BARNEGAT BAY PARTNERSHIP

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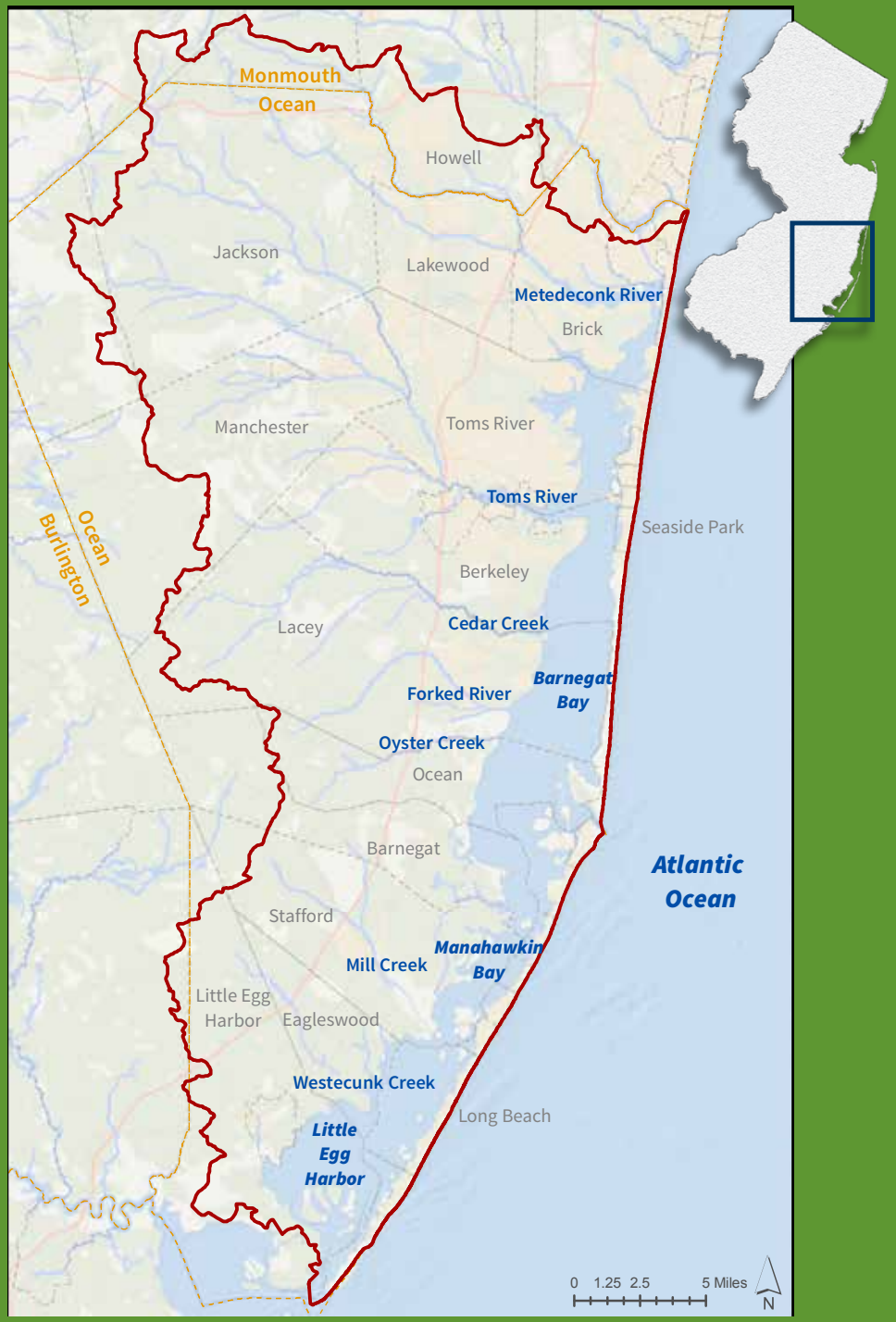
STATE OF THE BAY REPORT | 2021



COVER PHOTOS (l. to r.):
Measuring salt marsh resiliency. Photo by Barnegat Bay Partnership.
Preparing to seine. Photo by Pat Trotter.
Water Quality Monitoring. Photo by Barnegat Bay Partnership.
Capturing coordinates using an RTK system. Photo by Barnegat Bay Partnership.

OPPOSITE: Fall colors on the marsh at Island Beach State Park.
Photo by Emily Pirl/BBP.

BACK COVER: Barnegat Bay Estuary Sunrise. Photo by Michael Leon.

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Fall colors on the marsh at Island Beach State Park. Photo by Emily Pirl/BBP.

Director's Comments

The Barnegat Bay Partnership (BBP) recently released its 2021 ***Comprehensive Conservation and Management Plan*** (CCMP) as a roadmap to protecting and restoring the Barnegat Bay ecosystem for the next ten years. This was the first revision of the BBP's ***CCMP*** since the publication of the original 2002 ***CCMP***, which did not include the phrases/words "climate change, sea level rise, or jellyfish" anywhere in the document. The 2021 ***CCMP*** reflects significant improvements in our understanding of the bay's ecology that were identified as information gaps in the 2011 and 2016 ***State of the Bay*** (SOTB) reports. While most 2002 *CCMP* priorities (water quality, water supply, habitats, and living resources) remain as priorities in the 2021 ***CCMP***, a new priority, land use, has been added. The 2021 ***CCMP*** also identified specific goals, objectives, and actions within each priority area, all of which were considered with regard to specific manifestations of climate change.

We considered specific climate-change manifestations identified as priorities for EPA nationally [1]: 1) more variable summer weather (*e.g.*, the warm season being warmer than it was previously); 2) more variable winter weather (*e.g.*, the cold season not being as cold as it was); 3) warmer ocean, bay, and inland waters; 4) increasing duration, frequency, and severity of drought; 5) increasing storminess, encompassing precipitation in any form (*e.g.*, rain, snow) and its impacts (*e.g.*, storm surge, floods); 6) sea level rise, along the shore, in the bay, and farther inland; and lastly, 7) coastal and ocean acidification. Some of these climate-change manifestations are already occurring in the northeastern U.S., including New Jersey[2] .

In a significant improvement over the 2002 ***CCMP***, the 2021 ***CCMP*** also identified broad, aspirational, holistic-based targets, developed to integrate CCMP actions and environmental change across different priorities. These targets are based ***mostly*** upon existing data sets and are included as a component of existing monitoring programs within Barnegat Bay. The targets identified below were developed by considering the challenges of not only guarding against future loss/degradation in each respective area, but also of working toward measurable improvement in and restoration of these natural resources. Thus, we felt it important that our 2021 *SOTB* Report be re-organized to reflect our new ecosystem-based targets. Several targets would increase the acreage of key aquatic habitats: **Submerged Aquatic Vegetation (SAV) beds, Tidal Wetlands,** and **Approved Shellfish Areas**. These habitats reflect existing water quality and other conditions, provide other important ecosystem services, and support populations of biologically, commercially and recreationally important fishes, shellfishes, and other wildlife. In addition to simply increasing the acreage of shellfish beds, we also have set a target to increase **Hard Clam Abundance,** which has traditionally sustained the bay's most important commercial fishery and both responds and contributes to water quality improvements.

Using data collected over decades at sites throughout Ocean County, we have set two related targets to increase **Public Bay Beach Openings and Reduce Bay Beach Closures** to increase public access to and enjoyment of the bay. As the human population continues to rebound post-Sandy, we have also set a **Water Conservation** target to maintain adequate water for people. Additional details about these targets and their science-based foundations are provided in the accompanying report.

Unfortunately, SAV acreage is not regularly monitored throughout the Barnegat Bay, which is home to the largest population of eelgrass in New Jersey. This lack of information impacts our understanding of SAV beds in the bay, which post-Sandy assessments suggest are changing as a result of habitat changes in the bay and possibly climate change and sea level rise. We also lack information to establish two targets in the 2021 ***CCMP***, much as we lacked data to establish the conditions and trends of some indicators in previous ***SOTB*** reports. Acquiring information for these targets is critical for the protection and restoration of Barnegat Bay. First, we need document the current acreage of **wetland and riparian buffers** so that we can maintain or increase their size. Such buffers protect water quality, provide critical habitats for wildlife, and provide corridors for future wetland migration as sea level rises. We also set a target to maintain flows higher than **minimum ecological flows** for gauged waterways within the watershed. To achieve this target, the minimum ecological flows for gauged waterways need to be determined.

We have made significant progress improving our understanding of the bay; nonetheless, additional information about these three targets (**SAV acreage, wetland and riparian buffers,** and **minimum ecological flows**) is critical. These monitoring baselines are critical to assessing our efforts to improve the bay's condition.

While Superstorm Sandy was almost unprecedented in its impacts to the bay and the human population along the Jersey Shore, now nearly 10 years after Sandy, a larger and more lethal storm, COVID-19, has cut a swath across New Jersey, the entire nation, and the world. Climate change has been increasingly recognized to affect the geographic range, seasonality, and intensity of transmission of infectious diseases through food, water, and disease-carrying vectors[3]. More importantly, we know that COVID19 and climate change may also disproportionately impact communities with environmental justice concerns. New Jersey has provided additional tools[4] to identify overburdened communities and help address concerns. We must strengthen our efforts to work with all communities throughout the Barnegat Bay watershed.

To face these challenges, the Barnegat Bay Partnership will continue to use the best science available to work towards restoring and protecting this unique ecosystem that we all treasure. We hope that you will join us on these endeavors and build upon the successes of the past five years. To find out how you can help, please visit our website at www.barnegatbaypartnership.org

Barnegat Inlet lighthouse. Photo by Kathy White.

[1] U.S. Environmental Protection Agency. 2014. Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans. United States Environmental Protection Agency, Office of Water, Climate Ready Estuaries, Washington, DC 20460, EPA 842-K-14-002, 121 pp. https://www.epa.gov/sites/production/files/2014-09/documents/being_prepared_workbook_508.pdf.

[2] Dupigny-Giroux, L.A., E.L. Mecray, M.D. Lemcke-Stampone, G.A. Hodgkins, E.E. Lentz, K.E. Mills, E.D. Lane, R. Miller, D.Y. Hollinger, W.D. Solecki, G.A. Wellenius, P.E. Sheffield, A.B. MacDonald, and C. Caldwell, 2018: Northeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 669–742. doi: 10.7930/NCA4.2018.CH18; On the Web: https://nca2018.globalchange.gov/chapter/18/

[3] Ebi, K.L., J.M. Balbus, G. Luber, A. Bole, A. Crimmins, G. Glass, S. Saha, M.M. Shimamoto, J. Trtanj, and J.L. White-Newsome, 2018: Human Health. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Chang Research Program, Washington, DC, USA, pp. 572–603. doi: 10.7930/NCA4.2018.CH14; On the Web: https://nca2018.globalchange.gov/chapter/health

[4] New Jersey Environmental Justice Mapping Tool. 2021. New Jersey Department of Environmental Protection, Trenton, New Jersey. See https://www.arcgis.com/apps/webappviewer/index.html?id=34e507ead25b4aa5a5051dbb85e55055.

Executive Summary

This 2021 State of the Bay Report presents the current environmental conditions of the Barnegat Bay and its watershed, and compares current conditions with Ecosystem-Based Targets identified during the development of the Barnegat Bay Partnership's (BBP) 2021 Comprehensive Conservation and Management Plan (CCMP). In this report, eight holistic ecosystem targets are used to describe the overall physical, chemical, and biotic conditions of Barnegat Bay using recent and ongoing research by academic, government, and private-sector scientists and engineers.

Studies conducted by the National Oceanic and Atmospheric Administration in 1999 and 2007 reported that Barnegat Bay was impacted by excessive macroalgae and nuisance algal blooms, declaring it highly eutrophic. These conditions were largely attributed to increasing watershed development and associated increases in non-point source nitrogen loads. In 2011 and 2016, the BBP (a National Estuary Program comprised of federal, state, county, municipal, academic, business, nonprofit, and private organizations working together to protect Barnegat Bay) prepared State of the Bay Reports documenting continued excess nitrogen inputs to the bay, further losses in tidal wetland habitats, and increases in the amount of water withdrawn from rivers, streams, and aquifers for human use. However, good news was found in the continued preservation of open space preservation throughout the watershed and reductions in the number of bathing-beach closures.

Spurred on by the findings of these reports, a revision to the Barnegat Bay Partnership's Comprehensive Conservation and Management Plan resulted in the adoption of eight broad Ecosystem-Based Targets designed with a focus on holistically assessing the watershed. Members of the BBP also moved forward with various restoration projects to reduce negative impacts to the bay associated with watershed development and began research projects to fill the gaps in our understanding of the bay highlighted in earlier reports.

Targets Achieved

The number of **Public Beach Closures** due to bacteria and other pathogens continued to decline through the study period (2016-2020), and is below the target threshold of 75 days

In Progress

Based on the most recent data available (2011/2012) 60% of our **Clam Restoration** target of 377 million clams was achieved. While encouraging, the lack of recent data makes it difficult to determine if this increasing trend has continued or if the resource has slipped farther away from our target.

The acreage of **Approved Shellfish Areas** in Barnegat Bay has not changed substantially over the past nine years. This target remains a work in progress, as the targeted increase of 5% remains unachieved.

The most recent data available were used for the **Wetland Protection** target; thus, no change in status relative to the target is available. However, the trend over the past two decades has been a decrease in wetland area; this decrease suggests that much work remains to meet our goal of no wetland loss.

Not Achieving

Continued growth of the human population within the watershed is driving the withdrawal of increasing amounts of freshwater from the ecosystem over the past twenty years, resulting in exceedance of the **Water Conservation and Reuse** target to reduce withdrawals below the 2010 estimate (85.56MGD).

Critical Data Gaps

There is still no data available to quantify **Submerged Aquatic Vegetation Extent**. Seagrass is critically important to the bay's fishes and wildlife; data are needed to know the present-day condition of the resource and understand how this resource may be changing compared to its historic condition.

Additionally, the baseline mapping and information needed to set the target for **Wetland and Riparian Buffer Preservation** is not currently available. These buffers provide habitat for fish and wildlife, trap and remove sediments and pollutants, and store floodwaters. These data are needed to understand how watershed development impacts this key resource.

The **Ecological Flows** target has not yet been calculated for the major waterways within the watershed. Ecological flows are the amount of water needed to sustain the diversity of aquatic life and the functioning ecosystem in a river or stream. Stream flows below these values can lead to a cascade of adverse impacts for aquatic and human communities. Without an ecological flow target it is not possible to determine if current stream flows can sustain fish and wildlife populations.

