diversity Equity Inclusion and Justice (DEIJ) strategic plan. That plan and DEIJ principles will provide additional guidance for development and implementation of both short term and longer-term activities related to improved water quality, additional recreational use opportunities, and consideration of affordability.

2.2.2.2.2 Recreation at Reservoirs

DRBC will review plans for enhanced fisheries protection from Beltzville Reservoir when a proposal is developed by the Pennsylvania Fish and Boat Commission (PAFBC). Additional opportunities for recreation in the Lehigh River Valley will be considered as part of the F.E. Walter Reservoir Re-evaluation Study (see Part II - Section 2.2.1.1.4). DRBC will continue to work with the USACE in scoping, coordinating, and evaluating the impacts of new recreation opportunities on existing and proposed uses of water from the reservoir.

2.2.2.3 AQUATIC LIFE AND WILDLIFE HABITAT IMPROVEMENT

2.2.2.3.1 Ecosystem Needs

DRBC intends to remain involved in the development and expansion of creative funding opportunities, such as the Delaware River Basin Conservation Act, which was authorized by Congress in 2016 and supports the Delaware Watershed Conservation Fund (DWCF) grant program that is managed by USFWS as part of the Delaware River Basin Restoration Program (DRBRP). DRBC will continue to increase the understanding of ecosystem needs and habitat conditions in the Basin through ambient water quality monitoring, fluvial geomorphologic

assessments, and macroinvertebrate and periphyton surveys conducted in partnership with federal and state agencies. Commission staff continues to monitor macroinvertebrates, algae, and habitat of the non-tidal Delaware River, working to improve DRBC's existing macroinvertebrate Index of Biological Integrity (IBI) for assessing the aquatic life use of the Delaware River. See also Part II - Section 2.2.1.2.2 for Ecological Flows.

2.2.2.3.2 Ecosystem Restoration

The Commission has agreed to function as the recipient and distributor of certain funds required to be expended as a result of the damages resulting from the 2005 Ash Slurry Spill from the PPL Martins Creek facility, located in Lower Mount Bethel Township, Northampton County, Pennsylvania. The Natural Resource Damage Assessment (NRDA) was developed for the spill by PADEP in consultation with the NJDEP, Pennsylvania Fish and Boat Commission, and DRBC. With the settlement agreement ratified in 2016, the Commission is managing the funds for restoration projects located entirely within Pennsylvania and those defined as "mussel restoration projects," which may be located in Pennsylvania and/or New Jersey. The Pennsylvania restoration projects currently consist of dam removals on the Bushkill Creek. The Commission has entered into an agreement with a local watershed organization, The Wildlands Conservancy, who is taking the lead role in removal of the identified dams located within Pennsylvania. Wildlands is responsible for all design, permitting, administrative and construction costs. DRBC staff is overseeing performance under the Settlement Agreement to ensure that the deliverables are carried out in a timely manner and are consistent with the settlement terms. Dam removals on the Bushkill Creek are anticipated to take place during CY 2022.

2.2.2.3.3 Regional Sediment Management

The USACE and USEPA led a group of agencies in the development of a Regional Sediment Management (RSM) Plan as recommended in the *Water Resources Plan for the Delaware River Basin 2004* (Basin Plan, 2004; Objective 2.3.F.) Two RSM Teams were created: the RSM Workgroup Implementation Team worked with agencies and other entities to oversee the beneficial re-use of dredged material; the Regional Dredging Team worked to address water quality issues during the dredging process and at dredged material placement sites. The Delaware Estuary RSM Plan[30] is available online at the USACE website (USACE, 2013). DRBC staff participated on both teams.

