Surface Water Quality

Background

New Jersey contains a wide variety of water resources. Fresh water resources in the state include our rivers and streams, lakes, ponds, reservoirs, and freshwater wetlands. As a coastal state, New Jersey has the Atlantic Ocean as a saltwater resource along with brackish estuaries and tidal wetlands. New Jersey has adopted Surface Water Quality Standards (SWQS) to protect these water resources. The SWQS establish surface waters' designated uses and specify surface water quality criteria (numeric and narrative) to protect those uses, along with specific implementation and other policies necessary to protect the State's surface waters. Designated uses of surface waters of the State can be categorized as: aquatic life (general and trout), recreation, water supply (drinking, industrial, and agricultural), fish consumption, and shellfish harvest for consumption.

The federal Clean Water Act requires states to report on the quality of their waters, including overall water quality and support of designated uses (i.e., "Integrated List of Waters" or "305(b) Report"), and identify waters that are not supporting designated uses because they do not meet surface water quality standards (i.e., "List of Water Quality Limited Waters" or "303(d) List"). The New Jersey Department of Environmental Protection (DEP) uses all readily available data from its extensive monitoring network and other internal and external sources to generate New Jersey's 305(b) Report and 303(d) List, which are submitted to U.S. Environmental Protection Agency (EPA) and published as part of the biennial New Jersey Integrated Water Quality Assessment Report (Integrated Report).[1] Data needed to assess use support in New Jersey's waters are generated through ambient water quality monitoring conducted by the DEP and other entities. A detailed description of the DEP's surface water monitoring program is provided in the *New Jersey Water Monitoring and Assessment Strategy*[2] and the *Water Quality Monitoring Networks Report*.[3]

The data requirements and assessment methods used to generate the Integrated Report are provided in the *New Jersey Integrated Water Quality Assessment Methods* (Methods Document).[4] These methods include a conservative approach towards use assessments that requires extensive data to support a finding that a use is supported or not supported. These methods also specify the different types of data that are used to assess the different designated uses. For example, chemical water quality data for specific parameters are used to assess the drinking water supply use, while physical and chemical water quality data, as well as biological data, are used to assess aquatic life uses. Bacterial indicator data are used to assess recreation and shellfish uses, while chemical water quality and fish tissue data are needed to assess the fish consumption use.

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This chapter's primary focus is the assessment of New Jersey's surface water quality based on chemical/physical and biological water quality data collected between 2011 and 2015. See other chapters in this Trends Report series, including the chapter "Fresh Water Ecological Health: Stream Biomonitoring - Ambient Macroinvertebrate Network (AMNET) and Fish Index of Biotic Integrity Network (FIBI)" for more detailed discussions of specific types of water quality and quantity measurements, including longer term trends.

Status

For the 2016 Integrated Report, New Jersey's assessment units (AUs) (i.e., the scale for use assessments) were delineated based on Hydrologic Unit Code (HUC) 14 subwatershed boundaries. Based on these boundaries, New Jersey contains a total of

958 AUs. Each of these AUs has its own set of designated uses, depending on the classification of the waters located therein. Statewide use assessment results show that out of the 4,064 designated use results, 1,951 results indicated that designated uses are not supported, 768 uses are supported, and 1,345 uses have insufficient data. These results reflect an overall increase in the number of impaired waters in New Jersey compared to previous reporting cycles. However, this does not necessarily indicate worsening water quality conditions. In each listing cycle, there are changes that affect the assessment universe and the protocols used for assessment decisions, such as:

- improved detection limits for measuring pollutants,
- improved equipment technology,
- more rigorous assessment procedures, and
- most importantly, sampling in waters that were previously unassessed.

Results for key designated uses are shown in Figure 1. AUs shown as "Not Supporting" applicable designated uses include those where a Total Maximum Daily Load (TMDL) has been approved. A TMDL identifies the point and nonpoint sources contributing a pollutant of concern and sets load reductions needed to meet surface water quality standards.