How to Use the *State of the Bay Report*

A gauge is shown for each of the Ecosystem Targets described in the 2021 CCMP and detailed within this report. The gauge provides a summary of whether the target is being met, and what the trend has been. Determination of whether the target is being met is based on data available for 2016-2020, while the trend is based on the longest complete dataset available for that target.

The ability to achieve each target is dependent on the objectives and action in at least one of the four major focal areas of the 2021 CCMP; Water Quality, Water Supply, Living Resources, and Land Use. For each of the Ecosystem Targets the corresponding focal area(s) is identified by a color-coded tab.

Status Ratings (gauge and needle)

The status gauge is divided into three parts; Not Achieving, In Progress, and Achieving. The needle points to the appropriate status for the indicator. A status of "Not Achieving" indicates that there was no progress towards the target and may in fact be moving farther away from the target than the baseline condition. "In Progress" indicates that the actions taken thus far are getting the resource closer to the target than in the baseline condition, but additional effort is still required. The location of the needle within the area of the gauge indicates how much progress has been made. The "Achieving" status indicates that the target is currently being met.

Two Ecosystem Targets (Approved Shellfish Areas and Wetland Protection) utilize the most current data available to develop the baseline condition. In those cases, the needle points to the space between Not Achieving and In Progress, indicating that no progress has been made at this time.

Trend Ratings (internal arrow)

A trend arrow pointing to the right indicates an improving condition.

A trend arrow pointing to the left indicates a deteriorating condition.

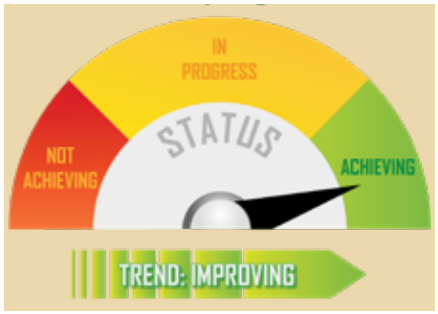
A double-sided arrow indicates no discernable trend.

"Unknown" indicates that there was not enough data to develop a trend.

Great blue heron. Photo by Shannon Vasquez.

Ecosystem Targets

Public Beach Openings/Closures



The Ocean County Health Department (OCHD) obtains and analyzes water samples from public bathing beaches in the county on a weekly basis during the summer bathing season. The number of public bathing beaches open in the watershed declined over the past two years due to COVID-19 pandemic and access issues. The number of bathing beach closures due to pathogen concerns is below the target and has generally declined over the past five years.

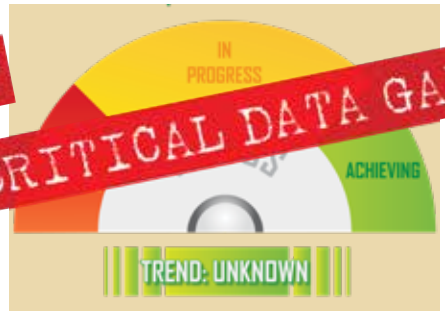
Approved Shellfish Areas

Harvest of shellfish is an important commercial activity within the bay and popular recreational past time. Currently, the waters of the Barnegat Bay consist of approximately 74% “approved,” 5% “prohibited,” 19% “seasonal and special restricted,” and 2% “suspended” for shellfish harvest. There have been no substantial changes in the area of waters classified as “restricted” or “prohibited” over the past nine years.

Submerged Aquatic Vegetation (SAV) Extent

The long-term decline of seagrasses in New Jersey’s coastal bays is a major concern because it is a critically important source of nutrition and habitat for many fish and invertebrates. Because seagrass acreage within Barnegat Bay has not been assessed since 2009 it is impossible to determine what progress, if any, was achieved, or what the trend is at present. This is a CRITICAL DATA GAP in the understanding of the bay.

Wetland and Riparian Buffer Preservation



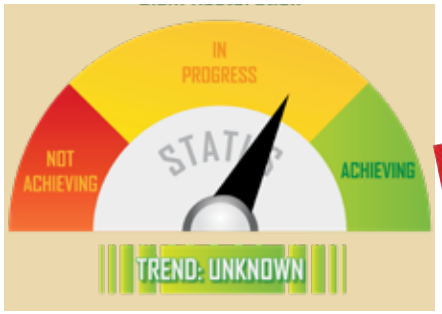
The upland areas surrounding wetlands and waterways serve as important buffers for these sensitive habitats, filtering nutrients and reducing erosion from stormwater runoff, as well as providing excess flood storage. The baseline information for this target is currently not available and is a CRITICAL DATA GAP in the understanding of the bay.

Ecosystem Targets

Wetland Protection

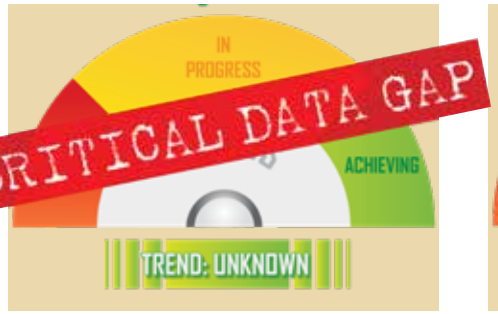
Wetlands provide habitats and a nursery for various fish, shellfish, and wildlife within the watershed and thus are an integral part of coastal estuaries. There were approximately 20,922 acres of tidal wetlands and 65,630 acres of freshwater wetlands within the Barnegat Bay watershed in 2015. Within the Barnegat Bay watershed, the amount of tidal wetland decreased approximately 2.7% between 1995 and 2015.

Clam Restoration



Bay-wide surveys for hard clams conducted in 2011 (Little Egg Harbor) and 2012 (Barnegat Bay) estimated a standing stock of approximately 224 million clams. Overall, the abundance of hard clams in Barnegat Bay in 2012 was down approximately 23% from the last survey completed in 1985/1986. For Little Egg Harbor, the overall abundance in 2011 was down approximately 57% compared with the 1985/1986 survey. However, the abundance of hard clams in Little Egg Harbor increased 32% between 2001 and 2011.

Ecological Flows



Ecological flows are the amount of water needed to sustain the diversity of aquatic life and the functioning ecosystem in a river or stream. There are currently no minimum ecological flow criteria for comparison with existing United States Geological Survey stream flow data. As such this is a CRITICAL DATA GAP in the understanding of the bay.

Water Conservation and Reuse

Fresh water is withdrawn from surface waterways and groundwater for a variety of purposes, including public supply, agriculture, landscape irrigation, commercial and industrial uses, mining, and power generation. The most recent estimate for 2015 shows that Ocean County's fresh water withdrawals averaged approximately 89 million gallons per day. Water withdrawals are closely linked to population size, and have exhibited an increasing trend over the past several decades.

Contents

Introduction

Watershed:
the geographic region within which water drains into a particular body of water.

Barnegat Bay: A Coastal Lagoon

The 75-square mile (194 km2) Barnegat Bay estuarine system is comprised of three shallow, micro-tidal bays (Barnegat Bay, Manahawkin Bay, and Little Egg Harbor). This estuarine system stretches over 42 miles (67 km) in length from the Point Pleasant Canal on the northern end to Little Egg Harbor Inlet at the southern end, and is separated from the open ocean by a nearly continuous barrier island complex of beaches, dunes, and wetlands.

The Barnegat Bay watershed is comprised of the more than 600 square miles (1,554 km2) of land areas that drain into the 11 rivers and streams that empty into the Barnegat Bay-Manahawkin Bay-Little Egg Harbor (BB-LEH) estuarine system. A significant source of freshwater for the Barnegat Bay estuarine system is derived from tributaries that drain the New Jersey Pine Barrens and other forested land. From the headwaters of these streams, pristine freshwater flows eastward through predominantly forested areas along the coastal plain to the bay. A nearly continuous barrier island complex runs along the eastern edge of the Barnegat Bay system. Seawater enters the Barnegat Bay system through the Point Pleasant Canal via the Manasquan Inlet in the north, the Barnegat Inlet in the middle, and the Little Egg Inlet in the south. The flow of fresh water from rivers, creeks, and groundwater into the bay produces the variety of salinity zones that are needed for the survival of crabs, fish, birds, and other wildlife, as well as for human uses. The Barnegat Bay watershed encompasses most of the 33 municipalities in Ocean County, as well as four municipalities in Monmouth County and one municipality in Burlington County. Activities impacting Manasquan Bay to the north and Great Bay to the south are of significance to the Barnegat Bay watershed as well.

Barnegat Bay Partnership

In response to growing concerns about the health of the Barnegat Bay and in recognition of the bay's economic importance, in 1987 the New Jersey Legislature mandated a study on the impact development had on the bay and its watershed. The results of the study led the Governor of New Jersey, Christine Todd Whitman, to submit an application to the U.S. Environmental Protection Agency (USEPA) in March 1995 that nominated Barnegat Bay to be identified as an estuary of national importance and be included in the National Estuary Program (NEP).

The NEP was established by Congress in 1987 through Section 320 of the Clean Water Act (33 U.S.C. §1330) to identify, restore, and protect nationally significant estuaries of the United States. In July 1995, USEPA accepted the nomination of the Barnegat Bay Estuary, officially making it one of the 28 estuaries of national significance in the United States. In April 1996, the USEPA and the New Jersey Department of Environmental Protection (NJDEP) signed a joint agreement and officially convened the Barnegat Bay National Estuary Program Management Conference. The primary initial responsibility of the management conference was to develop a comprehensive conservation and management plan (CCMP) to restore and protect the health of the Bay. The CCMP was approved by USEPA in May 2002 and served as a guide for the organization's work for nearly a decade.

Along with developing the CCMP for the Barnegat Bay, Section 320 of the Clean Water Act also established the Barnegat Bay Partnership (BBP) as a partnership of federal, state, county, municipal, academic, business, nonprofit, and private organizations working together to protect Barnegat Bay. The Barnegat Bay Partnership has continued to assess progress toward completion of the Goals, Objectives, and Actions established in the original 2002 CCMP and updated its priorities periodically through the completion of two Strategic Plans, 2008-2012 and 2012-2016. Between 2016 and 2020 the BBP undertook a revision to its CCMP, culminating in a 2021 update that reflects significant improvements in our understanding of the bay's ecology and the efforts needed to protect and restore its water quality, water supply, habitats, and biotic resources.

As part of the requirements pertaining to all NEPs under Section 320 of the Clean Water Act, every five years the Barnegat Bay Partnership produces a "State of the Bay Report." This report describes the status and trends of key indicators related to the health of the estuary, including water quality, natural resources, and estuary use. The reports are used to inform updates and revisions to the CCMPs. Previous reports were completed in 2005, 2011, and 2016.

2016 to 2020: Barnegat Bay restoration picks up steam

The timeframe covered in this report (2016-2020) saw a great deal of activity regarding research, restoration, and outreach within the Barnegat Bay watershed. The NJDEP transitioned to their "Moving Science Into Action" framework for the Barnegat Bay, which included $10 million in grants awarded to 20 projects throughout the watershed. The BBP Science and Technical Advisory Committee (STAC) funded two grant competitions which led to the creation of an oyster reef in the southern part of the bay, since expanded by a number of partners. The BBP upgraded two existing continuous water quality monitoring stations in the middle and upper bay that they operate, and with funding from the USEPA installed a new station, with specialized coastal acidification sensors, in Beach Haven. The "Jersey Friendly Yards" project is a comprehensive online resource developed by the BBP to help New Jersey property owners understand the complex issues associated with non-point source pollution and implement environmentally friendly landscaping practices in their own yards. The website provides information and interactive web-based tools, including a searchable plant database, to engage landowners in actions to reduce sources of pollution, conserve water, protect soil resources, and create wildlife habitat as they "landscape for a healthy environment." Between 2016 and 2020 BBP's coastal wetlands monitoring program, part of the Mid Atlantic Coastal Wetlands Assessment (MACWA) network, expanded the understanding of current conditions and ongoing stressors impacting the coastal wetland ecosystem. Approximately $1.2m in grant funding from the USEPA, NJDEP, and others supported long-term intensive monitoring, special studies, and nature-based shoreline pre and post installation monitoring. Additionally, in 2015 the BBP launched *Paddle for the Edge*, an annual event where community scientists collect shoreline data by kayak, canoe, and stand-up paddle board. To date volunteers have paddled a total of 125 miles of shoreline and collected more than 6,550 data points with their smartphones.

Introduction

continued

Ecosystem-Based Management and Ecosystem-Based Targets

The 2021 CCMP uses an ecosystem-based management approach–a means of protecting and managing natural resources that considers the various interrelated parts of the ecosystem and how they interact with each other–instead of addressing each issue or species separately. Using this approach, resource managers, researchers, policy makers, elected officials, and residents identify ways to assess and address the often-complex issues facing a natural system. By examining the many interrelated causes and/or modifiers of an identified problem, environmental decision makers can better understand the impacts of natural systems and human activity on the environment, leading to more holistic solutions.

Ideally, ecosystem-based targets are broad, with each individually spanning and integrating environmental improvements from actions across multiple priority areas (Water Quality, Water Supply, Living Resources, and Land Use). The Barnegat Bay targets were developed by expert panels, focused on those that are based on existing data sets and are included as a component within an existing monitoring program. Furthermore, the expert panels reviewed the metrics for each target, providing guidance on reasonable "stretch" goals based on prior actions within the watershed. The eight targets were developed taking into account the challenges of not only guarding against future loss/degradation in each respective area, but also working toward measurable improvement/restoration of these natural resources. The BBP will work with its partners towards reaching the ecosystem-based targets within the next 20 years.

How were the targets evaluated?

The targets were evaluated through a collaborative effort among the BBP office, NJDEP, Pinelands Preservation Alliance (PPA), USEPA, Stockton University (SU), Brick Township Municipal Utilities Authority (BTMUA), Clean Ocean Action (COA), and ReClam The Bay (RCTB). Recent and ongoing research and monitoring reports were reviewed to identify available data, their relationship to current conditions, and the ways in which the specific metrics for each target have changed over the last five years. Subsequent to the initial evaluation, additional review of the targets was provided by subject experts, many of whom serve on the BBP's STAC.

The data utilized for this report were generated by several federal and state agencies and academic institutions. The sources of data for each target are included at the conclusion of each target section. While the BBP strives to use only the highest quality data (please see our Quality Assurance Performance Plan), we rely upon the expertise of the contributors to determine its quality. Therefore, questions concerning data should be addressed to the appropriate contributing source. A separate technical document has been prepared that includes the rational and statistical reasoning (if appropriate) for status and trend determinations, and can be found in the *Bay Science and Research* section of our website.

Ecosystem Targets

Toms River flowing in the early morning. Photo by Ceili Pestalozzi/BBP.