[30] https://www.nap.usace.army.mil/Missions/Civil-Works/Regional-Sediment-Management/Delaware-Estuary-Regional-Sediment-Management/Delaware-Estuary-RSM-Plan/

DRBC WATER RESOURCES PROGRAM
2.2.2.3 Aquatic Life and Wildlife Habitat Improvement

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Ecosystem Needs	Review data and create an Index of Biological Integrity	2021-2022	General Fund
Ecosystem Restoration	Manage distribution of funds for PPL Martins Creek NRDA projects	2022-2023	PPL NRDA settlement via PADEP

2.2.3 Linking Land and Water Resource Management (KRA #3)

3.1 Integrated Resource Management and Watershed Partnerships

3.2 High Value Water Resource Landscapes

2.2.3.1 INTEGRATED RESOURCE MANAGEMENT AND WATERSHED PARTNERSHIPS

2.2.3.1.1 Watershed Management Partnerships

DRBC is involved in watershed management efforts that include watersheds overlapping two or more states as well as projects within a single Basin state, typically as pilot programs for larger multi-jurisdictional management efforts or when those projects have an effect on the Basin. Staff is involved with collaborative partnerships in these watersheds:

- **Christina Watershed.** DRBC is a founding member of the Christina Basin Clean Water Partnership, which was established in the 1990s to improve source water quality in the 300 mi^2, interstate watershed. DRBC participates in activities and provides support as the Partnership continues implementation of its long-term clean water strategy.
- **Coalition for the Delaware River Watershed.** CDRW is a coalition of non-governmental organizations created to achieve greater national recognition and funding for the Basin. DRBC's involvement is limited to general assistance and participation in the annual Forum.
- **Common Waters.** DRBC is a member of the Common Waters collaborative, which is led by the Pinchot Institute and dedicated to protection of the headwaters of the Delaware River Basin, a drinking water source for millions of users.
- **Delaware River Watershed Initiative.** This initiative has brought significant financial resources to bear in eight geographic areas (watershed "clusters") in the Basin through

the support of the William Penn Foundation (WPF). DRBC is involved in an advisory committee that provides oversight for mapping and modeling future growth (DRB Land Use Dynamics) led by Shippensburg University. Several SAN projects in two Schuylkill "clusters" are supported by WPF funds through this initiative. Projects are also supported in the Brandywine-Christina Basin and Poconos-Kittatinny cluster located in the Basin headwaters.

- **Schuylkill River Watershed.** DRBC is a founding member of the Schuylkill Action Network (SAN), a collaboration among federal, state, and regional agencies for local implementation of source water protection projects. DRBC serves on the Executive Steering and Planning Committees to oversee Work Groups that prepare and execute projects to improve the management of stormwater, agricultural activities, wastewater discharges, and mining reclamation. In addition, a portion of the Schuylkill River Restoration Fund (SRRF, see below) is directed to projects identified through SAN as priority source water protection projects.

2.2.3.1.2 Watershed Restoration

The Schuylkill River Restoration Fund, a unique public/private partnership, provides grants to local governments and non-profit organizations for projects that improve the quality of water in the Schuylkill watershed. The grants focus on three major sources of pollution: stormwater run-off, agricultural pollution, and abandoned mine drainage. DRBC participates in the steering committee that reviews proposals, selects projects for funding, and oversees program direction and expansion. The Executive Director is responsible for approving the distribution of Exelon Generation LLC's contributions to the SRRF.

2.2.3.1.3 Delaware Valley Early Warning System

The Delaware Valley Early Warning System (EWS) is an integrated monitoring, communication, and notification system used to provide advanced warning of water quality events to water suppliers and industrial intake operators in the Schuylkill and Delaware River watersheds. The EWS was initially deployed in 2004 and by 2008 had grown to include over 250 users in 47 different organizations within the EWS coverage area. The Commission is one of many EWS partners, which include 23 water treatment plants (WTPs) from 12 utilities in Pennsylvania and 5 WTPs from 5 utilities in New Jersey, along with PADEP, NJDEP, USEPA, USGS, US Coast Guard, County Health Departments, and over 25 industries. The EWS provides advanced warning of water quality events, web-based tools for determining proper event response, and a strong partnership between water users and emergency responders in the Schuylkill and Delaware River watersheds. The Commission currently serves as the "banker" for handling the annual administrative/user fees.

2.2.3.2 HIGH VALUE WATER RESOURCE LANDSCAPES

DRBC promotes sound practices of watershed management in the Basin (Compact §7.1). The Basin Plan goals regarding watershed management include:

- Preserving and restoring natural hydrologic cycles through improved stormwater management
- Maintaining and restoring the function of High Value Water Resource Landscapes

- The integration of water resource considerations into land use planning and growth management

The protection of water resources is incorporated into all DRBC programs, regulations, and permit conditions.

