



NJ Department of Environmental Protection
Water Monitoring and Standards
Marine Water Monitoring

**Sanitary Survey Report of Shellfish Growing Area NE4
Shark River**



December 2015

Sanitary Survey Report of Shellfish Growing Area NE4 Shark River

New Jersey Department of Environmental Protection (NJDEP)

Bureau of Marine Water Monitoring (BMWM)
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December 2015

Data from October 1, 2011 – October 31, 2015

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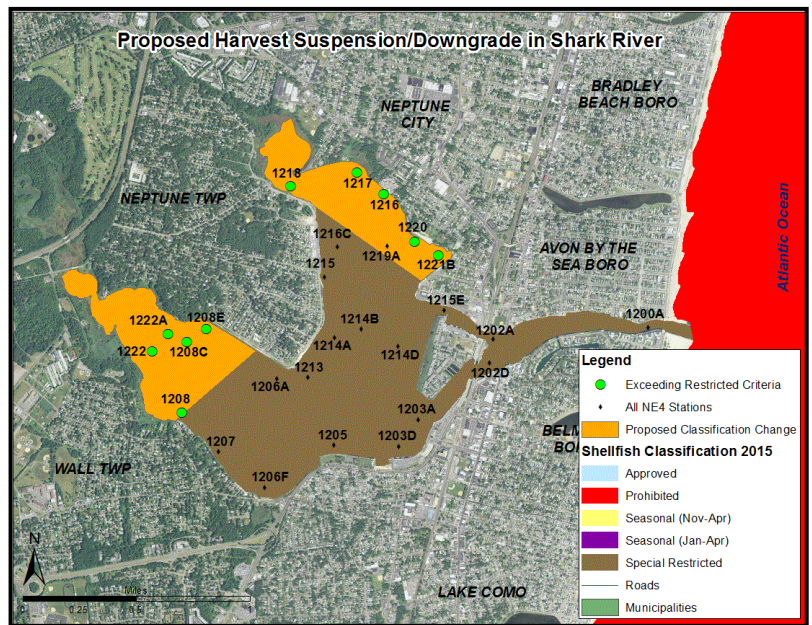
Cover Photo – Shark River Inlet (photo by Tracy Fay)

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EXECUTIVE SUMMARY

Shellfish Growing Area NE4, the Shark River, is located in southern Monmouth County and connects to the Atlantic Ocean via the Shark River Inlet. The approximate size of this shellfish growing area is about 800 acres. Water samples from the Shark River were collected, using the Systematic Random Sampling strategy, and analyzed from 27 sampling stations for fecal coliform. There are no direct discharges into the Shark River, although there are numerous stormwater outfalls and other indirect discharges. The timeframe for this sanitary survey report was October 1, 2011 through October 31, 2015. The entire Shark River has been classified as *Special Restricted* since 1987. Ten sampling stations were out of compliance with the criteria for the *Special Restricted* classification. The results of this data evaluation are to recommend two downgrades, from *Special Restricted* to *Prohibited*, in the Shark River, one in the northern portion, of approximately 123 acres, and a downgrade in the western portion, of approximately 150 acres. There is also a recommendation to add a station, 1220A, to the Shark River assignment run (057) to ensure that the proposed boundary line between the existing *Special Restricted* classification and the proposed *Prohibited* section in the northern portion of the river is adequately assessed in the future. The recommendation for further analysis is to continue the special pollution source track-down study in the area the Shark River.



DESCRIPTION OF GROWING AREA

Location & Description

The Shark River is located in Monmouth County (see below figure). Tidal waters enter the Shark River via the Shark River Inlet. There are numerous freshwater influences Shark River including Shark River Stream, Jumping Brook, Musquash Brook, and Laurel Gully Brook, and Heroy's Stream. The Shark River is bordered by the following municipalities: Avon-by-the-Sea, Neptune City, Neptune Township, Wall Township and Belmar Borough. In total, the

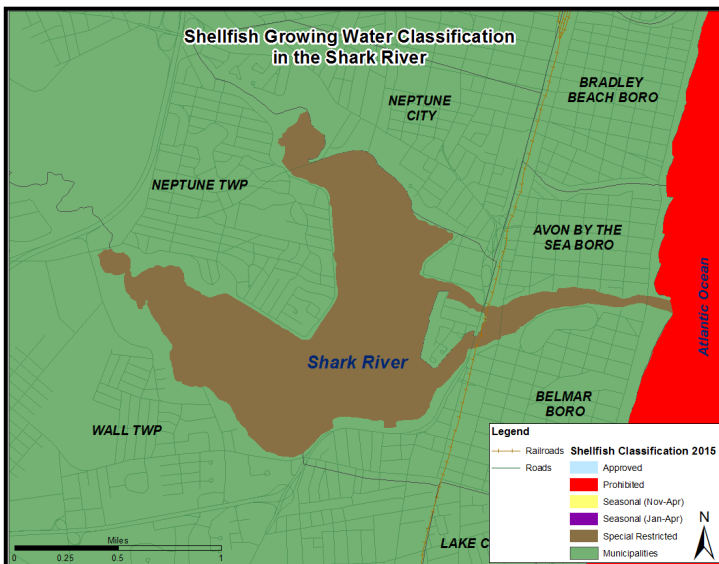


Shark River is about 11.5 miles long and has approximately 800 acres of shellfish growing waters.