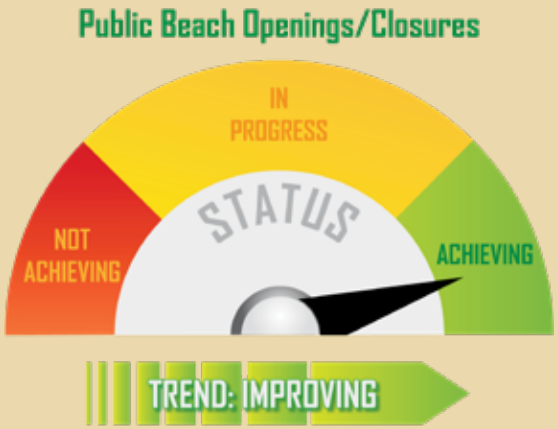
A happy angler with a bluefish from Barnegat Bay. Photo by Gregg Sakowicz.

Native plant gardens use less fertilizer and encourage healthy soils that improve water quality. Photo by Becky Laboy.

The Potter Creek Crusaders school group at protected open space in the watershed. Photo by Bob Birdsall.

Public Beach Openings/Closures

TARGET STATUS



Bathers enjoying a Barnegat Bay beach. Photo by Barnegat Bay Partnership.

Target

Work with the NJ Department of Environmental Protection (NJDEP), the NJ Department of Health (NJDOH), the Ocean County Health Department (OCHD) and the Long Beach Island Health Department (LBIHD) to potentially increase the number of bay beaches and lakes within the Barnegat Bay watershed open for swimming from the 2018 baseline of 32. Reduce the average number of annual beach closure days below that of 2016-2018 (74 days).

Background

For more than 30 years, as part of the Cooperative Coastal Monitoring Program, the Ocean County Health Department has collected and analyzed water samples from all public bathing beaches in the county on a weekly basis beginning two weeks before a beach opens for swimming and until the beach closes for the season, typically Memorial Day through Labor Day. Water quality results from bathing beach monitoring provide an indication of the levels of pathogenic bacteria in the waters. These findings are used to determine beach actions and provide public notification of water quality. Closure statistics for beaches on the bay, freshwater lakes, and rivers provide an indication of the bacteria level from various sources being flushed from the watershed into the waterways that eventually flow into the bay. Closure statistics also provide a general indication of the nonpoint source loadings of pollutants and pathogens other than bacteria. Stormwater typically contains suspended solids, nutrients, organic carbon, petroleum hydrocarbons, heavy metals, and pesticides, in addition to bacteria.

Freshwater samples are analyzed for *E. coli*, which is a species of fecal coliform bacteria present in the digestive tract of warm-blooded animals. In 2004, the NJDEP changed the required indicator organisms for brackish and saltwater beaches from fecal coliform to *Enterococcus*, a bacterium found in the digestive tracts of warm-blooded animals.

Primary Indicator: Beach Openings and Closures

Status

The number of public bathing beaches open in the watershed was generally stable at 32 between 2016 and 2018. In 2019 the number of bathing beaches open to the public dropped to 29 due to non water-quality related issues. The number of open beaches further declined in the 2020 season, when only 25 beaches were open to the public. However, this further reduction was due to restrictions associated with the COVID-19 pandemic and not due to water quality concerns.

The 3-year average of annual beach closures days was below the 2016-2018 baseline throughout the remainder of the 2016-2020 period (Figure 2), though as noted above fewer beaches were sampled in 2019 and 2020. To take the change in the number of open beaches into account, the percentage of days the beaches were closed in relation to the total number of beach days (number of beaches X number of days in the season) was also calculated. Those 3-year averages (2017-2019, 2018-2020) were also below the baseline.

During this 2016-2020 timeframe covered in this analysis the eight public recreation bathing lake sites represented approximately 70% (203 of 288) of all beach closings. Two factors, stormwater runoff and waterfowl waste, influence the occurrence of elevated bacterial counts in lakes of the BB-LEH watershed.

The OCHD sampled two public recreational bathing creek sites during the 2016-2020 bathing seasons, both on the fresh water portions of Cedar Creek (Figure 1). Cedar Creek is an example of how a water body can have very low pathogen levels without the influence of storm drains. The stream has very few storm drains and, as a result, it seldom has an elevated bacteria count (5 total closures from 2016-2020).

The OCHD and LBIHD sampled 13 public recreational bathing bay beach sites and eight public recreational

bathing brackish river sites (Figure 1) throughout the 2016-2020 recreational bathing beach seasons. The river sites are along the Toms, Metedeconk, and Manasquan rivers, while the bay sites are located throughout the eastern and western sides of the bay. The bay beaches accounted for a total of 35 closures over the five-year period, nearly half of which occurred at 5th Avenue beach in Seaside Park in 2020. Of the 70 closures at river beaches during 2016-2021, 23 were at Windward Beach on the Metedeconk River in Brick Township and 29 were at Beachwood Beach on the Toms River in Beachwood Township. Non-point source pollution delivered via stormwater is the primary source of bacteria at these beaches.

Trends

The number of public bathing beaches open during the summer season has remained generally constant through 2016-2020, except for those closed due to the COVID-19 pandemic and other non-water quality related issues (staffing, access issues, etc.). The 32 beaches generally open during the timeframe covered here is down slightly from the 35 beaches open during the 2010-2015 reporting period, but higher than the 2000-2010 reporting period.

While the three-year rolling average of beach closures has generally decreased during the time period covered by this report (2016-2018, 2017-2019, 2018-2020), the decrease appears to be due to a spike in lake beach water quality-related closures in 2016, which was the highest number of closures on record. Freshwater beach closures declined following that spike. Conversely, bay and river beach closures were lower in the first part of the time period and increased during 2019 and 2020, even though fewer beaches were sampled.

Data were provided courtesy of the Ocean County Health Department.

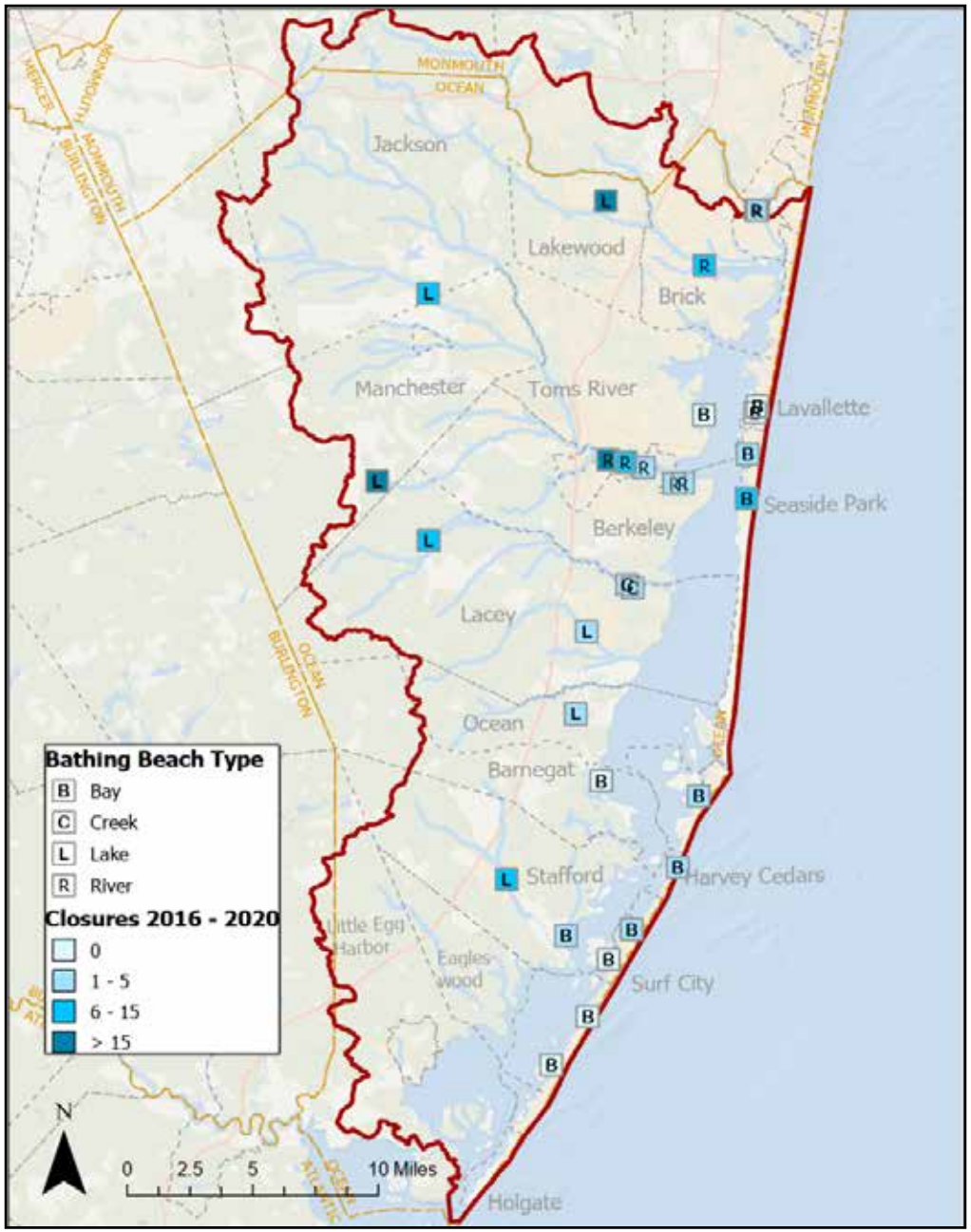


Figure 1: Location of bay, creek, lake, and river bathing beaches in the Barnegat Bay monitored for pathogens and included in this analysis.

Public Beach Openings/Closures

continued

What YOU Can Do

1. Dispose of pet waste properly.
2. Do not feed wildlife, including geese and seagulls, at parks and beaches.
3. If you have a septic system, get it pumped out and cursorily inspected by a licensed professional about every three years.
4. If you see pollutants in the water, report it to 1-877-WARNDEP (927-6337)

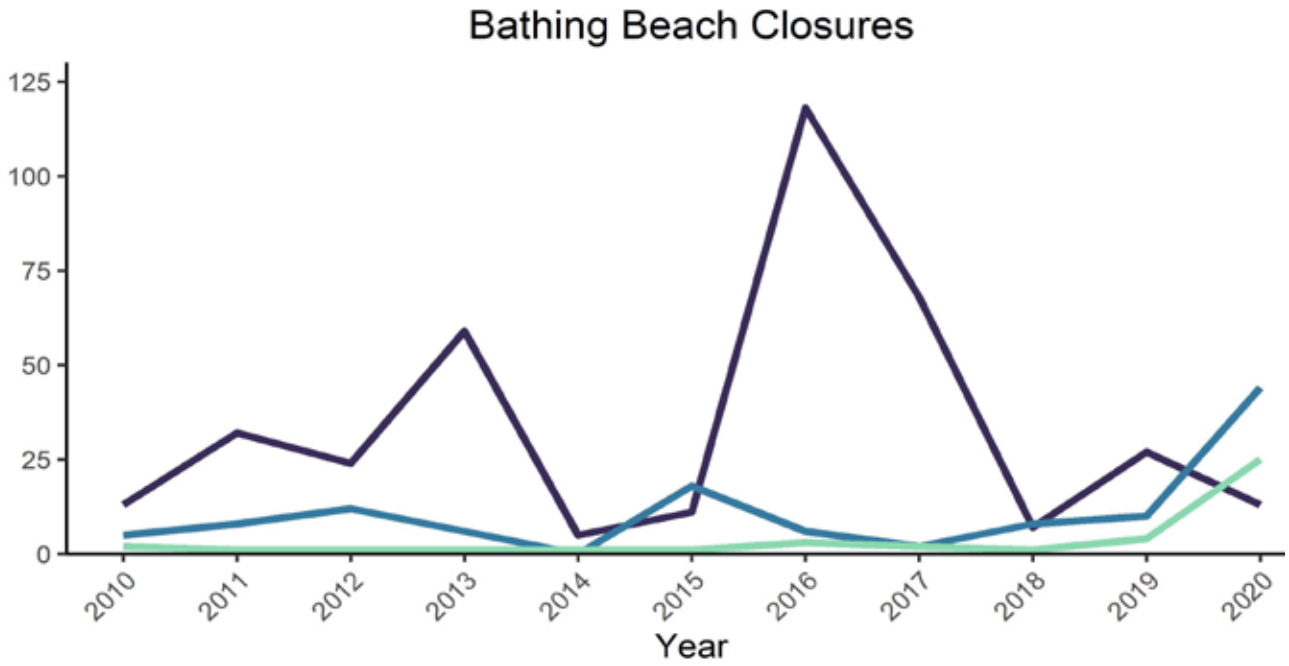
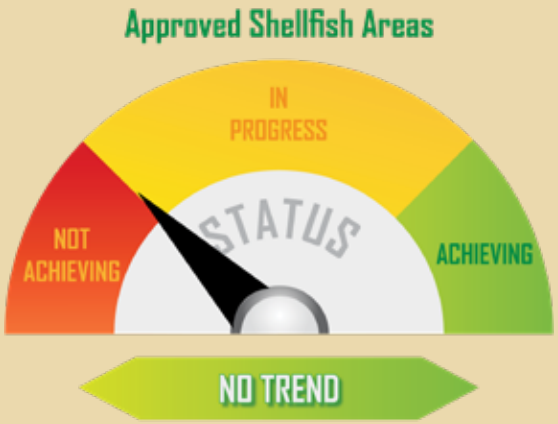


Figure 2: The annual number of bay, river, and lake/creek beach closings over the last 10 years. This includes beaches (bay=13, river=8, lake/creek=10) that were open in 2016-2018 but may have been closed in 2019 and/or 2020 due to non water-quality issues.

An empty beach on the Barnegat Bay. Photo by Emily Pirl/BBP.

Approved Shellfish Harvest Areas

TARGET STATUS



Shellfish aquaculture in Barnegat Bay. Photo by Ashley Kerr.

Target

Upgrade 5% of the potentially harvestable shellfish acreage that is currently restricted or closed for shellfishing compared to the 2020 acreage (11,267 acres).

Background

The NJDEP's Bureau of Marine Water Monitoring (Bureau) monitors the shellfish-growing waters contained within the Barnegat Bay. To ensure that shellfish within these waters are safe for consumption, the waters are analyzed using coliform bacteria as an indicator of human and animal waste. Based on the National Shellfish Sanitation Program requirements, the bay waters are classified as "approved," "seasonal," "special restricted," "prohibited," and "suspended." Updates to the classification of shellfish waters are completed annually and are based on the latest 30 data points for each station over multiple years.

