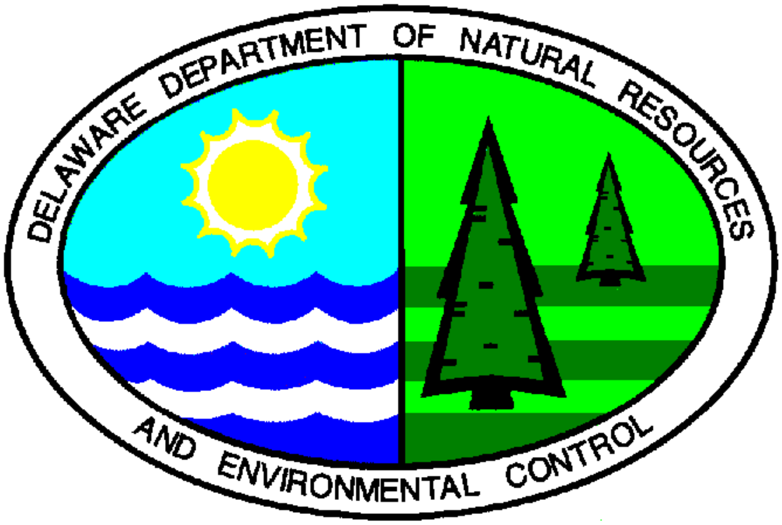
State of Delaware
2012 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs



Department of Natural Resources and
Environmental Control
April 2013

Preface

The State of Delaware 2012 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs provides a statewide assessment of surface water and ground water resources, highlights Delaware's initiatives in water resources management and pollution control and provides a list of waters that need TMDLs to meet water quality standards. The document fulfills the reporting requirements set forth under Sections 305(b) and 303(d) of the Federal Clean water Act of 1977, as amended in 1981 and 1987, and is organized in accordance with federal Environmental Protection Agency's (EPA) guidance documents.

This document summarizes statewide water quality assessments, provides an overview of major initiatives and concerns on a statewide basis, and lists waters needing TMDLs. Tables are provided which show the result of water quality analysis and designated use support findings for data from the period of September 2006 through August 2011.

There are three appendices to the report. Appendix A is the Watershed Approach to Toxics Assessment and Restoration plan which addresses remaining toxics TMDLs in the upcoming years. Appendix B contains Citizens Monitoring results . Appendix C contains comments and responses to the Tentative Determination for the State of Delaware 2012 Clean Water Act Section 303(d) List of Waters Needing TMDLs.

Assessments for the Delaware River and Bay are completed by the Delaware River Basin Commission (DRBC).

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Preface

Part I: Executive Summary

Executive Summary

As recently as 1975, Delaware routinely experienced serious water pollution and public health problems as a result of the discharge of untreated sewage and wastes. Since then, as a result of voluntary efforts, regulatory actions, and significant private and public investments in wastewater treatment facilities, localized improvements in water quality have been achieved.

The need for additional cleanup and pollution prevention continues. The focus of water quality management has shifted from point source discharges (end-of-pipe) to decreased stream flows and nonpoint source problems, such as urban and agricultural runoff, erosion, and sedimentation. Unaddressed, these problems lead to poor habitat conditions for fish and other aquatic life, decreased enjoyment of our surface waters for recreation, and unhealthy conditions for those surface waters upon which we rely for drinking water supply and other domestic uses.

Water Quality Monitoring

The DNREC recognizes the need to use its personnel and financial resources efficiently and effectively. To that end, surface water quality monitoring is conducted in a manner that focuses available resources on the Whole Basin Management concept. The Whole Basin Management Program in Delaware operates on a 5-year rotating basis. This approach enables the DNREC to comprehensively monitor and assess the condition of the State environment with due consideration to all facets of the ecosystem.

Elements of the State's specific Surface Monitoring Program include:

TMDL-Related Monitoring

General Assessment Monitoring

Toxics in Biota Monitoring

Toxics in Sediment Monitoring

Biological Assessment Monitoring

Delaware Rivers and Lakes

Delaware has classified more than 2,509 miles of rivers and streams, and 2,954 acres of lakes and ponds that have been classified using a rating system called for in the Federal Clean Water Act. The classification system is keyed to a management program designed to protect uses of the waters (referred to as "designated uses") for such purposes as drinking water supply, recreation, and the propagation of fish, aquatic life and wildlife. These designated uses serve as Delaware's water quality goals for specific watersheds. In order to protect those uses, a comprehensive set of chemical, biological, and habitat standards have been promulgated. Designated uses and standards are embodied in the State of Delaware Surface Water Quality Standards as amended on June 11, 2011.

The Department of Natural Resources and Environmental Control has found that 85% of Delaware's rivers and streams do not fully support the swimming use and 94% do not fully support the fish and wildlife use. Most of these waters do not meet the standards because of nonpoint source pollution impacts.

Ponds and lakes in Delaware exhibit many of the same problems as rivers and streams. However, ponds and lakes also serve as "catch basins" for a variety of pollutants that are washed from the land and the air into these water bodies. Two indicators which show the tendency for lakes and ponds to accumulate pollutants are fish consumption advisories due to toxic substances in the fish, and the extent of nutrient enrichment. Nutrient enrichment can lead to excessive weed and algae growth, reduced water clarity, and decreases in population of aquatic life and wildlife. The department has found that 41% of Delaware's fresh water ponds and lakes do not fully support the swimming use and 74% do not fully support the fish and wildlife use.

Wetlands in Delaware

Wetlands have many important functions and values to society. They provide fish and wildlife habitat, help maintain water quality, and provide indirect socioeconomic values such as flood and storm water damage protection. With the implementation of federally mandated regulations known as Total Maximum Daily Loads (TMDLs) to reduce pollutants into water bodies, wetland preservation is considered one of the most important strategies for achieving the pollution reduction efforts necessary to meet water quality standards.

Wetlands comprise a significant portion of Delaware's water resources covering over 300,000 acres (about 470 square miles or 23%) of the state. Throughout the state a wide diversity of wetland types occur including both tidal and nontidal wetlands. While some wetlands are directly connected or adjacent to other surface waters such as salt marshes and floodplains, others occur as isolated areas surrounded by uplands such as forested flats and Delmarva Bays. Preserving the abundance, quality, diversity and proportion of different types of wetlands in the landscape is essential to protecting the natural resources and waters of Delaware. Currently the State of Delaware is actively working in each of these areas to protect our high quality wetland resources and restore degraded systems on the watershed scale.

Bacteria (Pathogen Indicators)

As the name implies, "indicator bacteria" are indicators of pathogenic (disease causing) bacteria and viruses. Sources of indicator bacteria (enterococcus and coliform) are widespread. The sources of most concern are those of human origin such as raw or inadequately treated sewage. Wildlife and animal operations such as feedlots can also be significant sources of indicator bacteria, although they represent less of a risk to human health compared to human wastes.

High levels of bacteria pose an increased risk of illness to shellfish consumers, swimmers, and others who may come in contact with contaminated waters. Approximately 86% of Delaware's rivers and streams, 44% of ponds and lakes, and 2 % of estuarine waters (not including the Delaware River and Bay) were found to have bacteria concentrations above the levels considered acceptable for primary contact recreation (swimming, bathing, and water skiing). Many of Delaware's estuarine and tidal waters exhibited bacteria levels above those considered safe for the harvesting and consumption of shellfish. Waters most impacted include the tidal tributaries of the Delaware Bay and portions of Delaware's Inland Bays.

Nutrient Enrichment

Eutrophication of surface waters is a natural process, spanning hundreds to thousands of years, resulting from natural erosion and the breakdown of organic material. Over these extended periods many lakes and ponds under natural conditions would be expected to fill in with sediments and organic materials, eventually becoming marshes and meadows. Lakes and ponds in various stages of eutrophication are considered a natural feature of Delaware's environment. Activities linked to soil erosion, domestic waste disposal (on-site septic systems), and runoff, can greatly increase the rate and amount of nutrients reaching lakes and ponds, accelerating the eutrophication process. Characteristic symptoms of nutrient enriched water bodies include murky green waters or nuisance plant growth. Delaware waters are generally considered to be impacted by nutrients (nitrogen and phosphorus).