In May of 1998 that the Environmental Protection Agency approved the New Jersey Department of Environmental Protection's (NJDEP's) plan to make the Shark River a "no discharge zone", this means that no boats may dump treated or untreated sewage into the waters of the Shark River.

Growing Area Classification Summary

The Shark River has been classified as *Special Restricted* since 1987 (see adjacent figure); previously it was classified as *Prohibited* based on administrative reasons. Until 1998, this area was sampled under the Adverse Pollution Condition (APC) of rainfall; it is now sampled under the Systematic Random Sampling (SRS) strategy since there are no point sources contributing to bacterial contaminants in this area.



The *Special Restricted* classification means that it is prohibited to harvest shellfish from these waters for direct market; a special permit must be issued to be in compliance with the State of New Jersey's Relay or Depuration Programs. Recreational harvest of shellfish is not permitted from *Special Restricted* waters. This area is displayed on chart 4 of the current State of New Jersey Shellfish Growing Water Classification Chart (NJDEP, 2015) or on the Bureau of Marine Water Monitoring's (BMWM) website at <http://www.state.nj.us/dep/bmw/>; the official and most current classification descriptions can be found at N.J.A.C. 7:12.

Evaluation of Biological Resources

Commercially important shellfish native to New Jersey include hard clams (*Mercenaria mercenaria*), soft-shell 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 (*Aequipecten irradians*).

The Shark River has few to moderate densities of hard clams (according to the last clam census in the 1980's done by NJDEP's Division of Fish & Wildlife). 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

Waterfowl are known to inhabit the Shark River, especially during winter months. At low tide many gulls, ducks, and geese occupy the sandbars and shoreline. Oftentimes, these waterfowl also nest within the wetlands. Bird waste can add to contamination of the waters, which can contribute to high coliform

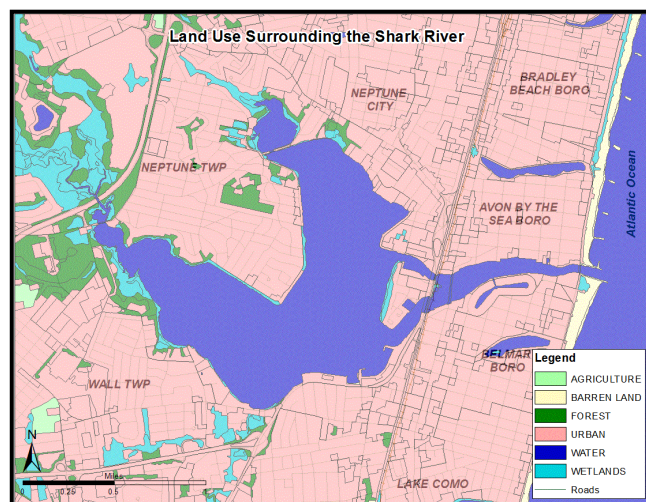
values. The Shark River Inlet is often used as a diving region because of its interesting and diverse wildlife. The area also entertains an influx of population in the summer months and is a well-known tourist spot on the New Jersey shore.

Vegetation is an essential part of the marine ecosystem, offering habitat and nursery grounds for numerous species. In the Shark River, the submerged aquatic vegetation (SAV) is prevalent in shallow areas. Some of the most common species of SAV in New Jersey include widgeon grass (*Ruppia maritima*), sago pondweed (*Potamogeton pectinatus*), horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*).

This area was heavily influenced by Superstorm Sandy in October of 2012. Since Superstorm Sandy there has been a lot of construction on condominiums and residential homes and rebuilding of docks, bulkheads and other structures at residential homes and commercial marinas (see adjacent photo). There are still areas that have undergoing repairs or have not been repaired.



Land Use



The current land use surrounding the Shark River is predominately urban, commonly residential. Most properties in this area contain a single family home; however, there are a few condominium-type structures. There are also areas of wetlands and scattered regions of forests, barren lands, and agricultural lands. Seven municipalities surround the Shark River; they are Wall Township, Neptune Township, Neptune City, Bradley Beach Borough, Avon-By-the-Sea, Belmar Borough, and Lake Como. Historically, most of this region has been urban land used for residential housing. Since this region is already highly developed there has not been much residential growth in recent years. The

surrounding landscape had not changed significantly since the last shoreline survey.

