pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

2016 Final Pennsylvania Integrated Water Quality Monitoring and Assessment Report

Clean Water Act
Section 305(b) Report and 303(d) List

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EXECUTIVE SUMMARY

Pennsylvania has a population of 12,787,209 and an area of 45,333 square miles. There are six major river basins - Delaware, Susquehanna, Genesee, Potomac, Ohio, and Lake Erie - with an estimated 86,000 stream and river miles and 161,455 lake acres. Seventeen square miles of Delaware Estuary and 512 acres of tidal wetlands exist in the southeast corner. In the northwest corner are 63 miles of Lake Erie shoreline. Scattered throughout the state are 403,924 freshwater wetlands. These numbers illustrate the magnitude and complexity the Pennsylvania Department of Environmental Protection (DEP) faces in assessing, protecting, and managing its water resources.

There are several goals of the 2016 Integrated Water Quality Monitoring and Assessment Report (Integrated Report). Foremost is to report on the condition of the waters in the Commonwealth. Other goals include describing the water pollution control and assessment and monitoring programs. Pollution control programs are discussed in detail in Part B and Assessment and Monitoring in Part C. The report concludes with a discussion of groundwater in Part D.

Part A summarizes and discusses stream and lake assessments. The introduction describes the five-part list. These lists of individual waterbodies are separate from the narrative due to their size and are available on DEP's website.

In April 2007, DEP completed a ten-year program to assess all wadeable streams. The census utilized a biological assessment of the aquatic life use. Since 2007, DEP has implemented new aquatic life biological assessment methods based on the current best science. Other designated uses and non-wadeable waters continue to be assessed as resources and time permit. As of this report, 84,372 miles of streams and rivers are assessed for at least one protected use. The aquatic life use has been assessed for all wadeable waters with 64,223 miles listed as attaining that water use. Of the impaired miles, 9,821 require the development of a Total Maximum Daily Load (TMDL) to reduce pollutant inputs and 7,283 have an approved TMDL. An additional 46 miles are under compliance agreements and expected to improve within a reasonable amount of time. The two largest problems are agriculture and abandoned mine drainage. The largest stressors are siltation and metals. However, other problems should not be minimized, because in local areas they may impact a relatively large percentage of waters. For example, urban runoff/storm sewers is a minor problem in rural areas but major in metropolitan regions.

There are 86,153 acres of lakes assessed for aquatic life use and 50,957 acres are attaining that use. Of the impaired acres, 7,563 require a TMDL, 5,635 have an approved TMDL, and 22,033 acres are impaired but do not require a TMDL because they are not affected by pollutants. The largest problem source is agriculture, and the largest stressors are nutrients, suspended solids, and organic enrichment/low D.O. As discussed above in regards to streams and rivers, smaller problems still have regional importance.

To protect the health of those who consume fish caught in the Commonwealth, DEP monitors fish flesh for possible contaminants. When concentrations of substances known to be harmful to humans reach action levels, fish consumption advisories are issued to inform people of the possible dangers and the actions they can take to protect themselves. Currently, there are approximately 2,052 miles of fish consumption advisories in need of TMDLs and 676 with approved TMDLs. Lake listings include 29,912 acres requiring TMDLs and an additional 5,642 with approved TMDLs. There is a statewide fish consumption advisory of no more than one meal per week for all waters to protect against the ingestion of unconfirmed contaminants. The fish consumption listings in this report have triggered action levels more restrictive than the one meal per week. It should be noted that DEP directs much of its fish tissue sampling to areas where there is a greater chance of problems. As a result, it is not surprising to see a higher number of stream miles and lake acres impaired for this use compared to the stream miles (5,830) and lake acres (38,131) attaining this use.

Aquatic life use was the original focus of the statewide surveys, because, with a rapid and efficient biological assessment of aquatic macroinvertebrates (insects, snails, clams, etc.), it was possible to canvas the state over a ten-year period. In addition, aquatic life use is a good measure because it is reliable as an indicator of long-term pollution problems. Since completing the statewide census for aquatic life use, DEP is emphasizing developing assessment methodologies, programs, and partnerships to increase recreational and potable water supply use assessments.

Of the 18,356 stream miles assessed for recreational use, 10,791 were attaining. There are 7,398 impaired miles requiring a TMDL and 155 with an approved TMDL. Lake recreational use was assessed for 86,106 acres with 79,638 attaining and 5,704 impaired requiring a TMDL. The potable water supply use was assessed for 3,446 stream miles with 3,390 attaining, 50 impaired requiring a TMDL, and 12 with approved TMDLs. Lake potable water supply use was assessed for 68,762 acres with 68,127 attaining and 635 impaired requiring a TMDL.

Part B is the narrative describing the Commonwealth’s water pollution control programs. The section begins with a description of efforts to prevent pollution before it becomes a problem. On other fronts, DEP has programs to encourage reductions in pollution that also provide cost savings to the treatment facilities. Examples of these successes are provided.

As evident in the Part B narrative, the Commonwealth’s permitting and National Pollution Discharge Elimination System (NPDES) program is complex and deals with a large number of inspections and permits including regulating and permitting treatment facilities for 10,500 industrial and sewage dischargers. Pennsylvania is a large producer of coal and natural gas and all mining and extraction activities require permits and inspection. It is DEP’s responsibility to issue permits that assure stormwater from earthmoving and construction activities is managed properly so as not to cause damage to streams or adversely affect their hydrology. County conservation districts work with DEP on stormwater protection. DEP also regulates combined sewer overflows (CSO) and manages and protects wetlands.

Part B also includes a discussion of nonpoint source programs. Pennsylvania’s Nonpoint Source (NPS) Program was developed in response to Section 319 of the federal Clean Water Act to address problems caused by pollution from nonpoint sources. Unlike point source pollution, which comes from easily identifiable sources such as pipes or ditches, the causes of nonpoint source pollution can be difficult to define or quantify because it comes from diffuse sources. Sometimes referred to as “polluted runoff,” a large portion of nonpoint source pollution is generally caused by stormwater runoff across the land or infiltration of pollutants into the groundwater.

Often nonpoint source problems require treating and controlling pollution runoff from large areas. Treatment and control are accomplished through what are known as best management practices (BMPs). BMPs are often specifically adapted to a particular location and problem. Examples include improving farming practices, reclamation of abandoned mines, installation of sediment ponds, and planting riparian buffers. A major function of the nonpoint source program is to identify the need for and initiate funding of BMP projects. In addition, since 2007, the nonpoint source program has been identifying improving waters to potentially delist from Category 5 (impaired waters requiring a TMDL) to Category 2 (waters attaining at least one use), and as a result 218 stream miles (total miles for all 4 uses) and 5,461 lake acres (total acres for all 4 uses) were identified as being restored and moved from Category 5 to Category 2 during the reporting cycle.

The NPS program works with the TMDL program. A TMDL model outputs a load reduction of a pollutant, such as sediment or phosphorus. For example, a sediment load reduction must be achieved to meet water quality goals, and the reductions are achieved through the use of nonpoint source BMPs. The NPS program provides technical assistance, education, and funding necessary to put the BMPs in place. Education is an important facet of the NPS program. It often takes a consortium of interested and active people concerned about their watershed to achieve NPS controls. The purpose and goals of the TMDL program are outlined following the section on the NPS program.

Growing Greener II funds were exhausted in 2009, however, multiple funding sources that include Section 319, Growing Greener I, USDA Farm Bill funds and Conservation Reserve Enhancement Program (CREP) funds are important to the success of nonpoint source controls and programs as illustrated in the Part B narrative. In 2014 and 2015, these programs funded numerous BMP and restoration projects.

The combined efforts of the NPDES and NPS programs to identify and correct problems have resulted in many water quality improvements. In 2007, DEP began an ongoing process of identifying areas where restoration efforts were underway and targeting them for monitoring. When monitoring indicates the waters are restored, Department biologists document the improvements and remove the problem from Category 5 of the List and place it in Category 2. Fifteen such sites were identified and sampled in 2014/2015.

Part C is the Surface Water Quality Monitoring and Assessment discussion. It begins with a discussion of the Water Quality Standards Program that includes water uses, water quality criteria, and Pennsylvania’s Antidegradation Program.

The next three sections discuss monitoring programs including intensive surveys, ambient fixed station monitoring at Water Quality Network (WQN) sites, and lake monitoring.

The Department no longer has a dedicated Citizen Volunteer Monitoring Program; however, the Department still values citizen volunteer monitoring as an important activity with the goal of working with interested groups on projects that generate quality assured data related to DEP’s highest priorities. Ongoing projects include bacteria sampling with the intent of assessing streams for recreational use and monitoring the effects of restoration efforts with the intent of tracking the improving water quality of streams and lakes.

EPA's Integrated Listing guidance requires states to gather and use all existing and readily available data generated by sources outside DEP. This data must meet quality assurance and procedural guidelines outlined by DEP. Data solicitations were sent to over 475 outside sources in an effort to satisfy this requirement.

The Assessment and Listing Methodology is a collection of protocols used to conduct field surveys and evaluate information for assessments. These protocols are the basis for the streams and lakes information contained in the Integrated Report narrative and the five-part list. These protocols were subjected to peer review. Before being adopted, the entire methodology was made available for public review during the spring of 2009, fall of 2013, and fall 2015. The methodology is lengthy, and as a result, is reported separately from this narrative and is available on DEP's website.

The next several sections present detailed tables summarizing stream and lake use support. These tables formed the basis for the discussions presented at the beginning of the Executive Summary. The lakes section also contains discussions on restoration and control efforts. Some funding is available from DEP to restore and/or protect lakes. DEP's Rules and Regulations at Section 96.5(b) - Discharges to Lakes, Ponds, and Impoundments, sets forth the obligation to control eutrophication by developing a TMDL that addresses both point and nonpoint source loads. Section C ends with an overview of wetlands that describes the types of wetlands found, DEP's jurisdiction and responsibility to protect wetlands, and other wetland-related activities.

Finally, Part D provides an overview of the groundwater program including assessment activities and wellhead and source water protection. Groundwater quality monitoring began in the mid-1980s but has been sporadic and limited because of resource constraints. Through a new collaborative effort with the U.S. Geological Survey, groundwater quality monitoring efforts are expanding to other parts of the state, particularly in the shale gas areas.

PART A: INTRODUCTION

This report is the twenty-third in a series of reports prepared in response to Section 305(b) of the federal Clean Water Act that requires states to provide an assessment of water quality. These reports are prepared on a biennial basis.

DEP uses an integrated format for Clean Water Act Section 305(b) reporting and Section 303(d) listing. The "2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report" satisfies the requirements of both Sections 305(b) and 303(d). The narrative that follows contains summaries of various water quality management programs including water quality standards, point source, and nonpoint source controls. It also includes descriptions of programs to protect lakes, wetlands, and groundwater quality. A summary of the use support status of streams and lakes is also presented in the narrative report.

In addition to this 305(b) narrative, the water quality status of Pennsylvania's waters is presented using a five-part characterization of use attainment status. The listing categories are:

<u>Category 1</u>: Waters attaining all designated uses.

<u>Category 2</u>: Waters where some, but not all, designated uses are met. Attainment status of the remaining designated uses may be unknown because data are insufficient to categorize the water for these other uses or it may be impaired.

<u>Category 3</u>: Waters for which there is insufficient information to determine if designated uses are met.

<u>Category 4</u>: Waters impaired for one or more designated uses but not needing a total maximum daily load (TMDL) or a TMDL is completed and approved. These waters are placed in one of the following three subcategories:

- *Category 4A*: TMDL has been completed.
- *Category 4B*: Expected to meet all designated uses within a reasonable timeframe.
- *Category 4C*: Not impaired by a pollutant and not requiring a TMDL.

<u>Category 5</u>: Waters impaired for one or more designated uses by any pollutant and requiring the development of a TMDL. Category 5 includes waters shown to be impaired as the result of biological assessments used to evaluate aquatic life use. Category 5 constitutes the Section 303(d) list EPA will approve or disapprove under the Clean Water Act.

- *Category 5alt*: Waters impaired for one or more designated uses by any pollutant that have been selected for water quality standards restoration through alternatives to TMDLs. These impaired waters remain on the 303(d) list until water quality standards are achieved or a TMDL is developed.

Each waterbody must be assessed for four different statewide uses as defined in DEP's rules and regulations at 25 Pa. Code Chapter 93 (Water Quality Standards) in Section 93.3 Protected Water Uses. The four include Aquatic Life, Water Supply, Fish Consumption, and Recreation. Generally, Aquatic Life pertains to maintaining flora and fauna indigenous to aquatic habitats; Water Supply relates to the protection of ambient water quality for possible use as a potable water supply; Fish Consumption protects the public from consuming tainted fish; and Recreation relates to water contact and boating. Each use may have different water quality criteria for individual chemical constituents and each use requires a different type of stream or lake assessment.

DEP encourages the use of the Internet to view the Integrated Report documents electronically on its website at http://www.dep.pa.gov (Search: "Integrated Report"). Because of the size of the five-part list, it will only be available electronically.

PART B: BACKGROUND

Part B1. Total Waters

Table 1
Atlas of Surface Waters in Pennsylvania

The following information is presented to provide a perspective on Pennsylvania's water resources:

State Population	12,787,209†
State Surface Area (square miles)	45,333
Number of Water Basins (major basins)	6
Total Miles of Rivers and Streams	86,000*
Number of Lakes/Reservoirs/Ponds** -Number of Significant, Publicly Owned Lakes (subset)	3,956 228
Acres of Lakes/Reservoirs/Ponds** -Acres of Significant, Publicly Owned Lakes (subset)	161,445†† 109,646
Square Miles of Estuaries/Harbors/Bays -Delaware Estuary -Presque Isle Bay	 17 6
Miles of Great Lakes Shore	63†††
Acres of Freshwater Wetlands	403,924
Acres of Tidal Wetlands	512

† 2015 US Census estimate
†† Lakes and ponds greater than two acres
††† Lake Erie - Fourteen miles comprise the Presque Isle Peninsula.
* DEP estimate based on 1:24,000 scale National Hydrography Data (NHD) GIS stream coverage. This 86,000 may change as the NHD is quality assured and corrected.
** "Total Water Estimates for United States Streams and Lakes", EPA, August 1993

Part B2.1. Pollution Prevention and Energy Efficiency Program

DEP recognizes the value of multi-media pollution prevention, resource conservation, and efficiency in providing environmental protection. Not only does preventing pollution create a healthier, more sustainable environment, it also saves money, contributing to a stronger economy. Programs throughout DEP are built upon the premise that not generating waste is preferable to handling waste after it is generated.

DEP's pollution prevention programs help citizens, government, and businesses move beyond compliance-based, "end-of-pipe" thinking to encourage people to focus on preventing pollution before it is created, effectively reducing adverse environmental impacts. The Office of Pollution Prevention and Energy Assistance (OPPEA) manages and administers programs for helping small businesses, industry, government, and schools to better manage their environmental impacts, reduce energy usage, and save money. Some major focus areas of OPPEA are financial and technical assistance, encouraging harnessing of indigenous energy, and promoting energy efficient technologies and green buildings.

The Small Business Pollution Prevention Assistance Account (PPAA) Loan Program provides low-interest loans to small businesses undertaking projects (located within the Commonwealth of Pennsylvania) that reduce waste, pollution, or energy use. Loans will be used to fund 75% of the total eligible project cost. The maximum loan amount is $100,000 within any 12-month period. Small businesses with 100 or fewer full-time employees are eligible. The loan has a fixed interest rate of two percent and a maximum loan term of 10 years. This funding can help small businesses comply with environmental regulations while receiving the economic benefits of preventing pollution and using energy more efficiently.

The Small Business Advantage Grant Program (SBAGP) provides 50% reimbursement grants up to $9,500 to support eligible projects for eligible businesses. Each eligible business may only receive $9,500 per fiscal year (FY). The SBAGP provides reimbursement grant funding to promote the pollution prevention and energy efficiency practices of small businesses. Businesses must reduce or save at least 25% of annual energy consumption or pollution-related expenses and $500 annually as a direct result of implementing the grant-supported project. During FY2013 Advantage issued 125 grants worth $904,467 that leveraged $3,837,773 of private sector funding. During FY2014 Advantage issued 130 grants worth $848,704 that leveraged $1,975,633 of private sector funding.

DEP's contractor, the Pennsylvania Technical Assistance Program (PENNTAP) is working on projects that are focused on economic development, improved energy efficiency, and waste reduction. Since July 2011, PENNTAP has provided technical assistance for nearly 122 facilities in the form of on-site support activities. For the period from July 1, 2014, through June 30, 2015, waste and energy use-reduction assessments were performed at 37 industrial facilities. The assessments included 27 targeted and ten ISO 50001 gap assessments. The PA Strategic Energy Management Showcase was hosted by Penn State at the Penn Stater Conference Center in State College on April 7, 2015. The event was planned to showcase the successes of six companies in Pennsylvania and one in New Jersey that over the past few years have been trained and mentored by PennTAP in the implementation of the requirements of the ISO 50001 Energy Management Standard and the Superior Energy Performance (SEP) standards in order to achieve third party certification. Approximately 90 attendees and nine exhibitors participated in the event. DOE presented five SEP certified companies with certificates and acknowledged the two ISO 50001 certified companies.

The Pennsylvania Energy Development Authority (PEDA) is an independent public financing authority created to finance clean, advanced energy projects in Pennsylvania. In October 2014, nearly $12.5 million in PEDA grants were awarded to 28 local governments, schools and businesses for projects such as the installation of solar arrays, replacement of old heating units and street lights with more energy efficient models, and the use of biogas from wastewater systems for industrial power and heating needs. Two projects of particular note with direct water quality impacts are anaerobic digester projects. Knouse Foods, Adams County, will install a 1,200 kW Combined Heat and Power (CHP) system to utilize the biologically derived methane biogas to generate electricity, steam, and hot water to benefit both Knouse Foods and surrounding community by significantly lessening its demand from the electric grid. Solid waste reductions are estimated at 7,540 tons/year. Water pollutant reductions are estimated at 68,689 lbs/year of nitrogen and 3,647 lbs/year of phosphorus. Nicholas Meats LLC, Clinton County, will install an anaerobic digester system in order to more effectively manage the wastewater flow, control odors, and produce biogas to offset propane purchases for hot water heating and steam production. This project will anaerobically treat a total of 36,500,000 gallons per year of wastewater and reduce as much as 7,600 tons of food waste.

Part B2.2 (a). NPDES – Sewage and Industrial

Pennsylvania implements the EPA-delegated point source National Pollutant Discharge Elimination System (NPDES) program through DEP's six regional field offices and six district mining operations offices. While program development and evaluation occur in DEP's central office, the field offices and district mining offices conduct site-specific permitting, monitoring, compliance, and enforcement activities. The central office also provides specialized assistance in the areas of policy, regulatory development, complex permitting, safety training, treatment plant operations, enforcement, and data management.

The Toxics Management Strategy provides a consistent statewide approach for addressing EPA priority pollutants and other toxic substances in the NPDES program. The strategy, parts of which are codified in Chapter 16, Water Quality Toxics Management – Statement of Policy, is a supporting document to DEP's toxics regulations, 25 Pa. Code Section 93.8a-93.8c of the rules and regulations.

In state fiscal years 2014 and 2015 (July 1, 2013 – June 30, 2015), field office staff issued the following numbers and types of NPDES permits: 779 new, 2,092 renewals, and 372 amendments for municipal or private sewage treatment plants, industrial waste discharges, Concentrated Animal Feeding Operations (CAFOs), industrial stormwater discharges, and municipal separate storm sewer systems (MS4s).

Water Quality Management (WQM) permits authorize the construction and operation of sewage collection and conveyance systems and sewage and industrial wastewater treatment facilities. The field offices issued 1,514 WQM permits and permit amendments for sewage and industrial waste treatment plants in state fiscal years 2014 and 2015.

Permitting summaries for other programs follow later in the document.

Part B2.2 (b). Compliance and Enforcement

The DEP point source control program regulates approximately 10,500 sewage and industrial dischargers in Pennsylvania. Approximately 408 of these are considered major dischargers based on EPA criteria. DEP field offices maintain a staff of field inspectors, hydrogeologists, biologists, compliance specialists, supervisors, and managers to conduct activities including inspections of both NPDES and non-NPDES wastewater treatment facilities, emergency response, investigation of pollution incidents and complaints, and routine stream monitoring.

Approximately 12,600 facility inspections were conducted during state fiscal years 2014 and 2015. Generally, if environmental damage or willfulness is not involved in violations, an attempt is made to obtain voluntary compliance. In more serious situations, criminal, civil, or administrative actions may be used. DEP field offices completed approximately 2,600 such actions in state fiscal years 2014 and 2015, resulting in approximately $3.2 million in penalties.

DEP's Outreach Assistance Provider Program conducted on-site training for wastewater treatment plant operators through 2009. Due to budget cuts, this program was ended in 2009.

Permanent funding for the program was included in the fee package for the implementation of the Drinking Water and Wastewater Systems Operator Certification Program. As a result, this program is now in the process of restoring the wage payroll positions that were lost in 2009. The program should be able to provide this service again in the very near future. The priority for this program will be enhanced process control through on-site training of certified operators, resulting in improved compliance with permit requirements.

Tracking of data on effluent quality for major dischargers is accomplished through EPA's Integrated Compliance Information System (ICIS). There has been an ongoing effort to enhance the compliance monitoring program by automating the input of effluent limits data and discharge monitoring data to ICIS. In 2007, DEP implemented an electronic Discharge Monitoring Report (DMR) system to store monitoring data as well as a data system called the NPDES Management System (NMS) to store permit information. These systems have significantly increased the number of data elements that are electronically available.

At this time, DEP is electronically transferring the following data from its Environment, Facility, Application, Compliance Tracking System (eFACTS) enterprise data system, NMS, and eDMR system to EPA's ICIS system:

- Permit action and facility data for all NPDES facilities, as updates occur;
- Permit limits and monitoring requirements for Major NPDES facilities;
- Compliance inspections for all NPDES facilities;
- Discharge Monitoring Report (DMR) data for Major and Significant Chesapeake Bay facilities; and
- Enforcement actions for all NPDES facilities.

There are several checks and balances in place to ensure the quality of self-monitoring data. Since 2006, DEP's Bureau of Laboratories (BOL) has been responsible for oversight of all environmental labs. BOL provides a year-end report to EPA with details and accreditation information. In addition, field inspectors review information and self-monitoring data during surveillance activities and follow up as appropriate.

Part B2.2 (c). Mining

District mining operations offices, under the direction of DEP's Bureau of Mining Programs (BMP), issue NPDES discharge permits for active mining operations. During federal FY 14 and FY 15, the following new permits were issued: 26 Government Financed Construction Contract (GFCC), two prep plant, 77 coal surface, ten coal underground, six coal refuse reprocessing, two coal refuse disposal, and 30 industrial mineral surface permits. In addition, the following reissuances were approved for expiring permits: 14 prep plant, 334 coal surface, 40 coal underground, 45 coal refuse reprocessing, 17 coal refuse disposal and six industrial mineral surface permits. Permit coverage under the General Permit for Stormwater associated with mining activities was approved for 119 industrial mineral and 81 coal mining operations.

Part B2.2 (d). Oil and Gas

Permits

An up-to-date summary of oil and gas permitting activity can be found at the following Website: http://www.dep.pa.gov (Search: "Oil and Gas Reports").

Erosion and Sediment Control General Permit (ESCGP-2)

This permit mandates protection of waterways and watersheds from sediment runoff during construction disturbing five acres or more over the life of an oil- or gas-related project.

DEP will no longer offer expedited review of permit applications for projects that have the potential to discharge sediment and runoff to exceptional value or high quality watersheds, have well pads that lie within floodplains, or would take place on contaminated lands. The agency may also revoke licensed professionals' ability to request expedited permit reviews if they routinely submit applications for coverage under the general permit that have administrative or technical problems.

For permit applications that do qualify for the expedited review process, DEP will complete its review and return a decision within 14 calendar days from the submission of a complete and accurate application. If the application is submitted for a standard review, staff will complete the review within 60 calendar days.

Oil and Gas operators are required to implement best management practices for erosion and sediment control, stabilize all areas where earth disturbance is conducted, and manage post-construction stormwater rate and volume. When submitting a notice of intent to construct, oil and gas operators must also demonstrate that their post-construction stormwater management plans are consistent with county stormwater management requirements. Operators must also restore a well site within nine months of completion of drilling of the well.

TENORM Study (Technologically Enhanced Naturally Occurring Radioactive Material)

In January 2013, DEP announced it would undertake a study to assess levels of naturally occurring radioactivity in the by-products associated with oil and natural gas development. DEP began studying radioactivity levels in flowback waters, treatment solids, and drill cuttings, as well as transportation, storage, and disposal of drilling wastes. This effort included a study of radon levels in natural gas to ensure that public health and the environment continue to be protected.

On April 4, 2013, DEP released a detailed project scope and sampling and quality assurance plan for this comprehensive study.

On January 15, 2015, DEP announced the results of its TENORM Study, which analyzed the naturally occurring levels of radioactivity associated with oil and natural gas development in Pennsylvania. While the study outlines recommendations for further study, it concluded there is little potential for harm to workers or the public from radiation exposure due to oil and gas development.

The study report is the culmination of a multi-year effort and represents what is considered the most comprehensive radiological study of the oil and gas industry ever conducted in Pennsylvania. While the recommendations for future actions contained in the report call for additional studies and efforts, the Department now has data to inform the management of natural gas resources and resultant wastes for environmental and health protection.

<u>Water Resources and Wastewater Disposal</u>

Recycling of flowback and produced water from unconventional wells for new hydraulic fracturing operations reduces the amount of water to be withdrawn from freshwater sources in Pennsylvania and reduces the amount of wastewater for disposal or treatment. Act 47 enacted in 2015 encourages the use of treated mine water for hydraulic fracturing operations, which also reduces the amount of wastewater for disposal and treatment. Based upon the 2014 waste data submitted by the Oil and Gas Operators, nearly 90% of the flowback and produced water from unconventional wells has been recycled. This reduces the amount of water to be withdrawn from freshwater sources in Pennsylvania and reduces the amount of wastewater for disposal or treatment.

In 2014, DEP continued to implement their policy of promoting the voluntary use of mine influenced waters by the oil and gas industry and establish a framework by which mine influenced waters can be used for natural gas extraction. The use of these waters by the gas extraction industry helps to protect streams and makes water resources available for other uses.

Part B2.2 (e). Municipal Stormwater Discharge Permits (MS4s)

The 1990 Phase I federal stormwater regulations require NPDES permits for discharges of stormwater from certain municipalities and sites associated with certain industrial activities. Initially, there were four Pennsylvania cities (Philadelphia, Pittsburgh, Allentown, and Erie) on EPA’s list of municipalities needing permits for stormwater discharges from their Municipal Separate Storm Sewers (MS4s). Later, Pittsburgh and Erie were exempted from the stormwater Phase I permitting requirements, because large areas of those cities were served by combined sewers, and the discharges were covered by permits for the wastewater treatment plants. Phase I MS4 permits for stormwater discharges were issued to Philadelphia and Allentown.