Fish Consumption Advisories

Toxic substances such as Polychlorinated Biphenyls (PCB's), metals and pesticides persist in the environment and accumulate in the flesh of fish. The Department of Natural Resources and Environmental Control and the Department of Health and Social Services issued updated fish consumption advisories for waterbodies in the State during2009. See the table in Section III, Chapter 4.

National Methylmercury Fish Consumption Advisory

On January 12, 2001, EPA and the Food and Drug Administration (FDA) issued concurrent national fish consumption advisories recommending restricted consumption of freshwater coastal and marine species of fish due to methylmercury contamination. EPA’s advisory targeted women of childbearing age and children who may be consuming noncommercial freshwater fish caught by family or friends. The advisory specifically recommends that women who are pregnant or could become pregnant, women who are nursing a baby, and their young children, should limit consumption of freshwater fish caught by family and friends to one meal per week unless the state health department has different advice for the specific waters where the fish are caught. For adults, one meal is six ounces of cooked fish or eight ounces uncooked fish; for a young child, one meal is two ounces of cooked fish or three ounces of uncooked fish.

General Changes or Trends in Water Quality

As a result of water quality protection programs that are in place in Delaware, surface water quality in general has remained fairly stable in spite of increasing development and population growth. Impacts to waters are generally the result of past practices or contamination events, activities that are not regulated nor otherwise managed, or changes that are occurring on a larger regional scale. For example, air pollutants from sources outside of Delaware contaminate Delaware's surface waters via rainfall.

Improvements in water quality have been documented in localized areas where a discharge was eliminated or better treatment installed. Basin-wide water quality improvements in waters that are being impacted by historical contamination and nonpoint pollution sources are very difficult to detect over a short period of time. Targeted monitoring over long time periods (years) is necessary in order to detect changes.

Although Delaware's surface water quality may not have changed significantly over the last several years, there have been many improvements made in watershed assessment approaches and methodologies. Additionally, many water quality criteria are stricter as a result of amendments to the State's Water Quality Standards. Therefore, we have become more proficient at identifying water quality problems and, at the same time, are calling for higher quality waters.

The stability of Delaware's surface water quality is likely the result of increased efforts to control both point and nonpoint sources of pollution. In addition to the significant investments in wastewater treatment technologies previously mentioned, many private business interests are investing in practical and cost-effective nonpoint source pollution control practices (Best Management Practices) on farms, residential developments, and commercial and industrial sites. Likewise, public agencies such as the Delaware Department of Transportation are investing revenues in improved storm water management practices and wetlands creation to mitigate the impacts of maintenance and new highway construction activities.

Ground Water Quality

Groundwater quality in Delaware was assessed based on raw-water data collected during 2010-11 from public water-supply (PWS) wells. The water-quality database consisted of over 50,000 analyses. Five aquifer types were recognized for reporting purposes: (1) unconfined, (2) confined, (3) semi-confined, (4) fractured-rock, and (5) karst. Unconfined, confined, and semi-confined aquifers occur in the mid-Atlantic Coastal Plain Physiographic Province, which comprises most (~96%) of Delaware's land-surface area. Fractured-rock and karst aquifers occur in the Piedmont Physiographic Province in the remaining northernmost portion of the state. There are 1,158 active PWS wells and more than three quarters (77%) of these wells produce from Coastal-Plain aquifers; 5% produce from Piedmont aquifers; and the remaining 18% are either not known or not yet established. Well depths range from 22 to 957 ft below land surface (bls) with a median well depth of 138 ft bls. Highlights from the groundwater-quality assessment follow:

- **Based on nitrate data, more than half of the wells evaluated are susceptible to human influence.** Nitrate concentrations exceeded 0.4 mg/L, a threshold indicative of human impacts, in 55% of the samples.
- **The unconfined and karst aquifers are the most susceptible to human influence.** These aquifers had the highest median nitrate concentrations (4.70 and 3.38 mg/L, respectively) and the largest fractions of concentrations exceeding 0.4 mg/L (90 and 100%, respectively).
- **Nitrate concentrations exceeded the drinking-water standard in 5% of all samples.** Concentrations above the Primary Maximum Contaminant Level (PMCL) of 10 mg/L for drinking water were associated with unconfined wells. Areally, PMCL exceedences were primarily limited to Sussex County with the exception of one exceedence in northern New Castle County.
- **Overall, nitrate concentrations decrease with depth.** Nitrate depth trends indicate that the vertical extent of human influence was limited to depths of ~400 ft below land surface and shallower. The deepest nitrate detections above 0.4 mg/L were associated with the karst aquifer. At depths greater than 400 ft, nitrate was rarely detected above the quantitation limit.
- **Organic compounds were frequently undetectable.** Organic compounds were not detected in 98% of the analyses. When detected, almost half (44%) were found at concentrations less than 1 µg/L. Chloroform, a disinfection byproduct, was the most-frequently detected organic compound.
- **Organic compounds rarely exceeded PMCLs.** Specifically, organic compounds exceeded PMCLs in 0.3% of the analyses. The following five analytes were found above the PMCL:

tetrachloroethylene (PCE), methyl tert-butyl ether (MTBE), trichloroethylene (TCE), di(2-ethylhexyl)-phthalate (DEHP), and chloroform.

- **Some organic compounds have depth trends similar to nitrate.** Specifically, concentrations of MTBE, TCE, and PCE with respect to sample depth indicate that the vertical extent of human impact is limited to depths of ~300 ft bls and shallower, with the deepest detections associated with karst wells; at greater depths these selected organic compounds were not detected.
- **Trace elements were frequently undetectable.** Trace elements were not detected in 74% of the analyses. When detected, more than two thirds (68%) were found at concentrations less than 0.1 mg/L and almost all detections (98%) were found at concentrations less than 1 mg/L. Barium, nickel, and chromium were the top three most-frequently detected trace elements.
- **Arsenic was the only trace element found above the PMCL.** Arsenic detections were primarily limited to confined wells greater than 200 ft deep that produce from the Rancocas, Mt. Laurel, or Piney Point aquifers, which are associated with glauconitic geologic formations.
- **Radionuclide data were very limited in this assessment.** Available radionuclide data were limited to the following parameters: uranium-234, uranium-238, radium-226, and radium-228. The PMCL for uranium (0.03 mg/L) was never exceeded. Four radium-226 and radium-228 combined results exceeded the 5 pCi/L PMCL.

Other groundwater-quality findings:

- **Overall, groundwater is predominantly soft or moderately hard.** Specifically, most of the results (87%) met either of these criteria; however, all of the hardness results for karst wells were classified as very hard.
- **Groundwater was acidic in almost half of the overall samples.** Specifically, pH values were less than the lower limit of the Secondary Maximum Contaminant Level (SMCL) range (6.5-8.5 standard pH units) in ~48% of the samples. Unconfined, semi-confined, and fractured-rock wells had the largest fractions of pH values below the SMCL range (86, 50, and 75%, respectively); in contrast, confined and karst wells had pH values that were predominantly within the SMCL range (73 and 100%, respectively).
- **Iron was elevated in one third of the samples.** Iron exceeded the SMCL (0.3 mg/L) in 33% of the samples. Elevated iron was detected in all aquifer types and at virtually all depths. Confined, semi-confined, and fractured-rock wells, however, had the largest fractions of concentrations above the SMCL.
- **Groundwater is generally dilute overall based on total dissolved solids (TDS) data.** Specifically, the median TDS concentration was 156 mg/L. Overall, TDS concentrations exceeded the 500 mg/L SMCL in a small fraction (2%) of the samples. Karst wells had the highest median TDS concentration (403 mg/L).
- **Chloride concentrations met the drinking-water standard in all samples.** Chloride concentrations never exceeded the SMCL (250 mg/L). The most elevated chloride concentration (177 mg/L) was associated with an unconfined well sample. Karst wells had the highest median chloride concentration (48.3 mg/L), consistent with the TDS data.

- **Sodium concentrations exceeded the drinking-water standard in more than one quarter of the samples.** Sodium concentrations exceeded the Health Advisory (HA) of 20 mg/L in 27% of the samples. Sodium concentrations above the HA were found at virtually all depths. Confined wells had the largest fraction of sodium concentrations above the HA (34%).