Surface and Ground Water Discharges

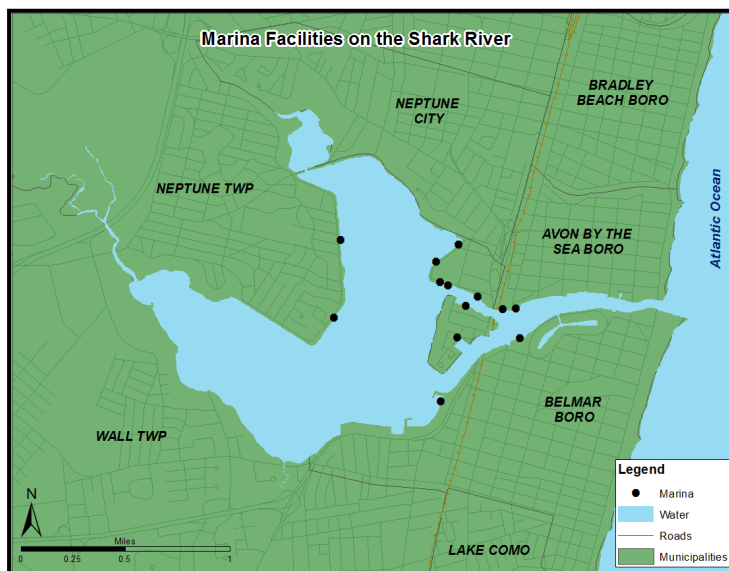
A surface water discharge involves the release of treated effluent from various municipal and industrial facilities directly into a river, stream, or the ocean. There are two domestic treatment facilities in the general vicinity, although neither directly discharges into the Shark River. The Southern Monmouth Regional Sewerage Authority (SMRSA) and the Township of Neptune Sewerage Authority (TNSA). Both facilities discharge treated wastewater into the Atlantic Ocean (TNSA, 2015 & SMRSA, 2015). As a precautionary measure, the NSSP requires a *Prohibited* safety zone of at least 1.5 miles around

each of the ocean outfalls. Therefore, the waters of the Atlantic Ocean outside of the Shark Inlet are classified as *Prohibited*.

According to New Jersey Pollutant Discharge Elimination System (NJPDES), there are a few facilities with an active Discharge to Groundwater (DGW) permit in this area. Besides groundwater dischargers, septic systems are occasionally used where public sewer lines are inaccessible. When septic systems fail to function properly, it could lead to groundwater contamination. The location of groundwater contamination sites, surface water discharges, domestic treatment plants, and sewer areas are shown in the above map.

Marinas

Boating is a popular summertime activity within the Shark River. In this growing area there are a total of 13 marinas (see adjacent map). Most of these marinas are located near the inlet. Some of the marinas in this area run charter and party boat trips, although there are also many private boats within the marinas. The waters enclosed by the footprint of a marina are classified as *Prohibited*; depending on the size of the marina and the water quality, water immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally Approved* (no harvest during summer months when the marina is active). Marina buffer zones were calculated using the Virginia Model or the marina buffer equation, depending on the location. Additional information on the marina equations used for buffer generation can be found in the NJDEP *Shellfish Growing Area Report Guidance Document* (2012).



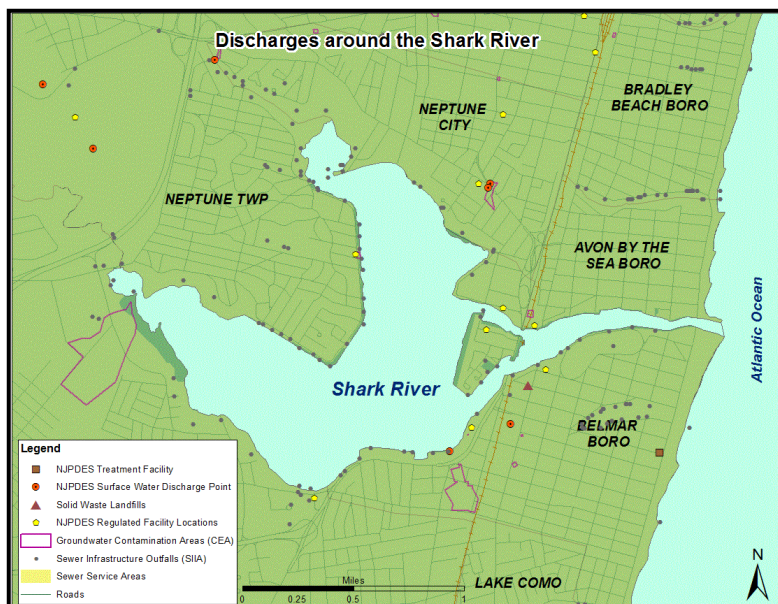
The 'Clean Marina' program is voluntary and provides guidelines that aim, "to reduce the sources and impacts of nonpoint source pollution, including sewage facility management, fueling operations, fish and solid waste management and boat cleaning" (NJDEP Clean Marina, 2015). Two marinas in this growing area have been certified as New Jersey Clean Marinas (NJDEP Clean Marina, 2015), Main One Marina and Shark River Municipal Marina.