Primary Indicator: Approved Shellfish Harvest Areas

Status

Currently, the waters of the Barnegat Bay consist of approximately 74% "approved," 5% "prohibited," 19% "seasonal and special restricted," and 2% "suspended" for shellfish harvest (Figure 1). These data are the baseline for the target, thus, no progress has been made at this time.

Poor water quality around shellfish beds is generally attributable to contamination from stormwater runoff and other nonpoint sources rather than single, point-source discharges. This can be seen in the northern portion of the bay, which represents a majority of the prohibited and special restricted waters. Red prohibited classifications in the Atlantic Ocean in figure 1 below, are a result of administrative buffers around wastewater discharges or known potential sources of bacterial pollution, and not due to degraded water quality.

Trends

There have been no substantial changes in the area of waters classified as "restricted" or "prohibited" over the past nine years. However, the area of waters classified as "approved" or "seasonal" has decreased slightly and the area classified as "suspended" has increased during that timeframe (see Figure 2).

What YOU Can Do

1. Use the Ocean County Pump-Out boats when boating on the bay: Don't discharge bilge water or sanitary tank contents into the bay.
2. Report broken sanitary sewer lines to the NJDEP.
3. Sweep streets and dispose of the sweepings properly.
4. Properly dispose of pet waste.

Data courtesy of New Jersey Department of Environmental Protection Bureau of Marine Water Monitoring.

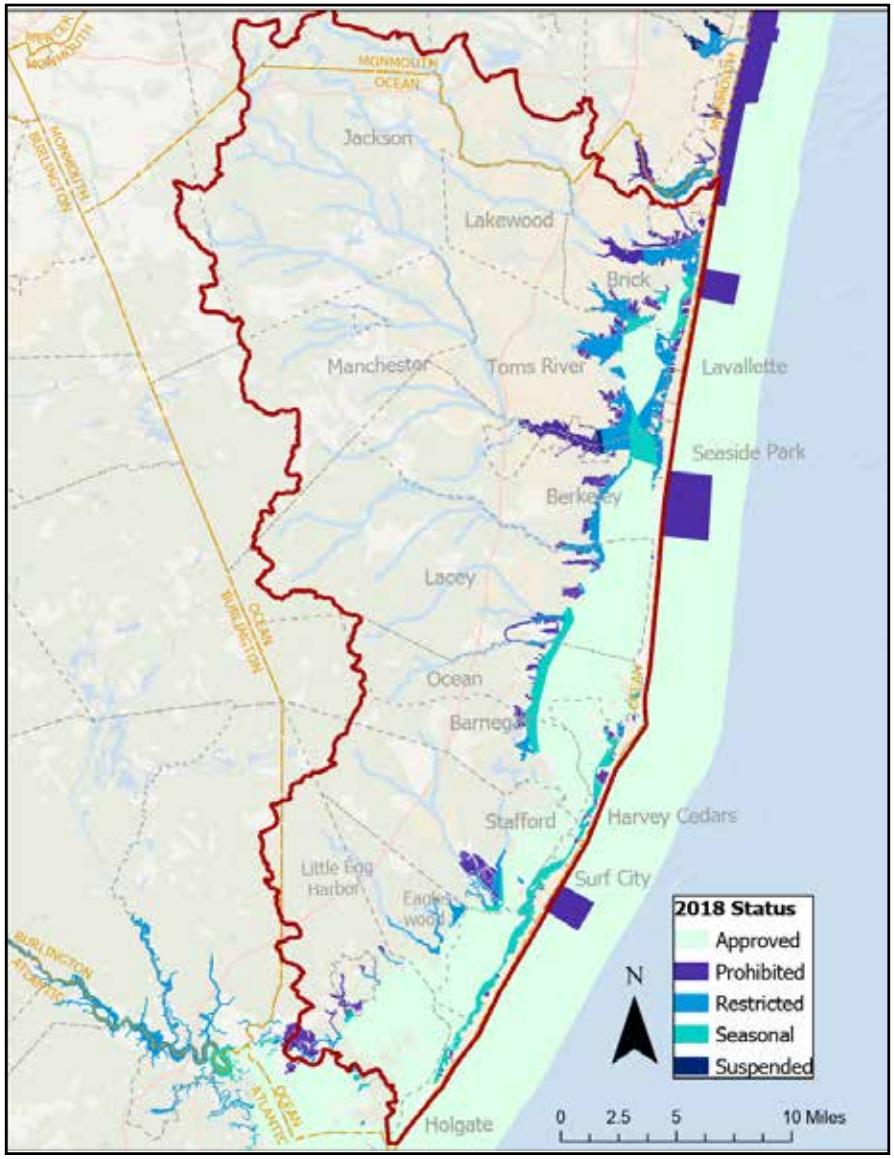


Figure 1: 2020 shellfish growing water classifications for the Barnegat Bay.

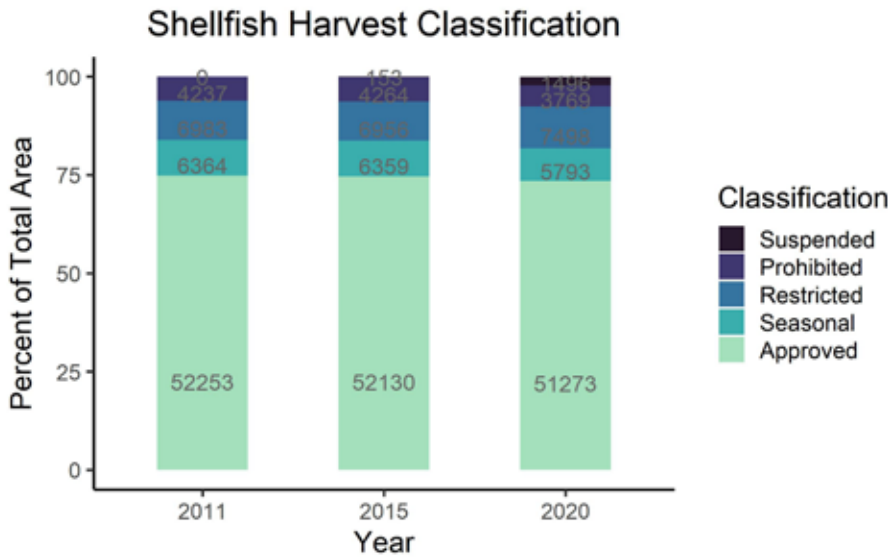
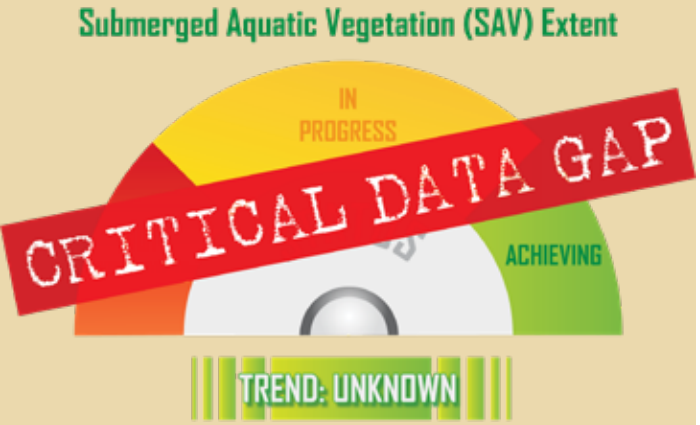


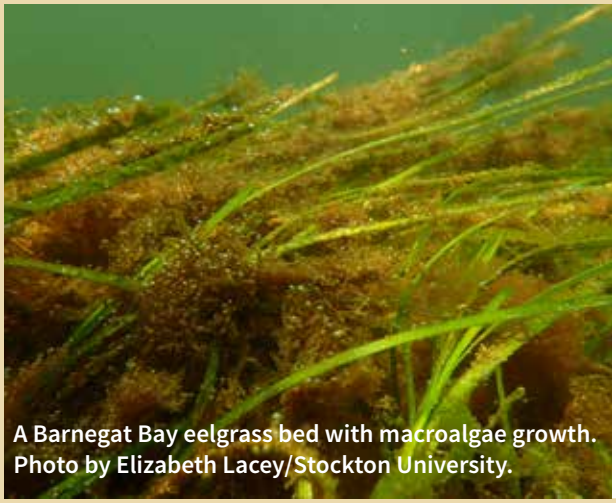
Figure 2: Percentage of the Barnegat Bay in each shellfish harvest classification for the 2011, 2015, and 2020 updates. The acreage within each category is included within the bar.

Harvested cultured oysters from Barnegat Bay. Photo by Matt Gregg.

Submerged Aquatic Vegetation Extent

TARGET STATUS





A Barnegat Bay eelgrass bed with macroalgae growth. Photo by Elizabeth Lacey/Stockton University.

Target

Maintain the overall extent of submerged aquatic vegetation (SAV) present in 2009 (12,980 acres) and restore an additional 10 acres of seagrass by 2040.

Background

Seagrasses provide food and habitats for many recreationally and commercially important estuarine and marine species (*e.g.,* bay scallop [*Argopecten irradians*], blue mussel [*Mytilus edulis*], blue crab [*Callinectes sapidus*], and weakfish [*Cynoscion regalis*]). Seagrass beds also play a significant role in nutrient cycling, carbon sequestration, filtering of essential elements, and wave dampening. In addition, seagrasses are excellent indicators of water and sediment quality as they indicate changes in water quality and benthic attributes. Seagrasses also play an important role in sediment stabilization. Seagrasses are impacted by water nutrient levels, elevated water temperatures, ice scouring, damage from boat props and anchors, disease and light intensity fluctuations caused by dredged or storm-tossed sediments and algal blooms or overgrowth. By assessing the condition of seagrass beds over time, it is possible to establish accurate trends in estuarine condition. Within Barnegat Bay, eelgrass (*Zostera marina*) dominates the seagrass beds south of Toms River, while mixed eelgrass and widgeon grass (*Ruppia maritima*) beds are found in the central and northern portions of the bay.

Primary Indicator: Extent of Submerged Aquatic Vegetation

Status

Because no systematic, bay-wide survey has been conducted since the baseline year of 2009 it is impossible to determine if the area is on track to meet the target. In 2009 seagrass beds covered approximately 14% of the estuarine bottom.

Trends

Because no systematic, bay-wide survey has been conducted since that time it is impossible to detect a direct trend.

Knowledge Gaps

An assessment of the extent (size and distribution) of SAV beds in the bay on a recurring, regular basis is needed to ascertain if work is on track to meet the target of maintaining and extending acres of seagrass. While overall seagrass bed conditions cannot determine the aerial extent, conditions can provide some limited clues as to the health of the estuary. A secondary indicator such as seagrass demographics (percent cover, biomass) has been used to establish SAV bed condition.

Secondary Indicator: Submerged Aquatic Vegetation Demographics Status and Trends

Bay-wide surveys of seagrass bed demographics in 2015, 2017, and 2019 found that some regions are experiencing an increase in *Zostera marina*, while others are experiencing a decline (Figures 1 and 2). Data also suggest there is a shift in species abundance from Z. *marina* to *Ruppia maritima*. Without future sampling it is unclear if these trends in eelgrass biomass observed through 2019 are due to weather variations, temporarily favorable water quality conditions, the result of nutrient reduction efforts over the past decades, or a combination of factors.

What YOU Can Do

1. Stay out of seagrass beds with boats and PWCs.
2. Anchor properly near seagrass beds.
3. Apply lawn care products only when needed, and following application directions.

For additional details on seagrass distribution and abundance in the Barnegat Bay please visit the Studies and Report section of the BBP website at https://www.barnegatbaypartnership.org/report/ and search for "seagrass".

Data courtesy of Rutgers University (2004-2011) and Barnegat Bay Partnership and Stockton University (2015-2019).

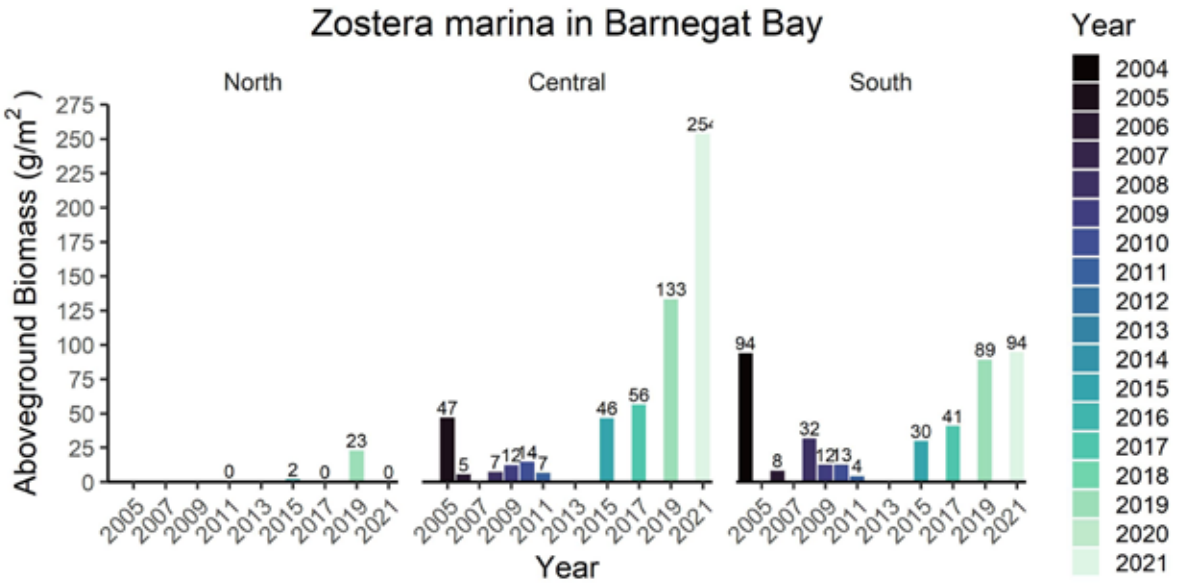


Figure 1: Annual spring mean above ground biomass of eelgrass (*Zostera marina*) in the Barnegat Bay-Little Egg Harbor estuary between 2004 and 2021. Years when no survey was conducted have no data.

