NJ Department of Environmental Protection
Water Monitoring and Standards

Reappraisal Report of Shellfish Growing Area BB3
(Barnegat Inlet Area)

November 2017

Reappraisal Report of Shellfish Growing Area BB3 (Barnegat Inlet Area)

New Jersey Department of Environmental Protection (NJDEP)

Bureau of Marine Water Monitoring
Robert Schuster, Bureau Chief

November 2017

Data from
October 2013 to August 2017

Report Prepared by:
Lisa DiElmo

Acknowledgements:
Special acknowledgments are given to the Boat Captains for their perseverance in collecting shellfish water quality samples and to the laboratory staffs at Leeds Point for their analysis of these water quality samples. Avery special thank you to Dominick Fresco for all of his hard work performing shoreline surveys.

Cover Photo by Lisa DiElmo

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Shellfish Growing Area BB3 is located in Ocean County. This growing area encompasses the back bay waters of Barnegat Bay from Forked River south to Westecunk Creek. Enclosed in these waterbodies are numerous channels, coves and thorofares. These include Oyster Creek, Channel Cove, Mud Cove, Double Creek, Big Cove, Mill Creek Thorofare, Gunning River, Big Flat Creek, Cedar Creek and Dinner Point Creek. The estimated size of this shellfish area is 30,980 acres. Approximately ninety-four percent of the waters in this area are classified as either *Approved* or *Conditionally Approved* for shellfish harvest. Less than six percent of shellfish waters are designated as either *Prohibited* or *Restricted*.

This growing area is bordered by the following municipalities: Long Beach Township, Ship Bottom, Surf City, Harvey Cedars, Barnegat Light, Lacey Township, Ocean Township, Barnegat Township, Stafford Township and Eagleswood Township. These communities are connected to city sewers that are managed by the Ocean County Utilities Authority (OCUA).

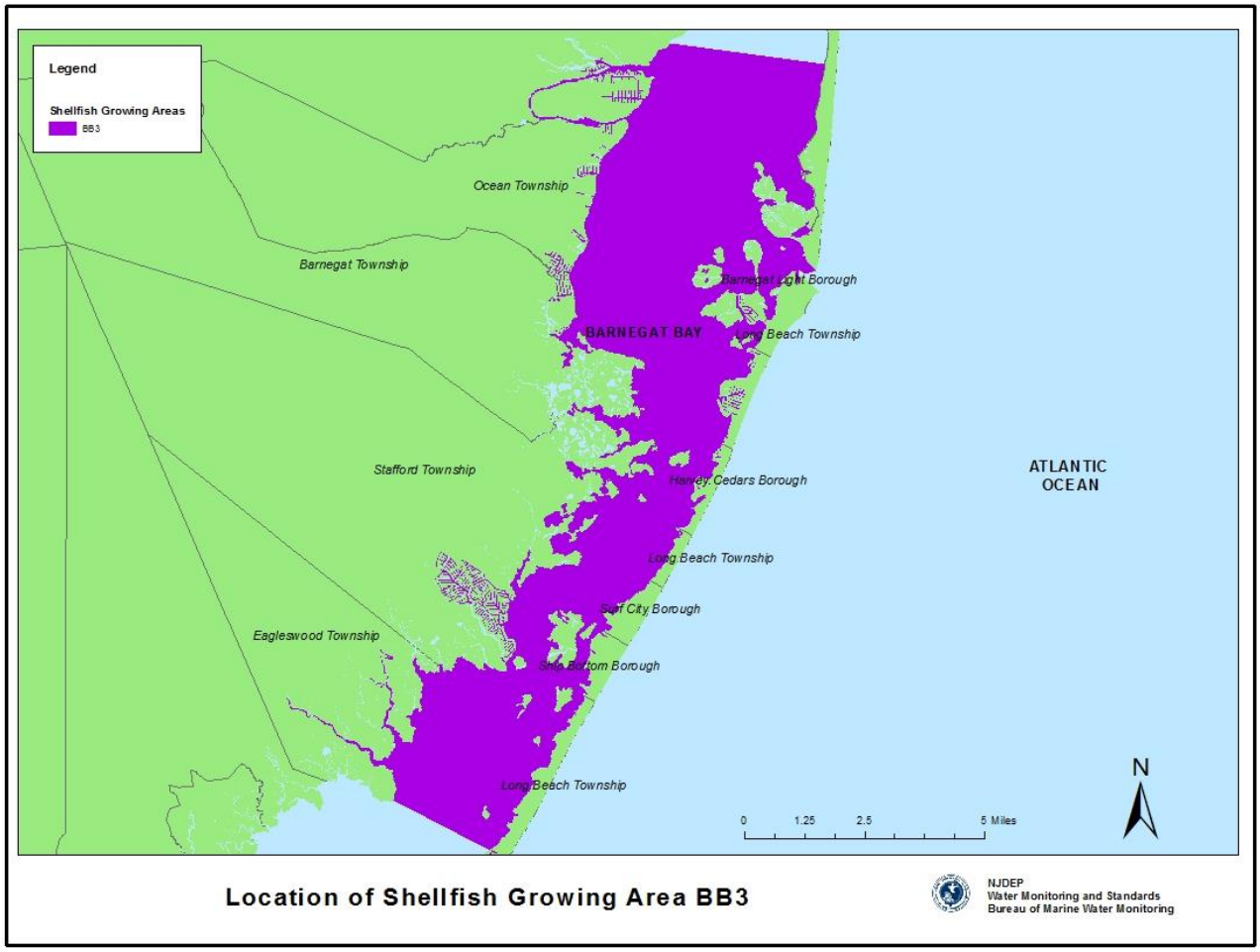
This report is based on data collected from October 2013 to August 2017. A total of 4834 water samples were collected from 141 sampling sites and analyzed for fecal coliform. Based on NSSP Systematic Random Sampling criteria, fourteen monitoring stations did not meet the *Approved* criteria. One of these stations (1669B) is located in *Approved* waters and ten stations are in *Conditionally Approved* waters. With an extended data time frame to include thirty pieces of data in the winter months when these stations are open for shellfish harvest, four stations (1664, 1666, 1667, 1670) do not meet the criteria for their current classification. At these four sites there is a strong rainfall component present. Rainfall impact is mainly due to runoff, carrying contaminants to open waters. There were no noticeable changes in shoreline, hydrography or land use that would require modification to the existing shellfish classifications. Since the elevated bacteria counts occur so seldom and likely don't remain elevated for extended periods, no downgrade of waters is recommended at this time.

GROWING AREA PROFILE

Location and Description

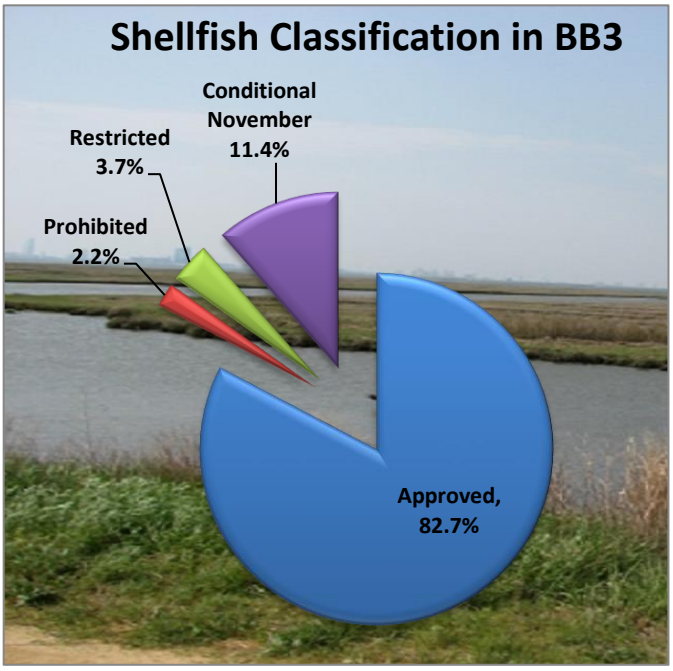
Shellfish Growing Area BB3 is located in Ocean County. This growing area encompasses the back bay waters of Barnegat Bay from Forked River south to Westecunk Creek on the western side and from Beach Haven terrace north to Berkeley Township on the eastern side. This growing area is bordered by the following municipalities: Long Beach Township, Ship Bottom, Surf City, Harvey Cedars, Barnegat Light, Lacey Township, Ocean Township, Barnegat Township, Stafford Township and Eagleswood Township. See map below.

Enclosed in these waterbodies are numerous channels, coves and thorofares. These include Oyster Creek, Channel Cove, Mud Cove, Double Creek, Big Cove, Mill Creek Thorofare, Gunning River, Big Flat Creek, Cedar Creek and Dinner Point Creek. All of these water sources feed into the Barnegat Bay which then feeds into the Atlantic Ocean via The Barnegat Inlet. The estimated size of this shellfish area is 30,980 acres.

