

Surface Water Quality- Rivers and Streams: Chemical and Physical Measurements

Background

New Jersey contains a wide variety of water resources. Within the State's 8,204 square miles are 127 linear miles of coastline, 18,126 miles of rivers and streams, and 52,804 acres of named lakes, ponds, and reservoirs. In addition, there are 260 square miles of estuaries, 739,160 acres of freshwater wetlands, and 209,269 acres of tidal wetlands (based on high resolution scale of 1:24,000). New Jersey has adopted Surface Water Quality Standards (SWQS) to protect these water resources. The SWQS establish the designated uses and specify the surface water quality criteria (numeric and narrative) 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 despite the implementation of technology-based effluent limits (i.e., "List of Water Quality Limited Waters" or "303(d) List"). The New Jersey Department of Environmental Protection (Department) uses all readily available data from its extensive monitoring network and other internal and external sources to generate New Jersey's Integrated and 303(d) Lists, which are submitted to USEPA 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 Department and other entities. A detailed description of the Department'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 and 303(d) Lists 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, and 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.

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 2008 and 2012. See other chapters in this Trends Report series, including the chapter "Fresh Water Pollution; Streams; Ambient Biomonitoring Network and Fish Index of Biotic Integrity Network" for more detailed discussions of specific types of water quality and quantity measurements, including longer term trends.

Status

For the 2014 Integrated Report, New Jersey's assessment units (the scale for use assessments) were delineated based on Hydrologic Unit Code (HUC) 14 subwatershed boundaries that were revised in 2013. Based on the revised boundaries, New Jersey contains a total of 958 assessment units (AUs). Each of the 958 AUs has its own set of designated uses, depending on the classification of the waters located therein. In 2014, over 2,630 designated uses were assessed out of a statewide total of over 4,074 possible assessments. Statewide, there are 102 AUs that overall meet their designated uses (not including fish consumption) that encompasses over 1,905 miles of rivers and streams, 4,810 acres of lakes/ponds/reservoirs, and 35 square miles of estuary waters. Only 348 miles of rivers and

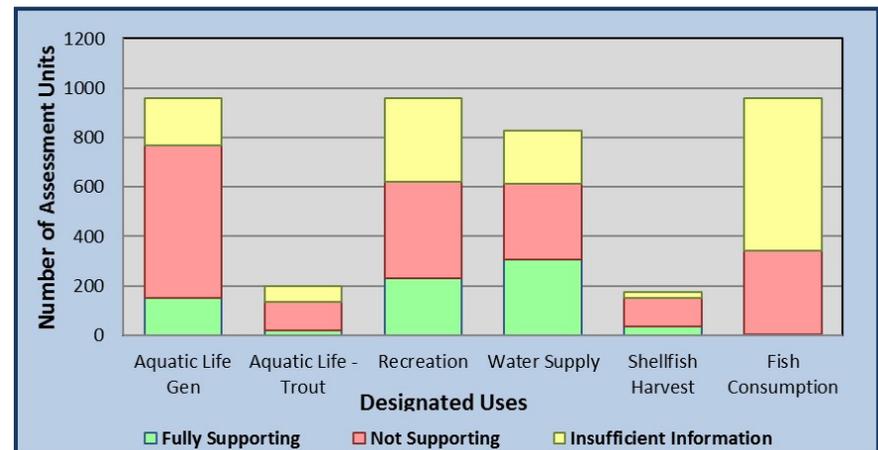


Figure 1: Statewide Designated Use Assessment Results, 2014

streams, and 510 acres of lakes located in 33 AUs are not assessed at all. 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 developed as well as those on the 2014 303(d) List that require a TMDL. A TMDL identifies the sources (point and nonpoint) contributing a pollutant of concern and sets load reductions needed to meet surface water quality standards. Due to changes in methodologies between assessment periods, direct comparisons to previous assessments are not applicable.