DRBC WATER RESOURCES PROGRAM
2.2.3 Linking Land and Water Resource Management

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Christina Clean Water Partnership	Continued participation to meet Long Term goal of restoring the water quality of all watershed streams to designated uses	Ongoing	General Fund
Coalition for the Delaware River Watershed	General assistance and participation in the annual Forum	Ongoing	General Fund
Common Waters	Participate with the Pinchot Institute for protection of the headwaters of the Delaware River Basin	Ongoing	General Fund
Delaware River Watershed Initiative	Participation in steering committees and workgroups as needed	Ongoing	General Fund
Schuylkill Action Network	Participation in the facilitation and oversight of watershed improvement projects for source water protection	Ongoing	General Fund
Watershed Restoration: Schuylkill River Restoration Fund	Annual review and recommendations of projects for funding	Ongoing	General Fund

2.2.4 Institutional Coordination and Cooperation (KRA #4)

4.1 Intergovernmental Coordination

4.2 Data Sharing and Management

4.3 Agency Funding

4.4 Associations and Internal Advisory Committees

4.5 Utilizing Planning and Regulatory Authority

2.2.4.1 INTERGOVERNMENTAL COORDINATION

2.2.4.1.1 Federal and Interagency Collaborative Partnerships

It is important that the activities and authorities of the Commission and of the multiple federal, state, and local governmental agency efforts to manage the water resources of the Basin are conducted in a coordinated and supportive fashion. Collaboration among state and interstate agencies across Basin boundaries encourages the exchange of information, ideas, and experience and supports initiatives of benefit to member agencies and to water resources management generally. The Commission is involved in several federal/state initiatives that not only stimulate positive environmental outcomes in the Basin, but also help shape water policy on regional and national scales. Other activities are focused on improving coordination and collaboration generally among federal and state agencies with authorities within the Basin, as well as with regional entities. This includes many ongoing as well as special initiatives.

- **Delaware Estuary Program.** Participation in multiple DELEP committees (Steering Committee, Estuary Implementation (EIC), Science and Technical Advisory Committee (STAC)), as well as special projects (State of the Estuary) and events (biennial Science Summit conference). DRBC assisted with the update of the Comprehensive Conservation Management Plan (CCMP) for the Delaware Estuary, which was completed in FY 2019. DRBC will continue to submit annual updates to the CCMP goal/strategy progress tracking tool.
- **Fish and Wildlife Management Cooperative – Delaware River Basin**. DRBC participates as a non-voting liaison to this Cooperative, which deals primarily with fishery management issues. DRBC also assists the Cooperative with field work as well as giving guidance on Basin issues and initiatives.
- **Lower Delaware Wild and Scenic Partnership River.** DRBC is a management committee member for implementation for the Lower Delaware Wild and Scenic Management Plan. DRBC has a collaborative relationship with NPS. DRBC conducts water quality monitoring and assessment in support of the Lower Delaware.
- **Office of the Delaware River Master.** DRBC coordinates with the Office of the Delaware River Master (ODRM) on flow related issues and negotiations regarding the Decree Parties.
- **Special Protection Waters (SPW) Monitoring Program.** This long-standing comprehensive water quality monitoring program (formerly referred to as Scenic Rivers

Monitoring Program) is a collaborative partnership between the DRBC and National Park Service (NPS) on the Upper and Middle Delaware designations.

- **Upper Delaware Council.** DRBC is a non-voting member of the UDC, which encourages collaboration among municipalities in the Upper Delaware Scenic and Recreational River corridor and reviews actions for conformity with the area-wide Management Plan.
- **USFWS Delaware River Basin Restoration Program.** The Delaware River Basin Conservation Act, signed into law in December 2016, emphasized the need for federal, state, and local governments and regional organizations to come together to identify, prioritize and implement restoration activities within the Basin. The Act established the Delaware River Basin Restoration Program (DRBRP), which is managed by USFWS and of which DRBC is a partner. DRBC serves as a standing member of the steering committee, the Delaware River Watershed Conservation Collaborative (DRWCC). DRBC is an active participant in the implementation of appropriated funds including review and approval of grant applications to the Delaware Watershed Conservation Fund (DWCF), which is administered by the National Fish and Wildlife Foundation (NFWF). DRBC will explore ways to work towards complementary purposes with the DRBRP via increased coordination, collaboration, and integration.
- **U.S. Coast Guard Local Area Committee.** Staff routinely participate in meetings of the U.S. Coast Guard Local Area Committee. This group exchanges information and updates the action plan for responding to spills of oil and other hazardous chemicals known as the *Local Area Contingency Plan*. Staff have provided technical support, modeling, and monitoring in support of the Coast Guard and state first responders.