The Phase II federal municipal stormwater regulations were published by EPA on December 8, 1999. Approximately 850 municipalities and other entities with federally-defined urbanized areas received municipal separate storm sewer system (MS4) general permits that initially became effective in March 2003. Those initial permits were administratively extended a number of times, expiring in March 2013. A second permit became effective for the period March 2013 through March 2018. Notice of the availability of a draft 2018 permit was published in the *Pennsylvania Bulletin* on May 30, 2015. The draft permit was issued as final on June 30, 2016.

Part B2.2 (f). Construction Stormwater and Urban Runoff

This category includes two major subcategories: highway construction and new land development including residential, industrial, commercial, institutional, and recreational construction. Uncontrolled runoff from these sites has the potential to cause significant soil erosion and localized sediment pollution in streams.

The Erosion and Sediment Control (E&S) regulations found at 25 Pa. Code, Chapter 102 describe the requirements for controlling accelerated erosion and preventing sediment pollution from various earth disturbance activities. The purpose of Chapter 102 is to protect surface waters of the Commonwealth from sediment and stormwater pollution by requiring the use of BMPs that minimize accelerated erosion and sedimentation and manage post-construction stormwater runoff, both during and after earth disturbance activities. Since 1972, earth disturbance activities related to agricultural plowing and tilling have also been regulated under this Chapter by requiring persons to develop, implement, and maintain BMPs.

On December 21, 2014, Act 162 became effective. Act 162 amended the Pennsylvania Clean Streams Law to remove the mandatory riparian buffer requirement in Chapter 102 while providing NPDES permit applicants the option of proposing and implementing BMPs equivalent to riparian buffers on the project site. Additionally, Act 162 requires offsetting of riparian buffers for projects located in special protection watersheds and proposing earth disturbance within 100 feet of a surface water.

In December 2014, PA DEP published as interim final the Act 162 Implementation Plan in the *Pennsylvania Bulletin* for a 60-day public comment period concluding on February 18, 2015. Two additional technical guidance documents were published in the *Pennsylvania Bulletin* as interim final in March 2015, the Riparian Buffer or Riparian Forest Buffer Equivalency Demonstration and the Riparian Buffer or Riparian Forest Buffer Offsetting Demonstration. The 60-day public comment period for these two documents concluded on May 20, 2015.

Standards and criteria for minimizing erosion and preventing sediment pollution, as well as post-construction stormwater management (PCSM), are contained in Chapter 102 rules and regulations. The erosion and sediment control requirements apply to any earth disturbance activity, including land development and road, highway, or bridge construction. Requirements for control measures and facilities are written to utilize best management practices, primarily by establishing design and performance standards. The PCSM requirements are mandatory when permit coverage under Chapter 102 is necessary.

DEP’s inclusion of PCSM into the Chapter 102 regulations emphasizes the mimicking of natural runoff conditions from stormwater runoff generated by development and other activities requiring permit coverage by minimization of impervious cover, use of low impact development designs, and use of innovative stormwater BMPs that provide infiltration, water quality treatment, and otherwise more effectively manage the volume and rate of stormwater discharges. DEP’s Pennsylvania Stormwater Management Best Management Practices (BMP) Manual provides the design standards and planning concepts to guide local authorities, planners, land developers, contractors, and others involved with planning, designing, reviewing, approving, and constructing land development projects. Currently, the Pennsylvania Stormwater Technical Workgroup, an independent partnership, is identifying potential BMP Manual revisions and recommendations to DEP.

DEP finalized revisions to the Erosion and Sediment Pollution Control Program Manual (Manual), DEP Document No. 363-2134-008, in March 2012. The Manual includes specific guidance, performance requirements, and design criteria to support the implementation of the

Department's water quality regulatory requirements for erosion and sediment control as provided in Title 25, Chapter 102, Section 102.11(a)(1), including antidegradation provisions.

DEP and county conservation districts jointly administer the issuance of NPDES permits for stormwater discharges associated with construction activities. During state fiscal years 2014 and 2015, conservation districts received, reviewed, and acknowledged 4,154 Notices of Intent (NOI) for coverage under the statewide general permit. Conservation districts also received, reviewed, and made recommendations to DEP for the authorization of 577 individual NPDES permits for stormwater discharges from construction activities. For oil and gas transmission lines, conservation districts authorized 107 Notices of Intent for ESCGP-2 permits. In addition, conservation districts conducted 24,492 compliance monitoring inspections at permitted and non-permitted sites. Conservation districts also conducted 3,615 complaint investigations, in addition to routine compliance inspections.

Part B2.2 (g). Combined Sewer Overflows

Combined sewer overflows (CSOs) to waters of the Commonwealth are considered point sources subject to NPDES permitting, compliance, and enforcement requirements. EPA has been regulating CSOs through the 1989 and 1994 national CSO policies that require each NPDES delegated state to develop and implement a state CSO control policy. Under Pennsylvania's policy, DEP conducts or provides for appropriate follow-up actions, including compliance monitoring, compliance actions, permit renewal, plan reviews, field inspections, water quality monitoring, and enforcement as necessary to promote the development and implementation of Nine Minimum Controls (NMCs) and the Long Term Control Plan (LTCP) at each CSO facility. LTCP milestones are placed in NPDES permits with dates for completing them. DEP has continued to place a high priority on the permitting and inspection program to deal with requirements for implementation of NMCs and LTCP.

Part B2.3 (a). Nonpoint Source Control Program

Pennsylvania's Nonpoint Source (NPS) Program was developed in response to Section 319 of the federal Clean Water Act and the Pennsylvania Clean Streams Law to address problems caused by nonpoint sources, such as the overland flow of stormwater or infiltration of pollutants into the groundwater. The three main sources of nonpoint runoff resulting in degraded water quality in Pennsylvania are agriculture, abandoned mine drainage, and urban runoff. Other sources include abandoned oil and gas wells, construction activities, land disposal, habitat modification, hydromodification, and silviculture (logging practices).

The development of an implementation, or restoration, plan begins with a more detailed assessment of a watershed. The detailed assessment includes an analysis of the known water quality, identification of quantities and locations of pollutant and pollution sources, and selection of priorities for corrective action. It concludes with a description of the management measures needed to restore and maintain water quality, and it provides for public input concerning water quality problems and the restoration measures needed. The result of these activities is a management plan that includes the goals and objectives for improving water quality, an estimate of the technical and financial resources needed to implement the plan, an education program, and monitoring to demonstrate the success of the plan. The document also includes a budget and a timetable for implementation that identifies interim milestones. DEP will encourage local groups, watershed associations, or county conservation districts to take the lead and/or play an active role in completing detailed assessments and developing the implementation plan. Grant monies from the CWA Section 319 Nonpoint Source Program and the Commonwealth's Growing Greener program can be used to complete these assessments. The final plan should meet the objective set in the TMDL.

The Clean Water Act requires each state to prepare a Nonpoint Source Management Program (Management Plan) for its nonpoint source program. This Management Plan outlines the program components to be used to address nonpoint source problems including a variety of non-regulatory, financial, and technical assistance programs needed to improve and maintain surface and groundwater quality. Pennsylvania has recently completed a 2014 update to the Management Plan.

Pennsylvania has received more than $112 million from the federal Section 319 Grant Program (FY 1990-2015). This money has been used to institutionalize a nonpoint source program, implement various innovative technologies to treat nonpoint source pollution problems, develop an educational program, and complete a large number of watershed initiatives. Other funding sources for nonpoint source pollution management include Pennsylvania's Chesapeake Bay Program, the Nutrient Management Act, the County Conservation District Assistance Funding Program, the Stormwater Management Act Fund, the Coastal Zone Resources Program, USDA's Environmental Quality Incentives and Conservation Reserve Enhancement Programs, and the Environmental Stewardship and Watershed Protection Grant, also known as Growing Greener.

Growing Greener has provided $363.6 million in watershed grants since 1999. The funding is being made possible through a $4.25-per ton tipping fee on solid waste disposed of in Pennsylvania's municipal waste landfills. The tremendous value of the program became clear to legislators, and Growing Greener funding was extended under Act 24 of 2010 through 2020. Passage of Act 13 of 2012 added drilling impact fees as an additional revenue source for the Environmental Stewardship Fund.

Monitoring of both land treatment and water quality for a five- to ten-year period is the best way to document the effectiveness of nonpoint source pollution control efforts. Pennsylvania has hosted 4 of the 24 EPA Section 319 National Monitoring Projects (NMP) across the country. Pennsylvania NMPs include the Swatara Creek NMP, monitoring the effect of passive treatment on abandoned mine drainage; the Stroud Water Research Center NMP, monitoring a riparian buffer project in an agricultural watershed; the Pequea and Mill Creek NMP, using a paired watershed approach to monitor the effectiveness of agricultural best management practices (BMPs); and the Villanova Urban Stormwater BMP demonstration site, monitoring a suite of innovative stormwater management practices.

Four watersheds in Pennsylvania were awarded EPA Targeted Watershed Grants: the Dunkard Creek Watershed, Christina River Basin Initiative, Upper Susquehanna River Basin Restoration, and Schuylkill River Watershed Initiative. The Targeted Watershed Grant is an EPA program designed to encourage successful community-based approaches and management techniques to protect and restore the nation's waters.

The Conewago Creek watershed, in Dauphin, Lebanon, and Lancaster Counties, has been identified by the USDA Natural Resources Conservation Service as one of the three selected Showcase Watersheds within the Chesapeake Bay drainage area. Showcase Watersheds are designed to show what can be accomplished by bringing people and groups together to solve natural resource problems in a targeted area. With this designation, the watershed receives priority consideration when allocating funding for BMP implementation and technical assistance.

Three watersheds in Pennsylvania have been selected for focused agricultural NPS work through the National Water Quality Initiative (NWQI). The NWQI is a joint effort between the USDA Natural Resources Conservation Service (NRCS) and EPA to provide intensive BMP implementation on priority stream reaches in order to obtain local water quality improvement and stream segment restoration. The three watersheds involved in this program are the Upper Kishacoquillas Creek, the Upper Maiden Creek, and the Sacony Creek. Water quality monitoring activities are being funded by the NPS Program to document the changes observed in these streams due to the focused BMP implementation work.

Part B2.3 (b). Highlights of Pennsylvania's Current NPS Program

Education and Outreach

One element of the Section 319 Grant Program involves projects fully or partially directed towards NPS education and outreach. Two initiatives funded through the Section 319 Grant Program that are directed entirely at education and outreach at the grassroots level include the Pennsylvania League of Women Voters (LWV) and the Pennsylvania Association of Conservation Districts (PACD). Using funds from the Section 319 Grant Program, the LWV Water Resources Education Network (WREN) supports 10 to 12 grants a year of up to $5,000 each to enable groups of local citizens and officials to build community support for water resource protection. PACD's NPS Pollution Prevention Educational Mini-Grant program provides funding of up to $2,500 each for approximately 30 projects a year. These projects include the development of audio-visual products, exhibits or models, production of special events, marketing tools, publications, actual stream reclamation projects, hands-on water studies, and educational workshops. Since 1999, the Growing Greener Program has provided over $12.1 million in grant funds to support the implementation of more than 260 education/outreach projects.

Building Capacity

DEP is working to establish a network of technical assistance providers to help watershed organizations effectively and efficiently achieve their watershed protection goals. These providers offer technical services to groups embarking on projects aimed at protecting and enhancing their local watersheds. Growing Greener, along with the 319 program, currently supports four technical providers.

Conservation district watershed specialists help local groups protect and improve their watersheds, provide expert advice to farmers and landowners for conservation practices, work with DEP regional staff, and help support local grant-funded restoration projects. There are now 67 Growing Greener-funded watershed specialists working in 66 of the state's 67 counties.

Pennsylvania’s Watershed Approach

Pennsylvania is committed to a watershed approach for water resource management. Locally managed and monitored watershed improvement projects are essential to enhancing, maintaining, and reclaiming the Commonwealth’s water resources.

More and more people are working to improve and protect Pennsylvania’s watersheds by learning about their watersheds and sharing that information with their neighbors, restoring water quality through hands-on projects, and planning for the future through water resources management.

DEP provides assistance to local groups planning to implement restoration measures in watersheds where one or more TMDLs have been identified. The goal is to help such groups develop implementation plans more expeditiously and in a manner that fully complies with EPA requirements for additional funding under the Section 319 Grant program.

Thirty-six watersheds across the state containing water bodies with water quality impairments caused by nonpoint source pollution have been targeted to have watershed-based implementation plans developed with funding from the Section 319 Grant program. One more plan is being prepared with other funds. The watershed-based plans identify the type, number, and an estimated cost of best management practices needed to eliminate water quality impairments. This work, in turn, qualifies local sponsors to receive Section 319 Grant program construction funds for restoration projects that implement the TMDLs.

Abandoned Mine Reclamation

Eliminating drainage from abandoned mines and restoring rivers and streams to a healthy state represent significant challenges. The vast majority of impacts result from mines and mining practices of the past, predating the 1977 federal Surface Mining Control and Reclamation Act (SMCRA).

It is estimated that in Pennsylvania, the cost of addressing all of the environmental impacts of mining activities prior to the passage of SMCRA will exceed several billion dollars. Therefore, it is unlikely that public funds alone will ever be sufficient to tackle this monumental set of problems. Considering the scope of the challenge and the resources required to mount a successful clean-up program, it is widely recognized that an active, cooperative partnership between involved citizens, academia, industry, and public agencies is essential to properly address acid mine drainage or abandon mine drainage (AMD).

Growing Greener has contributed significantly toward addressing AMD issues. The projected accomplishments of these grants include over 6,500 acres of abandoned mine reclamation and over 600 miles of stream improvements. In the past two years, Growing Greener funds have been used to treat over 7.4 MGD of AMD affected water by constructing or rehabilitating 29 components of treatment systems and reclaiming 3,375 feet of highwalls. Additionally, the Bureau of Abandoned Mine Reclamation awarded reclamation contracts using Growing Greener, State Capital Budget and Abandoned Mine Land (AML) Program funds aimed at reclaiming 1,211 acres of abandoned mine lands (560 acres in 2014 and 651 acres in 2015).

The Bureau of Abandoned Mine Reclamation (BAMR) continues to award contracts to reclaim abandoned mine sites in order to address health and safety hazards. Many of these projects also facilitate watershed restoration by reclaiming surface mines using alkaline addition techniques. BAMR's focus is to restore and remove polluted streams from the impaired streams list (Categories 4 and 5 of the Integrated Report). Funding for the programs comes from the AMD Set-Aside Fund, which receives 30% of PA's federal AML Title IV funds. Currently, there are seven active treatment plants operating and approximately 45 passive AMD treatment systems that were constructed by BAMR. Two more active treatment plants are in design with a third plant in the development stage. Additionally, eight passive treatment systems are in the design phase for rehabilitation within the next two years. Stream restoration work is done in Qualified Hydrologic Units as defined by the federal SMCRA.

The Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR) was formed in 1982 by six western Pennsylvania conservation districts. Today 24 county conservation districts make up WPCAMR. In 1996, the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) was formed covering 16 counties in the anthracite coal region and the northern bituminous region. Today EPCAMR represents a coalition of watershed organizations, reclamation partners, co-generation plants, the active anthracite mining industry, and regional non-profit organizations.

The goal of the coalitions is to provide leadership for building local watershed-based support and partnerships with grassroots organizations whose primary focus is abandoned mine drainage abatement and abandoned mine land reclamation.

An important event in the battle to address AMD occurred in December 2006 when the Abandoned Mine Lands (AML) Program was reauthorized in the final hours before Congress adjourned. The AML Reauthorization, which amends the 1977 SMCRA, extends the AML Program for at least 15 years and will triple the AML funding Pennsylvania receives from reclamation fees collected on every ton of coal produced. In the next 15 years, Pennsylvania should receive at least $1.5 billion to clean up Priority 1 and 2 AML sites. States can also set aside up to 30% of this funding to address AMD problems not associated with Priority 1 and 2 sites. This extra funding will increase the number of AML problems that can be remediated; however, it will not be enough money to address all of the problems in Pennsylvania.

The State's Section 319 Grant Program has also made a significant contribution toward correcting abandoned mine drainage (AMD) problems using passive treatment systems. A total of seven projects costing nearly $1.8 million to treat AMD through passive treatment were funded through this program in 2014 and 2015.

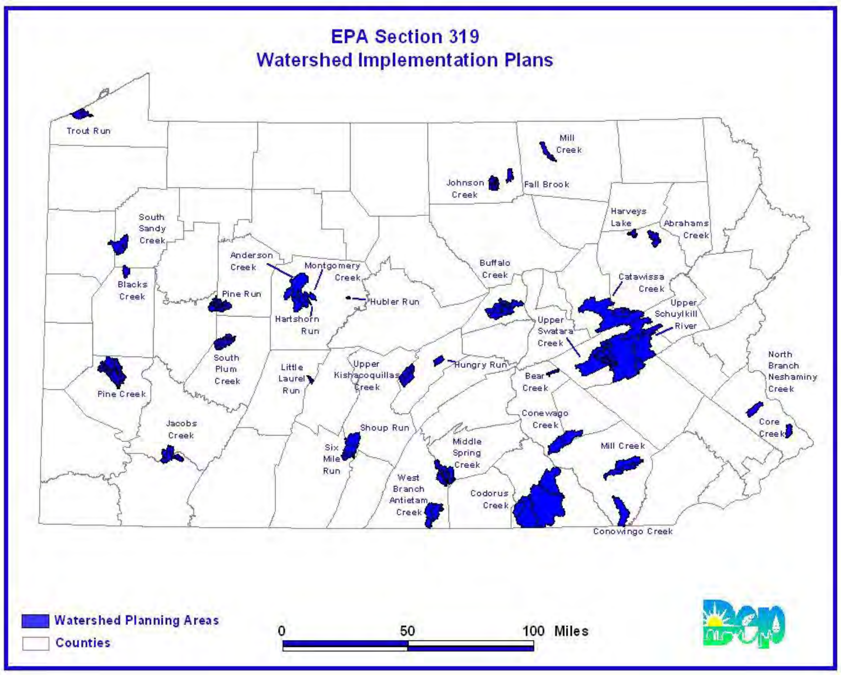
Organizations supported by Section 319 grants, the EPCAMR, WPCAMR, and Stream Restoration, Inc., are cooperating in inventorying and mapping AMD and AML features across the State, including abandoned mine lands, deep mine pools, and passive treatment systems.

Agriculture and Nutrient Management

Pennsylvania's Section 319 NPS Management Program provides significant financial and technical assistance resources to help reduce agricultural sources of sediment and nutrients to surface waters. Section 319 grants have provided $1.49 million in funding for six agricultural BMP implementation projects in 2014 and 2015.

Section 319 program agricultural projects are targeted to TMDL-approved watersheds with an approved Watershed Implementation Plan (WIP) or watersheds with 303(d) listed streams. Projects continue to be implemented in WIPs for agricultural NPS-impaired watersheds include Core Creek/Lake Luxembourg (Bucks County); Upper Kishacoquillas Creek (Mifflin); Conewago Creek (Dauphin); Mill Creek (Lancaster); Codorus Creek (York); Conowingo Creek (Lancaster); Mill Creek/ Stephen Foster Lake (Bradford); Hungry Run (Mifflin); and Buffalo Creek (Union). The figure below illustrates these agricultural WIP locations.

Figure 1
Map of Pennsylvania Watershed Implementation Plan watersheds.



The NPS Program website provides detailed information on WIPs and Pennsylvania's NPS Program at http://www.dep.pa.gov (Search: "Nonpoint Source"). Projects are being implemented in these watersheds to reduce impacts from nutrients, sedimentation/siltation, organic enrichment/low dissolved oxygen, and other causes of agricultural impairment. Program funds are used to develop and implement nutrient management and farm conservation plans and BMPs identified in these plans. Partnerships with the NRCS and county conservation districts assist with both plan and BMP implementation.

Nutrient Management Program

Pennsylvania's Nutrient Management Program (NMP), Act 38 of 2005, was revised as part of USDA's ACRE program initiative unveiled in 2004. Act 38 addresses all farms requiring the development of nutrient management plans. The Nutrient Management and CAFO programs coordinate efforts to ensure all farms are covered. The success of these programs is due to the partnership between the State Conservation Commission (SCC), PA DEP, PA Department of Agriculture, county conservation districts, private sector planners, and farm operators. Nutrient management planning revisions include the manure export requirements included in the CAFO program, along with additional phosphorus management, manure and soil testing, cover crop and residue minimums for ground cover, and riparian buffer requirements. A total of 937 Concentrated Animal Operations (CAOs), which are defined differently than CAFOs, were required to have NMPs for 2015, and an additional 993 voluntary NMPs were developed.

Concentrated Animal Feeding Operation Program

Pennsylvania's program is consistent with the federal EPA's CAFO rule. A major change under the revised program is the extension of CAFO permit coverage to a large portion of the state's poultry operations. With the new requirements including dry poultry and newly covered operations, total accepted applications rose from 170 CAFOs in March of 2006 to 371 as of March 31, 2015. DEP has delegated authority from EPA to implement the NPDES CAFO program and in 2008 completed the first update of its permits and forms. DEP is currently pursuing re-approval for its NPDES General Permit. The CAFO and nutrient management website includes a CAFO application review guidance document and is limited to NMP supporting materials. The CAFO website link is: http://www.dep.pa.gov (Search: "CAFOs"). DEP maintains an annual CAFO and CAO inspection goal in coordination with county conservation districts and assures all covered operations are following the program requirements.

Resources Enhancement and Protection Program

The Pennsylvania Resources Enhancement and Protection Program (REAP) was created through Act 55 of 2007. REAP allows farmers and businesses to earn tax credits in exchange for approved BMP implementation on agricultural operations that will enhance farm production and protect natural resources. Farmers receive tax credits of up to $150,000 per agricultural operation, covering 50% or 75% of the total cost of a BMP. Farmers also qualify for a 50% tax credit for no-till equipment purchase. REAP funding in 2013-2014 provided $10.4 million in tax credits that helped fund nonpoint source pollution control projects on 340 farms in 53 counties across the state. The nonpoint source control projects implemented with the assistance of REAP include the development of 136 Nutrient Management/Conservation/Manure Management Plans (Plans), 253 conservation equipment purchases, 67,000 feet of fencing, 15 livestock stream crossings, 35 off-stream watering facilities, and 54 water control structures. The State Conservation Commission administers REAP, and tax credits are granted through the PA Department of Revenue.

Conservation Reserve Enhancement Program

Pennsylvania's Conservation Reserve Enhancement Program (CREP) is funded through both the USDA-Farm Services Agency (FSA) and the DEP in the Susquehanna River and Ohio River basins. This voluntary initiative aids agricultural producers and other landowners in land preservation by decreasing erosion, restoring wildlife habitat, and safeguarding both ground and surface water. CREP continues to lead the nation in the number of acres enrolled in national Conservation Reserve Program. Total enrollment in the 59 counties of the CREP includes 12,546 landowners with contracts on 155,475 acres as of September 30, 2014. To date, FSA has provided $57,558,736 and DEP has provided $34,014,687 in cost share payments to CREP landowners. The original CREP contracts allowed for a potential maximum enrollment of 200,000 acres in the Chesapeake Bay area of PA and 65,000 acres in the Ohio River area of PA. In 2012, the CREP partners amended the existing contracts to increase the number of acres available in the Chesapeake Bay portion of PA from 200,000 to

219,746 acres. This was achieved by shifting 25,000 acres from the PA Ohio River CREP contract to the PA Chesapeake contract. This amendment is cost neutral and results in a slight decrease in the total number of acres due to the higher cost to enroll acres in some areas of the Chesapeake Bay drainage. The new total of available acres is 259,746 with 219,746 in the Chesapeake Bay and 40,000 in the Ohio River Basin. PA CREP will expand into seven counties within the Delaware River in 2016. The expansion will include the potential for 20,000 additional acres of conservation practices to bring the statewide total to 279,746 acres.

Natural Resources Conservation Service Programs

The Pennsylvania Office of the NRCS receives substantial funding through the federal Farm Bill for implementing conservation programs statewide and through the Chesapeake Bay Watershed Initiative (CBWI). The 2010 federal Farm Bill provided increased funding for PA NRCS agricultural conservation program implementation. Obligated funding for FY2014 totaled over $38.8 million. Funding was allocated to several program areas, including the Conservation Stewardship Program (CSP) $6.5 million, Environmental Quality Incentive Program (EQIP) $21.7 million, Grasslands Reserve Program $0.31 million, Agriculture Easement Program $8.48 million, Agricultural Management Assistance $1.08 million, and Healthy Forest Reserve Program $0.66 million. PA NRCS accomplishments are included on the PA NRCS website at www.pa.nrcs.usda.gov/programs/. CBWI priority watersheds and approved practices are included on the website at www.pa.nrcs.usda.gov/.

Environmental Stewardship and Watershed Protection Program

The Environmental Stewardship and Watershed Protection Act of 1999 (Growing Greener I) and the Watershed Stewardship Act 45 of 2005 (Growing Greener II) have funded many projects addressing nonpoint source pollution. Millions of dollars have also been invested through statewide efforts to implement nonpoint source BMPs through CREP, Chesapeake Bay Foundation initiatives, the PA Association of Conservation District Technical Assistance grants, and Conservation District Watershed Specialist staff. In 2014 and 2015, Growing Greener provided over $32.5 million in grant funds to 187 nonpoint source pollution abetment projects throughout PA. A complete summary of projects and funding provided is available on the DEP Grants Center website at http://www.dep.pa.gov (Search: “Growing Greener”).

Stream Corridor Protection and Restoration

Natural stream channel design addresses the entire stream system. It is based on fluvial geomorphology (FGM), which is the study of a stream’s interactions with the local climate, geology, topography, vegetation, and land use - how a river carves its channel within its landscape. All successful natural stream channel designs address sediment transport, habitat enhancement, and bank and channel stabilization. Natural stream channel design (NSCD) is relatively new to Pennsylvania. Our understanding of what works best to restore a channel’s natural stability is still evolving, particularly across a state as diverse in geography and land use as Pennsylvania. The Guidelines for Natural Stream Channel Design for Pennsylvania Waterways were developed with funding through a Section 319 grant by the Keystone Stream Team, an informal group comprised of government and environmental resource agencies, university researchers, sportsmen, citizen-based watershed groups, and private companies. These guidelines are aimed at watershed organizations and professionals involved in stream restoration design, construction, and permitting. The guidelines can be found at http://www.canaanvi.org/CVI/stream.html.