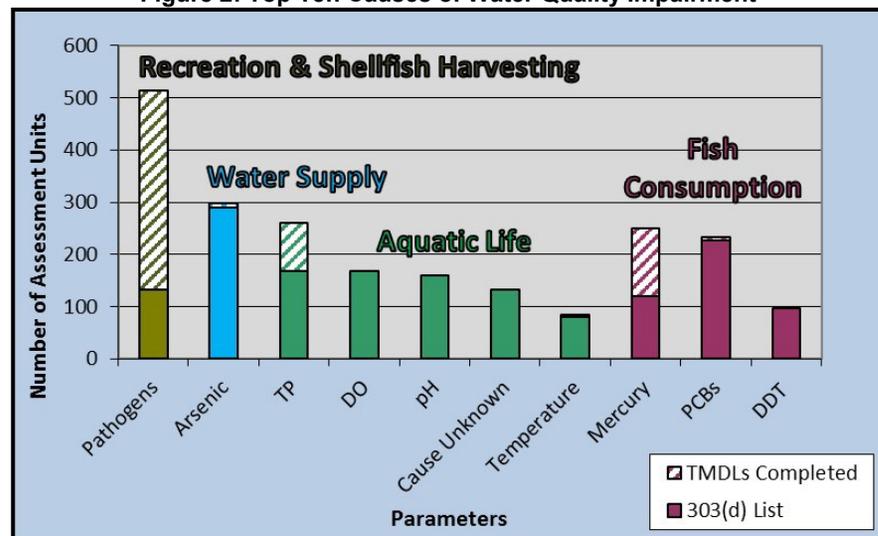
As shown in the chart below, use assessment results for 2014 are as follows:

- Over 35% of the applicable AUs fully support the drinking water supply use;
- Almost 25% percent of all AUs fully support recreational uses; however, all New Jersey’s ocean bathing beaches fully support swimming;
- Approximately 15% of all AUs fully support aquatic life uses;
- 20% of applicable AUs fully support the shellfish harvest for consumption use; however, 90% of New Jersey’s shellfish waters are classified as “harvestable” that includes seasonal and special restricted shellfish harvesting;

Where designated uses are not supported and a TMDL has not been developed, the assessment unit is placed on the State’s 303(d) List, along with the pollutant(s) causing non-support. The list is then ranked based on relative priority for TMDL development, in accordance with federal and state requirements, and the highest prior TMDLs are published in the Integrated Report’s “Two-Year Schedule for TMDL Development.”

Designated uses are not supported when there is some type of water quality impairment that prevents water quality standards from being met. There are a variety of causes of water quality impairment, including unknown causes of 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) and include waters where a TMDL has been established but water quality is still impaired. 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), and illicit

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 NJPDES permits, stormwater permits, watershed management plans, restoration projects, pollutant minimization plans and enforcement.

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 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.⁵ Consumer products containing mercury are being eliminated. 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.

Other causes of impairment affecting aquatic life uses include nutrients (primarily total phosphorus (TP) in freshwaters), DO, pH, “cause unknown” and temperature. TP, DO, and pH are often interrelated and reflect the inputs of excessive nutrients into waterways from both point and nonpoint sources. Cause unknown is used to identify biologically-impaired waters where chemical data are unavailable or show

no exceedance of applicable SWQS criteria, in which case, further study may be needed to identify the actual cause of biological impairment, such as habitat alteration, hydrologic modification, or other environmental stressors and chemical pollutant(s).

To address the complicated relationship between nutrients, DO, and pH impacts, TMDLs have already been established to address many of the waters impaired for nutrients. 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 Department is improving our understanding of nutrient impacts on water quality including DO and pH. The Department has established TMDL's 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 Plan⁶ for enhancing the existing nutrient criteria for freshwaters and is developing new nutrient criteria for other (estuarine, 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 drinking water supply use. (It should be noted that this use applies to all waters designated for potential use as a potable supply - assessment of this use does not evaluate compliance with the Safe Drinking Water Standards, which are measured at the point of delivery, not from the source waters.) Levels of arsenic in many waters of the State reflect natural conditions. The Department working with USGS has determined regional background concentrations in the Inner and Outer Coastal Plain. Waters found to be below the natural background are placed on a sublist in the 303(d) List that indicates natural conditions and a TMDL is not the appropriate action. The Department is working with the EPA on actions involving waters with natural background levels that exceed the arsenic water quality criteria.

Pollutants causing impairment that are not addressed by a TMDL are identified on the 303(d) List. The 2014 303(d) List identifies 32 pollutants causing water quality impairment in one or more assessment units for a total of 1,958 listings.

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 recent study conducted by the U.S. Geological Survey in cooperation with the NJ DEP and the Delaware River Basin Commission⁷ indicates that water quality has shown signs of improvement with total nitrogen and total phosphorus improving or remaining the same at most stream sites between the 1970s and 2011. These results are similar to those observed in other studies in New Jersey and the Northeastern United States.^{8,9,10} These studies each used water quality data collected from multi-site monitoring networks from varying time periods ranging from 1993 to 2009 with a few sites dated back to 1975.

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. Increases in nitrate may be due to the successful efforts of the Department 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 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) nonpoint source pollution control projects, and stewardship activities at the local level aimed at reducing nonpoint source of pollution.

