Barnegat Bay Comprehensive Plan – Action Item 7
Ambient Water Monitoring & Modeling
Water Quality Standards & Assessment
Total Maximum Daily Loads
Frequently Asked Questions (January 2015)

"Monitoring Programs"

1. Routine Monitoring – before June 2011

As is the case throughout New Jersey, prior to June 2011, fresh water streams within the Barnegat Bay watershed and the Bay itself were monitored primarily through limited routine monitoring programs conducted by the Department. The Division of Water Monitoring & Standards' Bureau of Freshwater and Biological Monitoring (www.state.nj.us/dep/wms/bfbm/), sometimes in cooperation with the U.S. Geological Survey (USGS), is responsible for monitoring fresh water tributaries to the Bay. The Division of Water Monitoring & Standards' Bureau of Marine Water Monitoring (www.state.nj.us/dep/wms/bmw/) is responsible for monitoring the estuarine waters of the Bay. All the data are available to be downloaded from the National Water Quality Portal (www.waterqualitydata.us). The USGS also maintains a series of stream flow and tide gages (http://nj.usgs.gov/).

2. Targeted Monitoring – June 2011 thru June 2013

In order to develop a comprehensive hydrodynamic and water quality model for Barnegat Bay, the Department designed a more expansive, frequent and synoptic monitoring project. Starting on June 6, 2011, the Barnegat Bay Targeted Water Monitoring Project was conducted over a 2 year period, in three phases, to collect the data needed to develop the model. A total of 4,100 tributary and Bay samples were collected. About 51,800 laboratory measurements and 30,500 field measurements were taken. This project could only be accomplished with the assistance of numerous partners, including local and county governments, State and Federal agencies, a science high school, a university and other organizations that were enlisted to assist the Department in sample collection and analysis. Many of these sampling partners are members of NJ's Water Monitoring Council.

Water quality was measured with grab samples taken at 12 streams which enter the Bay, as well as at 15 locations within the Bay. Water flow into the Bay was measured at 12 streams, and water flows into and out of the Bay were measured at the three inlets from the Atlantic Ocean. Also, water circulation within the Bay was measured at 3 locations by 3 major bridges. Continuous monitoring (at selected locations), 3 intensive summer season monitoring events, continuous temperature monitoring around the Oyster Creek facility, sediment monitoring, and a survey to map the bottom of the Bay (i.e. bathymetric survey) were also carried out. The continuous and intensive monitoring

components complemented the discrete sampling to capture the full range of daily, tidal and seasonal variations. A video describing the targeted monitoring project can be found at: www.nj.gov/dep/barnegatbay/bbvids.htm.

The purpose of this project was to address the following objectives:

a. Collect sufficient synoptic data (minimum 24 months) to develop water quality and hydrodynamics models;
b. Provide a more comprehensive assessment of the relevant water quality conditions throughout the Barnegat Bay both spatially and temporally;
c. Provide water quality and biomass data to better quantify biological productivity and its impact on dissolved oxygen (DO) concentrations in the Bay;
d. Determine the nutrient loadings into the bay and establish boundary conditions for the significant tributaries to the bay;
e. Provide nutrient concentration and loading data needed to evaluate the effects of nutrient load reduction scenarios;
f. Provide an understanding of the physical factors affecting the bay water quality; such as the flushing rate, temperature, salinity and the depth of the bay. These factors play a major role in the physical, chemical and biological processes occurring within the bay;
g. Collect data that captured daily and seasonal variability as well as variability between years;
h. Calibrate and validate modeling tools that can be used to direct water quality restoration of the bay.

Those data have been used to assess water quality in the bay, and to develop water quality and hydrodynamic modeling tools to set water quality targets and inform restoration strategies. **THE TARGETED MONITORING PROJECT WAS SUCCESSFULLY CONCLUDED ON JUNE 30, 2013.**

3. Long Term Monitoring – July 2013 to the present

After successfully collecting the data sets necessary for model development, the Department designed a long term monitoring program for Barnegat Bay and those tributaries with the most significant impacts/loadings to the bay. This monitoring program started on July 24, 2013, and is on-going.