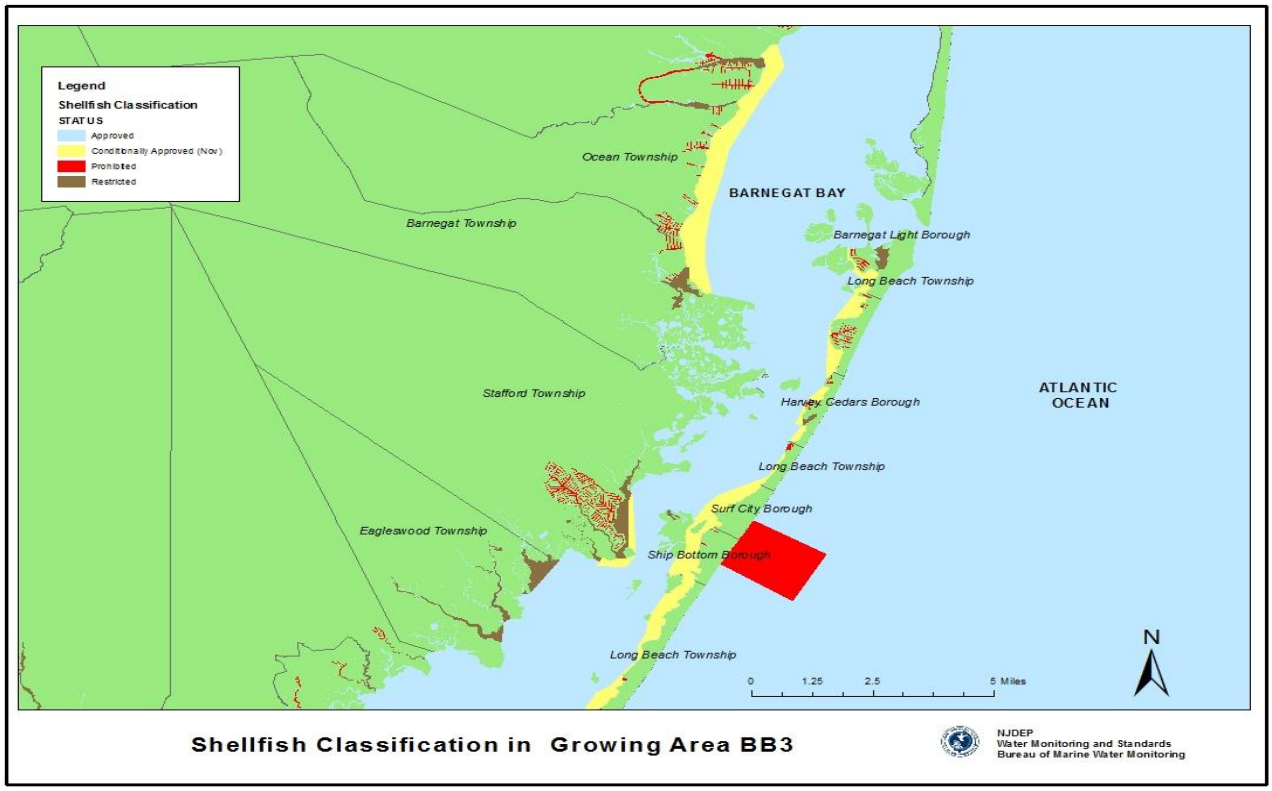


Growing Area Classification Summary

This growing area includes 30,980 acres of marine water. Approximately eighty three percent of the shellfish growing waters present in this area are classified as *Approved* and approximately eleven percent is classified as *Conditionally Approved*. The remaining six percent of these waters are classified as *Restricted* and *Prohibited.* Waters classified as *Restricted* and *Conditionally Approved* are used as buffers for marinas, lagoons and developed communities along the shoreline and are also sometimes used at the mouths of rivers or creeks that are classified as *Prohibited* to act as a buffer to an area leading into *Approved* waters.



The figure below illustrates the shellfish classifications for this growing area. It can also be found on the 2016 State of New Jersey Shellfish Growing Water Classification Charts # 7, 8 and 9 or on WM&S/BMWM website at http://www.state.nj.us/dep/



Evaluation of Biological Resources

There are several shellfish native to New Jersey that are commercially and recreationally important. These include: hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), eastern oysters (*Crassostrea virginica*), ocean quahogs (*Arctica islandica*), surf clams (*Spisula solidissima*), sea scallops (*Placopecten magellanicus*) and bay scallops (*Argopecten irradians*). According to the NSSP, scallops are considered shellfish except when the final product form is the adductor muscle only (2013).

The most densely populated and economically productive species in the area is hard clam (NJDEP, 1986). The most recent hard clam stock assessment, conducted in 2012, showed a 23 percent decrease in hard clam population in the Barnegat Bay since the last assessment in 1986. (NJDEP, 2015) According to this study, this growing area, for the most part, has a low to moderate distribution of hard clams. Factors that contribute to having a viable resource include: salinity, dissolved oxygen levels, bottom conditions and predator activity.

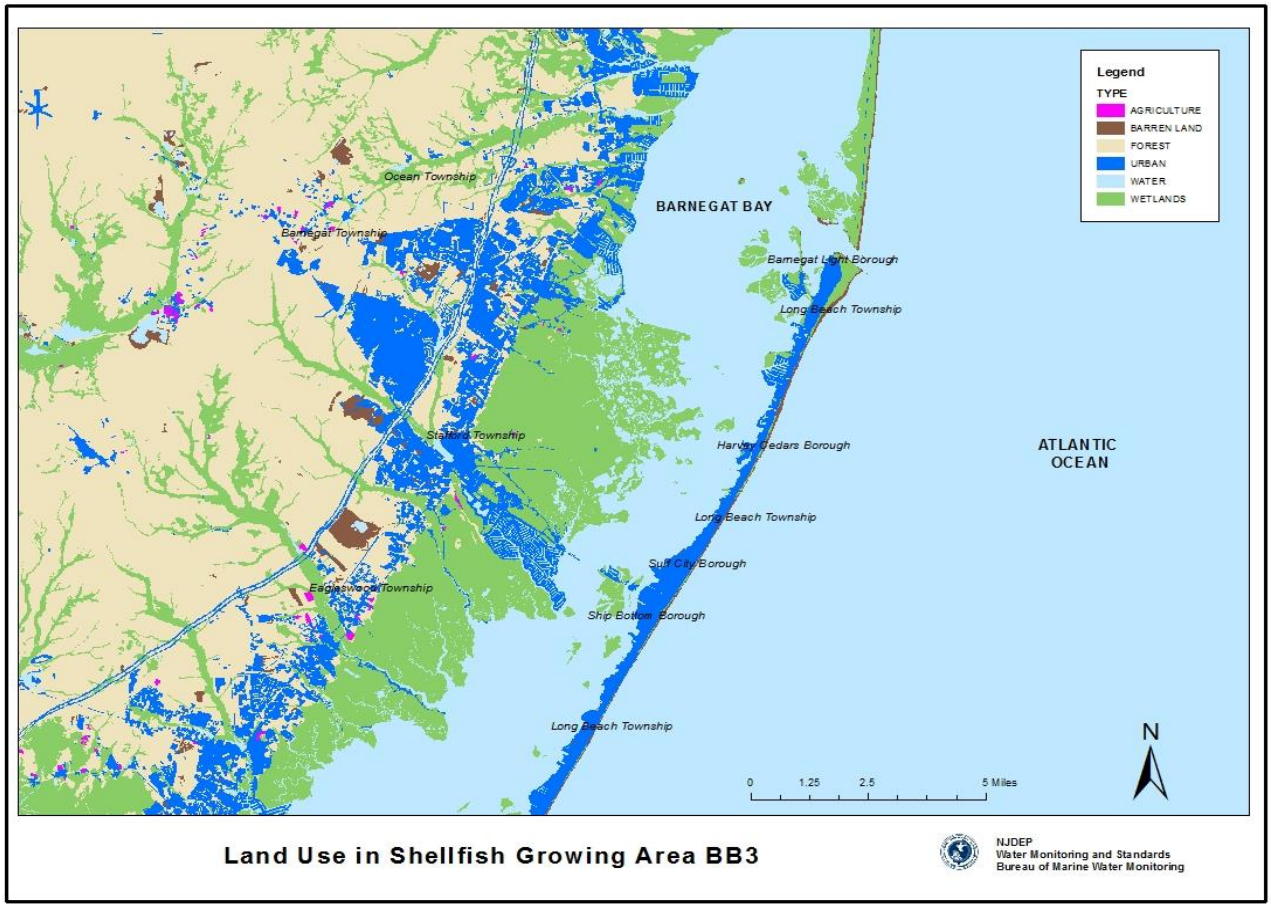
Shoreline Survey: Evaluation of Potential Pollution Sources

Shoreline surveys or site-specific visits of areas nearby or bordering shellfish growing waters can provide insight as to the location and nature of land use, surface water discharges, marinas, unpermitted discharges and stormwater inputs. Shoreline surveys of growing area BB3 were conducted during the timeframe of this report. The following sections detail information derived collectively from these surveys.

Land Use

The majority of land use in this area is comprised of urban communities. Long Beach Township, Ship Bottom, Surf City, Harvey Cedars, Barnegat Light, Lacey Township, Ocean Township, Barnegat Township, and Eagleswood Township are primarily residential communities with very few large commercial businesses. The biggest industry in this area is located in Stafford Township and is predominantly retail establishments. The communities along the shore are primarily connected to city sewer; however, there are some areas further inland that use septic systems.

The surrounding landscape has not changed significantly since the last shoreline survey, however there is still some rebuilding from Superstorm Sandy being done. Forest and wetlands are the second largest land use type in this growing area. The wetlands act as a barrier from the surrounding population centers. The wetlands utilize the nutrients obtained for plant growth and act as a purifier against pollutants. By doing so, these wetlands help to reduce pollutants entering the shellfish waters. The figure below shows a representation of land use in this growing area.