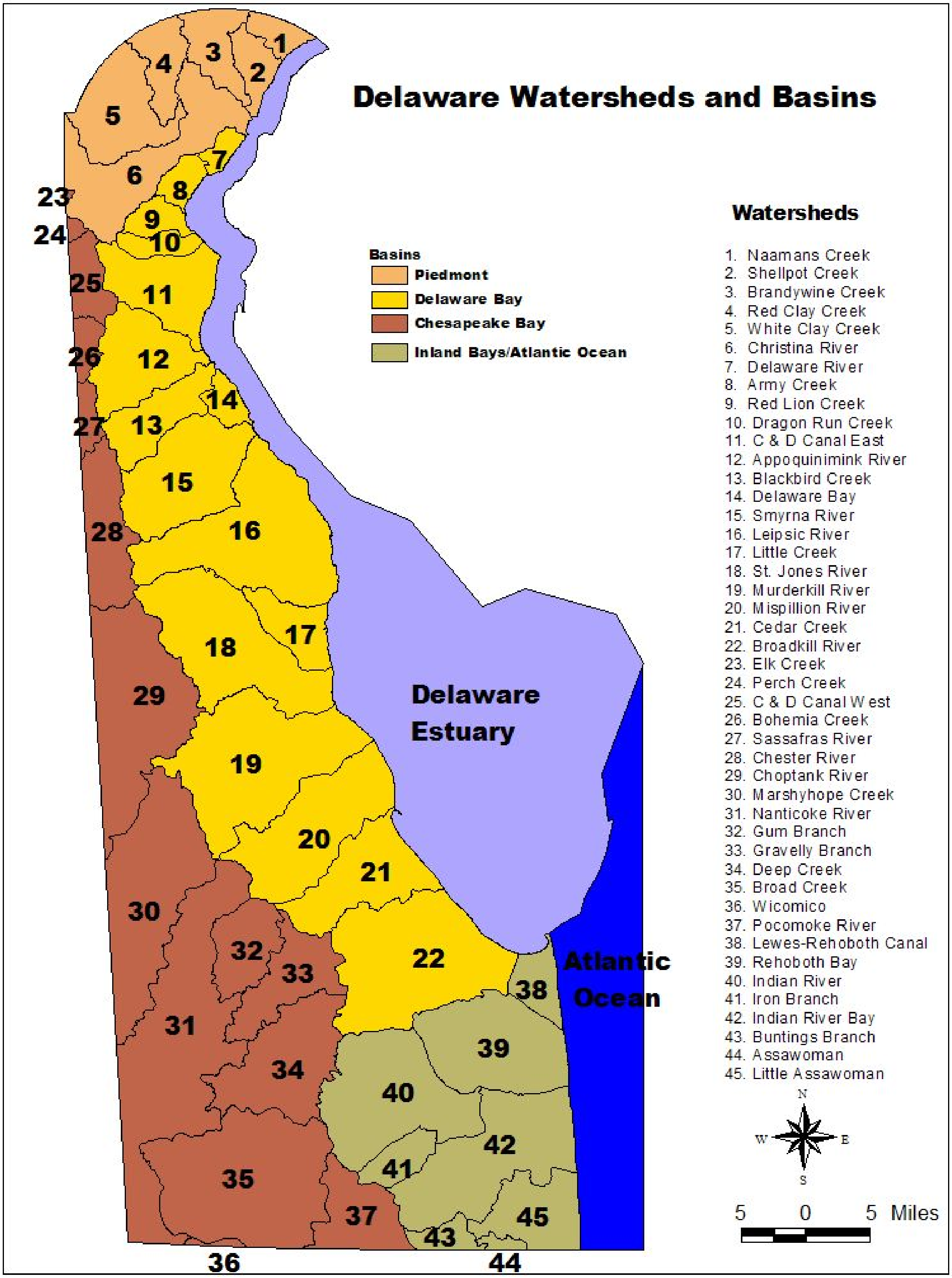
Future Needs and Activities to Improve Environmental Quality of the State

The State of Delaware will continue to focus on nonpoint source pollution problems such as urban and agricultural runoff, erosion and sedimentation and ground water contamination. The Department of Natural Resources and Environmental Control will emphasize pollution prevention, education, and both voluntary and regulatory efforts to improve the quality of surface and ground water resources. Additional research and assessment efforts will be necessary to better understand the response of aquatic systems to certain pollutants. Additionally, because of the relationship of stream flow to ecological health, the development of a surface water withdrawal/minimum stream flow maintenance policy is a priority. Improved assessment and management of biological health and physical habitat quality are also priorities.

The health of Delaware's aquatic systems and ground water resources will be assessed and managed within the framework of the Department of Natural Resources and Environmental Control's Whole Basin Management Program. This program calls for the Department, in partnership with other governmental entities, private interests, and all stakeholders, to focus its resources on specific watersheds and basins (groups of watersheds) within specific time frames.

Five basins and 45 watersheds have been delineated (see figure I-1 entitled "Delaware Watersheds and Basins"). The Whole Basin Management activities in the State started within the Piedmont Basin in 1996, and were followed by the Chesapeake Basin in 1997, the Inland Bays in 1998 and the Delaware Bay Drainage Basin started in 1999. Similar activities have begun for the Delaware Estuary.

In addition to the planning and preliminary assessment steps, Whole Basin Management will include intensive basin monitoring, comprehensive analyses, management option evaluations, and resource protection strategy development. Public participation and ongoing implementation activities will occur throughout the Whole Basin Management process.


Delaware Watersheds and Basins
Basins
Piedmont
Delaware Bay
Chesapeake Bay
Inland Bays/Atlantic Ocean
Delaware Estuary
Atlantic Ocean
Watersheds
1. Naamans Creek
2. Shellpot Creek
3. Brandywine Creek
4. Red Clay Creek
5. White Clay Creek
6. Christina River
7. Delaware River
8. Army Creek
9. Red Lion Creek
10. Dragon Run Creek
11. C & D Canal East
12. Appoquinimink River
13. Blackbird Creek
14. Delaware Bay
15. Smyrna River
16. Leipsic River
17. Little Creek
18. St. Jones River
19. Murderkill River
20. Mispillion River
21. Cedar Creek
22. Broadkill River
23. Elk Creek
24. Perch Creek
25. C & D Canal West
26. Bohemia Creek
27. Sassafras River
28. Chester River
29. Choptank River
30. Marshyhope Creek
31. Nanticoke River
32. Gum Branch
33. Gravelly Branch
34. Deep Creek
35. Broad Creek
36. Wicomico
37. Pocomoke River
38. Lewes-Rehoboth Canal
39. Rehoboth Bay
40. Indian River
41. Iron Branch
42. Indian River Bay
43. Buntings Branch
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45. Little Assawoman
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Figure 1 -1

Programs to Correct Impairments

State of Delaware Total Maximum Daily Load Program (TMDL)

Section 303(d) of the Federal Clean Water Act (CWA) requires States to develop a list of water bodies for which existing pollution control activities are not sufficient to attain applicable water quality standards (303(d) List) and to develop Total Maximum Daily Loads (TMDLs) for pollutants of concern. A TMDL sets a limit on the amount of a pollutant that can be discharged into a waterbody such that water quality standards are met.

The State of Delaware was operating under a court-approved Consent Decree that required establishment of nutrient, dissolved oxygen, bacteria, and zinc TMDLs for all impaired streams that were listed on the State's 1996 303(d) list by the year 2006. The Department met the requirements of the Consent Decree by December 2006 and completed TMDLs for all waters of the State that were impaired as the result of high nutrients, low dissolved oxygen, high bacteria levels, or high concentration of zinc.

The Department is currently developing TMDLs for toxics according to a schedule provided in the 303(d) List. Furthermore, the Department is taking the necessary steps to address habitat and/or biological degradation of the State’s waters according to a schedule provided in the 303(d) list.