The Keystone Stream Team used a Section 319 grant to develop a web-based database for reference reach information collected on NSCD projects. A Section 319 grant also enabled the U.S. Geological Survey to develop Regional Curves. More information on both projects is available on the Keystone Stream Team's website at http://www.keystonestreamteam.org/. In addition, the 319 Grant Program and the Growing Greener program continue to provide funding for the implementation of stream restoration projects using NSCD.

Documenting Restored Waterbodies

Significant funding has been provided over the past several years from nonpoint source programs such as Growing Greener and Section 319 in support of stream and lake assessment, planning, and restoration activities. Hundreds of projects have been successfully completed. Those activities are beginning to show water quality improvements, but efforts to document them have generally been localized and inconsistent.

During 2007, DEP launched a continuing effort to identify waterbodies across the state in which significant improvements to water quality have been observed. Stream names and locations are solicited from DEP watershed managers, conservation district watershed specialists, and citizen volunteer monitoring groups. DEP biologists then survey these water bodies to determine the extent of their recovery and their potential to be removed from the State's impaired waters lists (Category 4 and 5 of the Integrated Report). Analysis of the survey results is on-going and changes to the Department's stream and lake assessments are made as they become available. DEP has identified to EPA removal of stream segments and lakes from Category 5 of the Integrated Report as the result of this process. As of 2014, these delisted stream segments add up to a total of 218 restored stream miles (total miles for all four uses) and 5,641 lake acres.

Many other waterbodies have shown improved water quality but have not improved enough to be removed from the impaired lists. As more nonpoint source funding is applied in these watersheds, it is anticipated that water quality will continue to improve and additional stream segments will be removed from impaired status.

Part B2.3 (c). Total Maximum Daily Load (TMDL)

Section 303(d) waters are those waterbodies that do not or will not meet water quality standards even after the application of all required technology-based treatment and other pollutant control requirements. DEP assesses Commonwealth waters and places waters impaired by pollutants in Category 5 of the Integrated Report. Impaired waters on Category 5 require the development of a TMDL. A TMDL is the amount of pollutant loading that a waterbody can assimilate and still meet water quality standards. A TMDL is the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety. DEP uses mathematical models to develop the TMDLs.

TMDLs are planning tools that set water quality objectives for impaired waters. Meeting the water quality objectives of the TMDL will result in the attainment of water quality standards.

TMDLs are developed for the sources and causes of impairment that are identified in Category 5 of the Integrated Report. Individual WLAs are the amounts of the load allocated to point sources. WLAs are the basis for setting water quality-based effluent limits in NPDES permits, which are the implementation procedures used to correct pollutant problems attributed to point source discharges. The LA portion of the TMDL is the amount of the load that is allocated to categories of nonpoint sources. The LAs may form the basis of future watershed restoration plans, which are often the first part of correcting nonpoint source pollutant problems.

Part B2.3 (d). CWA Section 303(d) Revisioning

Beginning with this Integrated Report (2016) the US EPA and states are launching a new vision for meeting the goals of CWA Section 303(d). The new vision includes 6 goals: Engagement, Integration, Protection, Prioritization, Alternatives, and Assessment. Detailed information regarding these goals and the new vision can be found on the US EPA website http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/programvision.cfm. The first of these goals to be implemented was Engagement and DEP has been reaching out to county and local government officials, watershed groups and other stakeholders in several watersheds in the Commonwealth. Since 2014, EPA has implemented Integration to EPA CWA programs and for 2016 along with the states will begin implementation of "Alternatives". To implement Alternatives, EPA has provided a new tool to achieve water quality standards in the form of Category 5alt. An alternative restoration approach is a near-term plan or description of actions, with a schedule and milestones, that is more immediately beneficial or practicable to achieving water quality standards. Obligations to develop TMDLs for Category 5 waters, including Category 5alt, remain unchanged as long as the waters remain listed on the Categories. Category 5alt will contain waterbodies to which states have assigned TMDL alternatives in order to restore waters to water quality standards.

To achieve these new goals, DEP is focusing on statewide siltation impairments for TMDL development or TMDL alternatives. The Department has selected 24 named watersheds across the Commonwealth to focus TMDL development and/or TMDL alternatives. Seven watersheds have been selected for new TMDL development with an additional watershed, Casselman River, requiring its existing TMDL be revised to accommodate recent watershed development activities. The Department has identified 17 watersheds where TMDL alternatives will be developed to restore water quality standards. However, as plans progress and more information becomes available anyone watershed may move from one process to the other. These watersheds are areas where state and local governments and watershed groups are actively engaged in activities to restore waters. Even though siltation is the focus, watersheds with other causes of impairment were also selected for prioritization because there were entities interested in working together to improve the watershed. Several watersheds have pollution impairments listed on Category 4C that do not require a TMDL, however, for waters selected for TMDL alternatives, these impairments are likely to be addressed through the alternative restoration plan. It should be noted that any of the 24 waters selected either for TMDL development or TMDL alternatives may ultimately be switched from one track to the other as a result of new information or lack of progress towards achieving water quality standards.

Below is the list of DEP's priority watersheds, the reasoning for their prioritization, and a map of their location within the Commonwealth (Figure 2). Under EPA's new vision, the goal for these watersheds is to set a plan that will work towards the achievement of water quality standards by 2022. Stepwise measurable improvement must be demonstrated through the years to show the work is on track to ultimately achieve water quality standards. This plan can involve the development of a TMDL, or layout the framework for a TMDL alternative, and those waterbodies can be found on Category 5alt.

The following watersheds have been prioritized for TMDL development and are found in Appendix H:

1. Kishacoquillas Creek (SC): Impaired for siltation and nutrients and is prioritized for TMDL development.
2. Irish Creek (SC): Impaired for siltation and is prioritized for TMDL development.
3. Whiteley Creek (SW): Impaired for siltation and is prioritized for TMDL development.
4. Stony Run (SW): Impaired for siltation and is prioritized for TMDL development.
5. South Branch South Fork Pine Creek (SW): Impaired for siltation and nutrients and is prioritized for TMDL development.
6. Casselman River (SW): Impaired metals and pH and is prioritized for TMDL development and revision. This watershed currently has an approved TMDL that needs revisions to accommodate watershed development activities.
7. Octoraro Creek (SC & SE): The watershed is impaired by nutrients and siltation. Large-scale monitoring was completed by DEP SCRO and SERO in 2015. This watershed has been prioritized for TMDL development.

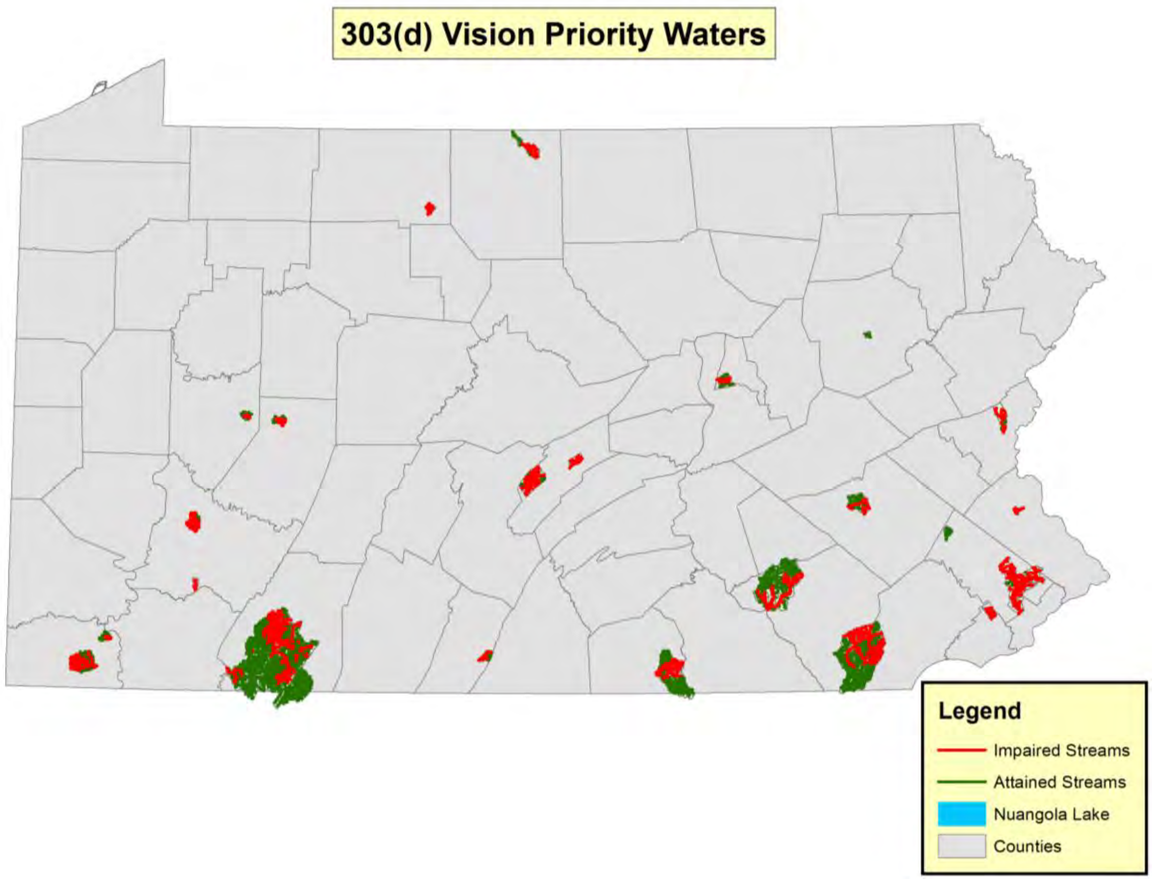
The following waters have been identified for the development of TMDL alternatives and are listed on Category 5alt:

1. Nuangola Lake (NE): The Lake is impaired for organic enrichment and low dissolved oxygen due to failing septic systems. An Act 537 Sewage Facilities Plan Update was developed for the Borough of Nuangola requiring sewage collection from the Borough and connection to the Mountaintop Area Joint Sanitary Authority to eliminate impacts to Nuangola Lake.
2. Little Bushkill Creek (NE): The Recreational Use impairment caused by pathogens was prioritized for this watershed. Plainfield Township initiated a Watershed Management Plan to help address this impairment in 2013 and has begun implementation.
3. Deer Run (SE): This is a small watershed impaired by nutrients and siltation from agriculture related activities. The watershed is currently being monitored and farm plans and BMPs are or will be developed.
4. Schlegel Run (SE): This is a small watershed impaired by siltation from agriculture related activities. The watershed is currently being monitored and farm plans and BMPs are or will be developed.
5. Wissahickon Creek (SE): This watershed currently has a sediment TMDL and a draft revised nutrient TMDL developed by EPA Region 3. EPA Region 3 in response to DEP has agreed to pursue a TMDL alternative for the nutrient impairment in the watershed. DEP SERO in cooperation with EPA Region 3 is working with watershed stakeholders that are interested in developing a TMDL alternative for nutrients.
6. Ithan Creek (SE): This watershed's siltation impairments are largely associated with Urban Stream Syndrome. The watershed is included in the William Penn Foundation's Delaware River Watershed Initiative/Upstream Suburban Philadelphia Cluster

Implementation Plan. This will provide funding for stormwater restoration and monitoring.

7. Genesee River (NC): This watershed's siltation and organic enrichment impairments are mostly related to agricultural activities. Ag BMPs have been implemented in the watershed.
8. Beaver Run (NC): This watershed is impaired for siltation and has had a lot of restoration work done such as streambank fencing, agriculture BMPs, and stream stabilization.
9. Hungry Run (SC): This watershed is impaired for siltation and nutrients and is currently being monitored by the Mifflin County Conservation District as part of the National Water Quality Initiative (NWQI). It has a 2008 Watershed Implementation Plan (WIP) and two major restoration projects were completed in 2015.
10. Spring Run (SC): This watershed is impaired for nutrients and siltation. The Fulton County Conservation District has been working with many farms implementing BMPs in the watershed since 2001.
11. Chiques Creek (SC): The TMDL for this watershed was withdrawn with EPA approval on October 28, 2015, and in its place, a TMDL alternative will be developed. A large scale monitoring and restoration plan is currently being implemented by DEP, SRBC, and watershed stakeholders.
12. South Branch Conewago Creek (SC): Impaired for siltation and is prioritized for a TMDL alternative. York County Conservation District has developed a county-wide pollutant reduction plan in cooperation with local governments and stakeholders. The implementation of this plan in the watershed will result in pollutant reductions in siltation and restore water quality.
13. Hamlin Run (NW): The stream is impaired by acid mine drainage (AMD) due to low pH and metals. The McKean County Conservation District received Growing Greener funds to develop a treatment system for the stream. This will raise the alkalinity and pH of the water.
14. Railroad Run (NW): The stream is impaired by acid mine drainage (AMD) due to low pH and metals. The McKean County Conservation District received Growing Greener funds to develop a treatment system for the stream. This will raise the alkalinity and pH of the water.
15. Shupe Run (SW): This watershed is impaired by metals and siltation related to AMD and received two EPA 319 grants. One focused on stream bank stabilization and restoration which was completed in 2013. The grant is ongoing for the construction of rain gardens, roof runoff collection, and installation of porous pavement at two residential areas.
16. Beaver Run (SW): This siltation impaired watershed received two Growing Greener funds: one to implement Ag BMPs on four farms and another that focuses on controlling sediment from dirt and gravel roads.
17. Ross Run (SW): This watershed is impaired for siltation. The Western Pennsylvania Conservancy received Growing Greener funds and conducted restoration focused on Ag BMPs, stream bank stabilization, and dirt/gravel roads. The work began in 2010 and was completed in 2015.

Figure 2
Map of 303(d) Vision Prioritized Waters.



PART C: SURFACE WATER QUALITY MONITORING AND ASSESSMENT

Part C1.1. Water Quality Standards Program

Water Quality Standards (WQS) are the combination of water uses to be protected, the criteria (i.e. levels of pollutants) that cannot be exceeded to maintain and protect the uses, and antidegradation requirements. WQS are important elements of Pennsylvania's water quality management program because they set the specific goals for the quality of our waters. WQS are instream water quality goals that are achieved by imposing specific regulatory standards, such as treatment requirements, effluent limitations, and best management practices.

Pennsylvania's WQS are found in DEP's rules and regulations at 25 Pa. Code Chapter 93 (Water Quality Standards). General or narrative criteria applicable to all waters are designed to control those substances not identified by specific criteria but which may be harmful to protected water uses or to human, animal, plant or aquatic life if present in excessive amounts. Numeric water quality criteria are contained in Chapter 93, including criteria for toxic substances identified as EPA priority pollutants, as well as other substances (available electronically at http://www.pacode.com/). Water quality standards implement the provisions of Pennsylvania's Clean Streams Law (35 P.S. Section 691.1 et seq.) and Sections 101 and 303 of the federal Clean Water Act (33 U.S.C.A. §§ 1251 and 1313).

Section 303(c) of the Federal Clean Water Act requires that "… the state shall from time to time (but at least once every three year period) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards..." The review and revisions to WQS are part of Pennsylvania's Continuing Planning Process and Water Quality Management Program. The development and review of WQS, and the complementary water quality assessment program, consider the fundamental policies that are set forth in state and federal law including the national goal to achieve "fishable/swimmable" waters.

Pennsylvania's most recent Triennial Review (TR13) included amendments to Chapter 93 to incorporate updated and revised water quality criteria for conventional pollutants and toxic substances. Other amendments include clarifications of terms and definitions, drainage list corrections, a review of waterbody segments that do not meet the fishable or swimmable uses, and other corrections of typographic, format, and grammatical errors. In addition, DEP adopted revisions to Chapter 16 for updates to the site-specific aquatic life and human health criteria and updates or corrections to the approved analytical methods. This triennial review of Pennsylvania's WQS was submitted to the US EPA Region 3 Administrator for review and approval on October 7, 2013, following adoption as final rulemaking at the April 16, 2013, Environmental Quality Board (EQB) meeting, and publication in the *Pennsylvania Bulletin* on July 20, 2013 (43 Pa.B. 4080). On May 22, 2014, EPA made a determination to approve the amendments to the program. However, the Department was informed, in this letter, that EPA will not be taking a CWA Section 303(c) action on the aquatic life criteria established for nonylphenol, in response to ongoing consultation with the US Fish and Wildlife Service, under Section 7(a)(2) of the federal Endangered Species Act.

The Antidegradation Implementation Guidance is designed to apply DEP's antidegradation regulation. The antidegradation policy, which applies to all waters, mandates the maintenance and protection of all existing uses and the maintenance and protection of existing water quality for High Quality and Exceptional Values waters.

In Pennsylvania, water uses that are protected statewide, except when otherwise specified in law or regulation, include Warm Water Fishes; Potable, Industrial, Livestock, Wildlife, and Irrigation Water Supply; and Boating, Fishing, Water Contact Sports, and Esthetics. Other uses, such as Cold-Water Fishes, Trout Stocking, High Quality or Exceptional Value waters, navigation, and others, are protected as applicable on a waterbody by waterbody basis.

Part C1.2. Plan for Achieving Comprehensive Assessments

Pennsylvania's plan for achieving comprehensive assessments includes the development of a variety of assessment methods for each of the protected uses, which are developed separately from the Integrated Report and are published to the DEP webpage. The assessment methods are subject to a public comment period that is completed before methods are posted as final and are revised and updated periodically as necessary. These methods are detailed in Section Part C2.1 Assessment and Methodology.

After completing the first-ever statewide aquatic life use assessment of the State's wadeable surface waters in April 2007, DEP replaced the original protocol with a more intensive assessment protocol for the second statewide aquatic life assessment. DEP's new plan for achieving comprehensive, statewide assessment of its surface waters is based on the implementation of the Instream Comprehensive Evaluation (ICE) program, which assesses aquatic life uses.

The ICE program is designed to assess the water quality of previously assessed streams using a more rigorous methodology. From 2006 through 2012, the monitoring program survey design included both probability based and targeted sampling within one major sub-basin in each of six DEP regions. Beginning in 2013, the monitoring program design was changed and is now based solely on targeted sampling. This design allows DEP staff to focus efforts on areas where the previous design identified potential use impairments for further assessment. DEP staff in the six regional offices and central office conduct assessments and identify priority monitoring areas each year and conduct surveys on a minimum of 75 sampling points in selected watersheds.

The ICE program uses an intensive biological assessment protocol that is a modification of EPA's Rapid Bioassessment Protocol (RBP) III method, which includes laboratory identification of benthic macroinvertebrates to genus level and an RBP habitat assessment. Each biological assessment results in an Assessment Summary for input to the 305(b) assessment database and GIS that identifies waters with obvious aquatic life use impairment and those with no obvious impairment. In addition to these stream assessment projects, a lake assessment element is also being implemented. Lake sampling efforts are described in the Lakes Water Quality Assessment section.

In 2006, DEP began a potable water supply monitoring program targeting the source waters for community water supplies in the Commonwealth to assess attainment of the potable water supply use (PWS). The monitoring protocol consists of the collection of multiple grab samples upstream of the point of withdrawal during the critical period when criteria violations are expected to occur. Water chemistry analysis is completed for 9 parameters of concern for drinking water. Analysis of collected samples according to the Chemical – Bacteriological Evaluations protocol results in an Assessment Summary for input to the 305(b) assessment database and GIS that identifies waters with obvious potable water use impairments and those with no obvious impairment. Because approximately 99% of permanent community PWS surface water sources had been monitored and assessed through 2013, a reassessment of previously assessed waters began in 2014.

In addition to the Aquatic Life and Potable Water Supply use assessments, DEP employs a Bacteriological Sampling Protocol to assess surface waters for water contact recreational use during the swimming season. DEP staff and citizen volunteers collect a minimum of five samples within a 30-day period. The samples are analyzed within eight hours of collection by a DEP-accredited laboratory for an exact count of fecal coliform units, and a geometric mean is calculated from the five results to determine compliance with standards. Each recreational assessment results in an Assessment Summary for input to the 305(b) assessment database and GIS that identifies waters with obvious recreational use impairment and those with no obvious impairment.

For the 2016 reporting cycle, DEP increased the total miles assessed for Recreational use. DEP assessed 13,571 stream miles for Recreational Use in 2014 and 2015 as a result of increased funding. This mileage represents approximately 74% of the total miles assessed for Recreational Use (18,356 stream miles) reported for the 2016 cycle. The majority of the monitoring was conducted at targeted locations sampled by DEP staff. Approximately 1,502 stations were monitored for Recreational Use in 2014 and 2015 and 210 of those stations were selected by a probabilistic sampling design. A two-stage Generalized Random Tessellation Stratified (GRTS) design for a finite linear resource was employed to randomly select 30 monitoring locations in each of seven watersheds.

The recreational use assessment is focused on water contact recreation as the Department believes it is the most critical use and it is important to reduce the risk of waterborne illness to individuals recreating in the surface waters of the Commonwealth. Other recreational uses, such as the fishing use, are deemed to be just as important as water contact. To evaluate the fishing use, the Department will take a holistic view of the sport fish community and will not focus on a single species, regardless of its economic importance in the overall fishery. However, the Department does not have an established method to evaluate the fishing use or other protected recreational uses. The Department does receive a limited number of comments and complaints regarding fishing for some game species, however, these anecdotal comments are difficult, if not impossible, to confirm and cannot be assessed in an objective manner. Factors influencing fishing aren't just limited to water quality or habitat problems but also include all sport fishes, the skill of the individual, appropriate habitat and conditions, and using appropriate equipment and bait.

The Department's narrative water quality criterion states: §93.6(a) Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life. In order to assess this criterion, the Department must detect a "substance" (pollutant or pollution) that is causing harm and is linked to point or non-point source discharges. The presence of compounds alone does not constitute a violation of this criterion as there must be some harm demonstrated to uses, such as aquatic life or human health. In an effort to assess this criterion the Department has conducted extensive studies on emerging contaminants in surface waters, such as endocrine disrupting compounds, personal care products, pharmaceuticals, and hormones.

Part C1.3. Intensive Surveys

Intensive surveys have been a key element of DEP's water quality assessment program since their inception in 1965. These chemical and biological stream and lake investigations are conducted to gather background or baseline data on specific streams or lakes to determine the effects of point and/or nonpoint source discharges on receiving water quality, provide data in support of administrative or enforcement actions, determine the source of spills or releases of pollutants and evaluate their effect on water quality, and assess the distribution and accumulation of trace metals and selected organics in fish tissue or sediments. These surveys can include any combination of chemical sampling of water, effluent, sediment, or fish tissue; flow measurement; qualitative, quantitative, or semi-quantitative EPA RBP macroinvertebrate sampling; qualitative or quantitative (RBP) habitat assessment; or qualitative (and sometimes quantitative) fish sampling. While the current emphasis is on the evaluation of waters previously assessed as attaining designated uses (discussed in the previous section), other types of intensive surveys remain important to the Commonwealth's water quality management program.

An important element of DEP's water quality assessment program is the evaluation of candidate waters for Special Protection designation as High Quality (HQ) or Exceptional Value (EV) Waters. These targeted, intensive surveys involve field studies of habitat and the aquatic community, observation of land use and water quality protective measures, historic and other known information to determine if a basin or stream segment qualifies for Special Protection in the Antidegradation program. Streams receiving HQ or EV designation are protected to maintain their existing quality.

Part C1.4. Ambient Fixed Station Monitoring

The Pennsylvania Water Quality Network (WQN) is a statewide, fixed station water quality sampling program operated by the Bureau of Clean Water. It is designed to assess both the quality of the Commonwealth's surface waters and the effectiveness of the water quality management program by accomplishing four basic objectives:

1. Monitor current status and temporal water quality trends in major surface streams (routine stations)
2. Monitor current status and temporal water quality trends in selected reference waters (reference stations)
3. Monitor current status and temporal water quality trends in major tributaries entering the Chesapeake Bay
4. Monitor current status and temporal water quality trends in selected lakes

Major streams are considered to be interstate and intrastate waters with drainage areas of roughly 200 square miles or greater. These waters receive both point and nonpoint source pollutants and are sampled at or near their mouths to measure overall quality before flows enter the next higher order stream. In this way, current water quality status and trends can be established and the effectiveness of water quality management programs can be assessed by watershed. In addition, reference stations are selected to represent: 1) ”ambient” waters of natural quality minimally affected by human activities, and 2) ”typical” waters with a quality representative of that normally found in the region of the state being sampled.

The WQN consists of 121 routine stations of which 94 are sampled bi-monthly and 27 are sampled monthly for stream discharge measurements and physical/chemical analysis. All routine stations are sampled every other year for biological evaluation. Twenty-three reference stations are generally sampled monthly for stream discharge and physical/chemical analysis and annually for biological evaluation. Also, 36 Chesapeake Bay Nutrient and Sediment loading stations are sampled monthly for stream discharge and physical/chemical analysis and every other year for biological evaluation. In addition, these Chesapeake Bay loading stations are targeted for sampling eight additional times per year during storm events.

Single mid-channel or spatially composited, depth-integrated samples are collected at each site depending on stream size. Stream discharge (flow volume) is measured or calculated each time a water sample is collected. United States Geological Survey (USGS) streamgaging facilities and/or extrapolation equations are utilized whenever possible. Where no USGS facilities/equations exist, stream discharge is measured by U.S. Army Corps of Engineers and private facilities, or calculated according to methods outlined by USGS. At a minimum, macroinvertebrate samples are collected every other year at both routine and Chesapeake Bay load monitoring stations between August 1st and October 31st for nonwadeable streams and between November 1st and April 30th for wadeable streams. Reference stations are sampled annually during fall (November 1 – December 30) or spring (March 1 – April 30) utilizing DEP benthic sampling methodology adapted from EPA Rapid Bioassessment Protocols.

Fish tissue is sampled periodically at the rate of about 100 WQN samples per year. Sampling locations are determined annually. Sampling is rotated through the network to provide periodic complete coverage and to maintain surveillance on problem waters. Fillets are sampled for appropriate pollutants in order to assess suitability for human consumption.