Surface water discharges

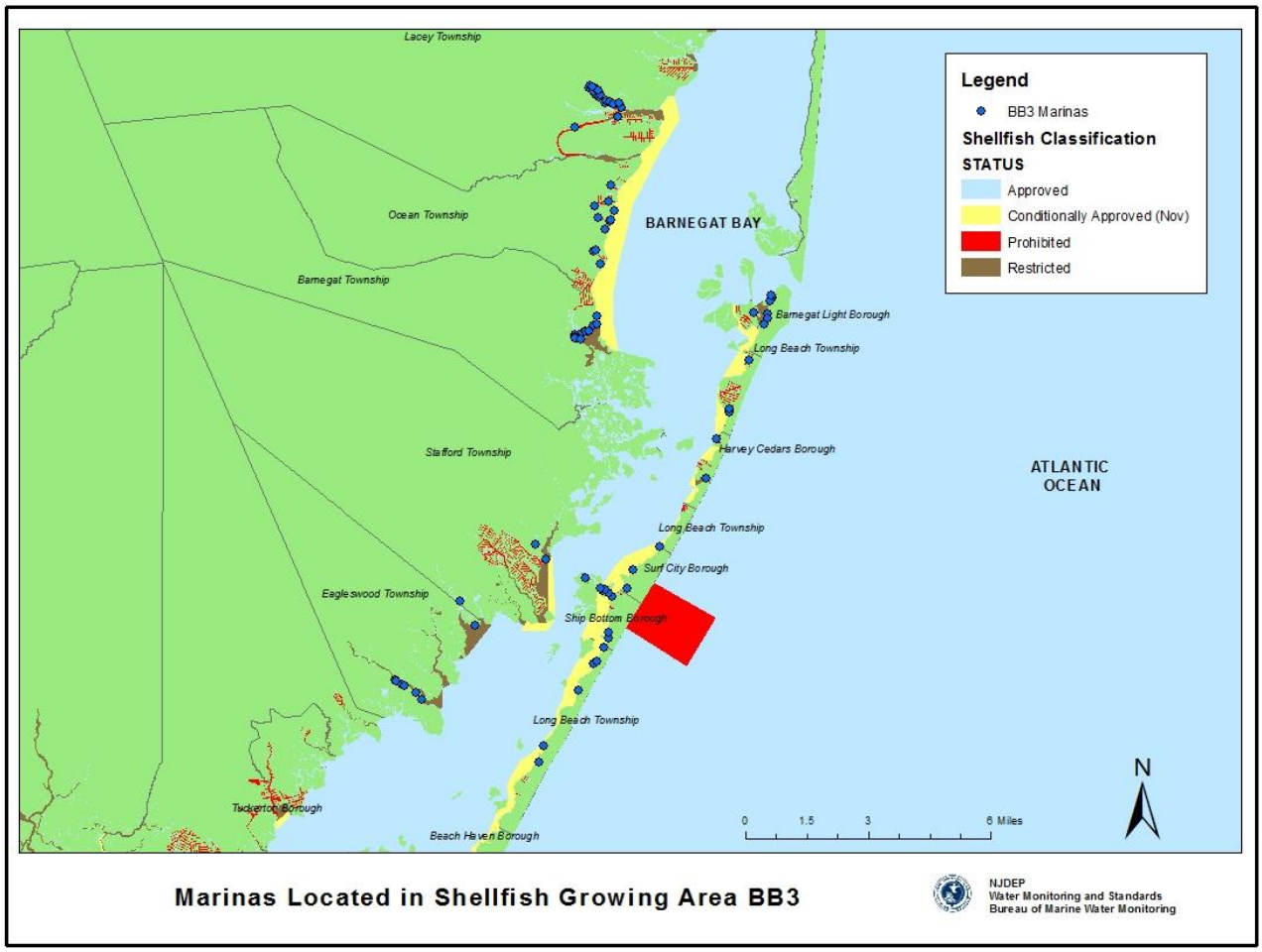
A surface water discharge involves the release of treated effluent from various municipal and industrial facilities directly into a river, stream or the ocean. The discharge of pollutants from a point source is authorized under the New Jersey Pollutant Discharge Elimination System (NJPDES) and the regulations are found at N.J.A.C. 7:14A. The main purpose of the NJPDES program is to ensure proper treatment and discharge of wastewater.

The only facility that does have the potential to impact water quality is the Oyster Creek Generating Station, located in Forked River. The facility has a NJPDES Permit that allows them to discharge non-contact cooling water from the operation of the plant and storm water runoff. For more information on this facility, please visit https://www.nrc.gov/info-finder/reactors/oc.html. The Oyster Creek Generating Station, a nuclear facility, is a direct effluent source for this area. The main discharge from this facility is non-contact cooling water. This predominantly involves the discharge of high temperature water into Oyster Creek. This water is discharged just under 3 miles from Barnegat Bay. This distance allows for mixing and dilution. The waters between the discharge location and the Barnegat Bay are classified as *Restricted* or *Prohibited* to create an additional buffer. Oyster Creek is scheduled to shut down operations in 2019. Upon the closing of this facility, the water will be reevaluated to determine the effects of the plant closure on water quality with respect to shellfish harvest.

Marinas

The discharge of sewage from vessels into the waterways can contribute to the degradation of the marine environment by introducing disease-causing microorganisms (pathogens) such as bacteria, protozoan and viruses into the marine environment. Chemical compounds, such as oil and gasoline resulting from spills, leaks and pressure washing from vessels can poison fish and other marine organisms. By-products from the biological breakdown of petroleum products can be harmful to fish and wildlife and pose threats to human health if ingested. *(Klein, 2009)* For this reason, waters within the marina basin are restricted to shellfish harvest.

The waters enclosed by the marina are classified as *Prohibited*. Depending on the size of the marina, the water quality, flushing rates and water depth, shellfish waters immediately adjacent to each marina, known as the buffer zone, may be classified as *Prohibited*, *Restricted* or *Conditionally Approved* (no harvest during summer months when the marina is normally active). Marina buffers are calculated using the NJ Marina Buffer Equation. For additional information on the marina buffer equation, see the *Shellfish Growing Area Report Guidance Document 2017*.
There are seventy-five marinas in this shellfish growing area. The locations of these marinas are displayed on the following map:



Marina Name	Address	Municipality	County	# of Boat Slips	Dates of Operation	Facility Services
Haven Beach Club	1 West Kentucky Ave.	Long Beach Twp.	Ocean	44	Seasonal	Restrooms, Fish Cleaning Table
Beach Haven Park Yacht Club	W. Lillie Ave.	Long Beach Twp.	Ocean	29	Seasonal	Restrooms, Boat Ramp
Brant Beach Yacht Club	6106 Bayview Ave.	Long Beach Twp.	Ocean	98	Seasonal	Maintenance, Fish Cleaning table,
Marine Max	20 W. 44th St.	Long Beach Twp.	Ocean	35	Year Round	Maintenance, Rest Rooms, Boat Lift, Pump Out
Hagler's Marina	4114 Long Beach Blvd.	Long Beach Twp.	Ocean	60	Year Round	Rest Rooms, Boat Ramp
Hochstrassers Marina	401 W. 8th St.	Ship Bottom	Ocean	30	Seasonal	Maintenance, Rest Rooms, Boat Lift
BB3 Unknown 10	Bay Ave.	Stafford Twp.	Ocean	20	Seasonal	
Surf City Marina	325 S. 1st St.	Surf City	Ocean	91	Seasonal	Rest Rooms, Boat Lift
Causeway Boat Rental and Marina	2200 E. Bay Ave.	Stafford Twp.	Ocean	325	Seasonal	Maintenance, Rest Rooms, Fish Cleaning Table, Boat Ramp
Ship Bottom Marine Center	2601 Central Ave.	Ship Bottom	Ocean	16	Seasonal	
Duck Cove Marina	3110 Long Beach Blvd.	Long Beach Twp.	Ocean	95	Year Round	Maintenance, Rest Rooms, Boat Lift, Pump Out, Fish Cleaning Table, Boat Ramp
Forked River State Marina	311 S. Main St.	Lacey Twp.	Ocean	120	Year Round	Restrooms, Boat Ramp, Pump Out
Grant Boat Works	120 Lakeside Dr.	Lacey Twp.	Ocean	27	Year Round	Maintenance, Rest Rooms, Fish Cleaning Table, Boat Lift
Tides End Marina	146 Marine Plaza	Lacey Twp.	Ocean	31	Year Round	Fuel, Pump Out, Rest Rooms, Fish Cleaning Table, Boat Lift
Rick's Marina	222 Marine Plaza	Lacey Twp.	Ocean	76	Year Round	Maintenance, Rest Rooms, Boat Lift, Pump Out, Fish Cleaning Table, Boat Ramp
Wilberts Marina	107 Bay Ave.	Lacey Twp.	Ocean	18	Year Round	Maintenance, Rest Rooms, Pump Out
Ted and Sons Forked River Marina	129 Bay Ave.	Lacey Twp.	Ocean	50	Year Round	Maintenance, Rest Rooms, Fish Cleaning Table, Boat Lift
Marina at Tall Oaks	107 Bay Ave.	Lacey Twp.	Ocean	128	Year Round	Maintenance, Rest Rooms, Pump Out, Boat Lift
Silver Cloud Marina	101 Bay Ave.	Lacey Twp.	Ocean	105	Year Round	Fuel, Rest Rooms, Pump Out, Fish Cleaning Table, Boat Lift
Townsend's Marina	221 E. Lacey Rd.	Lacey Twp.	Ocean	96	Year Round	Rest Rooms, Fish Cleaning Table, Boat Lift, Boat Ramp
Rivers Edge Marina	223 E. Lacey Rd.	Lacey Twp.	Ocean	30	Seasonal	
Captain's Inn	309 E. Lacey Rd.	Lacey Twp.	Ocean	58	Seasonal	Rest Rooms, Restaurant
Southwinds Harbour Marina	362 E. Lacey Rd.	Lacey Twp.	Ocean	170	Year Round	Fuel, Rest Rooms, Pump Out, Restaurant, Boat Lift, Boat Ramp
Holiday Harbor Marina	115 Admiral Way	Ocean Twp.	Ocean	203	Year Round	Fuel, Rest Rooms, Pump Out, Fish Cleaning Table, Boat Lift
Leamings Marina	910 Marine Rd.	Ocean Twp.	Ocean	75	Seasonal	Fuel, Maintenance, Rest Rooms, Pump Out, Boat Lift, Fish Cleaning Table
High Bar Harbour Marina	200 Sunset Blvd.	Barnegat Light	Ocean	175	Year Round	Maintenance, Rest Rooms, Pump Out, Fish Cleaning Table
Bayview Marina	13th and Bayview Ave.	Barnegat Light	Ocean	46	Seasonal	Fuel, Maintenance, Rest Rooms, Boat Lift, Fish Cleaning Table
Loveladies Marina	7 Lighthouse Way	Long Beach Twp.	Ocean	49	Year Round	Fuel, Maintenance, Rest Rooms, Pump Out
Key Harbor Marina	2 Point Dr.	Ocean Twp.	Ocean	270	Year Round	Fuel, Rest Rooms, Pump Out, Restaurant, Boat Lift, Fish Cleaning Table
Sun Harbor Marina	451 E. Bay Ave.	Barnegat	Ocean	60	Year Round	
Bobs Bay Marina	459 E. Bay Ave.	Barnegat	Ocean	84	Seasonal	Fuel, Maintenance, Rest Rooms, Boat Lift, Fish Cleaning Table
Mariners Marina	475 E. Bay Ave.	Barnegat	Ocean	190	Year Round	Maintenance, Rest Rooms, Pump Out, Boat Lift
Sherers Boat Basin	482 E. Bay Ave.	Barnegat	Ocean	40	Seasonal	Fuel, Maintenance, Rest Rooms, Boat Lift, Fish Cleaning Table
Toni G's Marina	491 E. Bay Ave.	Barnegat	Ocean	18	Seasonal	Rest Rooms, Fish Cleaning Table
Boat Yard	Bay Terrace	Harvey Cedars	Ocean	5	Seasonal	N/A
West Creek Marina	500 Dock Rd. West	Eagleswood	Ocean	50	Seasonal	N/A
Surf City Yacht Club	399 N. 9th St.	Surf City	Ocean	81	Seasonal	Rest Rooms, Boat Ramp
Harvey Cedars Marina	6318 Long Beach Blvd.	Harvey Cedars	Ocean	12	Year Round	Maintenance, Rest Rooms
BB3 Unknown5/ Private Property	Long Beach Blvd/Duck Blind Alley	Long Beach Twp.	Ocean	23	Seasonal	N/A
BB3 Unknown4/ Private Property	Long Beach Blvd/Sandy Island Dr.	Long Beach Twp.	Ocean	10	Seasonal	N/A
BB3 Private Property 1	Lady Bug Lane.	Long Beach Twp.	Ocean	6	Seasonal	N/A
Elks Point Marina	900 Beach Blvd.	Lacey Twp.	Ocean	188	Year Round	Rest Rooms, Pump Out, Restaurant, Fish Cleaning Table, Boat Ramp
Bobbies Boats	7th St. and Bay Ave.	Barnegat Light	Ocean	8	Seasonal	Maintenance, Rest Rooms, Fish Cleaning Table
Van's Boat Rentals	801 Bayview Ave.	Barnegat Light	Ocean	24	Seasonal	Fuel, Rest Rooms, Fish Cleaning Table
Lighthouse Marina	19 W. 6th St.	Barnegat Light	Ocean	46	Year Round	Fuel, Rest Rooms, Boat Ramp
Marina at Barnegat Light	1501 Bayview Ave.	Barnegat Light	Ocean	76	Year Round	Maintenance, Rest Rooms
Barnegat Light Yacht Basin	Bayview Ave.	Barnegat Light	Ocean	33	Year Round	Rest Rooms, Fish Cleaning Table