Of note, the trend reports found a universal increase in dissolved solids. 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 identifies 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.

Outlooks and Implications

As noted above, TMDLs have been established in many watersheds throughout the State to deal with the most frequent causes of water quality impairment: pathogens, nutrients, mercury, and PCBs. Recent sampling has shown that PCB levels in fish are declining, reflecting the gradual disappearance of PCBs in the environment since their 1978 production ban. The Department 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 which 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. Reductions in air deposition of mercury from in-state and upwind power plants, other industrial sources, and dental facilities in New Jersey 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 available monitoring and assessment. A long-term monitoring program for fish tissue concentrations is needed to evaluate effectiveness of these regulatory actions.

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, and the increase of impervious surface within the watershed. 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.

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. This issue needs to be better addressed by the Department's water quality management programs.¹¹

Ninety percent of shellfish waters are classified as harvestable. Harvestable waters include: approved with no restrictions, seasonal harvest, and special restrictions. Only shellfish waters approved with no restrictions are fully supporting the designated use; therefore only 20 percent of New Jersey's shellfish waters fully support this use. The Department has developed TMDLs for most of the impaired shellfish waters and is also conducting investigations to track sources of impairment.

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 other (estuarine, marine) waters of the State. 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. On December 9, 2010, Governor Chris Christie announced a comprehensive action plan to address the health of Barnegat Bay. In response, the Department has employed multiple measures to understand, protect, and restore the waters of Barnegat Bay.¹²

The Department 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 determine 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.

- Surface Water Quality Standards:
<http://www.state.nj.us/dep/wms/bwqsa/swqs.htm>
- Integrated Water Quality Assessment Report:
<http://www.state.nj.us/dep/wms/bwqsa/generalinfo.htm>
- Bureau of Water Quality Standards and Assessment:
<http://www.state.nj.us/dep/wms/bwqsa>
- Division of Water Monitoring and Standards:
<http://www.state.nj.us/dep/wms/>
- Division of Water Monitoring and Standards Publications:
<http://www.state.nj.us/dep/wms/publications.html>
- TMDL Program: <http://www.nj.gov/dep/wms/bear/tmdls.html>
- Nutrient Criteria Enhancement Plan:
http://www.state.nj.us/dep/wms/bwqsa/nutrient_criteria.htm

References

Much of the surface water quality information in this report was provided by the Department's Division of Water Monitoring and Standards staff and the New Jersey 2014 Integrated Water Quality Assessment Report.¹

¹ NJDEP, 2016, New Jersey 2014 Integrated Water Quality Assessment Report, http://www.nj.gov/dep/wms/bears/2014_integrated_report.htm

² <http://www.state.nj.us/dep/wms/longtermstrategyreport.pdf>

³ <http://www.state.nj.us/dep/wms/publications.html>

⁴ http://www.state.nj.us/dep/wms/bwqsa/2010_appendix_f_final_methods_document_with_response_to_comments.pdf

⁵ See the chapter "Mercury Emissions" in the Trends Report series, <http://www.nj.gov/dep/dsr/trends/pdfs/mercury.pdf>

⁶ http://www.state.nj.us/dep/wms/bears/docs/2013_final_nutrient_plan.pdf

⁷ Hickman, R. and Hirsch R. 2016. Trends in the Quality of Water in New Jersey Streams, Water Years 1971-2011. U.S. Geological Survey, Scientific Investigations Report 2016-5176. Available at <https://pubs.er.usgs.gov/publication/sir20165176/>

⁸ Hickman, R. and Gray, B. 2010. Trends in the Quality of Water in New Jersey Streams, Water Years 1998-2007. U.S. Geological Survey, Scientific Investigations Report 2010-5088. Available at <http://pubs.usgs.gov/sir/2010/5088/>

⁹ Todd Trench, E. et al. 2011. Nutrient Concentrations and Loads in the Northeastern United States – Status and Trends, 1975-2003. U.S. Geological

Survey, Scientific Investigations Report 2011-5114. Available at <http://pubs.usgs.gov/sir/2011/5114/index.html>

¹⁰ Heckathorn, H. and Deetz, A. 2012. Variations in Statewide Water Quality of New Jersey, Water Years 1998-2009. U.S. Geological Survey, Scientific Investigations Report 2012-5047. Available at <http://pubs.usgs.gov/sir/2012/5047/>

¹¹ NJDEP, 2012, New Jersey 2010 Integrated Water Quality Monitoring and Assessment Report, chapter 3, p. 14

¹² <http://www.nj.gov/dep/barnegatbay/>