Pollution Control Strategies

Pollution Control Strategies (PCSs) are plans to achieve the nutrient and bacteria load reductions delineated by Total Maximum Daily Loads (TMDLs). They describe the specific actions that are needed to achieve water quality standards and provide a schedule for implementing those actions. PCSs have been developed for seven watersheds: Christina (Brandywine Creek, Red Clay Creek, White Clay Creek, and Christina River), Appoquinimink River, St. Jones River, Murderkill River, Mispillion River and Cedar Creek, Nanticoke River (including Broad Creek and their tributaries), and the Inland Bays (Rehoboth Bay, Indian River and Bay, Little Assawoman Bay, and their tributaries). The PCSs, for these watersheds except for Mispillion and Cedar Creek Watersheds, have been recommended by diverse groups of citizens (including government officials) called Tributary Action Teams (TATs). These TATs work with the Department’s Whole Basin Management Teams and other experts during the process of formulating the PCSs.

The Inland Bays Tributary Action Team, convened by the Center for the Inland Bays, worked diligently in providing the Department with several sets of recommendations for their PCS. This Team was facilitated by Bill McGowan of the Cooperative Extension and Joe Farrell of Delaware Sea Grant. After 6 years of deliberations with a diverse group of watershed interests, DNREC proposed a draft PCS in early 2005. Based on comments received during three public workshops and other meetings with stakeholders, a second draft was presented at three additional workshops in May 2005. Significant concerns were raised by the development community and a group of interested parties including the Delaware Farm Bureau, the Delaware Realtors Association, the Positive Growth Alliance, and the Delaware Homebuilder’s Association lobbied the General Assembly to intervene in this process. The Department met with these parties for a year in order to incorporate their concerns and presented the revised Strategy at a third round of public workshops in August 2006. During these workshops, members of the scientific community raised substantive concerns relating to the buffer portion of the regulation and public outcry resulted in several legislators asking the Department to revisit the buffering issue with the Center for the Inland Bays. In April 2007, the Department attempted to promulgate the PCS regulation with the buffer portion reserved in order to move forward with the Strategy while still taking time to investigate how to successfully craft a buffer rule in lower Delaware. This approach was also not well received and the Department approached specific Sussex County developers to draft a buffer strategy for inclusion in the PCS regulations. Finally on November 11, 2008 the DNREC"s Secretary signed the Inland Bays Pollution Control Strategy which promulgated their regulations requiring regulatory actions in the Inland Bays watershed.

To insure implementation of the Inland Bays Pollution Control Strategy, staff from DNREC's Divisions of Water Resources and Soil and Water Conservation as well as the Sussex Conservation District routinely hold pre-application meetings for new proposed development projects to discuss new stormwater management and buffer requirements. In addition, if proposed projects use onsite wastewater treatment and disposal systems, applicants are informed of new PCS requirements that may apply to those systems as well. Since the PCS regulation went into effect, 12 proposed projects were discussed at these pre-application meetings.

The Cooperative Extension Service convened the Nanticoke watershed's TAT. This group of concerned residents submitted their recommendations at the end of 2002. A PCS has been drafted from their recommendations and has been undergoing review within the Department. The Nanticoke River and Broad Creek PCS will also address additional actions that will be needed for Delaware to achieve its nitrogen, phosphorus, and sediment load reduction commitments as part of the Chesapeake Bay Program. The Department anticipates scheduling public workshops for the draft Nanticoke PCS once the Inland Bays PCS is successfully promulgated.

Since 2000, Delaware has participated with the Chesapeake Bay Program and has committed to achieving water quality goals to protect and improve the bay and tributary waters. EPA is in the process of developing a Total Maximum Daily Load for nitrogen, phosphorus, and sediment that will require significant reductions in point and nonpoint pollutant loadings from all jurisdictions within the Chesapeake Bay Watershed in order to achieve water quality standards. Each jurisdiction is required to develop a Watershed Implementation Plan that details how load allocations will be achieved and maintained into the future. Additionally, jurisdictions will have to exhibit accountability through achieving 2-year milestone goals. In order to achieve these requirements and an aggressive schedule, DNREC has convened the Chesapeake Bay Interagency Workgroup made up of representatives from each DRNEC Division, Department of Agriculture, Department of Transportation, Office of State Planning Coordination, County Conservation Districts, the Natural Resource Conservation District, and other stakeholders. Eight subcommittees have been formed to address: Agriculture; Stormwater; Wastewater; Land Use and Comprehensive Plans; Restoration; Public Lands; Funding; and Information Technology. Subcommittees are tasked with recommending and reviewing sub-allocating methodologies to the various point and nonpoint sources within the basins, assessing current data tracking and reporting systems, determining maximum implementation goals and methods to fill program and funding gaps, and assist with writing and providing information for the Watershed Implementation Plan.

The Appoquinimink River Tributary Action Team, convened by members of the Appoquinimink School District, also worked hard to educate their community while formulating recommendations for their PCS. The Team created a speaker's bureau that made presentations on water quality for community group meetings and have a monthly column in the Middletown Transcript. A draft of the Pollution Control strategy is written and undergoing internal review. The Appoquinimink River Tributary Action Team has become a 501-c (Appoquinimink River Association) and has been very active implementing the voluntary components of PCS recommendations. Because of the activity of the Appoquinimink River Association, the Appoquinimink Watershed Coordinator, most of the regulations actions proposed in the PCS has been promulgation by the municipalities in the Watershed or be promulgated by State Septic and stormwater regulations.

In the Murderkill River watershed, the Division of Water Resources teamed with the Division of Parks and Recreation to convene the Murderkill TAT at Killens Pond State Park. This Team, formed in 2001, actually began its work before the promulgation of the Murderkill TMDL in December 2001. They held two public forums in May and another in August of 2002. Their recommendations have been drafted into a PCS and Kent County has been incorporating several of their recommendations into their County Comprehensive Plan and ordinances. The regulatory portions of this PCS will go to public hearing following the successful promulgation of the Nanticoke PCS.

The St. Jones TAT was convened by the Cooperative Extension at Delaware State University and held three public forums in early 2006 and submitted their recommendations into the Department in early 2007. In May of 2009, a St Jones Watershed Coordinator was hired to implement on the ground water quality improvement throughout the watershed. Funding for the coordinator has been extended until early 2012.

The Christina Basin was convened by the University of Delaware Water Resource Agency, met for over a year, and submitted their recommendations to the Department in fall 2007.

The Delaware Sea Grant Program convened the Broadkill River TAT in early 2006 and the Department expects the team to submit their recommendations in early 2008.

The Camden-Wyoming Rotary convened the Upper Chesapeake TAT in early 2006 and the Department expects the team to submit their recommendations in early 2008.

The City of Milford convened the Greater Mispillion Tributary Action Team which include Cedar creek Water in 2009, The Mispillion TAT is begin to formulate their Pollution Control recommendations.

Tributary Action Teams for other watersheds with TMDLs will be formed in mid to late 2011 and include the Army Creek-Red Lion Creek-Dragon Run Creek watersheds, the Smyrna River-Leipsic River-Little Creek watersheds, and the Marshyhope Creek-Pocomoke River watersheds.

To date, Tributary Action Teams have documented over 3000 pounds per day of total nitrogen and 275 pounds per day of total phosphorus reductions to Delaware’s surface waters and their proposed Pollution Control Strategies propose to reduce an additional 8,040 pounds per day of total nitrogen and reduced 133 pounds per day of total phosphorus. These measurable reductions will have significant impacts on Delaware's surface water quality.

The Delaware Nonpoint Source Program

The Delaware Nonpoint Source Program administers a competitive grant made possible through Section 319 of the Clean Water Act. The grant provides funding for projects designed to reduce nonpoint source (NPS) pollution in Delaware. NPS pollution may be defined as any pollution that originates from a diffuse source (such as an open field or a road) and is transported to surface or ground waters through leaching or runoff. Reduction of NPS pollution may often be achieved through incorporation of specific best management practices (BMPs) into project workplans. Projects may target any source of NPS pollution, but most frequently involve agriculture, silviculture, construction, marinas, septic systems, and hydromodification activities. Proposals are reviewed and evaluated, and those which are determined to meet specific requirements are eligible for funding. All projects must include matching funding from a non-Federal source totaling at least 40 percent of the overall project cost.