Marina Name	Address	Municipality	County	# of Boat Slips	Dates of Operation	Facility Services
BB3 Unknown 6	Dock Rd.	Eagleswood Twp.	Ocean	14	Year Round	Rest Rooms
Unknown	364 Dock Rd.	Eagleswood Twp.	Ocean	10	Year Round	N/A
D & S Marine Services	460 Dock Rd.	Eagleswood Twp.	Ocean	17	Year Round	Maintenance, Rest Rooms, Fish Cleaning Table, Boat Lift
Antoinetta's	Cedar Run Dock Rd.	Eagleswood Twp.	Ocean	8	Seasonal	
Hance & Smythe	1225 E. Bay Ave.	Stafford Twp.	Ocean	10	Year Round	Maintenance, Boat Lift, Boat Ramp
Morning Harbor Condo.	441 E. Bay Ave.	Barnegat	Ocean	32	Seasonal	Fish Cleaning Table
Captain Brownies Seafood	4 Woodmansee Dr.	Barnegat	Ocean	8	Seasonal	Rest Rooms, Fish Cleaning Table
Bartlett's Marina	485 E. Bay Ave.	Barnegat	Ocean	8	Year Round	Maintenance, Rest Rooms, Fish Cleaning Table
BB3 Unknown 9	409 E. Bay Ave.	Barnegat	Ocean	7	Seasonal	Rest Rooms
Barnegat on the Bay Condo at Little Beach	401 Bayshore Dr.	Barnegat	Ocean	50	Seasonal	N/A
Barnegat Beach Marina	Lagoon View Rd.	Ocean Twp.	Ocean	62	Seasonal	Rest Rooms
Grand Bay Harbor Yacht Club	Grand Harbor Dr.	Ocean Twp.	Ocean	75	Seasonal	N/A
Sanborn Marine Center	101 Baltic Ave.	Ocean Twp.	Ocean	39	Year Round	Maintenance, Rest Rooms, Boat Lift, Boat Ramp, Fuel, Pump Out
South Harbor Marine	116 Oregon Rd.	Ocean Twp.	Ocean	46	Year Round	Maintenance, Rest Rooms, Boat Ramp, Fuel, Pump Out, Fish Cleaning Table
Stan's Marine Center	Oregon Ave.	Ocean Twp.	Ocean	135	Seasonal	Rest Rooms, Fish Cleaning Table
Long Key Marina	104 Old Main St.	Ocean Twp.	Ocean	142	Seasonal	Maintenance, Rest Rooms, Boat Lift, Fish Cleaning Table, Pump Out, Fuel
Southwinds Harbor Condo.	E. Lacey Rd.	Lacey Twp.	Ocean	40	Seasonal	N/A
Viking Village Marina	1801 Bayview Ave.	Barnegat Light	Ocean	28	Year Round	Rest Rooms, Commercial Fishing Dock
Barnegat Light Municipal Dock	10th St. and Bayview Ave.	Barnegat Light	Ocean	45	Seasonal	Rest Rooms, Boat Ramp, Pump Out
USCG Barnegat Light Station	601 Bayview Ave.	Barnegat Light	Ocean	6	Year Round	Rest Rooms
BB3 Unknown 15	779 Cedar Run Dock Rd.	Stafford	Ocean	15	Seasonal	N/A
BB3 Unknown 16	Cedar Run Dock Rd.	Stafford	Ocean	6	Seasonal	N/A
Shroeder's Marina	546 E. Bay Ave.	Barnegat	Ocean	24	Seasonal	Maintenance, Fish Cleaning Table
Lacey Twp. Municipal Marina – South Dock	Yacht Basin Plaza	Ocean Twp.	Ocean	82	Seasonal	Rest Rooms
Spencer's Bayside Marina	65 Pennsylvania Ave.	Ocean Twp.	Ocean	24	Seasonal	Pump Out, Rest Rooms, Fish Cleaning Table
Ahearns Marina	63 Pennsylvania Ave.	Ocean Twp.	Ocean	20	Seasonal	Fuel
Unknown/Private Home	344 Duck Rd.	Eagleswood Twp.	Ocean	12	Seasonal	N/A
Unknown/Private Home 2	1st Ave.	Eagleswood Twp.	Ocean	10	Seasonal	N/A

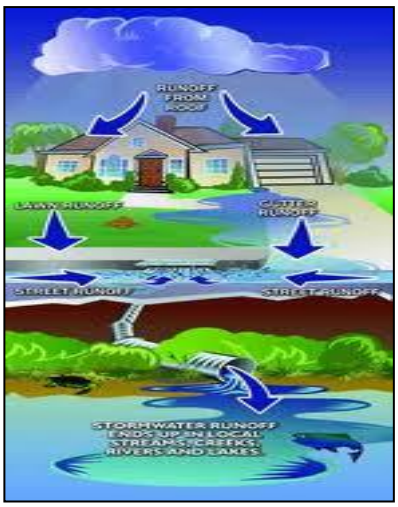
Spills, Unpermitted Discharges and Closures

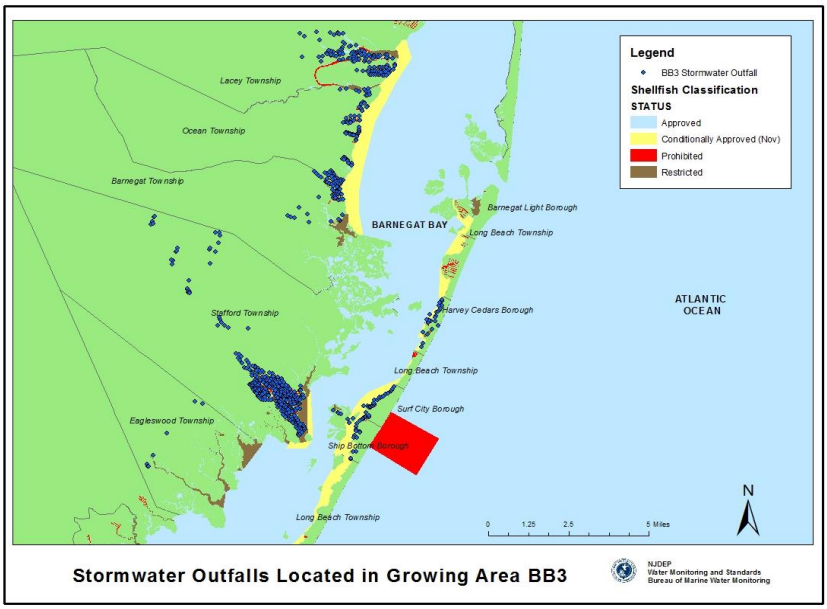
Indirect discharges are groundwater discharges, malfunctioning septic systems, known contaminated sites, spills and dredging projects. Under normal circumstances, these indirect discharges do not routinely affect water quality. However, on occasion they have the potential to result in the closure of shellfish waters due to accidental discharges that result in higher than normal bacteria counts.