2.2.4.1.2 State-DRBC Coordination

Actions and activities to improve coordination with agencies of the Basin states include:

- **Update DRBC-State Administrative Agreements.** On March 11, 2015, the Commission adopted Resolution No 2015-4 directing the Executive Director to initiate rulemaking to amend the Commission's Rules of Practice and Procedure to establish the One Process / One Permit Program (Rule). The Commission published a draft Rule in May 2015 and held a public hearing in June 2015. The Commission approved the Rule in December 2015. Since passing the Rule, DRBC has executed Administrative Agreements (AAs) with New Jersey and New York. Initial discussions have occurred between the Commission and PADEP regarding updating its existing AA (executed in 1976). Additional coordination is anticipated during the FY 2022-2024 period covered by this WRP.
- **State Advisory Committees.** DRBC participates in the New Jersey Water Supply Advisory Council, NJDEP Water Monitoring Council, and serves as a legislated member of the New Jersey Clean Water Council and the Delaware Water Supply Coordinating Council. DRBC also serves on the Drought Management Task Force for Pennsylvania.

2.2.4.2 DATA SHARING AND MANAGEMENT

Maintaining a Geographic Information System (GIS), along with gathering, processing, and mapping new data, is crucial for water resource management programs and projects within and external to DRBC. Staff will continue to provide interactive maps on the DRBC web site to allow for continued public access to information and water resources data. Maintaining the

Commission's Integrated Database, which includes water charging, water use, communications, and project review information, is also vital to implementing core Commission programs. Staff will continue efforts to assimilate data from the four Basin states and maintain datasets to support analysis at the Basin scale. The Commission's library and central files contain hard copies of the Commission's dockets and applicant information, vital to day-to-day operations and serves as the mechanism to capture and log official Commission actions.

During CY 2021, DRBC will initiate a Basin-focused Data Portal on the DRBC website, with funding from a DWCF 2020 grant, for the purpose of facilitating easier access to, and increased awareness of, the data available in the Basin to support restoration and conservation efforts.

2.2.4.3 AGENCY FUNDING

The Basin Plan acknowledges the necessity of securing adequate resources to support water resource management, as well as the challenge of doing so. DRBC management works to secure funding for ongoing agency support as well as for special projects. Staff efforts will focus on the following:

- Project/user Fees: Continue to evaluate and implement the annual monitoring and coordination fee program. Update and maintain fee structures for the regulatory program, including annually adjusting fees for review of project applications and coordinating with state permitting programs based upon the CPI.
- Re-establish and/or maintain signatory party contributions.

2.2.4.4 ASSOCIATIONS AND INTERNAL ADVISORY COMMITTEES

This category includes both voluntary partnerships with national and international organizations and committees assembled by DRBC for expert advice and support for the development and implementation of DRBC programs.

2.2.4.4.1 Associations

DRBC remains a partner in the Association of Clean Water Administrators (ACWA), the Interstate Council of Water Policy (ICWP), and the American Water Resources Association (AWRA). As water resource management faces the growing challenges associated with a changing climate, a challenging fiscal future, infrastructure needs, and shifting political environments, involvement with these partners will be of increasing benefit to DRBC.

2.2.4.4.2 DRBC Internal Advisory Committees

Continuing a long-standing practice, advisory committees aid the Commission in policy and standards development. Eight advisory committees meet on a regular basis. All administrative needs are met by DRBC staff, including the development of agendas, arrangement of venues, communicating with members, and processing formal meeting minutes. Staff also coordinates internally on issues that cut across the interests or expertise of more than one committee. Major focus issues for the advisory committees and subcommittees include:

- **Advisory Committee on Climate Change**. The ACCC is the newest advisory committee. It will provide the Commission and the Delaware River Basin community with vital

expertise, information, and advice as we endeavor to maintain and improve streamflows, water quality, habitat, wetlands, and watersheds in the face of changing hydrologic conditions and sea level rise.