The goals of the program are to:

a. Capture changes in water quality in the Barnegat Bay watershed over time.
b. Document changes in nutrient loadings to the Barnegat Bay watershed resulting from changes in fertilizer formulations and applications due to the fertilizer legislation.

c. Document changes as a result of restoration actions taken as part of the Governor's Comprehensive Plan, including actions guided by the water quality and hydrodynamic models that are currently under development, as well as other restoration actions.
d. Generate new data for assessment purposes as part of the Integrated Water Quality Monitoring and Assessment Report process.
e. Superstorm Sandy Impacts: It will be years before the full impact of the storm on the Bay is known. This long term monitoring program will help capture changes in water quality over time that may have resulted from Superstorm Sandy.
f. Characterize the normal fluctuations in water quality so that the uncertainty surrounding any given water quality measurement can be better defined.
g. Provide water quality data that can be referenced to the concurrently occurring biological research projects.
h. Interpretation of the narrative nutrient criteria requires water quality data to be collected at the same time as biological studies.

The stations included within the long term ambient monitoring program overlap with, but are not identical to, those sampled by the Targeted Water Monitoring Project. There are a total of 14 tributary stations and 13 Bay stations in this long term program. The station selection rationale was:

a. Major tributary stations where the major tributary loads come into the Bay. Eight out of 12 Head-of-Tide tributary stations were selected for this purpose (during 2011-2013 sampling, tributary stations were selected at the closest point to the Head-of-Tide as possible with the goal of quantifying the loading from the tributary to the Bay).
b. North Branch of the Forked River, in the vicinity of the Oyster Creek Nuclear Generating Station. During the Targeted Monitoring project, intensive monitoring was conducted in the vicinity of the Oyster Creek Plant to assure that the model being built can appropriately simulate the conditions pre- and post-plant closure. For the long term monitoring program, only one station was retained in that area, for a total of 9 Head-of-Tide tributary stations retained for long term monitoring.
c. Five additional tributary monitoring stations with long term historic records and located in the upper Barnegat Bay watershed were also included in this long term network to track changes and for potential trend analysis. The addition of these State ambient monitoring sites to this Barnegat Bay watershed network results in more frequent sampling (about 14X/yr vs 4 times/yr) and greater water quality data availability.
d. An analysis of the 2011-2013 data indicated some similarity among the data collected from different in-Bay stations. For the long term monitoring program, 9 out of 15 in-Bay stations were selected as representative.
e. Four in-Bay stations that have long-term historic records were included in this network to track changes and for potential trend analysis.

f. Flow gauges are being retained at the four major tributaries to the Bay, and the two major inlets to the Bay.

"Modeling and TMDLs"

4. Barnegat Bay – a complex system requiring a complex model

Barnegat Bay is a complicated system. The monitoring data shows that the Bay can be divided into 3 different zones based on the salinity levels. With the installation of the flow gages the Department gained a better understanding of the movement of water through the bay. The development of a hydrodynamic model is needed to adequately simulate the movement of water through the Bay, understand how long it resides in various parts of the Bay, understand the effects on water quality from things like mixing, settling, sunlight, temperature, and the activities of organisms that process pollutants. The model simulates the processes that have impacts on the water quality as they occur in the presence of rain, wind, tides and a cycle of day and night.

5. Air Deposition of Nitrogen – contribution and modeling

A 2009 USGS loading study estimates that air deposition accounts for 22% of the nitrogen loading to the open waters of the Bay. The model development for Barnegat Bay will include an air deposition component for nitrogen load that will utilize available air monitoring and air modeling information. In order to obtain improved information on the significance of air deposition to the Bay, in September 2012, the Department installed an additional air deposition monitoring station in the northern part of the Bay, at Cattus Island Park, to supplement the existing one south of the Bay; a third station is located in northern New Jersey. Based on the data being collected, air deposition rates clearly varied among all three air monitoring stations in the State. Therefore, air deposition data obtained from the local station within the watershed will improve the estimation of the nitrogen loading into the Bay through air deposition.