Leaks or spills can take place within shellfish growing waters and are frequently the result of a variety of conditions such as sunken boats, pump station failure, broken or blocked sewer lines, manhole overflow, broken pipes in commercial and residential locations or improper run off from construction and roadways.

Storm Water Discharges

Non-point source pressures on shellfish beds in New Jersey originate in materials that enter the water via stormwater. Stormwater runoff is generated when precipitation from rain and snowmelt flows over land or impervious surfaces and does not percolate into the ground. As the runoff flows over the land or impervious surfaces (paved streets, parking lots and building rooftops), it accumulates debris, chemicals, sediment or other pollutants that could adversely affect water quality if the runoff is discharged untreated. The typical pollutants that are associated with stormwater run-off are bacteria, heavy metals, pesticides, herbicides, fertilizers, chlorides, petroleum and nutrients. (NJStormwater.Org) Most of the stormwater outfalls within this growing area are near residential and urbanized areas. (Illustration by: morgan-hill.ca.gov)





Stormwater Outfalls Located in Growing Area BB3

Stormwater outfalls in this area generally discharge to nearby creeks and lagoons. The highest emphases are placed on the stormwater outfalls that discharge directly to shellfish waters. Stormwater impacted areas include lagoon communities in Stafford Township, Barnegat Township, Ocean Township and Lacey Township as well as lagoon areas off Long Beach Island. These areas tend to have higher bacteriological counts after a rainfall event.

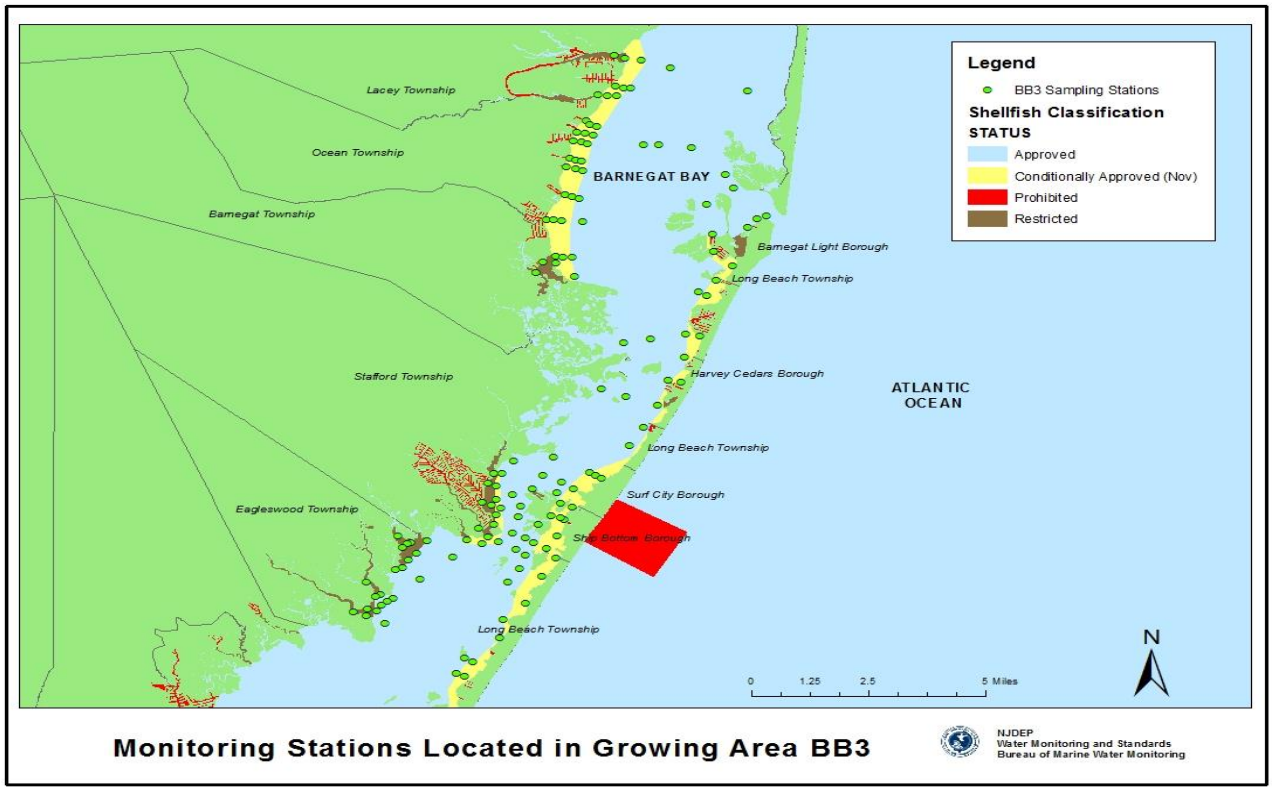
WATER QUALITIES STUDIES

Sampling Strategy

The State shellfish control authority has the option of choosing one of two water monitoring sampling strategies for each growing area, Systematic Random Sampling (SRS) or Adverse Pollution Conditions sampling strategy (APC). For additional information on the types of sampling strategies, see the *Shellfish Growing Area Report Guidance Document, 2017*. This growing area is sampled using the SRS strategy. The SRS strategy is regularly used in areas where precipitation, seasonality or tide play significant roles.

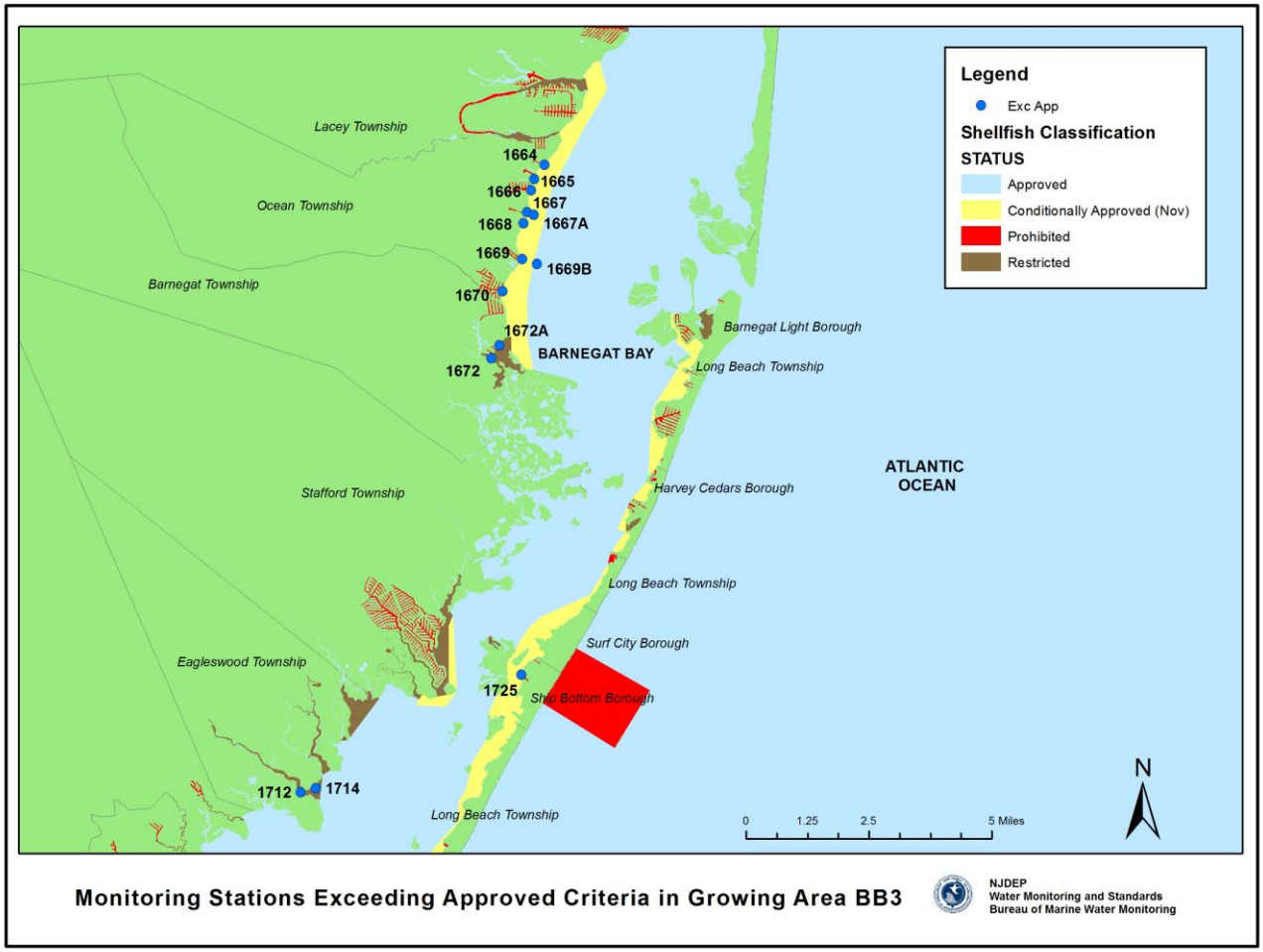
Each shellfish producing state is directed to adopt either the total coliform or fecal coliform criterion to classify its waters. The criteria were developed to ensure that shellfish harvested from designated waters would be free of pathogenic (disease-producing) bacteria. In 2012, New Jersey adopted the fecal coliform criterion for classifying shellfish waters. See, the *Shellfish Growing Area Report Guidance Document, 2017* for additional information.