- **Flood Advisory Committee.** The FAC has been inactive. If resources allow, during FY 2022, DRBC may hold one meeting to review the flooding in the lower Basin over the past year and discuss options for adding additional flood forecast locations in the lower Basin (Christina, Red Clay, White Clay Creeks). It is anticipated that new representatives will be needed to fill positions and/or the composition of the FAC reviewed and possibly revised.
- **Monitoring Advisory and Coordination Committee**. The MACC will review and offer recommendations for the improvement of Basin monitoring activities and will seek to enhance coordination among the parties with respect to monitoring programs and data sharing.
- **Regulated Flows Advisory Committee**. The RFAC serves as a vehicle for public input into the Flexible Flow Management Program and will continue to focus on reservoir operations, instream flow needs, and flooding. RFAC will be used to work with the public on, and convey information about, the FFMP 2017 studies.
- **Subcommittee on Ecological Flows**. The SEF will continue to focus on review of the Thermal Mitigation and Rapid Flow Change Guidelines for the banks provided by FFMP 2017. In addition, SEF will be charged with additional tasks to assess habitat issues.
- **Toxics Advisory Committee**. The TAC will be focusing on the review of new and existing toxics criteria including ammonia and emerging contaminants.
- **Water Management Advisory Committee**. The WMAC will continue to focus on the results of the water loss accounting program, groundwater management, and supply sufficiency. The committee will also review work on ecological flows as it progresses.
- **Water Quality Advisory Committee.** The WQAC will be focusing on a review of aquatic life designated uses and associated criteria for Zones 3 – 5, as well as development of a strategy to reduce bacteria levels in Zone 3 and 4. Work of the Expert Panel to consult on the development of the eutrophication model will continue.

2.2.4.5 UTILIZING PLANNING AND REGULATORY AUTHORITY

The Commission's planning and regulatory authority is used to facilitate, coordinate, and effect cooperation among water resource efforts across the Basin. Staff efforts to improve and direct the efficiency of DRBC programs include preparation of tools to guide resource allocation in accordance with Commissioner priorities. Based upon the mandate of the Compact and the goals of the Basin Plan, the Water Resources Program (WRP) notes the current conditions and needs of the Basin, the scope of DRBC programs, and the expected milestones to be achieved for a three-fiscal year time horizon. The DRBC Budget details the receipt and distribution of financial resources to carry out the associated fiscal year activities.

- **Water Resources Program**. A prospective, multi-year program prepared annually.
- **DRBC Budget.** Prepared annually.

DRBC WATER RESOURCES PROGRAM
2.2.4 Institutional Coordination and Cooperation

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
2.2.4.1 Intergovernmental Coordination			
Delaware Estuary Program (DELEP)	Participate in multiple committees (Steering, EIC, STAC) and in implementation of the revised CCMP	Ongoing	General Fund
Fish and Wildlife Management Cooperative	Coordination, management plans	Ongoing	General Fund
Lower Delaware Wild and Scenic Steering Committee	Voting member, monthly conference call, quarterly management council meetings	Ongoing	General Fund
Upper Delaware Council	Ex-Officio, non-voting member	Ongoing	General Fund
USFWS Delaware River Basin Restoration Program	Standing member of steering committee; Partner participant in the implementation of appropriated funds	2022-2024	General Fund
	Develop Roadmap for Program Integration	2021-2022	DWCF 2020 Grant
U.S. Coast Guard Local Area Committee	Routine participation in meetings	Ongoing	General Fund
Revise/Update DRBC-State Administrative Agreements	Update and maintain DRBC-state Administrative Agreements	2022-2024	General Fund
Delaware Water Supply Coordinating Council	Meetings as scheduled, typically quarterly	Ongoing	General Fund