6. Use of the Hydrodynamic/Water Quality Model

Identifying acceptable levels of response indicators, such as chlorophyll a, clarity, or DO and applying the modeled relationship to nutrients will enable setting numeric thresholds for nutrients specific to Barnegat Bay. Initially, the models will be used to develop management strategies to address eutrophication and related issues by evaluating water quality impairments, identifying numeric pollutant targets, and supporting the development of numeric water quality criteria and Total Maximum Daily Loads (TMDLs), as appropriate. In addition, research projects have been carefully selected to provide the missing links so that the selected restoration actions are the ones that will restore water quality and designated uses. Once the models can successfully simulate how the system responds to pollutants, different scenarios will be run in the model to see what happens when the system is changed. Eventually, the best option(s), in terms of the overall ecology of the Bay, will be selected to serve as the framework for restoration actions. The models will also be valuable tools that will allow the Department to simulate and evaluate other conditions that are or potentially will

impact the Bay, such as the shutdown of the Oyster Creek Nuclear Generating Station, evaluating the potential benefits of augmenting freshwater flows to the Bay, and climate change impacts, among others.

7. Total Maximum Daily Loads (TMDLs)

A TMDL (Total Maximum Daily Load) is the maximum amount of a pollutant that can be added to a waterbody and still have a quality of water that will protect human health and aquatic life. A TMDL is calculated when the water quality is found not suitable to protect human health or aquatic life and it is due to human activities that are adding more pollutant(s) than a particular waterbody can handle.

In order to calculate a TMDL, a target (usually the already established water quality standard) and a way to translate pollutant amounts into the actual quality of the water are needed. For more complex systems, like Barnegat Bay, this requires a dynamic model of the system. With a target and this relationship, a required reduction can be calculated in order to achieve a suitable water quality target.

It should be noted that TMDLs are a specific tool set forth in the Clean Water Act (CWA) and are primarily intended to address point sources of pollution, like wastewater treatment plants. Unlike Chesapeake Bay, there are no wastewater treatment plants discharging directly to Barnegat Bay. There are other approaches, such as development and implementation of Watershed Based Plans, that are more appropriate where sources are land use based, like in Barnegat Bay. Control of such sources is best accomplished through best management practices (BMPs). There are also a host of stressors beyond water quality that can affect the success of an ecosystem. TMDLs can only address water quality stressors.

For more information on BMPs go to: www.nj.gov/dep/barnegatbay/plan-stomrwaterrunoff.htm

"Assessment & Water Quality Criteria"

8. Determining Impairments

As required by the CWA, the Department routinely assesses the State's water quality every two years and identifies waters that are not attaining the designated uses because adopted surface water quality standards are not met. The assessment is based on readily available, relevant data that meets the data quality requirements for consideration. The Department published the 2012 Integrated Water Quality Monitoring and Assessment Report (IR), in the July 2, 2012 New Jersey Register. In the 2012 IR, some tributaries and some portions of the open waters of Barnegat Bay have been found not to meet certain surface water quality standards. The Department determined that it would use the more robust data collected under the Barnegat Bay Targeted Monitoring Project to conduct a special off-cycle assessment for the Barnegat

Bay watershed. This assessment has been completed and is posted on the Department's webpage at www.nj.gov/dep/barnegatbay/plan-wqstandards.htm.

Based on the more recent and comprehensive data collected, the Department determined that four of the nine open water Bay assessment units did not meet the pathogen criteria to support shellfish and recreational uses. Additionally four of the nine assessment units did not meet the existing dissolved oxygen and/or turbidity criteria. The current assessment was compared to the outcomes of the 2012 Integrated Report. The assessment unit status has changed in some cases as a result of the additional data that became available through the Barnegat Bay Targeted Monitoring Project, primarily with respect to recreational and aquatic life uses. Assessments were able to make in several tributary assessment units where data was not available previously. For the recreation use, three Bay assessment units were found to have improved to fully supporting status and ten tributaries assessment units were found to decline from fully supporting to not supporting status. For aquatic life use, improvements to fully supporting status were found in five tributaries assessment units and four Bay assessment units declined to not supporting status because of the levels of DO and turbidity.