In addition to funding projects that achieve reductions in NPS pollution, the Delaware NPS Program is committed to addressing the issue through educational programs, publications, and partnerships with other organizations working to reduce NPS pollution in Delaware. More information and annual reports are available online at this url: http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/NPS/index.htm .

Delaware Riparian Buffer Initiative

Local, State, and Federal governments across the country have recognized the benefits of riparian buffers, including protection of water quality, preservation of flood plains, wetlands, and other important wildlife habitats. Because riparian buffers provide so many different benefits, they can be used to serve many purposes. Grassed or tree-lined buffers at the edge of farm fields trap sediment and filter pesticides and fertilizer. Buffers in urban environments slow stormwater runoff from roads and parking lots. And buffers everywhere offer food and habitat for wildlife, as well as recreational opportunities for people.

The Delaware Riparian Buffer Initiative developed a Watershed level suite of tools for prioritizing areas for riparian buffers. This GIS Planning module was developed through a series of workshops and meetings taking input from Conservation Districts, NRCS, Delaware Department of Agriculture, USFWS, and DNREC staff, facilitated by the Delaware Coastal Programs. This resulted in criteria to identify Very High, High, Medium and Low Priority areas to target for riparian buffers based upon both water quality and wildlife considerations.

The four main functions of this GIS Planning Module are:

- Identify riparian and vegetated wetland areas within a watershed that have or do not have vegetated buffers
- Review the connectivity between riparian areas and plan for riparian corridors
- Prioritize targeting for riparian buffers
- Mapping function to a standard layout design.

Delaware Nutrient Management Commission

The Nutrient Management Act established a 19-member commission that is charged to develop, review, approve, and enforce regulations governing the certification of individuals engaged in the business of land application of nutrients and the development of nutrient management plans. The members of this commission come from many different backgrounds and professions. The Delaware Nutrient Management Commission's official mission is:

"To manage those activities involving the generation and application of nutrients in order to help improve and protect the quality of Delaware's ground and surface waters, sustain and promote a profitable agricultural community, and to help meet or exceed federally mandated water quality standards, in the interest of the overall public welfare.

The mission of The Delaware Nutrient Management Commission is to:

- Consider establishing critical areas for voluntary and regulatory programs.
- Establish Best Management Practices to reduce nutrients in the environment.
- Develop educational and awareness programs.
- Consider incentive programs to redistribute nutrients.
- Establish the elements and general direction of the State Nutrient Management Program.
- Develop nutrient management regulations.

The Delaware Nutrient Management Commission is online at the following url: http://www.state.de.us/deptagri/nutrients/ .

Part II :Background

Background

This report on Delaware's water quality has been prepared pursuant to the requirement set forth in the Federal Clean Water Act of 1977 and the 1981 and 1987 amendments of Section 305(b), which require each state to prepare and submit to Congress a description of the water quality of all navigable waterways within the State on a biennial basis. The information contained herein applies to the period of September 2006 through August 2011.

Water quality assessments contained in this report were based on information available at the time of assessment. All basin assessments were prepared by the Delaware Department of Natural Resources and Environmental Control, Division of Water Resources.

State Atlas

Table 2.1 provides a brief summary of statistics regarding population and waterbody sizes for Delaware. The waterbody sizes listed in the table were obtained from a Geographic Information System (GIS) data layer that was recently developed to index state's stream waters with the U.S. EPA's Reach File 3 network of streams.

Table 2.1 State Atlas

State Population[1]	907,135
State Surface Area	1981 square miles
Number of Basins	5
Number of Watersheds	45
Total Number of Stream and River Miles	2509
Number of Perennial River Miles	1778
Number of Intermittent Stream Miles	405
Number of Ditches and Canals	326
Number of Border Miles	87
Acres of Lakes/Reservoirs/Ponds	2954
Square Miles of Estuarine Waters	841
Number of Ocean Coastal Miles	25
Acres of Freshwater Wetlands	226,530
Acres of Tidal Wetlands	127,338

1. See page 50 of the 2012 Report on State Planning Issues, available online here: http://stateplanning.delaware.gov/docs/2012_cabinet_committee_annual_report_final_11_01_2012.pdf

2. Surface area for Delaware River Zone 5 and Delaware Bay provided by the Delaware River Basin Commission (DRBC), 1994 -1995 305(b) Report. For purposes of this report, Delaware reports on the Inland Bays and DRBC reports on the Delaware River and Bay.

Summary of Classified Uses

The State of Delaware Surface Water Quality Standards (as amended July 2004) contains the following Designated Use categories:

- Public Water Supply (PS)
- Industrial Water Supply (IS)
- Primary Contact Recreation (PCR)
- Secondary Contact Recreation (SCR)
- Fish, Aquatic Life, and Wildlife (FISH,WL)
- Cold Water Fish - Put and Take (CWF)
- Agricultural Water Supply (AS)
- Exceptional Recreational or Ecological Significance (ERES)
- Harvestable Shellfish Waters (SFH)

EPA recognizes that each state may have different designated use categories and definitions. In order to improve reporting consistency and interpretation of assessment information on the national level, EPA has recommended the use of the following designated use categories for reporting purposes:

- Fish Consumption
- Shellfishing
- Aquatic Life Support
- Swimming
- Secondary Contact Recreation
- Drinking Water Supply
- Agriculture

Delaware has applied EPA's categories in reporting designated use support on the following basis:

- Fish Consumption is assessed based on whether a fish advisory exists for a waterbody;
- Aquatic Life Support is equivalent to Delaware's Fish, Aquatic Life, and Wildlife designated use;
- Shellfishing is equivalent to Delaware's Harvestable Shellfish Waters designated use;
- Swimming is equivalent to Delaware's Primary Contact Recreation designated use and also includes water skiing;
- Secondary Contact is equivalent to Delaware's Secondary Contact Recreation designated use and includes activities such as boating;

- Drinking Water Supply is equivalent to Delaware's Public Water Supply designated use;
- Agriculture is equivalent to Delaware's Agricultural Water Supply designated use.

For this report, the attainment of the Clean Water Act goal of fishable waters is primarily based on Aquatic Life Support and Fish Consumption. Less than full support or attainment of either the Aquatic Life Support or Fish Consumption infers that the fishable goal of the Clean Water Act is not fully supported. Less than full support of the Swimming or Primary Contact Recreation designated use infers that the swimmable goal of the Clean Water Act is not fully supported.

Delaware's Exceptional Recreational or Ecological Significance (ERES) designation is applied to special State waters that are accorded a higher level of protection than other waters. Section 5 of the State of Delaware Surface Water Quality Standards (June 2011) contains specific criteria for ERES waters.

All the State's waters are designated for Primary Contact Recreation and for Fish, Aquatic Life, and Wildlife purposes.

Part III: Surface Water Assessments and TMDL List

Part III: Surface Water Assessments

Chapter 1 Monitoring Programs

Surface Water Monitoring Programs

Water quality and biological data for Delaware's surface waters are collected under Delaware's Ambient Surface Water Quality Monitoring Program and Biological Monitoring Program within DNREC. Several active citizen monitoring programs have also been developed throughout Delaware that augment the data collected by DNREC. These programs are discussed below.

The DNREC recognizes the need to use its personnel and financial resources efficiently and effectively. To that end, surface water quality monitoring is conducted in a manner that focuses available resources on the Whole Basin Management concept. The Whole Basin Management Program in Delaware operates on a 5-year rotating basis. This new approach enables the DNREC to comprehensively monitor and assess the condition of the State environment with due consideration to all facets of the ecosystem.

Elements of the State's specific Surface Monitoring Program include:

- TMDL-Related Monitoring
- General Assessment Monitoring
- Toxics in Biota Monitoring
- Toxics in Sediment Monitoring
- Biological Assessment Monitoring
- TMDL Related Monitoring

Section 303(d) of the Clean Water Act (CWA), as amended by the Water Quality Act of 1987, requires States to identify those waters within their boundaries that are water quality limited, to prioritize them, and to develop a Total Maximum Daily Load (TMDL) for pollutants of concern. A water quality limited water is a waterbody in which water quality does not meet applicable water quality standards, and/or is not expected to meet applicable standards, even after application of technology-based effluent limitations for Publicly Owned Treatment Works (POTW) and other point sources.