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Pennsylvania Drought Task Force	Meetings scheduled as needed	On-going	General Fund
NJ Clean Water Council	Permanent, legislated member; Monthly meetings, periodic chairmanship, annual public hearing	Ongoing	General Fund
NJ Water Supply Advisory Council	Meetings as scheduled, typically monthly	Ongoing	General Fund
NJ Water Monitoring Coordinating Council	Meetings as scheduled	Ongoing	General Fund
2.2.4.2 Data Sharing and Management			
Data Sharing and Management	IT systems update and maintenance, GIS data assembly, processing and distribution	Ongoing	General Fund
	Develop Data Portal	2021	DWCF 2020 Grant
2.2.4.3 Agency Funding			
Securing Funding	Meetings with federal and state legislators, state agency managers. Outreach to Basin community.	Ongoing	General Fund
2.2.4.4 Associations and Internal Advisory Committees			
ACWA	Contribute to discourse on national water policy, federal legislation and support for gaging infrastructure, and the development of federal decision support tools for water resource decisions	Ongoing	General Fund
AWRA			
ICWP			

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
DRBC Advisory Committees	Meetings as scheduled and/or necessary	Ongoing	General Fund
2.2.4.5 Utilizing Planning and Regulatory Authority			
Water Resources Program	Prepared annually	Ongoing	General Fund
DRBC Budget	Prepared annually	Ongoing	General Fund

2.2.5 Education and Outreach for Stewardship (KRA #5)

5.1 Reporting

5.2 Public Information

5.3 Technical Outreach

5.4 Promoting Stewardship

2.2.5.1 REPORTING

Many DRBC projects and programs have individual reporting elements. These are included as products and outputs for the fiscal year of their scheduled delivery. There are also routine reporting activities that require more significant resources for coordination, integration, and production. Among these are:

- **State of the Basin Report.** By resolution, DRBC is required to compile an "indicators" report every five years to review current trends and conditions in the Delaware River Basin. The most recent report was published in early FY 2020.
- **DRBC Annual Report.** Required by the Compact, this report reviews programs, activities, products, and milestones achieved during a calendar year. The most recent report published is the 2019 Annual Report[31] (DRBC, 2020a). DRBC annual reports[32] from 1969 onwards are available on the DRBC website.

[31] https://www.state.nj.us/drbc/library/documents/2019AR.pdf

[32] https://www.state.nj.us/drbc/public/annual-reports/index.html

2.2.5.2 PUBLIC INFORMATION

DRBC staff responds in a timely manner to inquiries and requests from the public, federal/state/local government officials, regulated community, students, educators, and the news media. This includes hosting visits by international delegations who wish to learn from Commission staff about water resource management at the Basin scale. DRBC also produces various publications and materials about the Basin and water resource management issues, many of which are available on the DRBC website.

The DRBC's website continues to be the Commission's primary communications tool, with an emphasis on providing information that is accurate, up-to-date, and presented in a user-friendly manner. The DRBC website makes extensive use of links to external government and other sites where additional information is available. Listserv capabilities allow DRBC to provide subject-specific information via email to recipients who have subscribed on the website to receive updates. In addition, the website is used for submitting on-line project review applications and for reporting.

Beginning in 2019, DRBC staff began systematic, proactive outreach to DRB state and federal elected officials. Face-to-face meetings with officials and legislative staff briefings were held to ensure that there is a collective and individual understanding and value of both the Basin's water resources and the Commission itself.

The DRBC uses several social media tools (Twitter, Flickr, LinkedIn, YouTube, and Instagram) to share news on Commission activities and related information. These may be accessed at:

- Twitter: https://twitter.com/DRBC1961/
- Flickr: https://www.flickr.com/photos/drbc1961/collections/
- LinkedIn: https://www.linkedin.com/company/delaware-river-basin-commission/
- YouTube: https://www.youtube.com/user/delrivbasincomm/
- Instagram: https://www.instagram.com/drbc1961/

In 2019 and in 2020, the William Penn Foundation provided funding for a DRBC-managed public outreach campaign designed to 1) provide Basin water-related organizations with a broader public exposure; 2) increase awareness of the DRB and the critical role it plays in their local water resources; and 3) provide a mechanism for the DRB community to contribute to a collective evaluation of the Basin's waters. Called "*Our Shared Waters*", the program includes an online component (Facebook, websites, and social/digital advertising), increased participation at community events, and experiential opportunities for Basin residents to get out on the Delaware River. Our Shared Waters is funded through December 2022.