Spills, Unpermitted Discharges, and Closures

Spills reported to the NJDEP hotline (1-877-WARN-DEP) are passed on to the BMWB when shellfish waters might be impacted. Since there is a direct relationship between the pollution of shellfish growing areas and the transmission of diseases to humans, BMWB must carefully assess each spill occurrence. If the spill is determined to be detrimental to the shellfish beds then a closure is made in the impacted area to protect public health. The closure is not lifted until the source of the problem is fixed/eliminated and all samples in that area fit within the appropriate classification criteria.

All state waters in New Jersey were closed for shellfish harvest in preparation for Hurricane Irene in 2011 and Superstorm Sandy in 2012. In both instances the shellfish growing waters of the state remained closed until water and, in some cases, tissue tests showed that the shellfish were safe for human consumption.

There were no other significant spills, unpermitted discharges, or closures concerning the Shark River since the last report on the area. Closures prior to this time period are discussed in the prior reports on this area, see www.nj.us.gov/dep/bmw for more information.



The process of dredging can impair water quality and contaminate shellfish beds that are near dredging and disposal sites. BMWM is given the opportunity to review such project through CAFRA submission and will deny a project if the proposed dredging or disposal site can potentially contaminate shellfish beds or impair water quality. BMWM's comments are taken into consideration by the NJDEP, Division of Land Use Regulations (DLUR) when approving or denying a permit. Plans remain to dredge the Shark River, currently; a portion of the channel is in the process of getting approvals.

Stormwater Discharges

Environmental pressures on shellfish beds in New Jersey can originate in materials that enter growing waters via stormwater discharges. Runoff is a term for the surface water that moves from land to the ocean. During this transition the water picks up both nutrients (helpful and harmful) and pollutants. While some of this runoff provides nutrients for plants and animals, it also carries pollutants that can potentially contaminate the waters. Some pollutants include bird waste, agricultural pesticides, animal waste, and bacteria from faulty septic systems and failing municipal infrastructure. Storm drains along roads collect the runoff and transmit it to stormwater outfalls. The outfalls discharge the runoff into streams, bays, oceans, and other bodies of water. They are often found in urban areas, and are especially common within lagoon communities. The first flush after a rain event often carries the most pollutants. Stormwater outfalls are one of the most significant non-point sources of pollution in this shellfish growing area.

The Bureau of Marine Water Monitoring conducts stormwater projects to help lessen the effect of stormwater runoff. Water samples are taken during a storm event and the preceding days in order to determine the effect of runoff. Once a possible source of the problem is identified, the appropriate people



(usually the municipality/county) are notified to remedy the situation. Currently, a stormwater project is being conducted in the Shark River, once concluded, the results of the findings will be made available online at www.nj.gov/dep/bmw.

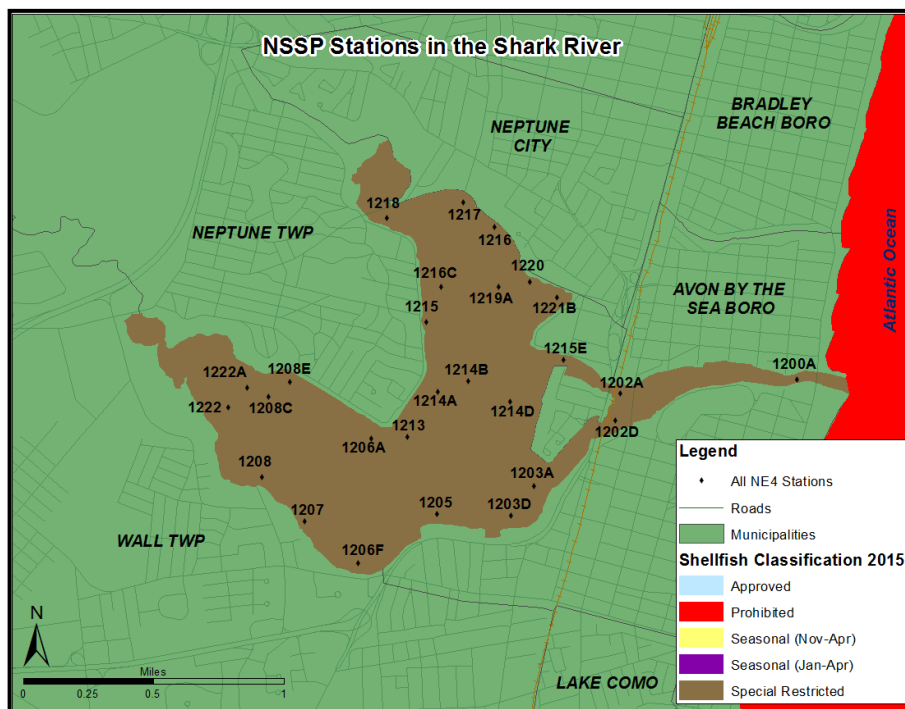
WATER QUALITY STUDIES

Sampling Strategy

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area. For additional information on the types of sampling strategies see the NJDEP *Shellfish Growing Area Report Guidance Document* (2012). This shellfish growing area is not impacted by discharges from sewage treatment facilities or combined sewer overflows; therefore, it was sampled under the Systematic Random Sampling Strategy (SRS).