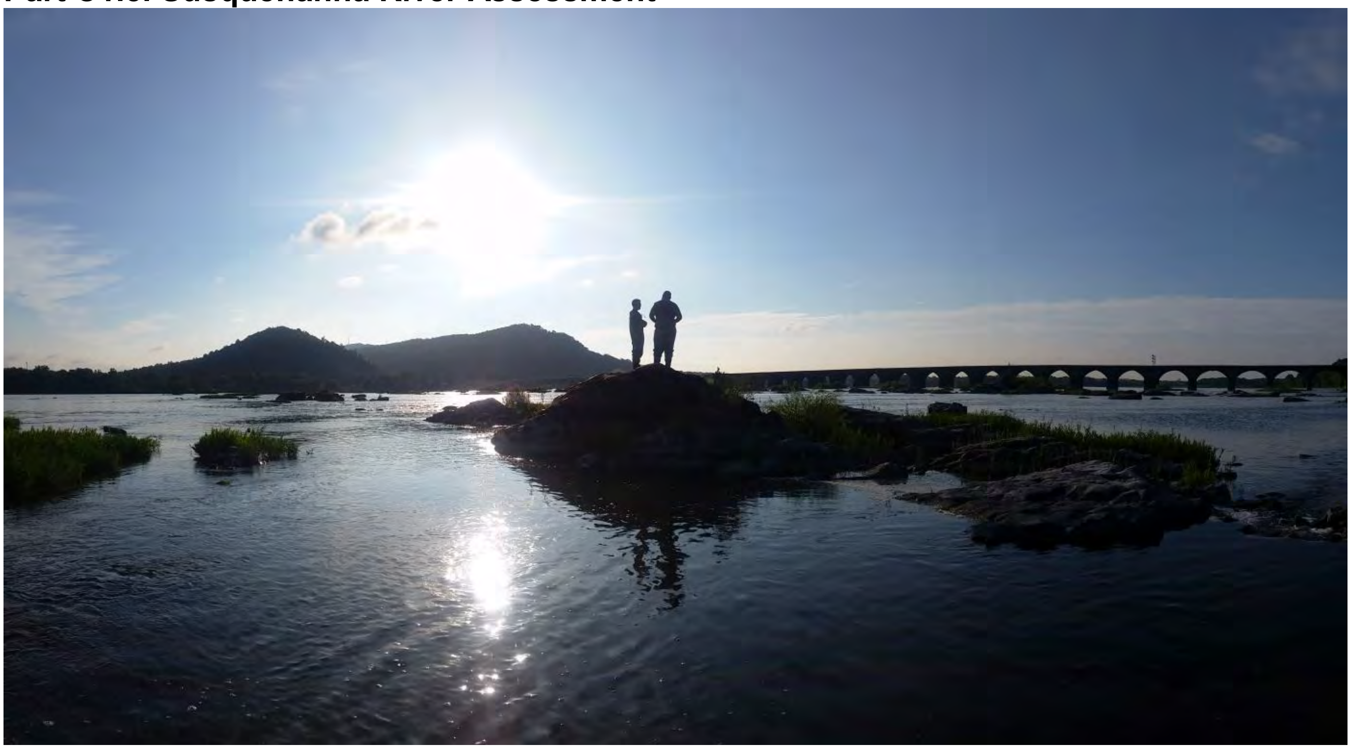
Lakes included in the WQN (except for Lake Erie and Presque Isle Bay that are part of the base network) are selected after consideration of size, public access, the intensity of use, and availability of existing data. Large lakes with heavy public use and/or historical data are favored for inclusion because changing trends in the water quality of these resources have the potential for serious impacts on water uses.

In the past, lakes have been scheduled for annual sampling in groups of 15 to 20. Lake groups are sampled once a year for five consecutive years before initiating a new group. The five-year data blocks were then used to assess lake water quality trends. Thirteen lakes are currently being sampled in addition to Lake Erie and Presque Isle Bay. Lake levels for Lake Erie and Presque Isle Bay stations are measured at the U.S. Coast Guard station at the entrance to Erie Harbor.

Lake Erie and Presque Isle Bay samples are collected at mid-depth. The other lake WQN samples are collected at two depths per site during mid-summer stratification. These sites correspond to the deepest point in each lake and one uplake station; at each site, one sample is collected one meter below the surface and the second sample one meter above the lake bottom. A temperature/dissolved oxygen profile is recorded through the vertical water column and an aliquot from the one-meter sample is filtered for chlorophyll-a analysis. Secchi depth is also recorded.

Qualitative plankton samples and chlorophyll-a are collected annually from Lake Erie and Presque Isle Bay. Quantitative invertebrate or plankton sampling and qualitative or quantitative fish sampling is optional at other lakes and may be conducted at the discretion of the collector.

Part C1.5. Susquehanna River Assessment



The Susquehanna River at Rockville, PA. Photo provided by the Susquehanna River Basin Commission.

The Susquehanna River originates from Ostego Lake in Cooperstown, New York and flows south through Pennsylvania and Maryland into the Chesapeake Bay. The Susquehanna River drains approximately 71,000 km^2 and is the largest source of fresh water to the Chesapeake Bay (Brown et al. 2005). Most of the Chesapeake Bay and tidal tributaries have been declared impaired by EPA, and on December 29, 2010, EPA established the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment that includes the Susquehanna River. Consequently, the Susquehanna River has received a large amount of attention concerning nutrient and sediment transport.

Assessment of water quality is complicated in the Susquehanna River for several reasons. At the confluence of the West Branch Susquehanna River, there are two distinct water quality influences that remain separated and do not mix. With the confluence of the Juniata River, the Susquehanna River mainstem becomes three distinct water columns. Then, each additional tributary that flows into the Susquehanna River creates another unique ribbon of water quality that flows closely along each bank of the River. This results in five distinct water columns from the east to west shores in the Susquehanna River around Harrisburg, PA. These waters do not mix due to the Susquehanna River being relatively wide and shallow. Some aquatic organisms may be relegated to one water quality influence for most – if not all – of their life cycle, whereas others may reside in one influence for a time, moving freely between the differing water qualities. These factors, for the most part, determine what DEP currently has the ability to assess and where future efforts will be directed in order to assess and protect all Uses of the Susquehanna River.

The Susquehanna River has been the focus of attention in recent years due to mortality of Young-Of-Year (YOY) Smallmouth Bass (SMB) and reduced recruitment of YOY into the adult population. Throughout the Susquehanna River and its larger tributaries, SMB angling is a popular recreational activity resulting in a great deal of public concern over the health and population of this species. Prior to 2005, no substantial disease-related YOY SMB mortality events were documented in the Susquehanna River, but beginning in 2005, dead and dying YOY SMB were observed in larger numbers, particularly in the middle Susquehanna (between Sunbury and York Haven, Pennsylvania). Since that time, SMB data has suggested the rates of reproduction, growth, and recruitment of younger fish into older age classes are lower than years prior to 2005. Growing concern over the health and abundance of SMB has spurred an unprecedented amount of research and public interest.

In September 2007, the Susquehanna River Technical Committee, composed of representatives from the Pennsylvania Fish and Boat Commission (PFBC), DEP, USGS, EPA, and Susquehanna River Basin Commission (SRBC) was formed and met for the first time. The Committee's primary responsibility is to identify and interpret existing data, determine data gaps, and develop recommendations for future action to restore and maintain the SMB fishery. Beginning in 2012, DEP initiated an unprecedented large-scale investigation into the potential cause(s) of the SMB decline and to assess the protected uses of the Susquehanna River. The survey design included conventional chemical parameters measured in water and sediment such as nutrients and metals, as well as emerging contaminants. Emerging contaminants are a broad category of compounds attributable to a number of sources including pesticides, pharmaceuticals, fertilizers, and household cleaning products. These chemicals may cause stress or immunosuppression in organisms predisposing them to diseases, similar to what has been observed in SMB.

In an effort to remain transparent to the public, DEP established a webpage to provide up-to-date information regarding the Susquehanna River that can be accessed at this web address: http://www.dep.pa.gov (Search: "Susquehanna River"). This webpage includes links to various reports and other information related to the Susquehanna River study.

With the vast amount of research conducted since 2005 including conventional pollutants (ammonia, metals, dissolved oxygen, pH etc.), emerging contaminants, aquatic communities (macroinvertebrates, fish, algae, mussels), invasive species, and various diseases and parasites, there was a significant need to consolidate resources and data. The data were collected for two purposes: (1) determine the cause(s) for the SMB population decline and (2) assessing the Uses of the Susquehanna River. To achieve the first goal (determine the cause of SMB population decline), DEP requested assistance from the EPA to begin the stressor identification process. This method is described as the Causal Analysis/Diagnosis Decision Information System (CADDIS, www.epa.gov/caddis). This process convened a workgroup of over 50 experts from various State, Interstate, Federal, and academic organizations including, the PFBC, DEP, EPA, SRBC, USGS, United States Fish and Wildlife Service (USFWS), and Susquehanna River Heartland Coalition for Environmental Studies (SRHCES).

The resulting CADDIS report (http://www.dep.pa.us (Search: “CADDIS”)) represents a large amount of work from many dedicated professionals across multiple agencies and organizations. It is the compilation of the current understanding as it relates to the SMB population decline in the Susquehanna River and clarifies the need for continued research. This report provides greater transparency on work completed from 2012 to 2014. DEP has summarized the findings through public webinars, a final report, and over 50 worksheets used by the group, which are found on the Department’s Susquehanna River website link: (http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/SusquehannaRiverStudyUpdates/Appendix%20B%20Worksheets.pdf). CADDIS proved to be a valuable effort as it identified the more probable causes of the SMB problem while eliminating others. With these results, efforts going forward can be more focused and efficient. The process also made the data and analysis transparent to both experts and the public.

The CADDIS process was a stepwise scientific process to identify the most probable stressors affecting one species (SMB). CADDIS was not a decision to assess the protected Uses of the Susquehanna River for the Federal Clean Water Act Section 303(d). Although CADDIS utilized the same data DEP collected for water quality assessments, it is important to note that the CADDIS process analyzed these data using different methods than how the Department is required to assess protected uses.

Nonetheless, the intensive monitoring effort during the past two years resulted in adding new listings relevant to the Susquehanna in this 2016 Integrated Report. Chemical, physicochemical, and biological data collected through 2014 were used to evaluate the Recreational, Fish Consumption, Aquatic Life, and Water Supply protected water uses described in Table 1 of 25 Pa. Code § 93.3.

New assessments in the 2016 Integrated Report for the Susquehanna River include approximately 68.2 stream miles for Recreational Use. These Recreational Use assessments are based on observed levels of fecal coliform bacteria. If the bacteria levels are considered unsafe for water contact sports, such as swimming, the water is considered impaired. The portion of the Susquehanna River from Sunbury to the confluence with Conodoguinet Creek is attaining the Recreational Use. The portion of the Susquehanna River from the confluence with Conodoguinet Creek to the confluence with Yellow Breeches Creek is listed as impaired for Recreational Use. A 1.2 stream mile portion of the Susquehanna River immediately upstream and downstream of the Route 462 Bridge (Columbia, PA) is listed as impaired for Recreational Use. Lake Clarke, immediately downstream of the impaired reach by the route 462 bridge downstream to the Safe Harbor Dam, is attaining the Recreational Use.

The smallmouth bass fishery of the Susquehanna River is an important component of the overall recreational fishery and anglers have expressed concern that the declining smallmouth bass population impacts recreation associated with the Fishing Use. While DEP does not have a formal method to assess the fishing use, DEP evaluated fishery data for the mainstem of the river to gauge the overall condition of the sport fish community. Electrofishing surveys of the river attempt to collect all fish species present in order to evaluate the ecological condition of the fishery and this also provides the opportunity to evaluate subsets of the fish community, such as the sport fishes. DEP surveys since 2013 have demonstrated a healthy sport fish community composed of a variety of sport fishes in numbers adequate to support the fishing use. While the smallmouth bass populations had declined, they still remained a large part of the sport fish community. Now, reports of days with high catch rates continue to grow with the return of high smallmouth bass populations.

Fish consumption assesses the Fishing Use by testing for contaminants in fish flesh. This testing provides protection by assuring the fish are safe to eat. It was found that the Channel Catfish in the Lower Susquehanna over twenty inches long have levels of PCBs above U.S. Food and Drug Administration (FDA) guidelines. The advisory is to not consume more than one meal per month of these fish. The fish consumption impairment listing in the Integrated Report extends from the confluence of the West Branch Susquehanna River to the Maryland/Pennsylvania state line. Fish consumption advisories can be viewed on the DEP webpage at: http://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/FishConsumptionAdvisory/Pages/default.aspx.

Water chemistry was collected at all four community drinking water intakes in the lower Susquehanna to determine if the levels were acceptable when compared to criteria in 25 Pa. Code §93.7, Table 3. All sample results were within the applicable range, so four segments totaling 34 stream miles are attaining the Potable Water Supply Use.

There is a great deal of interest as to how DEP will assess the Susquehanna River in the 2016 Integrated Report for the Aquatic Life Use especially in relation to the decline in SMB. DEP has collected thousands of water samples and deployed continuous data monitors to measure water temperature, dissolved oxygen, pH, and specific conductance every half hour at numerous locations in the river. Since 2012, this intensive continuous monitoring has not detected water quality criteria violations, with the exception of bacteria. There is a 2.3 mile impaired reach of the river for metals at Columbia, first listed in 2006. Additionally, an in-depth analysis of toxic metals is still ongoing. These include samples collected during storm events, and since 2014, the dissolved fraction, as well as the total amount of the metals, are being measured. The dissolved, rather than the total amount of a metal is the fraction that is toxic to organisms. These metals are not the cause of the problem, as the primary source of the metals is from abandoned coal mine discharges, and these were present and probably produced higher levels of metals when the populations were doing well pre-2005. The aquatic life use is unassessed for the remaining portions of the River.

DEP will continue to address this lack of assessment through two approaches; (1) develop assessment methods for both fish and macroinvertebrate communities in large rivers and (2) seek defensible links between water quality and the observed conditions affecting certain fish species.

With the exception of the mainstem Susquehanna River from Sunbury to Holtwood Dam, tributaries and other portions of the river have been fully assessed for aquatic life use. There are generally fewer impaired tributaries in the upper portions of the Susquehanna and West Branch Susquehanna River basins, which contribute water to downriver reaches that meet water quality standards. As the Susquehanna River flows south through its middle reaches, the number of impaired tributaries increases; therefore, the percent contribution of these waters to the Susquehanna River also increases. Although the number of impaired tributaries increases, the water quality across the width of the River does not necessarily decrease. This is due to the shallow and wide physical characteristics of the River, and the resulting lack of tributary waters mixing with the volume of water that originates upriver. From the confluence of the West Branch to the confluence of the Juniata River, the Susquehanna River exhibits two significantly different and incompletely mixed water quality influences with varying water quality conditions hugging each shore. Tributaries or portions of tributaries, including Penns Creek and Mahantango Creek (west shore of the river in Juniata and Snyder Counties), currently have both Aquatic Life and Recreational Use impairments. Continuing south, the Juniata River introduces a third significant water quality influence that does not mix, resulting in three significantly different and incompletely mixed water quality influences with, again, varying water quality conditions hugging each shore (Figure 3). Additional tributaries, or portions of tributaries farther downriver, including Conodoguinet, Yellow Breeches, Codorus, and Swatara Creeks, also have both Aquatic Life and Recreational Use impairments, which results in the tributaries degrading the water quality of the river. The lower water quality of these tributaries causes two short Recreational Use impairments and a single Aquatic Life Use impairment on the Susquehanna River of approximately 2.3 miles at Columbia.

Figure 3
Approximate delineation of distinct water quality differences on the Susquehanna River at Rockville, PA.

The lower Susquehanna River then flows into a series of four major impoundments. The impoundments present new challenges for DEP biologists to monitor and assess the River including the need to develop appropriate methods to measure and assess water quality. Many of the tributaries to the impounded lower reaches are routinely being assessed, and as a result, significant Aquatic Life and Recreational Use impairments have been identified and appropriately listed for these lower Susquehanna River subbasins.

Relative to other rivers, the Susquehanna River is more wide and shallow, so its water column is more rapidly warmed by the sun and light easily reaches the substrate. These are conditions conducive to algae and aquatic plant growth. As a result, there may be excessive growth during low flows and higher temperatures despite the declining levels of nutrients over the past 30 years. Excessive plant growth can result in low dissolved oxygen levels and high pH. Continuous instream monitors that measure dissolved oxygen, temperature, and pH throughout the critical periods have not detected any water quality criteria violations since 2012.

There has been a general concern that low dissolved oxygen and high pH in some of the river near-shore areas are affecting YOY SMB. As discussed, tributaries to the river do not readily mix with the river but stay close to the bank for many miles downstream. As a result, the water quality in these near-shore areas is a reflection of the water quality of the tributaries. Therefore, DEP is placing more emphasis on studying the tributaries, which will help identify backwater areas of the River that may be downstream of a poor quality tributary.

Emerging Contaminant Analyses:

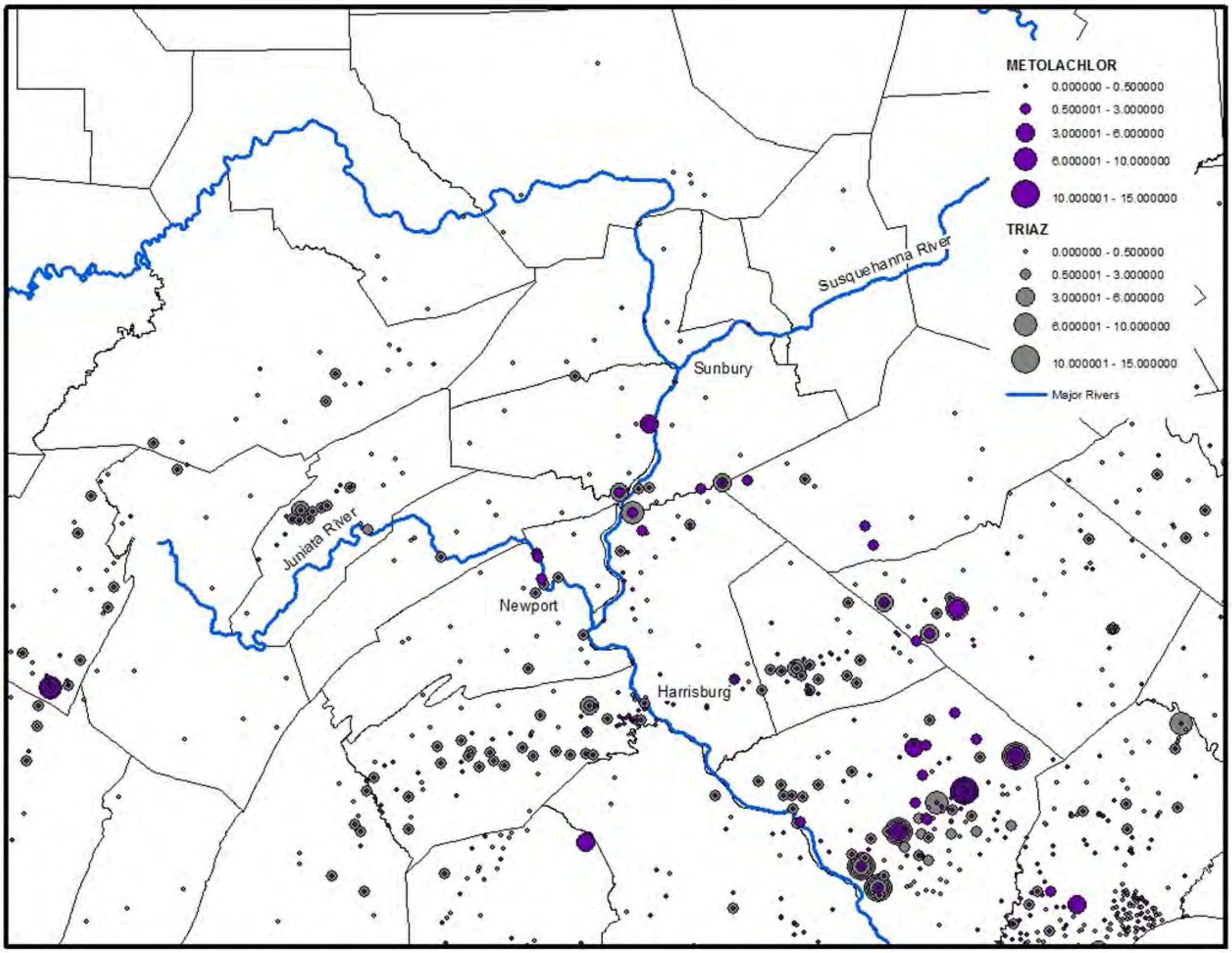
Emerging contaminants such as endocrine disrupting compounds and herbicides were identified as a potential concern by CADDIS with more research recommended. DEP has collected over a thousand samples analyzing over two hundred compounds searching for contaminants that could impact the immune system of the bass. This includes wastewater compounds, pharmaceuticals, endocrine disrupting compounds, herbicides, pesticides, and others lumped under the “emerging contaminants” label. Collection methods include discrete water samples, sediment samples, and passive samplers. Sediment samples are important because some contaminants can accumulate in sediment thereby entering the food chain or coming into direct contact with fish or eggs during spawning. Passive samplers are deployed for up to 30-days and during that time collect any contaminants in the water. They provide information on compounds that may be at very low or undetectable levels by conventional sample collection, or compounds that occur episodically. In addition to the Susquehanna River, 48 streams across the Commonwealth were sampled by at least one of the three methods.

Herbicides and other emerging contaminants known to cause endocrine disruption can potentially lead to immunosuppression, which ultimately leads to increased disease and parasites. Increased concentrations in water have previously been associated with nonpoint source runoff following rain events. The Department sampled for herbicides following rain events in the spring of 2015 when several aquatic species begin spawning. This analysis was done because it is hypothesized that early life stages may be the most susceptible to these chemicals. There were 112 samples collected in the mainstem Susquehanna River, tributaries, and out of basin controls. DEP also evaluated historic records provided by USGS (Figure 4). The spring 2015 results showed elevated concentrations during rainstorms as expected. Elevated levels were detected in a few near-shore areas of the Susquehanna and Juniata Rivers, but the highest concentrations were in tributaries, both in and out of the Susquehanna basin.

To date, there has been no correlation between the occurrence and concentrations of these compounds with diseased fish. Some of the highest concentrations occur in tributaries to the Upper Juniata River. Because there is no data documenting a population decline in these tributaries, there is no evidence that these compounds are impacting population levels.

Figure 4

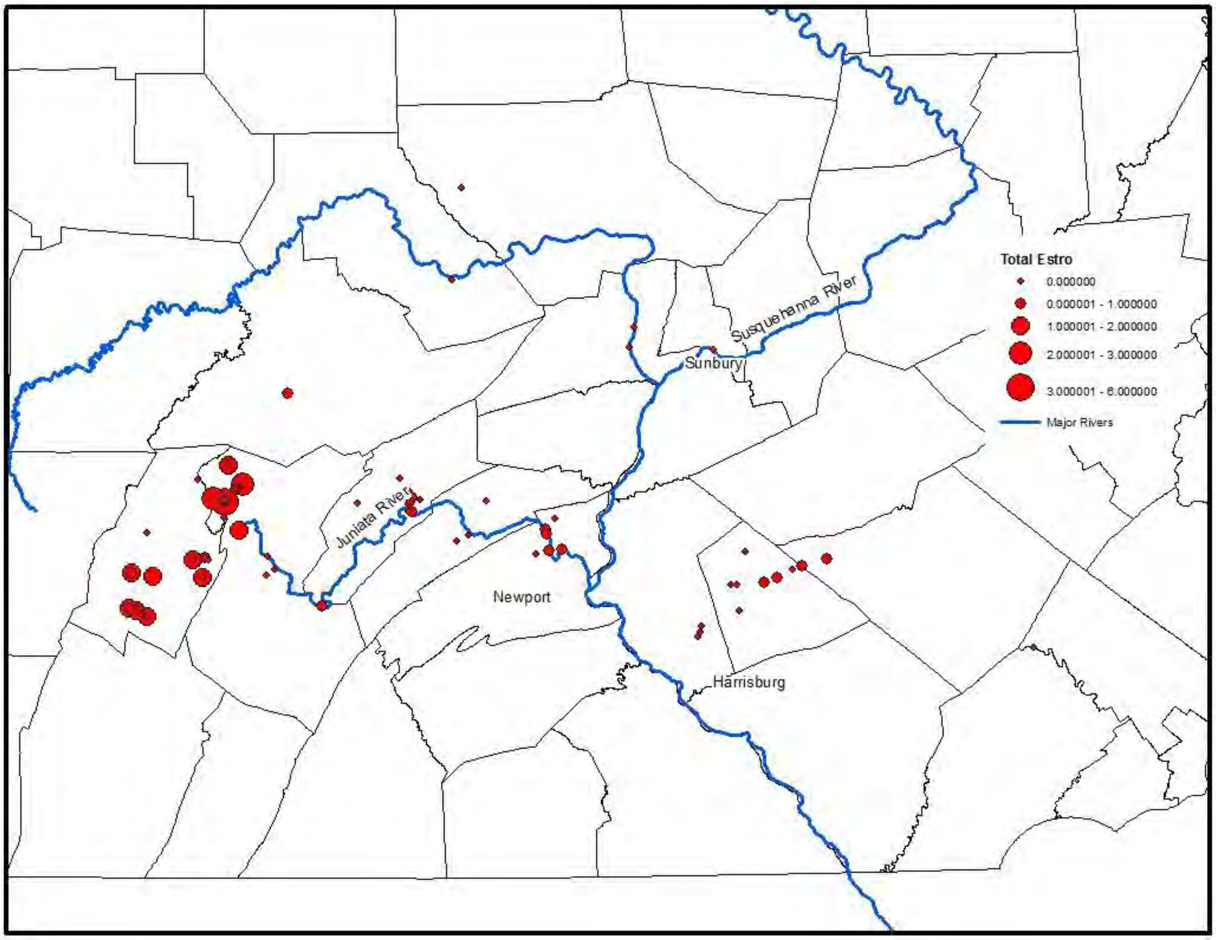
Results of herbicide analysis from 2012 to 2015. Larger points indicate higher concentrations found. TRIAZ is a suite of chemical analysis that includes chemicals in the Triazine family.



Total estrogenicity, an estimation of the total concentration of compounds affecting estrogen receptors, was collected at many locations in the basin (Figure 5). Highest concentrations were found in the Upper Juniata Basin. Because smallmouth bass concerns were lowest in the Upper Juniata Basin, it is unlikely total estrogenicity is having a major effect without more research into indirect linkages.

Intersex in male fish is a concern throughout the country and may indicate the localized presence of endocrine disrupting chemicals. At this time, only a few segments in the Susquehanna and Juniata mainstem have been sampled for smallmouth bass intersex by USGS so it is unclear how extensive the problem may be. DEP is continuing to work with partners to determine relationships and sources of emerging contaminants with aquatic life health and severity of intersex in male fish.

Figure 5
Total Estrogenicity results from samples collected between 2012 and 2015.



<u>Fishery Data:</u>

PFBC data show that the smallmouth bass populations have been increasing for several years and have surpassed the pre-2005 catch rate medians at the middle Susquehanna River (from Sunbury to York Haven, Figure 6). The <u>second highest catch rate on record</u> (2016) demonstrates some measure of population recovery. Smallmouth bass population characteristics are also returning to levels consistent with the 1990s (Figure 7), suggesting that 2016 adult catch rates <u>are not simply a one-year outlier</u>. The balance of old versus young in the population is now consistent with what was seen in the 1990s. This is more cause for optimism that the population is rebounding. In addition, data collected by PFBC shows a clear trend of <u>decreasing disease in the middle Susquehanna River with record low disease in 2016</u> (Figure 8). These fluctuations in fish population data support DEP's decision to not base aquatic life use assessment decisions on the population metrics of a single non-native species without clear linkage to a water quality problem.