2.2.5.3 TECHNICAL OUTREACH

In order to keep current on technical issues and to share information with peers and various stakeholders, DRBC staff members attend and/or participate in regional, state, and national conferences and workshops throughout the year hosted by other government agencies, professional groups, or other organizations. DRBC periodically hosts workshops on timely issues. The DRBC website and social media sites are used to supplement this information exchange.

2.2.5.4 PROMOTING STEWARDSHIP

Commission staff communicates information in various formats and, as funding allows, participates in a variety of events, workshops, and conferences throughout the Basin to raise public awareness about water resource issues affecting the watershed and the need for stewardship. DRBC continues to support the Delaware River Sojourn through its active membership on the steering committee. Additionally, as part of the Our Shared Waters program (Part II - Section 2.2.5.2 above), Commission staff participates in both on-the-water experiential events (such as educational sales aboard the AJ Meerwald) and Basin community festivals and events such as the Delaware River Festival, Coast Day, and Easton Heritage Day, among others.

DRBC WATER RESOURCES PROGRAM
2.2.5 Education and Outreach for stewardship

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
2.2.5.1 Reporting			
DRBC Annual Report	Report – post on web; limited paper copies	Ongoing	General Fund
2.2.5.2 Public Information			
Provide timely information to the Public	Clear, consistent message on water resource issues and DRBC activities; produce various handouts	Ongoing	General Fund
Media/External Relations	Clear, consistent message on water resource issues and DRBC activities; timely responses	Ongoing	General Fund
Our Shared Waters	Educating the public and decisionmakers about the current state of the Basin and the opportunities available to support its continued sustainability	2020-2023	WPF Grant

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Website	New features, improvements, updated information	Ongoing	General Fund
Host foreign delegation visits	Information exchange	Ongoing	General Fund
2.2.5.3 Technical Outreach			
Conference attendance and presentations	Information exchange	Ongoing	General Fund
Social media	Information exchange	Ongoing	General Fund
2.2.5.4 Stewardship Events			
Community events	Delaware River Sojourn, Lambertville Shad Festival, EarthFest, HydroMania, Coast Days, educator training, etc.	Ongoing	General Fund
Event follow-up	Information on website	Ongoing	General Fund

2.2.6 Special Section: Hydraulic Fracturing

By Resolution No. 2021-01[33] at a special meeting on February 25, 2021, the Commission adopted a final rule amending the Water Code and Comprehensive Plan to prohibit high volume hydraulic fracturing (HVHF) in the Delaware River Basin. As stated in the resolution, in adopting the final rule, the Commission determined that:

- HVHF poses significant, immediate and long-term risks to the development, conservation, utilization, management, and preservation of the water resources of the Delaware River

[33] https://www.nj.gov/drbc/library/documents/Res2021-01_HVHF.pdf

Basin and to Special Protection Waters of the Basin, considered by the Commission to have exceptionally high scenic, recreational, ecological and/or water supply values.

- Controlling future pollution by prohibiting such activity in the Basin is required to effectuate the Comprehensive Plan, avoid injury to the waters of the Basin as contemplated by the Comprehensive Plan, and protect the public health and preserve the waters of the Basin for uses in accordance with the Comprehensive Plan.

As a part of Resolution 2021-01, the Commission also adopted the February 25, 2021, Comment and Response Document[34] in its entirety (DRBC, 2021). In addition to responding to the comments received during the rulemaking process, the CRD provides background and support for the Commission's action. It makes extensive reference to scientific and technical literature and to the reports, studies, findings, and conclusions of other government agencies, which the Commission reviewed and considered in the course of its decision making.

In a separate Resolution for the Minutes[35], the Commissioners provided that no later than September 30, 2021, the Executive Director will prepare and publish for public comment a set of amendments to the Comprehensive Plan and implementing regulations to update its policies and provisions concerning inter-basin transfers of water and wastewater from and to the Delaware River Basin.