New Jersey bases its growing water classifications on the fecal coliform criterion. The classification criterion is composed of a measure of the statistical ‘central tendency’ (geometric mean) and the relative variability of the data set. The criteria were developed by the NSSP to ensure that shellfish harvested from designated waters would be safe for human consumption (NSSP, 2013). For the Systematic Random Sampling Strategy, variability is expressed as the estimated 90th percentile.

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 2005). Water quality sampling, shoreline, and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish*, 2013 Revision. Data management and analysis were accomplished using database applications developed for the Bureau of Marine Water Monitoring. Mapping of data was performed with Geographic Information System software (GIS: ArcMap).



Bacteriological Quality

Approximately 810 water samples were collected from this shellfish growing area for fecal coliform testing from October 1, 2011 through October 31, 2015. The above map shows the 27 Shellfish Growing Water Quality monitoring stations in the Shark River. All of these stations are currently located in *Special Restricted* waters and were sampled using the Systematic Random Sampling (SRS) strategy.

Compliance with NSSP Criteria

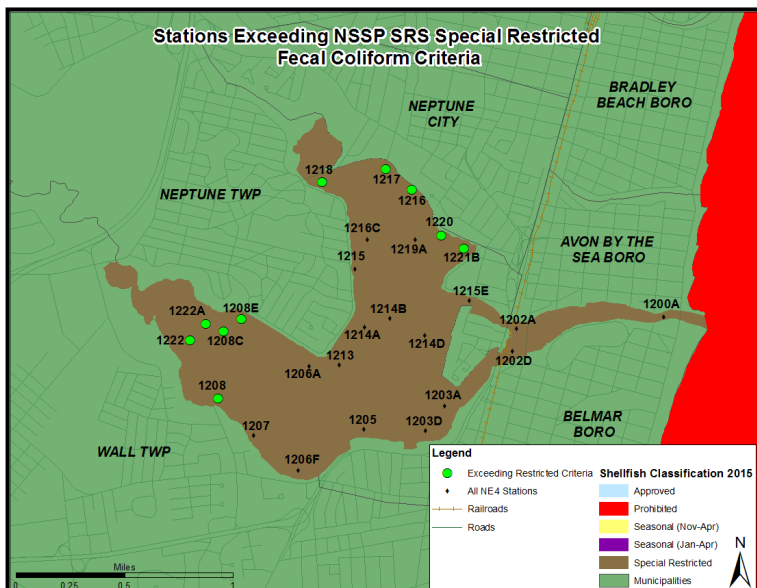
According to the National Shellfish Sanitation Program's (NSSP) *Guide for the Control of Molluscan Shellfish* (2013 Revision), the water quality of each growing area must be evaluated before an area can be classified as *Approved*, *Seasonal (Nov-Apr or Jan-Apr)*, *Special Restricted*, or *Prohibited*. A *Seasonal* area must be sampled and meet the *Approved* criterion during the time of the year that it is open for harvest. The summer season runs from May through October, and the winter season runs from November through April.

There is one assignment run for the Shark River. This report examined the data from the assignment runs done in-between October 1, 2011 and October 31, 2015. These assignment runs provided sufficient samples for evaluation, bearing in mind the sample size must be at least 30 for each station according to the Systematic Random Sampling strategy.

The NSSP establishes the guidelines for classification. In order for waters to be classified as *Approved* the Geometric Mean must be below 14 CFU's/100mL. For waters to be classified as *Special Restricted* the Geometric Mean must be below 88 CFU's/100mL. The Estimated 90th Percentiles must also fit within NSSP criteria.

Twenty-three stations within the Shark River did not meet the year-round SRS *Approved* criteria, since all waters of the Shark River are classified as *Special Restricted* this is not a problem.

For waters to be classified as *Special Restricted*, the Geometric Mean must be below 88 CFU's/100mL and the appropriate Estimated 90th Percentile criteria for that station. Ten stations sampled exceeded the NSSP fecal coliform criteria for *Special Restricted* waters.



Although there is a special pollution source trackdown project on-going in the Shark River, it is recommended that two portions of the Shark River be downgrade from Special Restricted to Prohibited. In the western portion of the river 5 stations, 1222, 1222A, 1208, 1208C, & 1208E, exceed the Estimated 90th Percentile criteria for Special Restricted waters, and (see the Recommendations section for more information). In the northern portion of the river 5 stations, 1218, 1217, 1216, 1220, & 1221B, exceed the Estimated 90th Percentile criteria. Previous annual reports

showed high values around station 1221B and a special pollution source trackdown study was recommended for the area. The study has started, but since other stations now exceed the NSSP criteria a downgrade of the northern portion of the river and a downgrade of the western portion of the river are being recommended in this report (see the Recommendations section for more information).