Figure 6

Data provided by PFBC. Boat electrofishing catch rate of adult smallmouth bass (≥ age-1) at the middle Susquehanna River during September index period.

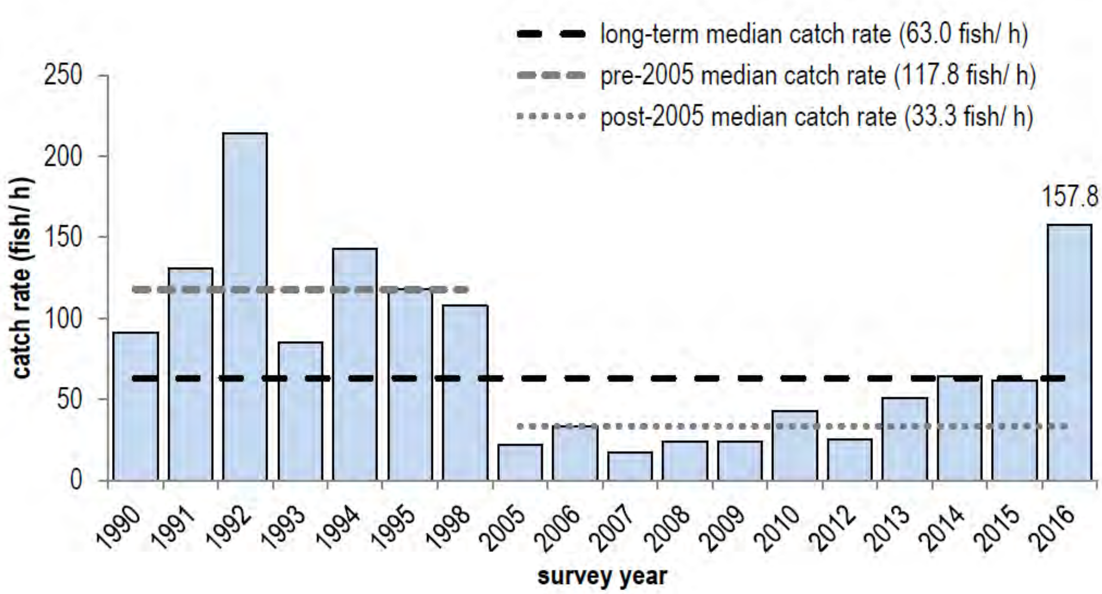


Figure 7

Data provided by PFBC. Proportional Stock Distribution based on boat electrofishing catch of adult smallmouth bass at the middle Susquehanna River during September index period. Lower percent scores indicate a higher proportion of younger fish than older fish. A larger proportion of smaller fish for the past 4 years recorded suggests the population has returned to a distribution consistent with the 1990s, and that recruitment of YOY into the adult population is occurring.

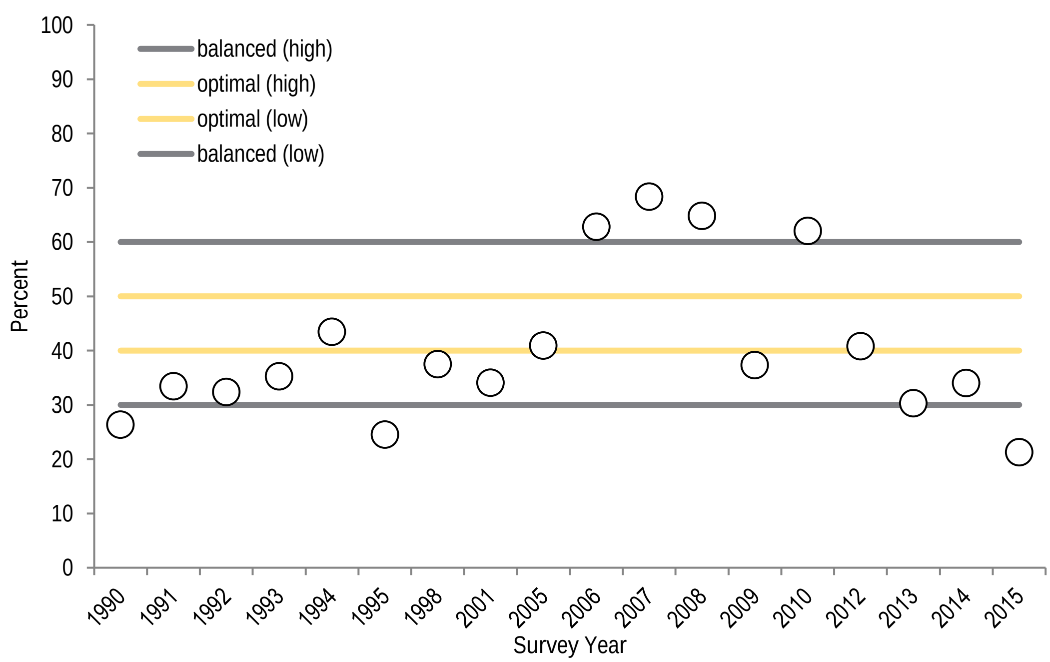
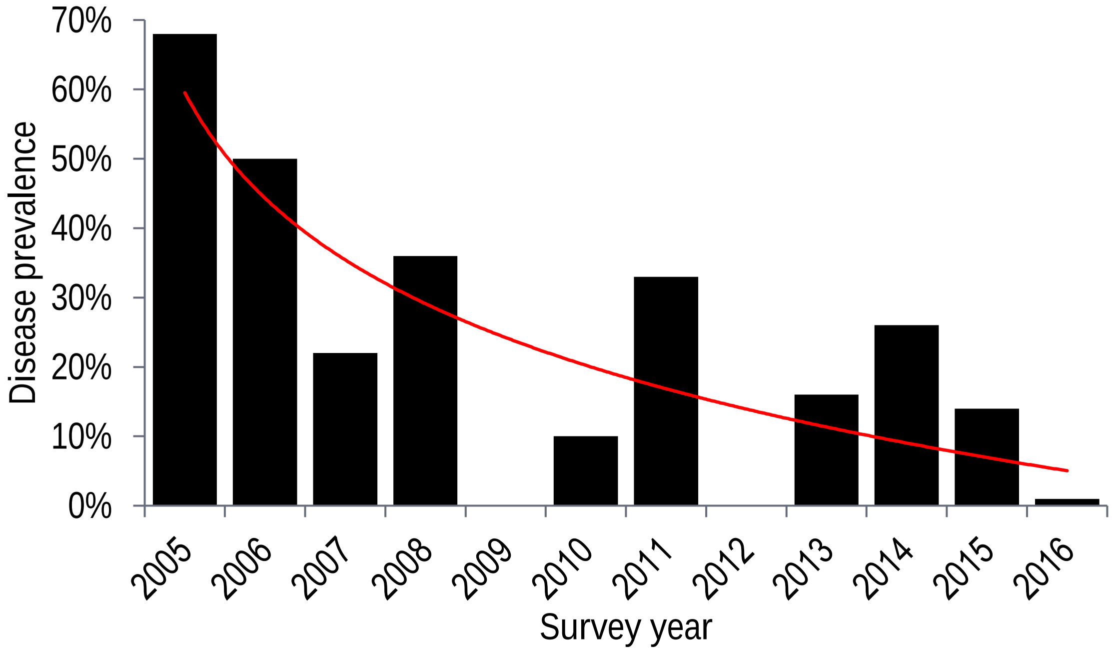


Figure 8

Data provided by PFBC. Proportion of YOY smallmouth bass caught displaying signs of disease at the middle Susquehanna River during backpack electrofishing surveys. Red line indicates line of best fit based on the dataset. Data not recorded during 2009 and 2012.



There is much that is not known. Bass move in and out of locations within the waterbody and concentrations of contaminants fluctuate seasonally and yearly. Little is known about how the hundreds of different compounds may alter the physiology of the bass. DEP is working closely with USGS to answer these questions. There are diseased young of the year smallmouth bass but there will always be some natural percentage of diseased fish. What is the natural percentage of diseased fish? This is not known and it is hard to know as field collections will be biased to catching the slower moving diseased fish while the healthy fish swim away. Is there some virulent form of a new virus such as the largemouth bass virus that can infect smallmouth bass? This is under study and preliminary results indicate it may be a problem. There can be disease and parasite epidemics in the absence of any water quality problems. The increase in the smallmouth bass population and decrease in disease rates in recent years and especially in 2016 is a good indication this was a disease problem not related to water quality.

It is important and necessary for the DEP to continue to work with other agencies, better understand what caused the population decline, and evaluate why there is currently decreased disease and higher populations. DEP has been working closely with – and provided a significant portion of funding to – PFBC and Michigan State University on one of the likely causes of SMB decline (determined during CADDIS), pathogens and parasites. Progress has been made on determining if the Largemouth Bass Virus (LMBV) could be contributing to disease and population decline. Through quarterly reports provided by Michigan State University, it has been reported that LMBV strains isolated from the Susquehanna and the Juniata River were highly lethal to SMB in two separate trials. This demonstrates the possibility a virus and not a water quality problem can result in a population decline. DEP and PFBC are still awaiting final results and a report to confirm these quarterly reports.

How current impairments and TMDLs are addressing concerns over SMB and water quality:

The entire Susquehanna River Basin is already included in the Chesapeake Bay TMDL. The TMDL is designed to reduce nutrients and sediment from all sources. In 2016, in order to achieve these goals, DEP and other parties developed a Bay restoration strategy comprised of several short, mid and long-term recommendations, aimed at augmenting our approach to water quality improvements in the Chesapeake Bay watershed. The Bay Plan is a collaborative effort between DEP and the Departments of Agriculture, and Conservation and Natural Resources, along with other stakeholders in the design, development, and implementation of this strategy. All parties are working together to coordinate plans, policies, and resources. There are six essential recommendations laid out in the new strategy:

- Site high-impact, low-cost Best Management Practices (BMPs) on the ground, and quantify undocumented BMPs in watersheds impaired by agriculture or stormwater.
- Improve reporting, record keeping, and data systems to provide better and more accessible documentation.
- Address nutrient reduction by meeting EPA's goal of inspecting 10 percent of farms in the watershed, ensuring development and use of manure management and agricultural erosion and sediment control plans, and enforcement for non-compliance.
- Identify legislative, programmatic, or regulatory changes to provide the additional tools and resources necessary to meet federal pollution reduction goals by 2025.
- Obtain additional resources for water quality improvement.
- DEP's Chesapeake Bay Office coordinates and directs the development, implementation, and funding of the Commonwealth's Chesapeake Bay efforts.

The strategy relies on a mix of technical and financial assistance for farmers, expanded data gathering, improved program coordination and capacity and – only when necessary – stronger enforcement and compliance measures. The efforts to reduce nutrients and sediment will result in additional benefits by reducing the amount of herbicides and other compounds in runoff and the sediment, associated with agriculture, reaching the water.

Furthermore, there is a significant amount of tributary stream miles that are impaired in the Susquehanna Basin. To address these impairments, DEP and other agencies have been providing funds to local governments, nonprofit, environmental and watershed organizations to ensure restoration efforts are underway. Many in the public, particularly farmers, are aware of – or have participated in – the efforts to restore riparian buffers along streams, for example. It is through these efforts at the local watershed scale that real progress toward improving water quality can be made in the Susquehanna River.

Moving Forward:

DEP is engaged in developing and implementing a large river assessment protocol. DEP has completed the draft of the sampling methods and will complete a draft of the assessment method in the first half of 2017. The new assessment method, along with the sampling methodologies and techniques, will be made available for public comment in advance of the 2018 Integrated Report. The new methods related to large rivers, once finalized, should be completed in time to make accurate aquatic life use assessments in the Susquehanna River Basin as part of the next Integrated Report.

It is important to note that the CADDIS process and subsequent report highlighted several other potential stressors to aquatic life. The Susquehanna River and many of its tributaries support a relatively high number of aquatic invasive species. Invasive species can physically disrupt habitats, out-compete native species, carry pathogens, and disrupt the food chain. Another issue currently being tracked is an increase in some organisms such as snails, which may act as intermediate hosts for various parasites that affect aquatic life. An increase of these intermediate hosts could result in increased infection rates and subsequent disease.

The prevalence of pathogens and parasites is not well understood at any academic or regulatory level, especially as it relates to the aquatic life of the Susquehanna River. Furthermore, it is understood that the pathogen and parasite prevalence may be exasperated by some interaction with water quality conditions, natural or unnatural. More data are needed on these topics. Finding a scientifically defensible link between these potential stressors and observed effects to aquatic life is a high priority for DEP.

As a result of the intense studies conducted on the Susquehanna River since 2012, DEP has developed new sampling methodologies and techniques, which have significantly expanded DEP's ability to assess waters not only in the Susquehanna but all waterbodies across the Commonwealth. Some of these techniques include emerging contaminant sampling, algal composition and toxicity studies, and deployment of continuous data monitors. DEP will use these methods to formulate assessment methodologies in order to make Aquatic Life Use decisions on the Susquehanna River and other large waters.

DEP will apply new sampling methodologies and continue to move more effort into the tributaries of the Susquehanna River during 2016 and subsequent years. Since 2012, there has been an increasing effort to monitor and reassess Susquehanna River tributaries. Forty-three tributaries have been reassessed as part of this recent work. Thirteen tributaries are listed as attaining, nineteen have both attaining and impaired segments, and eleven are impaired. As more tributaries are reassessed, a complete picture of problem areas impacting the Susquehanna River will become evident.

In summary, DEP has significantly increased the number of assessed miles on the Susquehanna River for the 2016 Integrated Report, particularly for the Recreational Use. Portions of the Susquehanna River have been impaired for Recreation where appropriate. DEP acknowledges the SMB disease and population decline as being potentially related to water quality issues, but data collected to date are not supporting that position. DEP will continue to monitor the situation and develop appropriate biological assessment methods that look at whole biological communities. At this time, DEP has decided to continue listing the Susquehanna River in Category 3 of the Integrated Report for Aquatic Life Use for the following reasons:

- Population data collected by PFBC and DEP show significant increases since 2013. PFBC data shows a continued decrease in disease prevalence at the middle Susquehanna River. This information suggests a lack of connection to water quality in the Susquehanna River at this time.

- Evaluation of the conventional water quality data available demonstrates attainment of numeric water quality criteria in the River study areas.

- Emerging contaminants are at higher concentrations in tributaries than in the Susquehanna River mainstem where the highest levels of diseased YOY bass are observed.

- While emerging contaminants have been found, it is unknown if and at what concentrations these contaminants might result in disease due to immunosuppression. To date, no connection between the contaminants and disease data is evident.

- Preliminary qualitative and semi-quantitative analysis of macroinvertebrate and fish community data do not suggest there are major issues occurring to aquatic life. However, more rigorous analyses are needed to correctly assess the aquatic life and they are currently under development.

Part C1.6. Lake Water Quality Assessments (LWQA)

Basic water quality assessments for lakes are achieved mainly through two programs in Pennsylvania – the Lake Water Quality Network sampling, and the TSI or Trophic State Index evaluations described below.

- LWQN – a statewide set of lakes is sampled once each summer for five years to track trends. A new set of 15 lakes was selected for the 2011-2015 sampling round (two were dropped because of dewatering). LWQN sampling is funded mainly through the 106 grant.

- Lake TSI studies – all six DEP Regions incorporate TSI lake surveys to determine if phosphorus controls are needed for point source discharges in the watershed or to characterize and determine the current trophic status of a lake. Samples are collected three times in one year to cover the spring, summer, and fall seasonal variation; each date includes a minimum of two stations, sampled at surface and bottom locations. Approximately 15 to 20 lakes per year are normally sampled using this program. Additional summer sampling was done on several lakes in 2015 lakes to gather more specific information on nutrient and profile variability within the summer productive period from mid-July to early September. This data will be used to guide further nutrient criteria studies for PA lakes. Funding for these studies is through the 319 Program, the State's Clean Water Fund, and through the State's Growing Greener Program.

Pennsylvania's definition of a "significant lake" is a waterbody with public access and a hydraulic residence time of 14 days or more. Pennsylvania currently has 230 significant lakes totaling 109,646 acres. Another 155 public waterways are used as lakes but may not have the 14-day retention time. Lake assessments are done on "significant" lakes and other lakes by DEP and various partners including USGS, SRBC, EPA, other state agencies, including Department of Conservation and Natural Resources (DCNR), citizen volunteers, County Conservation Districts, Morris Arboretum, and consultants. Currently, 523 lakes totaling 123,008 acres have current assessments on at least one of four uses and are the basis of the Integrated Report. Not all uses are assessed for all lakes. Lakes assessed through 2015 are included in this Report.

Lake data from the above efforts are reviewed to evaluate support of designated uses and compliance with water quality criteria. Updated DEP lake assessment methodologies have been publicly reviewed and are posted on DEP's webpage at http://www.dep.pa.gov (Search: "2015 Assessment Methodology").

Lake impairment screening to determine the TSI, identify water quality violations, and determine impacts on recreational uses and aquatic life is ongoing statewide. TSI lake survey results, along with other water chemistry parameters, fish and aquatic macrophyte survey data, lake habitat surveys, and microbiological data (bacteria, algal, and cyanotoxin data) are used to determine lake use attainment status. These studies also identify waterbodies in need of more in-depth (Clean Lakes Phase I type) studies to evaluate existing water quality conditions in the lake and watershed, identify sources and magnitude of pollutants, and recommend lake and watershed management plans to restore or protect water quality. Phase II projects continue to document water quality conditions and also implement lake and watershed BMPs as recommended in the Phase I diagnostic and management plan.

Institutional BMPs (environmental education efforts, such as workshops and outreach) are integral components of successful projects and can be as important as structural BMPs. Continued water quality studies are recommended to monitor the success of control efforts. Also, TMDL lakes are targeted for monitoring on a continuing basis, post-BMP installation, so that water quality improvements may be detected and reported. Several of the TMDL lakes are improving and have been subjects of "Success Stories" on the DEP website: http://www.dep.pa.gov/Business/Water/PlanningConservation/NonpointSource/Pages/Success.aspx and EPA's "Success Stories" featured on their website: http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/nonpoint-source-success-stories.

Lake acreages herein are standardized to the acres reported in the National Hydrography Dataset (NHD) where possible. Some differences in reported acreages will remain until all data are extracted from only the NHD layer and errors in the NHD layer are corrected. Until then, lake numbers reported for various statistics and tables will be variable.

Part C1.7. Citizens' Volunteer Monitoring

In July 2009, due to budget constraints, DEP began limiting its direct technical and financial support for volunteer monitors to specific DEP high priority projects. Projects related to DEP's priorities include working with program staff and volunteers to monitor sections of streams to assess impacts from stream restoration projects, best management practices and abandoned mine land remediation projects, which are supported by 319 Nonpoint Source Program or DEP monies. Conservation Reserve Enhancement Program (CREP) activities are also being monitored to assess the effectiveness of these practices. As priorities change and needs arise, DEP will continue to work with volunteers in monitoring the effectiveness of projects.

DEP recruits citizen volunteers from across the state for bacteria monitoring for the purpose of Recreational Use assessment. Volunteers from Senior Environmental Corps, Watershed Associations, and County Conservation Districts are trained by DEP in adherence to sampling protocol and quality assurance plans. All fecal coliform laboratory analysis is completed by DEP certified laboratories. The bacteria data collected by various citizen volunteer groups in

2014 and 2015 resulted in the assessment of approximately 250 stream miles for Recreational Use.

Requests from volunteer monitors for services previously provided by DEP such as routine technical assistance and training on preparation and implementation of a locally driven monitoring plan are being directed to the Consortium for Scientific Assistance to Watersheds or Nature Abounds. The Consortium, a group of service providers, is funded through a Growing Greener grant administered by DEP while Nature Abounds, a nonprofit organization, has a 319 Nonpoint Source Management Grant to support the Pennsylvania Senior Environment Corps program and monitoring.

Part C1.8. Existing and Readily Available Information

In an effort to utilize all existing and readily available data, DEP contacted approximately 475 potential outside data sources (federal, state, and local governments; universities; advisory groups; citizen monitoring groups; watershed associations; public interest groups; and sportsmen's groups) to request information regarding water quality. Each group on the mailing list received materials that briefly explained the reasons why DEP was soliciting information from them. Minimum quality assurance standards for the data were made available on DEP's website. Those groups with data and/or information regarding water quality limited segments were requested to fill out a data submission form and return it, along with any pertinent supporting documentation, to DEP.

For any given listing cycle, DEP determines the accuracy and validity of existing and readily available data and information provided by outside groups based on a set of minimum quality assurance requirements. These requirements include the specific location of the reported impairment, identification of the particular water quality standards violation(s), data to substantiate the conclusion of impairment, identification of the source(s) and cause(s) of impairment, and the presence of a quality assurance/quality control plan. Acceptable data from these sources are then included in the assessment database to prepare the use support summary in this narrative report and the five-part list of waterbody-specific use support decisions. More detail on this process is provided in the assessment and listing methodology document associated with the five-part list.

Data from three separate outside data sources were submitted to DEP for consideration in the 2016 Integrated Report.

Pennsylvania Fish and Boat Commission (PFBC) submitted data pertaining to a follow-up survey completed on August 14, 2015, in response to reports of nuisance algae levels on August 8, 2015, on the Juniata River. The PFBC data included photographs, site-specific observations, and descriptions including percent algae coverage visual estimates, and water quality data at Lewistown, Mifflintown, Port Royal, and Thompsontown. The higher channel filamentous algae (*Cladophora* sp.) coverage estimates were ~75% at Thompsontown and ~50% at Port Royal and Lewistown (Veterans Memorial Bridge) on August 14, 2015. The PFBC staff noted that algal growth and density declined on the Juniata River reaches between the communities noted above and was sporadic in occurrence but in general was at a higher density at downstream sites. Physicochemical data results collected at each site were within the expected range and did not exceed established water quality criteria.

In order to use this information for an assessment of the recreational use, more information is needed regarding the frequency and persistence of algae blooms at these locations on the Juniata River to determine whether the problem is an acute event or more chronic in nature. The Department is currently working on developing an assessment methodology that will have magnitude, duration, and frequency components to determine when algae levels impair the recreational use of a waterbody.

The Chester Water Authority submitted 2014 and 2015 fecal coliform and nitrite plus nitrate data for the Octoraro Reservoir and nitrite plus nitrate data for the East and West Branches of Octoraro Creek. The nitrite plus nitrate criterion stated in Chapter 93 of the Pa. Code provides a maximum level of 10 mg/l, which cannot be exceeded more than one percent of the time. The fecal coliform criterion for potable water supply provides a maximum of 5,000/100 ml as a monthly average, with no more than this number in >20 samples collected in a month, nor more than 20,000/100 ml in more than 5% of the samples. The Octoraro Reservoir exceeded the potable water supply criteria for fecal coliforms in both 2014 and 2015. Eleven percent of the samples were greater than 20,000/100 ml in 2014 and nine percent were greater than 20,000/100 ml in 2015. The East and West Branches of Octoraro Creek were placed in Category 5 of the Integrated Report in 2006, with a cause of nutrients. The data submitted this year confirms the continued impairment of the West Branch Octoraro Creek which violated the 99% rule for the nitrite plus nitrate criterion in 2014. The East Branch Octoraro Creek did not exceed the criterion for nitrite plus nitrate in either the 2014 or 2015 datasets, however, the nutrient impairment will remain on the East Branch Octoraro Creek due to the Authority implementing advanced treatment to meet drinking water standards at current elevated levels of nitrite plus nitrate.

The Susquehanna River Basin Commission (SRBC) submitted data and documentation for four different studies they conducted in the Susquehanna River basin during 2013. Quality Assurance Plans and final reports were provided for all four studies. Water chemistry data was collected during the four studies and 73 samples were submitted for review. The water chemistry data is valuable information that DEP can use while monitoring and assessing streams in the Susquehanna River watershed. Many of the sites were sampled only one-time for water chemistry or targeted higher flows and therefore could not solely be used to make an assessment. A few stations had four samples and that data was reviewed for assessment purposes; however, no new assessments were made because additional sample locations were necessary. Macroinvertebrate data was collected for all four studies and 62 samples were submitted to DEP. Three of the studies used DEP's macroinvertebrate sampling protocol. DEP's macroinvertebrate Index of Biotic Integrity (IBI) was calculated for all 45 samples that used the PA DEP protocol. Single stations do not adequately represent the water quality of large watersheds so in these instances an assessment for the Integrated Report was not done. However, the macroinvertebrate data will help DEP biologists when considering watersheds for reassessment. Where there was adequate data to make assessments, four aquatic life use assessments were entered based on the IBI score. All four assessments were for stream segments attaining their aquatic life use. Fish survey data was collected during two of the studies and data for 36 samples was submitted. DEP is currently developing a Susquehanna\Potomac basins fish IBI and has published a semi-quantitative fish sample protocol for wadeable streams in the 2013 Assessment Methods. Stations sampled with methods comparable to DEP's protocol will be assessed using the fish IBI when it becomes available.

Data is often provided to DEP outside of the data submission window. The Department may specifically request this data or it may be provided by the data holder on their own. This data is very valuable to the Department and it is also considered for assessment purposes. For example, data was received from Trout Unlimited which was used to reassess the Potts Run watershed in Clearfield County.

Part C2.1. Assessment and Methodology

On October 3, 2015, the Department sought public comments on several new or revised assessment methods. The public participation period closed on November 17, 2015, and the Department received comment from one commenter. The revised and new protocols were finalized in February 2016.

Revised protocols include:
Lake Assessment Protocol
Aquatic Macrophyte Cover
Plankton Sampling
Chlorophyll-a Sampling

New protocols include:

Cause and Effect Surveys
Bacteriological Sampling Protocol

The other methods remain unchanged from the 2013 assessment methods.

Because of its length, the 2015 Assessment Methodology is not included in this report but rather is posted separately on DEP's website. It is available electronically at http://www.dep.pa.gov (Search: "2015 Assessment Methodology").

The Methodology describes the collection and analytical methods used to evaluate stream assessment information. The resulting assessments comprise the stream miles, lake acreages, and attained/impaired status reported in the 2016 Integrated Report.