Delaware DNREC has developed a list of water quality limited waters (303(d) List) completed nutrient and bacterial TMDLs for all segments on the 1996 list over a ten-year period. The TMDL development schedule is coordinated with the Department’s Whole Basin Management Program.

The TMDL related monitoring is designed to provide the necessary information to develop, calibrate, and verify hydrodynamic and water quality models and/or to support the existing models. The Department uses the hydrodynamic and water quality models as management tools for establishing total maximum daily loads; for allocating loads between point and nonpoint sources of pollutants; and for monitoring progress toward achieving water quality goals and standards.

General Assessment Monitoring

The General Assessment Monitoring Network (GAMN) provides for routine water quality monitoring of surface waters throughout Delaware. Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, hardness, and metals. The data from this monitoring is entered into the EPA's STORET database, is reviewed and then analyzed in assessing the water quality condition of each water body system. Figure III-1 is a map of active STORET stations used for this report.

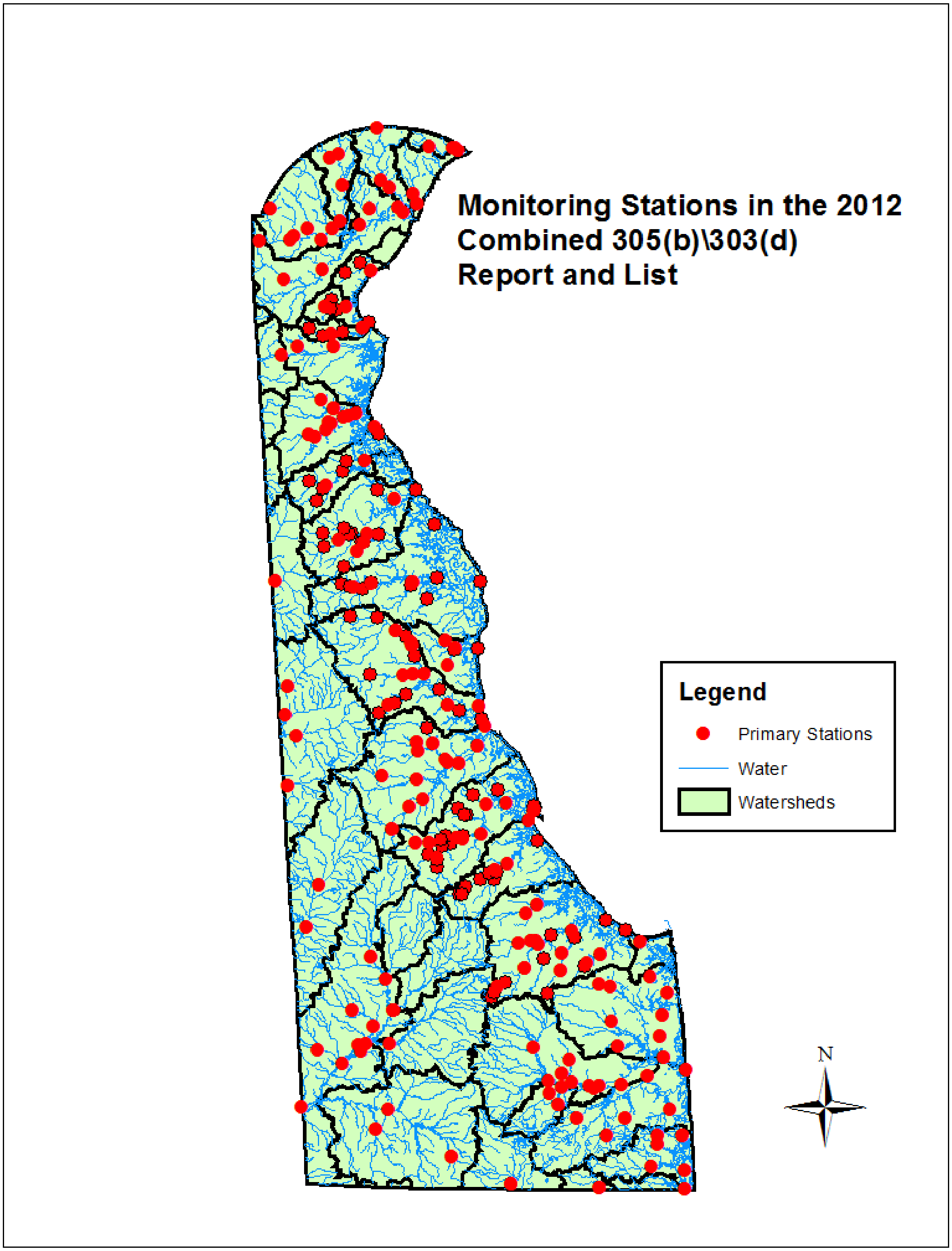

Monitoring Stations in the 2012
Combined 305(b)\303(d)
Report and List
Legend
● Primary Stations
Water
🟩 Watersheds
N

Figure 3 - 1

Annual Toxics in Biota Monitoring

The Annual Toxics in Biota Monitoring provides for screening level surveys and intensive surveys for toxic contaminants in fish/shellfish. Provision is also made to revisit waters where fish consumption advisories have been issued in the past to determine if contaminant levels in fish are increasing or decreasing over time. Intensive surveys are planned and conducted in areas where contamination has been detected in screening level surveys.

Toxics in Sediment Monitoring

The purpose of the Toxics in Sediment program is to obtain baseline information regarding the levels of various toxics in the sediments of waters throughout the State. The program is designed to complement the Annual Toxics in Biota Monitoring.

Biological Assessment Monitoring

The assessment of the quality of surface waters utilizes a multi disciplinary approach involving physical, chemical, and biological measures. The biological monitoring program is a major tool used by the Department to assess the conditions of surface waters. It includes the assessment of indigenous biological communities and physical habitats of streams, ponds, estuaries and wetlands. The goal of the program is to establish numeric biological criteria in State water quality standards to complement both existing chemical criteria and other assessments focused on fish tissue monitoring and bioassay testing. Standard methods have been developed and tested for assessing the biological community and habitat quality of nontidal streams, and draft numeric criteria are under development. Efforts over the next few years will focus on the development of methods for assessing estuaries and ponds and for assessing the quality and quantity of wetlands

Coordination/Collaboration

Delaware Center for the Inland Bays

The Delaware Center for the Inland Bays was established as a nonprofit organization in 1994 under the Inland Bays Watershed Enhancement Act (Chapter 76 or Del. C. S7603). The mission of the Center for the Inland Bays is to oversee the implementation of the Inland Bays Comprehensive Conservation and Management Plan and to facilitate a long-term approach for the wise use and enhancement of the Inland Bays watershed by conducting public outreach and education, developing and implementing conservation projects, and establishing a long-term process for the preservation of the Inland Bays watershed.

The goals of the Center for the Inland Bays are:

To sponsor and support educational activities, restoration efforts, and land acquisition programs that lead to the present and future preservation and enhancement of the Inland Bays watershed.

To build, maintain, and foster the partnership among the general public; the private sector; and local, state, and federal governments, which is essential for establishing and sustaining policy, programs, and the political will to preserve and restore the resources of the Inland Bays watershed.

To serve as a neutral forum where Inland Bays watershed issues may be analyzed and considered for the purposes of providing responsible officials and the public with a basis for making informed decisions concerning the management of the resources of the Inland Bays watershed.

The establishment of the Center was the culmination of more than 20 years of active public participation and investigation into the decline of the Inland Bays and the remedies for the restoration and preservation of the watershed. A key element of this progression was the publication of a Decisions for Delaware: Sea Grant Looks at the Inland Bays (1983) and the participation by Sea Grant researchers and outreach personnel in the problem-solving process. The last six years of this work were accomplished as part of the National Estuary Program.