As shown in Figure 1, use assessment results for the 2016 Integrated Report reflect:

- 38% of the applicable AUs fully support the drinking water supply use;
- 24% percent of all AUs fully support recreational uses; however, all of New Jersey's ocean bathing beaches fully support swimming;
- 20% of applicable AUs fully support the shellfish harvest for consumption use; however, 90% of New Jersey's shellfish waters are classified as "harvestable," including seasonally approved and restricted shellfish waters;
- 17% of all AUs fully support aquatic life uses; and
- Less than 1% of all AUs support the fish consumption use, but the majority are not assessed because of insufficient information.

Designated uses are not supported when there is at least one type of water quality impairment that prevents water quality standards from being met. There are a variety of causes of water quality impairment, including chemical pollutants, metals, toxins, nutrient enrichment and their associated effects, unknown causes of

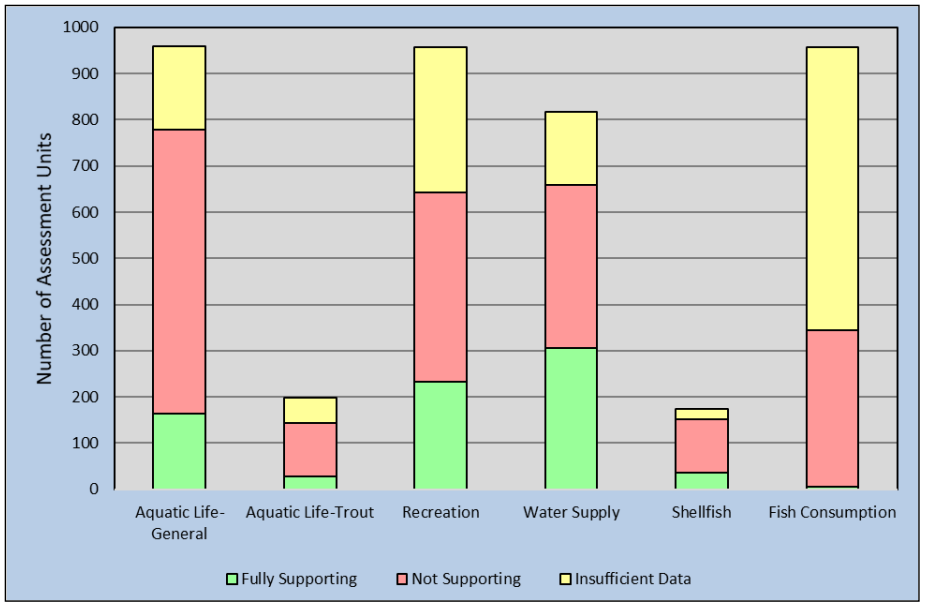

Figure 1. Statewide designated use assessment results, 2016.

biological impairment and known causes that are not attributable to chemical constituents (i.e., "pollution"). The most frequent causes of water quality impairment are shown in the chart entitled, "Top 10 Causes of Water Quality Impairment" (Figure 2).

The pollutants responsible for causing most of New Jersey's water quality impairment are the indicators of bacteria collectively referred to as pathogens. Pathogenic indicators are generally present in fecal material that may contain diseases. Sources of such pathogens include nonpoint sources, stormwater discharges, combined sewer overflows (CSOs), wildlife, and illicit discharges. Pathogens are the primary cause of impairment for recreational and shellfish harvest for consumption uses. TMDLs have been established to reduce sources of pathogens in most of the waters where recreational and shellfish uses are impaired due to pathogens.

The 2016 list of impaired parameters includes 34 pollutants causing water quality impairment in one or more assessment units for a total of 2,912 listings. The top 10 pollutants exceeding water quality standards are presented in Figure 2.