The 2015 Assessment Methodology contains the following protocols:

Watershed Assessment Protocol
Instream Comprehensive Evaluations (ICE)

Macroinvertebrate Stream Protocols
Limestone Steams
Multi-Habitat Pool/Glide Streams
Riffle/Run Freestone Streams (PDF)

Field Sampling Protocols
Bacteriological Sampling Protocol (PDF)
Cause and Effect Survey (PDF)
Continuous Instream Monitoring (PDF)
Periphyton (PDF)

Streambed Sediment (PDF)
Surface Water Collection (PDF)
Semi-Quantitative Fish Sampling protocol (PDF)

Lake Assessment Protocols
Lake Assessment Protocol
Aquatic Macrophyte Cover
Lake Fisheries
Evaluations of Phosphorus Discharges to Lakes, Ponds, and Impoundments
Plankton Sampling
Chlorophyll A Sampling

Chemistry and Bacteria
Chemistry - Bacteriological Evaluations (PDF)
Fish Tissue Sampling

Natural Sources
Natural Pollutant Sources

Outside Agency
Outside Agency Data

Appendices
Appendix A - Sources and Cause Definitions (PDF)
Appendix B - Taxa Tolerances
Appendix C - Biological Field Methods
- Appendix C1 - Habitat (PDF)
- Appendix C2 - Benthic Macroinvertebrates (PDF)
- Appendix C3 - Fish (PDF)
- Appendix C4 - Taxonomic Reference (PDF)

Part C3.1. Stream Use Support

Table 2 is a summary of the four Use Support categories used in the listing. Miles "supporting" are the number of miles not impaired for an assessed water use; "impaired" are not supporting the assessed use and requiring a TMDL; "approved TMDL" refers to impaired segments for which an approved TMDL is in place to address the problem(s), and "compliance" lists stream miles impaired but expected to improve in a reasonable amount of time because formal agreements are in place obligating responsible parties to take corrective action. "Pollution" is a special category of impairment listing problems that cannot be addressed through a TMDL because they are not caused by pollutant loading. "Assessed" represents the total miles surveyed for that use. "Restored" represents waters that were impaired (Category 4 or 5) on previous Integrated Reports but are now attaining one or more uses (Category 1 or 2).

Table 3 summarizes the sources of impairment problems and Table 4 the causes. Note that totaling the sources or causes will not equal the miles summarized in Table 2 because a given waterbody may have multiple sources and/or causes. The tables are statewide summaries. The individual source/cause pairs for each waterbody are found on Categories 4b, 4c, and 5. The lists are large and, as a result, are provided on the DEP website at http://www.dep.pa.gov

(Search: "Integrated Report"). Continued database and stream layer corrections to remove stream assessment errors from many lakes and impoundments resulted in a reduction of the total miles assessed for aquatic life use.

Table 2
Statewide Assessment Summary
A statewide summary of use support status for four water uses in assessed streams

	Aquatic Life Use	**Fish Consumption Use**	**Recreational Use**	**Potable Water Supply Use**
Streams (miles)				
Assessed*	83,222	8,177	18,356	3,446
Supporting	66,565	5,830	10,791	3,390
Impaired	9,821	2,052	7,398	50
Approved TMDL**	7,283	676	155	12
Compliance	46	---	---	---
Pollution***	3,229	---	---	---
Restored****	167	84	47	21

* Database management to remove assessments from stream lines in lakes and impoundments reduced total miles assessed.
** TMDL miles reported here are only those overlapping impaired segments. A TMDL allocation may include an entire watershed, including streams listed as attained.
*** 2,489 miles have both pollution and pollutant problems.
**** Stream miles now attaining and removed from Category 5 and placed in Category 1 or 2. The sum of miles exceeds total miles restored due to overlap between assessed uses.

Table 3
Statewide Assessment Summary
Sources of Impairment: Streams
Totals Include List 4a, 4b, 4c, and 5
(Mile totals will not equal Table 2 because a waterbody can have multiple impairments)

	Designated Use (Miles)				
Source	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Source Unknown	606	3,467	7,155	40	11,268
Agriculture	6,421		372	4	6,798
Abandoned Mine Drainage	5,595			12	5,607
Urban Runoff/Storm Sewers	2,902		149		3,051
Habitat Modification	1,090				1,090
Road Runoff	932				932
Small Residential Runoff	746				746
Atmospheric Deposition	520				520
Municipal Point Source	415		7	1	423
Removal of Vegetation	399				399
Channelization	334				334
Other	314		2		316
Bank Modifications	310				310
Land Development	228				228
On-site Wastewater	199		3		202
Hydromodification	195				195
Erosion from Derelict Land	192				192
Construction	164				164
Upstream Impoundment	159				159
Natural Sources	138				138
Industrial Point Source	110	11			121
Flow Regulation/Modification	120				120
Subsurface Mining	120				120
Surface Mining	117				117
Combined Sewer Overflow	102			12	114
Petroleum Activities	63				63
Golf Courses	60				60
Silviculture	18				18
Highway, Road, Bridge Const.	16				16
Package Plants	15				15
Land Disposal	13				13
Draining or Filling	10				10
Logging Roads	2				2
Recreation and Tourism	2				2
Dredging	1				1

Table 4
Statewide Assessment Summary
Cause of Impairment: Streams
Totals Include List 4a, 4b, 4c, and 5
(Mile totals will not equal Table 2 because a waterbody can have multiple impairments)

	Designated Use (Miles)				
Cause	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Siltation	9,624			2	9,626
Pathogens			7,565	38	7,603
Metals	5,143			12	5,155
pH	2,879				2,879
Nutrients	2,605			1	2,606
PCB		2,015			2,015
Cause Unknown	1,867				1,867
Water/Flow Variability	1,826				1,826
Mercury		1,662			1,662
Other Habitat Alterations	1,481				1,481
Organic Enrichment/Low D.O.	1,313				1,313
Flow Alterations	721				721
Suspended Solids	528				528
Turbidity	222				222
TDS	169			7	176
Excessive Algal Growth	148				148
Thermal Modifications	78				78
Unknown Toxicity	66				66
Other Inorganics (Sulfates, etc.)	51			3	54
Osmotic Pressure	37				37
Oil and Grease	35				35
Exotic Species	31				31
Dioxins		46			46
Nonpriority Organics	23				23
DO/BOD temp	19				19
Un-ionized Ammonia	18				18
Priority Organics	18				18
Pesticides	10				10
Chlorine	9				9
Filling and Draining	6				6
Chlordane		3			3
Chlorides	3				3
Trash	1				1

Monitoring information indicates that 66,565 miles support designated aquatic life use. A total of 9,821 miles are reported as impaired and still requiring a TMDL and 7,283 miles are impaired but already have an approved TMDL. There are 3,229 miles with pollution problems not requiring a TMDL, and 46 miles are impaired but expected to improve in a reasonable time pending agreed upon corrective action.

The four largest sources of reported impairment for aquatic life are agriculture, abandoned mine drainage, urban runoff/storm sewers, and habitat modification. The leading causes are siltation, metals, pH, nutrients, and water/flow variability. While it is not possible to link sources to causes at the level of detail presented in Tables 3 and 4, many of the causes other than water/flow variability are known to be associated with the three leading sources of abandoned mine drainage, agriculture, and urban runoff/storm sewers. Agricultural impairments are generally caused by nutrients and siltation associated with surface runoff, groundwater input, and unrestricted access of livestock to streams. Low pH, elevated concentrations of metals, and siltation are the result of abandoned mine drainage runoff from mine lands and refuse piles. Increased levels of nutrients and siltation, along with flow variability, are associated with urban runoff. The sources associated with water/flow variability are varied including hydromodification, road runoff, urban runoff/storm sewers, and several others. Any source that alters runoff or streamflow can affect water/flow variability. Water/flow variability is considered pollution not requiring a TMDL but the problem still requires remediation.

There are 8,177 assessed miles supporting the fish consumption use and 2,052 miles impaired and still requiring a TMDL. There are approved TMDLs for 676 miles. The 8,177 miles supporting this use is a conservative estimate. As a rule, when fish tissue samples are clean the results are only extrapolated to represent two miles on small streams and ten on larger waterbodies. To protect the public, larger extrapolations are made when the fish tissue samples are tainted.

The major source of contamination resulting in fish consumption advisories is listed as unknown because it is difficult to trace the sources. The contamination can be in the soil, groundwater, stream sediment, or point sources. The contaminants do not readily break down and can linger for decades. In addition, fish can move considerable distances. Only with careful study can the source of contamination be determined with certainty. The contaminants documented are PCB, mercury, chlordane, and dioxin, in decreasing order. Atmospheric deposition is the most likely source of mercury. There is a statewide advisory limiting consumption of recreationally caught fish to one meal per week. If fish tissue mercury concentrations are greater than the one meal per week level (higher concentrations), they are placed in the Category 5 of waters. Conversely, if subsequent samples indicate the concentrations are now less than the one meal per week level, meaning it is okay to eat more than one meal per week, they are removed from Category 5.

Recreational use is assessed primarily by measuring bacteria levels. High bacteria densities indicate conditions that might cause sickness from contact with or ingestion of the water. Many of the waters targeted for sampling were suspected of having bacteria problems, so the 7,398 miles of impaired miles versus the 10,791 miles attaining is not unexpected. There are 155 miles with an approved pathogen TMDL. The major source of pathogens is listed as source unknown followed by agriculture. If there are several potential sources of bacteria in the watershed, the assessor lists the source as unknown until better information becomes available.

Potable water supply use was supported in 3,390 miles of streams assessed, not supported in 50, and 12 had approved TMDLs. This potable water supply use is measured before the water is treated for consumption. The primary assessment measures are nitrate and nitrite levels and bacteria but additional parameters, both organic and inorganic, are considered.

Part C3.2. Record of Changes to the 2014 Integrated List 5 Made in the 2016 Integrated List

The Integrated List is part of a biennial report. The previous list included data gathered through 2013. In the two-year period leading up to this report, a number of waterbodies listed as impaired on the 2014 Integrated Report were resurveyed. Impaired waters may be resurveyed for a number of reasons including the need for additional data to support TMDL development, or changes in land use, or point source discharge characteristics. Waters are re-evaluated on a rotating basis as per the ICE sampling protocol outlined in the 2015 Assessment Methodology. Areas where watershed improvement projects are in place are also targeted to document improvements that may result.

Appendix E tracks changes in the status of waters impaired in 2014 but attaining uses in 2016. Each of these delistings is the result of a detailed chemical or biological survey and subsequent data evaluation. Appendix F tracks changes in the pollutant causes. Entries for waters that were reported as impaired in the 2014 Integrated Report, but subsequent surveys found them to be impaired by different pollutants than initially reported, are edited to better reflect the issues. The comments associated with each record describe the changes. Lastly, Appendix G describes records with errors. Some are mapping errors discovered because the GIS coverage has undergone several revisions and, occasionally, some legacy mapping errors are uncovered. Other errors relate to an impairment being incorrectly mapped to a pollutant source. Comments in these records describe the error.

Part C3.3. Lakes Use Support

Table 5 is a summary of the four use support categories for lakes. Acres “supporting” represents the number of acres not impaired for the assessed use. “Impaired” acres (Category 5) do not support the assessed use and still require a TMDL. “Approved TMDL” includes impaired lake waters where a TMDL has been completed and approved by EPA. “Impaired (Category 4c)” is a special category of use impairment where a problem is documented but it will not be addressed through a TMDL. Pollution is a special category of impairment, where the issues are caused by natural lake conditions, rather than pollutant loadings, so the issues will not be addressed through a TMDL. “Assessed” refers to the total acres surveyed for that use. “Restored” represents waters that were impaired (Category 4 or 5) on previous Integrated Reports but are now attaining one or more uses Category 1 or 2).

Table 6 summarizes the sources of impairment problems, and Table 7 summarizes the causes. Note that totaling the sources or causes will not equal the acres summarized in Table 5. This is because a waterbody may have multiple sources and causes. The individual source/cause pairs for each waterbody are found on Categories 4b, 4c and 5.

The lists are large and as a result are provided on the DEP website at http://www.dep.pa.gov (Search: “Integrated Report”).

Table 5
Statewide Lake Assessment Summary
A statewide summary of use support status for four water uses in assessed lakes

	Aquatic Life Use	Fish Consumption Use	Recreational Use	Potable Water Supply Use
Lakes (acres)				
Assessed	86,166	74,504	86,768	68,972
Supporting (Lists 1 & 2)	53,533	38,024	79,638	68,337
Impaired (List 5)	6,448	30,838**	7,130	635
Impaired (List 4c)	17,549	---	---	---
Approved TMDL (List 4a)	5,635*	5,642	---	---
Restored***	8,536	---	---	---

* Lake Wallenpaupack is now attaining ALU, and no longer included in the TMDL total.
** Presque Isle Bay acres are included in the fish consumption and recreation use totals. The remainder of Lake Erie is not included in the pathogen and recreation acre totals. Pennsylvania has 63 miles of Lake Erie shoreline, 14 of which comprise Presque Isle.
*** Lake acres now attaining and removed from Category 5 and placed in Category 1 or 2.

Table 6
Statewide Assessment Summary
Sources of Impairment: Lakes
Totals Include List 4a, 4b, 4c, and 5
(Acre totals will not equal Table 5 because a waterbody can have multiple impairments)

Designated Use (Acres)					
Source	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Source Unknown	3,609	16,407	5,144		25,160
Atmospheric Deposition	219	19,461			19,679
Other	16,628				16,628
Agriculture	8,677		1,266	623	10,565
Urban Runoff/Storm Sewers	3,523		82		3,605
On-site Wastewater	3,218		87		3,304
Municipal Point Source	2,964		24		2,988
Habitat Modification	2,259		622		2,881
Natural Sources	1,242				1,242
Small Residential Runoff	540				540
Removal of Vegetation	445				445
Abandoned Mine Drainage	365			12	377
Hydromodification	171		68		239
Golf Courses	210				210
Bank Modifications	192				192
Road Runoff	185		5		190
Recreation and Tourism	185				185
Package Plants	160				160
Construction	76				76
Draining or Filling			15		15
Land Development	5		5		10

Table 7
Statewide Assessment Summary
Causes of Impairment: Lakes
Totals Include List 4a, 4b, 4c, and 5
(Acre totals will not equal Table 5 because a waterbody can have multiple impairments)

Designated Use (Acres)					
Cause	**Aquatic Life**	**Fish Consumption**	**Recreation**	**Water Supply**	**Total**
Mercury (Lakes)		32,449			32,449
pH	17,284				17,284
Nutrients	8,660		137	623	9,420
Organic Enrichment/Low D.O.	5,221				5,221
Suspended Solids	4,886		57		4,943
Pathogens			4,897*		4,897
PCB		3,899*			3,899
Noxious Aquatic Plants	341		1,942		2,283
Excessive Algal Growth	1,834		31		1,866
Exotic Species	1,771		84		1,854
DO/BOD	1,232				1,232
Turbidity	445				445
Metals	365			12	377
Siltation	280		20		300
Other Habitat Alterations	210		74		284
Un-ionized Ammonia	25				25

* Additional 63 shoreline miles for Lake Erie are not included in the acres total.

A total of 86,166 acres of Commonwealth lakes have been assessed for aquatic life use, and of these acres, 53,533 acres support that use. There are 6,448 assessed lake acres that are impaired and still require a TMDL. Approved TMDLs are in place for 5,635 acres. Pollution problems that do not require TMDLs impair 17,549 acres. The major sources of aquatic life use impairment in lakes are “other” and agriculture. “Other” is the source used for lakes on Category 4c which are impaired from water quality violations but not requiring a TMDL. These lakes show short term fluctuations in DO or pH but support a healthy biotic community. The primary stressors are nutrients, suspended solids, organic enrichment/low DO, and pH. Low DO and high pH problems are associated with summer lake stratification and high productivity in the epilimnion while low pH problems are associated with natural bog conditions.

Fish consumption assessments covered 74,504 lake acres (excluding Lake Erie but not including Presque Isle Bay). Of these, 38,024 acres are assessed as supporting this use, 30,838 acres are reported as requiring a TMDL, and 5,642 acres have approved TMDLs. The reason for the large proportion of impaired acres is the implementation of Pennsylvania’s risk-based mercury fish consumption advisory methodology in 2001. Nearly all of the lake advisories are due to mercury with atmospheric deposition listed as the source.

In addition, fish consumption advisories are in place for a number of species in the Pennsylvania portion of Lake Erie. These advisories are due to the presence of PCB and mercury. There are 63 miles of Lake Erie shoreline in Pennsylvania, fourteen of which comprise the Presque Isle Peninsula.

A total of 86,768 lake acres have been assessed for recreational use support and 7,130 of those acres require TMDLs. Pathogens and exotic and/or noxious species are responsible for the impairments.

All but 635 acres of 68,972 acres assessed for potable water supply use were found to be attaining that use.

Part C3.4. Excluding the Fishable and Swimmable Uses

DEP routinely re-evaluates, as part of its triennial review of water quality standards, the two water bodies where the fishable or swimmable uses specified in Section 101(a) (2) of the federal Clean Water Act are not being met: (1) the Harbor Basin and entrance channel to Outer Erie Harbor/ Presque Isle Bay and (2) several zones in the Delaware Estuary.

The swimmable use designation was deleted from the Harbor Basin and entrance channel demarcated by U.S. Coast Guard buoys and channel markers on Outer Erie Harbor/Presque Isle Bay because boat and commercial shipping traffic pose a serious safety hazard in this area. This decision was based on a Use Attainability study completed in 1985. Because the same conditions and hazards exist today, no change to the designated use for Outer Erie Harbor/Presque Isle Bay is proposed.

DEP cooperated with the Delaware River Basin Commission (DRBC), EPA and other DRBC signatory states on a comprehensive Use Attainability study in the lower Delaware River and Delaware Estuary. This study resulted in appropriate restrictions relating to the swimmable use, which DRBC included in water use classifications and water quality criteria for portions of the tidal Delaware River in May 1991. These changes were incorporated into Sections 93.9e and 93.9g (Drainage Lists E and G) of Pennsylvania's Water Quality Standards in 1994. The primary water contact use remains excluded from the designated uses for river miles 108.4 to 81.8 because of continuing significant impacts from combined sewer overflows and other hazards, such as commercial shipping traffic.

Part C3.5. Lakes Trophic Status

Lake trophic status, based on Carlson's Trophic State Index (TSI), is used as a tool to monitor lake status in Pennsylvania. Lakes with a TSI of less than 40 are oligotrophic (nutrient poor); 40-50 is mesotrophic; 50-65 is eutrophic (nutrient rich); and greater than 65 TSI is considered hypereutrophic. TSIs for Pennsylvania lakes are based on seasonal mean values of phosphorus, Secchi depth and chlorophyll-a. See Methods documents cited above. The trophic category is based on the Total Phosphorus (TP) TSI. Table 8 summarizes lake trophic status. Sums do not include Lake Erie but do include Presque Isle Bay for pertinent data.

Table 8
Lake Trophic Status: Summary of Lakes Assessed

	Number of Lakes	Acreage of Lakes
Total Assessed (all types)	507*	
Assessed for TSI (2004 to 2015)	218	84,351**
Oligotrophic	13	2,143
Mesotrophic	81	21,491
Eutrophic	86	31,757
Hypereutrophic	18	27,439
Unassigned (incomplete data) datacompletcurrent WQNs)	20	1,521

* Excel summary table of recent data not from NHD coverage.
** Total Lakes assessed since the inception of lake assessment program for all categories.

Part C3.6. Lake Restoration Efforts

The Commonwealth's lake protection and restoration program is mainly supported by EPA's Nonpoint Source Program (Section 319 of the Clean Water Act) and the State's Environmental Stewardship Program, through Growing Greener grants. Other funding sources include EPA Section 104(b)3 grants, the Natural Resources Conservation Service (NRCS) PL566 program, and other programs such as the Chesapeake Bay Program and PENNVEST (Clean Water State Revolving Funds). DCNR also funds in-lake restoration practices for State Park lakes. Various partners are engaged in lake and lake watershed restorations and are not limited to the lake owners. Watershed partners include county Conservation Districts, which implement many DEP program initiatives and also serve as grant and project managers. Program goals to restore and/or protect lake water quality are based on studies that identify impairments, pollution sources, and the course of remediation. Public use and benefit of the lake, and watershed priority based on impairment, are important criteria in prioritizing lakes to be funded.

Restoration techniques implemented through Phase II or restoration grants include various watershed and in-lake best management practices (BMPs) such as agricultural BMPs, riparian corridor protection and restoration (buffers and in-stream structures), lake shoreline protection, dredging, stormwater management and control techniques, point source controls, aquatic macrophyte controls, lake and watershed liming, alum treatments, biomanipulation to benefit fisheries, lake drawdowns, septic management, wildlife control, and institutional BMPs including public education efforts and enacting protective municipal ordinances. Sewage treatment plant upgrades are also an important control technique to improve lake water quality. Additionally, controlling invasive species is an important restoration theme, with increasing numbers of lakes impacted by Eurasian watermilfoil, water chestnut, and zebra/quagga mussels. Some limited Growing Greener and Sea Grant funds are available for control of these organisms.

Table 9 provides information on current Phase I (assessments) and Phase II (restoration/implementation) lake work conducted in the Commonwealth. Expenditures on active lake projects or lake watershed projects in Pennsylvania currently amount to approximately $3.88 million for projects ongoing in 2014-2015. Table 10 summarizes known techniques used in lake restoration projects in Pennsylvania's public lakes as of 2015.

Part C3.7. Lake Control Methods

Pennsylvania's lake management regulation is codified in DEP's Rules and Regulations at Section 96.5(b) - Discharges to Lakes, Ponds, and Impoundments, which sets forth treatment requirements for point source discharges necessary to control eutrophication. It is a technology-based approach that results in increasingly stringent effluent requirements based on an assessment of the water quality benefits of such controls. The need for and extent of point source controls for a specific lake are determined by field studies conducted during spring overturn, summer stratification, and fall overturn. Appropriate nutrient limitations and monitoring requirements are included in NPDES permits based on the trophic conditions found during these studies. In most cases, follow-up monitoring is conducted to evaluate the adequacy of the effluent limitations.

Nonpoint source pollution can also impact lake water quality. Phase I diagnostic studies on Pennsylvania lakes have identified nonpoint source impacts from acid deposition, agricultural runoff, streambank erosion, malfunctioning septic systems, construction, stormwater runoff, and pathogens. Ecosystem impacts from exotic invasive aquatic plants are also increasing. Mitigation of these sources is highlighted in the previous section. Acidity problems, resulting mostly from acid deposition, but also in a few cases mining runoff, may be mitigated with lime treatments, although funding for these types of projects is very limited. Lakes with naturally low pH (swamps and bogs) are not considered for treatment but may be listed in part 4C of the Integrated List. Liming is the current method to mitigate low pH in lakes, and is used in PA on both public and private lakes. Some lakes (reservoirs) have been identified as impaired by metals from mine drainage, or more commonly by mercury (mainly via fish tissue), and no lakes have been identified as impacted by "high acidity," based on high concentrations of dissolved metals. Restoration efforts and BMPs in the watershed are the best way to reduce mining effects in waterbodies (i.e. treating the source of the problem). In-lake mitigation could be explored by using alum treatments to bind metals into the lake sediments. Some "toxics" can be removed by dredging but, again, funding for dredging is limited. Most efforts have focused on source control (mining BMPs or AMD BMPs) and natural recovery rather than in-lake mitigation.

Table 9

Active Lake Projects in Pennsylvania Public Lakes as of 2015. Does not include water quality assessments done by DEP. Growing Greener and 319 final reports available from DEP, Bureau of Conservation and Restoration.

Lake or Study Name	County	Study Type	Study Period	Federal Funds	Fund Source	State Funds	Match	Sponsor /Project
Antietam Lake	Berks	Phase II	2010-2016	$100,000	319		$28,885	Berks Co Commissioners; stream BMPs
Beaver Run Reservoir	Westmoreland	Phase II	2014-2017		GG	$129,945	$29,838	Westmoreland CCD; ag BMPs in watershed
Beaver Run Reservoir	Westmoreland	Phase II	2014-2017		GG	$70,000	$152,540	Westmoreland CCD; dirt & gravel roads in watershed
Blue Marsh Lake	Berks	Phase II	2014-2017		GG	$292,961	$54,068	Berks CCD; ag BMPs
Conneaut Lake	Crawford	Phase II	2010-2015		GG	$43,050	$6,458	Crawford CCD; ag BMPs, partial in lake's watershed
Conneaut Lake	Crawford	Phase I and Phase II	2015-2018		GG	$104,167	$28,384	Crawford CCD/ ag BMPs
C-SAW - Various Small Lake Projects	multi	Phase I and Phase II	2012-2016		GG	$2,800		C-SAW - Consortium of Scientific Assistance to Watersheds
Frances Slocum Lake	Luzerne	Phase II	2013-2015	$269,964	319		$24,580	Luzerne CCD, in-lake and watershed BMPs
Glendale Lake	Cambria	Phase II	2012-2016		GG	$16,580	$12,544	Cambria CCD, shoreline rehab.

Lake or Study Name	County	Study Type	Study Period	Federal Funds	Fund Source	State Funds	Match	Sponsor /Project
Harvey's Lake	Luzerne	Phase II and III	2012-2016	$366,100	319			Harvey's Lake Borough; stormwater BMPs and monitoring
Harvey's Lake	Luzerne	Phase II and III	2014-2018	$196,810	319			Harvey's Lake Borough; stormwater BMPs and monitoring
Lake Carey	Wyoming	Phase II and III	2013-2016		GG	$111,610	$22,240	Lake Carey Welfare Assn; stormwater BMPs
Lake Erie	Erie	Phase II	2008-2014		GG	$91,785	$13,785	Erie PSU; stream projects & monitoring Bear Run
Lake Erie	Erie	Phase II	2012-2016		GG	$371,843	$71,282	Penn State University
Lake Luxembourg	Bucks	Phase II	2012-2016	$293,900	319		$52,680	Bucks CCD; watershed BMPs
Lake Luxembourg	Bucks	Phase II	2014-2018	$153,145	319		$26,820	Bucks CCD; forebay rehab.
Lakes Redman & Williams	York	Phase II	2014-2015	$59,925	319			Izaak Walton League; stream BMP design
Lake Ontelaunee	Berks	Phase II	2015-2018		GG	$292,961		Berks CCD; ag BMPs
Lake Wallenpaupack	Pike	Phase II	2012-2016		GG	$76,050		Lake Wallenpaupack Watershed Mgmt Dist.