The National Estuary Program, established under the Clean Water Act and administered by the U.S. Environmental Protection Agency (EPA), provided approximately $2 million to study the Inland Bays, characterize and set priorities for addressing the environmental problems in the watershed, and develop a Comprehensive Conservation and Management Plan (CCMP) to protect and restore the bays. The underlying theme of the program is that a collaborative, consensus-building effort involving citizens; private interests; organized groups; and federal, state, and local governments is essential to the successful development and implementation of the CCMP. Recently completed through a highly successful participatory effort, the Inland Bays CCMP has now been approved by Governor Thomas Carper and the EPA. Funding is provided by the EPA, the State of Delaware and private donations.

Delaware Nature Society Watershed Stewardship Programs

Watershed Stewardship – comprised of Stream Adoption, Technical Monitoring, and Backyard Habitat – is designed to engage citizens statewide in the protection of Delaware's watersheds.

Stream Adoption

The Stream Adoption program educates individuals, families, scout and school groups about stream ecology, the threats to stream health, and their individual role in protecting water quality. Currently, 70 stream segments are "adopted" in 20 watersheds statewide. In 2009, Nature Society staff provided workshops and presentations reaching over 277 individuals. The Nature Society made over 6278 contacts with school students and scout groups through Water Quality education programs.

Technical Monitoring

Established in 1995, Technical Monitoring is a nationally recognized example of the acceptance and use of citizen science data by the State and the Environmental Protection Agency (EPA). Technical Monitoring was developed to supplement the State's monitoring efforts in other locations by providing reliable baseline values for several different chemical and physical parameters. The monthly sampling frequency, strategic site selection, rigorous quality assurance and control measures, and technical equipment allow for more subtle trend analysis.

Technical monitoring data is collected at 37 sites in the Christina River Basin, which includes the Brandywine, Red Clay, and White Clay Creeks, all in northern New Castle County. There are 4 sites monitored on the Mispillion River in Kent & Sussex counties. Technical Monitoring volunteers started monitoring 5 sites on the Appoquinimink River in southern New Castle County in 2008. The Christina Basin Technical Monitoring data is being incorporated into a non-point source pollution water quality model used by DNREC's Division of Water Resources and the US Geological Survey for the Delaware – Pennsylvania Total Maximum Daily Load (TMDL) effort for the Upper Christina Watershed. Data collected in the Mispillion Watershed is providing supplementary data to the Division of Water Resources. In 2009, Technical Monitoring volunteers logged 457 hours.

In addition, the data in both watersheds is published every five years in the Nature Society's State of the Watershed reports. Data collected in the Christina Basin Watershed from 2001-2005 is available online at www.delawarenaturesociety.org. The report summarizing the data from the Mispillion Basin Watershed from 2004-2008 is also available online.

Backyard Habitat

Backyard Habitat, launched in September 2001, provides official certification for properties or residences that provide food, cover, water, and places for wildlife to raise their young. By adopting practices beneficial to wildlife such as landscaping with native plants and limiting use of pesticides, participants help to improve local water quality by reducing their reliance on products that contribute to non-point source pollution. The Nature Society offers homeowners interested in Backyard Habitat certification free, one-on-one technical assistance through our trained Habitat Stewards volunteer corps. In 2009, the Nature Society has certified 32 properties (435 total to date) representing a variety of development types ranging from urban to suburban reserve across all three Delaware counties. Habitat Stewards have provided 16 hours of volunteer service in the past year.

Citizens Monitoring Programs in Delaware

In recent years, many citizens' groups have been formed nationwide in response to the growing concerns about degraded water quality. Delaware was one of the first states to initiate citizens' water quality monitoring program of streams to augment fixed monitoring by state agencies. The involvement of citizens in collecting data and making observations on their streams results in an educated public with an appreciation for their watersheds and awareness of pollution threats to vital resources. Data and observations collected by citizens with a strong sense of environmental stewardship will contribute to the long-term success of environmental strategies.

Delaware has four programs that use citizens to monitor water quality. The Delaware Nature Society in cooperation with DNREC established Delaware Stream Watch in 1985. The Inland Bays Citizen Monitoring program was established in 1990 as part of the Inland Bays Estuary Program. Concerned citizens of the City of Seaford in cooperation with DNREC founded the Nanticoke Citizen Monitoring Program in 1991. The Adopt A Wetland Program initiated in May 1993 by the Division of Water Resources and later transferred to the division of Fish and Wildlife.

Inland Bays Citizen Monitoring Program

The Inland Bays Citizen Monitoring Program is managed by the University of Delaware Sea Grant Marine Advisory Service (SGMAS) through an MOU with DNREC, Division of Water Resources. The progam was established in 1991. The goals of the Inland Bays Citizen Monitoring Program are: 1) to collect verifiable water quality data to be used to support public policy decisions with regard to the management of the Inland Bays and 2) to increase public awareness and support for the protection and management of these aquatic resources through public participation.

About 30 citizen monitors make observations at 25 sites encompassing the Inland Bays watershed, evaluating dissolved oxygen, surface water and air temperature, salinity, secchi depth and water depth. Additional site observations include weather, tides and the abundance of macroalgae in near-shore waters. Volunteers collect samples on a weekly basis from mid-April to mid-October, and every two weeks otherwise, if weather permits. Rainfall data are collected daily at three designated locations in the watershed. Volunteers complete data collection sheets and send them to SGMAS for data entry. Volunteer data are reviewed for errors and entered by the field coordinator into a Microsoft Excel spreadsheet on a microcomputer.

Twice a month, volunteers collect water samples from 17 sites that are transferred to College of Marine Studies (CMS) laboratories for analysis of dissolved inorganic nitrogen (nitrate, nitrite and ammonium), dissolved inorganic phosphorous (orthophosphate), chlorophyll a, and total suspended solids using standard laboratory methods. Six times from April through October, volunteers collect water samples from six sites that are transferred to the DNREC Shellfish Program for analysis of fecal coliform bacteria.

The sampling methodology used in this program has been approved by the U.S. Environmental Protection Agency and has been published under the title Quality Assurance Project Plan for the Inland Bays Citizen Monitoring Project. Quality Assurance is maintained by holding group Quality Assurance/Quality Control (QA/QC) sessions at six month intervals. Sessions are conducted as needed for individual volunteers.

The Citizen Monitoring Program has been successful at forging partnerships with data users, most notably State and local governments. The data is an integrated component of the Inland Bays Monitoring Plan. Citizen data has 1) supported the siting of submerged aquatic vegetation test plots, and 2) has been utilized in the Hydrodynamic and Water Quality model used to calculate Total Maximum Daily Loads (TMDL), or to predict tidal flushing from a proposed artificial inlet. Volunteers have participated in several cooperative mini-projects in which the data they collected was used to support research conclusions made by DNREC and CMS scientists. Citizen concern about pathogens in the water and adverse health effects prompted the addition of fecal coliform testing in 1992. The data has been used to support the opening of shellfish beds in the Inland Bays. Citizen monitors have also been involved in monitoring the growth and survival of clams and oysters to support the development of a shellfish management plan. Community concern about water quality in the canal systems of South Bethany prompted the town council to initiate a community-based study in 1995 to support the development of a stormwater management plan.

Project benefits include 1) improved understanding of water quality dynamics, 2) sense of “ownership” of the study by the community and interest in improving water quality through better management practices, 3) cooperation among resource agencies and community leading to trust and ongoing relationships.

The Sea Grant Program Manager provides oversight and coordination of the Program. A field coordinator is employed on a one-half time basis. The management team is responsible for data management and analysis, public education, quality assurance, volunteer recruitment, management and training of volunteers, daily operations of the project, conducting training sessions and field workshops, writing summary reports, and writing grant proposals to support additional mini-projects. Funding for the project is through a line-item in the DNREC budget. CMS provides office, laboratory and classroom space, laboratory equipment and technical support. DNREC provides technical advisors for program initiatives, and assistance with training and field sessions. The annual budget is approximately $37,000.

Data Interpretation and Communication

Delaware has converted its older Waterbody System (WBS) database to the new EPA provided Assessment Database (ADB). The ADB is a Microsoft Access© database that generated the summary Use Assessment tables in this report. The ADB was updated in 2007 to a newer version. During the conversion process, it was determined that nutrient impairments had not been accounted for within the database. Accounting for the impairments changed the percent of waters that were supporting their uses. This was not an increase in actual impairments; rather it was a correction to the database. Changes in the ADB and computer operating environment have rendered the ADB inoperable at this time. The Department is working with EPA to implement an updated reporting system similar in functionality to the ADB.