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 2005). From 2013 through 2017, approximately 4834 water samples were collected for fecal coliform bacteria from 141 monitoring stations. The locations of these stations are shown in the map below. Data management and analysis was accomplished using database applications developed for the Bureau. Mapping of pollution data was performed with the use of Geographic Information System (GIS: ArcGIS).



BACTERIOLOGICAL QUALITY

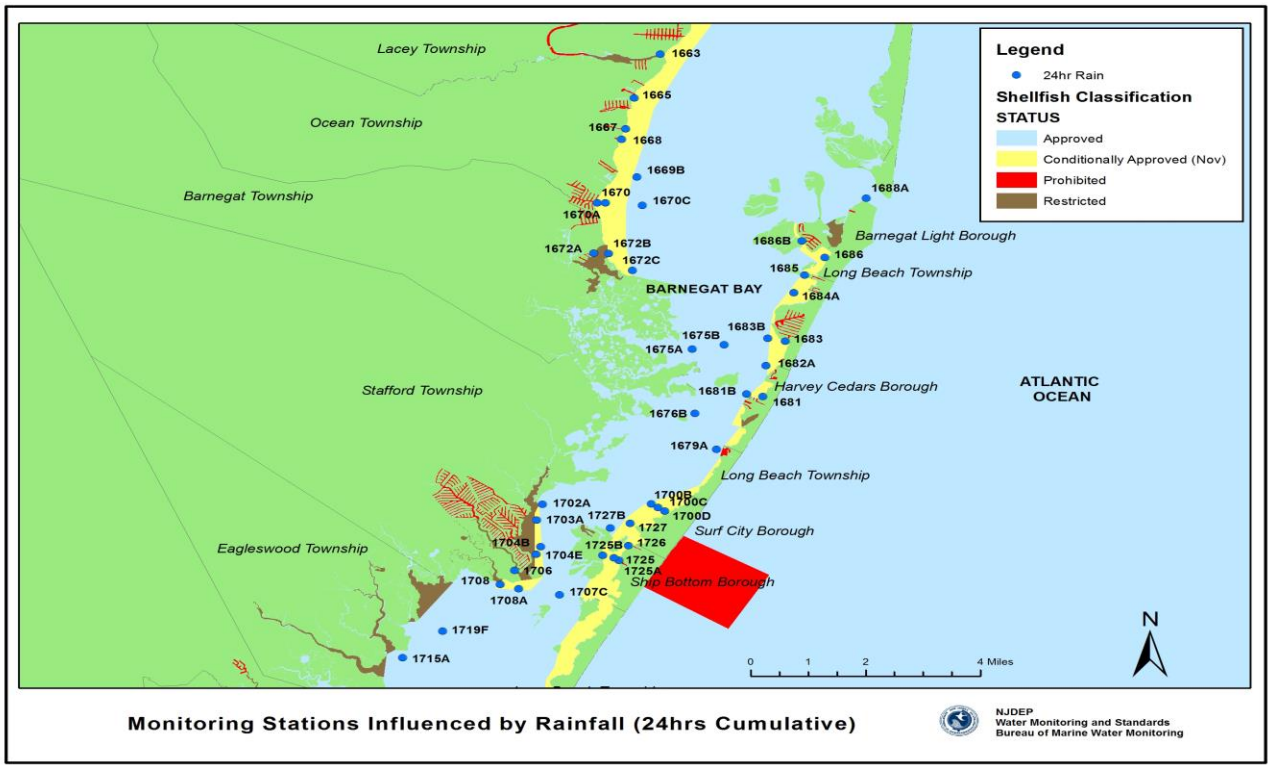
Compliance with NSSP SRS Criteria



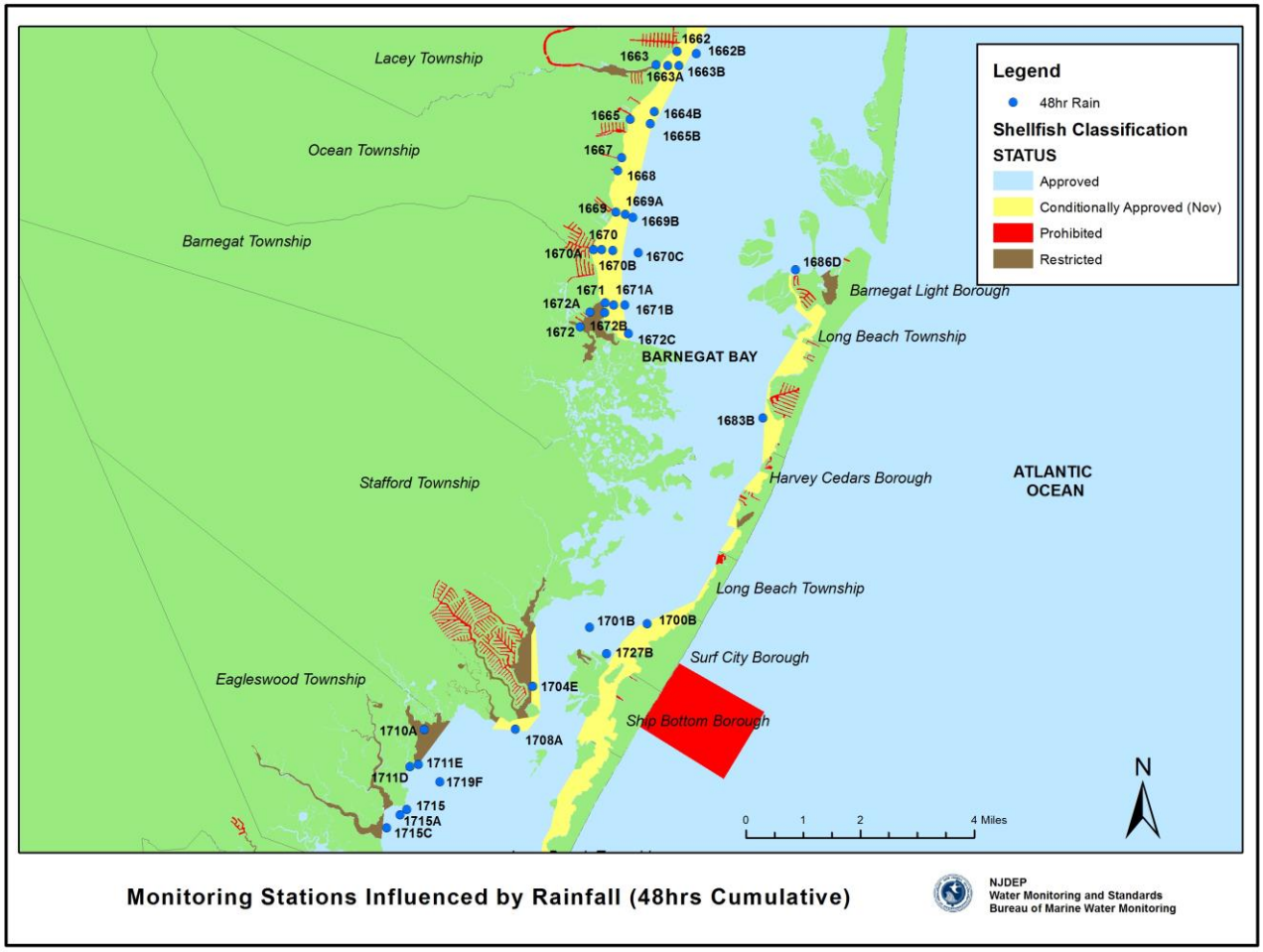
There are fourteen monitoring stations in this growing area exceeding the SRS *Approved* criteria. One of these stations (1669B) is located in *Approved* waters and ten stations are in *Conditionally Approved* waters. With an extended data time frame to include thirty pieces of data in the winter months when these stations are open for shellfish harvest, four stations (1664, 1666, 1667, 1670) do not meet the criteria for their current classification. At these four sites there is a strong rainfall component present. Rainfall impact is mainly due to runoff, carrying contaminants to these sites from nearby land masses and lagoons. There were no noticeable changes in shoreline, hydrography or land use that would require modification to the existing shellfish classifications. Since the elevated bacteria counts occur sporadically and likely don't remain elevated for extended periods and the numerous surrounding stations meet their criteria, no downgrade of waters is recommended at this time.