Lake or Study Name	County	Study Type	Study Period	Federal Funds	Fund Source	State Funds	Match	Sponsor /Project
Octoraro Lake	Lancaster, Chester	Phase II	2014-2017		GG	$28,300	$19,256	Octoraro Watershed Assoc; ag BMPs
PA Lake Management Society (PALMS)	statewide	Phase II	2011-2016		GG	$283,000	$105,074	PALMS – small lake BMPs statewide
Pinchot Lake	York	Phase II	2014-2016		GG	$41,200	$17,622	Warrington Twp; wetland islands
Speedwell Forge Lake	Lancaster	Phase II	2012-2014		GG	$43,509	$7,603,858	Save Speedwell - dam repair and restoration
Stephen Foster Lake	Bradford	Phase II	2014-2017	$214,967	319			Bradford CCD; forebay rehabilitation
Stephen Foster Lake	Bradford	Phase III	2013-2015	$6,000	319			Bradford CCD for efficacy monitoring - 2 yrs.
Tioga Lake	Tioga	Phase II	2008-2014		GG	$227,107	$34,066	Tioga CCD; Dirt & Gravel Roads
Total Funds				**$1,660,811**		**$2,226,868**	**$8,303,980**	
Total Federal and State Funds								**$3,887,679**

319 = Nonpoint Source Program
DCNR = PA Dept. of Conservation & Natural Resources
GG = Growing Greener Program, PA Environmental Stewardship Funds
CCD = County Conservation District
Phase 1 = lake & watershed assessment/monitoring & management plan
Phase II = restoration BMPs, including Educational
Phase III = monitoring for efficacy, post-TMDL

Table 10
Lake Rehabilitation Techniques Used in Public Lakes

Technique	Number of Lakes on which Technique is Used	Acres of Lakes on which Technique is Used
In-Lake Treatment		
Aeration	4	130
Aquatic herbicide treatment	44	1471
Aquatic macrophyte harvesting	5	345
Artificial Wetland Islands	6	200
Dredging	2	53
Invasive species controls	10	549
Lake drawdowns	22	7,121
Liming	2	120
Watershed Treatments		
Sediment traps/detention basins	8	8,317
Shoreline erosion controls/bank stabilization	17	15,097
Conservation tillage	5	7,739
Animal waste management practices	11	12,258
Riprap installed	4	7,334
Road or skid trail management	6	16,029
Stream restoration (natural channel design)	4	1,821
Created wetlands	6	1,834
Other Lake Protection/Restoration Controls		
Local lake management program in place	26	15,941
Public information/education	60	63,807
Local ordinances/regulations to protect lake	4	7,537
Point source controls	19	13,251
Dam repairs	8	878

Part C4. Wetlands Protection Program

Pennsylvania has 403,924 acres of wetlands and 412,905 acres of deep-water habitats such as ponds and lakes. About 1.4% of the Commonwealth's land surface is represented by wetlands, with 97% classified as palustrine. Approximately 76% of the palustrine wetlands are further classified as forested and scrub/shrub wetlands. Lacustrine wetlands, mainly composed of the shallow zone (less than 6.6 feet deep) of Lake Erie, represent about two percent of the total while riverine wetlands make up the remaining one percent. Pennsylvania has 1,382 acres of tidal wetlands in the Delaware Estuary.

Wetlands are most abundant in the glaciated portions of northeastern and northwestern Pennsylvania. Crawford, Mercer, Erie, Monroe, Pike, Wayne and Luzerne counties contain 40% of the Commonwealth's wetlands. Pike and Monroe counties have the highest percentages of land covered by wetlands with 6.7% and 6.4%, respectively.

The term "wetland" describes, in a collective way, what are more commonly known as marshes, bogs, swamps, and wet meadows. While there are several technical definitions of wetlands, for regulatory and legal purposes, the Commonwealth of Pennsylvania (25 Pa. Code Chapter 105) uses the following:

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions including swamps, marshes, bogs and similar areas."

25 Pa. Code Chapter 105.18a requires the applicant to replace all unavoidable wetland impacts in accordance with 25 Pa. Code Chapter 105.20a, which requires wetland replacement to meet three criteria: area ratio, function and value replacement, and siting criteria. In addition, decisions will be made based on Department guidelines entitled "Design Criteria for Wetlands Replacement".

DEP's authority for the protection of wetlands is primarily established by the Dam Safety and Encroachments Act of 1978 and The Clean Streams Law. The Environmental Quality Board adopted Chapter 105, Dam Safety and Waterway Management rules and regulations effective September 27, 1980. Amended regulations, including permit authorization fees, became effective February 16, 2013. Since March 1, 1995, DEP has been given authority to attach federal Section 404 authorization along with state permit approvals for most projects through the Pennsylvania State Programmatic General Permit (PASPGP-5). This provides "one-stop shopping" for approximately 80-90 percent of the state and federal permit applications received. PASPGP-5 will expire on June 30, 2021. This reissuance of the PASPGP-5 included the Mineral Resource program area for the first time as eligible to include the federal Section 404 authorization along with the state permit approvals.

Thirty-two of Pennsylvania's 66 county conservation districts have Chapter 105 Delegation Agreements with DEP to register Bureau of Waterways Engineering and Wetlands General Permits within their counties. The basic duties of each district are to provide information and written materials to the general public on the Dam Safety and Encroachments Act and Chapter 105 regulations, register general permits, and perform on-site investigations as the first step to gain voluntary compliance. In addition to county delegations, program implementation for general and individual permit processing and issuance is also delegated to the several DEP program areas including the Mineral Resources, Abandon Mine Lands, Conservation, and Restoration, Oil and Gas, and Flood Protection programs. The Office of Water Management coordinates this program.

An Environmental Review Committee, consisting of representatives of the U.S. Fish and Wildlife Service (USFWS), Pennsylvania Game Commission (PGC), Pennsylvania Fish and

Boat Commission (PFBC), EPA, U.S. Army Corps of Engineers (ACOE) and DEP, meets bimonthly to review selected applications submitted to DEP. This coordination economically utilizes the limited staff of both state and federal agencies.

Ongoing Waterways and Wetland Program initiatives include:

1) Pennsylvania Aquatic Resource Protection and Management Action Plan

The Commonwealth, while accomplishing the previous action plans' goals, was in critical need to develop a new overarching Pennsylvania Aquatic Resource Protection and Management Action Plan (PARMAP) to focus the Commonwealth's wetland and waterways program development efforts over the next 10 years. PARMAP provides a framework and direction for the DEP and its partners to strengthen and improve the programs that provide regulatory oversight, management, restoration, and monitoring of wetland and other aquatic resources. It is intended to be a "living" document which may be periodically revised to advance the goals as necessary. Various agencies and institutions that share common interests in aquatic resources provided input into the PARMAP initiatives and will continue to contribute towards the improvement and implementation in the future.

2) EPA Wetland Program Development

In order to develop PARMAP initiatives, DEP receives grant monies from the EPA to help fund Wetland Program Development. Program development is needed to help address new threats, ensure compensatory mitigation provides for lost functions and improve the scientific understanding of the resources to develop better tools for restoration, protection and monitoring and assessment activities. The outputs from these projects will impact other programs beyond the wetland program including Erosion and Sediment Control program (riparian buffers); TMDL program (Chesapeake Bay TMDL nutrient reduction efforts); Public Water Supply; Sewage Facilities; and the Post Construction Stormwater programs (wetland antidegradation).

3) Aquatic Resource Compensatory Mitigation

DEP is actively working in coordination with other state and federal agencies to update aquatic resource (wetland and waterways) compensatory mitigation via development of a new aquatic resource compensatory banking program and revisions to the existing In-Lieu-Fee program. Both programs will provide partnering opportunities for the regulatory and resource agencies to work together to meet resource restoration needs on both private and public lands.

4) Technical Guidance Documents for Compensatory Mitigation

DEP is developing a series of plans and technical guidance documents to provide a basis for federal and state-recognized mitigation for wetland and stream impacts. This effort presents a major opportunity for ensuring that science-based planning and data are used to guide mitigation decisions across the Commonwealth. The Nature Conservancy, Western Pennsylvania Conservancy, and Environmental Law Institute have assumed coordinated activities to ensure that Pennsylvania provides a lasting and robust program that will support the achievement of critically needed conservation.

5) Outreach

DEP continues to participate in seminars and workshops on wetlands and other environmental issues, as well as semi-annual training sessions for the public and private sector. Topics may include wetland functions and values, identification and delineation, permitting, and statewide policies

Part C5. Trend Analysis for Surface Waters

Introduction

Periodically, DEP–assisted greatly by the USGS–analyzes long-term trends of chemical water quality using data collected at fixed-site monitoring stations throughout the Commonwealth. Trend analysis is a statistical technique used to determine whether values of water quality generally increase or decrease over some time period. Lack of a trend is good evidence that none exists; however, there is some possibility that more sample collection will reveal a less obvious trend. Conversely, we can be quite confident that changes in water quality are occurring where trends are detected.

Methods

Trend tests were run for 16 water quality parameters (Table 11) at a set of 14 Water Quality Network (WQN) monitoring stations (Figure 9). Most samples in the datasets were collected on a monthly or a bi-monthly basis at each station. Many more water quality parameters were considered for analysis; however, trend tests were not run for datasets that had: (1) more than half of the data recorded as non-detects; (2) a lot of missing data; or (3) model validation issues.

The present analyses utilized two different trend models developed and performed by USGS staff. Both approaches adjust observed variation in water quality parameters for variation in flow because most water quality parameters exhibit substantial co-variation with stream flow. The two models used are the traditional 7-parameter multi-coefficient regression (ESTIMATOR) and the recently developed Weighted Regression on Time, Discharge, and Season (WRTDS) model. Both models are similar except for an important distinction in how daily mean discharge is normalized. Comparisons between these two models suggest overall trend agreement with the exception of a few parameters, during certain time periods (Table 12). However, the ESTIMATOR model's formula inaccurately biases high for certain water quality parameters such as suspended sediment and orthophosphorous, as clearly demonstrated in Table 12. For example, a 1.3 million percent increase of Suspended Sediment in the Conestoga River over the last 20 years is extremely unlikely. Once the WRTDS model was implemented by USGS, these errors were corrected. For more information on model discrepancies, please contact the USGS. As a result of these finding, the Department will be moving toward reporting more water quality trends through WRTDS instead of ESTIMATOR.

Trend analyses were run for two different time frames for both models. For the ESTIMATOR model, time periods were from 1994 to 2014 (20 years, long-term) and from 2004 to 2014 (10 years, short-term). For the WRTDS model, time periods were from approximately 1985 to 2014 (≈30 year, long-term) and from 2004 to 2014 (10 years, short-term).

Table 11
List of 16 selected chemical and water quality parameters analyzed.

Group	Parameter Name	Parameter Abbreviations
Nutrient	Total Nitrogen	TN
	Total Ammonia	NH4+NH3
	Total Nitrate	NO3
	Total Phosphorus	TP
	Orthophosphorus	OP
	Total Organic Carbon	TOC
Sediment	Suspended Sediment	SS
Major Ion	Hardness	Hard
	Alkalinity	Alk
	Calcium	Ca
	Magnesium	Mg
	Sulfate	SO4
Metals	Aluminum	Al
	Iron	Fe
	Lead	Pb
	Zinc	Zn

Figure 9
Locations of the 14 fixed-site, long-term water quality network (WQN) monitoring stations used in the 2016 trend analysis. Major waterways (blue) and county boundaries (black) are also shown.

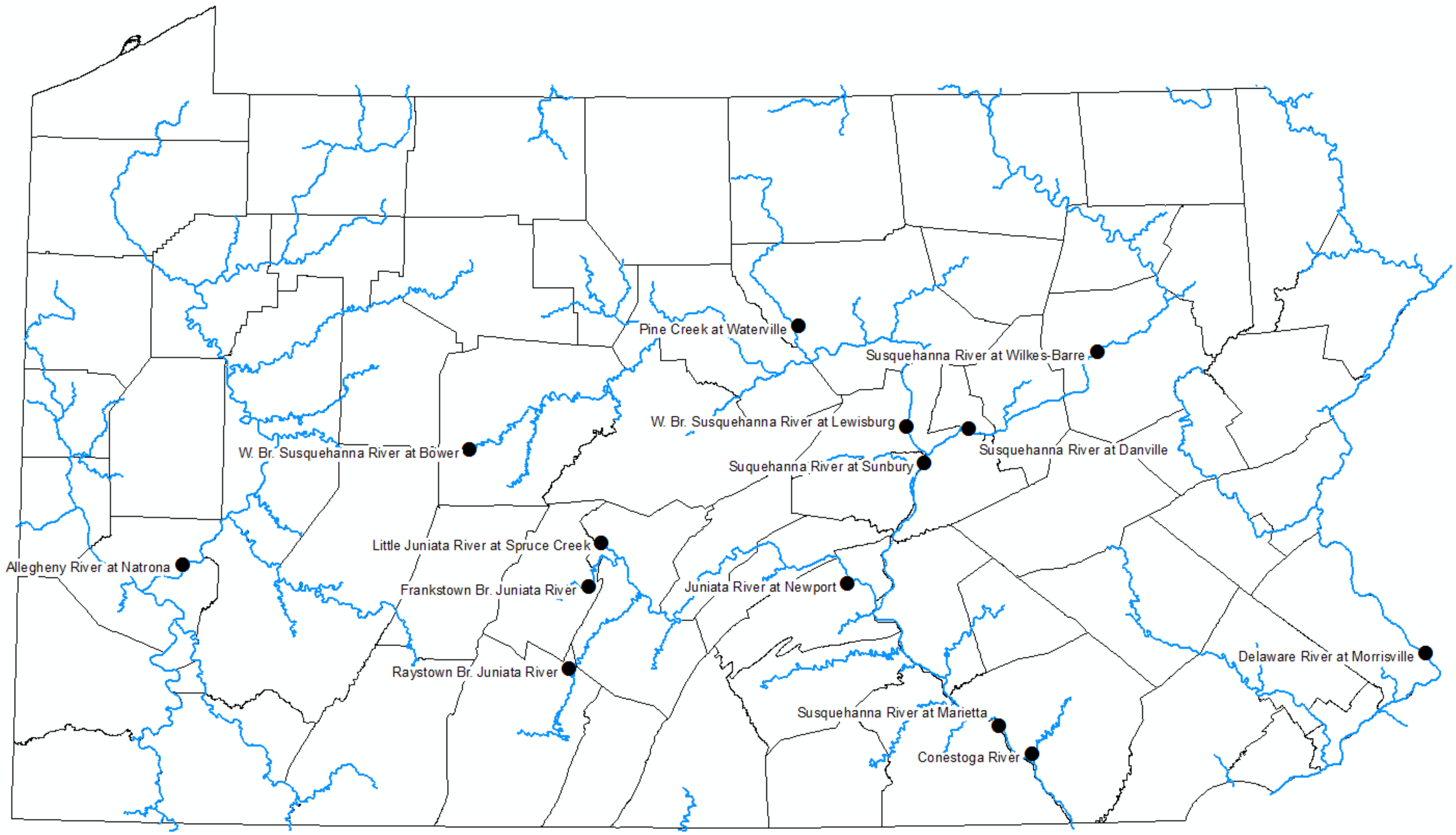


Table 12

Comparison between ESTIMATOR and WRTDS model results at three sites in the Susquehanna Basin between 1994 and 2014, which illustrates the agreement and disagreement between certain water quality parameters. Numeric trend values are the percent change in flow adjust concentration for ESTIMATOR and the flow normalized concentration for WRTDS.

20 Year Trend Comparison				
Model	**Site**	**Parameter**	**Trend**	**Trend Result**
ESTIMATOR	Juniata River at Newport, PA	SS	47	Not Significant
	Juniata River at Newport, PA	TN	-10	Improving
	Juniata River at Newport, PA	NO3	-4	Not Significant
	Juniata River at Newport, PA	TP	-32	Improving
	Juniata River at Newport, PA	OP	3495	Degrading
	Susquehanna River at Marietta, PA	SS	-4	Not Significant
	Susquehanna River at Marietta, PA	TN	-21	Improving
	Susquehanna River at Marietta, PA	NO3		Poor model
	Susquehanna River at Marietta, PA	TP	-33	Improving
	Susquehanna River at Marietta, PA	OP	-86	Improving
	Conestoga River at Conestoga, PA	SS	1295073	Degrading
	Conestoga River at Conestoga, PA	TN	-20	Improving
	Conestoga River at Conestoga, PA	NO3	-6	Not Significant
	Conestoga River at Conestoga, PA	TP	-62	Improving
	Conestoga River at Conestoga, PA	OP	22247	Degrading
WRTDS	Juniata River at Newport, PA	SS	-28	Improving
	Juniata River at Newport, PA	TN	-12	Improving
	Juniata River at Newport, PA	NO3	-11	Improving
	Juniata River at Newport, PA	TP	-33	Improving
	Juniata River at Newport, PA	OP	-67	Improving
	Susquehanna River at Marietta, PA	SS	-25	Improving
	Susquehanna River at Marietta, PA	TN	-25	Improving
	Susquehanna River at Marietta, PA	NO3	-24	Improving
	Susquehanna River at Marietta, PA	TP	-29	Improving
	Susquehanna River at Marietta, PA	OP	0	No Trend
	Conestoga River at Conestoga, PA	SS	-70	Improving
	Conestoga River at Conestoga, PA	TN	-18	Improving
	Conestoga River at Conestoga, PA	NO3	-7	Improving
	Conestoga River at Conestoga, PA	TP	-42	Improving
	Conestoga River at Conestoga, PA	OP	-20	Improving

Results

The ESTIMATOR generated acceptable models for 14 of the 16 water quality parameters (Table 13). Suspended sediment and orthophosphorus were not confidently modeled using ESTIMATOR; however, trends for these two parameters were determined using the WRTDS model for 6 of the 14 sites. WRTDS trend data also included other nutrient parameters that show better agreement between the two models (Table 14).

ESTIMATOR Trends:

Most water quality parameters show either a decreasing value as an improving condition or an increasing trend as a degrading condition. However, there are several interesting trends throughout the Commonwealth that may or may not be considered improving or degrading. For instance, there are mostly increasing trends in alkalinity throughout the state. Trends were more mixed for the two alkali earth metals (Ca, Mg) and hardness, which suggests that the increase in alkalinity was more likely due to a decrease in the hydrogen ion concentration at these sites. In fact, hydrogen ion deposition has significantly decreased as a result of the implementation of Title IV of the Clean Air Act Amendments in 1990. Reductions in hydrogen ion deposition can increase pH, particularly in smaller streams with low alkalinity, and yet the cumulative effect may be perceived even in larger systems. In addition, a significant amount of work has been completed in the Allegheny and Susquehanna watersheds specifically addressing acid mine drainage, restoring many stream miles to biologically productive conditions. It is plausible to conclude that the culmination of restoration activities to both air and water may be contributing to the increase in alkalinity. It is also important to note that increases in alkalinity can affect the way other chemicals behave in the environment.

For the nitrogen species (TN, NO3, and NH4+NH3), there were mostly improving conditions observed. The only exception to this trend was the long-term trend for total ammonia at Raystown Branch Juniata River. There are also improving conditions in total phosphorus at most sites, with the exception of the Susquehanna River at Sunbury and the Little Juniata River. Decreasing trends were seen at all sites with good models for Sulfate and the poor metals (Al, Pb). Results were mixed for total organic carbon and transition metals (Cu, Zn, Fe).

WRTDS Trends:

Generally speaking, the WRTDS trends for nutrients and sediment are improving over the long- and short-term time periods, but there are many trends that show greater improvements over the 30-year long-term than the 10-year short-term. One exception to the overall improving trend was orthophosphorus for the Susquehanna River at Marietta, PA, which shows a degrading trend over the 30-year long-term trend. However, this site is showing recovery over the 10-year period.

The WRTDS model also gave the ability to graphically represent changes in load over time. This elucidated several interesting patterns in the data. For instance, at many available sites, there was an observed increase and subsequent decrease between 1995 and 2005, in phosphorus species and sediment specifically. This is exemplified with the phosphorus data from the Susquehanna River at Marietta, PA (Figure 10). Reasons for this bump in the trend during the late 1990s and early 2000s have not yet been confidently answered.

Table 13

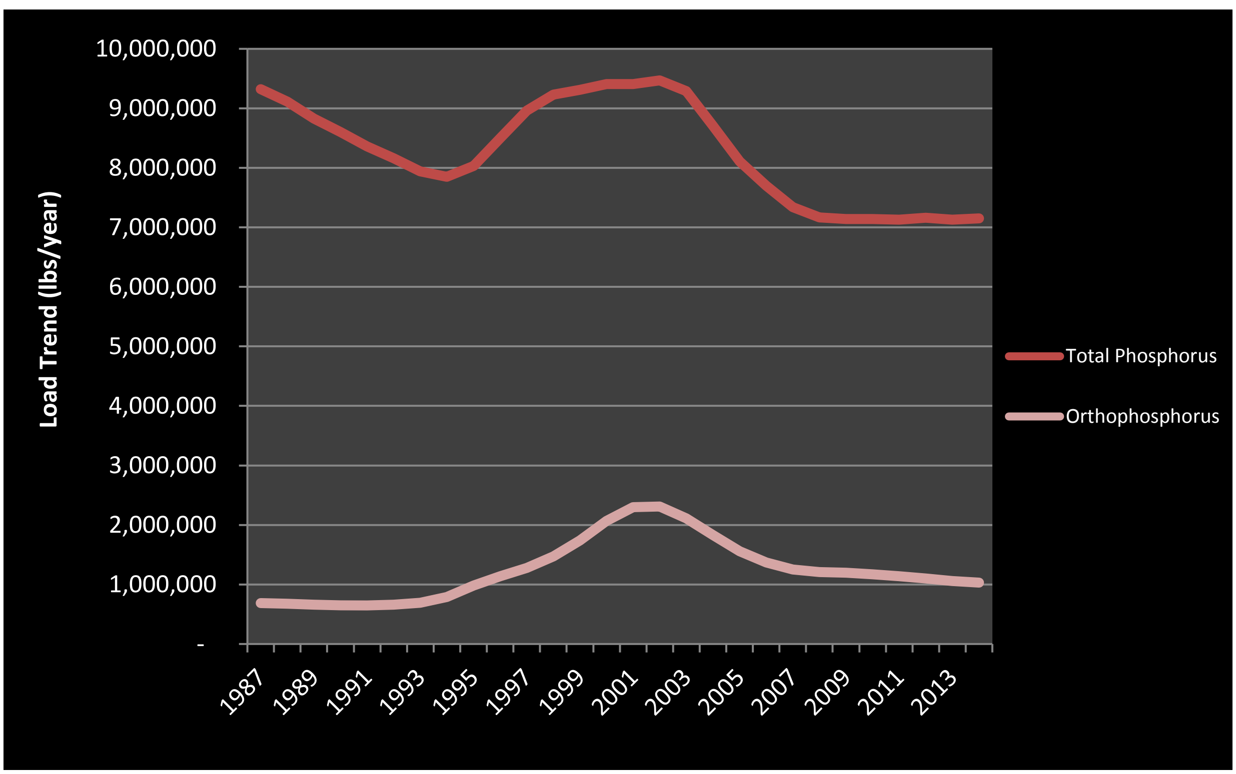
Approximate percent change in flow-adjusted concentration trends over the tested time periods using the ESTIMATOR model. The long-term trend is approximately 20 years and short term trend is 10 years. -- indicates either that there were not enough data to complete the trend, results were not statistically significant, or there was a high rate of error in the model. Green dots indicate improving conditions while red dots indicate degrading conditions for the time period analyzed.

Station	Time Period	Alk	Hard	Ca	Mg	SO4	TN	NO3	NH4+ NH3	TP	TOC	Fe	Pb	Al	Zn
Delaware River at Morrisville, PA	Long Term	18	21	--	--	-46	-62	-13	--	-21	--	-36	--	--	-44
Delaware River at Morrisville, PA	Short Term	--	--	-12	--	-22	--	--	--	--	--	--	--	-45	--
Susquehanna River at Marietta, PA	Long Term	25	15	--	--	--	-21	--	-30	-33	38	--	--	--	--
Susquehanna River at Marietta, PA	Short Term	--	--	--	--	--	--	--	-46	--	--	--	-49	--	--
Susquehanna River at Sunbury, PA	Long Term	30	13	--	--	-27	-76	-52	--	--	13	--	--	-34	--
Susquehanna River at Sunbury, PA	Short Term	--	--	--	--	--	--	--	--	73	--	108	--	--	--
Juniata River at Newport, PA	Long Term	15	25	16	--	--	-10	--	--	-32	--	--	--	--	--
Juniata River at Newport, PA	Short Term	--	-8	-9	--	-8	-14	-16	-49	-35	--	--	--	--	--
Little Juniata River at Spruce Creek, PA	Long Term	7	23	--	--	-28	--	--	--	33	--	--	--	--	--
Little Juniata River at Spruce Creek, PA	Short Term	--	--	-8	-10	--	-14	--	--	-43	79	95	--	-63	--
Raystown Br. Juniata River at Saxton, PA	Long Term	13	18	--	--	--	--	--	144	-21	--	--	--	-29	1759
Raystown Br. Juniata River at Saxton, PA	Short Term	--	-8	-8	--	--	--	--	--	--	--	--	--	-27	138
Frankstown Br. Juniata River at Williamsburg, PA	Long Term	17	27	--	--	--	--	--	--	--	--	--	--	--	--
Frankstown Br. Juniata River at Williamsburg, PA	Short Term	--	--	--	--	--	-16	--	--	--	--	--	--	--	--
Conestoga River at Conestoga, PA	Long Term	--	--	--	--	--	-20	--	-52	-62	--	--	--	--	--
Conestoga River at Conestoga, PA	Short Term	--	--	--	--	-17	--	--	-30	--	-18	--	-70	-36	--
Susquehanna River at Danville, PA	Long Term	17	--	--	--	-47	--	--	--	-46	--	-42	--	-53	--
Susquehanna River at Danville, PA	Short Term	--	-14	--	-14	-32	--	--	--	-48	--	--	--	-27	--
Susquehanna River at Wilkes-Barre, PA	Long Term	15	15	--	--	-56	-84	-45	--	--	-73	--	--	--	--
Susquehanna River at Wilkes-Barre, PA	Short Term	--	--	--	--	-27	--	--	--	--	--	109	--	--	--
W. Br. Susquehanna River at Lewisburg, PA	Long Term	49	--	--	--	--	-37	-29	-24	-55	--	--	--	--	-46
W. Br. Susquehanna River at Lewisburg, PA	Short Term	--	--	--	--	--	-20	-26	-31	-65	--	46	--	--	--
W. Br. Susquehanna River at Bower, PA	Long Term	49	--	--	--	-19	--	-56	-62	--	--	-27	--	-63	--
W. Br. Susquehanna River at Bower, PA	Short Term	15	-14	-15	--	--	--	--	--	--	--	--	--	--	--
Pine Creek at Waterville, PA	Long Term	23	30	--	8	-15	-77	-79	--	-47	--	--	--	--	--
Pine Creek at Waterville, PA	Short Term	--	--	--	--	--	--	--	--	--	-79	--	--	-57	--
Allegheny River at Natrona, PA	Long Term	35	--	--	--	-31	--	-17	--	-30	--	-35	--	-48	--
Allegheny River at Natrona, PA	Short Term	19	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 14
Approximate percent change in the flow normalized load using the WRTDS model. The long-term trend is approximately 30 years and short-term trend is 10 years. -- indicates that there were not enough data to model or that there was no likely trend. Green dots indicate improving conditions while red dots indicate degrading conditions for the time period analyzed.