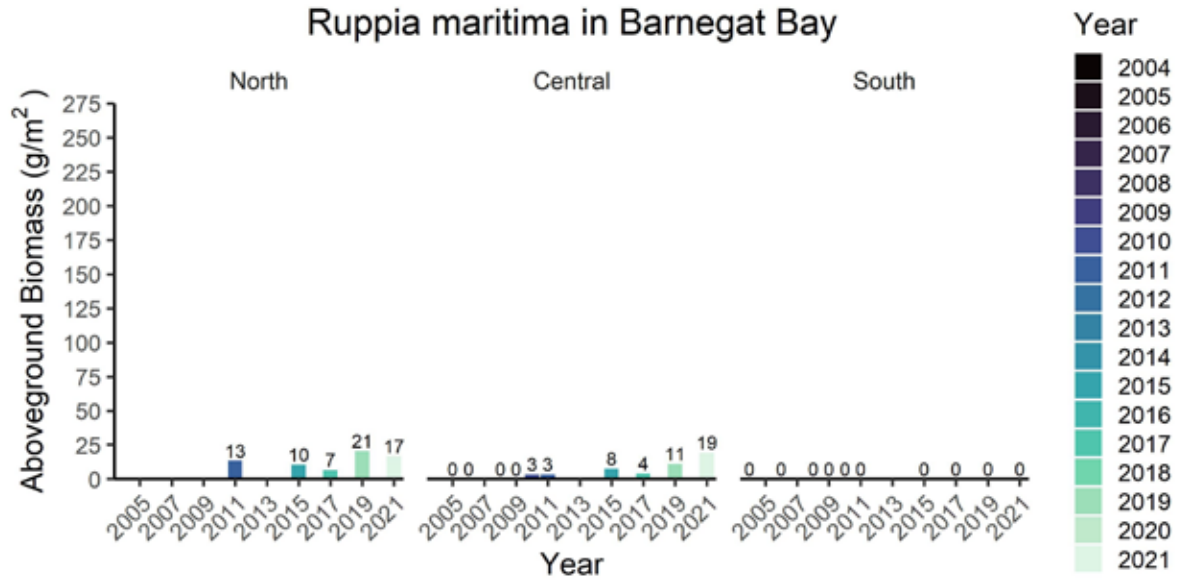
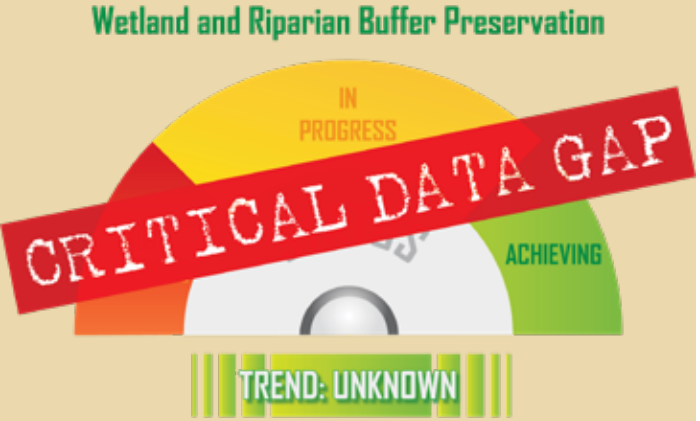


Figure 2: Annual spring mean above ground biomass of widgeon grass (*Ruppia maritima*) in the Barnegat Bay-Little Egg Harbor estuary between 2004 and 2021. No widgeon grass was recorded in the southern part of the estuary. Years when no survey was conducted have no data.

Wetland & Riparian Buffer Preservation

TARGET STATUS



Development up to the stream edge leaves no riparian buffer. Photo by Ceili Pestalozzi/BBP.

Target

Maintain or increase the current acreage of upland buffers adjacent to all wetland and riparian corridors.

Background

Riparian buffers are defined as those land areas that are adjacent or hydrologically connected to surface waters such as streams, rivers, lakes or reservoirs. Sometimes they are described as the floodplain or riparian zone. Riparian buffers support high levels of biodiversity and perform a variety of functions with environmental, economic, and social value. Examples include providing habitat for aquatic and terrestrial organisms, trapping and removing sediments and pollutants from stormwater runoff, stabilizing streambanks and reducing channel erosion, and storing floodwaters and decreasing potential for property damage. Because they provide all of these services and more, maintaining healthy riparian buffers can be considered an economical means to ensure future water quality and natural flows. Disturbance of riparian zones from "urban and suburban creep" remains a concern. Clearing of native vegetation and other disturbance activities can cause a cascade of unintended changes, such as altered streamflow, serious losses of stream habitat, and degradation of water quality. Sedimentation, streambank erosion, changes in the amount and timing of water flows, and increases in the frequency and magnitude of flood events are commonly encountered problems associated with disturbed riparian buffers.

Primary Indicator: Wetland and Riparian Buffer Area Status

No watershed-wide digital mapping and analysis of wetland and riparian buffer areas has been completed at this time, so the status cannot be determined. This analysis is a priority action item in the CCMP and remains a CRITICAL DATA GAP.

Trends

No watershed-wide digital mapping and analysis of wetland and riparian buffer areas has been completed at this time, so a trend cannot be determined. This analysis is a priority action item in the CCMP and remains a CRITICAL DATA GAP.

What YOU Can Do

1. If you live adjacent to a wetland or waterbody, maintain an area at least 25 feet wide of undisturbed native vegetation, including trees and shrubs, along the feature.
2. Take part in community clean-ups and restoration activities that help to maintain existing buffers.
3. Support the purchase of buffer areas to be maintained as preserved open space.
4. Promote "living shorelines," not bulkheading, wherever possible.

The headwaters of the Toms River and its riparian buffer. Photo by Ceili Pestalozzi/BBP.

Wetland Protection

TARGET STATUS

A recently installed living shoreline protecting a marsh edge. Photo by Emily Pirl/BBP.

Target

Maintain overall extent of tidal wetland acreage (20,922 acres) as identified on the 2015 aerial imagery. Restore or enhance 10 acres of tidal wetlands impacted by sea level rise and erosion through nature/natural based strategies to limit further loss.

Background

The Barnegat Bay estuary is home to many diverse species of plants and wildlife. The wetlands surrounding the area are an integral part of this sensitive ecosystem, providing forage and nursery habitats for various fishes, shellfish, and wildlife. In the latter half of the 20th century, Ocean County experienced an exponential population growth which stressed the bay waters, as well as the wetlands and wildlife. Increased boat traffic wake accelerated the erosion of salt marshes along the waterfront, and development along the mainland and barrier islands changed the land cover in many places, resulting in wetlands losses.

The Stockton University Coastal Research Center (CRC) completed tidal- and freshwater- wetlands trends analyses using Geographic Information System (GIS) Land Use/Land Cover datasets available from the NJDEP for the years 1995, 2002, 2007, 2012 (conditions prior to Hurricane Sandy), and 2015.

Primary Indicator: Wetland Area Status

There were approximately 20,922 acres of tidal wetlands and 65,630 acres of freshwater wetlands within the Barnegat Bay watershed in 2015. This year represents the baseline target; therefore, there has been no progress made towards the target at this time.

Trends

Within the Barnegat Bay watershed, the amount of tidal wetland decreased approximately 2.7% between 1995 and 2015 (Figure 1). Over the last 20 years the percent decreases in tidal wetlands were determined to be 0.94% (1995 – 2002), 0.45% (2002 to 2007), 0.83% (2007 to 2012), and 0.45% (2012 - 2015). The latest data suggest wetland loss across the watershed is decreasing, but it is important to consider where the changes to tidal wetland shorelines are occurring. In previous iterations of this analysis, the majority of tidal wetland losses were recorded along the bay and tidal waterway edges, which now appear stable. Between 2012 and 2015, a notable area of tidal wetland losses occurred along the back-barrier side of the E.B. Forsythe National Wildlife Refuge Holgate Unit, located at the southern end of Long Beach Island. In this area tidal wetland losses occurred because of storm induced over wash events: sand washed over and buried the marshes.

The rate of loss of freshwater wetlands within the watershed continued to slow during the 2012-2015 timeframe (Figure 2). Over the last 12 years of data, the percent decreases in freshwater wetlands were 1.01% (1995 – 2015), 0.61% (2002 to 2007), 0.31% (2007 to 2012), and 0.26% (2012 - 2015). Losses of freshwater wetlands are primarily attributed to human alteration for residential or commercial uses.

What YOU Can Do

1. Participate in citizen science monitoring programs like Paddle For the Edge and MyCoast to help collect data and further understanding of the coastal wetlands.
2. While boating, maintain safe distances from the wetlands and reduce your speed to reduce edge erosion from waves/wakes.
3. Take part in various community wetland cleanups that happen throughout the year.

Data were provided courtesy of Stockton University Coastal Research Center.

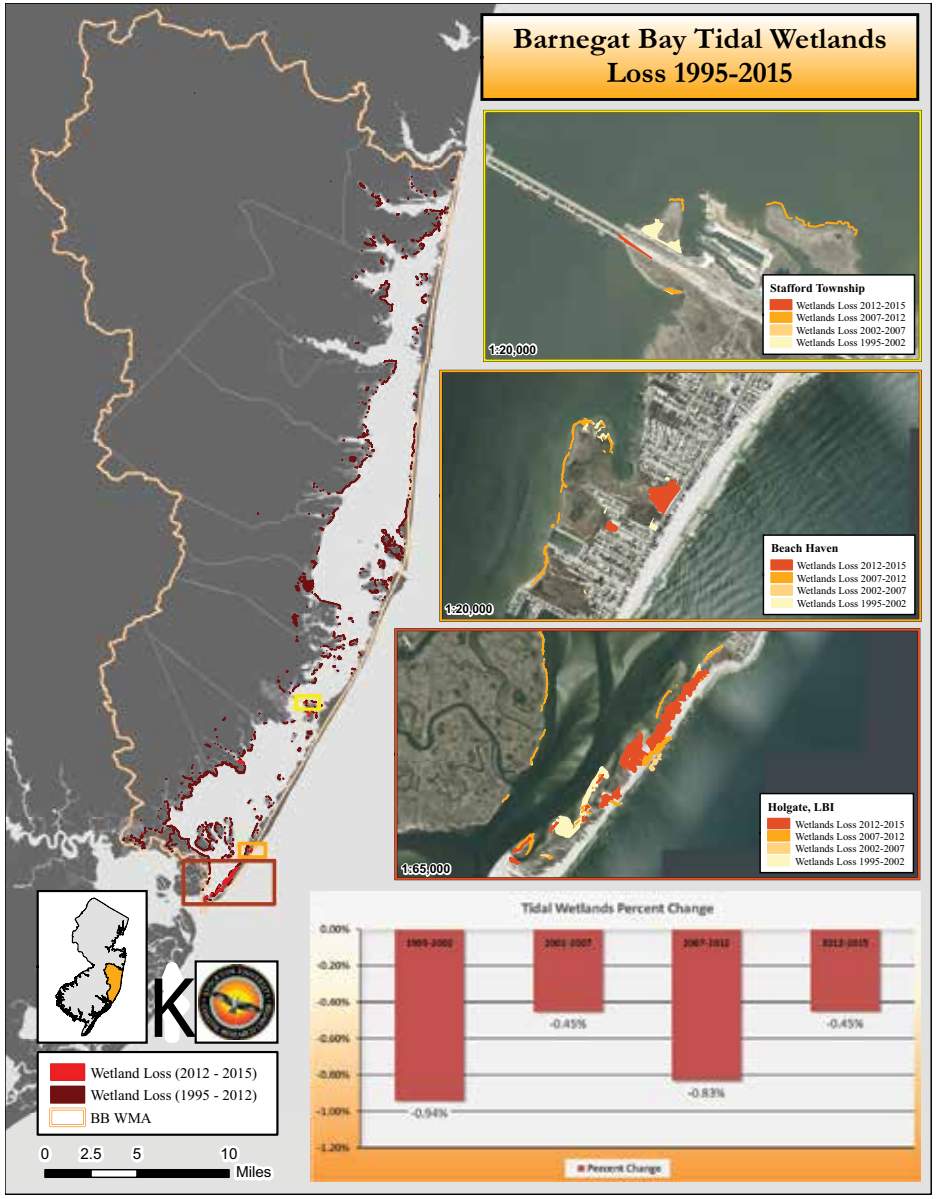


Figure 1. The red areas on the map on the left depict tidal wetland losses between 1995 and 2015. The insets show select areas of wetland losses between 2012 to 2015. The graph below shows percent changes between datasets.

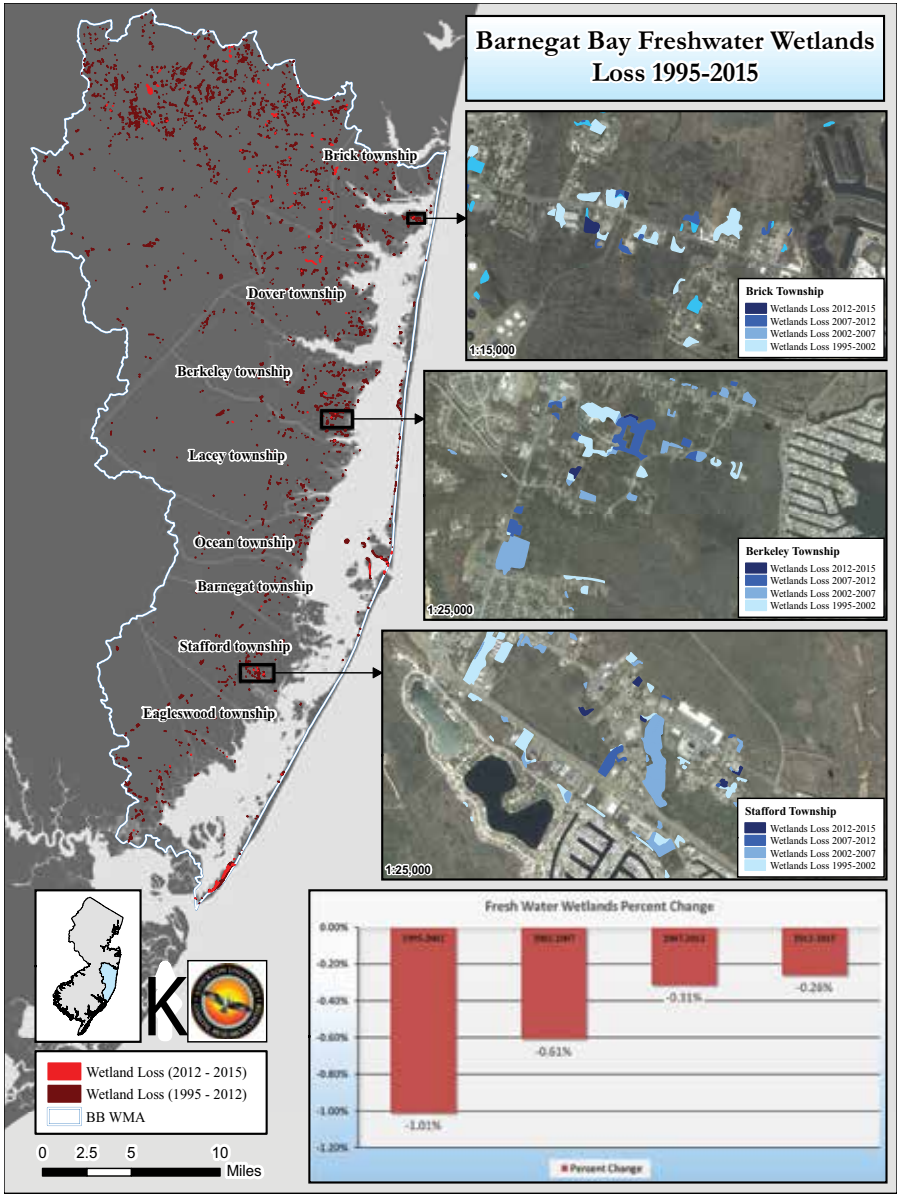


Figure 2: The areas of the main figure in red depict freshwater wetlands lost in the watershed between 1995 and 2015, with close-ups of select areas in the insets. The acreage of freshwater wetlands lost between study dates, as calculated from aerial photographs, are shown on the column graph.