Rainfall Effects

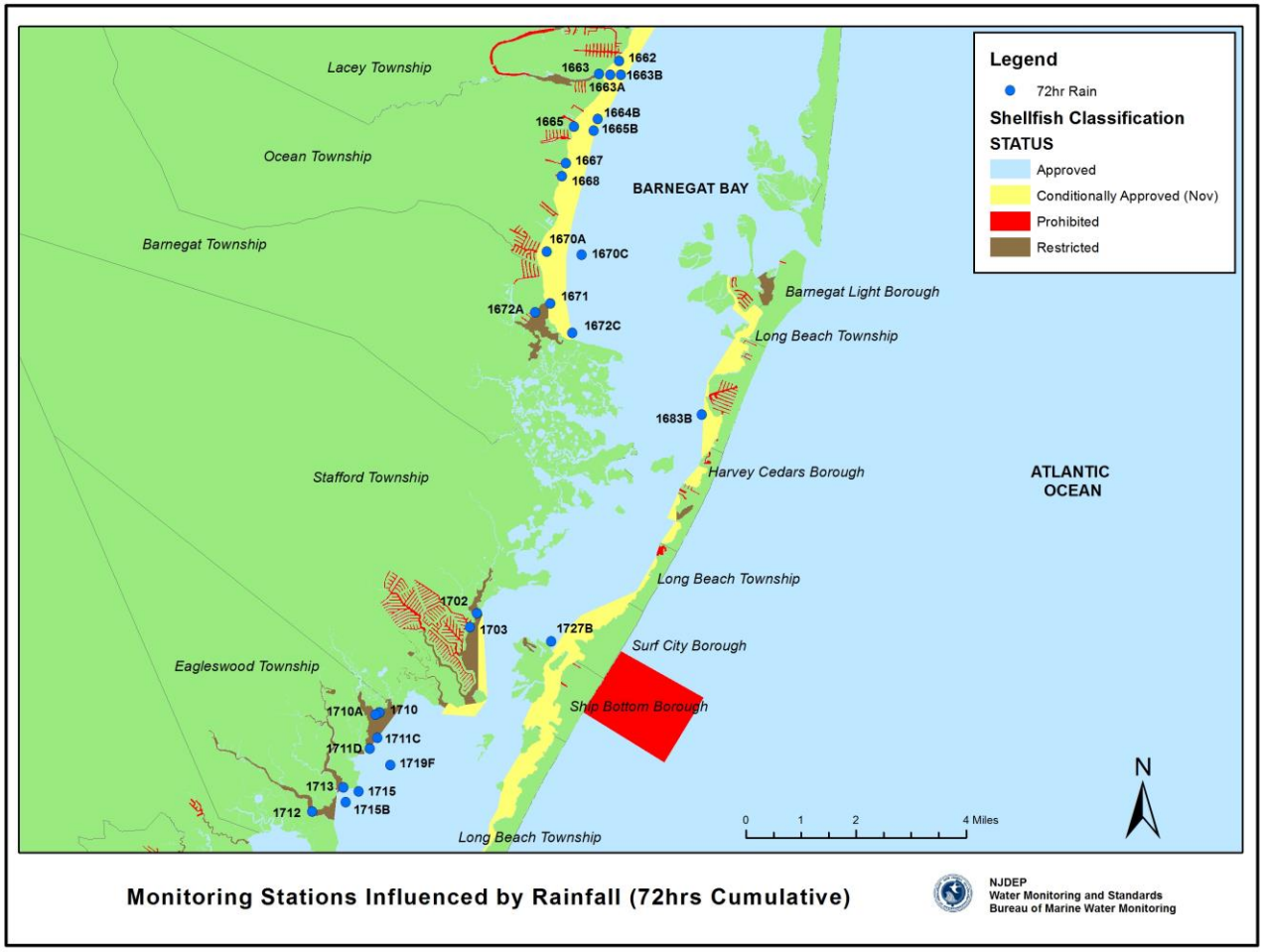
The meteorological monitoring provides valuable contextual data for interpreting water quality implications of short-term weather events and for investigating estuarine responses to longer-term climatic variability (NERRS, 2008). Rainfall amounts are based on the closest established NOAA/National Weather Service station; each assignment run is assigned to a weather station to accurately reflect the rainfall at the sampling stations. Precipitation assessment for this shellfish growing area was based on rainfall data collected at Stations RA016, RA017, RA018 and RA019. These rainfall stations were selected to help determine whether run-off would affect the shellfish waters within this growing area. WM&S/BMWM uses the t-test method to assess rainfall effects. This method compares the coliform values from samples collected during dry weather to samples collected during wet weather and identifies areas where runoff can potentially affect water quality. The wet/dry cutoff determines whether a sample was collected under wet or dry conditions. For this growing area, the wet/dry cutoff criterion was set at 0.2 inches, which is the typical standard used for assessing rainfall effects. The t-test calculated the statistical probability for each station based on 24, 48 and 72 hours of rainfall cumulative. Any stations with a t-statistical probability of less than 0.05 are believed to be impacted. Stations that are found to be impacted tend to have a higher coliform count during a rainfall event. However, if they are impacted by rain it does not necessarily mean they are also out of compliance with NSSP.



This growing area sees the greatest rainfall influence with rainfall 24 cumulative prior to sampling with forty-four stations being affected. This immediate influence is likely due to runoff from the seasonally populated areas located on Long Beach island. Two of the stations affected (1667 and 1670) do not meet the criteria for their current classification. The influence at these two stations is likely from the lagoon systems and storm water outfalls located nearby.



There are thirty-nine stations seeing a rainfall influence with rainfall 48 hours prior to sampling. This delayed response is likely due to runoff from the lagoon communities infiltrating the *Conditionally Approved* areas adjacent to them. Two of the stations affected (1667 and 1670) do not meet the criteria for their current classification. The influence at these two stations is likely from the lagoon systems and storm water outfalls located nearby.



There are twenty-seven stations in this growing area that were affected by rainfall at 72 hours cumulative. The rainfall affect in this area dissipates from 24 hours to 72 hours cumulative with 72 hours having the least rainfall affect. One of the stations affected (1667) does not meet the criteria for its current classification. The influence at this station is likely from the lagoon systems and storm water outfalls located nearby.

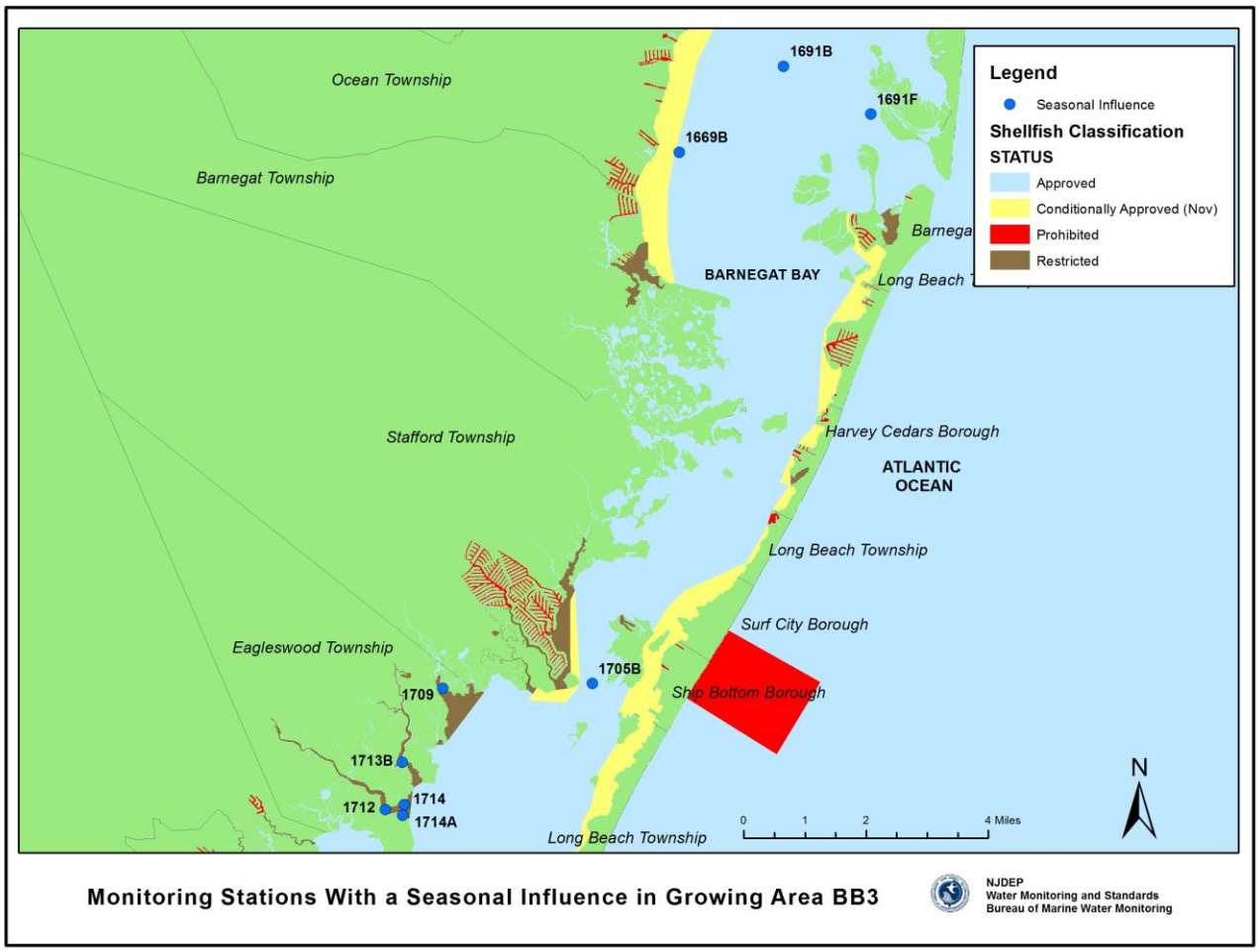
Seasonal Effects

Temperature, precipitation, wind and the general circulation of the atmosphere have seasonal variations that also affect the marine environment (Ingmanson and Wallace, 1989). Seasonal variation may also be the result of a variety of conditions, including specific agricultural land-use practices, biological activity, stream flow and/or sediment.

To determine whether seasonal variation can influence bacteria counts, WM&S/BMWM uses a t-test to compare the coliform values from samples collected during the summer season versus samples collected during the winter season. Based on the t-test results, nine monitoring stations had a t-statistical probability of less than 0.05. Seven of the nine monitoring stations show a higher summer

geometric mean. This is likely due to summer related activities. All the stations with a seasonal influence meet the criteria for their current classification.

Four stations (1664, 1666, 1667, 1670) do not meet their classification criteria in the winter months when they are open for harvest. These stations are not represented on this map due to an extended data timeframe needed to capture thirty sets of winter data.