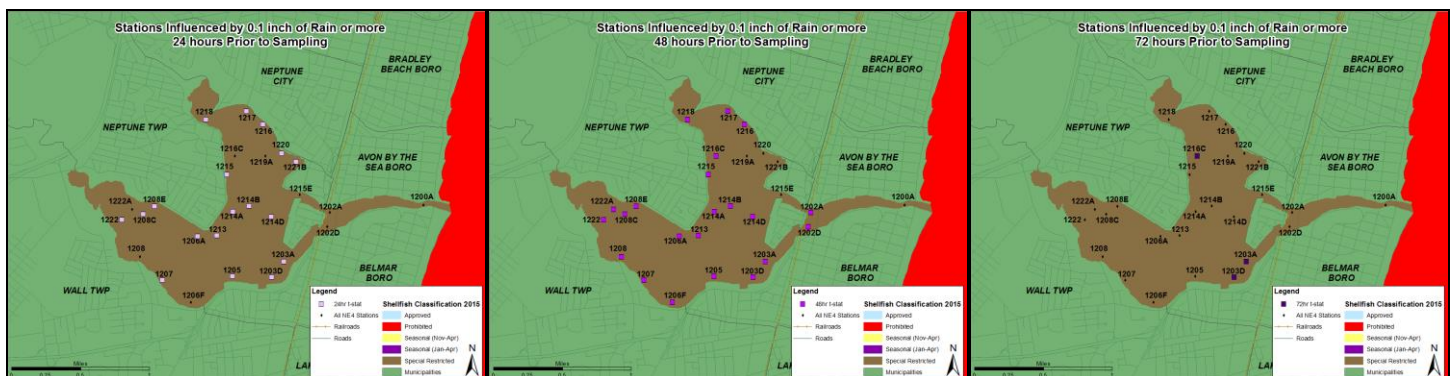
The year round data are divided between the summer and winter sampling seasons. The summer season runs from May through October, and the winter season runs from November through April. There are no seasonal waters in the Shark River and no upgrade to a *Seasonal* classification is being considered at this time.

Rainfall Effects

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region. Summer storms are localized and often associated with thunder and lightning activity. Winter storms are frequently associated with northeasters. Hurricanes can occur during the summer and early fall.

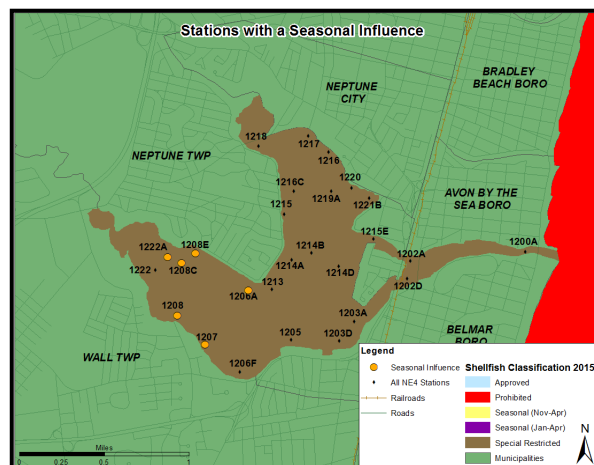
A *t*-test is used to compare log-transformed total coliform values for wet verses dry data. The *t*-statistical probability must be less than or equal to 0.05 for a station to be rainfall impacted. There is also a wet/dry cutoff for each growing area that dictates what data is considered ‘wet’ and what data is considered ‘dry’. The scenario used for this growing area was based on a wet/dry cutoff of 0.1 inch.

Rainfall amounts are based on the closest established National Weather Service station; each assignment run is assigned to a weather station to accurately reflect the rainfall at the sampling stations; this shellfish growing area uses rainfall station RA005.



Seasonal Effects

Seasonal variations in temperature, precipitation, wind, and circulation of the atmosphere affect marine environments. Seasonal variation may also be the result of a variety of conditions, including specific agricultural land-use practices, biological activity and/or stream flow. Statistically significant seasonal impacts were observed at six of the stations in the Shark River, all in the western portion of the river, near Wall Township (see adjacent figure). The *t*-statistical probability must be less than 0.05 for a seasonal difference at that station to be considered significant. Summer includes the months of May through October and winter includes November through April. Summertime pressures are usually more likely to impact these waters because of such things as heavy boat travel and higher summer temperatures. The water quality also has the potential to be affected by other non-point sources from increased summer population and/or increased use of recreational water activities.



RELATED STUDIES

Water Monitoring and Standard's (WM&S) Bureau of Marine Water Monitoring (BMWM) also monitors New Jersey waters for levels of nutrients (estuarine monitoring), phytoplankton, and bathing beach standards.

Nutrients

Nutrient stations are sampled monthly on a biennial basis. The 82 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. BMWM compiles the results of nutrient levels from such stations and then prepares a separate report. For full nutrient assessment, see www.nj.gov/dep/bmw.