Clam Restoration

TARGET STATUS

Juvenile hard clams for restoration collaboration between ReClam the Bay and Rutgers Cooperative Extension. Photo by Doug Zemeckis, Rutgers Cooperative Extension.

Target

Return the hard clam abundance in Barnegat Bay-Little Egg Harbor to 1985/87 estimated population size of roughly 377,000,000 clams by means of stock enhancement, habitat restoration, and other management actions.

Background

Most estuarine shellfish have limited mobility, are sensitive to environmental changes, and are commercially and recreationally important species, making them key indicators to assess ecological condition and impairment of estuarine systems nationwide. Historical records note the presence of hard clams (*Mercenaria mercenaria*), Eastern oysters (*Crassostrea virginica*), and bay scallops (*Argopecten irradians*) in Barnegat Bay. Hard clams supported a robust wild harvest fishery into the middle of the 20th century. Since that time the wild harvest fishery declined in importance, replaced by hard clam aquaculture, primarily in the Little Egg Harbor area.

Primary Indicator: Hard Clam Abundance Status

Bay-wide surveys for hard clams conducted in 2011 (Little Egg Harbor) and 2012 (Barnegat Bay) estimated a standing stock of approximately 224 million clams. There is currently a limited commercial wild fishery for hard clams within the Barnegat Bay, though there is an aquaculture industry active primarily in Little Egg Harbor. Hard clams are also harvested on a recreational basis, centered mainly around the southern portion of the estuary.

Trends

The abundance of hard clams in Barnegat Bay in 2012 was down approximately 23% from the survey completed in 1985/1986. For Little Egg Harbor, the abundance in 2011 was down approximately 57% compared with the 1985/1986 survey. However, the abundance of hard clams in Little Egg Harbor increased 32% between 2001 and 2011.

Knowledge Gaps

Without regularly scheduled surveys, it will be difficult to determine if the increase in abundance seen in Little Egg Harbor between 2001 and 2011 is the beginning of a rebound in hard clam abundance or a temporary increase associated with a single large spawning event. Additionally, there are currently no data collected on the commercial or recreational harvest of wild hard clams and incomplete data on cultured hard clam harvest level.

What YOU Can Do

1. Buy local shellfish.
2. Support oyster and clam shell recycling.
3. Harvest legal-sized shellfish in approved waters during approved times only.

Data courtesy of New Jersey Department of Environmental Protection Bureau of Shellfish.

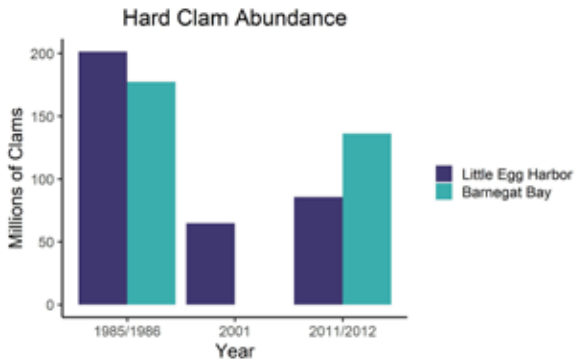


Figure 1: Hard clam abundance in Barnegat Bay as estimated during NJDEP surveys.

ReClam the Bay volunteers and Coastal Stewardship students through Rutgers Cooperative Extension maintaining hard clams for restoration. Photo by Paul Jeffrey.

Ecological Flows

TARGET STATUS

Long Swamp Creek.
Photo by Barnegat Bay Partnership.

Target

Maintain flow levels at least 30% over minimum ecological flows for gauged waterways within the watershed.

Ecological flows - The amount of water needed to sustain the diversity of aquatic life and the functioning ecosystem in a river or stream

Background

Approximately 590 million gallons per day of freshwater enter the Barnegat Bay through more than 15 rivers, streams, and creeks. The water in these streams and creeks can be split into two components, base flow and runoff. Base flow is the sustained flow of a stream that comes largely from groundwater entering the waterway. Runoff is the portion of streamflow that comes from precipitation, snow melt, or irrigation water flowing across the land surface (or piped) before entering the waterway. In undeveloped watersheds, runoff is a small part of the total flow, and as development occurs (*i.e.*, an increase in impervious surfaces, groundwater withdrawals for irrigation and consumption) the fraction of total flow contributed from base flow decreases. Reductions in base flow can have serious ecological repercussions, as changes in the timing and amount of freshwater entering the streams and eventually reaching the estuary can affect water quality and habitat for many of the bay's species, including humans!

Primary Indicator: Streamflow

The United States Geological Survey (USGS) maintains a network of stream gauging stations that measure the rate of flow in some of the major streams in the watershed on a continuous basis, including the North Branch of the Metedeconk River, Toms River, Cedar Creek, and Westecunk Creek (Figure EF1 – a map of the watershed with station locations).

Status

There are currently no minimum ecological flow criteria for comparison to existing stream flow data. This is a CRITICAL DATA GAP in the understanding of the bay.

Available stream flow information indicates that base flow accounted for 73% - 97% of total streamflow at the monitored streams in 2019, the last year for which approved data are available (Figure 2). The Westecunk Creek had the highest percentage of base flow (97%), followed by Cedar Creek (92%), Toms River (87%), and the North Branch of the Metedeconk River (73%). The pattern in the percentage of base flow reflects the north to south urbanization gradient in the Barnegat Bay watershed.

Trends

There is currently no minimum ecological flow criteria to compare trends in existing stream flow data to. As such this is a CRITICAL DATA GAP in the understanding of the bay.

The stream flow information that is available indicates that from 2004-2019 there has been a high degree of variability in base flow in all four streams, with no overall trend present. However, over the last 47 years, the percentage of base flow in the total flow has significantly declined in the North Branch of the Metedeconk River and Toms River.

Knowledge Gaps

There are currently no identified minimum ecological flows for the gauged waterways within the Barnegat Bay watershed. Without a defined criterion, it is impossible to know if we are meeting our goals.

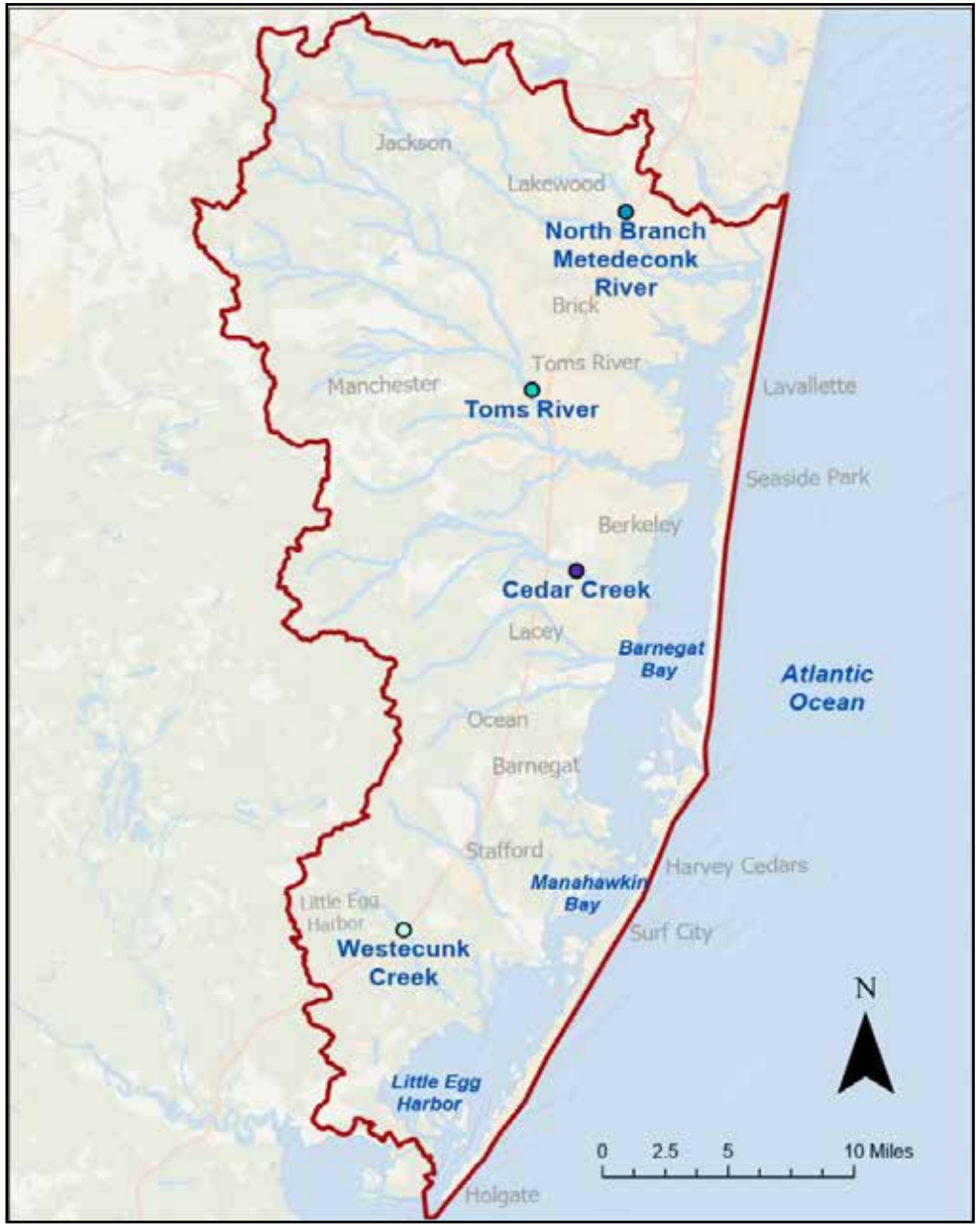


Figure 1: Location of continuously operating streamflow gauging stations in the Barnegat bay watershed used in the analysis.

What YOU Can Do

1. Use native vegetation to replace lawn areas to cut back on the use of water for irrigation (see Jersey Friendly Yards website for a searchable database of plants and helpful tips).
2. Catch and use rainwater to irrigate gardens and vegetation.
3. Install water efficient fixtures and appliances where you live and work.

Data courtesy of the U.S. Geological Survey.

For additional streamflow data, including in near real time for the continuously operated gauging stations, please visit the USGS New Jersey Water Science Center's website.

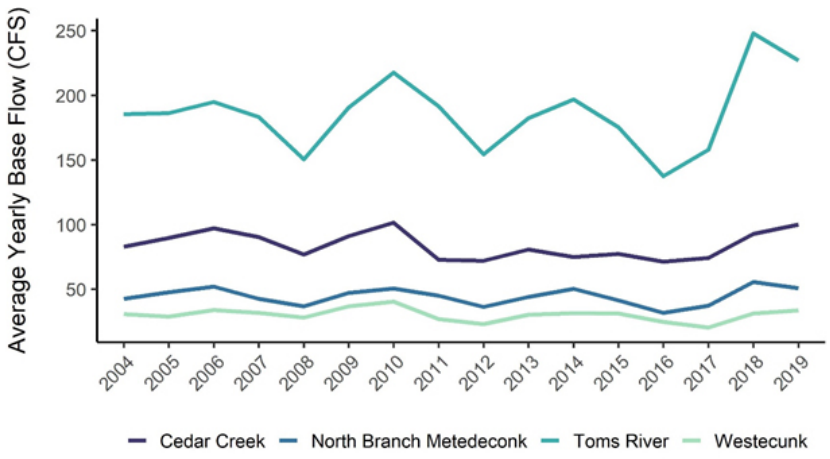


Figure 2: The base flow for the Westecunk Creek, Cedar Creek, Toms River, and North Branch Metedeconk River from 2004-2019 (CFS = cublic feet per second).

Water Conservation and Reuse

TARGET STATUS

Rain gardens capture excess stormwater and require less watering. Photo by Lisa Mazzuca.

Target

Reduce five-year rolling average water withdrawals 10% below the 2010 estimate of 85.56 million gallons per day (MGD).

Background

Fresh water is important for a variety of human activities, including potable supply, agriculture, landscape irrigation, and industrial uses. As stable fresh water flows are necessary to sustain the chemical and biological balance of the Barnegat Bay, excessive water diversion can have negative consequences on the system. As climate change alters the climate of the region, surface and ground water resources will become increasingly stressed. By reducing the water footprint through water conservation and reuse strategies, water resources can be secured for both societal and environmental needs. Potable supply is by far the largest use of diverted water within Ocean County. Water distributed to homes by a water utility is generally used once and then sent to a treatment plant as wastewater. Fortunately, there are many domestic water conservation opportunities available both indoors and outdoors.

Water conservation is the practice of minimizing water use through a combination of conscious behavior and efficient application. Perhaps the most successful water conservation initiative of the last 30 years has been USEPA's WaterSense program, which encourages the installation of water-efficient appliances. In recent years, water reuse has been identified as critical water conservation technique. Promotion of reclaimed water for beneficial reuse is identified as a core water conservation strategy by NJDEP in the 2017-2022 New Jersey Water Supply Plan. The core concept of water reuse is to find a second use for water before it is ultimately treated and discharged into the ocean in the case of wastewater or reaches surface water in the case of stormwater.

Effective water reuse programs require matching large quantities of water with a second use that does not require pristine quality water. Examples of water reuse include using stormwater for irrigation, industrial process water for street sweeping, or domestic grey water for use in toilets. Water reuse not only conserves water resources but reduces the energy demand required to treat the water at both the potable and wastewater treatment facilities. In highly water-stressed regions, water reuse technology can even produce potable water for direct reuse. Several communities (Fairfax, Virginia; Wichita Falls, Texas; Orange County, California) have constructed water treatment plants that are capable of treating wastewater to drinking water standards, and are able to provide water to residents when traditional water supplies are unavailable.