Station	Time Period	TN	NO3	TP	OP	SS
Conestoga River at Conestoga, PA	Long Term	-30	-19	-56	-53	-79
Conestoga River at Conestoga, PA	Short Term	-15	-11	-10	-1	-33
Juniata River at Newport, PA	Long Term	-26	-15	-48	-51	-56
Juniata River at Newport, PA	Short Term	-13	-15	-31	-46	-39
Susquehanna River at Wilkes-Barre, PA	Long Term	-42	-36	--	--	--
Susquehanna River at Wilkes-Barre, PA	Short Term	-8	-19	--	--	--
Susquehanna River at Danville, PA	Long Term	-41	-32	-23	-20	-27
Susquehanna River at Danville, PA	Short Term	-5	-13	-11	-66	--
W. Br. Susquehanna River at Lewisburg, PA	Long Term	-37	-20	-48	-67	-29
W. Br. Susquehanna River at Lewisburg, PA	Short Term	-19	-22	-32	-81	-20
Susquehanna River at Marietta, PA	Long Term	-33	-24	-23	51	-39
Susquehanna River at Marietta, PA	Short Term	-13	-19	-12	-34	-23

Figure 10
WRTDS flow normalized load trend for the phosphorus species (TP and OP) in the Susquehanna River at Marietta, PA.



PART D: GROUNDWATER

Part D1. Groundwater Assessment

Ambient and Fixed Station Network Groundwater Quality Monitoring Program

The Ambient and Fixed Station Network Groundwater Quality Monitoring Program began in the mid-1980s to characterize the general background quality of the State's groundwater and to assess changes in groundwater quality within the 478 groundwater basins identified in the state. The basins were prioritized for monitoring based on socioeconomic and environmental factors. Under this scheme, the highest priority basins were located primarily in areas of growth near urban areas in the southeastern, south-central and southwestern parts of the state. Because of resource constraints, monitoring efforts have been very limited since the late 1990s and only ~11% of the state has had any monitoring conducted.

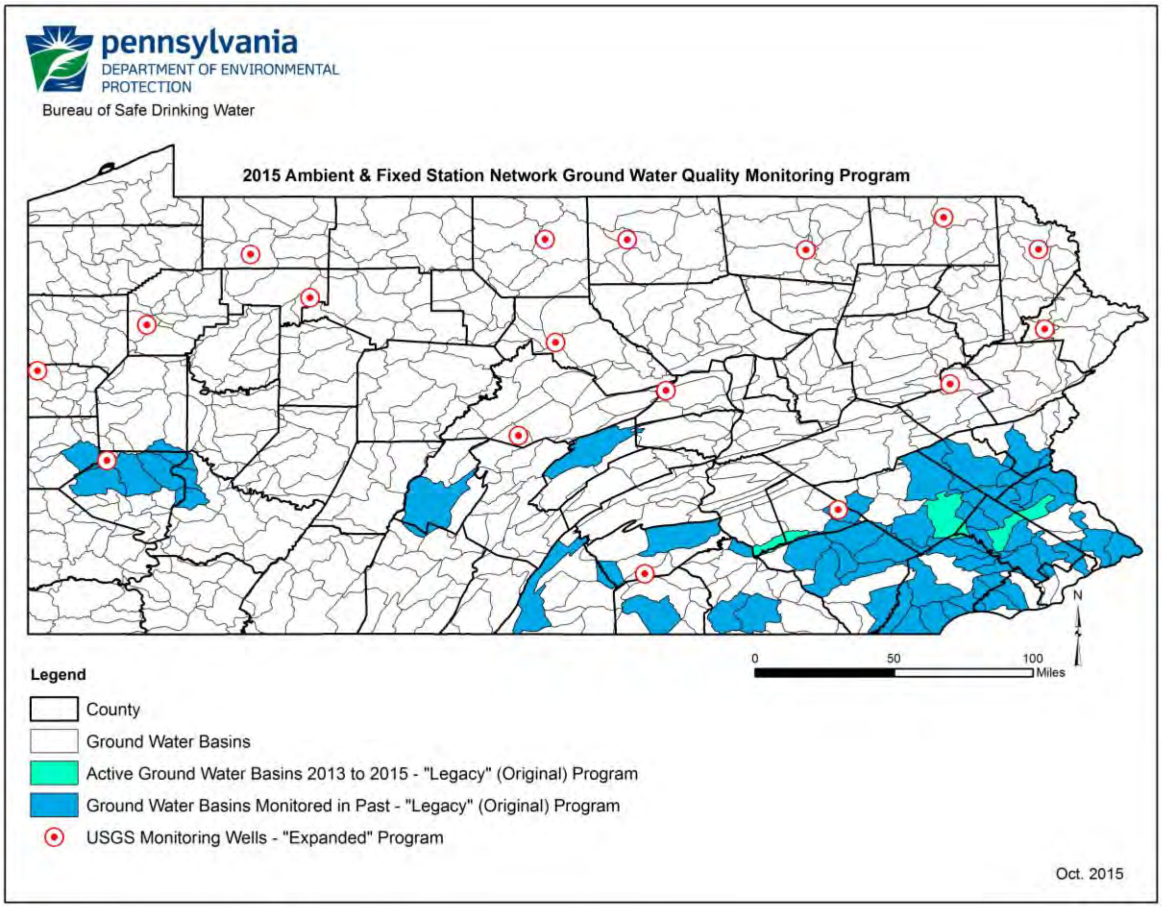
Resources available to operate the Ambient Fixed Groundwater Monitoring Program continue to be limited. Groundwater quality monitoring has been active from 2013 to 2015 in two groundwater basins in the Southeast Region (Pottstown Basin, #58 and Telford Basin, #61) and one basin in the Southcentral Region (Colebrook Basin, #174). See Figure 11 for the locations of these basins. Monitoring is conducted by DEP field staff, and analytes consist primarily of nutrients, metals, and ions.

The Pottstown and Telford basins have been sampled for over 10 years at over 40 stations depending on access. The most common contaminant is nitrate-nitrogen but the trend has been for improving water quality for this contaminant. A few locations in the Pottstown Basin regularly do not meet drinking water standards but still show a trend toward lower nitrate-nitrogen concentrations. The most likely source of elevated nitrate-nitrogen in groundwater is agricultural land use as the sampling points are located adjacent to agricultural fields. Septic systems are also a possibility because the properties and surrounding area are served by on-lot sewage disposal. One sampling point in the Telford Basin also had nitrate-nitrogen that did not meet drinking water standards, but conditions have improved markedly, and the well no longer shows nitrate-nitrogen contamination. While concentrations are elevated, they rarely do not meet drinking water standards. As agriculture is not present in proximity to this location, contamination is presumed to be from septic systems or possibly prior agricultural activity. Some locations in the Telford Basin show detectable concentrations of arsenic and lead that are less than drinking water standards. It is rare to see detectable levels of these metals in these basins but the concentrations appear to be consistent and suggest that the likely sources would be the local geology.

Monitoring in the Colebrook Basin commenced in Spring 2015 and only one round of sampling has been performed to date.

To distinguish the above monitoring efforts from more recent ones that are discussed below, the original monitoring program is referred to as the "Legacy" Ambient and Fixed Station Network Groundwater Quality Monitoring Program.

Figure 11
Monitoring locations and status of the Ambient and Fixed Station Network
Groundwater Quality Monitoring Program, Fall 2015.

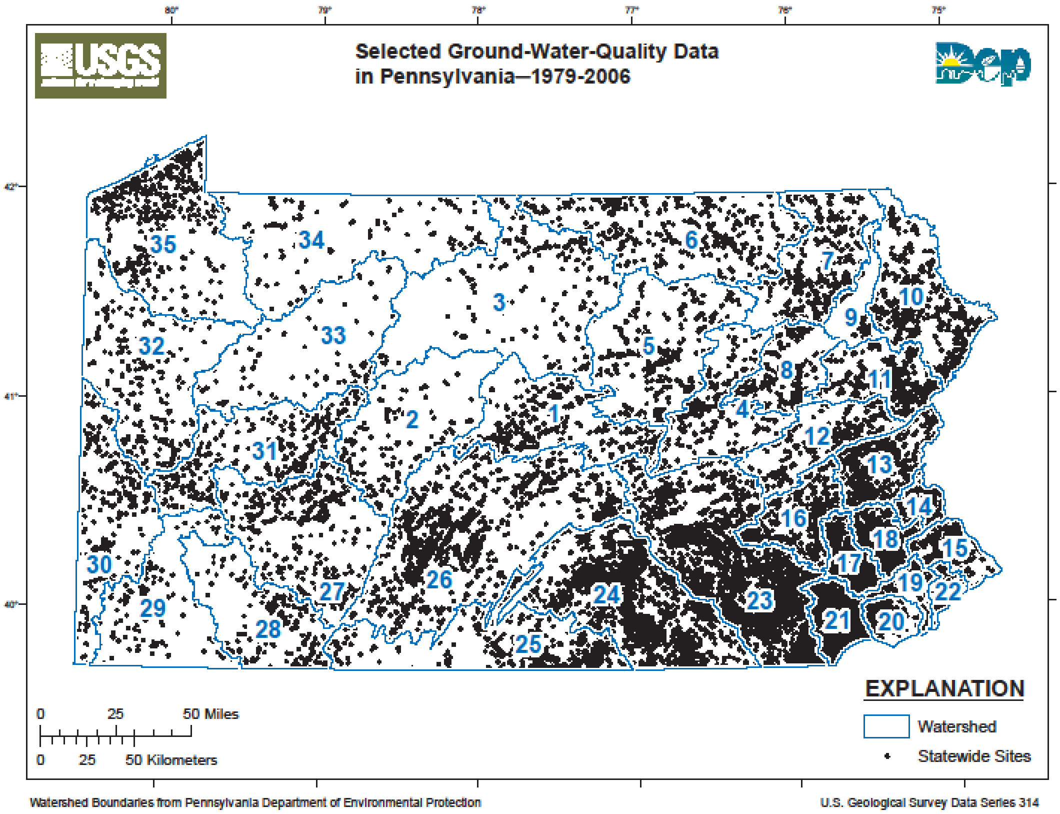


Recognizing the need for increased groundwater quality monitoring coverage of the state to meet program goals and to provide a better statewide characterization, DEP worked with the USGS in 2002 to design a plan for a statewide, watershed-based groundwater quality monitoring network using the stratified design approach applied in the USGS National Water Quality Assessment Program. The approach involved identifying 13 major aquifer groups based on lithology. To develop the statewide network, 30 groundwater quality monitoring points are needed within each aquifer group. The network could also be reconfigured and sampled on a watershed basis. Although the network design was completed, sufficient Commonwealth resources were not available to conduct the pilot monitoring and to fully evaluate the establishment of a statewide network.

In lieu of efforts to establish a statewide groundwater quality monitoring network, resources were available for DEP to partner with the USGS in 2004 to compile electronically available groundwater quality monitoring data for a 26-year period to help point out data gaps and guide future monitoring efforts.

Under a joint funding agreement with DEP in 2005, the USGS updated the original Data Series report to provide a compilation of electronically available groundwater quality data for a 28-year period based on water samples from wells throughout Pennsylvania (Figure 12). Fourteen data sources from local, state, and federal agencies were used in the updated compilation, which covers 11 different analyte groups. The data are presented both in terms of 35 former water planning watersheds used by DEP as well as the 13 major geolithologic units representing the major aquifers in the state. Over 24,000 wells were included in the project, and the number of analyses ranged from several thousand for nutrients and other inorganic compounds to two dozen for antibiotics. The number of wells sampled varies considerably across the state with most being concentrated near major urban centers. Minimal data exists for about a fourth of the State's drinking water wells. When compared to maximum contaminant levels (MCL), the analyte group with the highest MCL exceedance was microorganisms (50% of 4,674 samples), followed by volatile organic compounds (24% of 4,528 samples). The lowest MCL exceedances were for insecticides (<1% of 1,424 samples) and wastewater compounds (<1% of 328 samples). This data compilation, in addition to capturing compliance groundwater quality data, will help address groundwater data needs in the areas of unconventional hydrocarbon development in the state. The report (Low, D.J., Chichester, D.C. and Zarr, L.F., 2008, Selected groundwater quality data in Pennsylvania – 1979-2006: USGS Data Series 314, 22 p.) is available on-line at http://pubs.usgs.gov/ds/314/.

Figure 12
Well and spring locations with groundwater quality data used in USGS Report DS-314 (from Low, Chichester and Zarr, 2008).



Through a partnership with USGS, DEP initiated a new project in 2014 to expand groundwater quality monitoring efforts in Pennsylvania by collecting samples on a semi-annual schedule at select locations across the state. This effort is referred to as the "Expanded" (or "Statewide") Ambient and Fixed Station Network Groundwater Quality Monitoring Program to distinguish it from the original "Legacy" effort. The first phase of this network consists of 17 monitoring wells within the Pennsylvania Drought Monitoring Network. The wells are drilled in a variety of different geolithologic units and are primarily located in the northeast, north central, and western portions of the state where pressures from shale gas development exist (Figure 11). Through the end of 2015, a total of 34 water quality samples were collected from the initial 17 monitoring wells, a sample size too small to detect any trends in water quality. Sampling is conducted by USGS staff and analytes include metals, ions, nutrients, dissolved gasses, and volatile organic compounds. All analytical results are reported to EPA's national STORET database and the USGS National Water Information System (NWIS) database. A second phase of this project was subsequently approved, and the statewide monitoring network will be expanded by two sampling locations in 2016 with the potential for more locations to be added in future years depending upon funding and availability of suitable monitoring points. An educational website will be developed and maintained so the public can view the spatial characteristics of the statewide network and have access to all available groundwater quality data. Data that becomes available from this monitoring effort will allow for better characterization and assessment of groundwater resources along with a spatial/temporal analysis of ambient groundwater quality on a statewide scale.

Part D2. Sources of Groundwater Contamination

Each DEP regional office previously defined its highest priority sources of groundwater contamination and a preliminary attempt to revisit the information was undertaken in 2013. The information was updated in 2015, and the concerns are generally consistent with previous reports with a few new additions (impoundments, waste piles) and are shown below in Table 15. The priorities include industrial facilities, surface impoundments including centralized impoundments at unconventional gas well sites, underground storage tanks, hazardous waste sites, landfills, waste piles, aboveground storage tanks, manure/fertilizer applications, chemical facilities, septic systems, acid mine drainage, and abandoned oil and gas wells. The contaminants associated with these sources are also shown. Additionally, bulk salt storage and active natural gas wells were noted as significant sources of groundwater contamination by one region.

Multiple regional studies have indicated 30% to 90% of private water wells have total coliform contamination. In addition, one study showed up to 30% *E. coli* contamination. A USGS study, (Zimmerman, T.M., Zimmerman, M.L. and Lindsey, B.D., 2001, Relation between selected well construction characteristics and occurrence of bacteria in private household supply wells, south-central and southeastern Pennsylvania: USGS WRIR 01-4206, 22 p.) stated that either or both well construction and aquifer contamination could be responsible for the results, but problems were more likely to occur where the well was poorly constructed.

Table 15
Major Sources of Groundwater Contamination

Contaminant Source	High Priority Sources (√)	Factors Considered in Selecting Contaminant Sources (1)	Contaminants (2)
Agricultural Activities			
Animal feedlots			
Chemical facilities	√	ADCEFG	ABCDE
Drainage wells			
Manure/fertilizer applications	√	ABCDEFGH	DEIK
On-site pesticide mixing & loading			
Pesticide applications			
Storage/Treatment Activities			
Land application of biosolids			
Lawn maintenance/pest treatment			
Material stockpiles			
Storage tanks (above ground)	√	ABCDEFGH	ABC
Storage tanks (underground)	√	ABCDEFGH	ABC
Surface impoundments (all types)	√	ABCDEFGH	ABFGHJK
Waste piles or tailings	√	ABCDEFGHI (slag/CKD)	AGJKL
Disposal Activities			
Abandoned landfills	√	ABCDE	ADGJ
Landfills (current)	√	ADEFGHI	ABCDEFGHIJKL
Septic systems	√	ABCDEFGH	EIK
Underground injections wells			
Resource Extraction			
Abandoned oil/gas wells	√	DHI	BFGL (CH_4)
Existing/active oil/gas wells		ACDEFG	ABFGJKL (CH_4, C_2H_6)
Abandoned/poorly built water wells			
Coal mining/acid mine drainage	√	BCDEFH	JKL (pH)
Quarries (noncoal)/borrow pits			
Other			
Atmospheric deposition			
Industrial facilities	√	ABCDEFG	ABCG
Hazardous waste generators			
Hazardous waste sites	√	ABCDEFG	ABCDEGHIJK
Natural groundwater conditions **(3)**			
Petroleum/fuel pipelines			
Sewer lines			
Salt storage & Road deicing Spills/transportation of materials		ABCDEF	FGK
Urban runoff			

Table 15. (Continued)

(1) Factors in Selecting a Contaminant Source

A. Human health and/or environmental risk (toxicity)
B. Size of the population at risk
C. Location of the source relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrogeologic sensitivity
F. State findings, other findings
G. Documented from mandatory reporting
H. Geographic distribution/occurrence
I. Other criteria (please describe)

(2) Contaminants

A. Volatile organic chemicals
B. Petroleum compounds
C. MTBE/TBA
D. Pesticides
E. Nitrates
F. Salinity/brine
G Metals
H. Radionuclides
I. Microbiological
J. Sulfates, manganese and/or iron
K. Total dissolved solids
L. Other contaminant (please describe)

(3) This could include naturally occurring contaminants such as radium, radon, sulfate, arsenic, iron, manganese, salt, etc.

Part D3. Statewide Groundwater Protection Programs

A summary of state groundwater protection programs is presented in Table 16. Important groundwater protection programs are summarized following the table. Pennsylvania does not have statewide, private water well construction standards.

Table 16
Summary of State Groundwater Protection Programs

Programs or Activities	Implementation Status	Responsible State Agency
Active SARA Title III Program	Fully established	PDLI*
Ambient groundwater monitoring system	Continuing efforts (limited)	BSDW
Aquifer vulnerability assessment (pesticides)	Continuing efforts	PDA
Aquifer mapping	Continuing efforts	PaGS
Aquifer characterization	Continuing efforts	PaGS
Comprehensive data management system	Continuing efforts development	BSDW*
EPA-endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP)	Partially established	BSDW*
Groundwater discharge permits	Continuing efforts	RCW
Groundwater Best Management Practices	Continuing efforts	BSDW*
Groundwater legislation (remediation)	Fully established	BECB
Groundwater classification (remediation)	Continuing efforts	BECB
Groundwater quality standards (remediation)	Fully established	BECB
Interagency coordination for groundwater protection initiatives	Continuing efforts	BSDW*
Nonpoint source controls	Continuing efforts	BCW*
Pesticide State Management Plan	Continuing efforts	PDA
Pollution Prevention Plan	Continuing efforts	OPPEA

Programs or Activities	Implementation Status	Responsible State Agency
Resource Conservation and Recovery Act (RCRA) Primacy	Fully established	BWM
Source Water Assessment Program (EPA approved 2000)	Fully established	BSDW
State Superfund	Fully established	BECB
State RCRA Program incorporating more stringent requirements than RCRA primacy	Not applicable	-
State septic system regulations	Fully established	BCW
Underground storage tank installation requirements	Fully established	BECB
Underground storage tank remediation fund	Fully established	BECB
Underground storage tank permit program	Fully established	BECB
Underground injection control program	Not applicable; EPA direct implementation	-
Vulnerability assessment for drinking water/wellhead protection	Partially established	BSDW*
Water well drilling/Well abandonment guidelines	Fully established	PaGS*
Wellhead Protection Program (EPA approved 1999)	Continuing effort	BSDW
Well installation regulations (Public Water Supplies)	Fully established	BSDW
Others:		
Monitoring well installation guidance	Fully established	BSDW*
Nutrient management program	Continuing efforts	BCR
Private well installation guidance	Continuing efforts	BSDW
Voluntary site remediation program	Fully established	BECB

BCR DEP Bureau of Conservation and Restoration
BECB DEP Bureau of Environmental Cleanup and Brownfields
BCW DEP Bureau of Clean Water
BSDW DEP Bureau of Safe Drinking Water
BWM DEP Bureau of Waste Management
OPPEA DEP Office of Pollution Prevention and Energy Assistance
PaGS PA Geological Survey – Department of Conservation & Natural Resources
PDA PA Department of Agriculture – Bureau of Plant Industry
PDLI PA Department of Labor & Industry – Bureau of PENNSAFE
RCW DEP Regional Clean Water Program
* Indicates lead agency/bureau

Part D4. Groundwater Protection Program

DEP's *Principles for Groundwater Pollution Prevention and Remediation* (DEP Document Number: 383-0800-001) has been in place since 1996 and is available on DEP's website at http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-47483/383-0800-001.pdf

This document sets forth the principles for a consistent statewide program for prevention of groundwater pollution and remediation of contaminated groundwater. The ultimate goal for groundwater protection, as set forth in the Principles, is the prevention of groundwater contamination whenever possible.

Part D5. Wellhead Protection and Source Water Protection Program

Pennsylvania's Wellhead Protection (WHP) Program for groundwater sources serving public water systems is the cornerstone of the Source Water Assessment and Protection (SWAP) Program. Pennsylvania's Wellhead Protection Program was developed in 1989 and subsequently approved by EPA in 1999. The Pennsylvania safe drinking water regulations direct public water suppliers to find and utilize the best sources available and take measures necessary to protect those sources. These regulations define wellhead protection, set permitting requirements for groundwater sources and set forth requirements for state approval of local WHP programs.

Over 800 municipalities or water suppliers have substantially implemented local WHP programs and/or watershed protection programs to protect surface-water intakes, and over one hundred municipalities or water systems are developing strategies for protecting drinking water sources used by public water systems. DEP provides direct technical assistance and supports partnerships to assist communities and water systems to protect community drinking water sources from contamination. These efforts and previous grants support the voluntary development of local Source Water Protection (SWP) programs that meet DEP's minimum requirements. Since 2007, direct technical assistance has been provided to community water systems and municipalities through the Source Water Protection Technical Assistance Program. Over 150 Community Water Systems (CWS) have developed local SWP programs and over 40 water systems are participating in the program at this time. In addition to protecting public health and infrastructure investment by avoiding costly contamination, local SWP efforts complement water resource protection and management through sound land-use planning and pollution prevention activities. Source water protection is an integral part of a sustainable infrastructure for public water supply.

Part D6. Source Water Assessment and Protection (SWAP) Program

The 1996 Safe Drinking Water Act reauthorization requires states to develop a Source Water Assessment and Protection (SWAP) Program. The SWAP program assesses the drinking water sources that serve public water systems for their susceptibility to pollution. This information is used as a basis for building voluntary, community-based barriers to drinking water contamination. States are required to assess all sources (both groundwater and surface water) serving public water systems. In Pennsylvania, this represents about 14,000 permanent drinking water sources. EPA approved Pennsylvania's SWAP program in March 2000. Pennsylvania has completed source water assessments for over 99% of the systems in the state from the 1999 baseline. Under the plan, Pennsylvania will continue to conduct assessments for new sources and update completed assessments as needed.

For the assessments that have been completed, the SWAP program has delineated the boundaries of the areas providing source waters for all public water systems and has identified (to the extent practicable) the origins of regulated and certain unregulated contaminants in the delineated area to determine the susceptibility of the water sources to such contaminants.

The SWAP program provides prioritized information on the potential sources of contamination that will be the basis for coordination of restoration efforts and development of local source water protection programs. These efforts will lead to improvements in raw water quality and may also result in reduced treatment costs for the public water system. The following table provides a summary of the results of the source water assessments for the most common and the most threatening potential sources of contamination to sources of public drinking water conducted under the EPA Program. More detail on how the source water assessments were conducted can be found in the Source Water Assessment and Protection Program guidance.

Table 17
Most Prevalent and Threatening Sources of Contamination

GW RANK	EPA Most Threatening	EPA Most Prevalent
1	Underground Storage Tanks	Transportation Corridors
2	Transportation Corridors	Agriculture
3	Agriculture	Underground Storage Tanks
4	Automobile Related Activities	Septic
5	Mining	Mining
SW RANK	EPA Most Threatening	EPA Most Prevalent
1	Transportation Corridors	Transportation Corridors
2	Agriculture	Municipal Sanitary Waste Disposal
3	Fertilizer and Pesticide Applications	Septic Systems
4	Storm water	Mining
5	Mining	Animal Feeding Operations

Source water assessments support emergency response, improved land use planning and municipal decisions. They also prioritize and help coordinate actions by federal and state agencies to better protect public health and safety. Spill detection and emergency response networks for public water systems in Pennsylvania have been established on the Allegheny, Monongahela, Susquehanna, Schuylkill, and Delaware Rivers. They include a variety of on-line detectors to alert operators to imminent changes in raw water quality at surface water intakes. Long-term trends in raw water conditions based on data provided by these monitors may be the basis for restoration and protection efforts or changes in water treatment schedules. The core of these programs is the Internet-based communication network that shares raw water data, incident information, and response efforts in real-time.

LITERATURE CITED

Ator, S.W., Brakebill, J.W., and Blomquist, J.D., 2011, Sources, fate, and transport of nitrogen and phosphorus in the Chesapeake Bay watershed—An empirical model: U.S. Geological Survey Scientific Investigations Report 2011–5167, 27 p. (Also available at http://pubs.usgs.gov/sir/2011/5167/).

Blazer, V.S. 2012. Indicators of Reproductive Endocrine Disruption in Fish in the Chesapeake Bay Watershed. http://chesapeake.usgs.gov/documents/reproductiveendocrinedisruption.pdf.

Blazer, V.S., D.D. Iwanowicz, H.L. Walsh, A.J. Sperry, L.R. Iwanowicz, D.A. Alvarez, R.A. Brightbill, G. Smith, W.T. Foreman, R. Manning. 2014. Reproductive health indicators of fishes from Pennsylvania watersheds: association with chemicals of emerging concern. Environ. Monit. Assess. 186 (10). 6471-6491.

PADEP. 2014. 2012-13 Susquehanna River Sampling and Assessment Report. http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/Water%20Quality%20Standards/Susquehanna_Report_2013_FinalDraft.pdf

SRBC. 2014. Sediment and Nutrients Assessment Program: 2013 Summary Report. Publication No. 296A. http://www.srbc.net/pubinfo/techdocs/Publication_296/techsummary296A.PDF.

U.S. Fish & Wildlife Service. Intersex Fish: Endocrine disruption in Smallmouth Bass. https://www.fws.gov/chesapeakebay/pdf/endocrine.pdf.