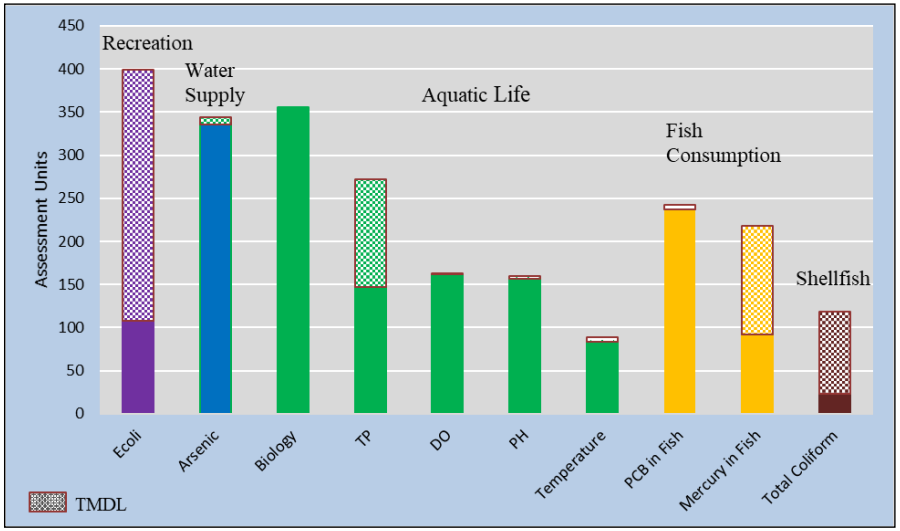

Figure 2. Top ten causes of water quality impairment.

Note: Many of the assessment units that are on the 303(d) List but not covered by a TMDL include areas where water quality is being managed by remediation/protection measures such as NPDES permits, stormwater permits, watershed management plans, restoration projects, pollutant minimization plans and enforcement.

Other causes of impairment affecting aquatic life uses include nutrients (primarily total phosphorus in freshwaters), dissolved oxygen, pH, biological - cause unknown and temperature. Total phosphorus, dissolved oxygen, and pH are often interrelated and reflect the inputs of excessive nutrients into waterways from both point and nonpoint sources. An assessment finding of "biological - cause unknown" is used to identify biologically-impaired waters where indices have been developed to determine the condition of biological communities such as benthic macroinvertebrates or fish. The causes of the impairment are unknown and further studies are needed to identify the actual cause of biological impairment, such as habitat alteration, hydrologic modification or other environmental stressors and chemical pollutants.

To address many of the waters impaired for nutrients and recognizing the complicated relationship between dissolved oxygen and pH impacts, TMDLs have already been established throughout the state. Studies show that the impact of nutrients on water quality is strongly influenced by other environmental factors such as sunlight availability, stream velocity, water clarity and the interaction between the water column and sediment. By establishing TMDLs through modeling, additional sampling and detailed analysis, the DEP is improving its understanding of nutrient impacts on water quality, including dissolved oxygen and pH. The DEP has established nutrient TMDLs for the Passaic River Basin and the Raritan River Basin as well as numerous rivers and lakes throughout the State. New Jersey has also developed a Nutrient Criteria Enhancement Plan[5] for enhancing the existing nutrient criteria for freshwaters, and is developing new nutrient criteria for estuarine and marine waters of the State.

Temperature is the predominant cause of impairment of waters classified for trout production or trout maintenance (i.e., trout aquatic life use). Temperature exceedances are generally associated with loss of riparian buffers and tree canopies, the presence and expansion of impervious cover throughout the watershed, and the abundance of small run-of-the-river impoundments common in New Jersey watersheds. A temperature TMDL was developed for the Pequannock River to restore and maintain its trout aquatic life use.

Arsenic is the predominant cause of impairment of the water supply use. It should be noted that all fresh surface waters in New Jersey are designated for potential use as a potable supply, and assessment of this use does not evaluate compliance with drinking water standards developed under the State and Federal Safe Drinking Water Acts, which are measured at the point of delivery, not from the source waters. Levels of arsenic in some waters in the state reflect natural conditions. In addition to the long-understood sources of arsenic in northern areas of the State, the DEP, working with USGS, has determined regional background concentrations in the Inner and Outer Coastal Plains.[6,7] Waters found to be below the natural background but above the surface water quality standard are placed on a sublist in the 303(d) List that indicates natural conditions and a TMDL is not the appropriate action. The DEP is working with the EPA on actions involving waters with natural background levels that exceed the arsenic water quality criteria.