Primary Indicator: Water Withdrawals Status

The latest US Geological Survey estimate of water withdrawals in Ocean County in 2015 is 89.46 million gallons per day (MGD), a 4.5% increase from 2010 and roughly 12% above the target level of 85.56 MGD (Figure 1).

Trends

Water withdrawals in Ocean County as estimated by USGS have continued to trend higher since 2000, up nearly 29 percent over that time period. The rate of increase between 2010-2015 (4.56%) was half of that of 2000-2005 (10.1%) and 2005-2010 (10.89%).

Secondary Indicators: Wastewater Flow and Water Reuse Data Status

Water conservation measures implemented throughout the watershed led to a per capita wastewater flow of 86.03 gallons per day (GPD) in 2019, a 21% reduction compared to the high of 108.74 recorded in 1998 (Figure 2). Additionally, water reuse efforts at the Ocean County Utilities Authority within its wastewater treatment processes have been highly successful. By re-using water for fire protection, irrigation, plant washdowns, and other process tasks, water reuse totals exceeded 2 billion gallons in 2017 (see sidebar, Figure 3).

Trends

Water conservation and reuse measures have resulted in a decrease in per capita water use, but a continued increase in the population of Ocean County results in a steady increase in total water use. The NJDEP 2017-2022 New Jersey Water Supply Plan forecasts that the state will have ample water resources with increased water efficiency through conservation and reuse. The NJDEP's plan suggests that a further 3.4 MGD of water conservation savings are possible within the Barnegat Bay watershed, which adds up to roughly 1.2 billion gallons per year.

Knowledge Gaps

Water withdrawal data for Ocean County are either self-reported to NJDEP or estimated by USGS. Groundwater diversions below 100,000 gallons per day are not required to be reported to NJDEP, leading to an undercount of total groundwater diversions and a disparity between NJDEP's and USGS's figures for water use.

As the Barnegat Bay watershed is multijurisdictional, it is difficult to get entirely accurate population estimates. The watershed boundaries divide several towns and include areas from both Ocean and Monmouth counties. Data from Ocean County is used in the analysis as the borders roughly align with that of the Barnegat Bay watershed.

While wastewater flow is a stable metric of domestic water use, trends may be changing. Wastewater flows do not account for consumptive use (irrigation or industrial uses that are not ultimately returned to the sanitary sewer system) or water reuse. Accurate domestic and industrial water reuse data may require direct surveying.

As the northern part of the watershed develops, water demands are being fulfilled by sources outside the watershed in addition to existing sources within the Barnegat Bay watershed. These transfers of water across natural boundaries, known as inter-basin transfers, are not reflected in water withdrawal figures and result in artificial lowering of the calculated per capita consumption figures. As such, reported water withdrawals become a less stable indicator of water use.

What YOU Can Do

1. Install a rain barrel under a roof downspout and collect a free supply of water for use in the yard.
2. Minimize lawn watering needs by selecting turfgrass species resistant to drought, such as tall fescues.
3. Use weather-based or soil moisture-based controllers in irrigation systems. WaterSense labeled products meet USEPA's specifications for water efficiency and performance.
4. Use porous surfaces on driveways, walkways, or patios.

Data courtesy of NJDEP Office of Water Allocation, NJDEP Division of Water Quality, U.S. Geological Survey, and US Census Bureau, Population Division.

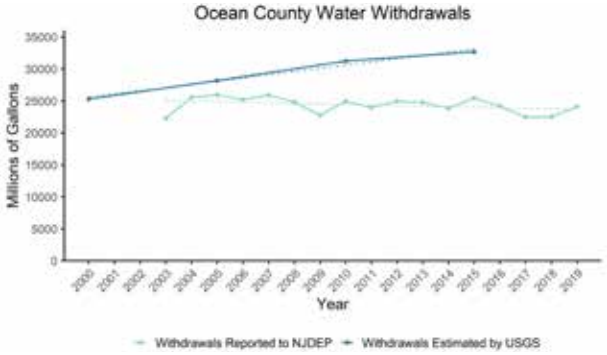


Figure 1: Water withdrawals in Ocean County as reported to the NJDEP (green) and estimated by USGS (blue). The dashed lines indicate the long-term trends.

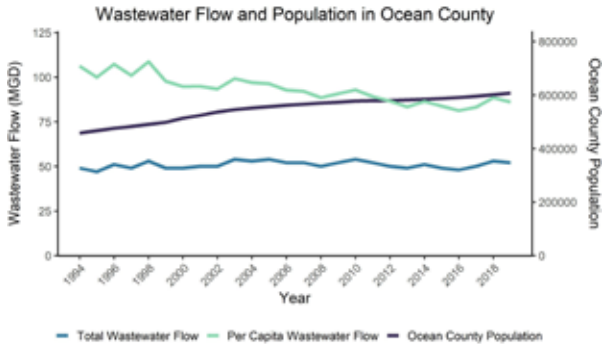


Figure 2: Total wastewater flow (blue), population (black), and per capita wastewater flow (green) for Ocean County from 1994 to 2019.

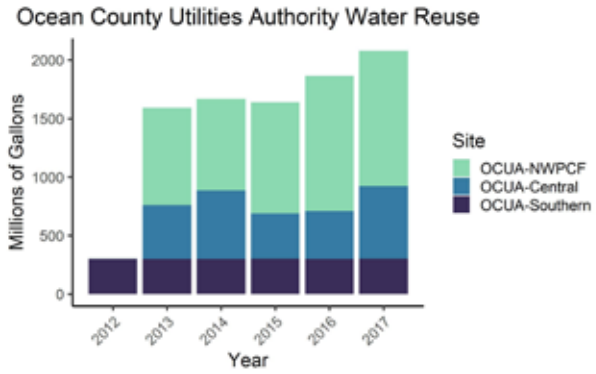


Figure 3: The amount of water reused by the Ocean County Utilities Authority as part of their wastewater processes from 2012-2017 at each of their facilities.

State of the Bay Extra:

OCUA Water Re-Use

One significant way to save potable water supplies and reduce overall water production costs is to beneficially re-use sewage treatment plant effluents for appropriate purposes. Within the Barnegat Bay watershed, the Ocean County Utility Authority (OCUA) is permitted by NJDEP to use secondary-treated sewage effluent for various purposes. This water re-use provides a tremendous cost savings to the OCUA (and the residents of Ocean County). The OCUA does not need to purchase potable water from a water supplier, which in turn does not have to withdraw water from a well or surface water body, which saves water reserves in Ocean County, which also support the living resources of the Barnegat Bay and industries, such as fishing, which are dependent on clean water.

You might wonder how this sewage effluent is treated and what it is used for. The Ocean County Utilities Authority's three treatment plants process all wastewater in Ocean County consistent with NJDEP and USEPA standards. First, the primary treatment process uses mostly physical processes to remove pollutants: screens to remove debris and grit, settling tanks to remove sludges via sedimentation, and other tanks to skim off fats, oils and greases (FOGs) from the water's surface. This primary treatment generally removes about half of the materials and pollutants in the waste water.

Secondary treatment involves aeration, biofiltration and microbial processing treatments, both aerobic and anaerobic, prior to final sedimentation and disinfection using various forms of bleach to kill any remaining pathogens. Usually, this final secondary-treated effluent is pumped to the Atlantic Ocean several miles offshore, but the OCUA conserves a lot of potable water by using secondary treated effluents in various operations at its three treatment plants.

In 2020, the OCUA's three plants reused a total of nearly 2.1 billion gallons of secondary treated effluent, which is almost 3.4% of the bay wide estimate of 62.8 trillion gallons of water. This water is used for many different purposes at the plants, including wash-down water, boiler-makeup water, non-contact cooling water, sanitary sewer jetting (cleaning out sewers), fire protection, and restricted-access spray irrigation. Different portions of Ocean County are located within New Jersey's most critical water supply planning areas, so water re-use by the OCUA contributes to conservation of one of the state's most critical natural resources, its water. Without conservation, meeting future water supply needs in the Barnegat Bay watershed will require significant additional infrastructure expenditures for water treatment, distribution, and storage.

Aeration basin at an OCUA facility. Photo by OCUA.

Dunlins and short-billed dowitchers taking flight over the marsh. Photo by Shannon Vasquez.

Climate Change

Boots sitting on a flooded dock during a King Tide. Photo by Carol Bradshaw.

The effects of climate change are all around us, and impact both human and natural communities in numerous ways. Here the report describes the trend in three climate measures (sea level, air temperature, and precipitation) and describe how those changes will influence how the people of Ocean County interact with the Barnegat Bay. Next the report discusses how the BBP is planning to incorporate the effects of climate change in program activities, and lastly provide some actions that you can take to help reduce the impacts of climate change.

Sea Level Rise

The impacts of climate change have already been observed here in New Jersey, which is experiencing rates of sea-level rise well above the global average. Sea level in New Jersey as measured at Atlantic City rose 17.6 inches (4.14 mm/yr) along the New Jersey coast from 1911 to 2019, more than double the change in the global mean sea-level (Figure 1). This increased rate of change is due in part to the land along the coast sinking over the last four thousand years in response to the melting of the North American ice sheet, and more recently associated with extensive groundwater withdrawals (Kopp *et al*. 2019).

A recent report by the New Jersey Science and Technical Advisory Panel suggests that by 2030 sea level is likely to rise by 6 to 13 inches over 2000 levels, and that by 2050 it is likely to rise between 11 to 25 inches over 2000 levels (Kopp *et al*. 2019). The impacts of higher water levels are already being felt by coastal residents in the form of more frequent high-tide flooding (*i.e.*, flooding not associated with storm events). For example, Atlantic City had an average of 8 high tide flood events per year between 2007-2016, up from an average of less than one per year in the 1950s. The frequency of high tide flooding will increase as sea levels rise; Atlantic City is likely to experience between 17-75 days of flooding per year in 2030 and 45-255 days per year in 2050.

Air Temperatures

The statewide average temperature in 2012 was the highest since 1895, with the five warmest years all occurring since 1998 (Figure 2). The ten warmest calendar years on record occurred post 1990; this pattern is consistent with the long-term upward trend of approximately 3°F per century (Runkle *et al*. 2017).

As temperatures have risen, temperate zone areas including New Jersey, have seen an earlier onset of spring. This can have severe consequences for our native flora and fauna, which rely on the timing of these temperature changes as a cue for important life history events. Furthermore, an earlier spring leads to an earlier, and longer, pollen season, which will adversely affect those who suffer from allergies. Additionally, the Fourth National Climate Assessment projects that the annual average temperature for the Northeast region will rise 5°F to 9°F by late century compared to the 1976-2005 average (Vose *et al*. 2017). This means the recent record-breaking years may be "common" in the next few decades.

Precipitation

The most recent assessment by the Intergovernmental Panel on Climate Change (IPCC) provides more and robust evidence to support the conclusion that "it is very likely that extreme precipitation events will be more frequent and more intense over most of the mid-latitude land masses and wet tropics in a warmer world (IPCC 2021)." These heavy precipitation events have occurred more than twice as frequently over the past 20 years compared to the prior century (Figure 3), and the trend is likely to continue (Broccoli et al. 2013). These heavy rainfall events can cause flooding, streambank erosion, and increases in the rate and amount of nutrients, sediments, and other pollutants delivered into the estuary. Stormwater rules and regulations are being modified to address these events; thus, the costs of stormwater management are also increasing.

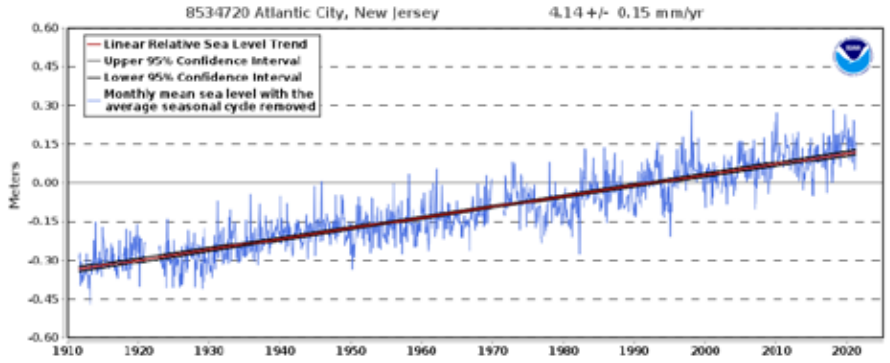


Figure 1: Tide gauge records for Atlantic City; red trend line shows steadily increasing sea level since 1912. Courtesy of NOAA.

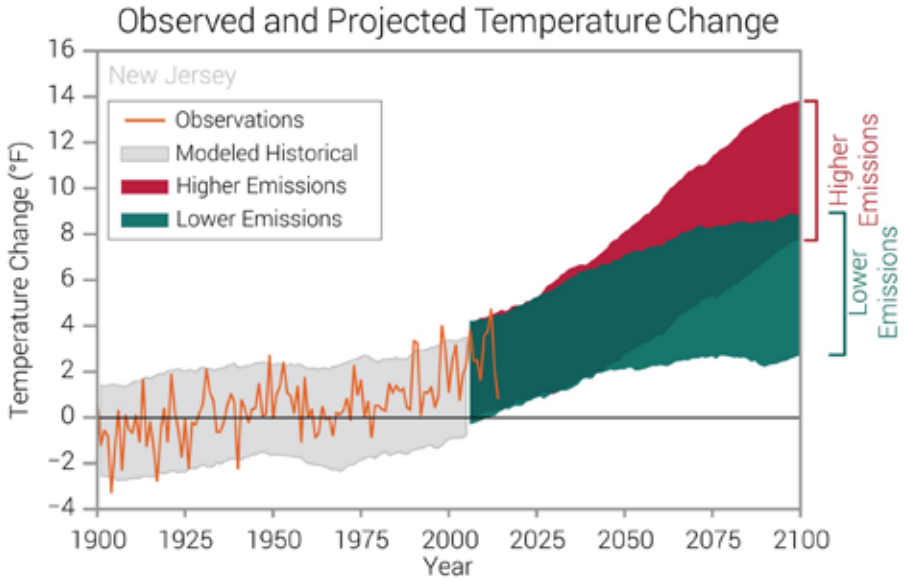


Figure 2: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for New Jersey, averaged over 5-year periods. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Historically unprecedented warming is projected during the 21st century. Less warming is expected under a lower emissions future (the coldest years being about as warm as the warmest years in the historical record; green shading) and more warming under a higher emissions future (the hottest years being about 10°F warmer than the hottest year in the historical record; red shading). Figure from Runkle et al. 2017.