Phytoplankton

Phytoplankton are photosynthetic algae that play a critical role at the base of aquatic food webs. The Bureau of Marine Water conducts routine sampling year-round at 45 static stations (up to 10 times a year) throughout New Jersey marine waters to detect the occurrence of species of marine phytoplankton that could produce biotoxins. BMWM, in accordance with the NSSP requirements, also analyzes the data and annually updates its Marine Biotoxin Contingency Plan. For more information on the BMWM phytoplankton program visit the BMWM website, www.nj.gov/dep/bmw.

Bathing Beaches

The WM&S group cooperatively works with the New Jersey Department of Health and local health agencies to monitor the bathing beaches in New Jersey. Together, these agencies implemented the

Cooperative Coastal Monitoring Program (CCMP). With this program, the coastal and estuarine waters that are open to the public for recreational bathing are surveyed and regularly monitored for the concentration of bacteria. The CCMP, in conjunction with US Army Corps of Engineers, also carries out the NY/NJ Harbor Estuary Program's Floatables Action Plan that utilizes aerial surveillance to detect floating solid waste and debris. Flights are scheduled for six days a week, weather permitting, during the summer months.

Typically, bathing beach samples are taken once a week for the entire summer. These samples are tested for Enterococci as a fecal coliform indicator. Ocean and bay recreational beaches are subject to opening and closing procedures of the State Sanitary Code. Local health agencies and law enforcement may close a bathing beach if the results exceed the State Sanitary Code of 104 Enterococci per 100mL. Stations must be re-sampled when bacteria concentrations exceed the primary contact standard of 104 Enterococci per 100 mL of sample. Consecutive samples that exceed the standard require the closing of the beach until a sample is obtained that is within the standard. Environmental stations are not bathing beaches and do not require re-sampling. Beaches can also be closed at any time if health or enforcement agencies believe it is in the interest of public health. BMWM utilizes these data as adjunct information; the closure of shellfish waters does not correspond with these results. Please see <http://www.njbeaches.org/> for further information.

Toxic Monitoring

Toxic chemicals such as heavy metals, pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) are dangerous chemicals that can be found in the environment. These substances can be released into the environment by storm drains, runoff, sewage treatment facilities, and atmospheric deposition. Bottom dwelling organisms are most vulnerable to these chemicals and may pose a risk to human health if consumed.

USEPA National Coastal Condition Assessment Program (NCCA)

USEPA National Coastal Condition Assessment (NCCA) and its partners began sampling in the coastal and estuarine waters of the United States in 1990. Data collected includes water column parameters, sediment chemistry & toxicity, benthic communities, and tissue contaminants. No new NCCA data is available for the coastal waters of the Shark River since the last reappraisal report (EPA, 2015). Please see <http://www2.epa.gov/national-aquatic-resource-surveys/national-coastal-condition-assessment> for further information and the most recent data.

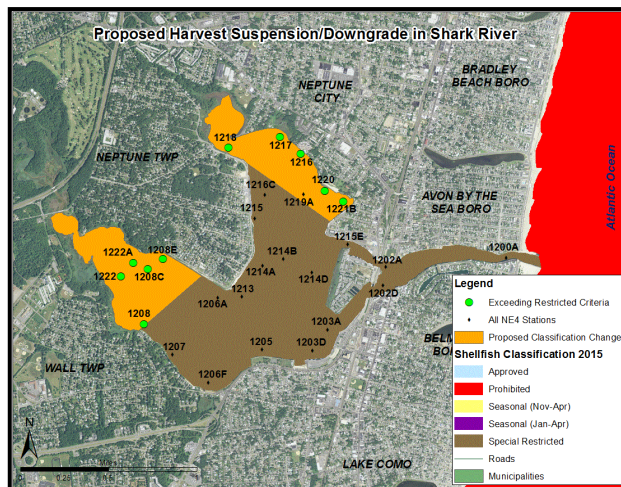
National Oceanic and Atmospheric Administration (NOAA) Mussel Watch

The National Oceanic and Atmospheric Administration (NOAA) Mussel Watch Program monitors the levels of toxins and metals in shellfish. The blue mussel, *Mytilus edulis*, occurs worldwide and effectively takes up toxins and metals from seawater and sediments. The toxins and metals then become concentrated in the mussel's living tissues. Assays from the living tissues of this shellfish can be made easily and cheaply. The Mussel Watch Program monitors metals such as mercury, lead, zinc, nickel, cadmium, copper, chromium, aluminum, silicon, manganese, iron, arsenic, selenium, tin, antimony, thallium, and silver. The program also monitors toxins such as the synthetic organic compounds that are widely used in pesticides, solvents, flame-retardants, and other products. There is a mussel watch station outside of the Shark River Inlet. Please see <http://coastalscience.noaa.gov/about/centers/ccma> for further information and the most recent data.

CONCLUSIONS

The appendix lists the water quality data obtained from the sampling period of October 1, 2011 to October 31, 2015. Systematic Random Sampling strategy was used to collect the samples, laboratory tests were run for fecal coliform, and a thorough analysis of the data was assembled for this report. There were 6 stations with a seasonal component. It was found that the Shark River shows the most impact 24-48 hours after 0.1 inches of rainfall. Currently, the bacteriological data for most stations support the respective criteria for the *Special Restricted* classification under the fecal coliform standards; however, based on the data, some stations in this growing area are not adequately classified.