The main pollutants causing impairments related to fish consumption are mercury, PCBs, and DDT and its metabolites (collectively referred to as "DDx"). Toxic inputs to the environment are being significantly reduced within the state. Consumer products containing mercury are being eliminated with measurable reductions in mercury occurring in the environment.[8] PCBs and DDT have been banned. A statewide mercury TMDL has been established, which identifies the predominant source of mercury in fish tissue as air deposition, including sources from other states and countries.

Trends

Long-term water quality trends in rivers and streams indicate improvement over the past 40 years, likely the result of elimination or minimization of point sources, upgrades of wastewater treatment plants, stormwater management actions, and natural attenuation of pollutants. A 2020 study conducted by DEP indicates that water quality is recovering with total nitrogen and total phosphorus improving or remaining the same at most stream sites between 1971 and 2016.[11] These results are similar to those observed in other studies in New Jersey and the Northeastern United States.[9,10,11,12] These studies each used water quality data collected from multi-site monitoring networks from varying time periods with a few sites dating back to 1971.

While overall trends in the studies showed decreasing or no significant change for total phosphorus and total nitrogen concentrations, nitrate trends indicated increasing concentrations at many stations.[10] Increases in nitrate may be due to the successful efforts of the DEP to reduce ammonia discharges from wastewater treatment facilities by oxidizing it to nitrate. Ammonia is more deleterious to the environment because it creates an oxygen demand, thereby lowering dissolved oxygen in the water. In addition, ammonia can also be toxic to aquatic life under certain conditions, and like nitrate, it is often associated with blooms of blue green algae, a noxious and sometimes toxic alga when present in large quantities.

Changes in total phosphorus likely reflect localized land use changes. Where improvements are observed, they are likely the result of implementing phosphorus limits in New Jersey Pollution Discharge Elimination System (NJPDES) permits, as well as improvements with reducing loads from non-point sources, including Section 319(h)-funded nonpoint source pollution control projects, and stewardship activities at the local level aimed at reducing nonpoint sources of pollution. The NJ Fertilizer Law passed in 2011 also helped to reduce the input of nutrients by eliminating phosphorus from most lawn fertilizers and restricting the amount of total nitrogen used in a single application and the total amount used in a year.[13]

The trend reports found a universal increase in total dissolved solids (TDS). TDS and chloride increases have been associated with runoff from urban and agricultural areas, especially runoff of salt used for road deicing. The data reviewed to develop the Integrated Report identify numerous occasions of excessive TDS concentrations as well as chlorides that coincide with winter storm events of most years; however, the number of chloride exceedances resulting in use impairment remains relatively low. Discharges from wastewater treatment facilities, including septic systems, can also contribute to increased TDS loadings. Increasing TDS trends were found in all types of land uses and physiographic regions.

Observable trends of the 303(d) List show metal and ammonia impairments significantly decreasing statewide. This does not include arsenic, which continues to be detected at levels that exceed the human health criteria. The most dramatic reductions in the Raritan Region show a 95% decrease in the number of impairments on the 303(d) List since 1998. In 1998, there were 191 303(d) listings including metals and unionized ammonia. Years of monitoring have revealed only nine 303(d) listings for metals remain in 2016. This remarkable improvement is the result of rules and regulations that have limited the discharge of toxins in the waterways and air, the remediation of contaminated sites, and the closing or shifting of many manufacturing sites out of the region. Statewide metals and toxins discharging into waterbodies have been drastically reduced, however, legacy issues still impact some areas of the State where metals remain in the sediment.

Outlook and Implications

The low percentage of New Jersey waters that attain aquatic life uses is a significant concern. Biological monitoring is the primary data type used to assess aquatic life use attainment. Recent trends show biological communities declining throughout the state. Multiple stressors can impact these communities, including nutrients, chemical pollutants, hydrological modification, habitat loss, erosion, the increase of impervious surface within the watershed, and warming temperatures

associated with climate change. More investigation is needed to determine the stressor(s) causing the biological impairments to identify the issues, develop the proper management strategy, and implement the most effective restoration actions to address the impairments.