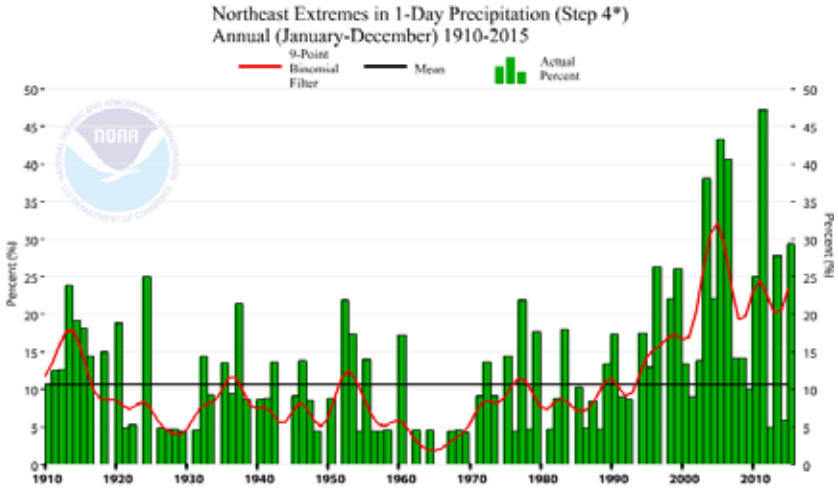


Figure 3: An index of the percentage of precipitation falling as part of a heavy precipitation event in the Northeastern United States. Courtesy of NOAA National Climatic Data Center.

Climate Change

BBP Activities Vulnerable to Climate Change

With climate change recognized as increasingly impacting coastal communities and economies, there was an identified need to assess the vulnerability of all CCMP actions to recognized climate change stressors, and, specifically, to consider the likelihood and magnitude of climate change impacts upon proposed CCMP actions. Thus, the BBP made use of its own partners, regional experts, and the latest science to assess the vulnerability of its actions to the following stressors: 1) warmer and more variable winter weather, 2) warmer and more variable summer weather, 3) warmer water, 4) drought, 5) more frequent and bigger storms, 6) sea level rise, and 7) coastal acidification.

These climate stressors varied widely in their potential adverse impacts on different CCMP actions. Some categories of actions, such as education or coordination activities, were thought to be minimally affected by climate change stressors; however, other actions, such as wetland or shoreline restoration, were recognized to be potentially or significantly impacted by the identified climate change stressors. More frequent and bigger storms, sea level rise, and drought were recognized as the most likely and significant stressors affecting the largest number of CCMP actions. Changes in both winter and summer weather were considered equally likely but had different mechanisms of impact. Warmer water and coastal acidification, though generally considered to be the least likely and least consequential stressors to most CCMP actions, were identified as having significant potential impacts on some uses of the bay (*e.g.*, tourism, shellfish culture, fishing). Specific details can be found in Chapter 8 of the 2021 CCMP.

What YOU Can Do

1. Consider ways to reduce your use of fossil fuels when traveling (*e.g.*, carpooling, electric vehicles, public transportation, biking).
2. Conduct a home energy audit and consider various home improvements (*e.g.*, ENERGY STAR certified products, solar power, additional home insulation, replace windows and inefficient heating and air conditioning systems).
3. Have a water-smart landscape and plant long-lived tree species to provide shade where desired.

For more tips on simple steps you can take to lessen the impacts of climate change visit EPA's What You Can Do about Climate Change website.

Data Sources

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Morning along the Barnegat Bay Estuary. Photo by Michael Leon.

On The Horizon

Photo by Shannon Vasquez.

During the past five years a number of policy actions and projects were initiated that may not have had obvious immediate effects, but have the potential to positively impact the Barnegat Bay watershed over the coming decade.

Legislative Actions

New Jersey's state highway agencies (Department of Transportation, NJ Turnpike Authority, and South Jersey Transportation Authority) are now required to use native vegetation when landscaping, reforesting, or conducting other land management activities under a law signed May 1, 2017. The use of native plants in roadway projects reduces the need for fertilizer and pesticides, which often end up in local waterways due stormwater runoff, where they contribute to environmental degradation. Native plants, besides reducing pollution, also support a host of pollinators, birds, and other wildlife, so this law is great not only for the Barnegat Bay ecosystem but also the entire state of New Jersey.

In March 2019 the Clean Stormwater and Flood Reduction Act was signed into law, which gives local government entities the ability to create stormwater utilities and establish fees. New Jersey's law allows, but does not require, local governments to establish stormwater utilities to collect fees based on the amount of stormwater the property generates that needs to be managed. Funds generated from these fees are dedicated to stormwater management and cannot be diverted for other purposes. This law gives local governments a new tool to address stormwater runoff, which has long been a major contributor to the pollutant loadings of the bay.

On Nov. 4, 2020, the "single use plastic bag ban" (P.L. 2020, c117) was signed into law, prohibiting the use of single-use plastic carryout bags in all stores and food service businesses statewide and single-use paper carryout bags in grocery stores that occupy at least 2,500 square feet beginning May 4, 2022. The measure also bans disposable food containers and cups made of polystyrene foam, and, starting in November 2021, requires restaurants give out single-use plastic straws only on request. These items are often found as litter in the rivers, creeks, and streams in the watershed and along the bay's beaches. A reduction in plastic pollution is consistent with the BBP's engagement with USEPA's "Trash Free Waters" program.

New Projects

In 2017, the NJ Department of Environmental Protection released their Barnegat Bay Restoration, Enhancement, and Protection Strategy: Moving Science into Action. To implement the various activities laid out in the overall strategy, the Department provided funding in 2019 to 20 separate projects. Due to the COVID-19 pandemic many of these projects have just recently begun, and we expect to see the results from them in the coming years. The projects and their descriptions are briefly described here: see the Department's website for additional information.

Stormwater Basin Retrofits and Green Infrastructure

These projects implement on-the-ground stormwater quality improvements within the Metedeconk River sub-watershed through the use of green infrastructure and stormwater basin improvements.

Watershed Planning and Implementation

The three projects included in this category will develop watershed protection and restoration plans for the Toms River, Cedar Creek-Forked River-Oyster Creek, and Southern Barnegat Bay sub-watersheds. The plans will include a characterization and water quality assessment of the watersheds, development of load reduction estimates necessary to achieve state water quality designated uses and corresponding water quality standards, and the development of a priority list of implementation measures to achieve the necessary load reductions. Once completed, the entire Barnegat Bay watershed will be covered by watershed plans (the Metedeconk River sub-watershed was completed in 2013).

Living Shorelines/Resiliency

Living shorelines are nature-based techniques, like oyster reefs and vegetated plantings, used to reduce erosion and improve water quality along beach and salt marsh edges. The five projects will create living shorelines to protect public open space in Long Beach Island, South Toms River, Forked River, Tuckerton, and Cattus Island Park.

Education/Stewardship

Three grants were awarded to projects focused on educating municipal officials regarding stormwater runoff and water quality, community awareness of bay nettle issues, and a stewardship certification program.

Enhanced Stormwater Mapping

Point Pleasant Beach Borough and Lacey Township received grants to update the mapping of their stormwater facilities and infrastructure to support future non-point source pollution reduction and pathogen source track down efforts.

Pathogen Source Tracking

This project will use advanced monitoring techniques to identify potential cross-connections between the sanitary and stormwater systems and other infrastructure issues in the Toms River watershed and will lead to corrective measures and water quality improvements thereby reducing closures of recreational bathing beaches on the Toms River.

Submerged Aquatic Vegetation and Shellfish Restoration, Enhancement and Protection

A suite of three projects will conduct in-the-water restoration, creating two new oyster reefs, a series of submerged aquatic vegetation beds, and a mixed oyster reef submerged aquatic vegetation bed. These projects will add critically important habitat to the bay and refine techniques that will allow practioners to restore these sensitive habitats more efficiently in the future.

Environmental Sensitive Area Enforcement

This project will fund enforcement support, education, and outreach in Ecologically Sensitive Areas (ESAs), specifically Sedge Island Marine Conservation Zone (SIMCZ), within the bay. Ecologically Sensitive Area (ESA) were designated where substantial SAV beds and wildlife are found. Personal watercraft and commercial activity are excluded from the SIMCZ to help prevent damage to SAV and harm to marine life. Protecting SAV stabilizes bottom sediments, increases sediment removal from the water column, and enhances nutrient uptake.

Recycled oyster shell with baby oysters being deployed in Barnegat Bay. Photo by Susan Allen/Stockton University.

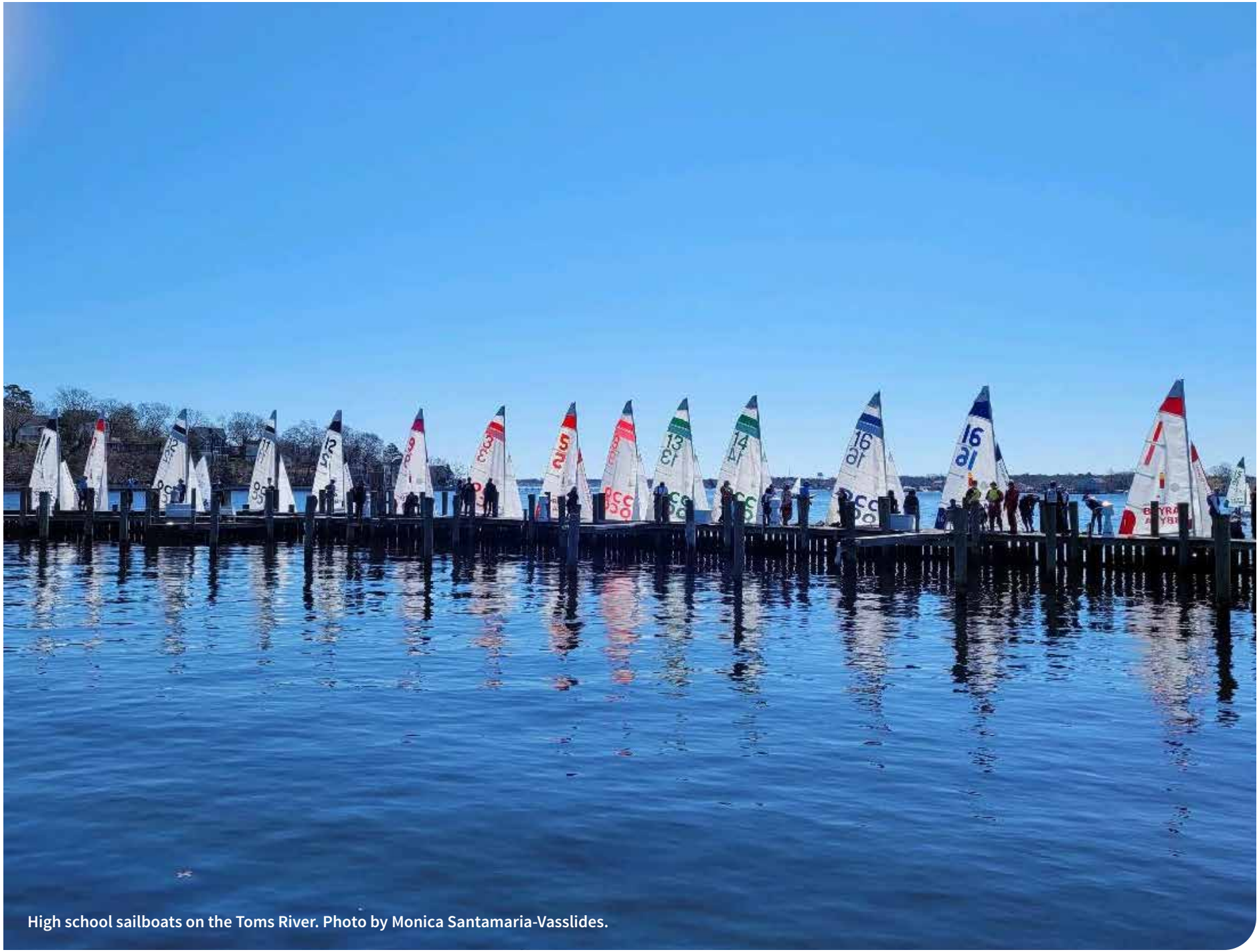
Conclusion

As evident from this *State of the Bay Report*, there is still much work to be done to meet the ecosystem targets agreed to in the Comprehensive Conservation and Management Plan. As the human population within the watershed continues to increase, it places additional strain on the watershed's critical resources. Watershed residents and visitors are removing freshwater from the ecosystem at a pace that is not likely to be sustainable over the long run for either humans or fish and wildlife. The Bay is still losing freshwater and tidal wetlands to human disturbance, despite evidence showing that these habitats provide our communities with important services that cannot be replaced or can only be replaced at great cost. Even though it was identified as a critical data gap in the 2011 and 2016 *State of the Bay Reports*, there has still not been a bay-wide survey of the area of seagrasses, a crucially important habitat for fish and wildlife, since 2009. Lastly, the effects of human-induced climate change continue to be felt in our watershed in the form of more frequent high-tide flooding, warmer air temperatures, and heavier precipitation events.

There are some areas where progress towards the ecosystem targets were achieved. Total Maximum Daily Loads (TMDLs) and other non-point source pollution reduction measures are leading to less pathogens in estuary and fresh waters, resulting in a decline in the number of bathing beach closures. The area of the bay closed/restricted for shellfish harvest due to pathogens has remained relatively low over the past decade, while hard clam abundance has increased from historic lows in the 1980s (though the most recent data are nearly a decade old now). And even though overall water consumption has increased, the per-person consumption rate has steadily declined over a quarter century and industrial users are now actively engaged in water reuse and reclamation.

With the CCMP and ecosystem-based targets as a guide, the partners of the Barnegat Bay Partnership remain steadfast in its mission to understand, protect, and restore this special ecosystem. Over the past five years a bevy of education, research, and restoration projects were undertaken within the Barnegat Bay watershed to address a diverse suite of topics, including non-point source pollution reduction planning and projects, pathogen source tracking, construction of living shorelines to protect our beach and salt marsh edges, salt marsh restoration, seagrass and shellfish restoration and enhancement, and community stewardship, including enforcement.

While the efforts of the many groups that compose the Barnegat Bay Partnership will continue to move our bay in the right direction, everyone's help is needed to reach the targets. Everyone who works, resides, or visits the Barnegat Bay watershed can help the BBP achieve its goals. The tips and web-links included in each target section are a good place to start; to learn about additional steps you can take and how you can be a good steward for the Barnegat Bay please visit https://www.barnegatbaypartnership.org/.



High school sailboats on the Toms River. Photo by Monica Santamaria-Vasslides.

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Barnegat Inlet lighthouse at sunset. Photo by Ed Hewitt.


Barnegat Bay
Partnership
RESEARCH · EDUCATE · RESTORE