Analyses of the Shark River shellfish growing area samples indicate that the Estimated 90th percentile fecal coliform levels of 10 stations do not meet the standards of the National Shellfish Sanitation Program (NSSP). Therefore, the fecal coliform levels sampled from October 1, 2011 to October 31, 2015 do not support the current classification of the Shark River. Portions of the Shark River are being recommended for a downgrade from *Special Restricted* to *Prohibited* in this Sanitary Survey report (see the Recommendations section below).



RECOMMENDATIONS

Two downgrades are being recommended for the Shark River in this sanitary survey report. The areas that are being recommended for a suspension of harvest and subsequent downgrade include the northern portion of the Shark River, of approximately 123 acres, and a western portion of the Shark River, of approximately 150 acres. The downgrades are recommended due to fecal coliform water quality results. The description of the recommended downgrades are below.

There is also a recommendation to add a station, 1220A, to the Shark River assignment run (057) to ensure that the proposed boundary line between the existing Special Restricted classification and the proposed Prohibited section in the northern portion of the river is adequately assessed.

The recommendation for further analysis is to continue the special pollution source track-down study in the area the Shark River. Information and results gathered will be included in a separate report or the next reappraisal report on the Shark River. If source(s) can be identified, hopefully work can be done to improve the water quality.

Current Regulations (as proposed in register, but not adopted)

SUBCHAPTER 3. SHELLFISH GROWING WATERS CLASSIFICATION - RESTRICTED

7:12-3.1 Shellfish growing waters that are classified as Restricted

- (a) The following shellfish growing waters are classified as Restricted:

...

4. All of Shark River and tributaries. This closure adjoins those Prohibited waters defined in N.J.A.C. 7:12-2.1(a)21i.

Suggested Changes to Regulation

SUBCHAPTER 2. SHELLFISH GROWING WATER CLASSIFICATION - PROHIBITED

7:12-2.1 Shellfish growing water classification - Prohibited

(a) The following shellfish growing waters are classified Prohibited:

...

4. **Shark River (Note: A portion of the Shark River is designated as Restricted, see N.J.A.C. 7:12-3.1(a)4):**

i. The waters of Shark River and tributaries north of a line stating at a point with coordinates of latitude 40 degrees 11 minutes 25.4 seconds N., and longitude 74 degrees 1 minute 49.4 seconds W., then bearing 125 degrees T to a point on the western shoreline with coordinates of latitude 40 degrees 11 minutes 42.6 seconds N., and longitude 74 degrees 2 minutes 21.21 seconds W., and terminating.

ii. The waters of Shark River and tributaries west of a line stating at a point with coordinates of latitude 40 degrees 11 minutes 9.6 seconds N., and longitude 74 degrees 2 minutes 39.0 seconds W., then bearing 230 degrees T to a point on the western shoreline with coordinates of latitude 40 degrees 10 minutes 53.5 seconds N., and longitude 74 degrees 3 minutes 3.4 seconds W., and terminating.

SUBCHAPTER 3. SHELLFISH GROWING WATERS CLASSIFICATION - RESTRICTED

7:12-3.1 Shellfish growing waters that are classified as Restricted

(a) The following shellfish growing waters are classified as Restricted:

...

4. Shark River [and tributaries. This closure adjoins those Prohibited waters defined in N.J.A.C. 7:12-2.1(a)21i] **(Note: A portion of the Shark River is designated as Prohibited, see N.J.A.C. 7:12-2.1(a)4): All those waters of the Shark River starting from a point with coordinates of latitude 40 degrees 11 minutes 11.3 seconds N., and longitude 74 degrees 0 minute 27.8 seconds W. then bearing 168 degrees T to a point with coordinates of latitude 40 degrees 11 minutes 14.7 seconds N., and longitude 74 degrees 0 minute 29.0 seconds W., then following the northern shoreline in a westerly direction to a point with coordinates of latitude 40 degrees 11 minutes 25.4 seconds N., and longitude 74 degrees 1 minute 49.4 seconds W., then bearing 125 degrees T to a point on the western shoreline with coordinates of latitude 40 degrees 11 minutes 42.6 seconds N., and longitude 74 degrees 2 minutes 21.21 seconds W., then following the western shoreline in a southerly direction to a point with coordinates of latitude 40 degrees 11 minutes 9.6 seconds N., and longitude 74 degrees 2 minutes 39.0 seconds W., then bearing 230 degrees T to a point on the southern shoreline with coordinates of latitude 40 degrees 10 minutes 53.5 seconds N., and longitude 74 degrees 3 minutes 3.4 seconds W., then following the southern shoreline in a easterly direction to the point of origin and terminating.**

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APPENDICES

- A. Statistical Summary
- B. Seasonal Evaluation
- C. Precipitation
 - Rainfall Amount
 - Wet/Dry Statistics
- D. Data Listing: October 1, 2011 to October 31, 2015