9. Isn't the Bay already impaired by nutrient pollution?

The Department has made it clear that the metrics to make the nutrient impairment decision are under development. There are 10 projects funded in the Bay to help us select metrics and to help assess what factors, other than pollutants, may affect the health of the bay. They include a look at the following: multiple trophic levels and how they respond to changing conditions; the past diatom communities to see if they can help set thresholds based on a reference condition; the food source suitability for clams; the role of wetlands in affecting nutrient levels; an assessment of the organisms that live in the sediment, small plants and animals that live in the water column, fish and crabs; and how nutrients and shoreline hardening affect stinging nettle populations. (For more information on the research projects go to: www.nj.gov/dep/barnegatbay/plan-research.htm.) This work is underway and will be completed in 2015. The results of year one research have been posted and year two reports will be posted when ready. Nevertheless, the lack of an impairment listing for nutrients is not hindering remedial/preventive actions in the Bay or delaying development of a TMDL, if it is determined that this tool would be the appropriate one to address water quality impairments. While work is proceeding on linked water quality and hydrodynamic models and the research studies on the biology, other actions are occurring under the Governor's comprehensive plan including funding stormwater mitigation projects, fully implementing the new fertilizer law, preserving open space, public education programs (e.g., Blitz) and boater education and enforcement.

The Department believes that the question of how to restore the ecological health and designated uses of Barnegat Bay is not simply a question of determining if nutrients are present in excessive amounts. There are other factors potentially impacting the Bay

such as sea level rise, overfishing, fresh water diversions and boating. The loss of a specific commercial shellfish species doesn't necessarily mean that ecological health is impaired; it could be a reflection of unsustainable levels of harvesting. The assessments of ecological health are typically based on a number of metrics, including biodiversity, the composition of the aquatic community, and the numbers of organisms. The impacts identified in the Bay – loss of shellfish, loss of submerged aquatic vegetation and the presence of stinging nettles – may be related to the levels of nutrients, but they also could be significantly affected by other factors. The existing and on-going research and monitoring is designed to provide better information on overall ecological health and establish the relationships that exist between nutrients and the biological responses.

10. Assessing attainment of the existing narrative nutrient criteria

The narrative criteria for nutrients describe what it looks like if the waterbody is not suitable to protect aquatic life (e.g., objectionable algal blooms, nuisance aquatic vegetation, excessive diurnal dissolved oxygen fluctuations), but lacks a translation of these described conditions into specific water quality levels. Developing thresholds to interpret the existing narrative nutrient criteria depends in part on the results of the scientific studies and modeling the relationship between pollutants - including nitrogen – and thresholds identified as necessary to support a healthy aquatic community. The Department will develop methods and thresholds to evaluate these metrics and, once that work is completed, they will be incorporated into the Water Quality Monitoring and Assessment Methods Document. The public will be provided an opportunity to review and comment before these methods are used to assess the conditions of Barnegat Bay.

11. Establishing Numeric Criteria for Nitrogen

Understanding the relationship between pollutants - including nitrogen - and productivity that results in a eutrophic condition will provide the basis to determine how much nitrogen and other pollutants can be contributed from the various sources and still maintain response indicators at acceptable levels. Because of the complex relationship between nutrient loads and concentrations and how the response indicators respond in the highly dynamic system that is the Bay, it is likely that endpoints will be set in terms of one or more of these response indicators (e.g., chlorophyll-a and/or water clarity) and a model used to determine what levels of nutrients would achieve them. Once the modeling and biological studies are completed, the Department may be in a position to adopt numeric criteria through rulemaking or through a TMDL process.

12. Existing Impairments for Pathogens and Dissolved Oxygen

The existing 303(d) listed impairments for dissolved oxygen are based on the existing water quality criteria using data that has since been reviewed and found to have some quality assurance concerns. Based on the Barnegat Bay Interim Assessment, three of the nine assessment units in the open water of Barnegat Bay did not meet the existing water quality criteria for dissolved oxygen. The numeric criterion for dissolved oxygen may need to be revised to reflect a level that would be consistent with supporting a

healthy ecosystem that would be indigenous to the Barnegat Bay. For pathogens, the Department has adopted the WMA 13 coastal pathogen TMDL, as set forth in the March 18, 2013 New Jersey Register. Based on its experience elsewhere in the State, the Department plans to utilize sanitary surveys, conducted by its shellfish program, to effectively address the sources. Meeting the shellfish standards will also ensure that the waters meet recreational uses. Additionally, based on the Barnegat Bay Interim Assessment, four of the nine open water Bay assessment units did not meet the pathogen criteria to support shellfish and recreational uses. Three assessment units in the Bay have shown improvement in pathogen levels.