New Jersey has developed a Nutrient Criteria Enhancement Plan (Nutrient Plan) for enhancing the existing nutrient criteria for freshwaters and developing new nutrient criteria for estuarine and marine waters of the State. Additional nutrient criteria will be developed to address and prevent nutrient-related use impairment in New Jersey waters. Nutrients are also suspected of being a source of water quality problems in the Barnegat Bay. In 2010, the Barnegat Bay Comprehensive Action Plan was initiated to address the health of bay. The DEP has employed multiple measures to understand, protect, and restore the waters of Barnegat Bay,[14] including the Barnegat Bay Restoration, Enhancement, and Protection Strategy. This plan is moving science into action within the Barnegat Bay watershed, in keeping with the DEP's priority of using the best available science to protect New Jersey's waters.

Rising levels of TDS in many streams are also a cause for concern. Road salting and improper salt storage are major contributors to TDS concentrations, with monitoring confirming criteria exceedances during and after winter storms.[15]

Ninety percent of shellfish waters are classified as harvestable. Harvestable waters include those waters approved with no restrictions, seasonally approved, and restricted classifications. For the Integrated Report, only shellfish waters approved with no restrictions are fully supporting the designated use, resulting in only 20 percent of shellfish waters fully supporting this use. The DEP has developed TMDLs for most of the impaired shellfish waters and is also conducting investigations to track sources of impairment.

Recent sampling has shown that PCB and mercury levels in fish are declining, reflecting the gradual reduction of these pollutants in the environment.[8] Since the 1978 ban on PCB production, the DEP also adopted amendments to the NJPDES rules at N.J.A.C. 7:14A that require major facilities discharging to PCB-impaired waters to monitor their effluent for PCBs. Some of these facilities will also be required to develop and implement PCB Pollutant Minimization Plans that will lead to the identification and elimination of PCB-contaminated areas on facility sites. The DEP's efforts to reduce air deposition of mercury from in-state and upwind power plants and other industrial sources, as well as regulating sources such as in-state dental facilities, are expected to reduce mercury loadings to the State's waters over time. However, these reductions are not yet sufficient to eliminate the need for fish consumption advisories. Therefore, the number of waters listed as impaired based on fish consumption advisories for these pollutants may increase in the future due to their persistence in the environment and an increase in the scope of monitoring and assessment.

The DEP continues to improve and enhance its water quality management programs, and to better relate these actions to documented changes in water quality status and trends. Additional monitoring is needed in most assessment units to assess all uses. This information is vital to determining the causes and sources of impairment so that appropriate restoration measures may be taken to ultimately meet the Clean Water Act goal of 100% fishable and swimmable waters throughout the State of New Jersey.

More Information

Surface Water Quality Standards: https://www.nj.gov/dep/wms/bears/swqs.htm
Integrated Water Quality Assessment Report: https://www.nj.gov/dep/wms/bears/assessment.htm
Bureau of Environmental Analysis, Restoration and Standards: https://www.nj.gov/dep/wms/bears/index.html
Division of Water Monitoring and Standards: https://www.nj.gov/dep/wms/
Division of Water Monitoring and Standards Publications: https://www.nj.gov/dep/wms/reports_publications.html
TMDL Program: https://www.nj.gov/dep/wms/bears/tmdls.html
Nutrient Criteria Enhancement Plan: https://www.nj.gov/dep/wms/bears/docs/NCEP-WEB-LINKS-CHECKED-EPA-R2-comments-incorporated-15-OCT-2018_2.pdf

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[8] See the chapter "Mercury Emissions" in the Trends Report series, https://www.nj.gov/dep/dsr/trends/mercury.pdf

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[14] http://www.nj.gov/dep/barnegatbay/

[15] NJDEP, 2020, New Jersey 2016 Integrated Water Quality Monitoring and Assessment Report, chapter 4, p. 71