[34] https://www.nj.gov/drbc/library/documents/CRD_HVHFrulemaking.pdf

[35] https://www.nj.gov/drbc/library/documents/ResForMinutes022521_regs-transfers.pdf

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APPENDIX A

SUPPLEMENTAL TABLE A: Summary of Prospective Changes to DRBC Comprehensive Plan, Regulations and/or Programs

Management Topic	Affected Program and/or Rule	Products/Outputs	FY 2022	FY 2023	FY 2024
Import/Export Rules	Comprehensive Plan, Water Code, Rules of Practice & Procedure (RPP), and Project Review Program	Regulations concerning inter-basin transfers of water and wastewater	Publish for public comment by September 30, 2021	Implement any adopted rules	
Rule Updates	RPP	Update fees and other provisions as necessary	Evaluation and rulemaking as directed		
	Water Code, Water Quality Regulations	Replace Incorporation by Reference in the Code of Federal Regulations (CFR) by codifying all sections in the CFR	Evaluation and rulemaking as directed		
Interagency Project Review Coordination	Administrative Agreements	Alignment with partner agencies	Update and implement Administrative Agreements (AA)		

Management Topic	Affected Program and/or Rule	Products/Outputs	FY 2022	FY 2023	FY 2024
Water Supply	Comprehensive Plan	Update Comprehensive Plan including Existing Facilities Inventory	Water Inventory, Water Budget and Needs Assessments, Water Supply Options		Initiate Comprehensive Plan Update Process
Ecological Flow Requirements	Comprehensive Plan and Water Code	Update Water Code to include pass-by flows, conservation releases, and consumptive use mitigation trigger policies	Technical Review and Analysis to support future Policy Options, Recommendations, and Rule Development and Proposal, as appropriate (beginning FY 2023)		
Water Quality	Designated Uses and Stream Quality Objectives	Aquatic Life Designated Use Project (Zones 3 – 5) (WQAC Coordination)	Model calibration; Draft analysis of attainability		Develop rule and implementation strategy (FY 2025)
		Stage 2 PCB TMDLs	USEPA to Establish TMDLs		Assist with implementation and management
		Revised ammonia toxicity criteria (TAC Coordination)	TAC Recommendations		Rulemaking Process and Adoption beyond 2024
		Recreational Designated Use Strategy	Conduct monitoring, coordinate with co-regulators, and engage stakeholders to develop a strategy to reduce bacteria levels in Zones 3 and 4 (see Part II - Section 2.2.2.2.1)		

Management Topic	Affected Program and/or Rule	Products/Outputs	FY 2022	FY 2023	FY 2024
		Revised allocation methods for SPW	Initiate discussion on alternative No Measurable Change (NMC) allocation methods for watersheds draining into Special Protection Waters. Develop policy options and possible rule revisions as appropriate.		

APPENDIX B

SUPPLEMENTAL TABLE B: Summary of Modeling Projects

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Flow Management	Continued use and maintenance of DRB-PST and salinity screening and 3-D models to support the evaluation of water supply management options, salinity intrusion, and Decree Party negotiations	On-going	General Fund
	Updated HEC-HMS model for the DRB (USACE PAS program)	2022	USACE, DRBC in-kind
Water Supply Planning	Assess future water availability against withdrawal projections and drought of record	On-going	General Fund
Emergency Response	Real time, one-dimensional flow and transport model	Daily	General Fund
	Water quality model	As needed	
	Rapid Dilution Assessment Tool	As needed	
Lower Delaware River and Tributaries Model	Model refinement and validation	As needed	General Fund
Brodhead Model	Model refinement and validation	As needed	General Fund
Neversink Model	Model refinement and validation	As needed	General Fund

Program/Project	Products/Outputs	Fiscal Year	Funding Sources
Lehigh River Model	Model refinement and validation	As needed	General Fund
Eutrophication Model for Delaware Estuary	Development of a state of the art 3-D hydrodynamic and eutrophication model. Data collection for model calibration	2021-2023	USEPA §106, General Fund, PA and NJ grants
	Model calibration and validation for CBOD, NBOD and ammonia allocations, and other nutrient requirements	2021-2023	USEPA §106, General Fund
CORMIX mixing zone models	Project Review and NPDES permit support	As needed	General Fund