RELATED STUDIES

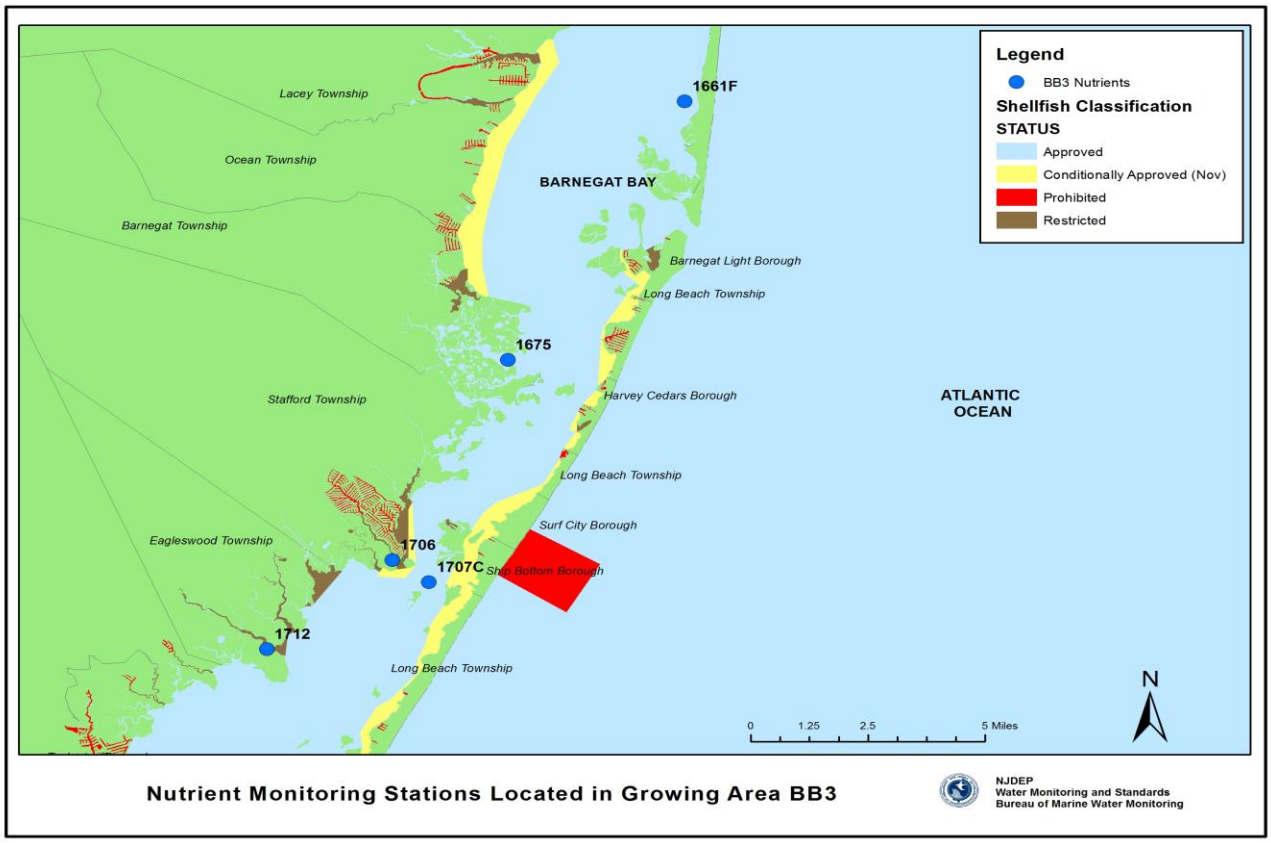
Nutrients

WM&S/BMWM performs additional water quality studies related to the bacteriological monitoring program. Nutrient monitoring and the collection of nutrient data as part of the NJ Coastal Monitoring Network is an example of one of those studies.

Nutrient stations are sampled monthly on a biennial basis. The 90 nutrient stations are spread throughout the State's back bay waters and tidally impacted rivers. At these nutrient monitoring sites,

various parameters are measured including water temperature, biogenic silica, chlorophyll a, pH, salinity, secchi depth, total suspended solids, dissolved oxygen, ammonia, nitrate and nitrite, orthophosphate, total nitrogen and total phosphorus. WM&S/BMWM compiles the results of nutrient levels from such stations and then prepares a separate report. For full nutrient assessment, see the Estuarine Monitoring Reports, available at: http://www.state.nj.us/dep/bmw/.

Five nutrient monitoring sites sampled under the Estuarine monitoring program are located within this shellfish area. Between 2013 and 2017, water samples were collected and analyzed for various parameters (listed above). The map below displays the location of the nutrient monitoring sites.



Cooperative Coastal Monitoring Program

NJDEP, along with the New Jersey Department of Health and Senior Services and local health agencies, implements the Cooperative Coastal Monitoring Program (CCMP) which is responsible for conducting sanitary surveys of beaches and monitors the concentration of bacteria in coastal and estuarine waters that are open to the public for recreational bathing. Samples are taken once a week, usually on Monday, for the entire summer. The samples collected at these sites are tested for Enterococci. Local health agencies and law enforcement may close a beach at any time if the results exceed the State Sanitary Code of 104 Enterococci per 100mL. WM&S/BMWM utilizes these data as adjunct information. The closure of shellfish waters does not necessarily correspond to these results. There are seven CCMP beach sampling sites located within this growing area. For more information regarding this program, bathing beach data and closures, see https://www.njbeaches.org/.

CONCLUSIONS

The following conclusions are based on the water quality data from October 2013 through August 2017. Based on NSSP Systematic Random Sampling criteria, five monitoring stations are out of compliance with NSSP *Approved* criteria. These stations are in the *Approved* and *Conditionally Approved* waters of Barnegat Bay. Historically, coliform counts in these areas have been considerably low. At these sites there is a rainfall influence present. Rainfall impact is mainly due to runoff, carrying contaminants to open waters via storm drains. There were no noticeable changes in shoreline, hydrography or land use that would require modification to the existing shellfish classifications. Since the elevated bacteria counts occur sporadically and likely don't remain elevated for extended periods and the numerous surrounding stations meet their criteria, no downgrade of waters is recommended at this time.

RECOMMENDATIONS

Even though the data suggests a downgrade due to elevated bacteria counts, no downgrade is recommended at this time. WM&S/BMWM will continue to closely monitor the area and if water quality continues to decline, WM&S/BMWM will downgrade waters appropriately. Continue sampling under existing protocol in accordance with NSSP.

LITERATURE CITED

APHA. 1970. Recommended Procedures for the Examination of Seawater and Shellfish, 4th ed., American Public Health Association, Washington, DC.

APHA. 1995. Standard Methods for the Examination of Water and Wastewater, 19th ed., American Public Health Association, Washington, DC.

Celestino, Michael. 2003. Investigations of Potential Aquaculture Expansion Areas: A Report to the Aquaculture Advisory Council. New Jersey Division of Fish and Wildlife, Bureau of Shellfisheries, Nacote Creek, NJ.

Ingmanson, Dale E., and William J. Wallace. 1989. Oceanography: An Introduction. Wadsworth Publishing Company, Belmont, California.

Long, E. R., D. D. MacDonald, S. L. Smith, F. D. Calder, 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19: 81-87.

National Estuarine Research Reserve System (NERRS), 2008, http://www.jcronline.org/doi/pdf/10.2112/SI55-012.1.

NJDEP, Bureau of Geographic Information, http://www.nj.gov/dep/gis/.

NJDEP, Bureau of Marine Water Monitoring, http://www.nj.state.nj.us/dep/bmw.

NJDEP, Cooperative Coastal Monitoring program, https://www.njbeaches.org/ .

NJDEP, Division of Fish and Wildlife, http://www.nj.gov/dep/fgwhttp://www.fws.gov/refuges/?ref=topbar.

NJDEP, Field Sampling Procedures Manual. New Jersey Department of Environmental Protection, Trenton, NJ, 2005.

NJDEP Hard Clam Shellfish Survey, 1986. Fish and Wildlife. Bureau of Shellfisheries, Port Republic, NJ.

NJDEP Inventory of New Jersey's Estuarine Shellfish Resources: Hard Clam Stock Assessment, 2015. Fish and Wildlife. Bureau of Shellfisheries, Port Republic, NJ.

NJDEP, NJStormwater.org, http://www.njstormwater.org/.

NJDEP, Shellfish Growing Area Report Guidance Document. New Jersey Department of Environmental Protection, Marine Water Monitoring, Leeds Point, NJ, 2017.

NJDEP, State of New Jersey Shellfish Growing Water Classification Charts. New Jersey Department of Environmental Protection, Marine Water Monitoring, Leeds Point, NJ, 2016.

NJDEP, Water Sampling Assignments. New Jersey Department of Environmental Protection, Trenton, NJ, 2013-2017.

Ross A. Klein, PhD. 2009. Getting a Grip on Cruise Ship Pollution, pg 10.

US Geological Survey, www.usgs.gov/.

USPHS, Revision. National Shellfish Sanitation Program *Guide for the Control of Molluscan Shellfish*. US Public Health Service, Food and Drug Administration, Washington, DC, 2009.

Supporting Documentation

Data Sheets - Reappraisal Report for Shellfish Growing Area BB3 (Barnegat Inlet), November 2017 see the Shellfish Growing Area Reports section at *www.state.nj.us/dep/wms/bmw*.

Shoreline survey field notes and pictures - Reappraisal Report for Shellfish Growing Area BB3 (Barnegat Inlet), November 2017 see the Shellfish Growing Area Reports section at *www.state.nj.us/dep/wms/bmw*.

APPENDICES

A. Data Listing – October 2013 through August 2017
   1. Seasonal Evaluation
   2. Wet/Dry Statistics
   3. Rainfall Amount

B. Shoreline Survey Sheets