Chapter 2: Assessment Methodologies and Summary Data

2012 Assessment, Listing and Reporting Methodologies Pursuant to Sections 303(d) and 305(b) of the Clean Water Act

General Provisions

All readily available data and information for the period of September 1, 2006 through August 31, 2011 will be considered for the assessment of most designated uses. Given that adequate water quality data may not be available in all cases, determinations of use attainment will be made with an abundance of caution.

Data Quality and Quantity

Data from the Department of Natural Resources and Environmental Control's (DNREC's) Environmental Laboratory Section (ELS) will be considered for use if it is collected and analyzed in accordance with the DNREC ELS Quality Assurance Project Plan. For data from sources other than the DNREC ELS, the Department will consider the quality controls used in collection and analysis to determine if it will be appropriate for use in this assessment. Data will be considered readily available if it is in an electronic format that can be imported into or exported from a modern spreadsheet or database program like Microsoft Excel, Access or Quattro Pro. Data that is only available on paper will be considered on a case by case basis given the limited resources available to the Department to convert such data to the more usable electronic format.

The Department routinely currently collects water quality samples at about150 stations throughout the State. For this cycle, data is available from 186 stations. That data makes up the bulk of the data available for use in 305(b) assessments. The Department considers data from the most recent five-year period, thus, at each station, there are usually data from 20 sampling dates or more. Some stations are in place for a more limited time period and have smaller data sets. Other readily available data and reports are requested in advance of each assessment from parties outside of the Department and used when they are made available. In addition to electronic mail requests from specific organizations, a notice will be published in the Delaware State News and the News Journal.

For the 2012 assessment, the Department will consider data and information received on or before Feb 15th, 2012 from the following sources:

- Reports prepared to satisfy Clean Water Act (CWA) Sections 305(b), 303(d) and 314 and any updates;
- The most recent Section 319(a) nonpoint source assessment;
- Reports of ambient water quality data including State ambient water quality monitoring programs, citizen volunteer monitoring programs, complaint investigations, and other readily available data sources (e.g., EPA's Storage and Retrieval System (STORET), the United States Geological Survey, and research reports), and data and information provided by the public;
- Reports relative to dilution calculations or predictive models;
- Water quality management plans;
- Superfund Records of Decision; and

- Safe Drinking Water Act source water assessments.
- Fish and shellfish advisories
- Restrictions on water sports or recreational contact

Coordination with Delaware River Basin Commission (DRBC) and Chesapeake Bay Program Assessments

The DRBC prepares 305(b) assessment reports every two years for the Delaware River and Delaware Bay. Delaware will incorporate the most recent use attainment determinations made by DRBC for the shared waters of the Delaware River and Delaware Bay into its 2012 303(d) list. Delaware expects to work cooperatively with the DRBC, member states and stakeholders to develop and implement TMDLs in waters of the Delaware River and Bay that the DRBC determines to be impaired.

The Chesapeake Bay Program (CBP) is doing assessments for waters in the Chesapeake Bay and nearby waters that drain into the bay in co-operation with Maryland, Virginia, Washington D.C. and Delaware. Delaware will incorporate the most recent use attainment determinations for waters of the state that use criteria developed by the CBP for waters that drain to the Chesapeake Bay.

Use of Environmental Protection Agency Integrated Assessment Guidance

On July 29, 2005, the EPA published “Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act.” The guidance is available on the internet at this URL: http://www.epa.gov/owow/tmdl/2006IRG/index.html. The Guidance was reaffirmed in for the 2008 listing process in a memo by Diane Regas of the EPA. That memo is online at this URL: http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html . The Guidance was reaffirmed and expanded upon in a May 5, 2009 memorandum posted online at this URL: http://www.epa.gov/owow/tmdl/guidance/final52009.html . No significant changes were made to the guidance in the March 21, 2011 memo online here: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/ir_memo_2012.cfm .

The core recommendation of the guidance is to categorize all waters of the state according to the following five categories:

Category 1: All designated uses are met;

Category 2: Some of the designated uses are met but there is insufficient data to determine if remaining designated uses are met;

Category 3: Insufficient data to determine whether any designated uses are met. Either no data is available or some data is available, but it is insufficient to make a determination

Category 4: Water is impaired or threatened but a TMDL is not needed;
- 4A: All TMDLs for this segment have been completed and EPA approved. Class 4A waters have all necessary TMDLs approved, but one or more impairments exist, despite the approved TMDLs.
- 4B: Other required control measures are expected to result in the attainment of WQSs in a reasonable period of time

- 4C: The impairment or threat is not caused by a pollutant

Category 5: Water is impaired or threatened and a TMDL is needed for at least one pollutant or stressor

Each of Delaware's waterbody segments will be assigned to the appropriate category for each designated use and then 'rolled up' into a final categorization for the segment. For the final categorization, the highest category number from the applicable use determinations will be assigned to each segment. For example, if a hypothetical segment has a Category 1 determination for aquatic life use support based on average dissolved oxygen, a Category 3 determination for primary contact use, and a Category 5 determination for aquatic life use support based on the dissolved oxygen minimum criteria, then the segment would be given an overall categorization of category 5. In this case, DNREC would pursue the collection of additional enterococcus data in order to assess the primary contact use and establish a schedule for developing a TMDL in order to meet the minimum dissolved oxygen criteria.

Dissolved Oxygen (DO) Aquatic Life Use Support (ALUS)

The following types of DO data are potentially available for analysis:

- Field measurements taken by personnel using handheld DO probes; and
- Continuous monitoring data collected using multiparameter monitoring systems that are typically deployed for several days, weeks, or months. In order to get a more accurate picture of dissolved oxygen dynamics and other water quality parameters, the Department continues to increase its use of continuous monitoring systems.

To determine ALUS with regard to Dissolved Oxygen (DO), the following methodology will be used to compare measured DO concentrations to two different standards, the minimum at all times and daily average concentrations. Average DO concentrations are considered to be met if the 10th percentile of available data is above the applicable criteria of 5.0 mg/l for marine waters and 5.5 mg/l for fresh waters. The statewide minimum DO concentration for surface waters is 4.0 mg/l at any time. Stations are judged to be in compliance with this criterion if the minimum is not violated by more than 1% of continuous monitoring data and no more than two field samples are below the minimum.

Assessments of Average DO Criteria Attainment:

If sampling events occurred on at least ten different days during the assessment period for each station, attainment of the DO average criteria will be assessed using the method that follows. Stations with fewer than ten different sampling days will be considered to have insufficient data and be placed in Category 3 for this assessment cycle.

For purposes of DO compliance with the daily average criteria in a segment, continuous monitoring data, if available, will be averaged on a daily basis for each station. If no continuous data is available, then the field measurements (as available) will be considered to be representative of the daily average for that day. Any type of sample (continuous or field measurement) will be considered to be representative for that station at the time of collection. Once the daily average for each station (station daily average, SDA) has been determined, the

SDAs for each station will be pooled and the upper confidence limit (UCL) of the nonparametric 10th percentile confidence interval will be determined using methods described in Section 3.7 of Helsel and Hirsch . That UCL will be compared to the applicable standard. If the UCL is above the applicable average criteria for all stations in a segment, the segment will be considered to be fully supporting (Category 1) for the DO average portion of ALUS. If the UCL from any station in a segment is below the applicable average, the segment will be considered not fully supportive of the aquatic life use (Category 5)

Formally stated, the following hypotheses will be tested:

$$H_0\text{: at the 90\% Confidence level, } X_{10} \geq \text{Standard}$$

$$H_1\text{: at the 90\% Confidence level, } X_{10} < \text{Standard}$$

Where X_{10}= Non parametric estimate of the 10th percentile of available data.

Assessments of Minimum DO Criteria Attainment:

Attainment of the minimum DO criteria will be assessed based on all available data (note that ten samples in 5 years are not needed for the comparison to the minimum). For stations for which no continuous DO monitoring data are available, two or more SDAs in five years below the applicable minimum will be sufficient evidence to show that the aquatic life use is not supported (Category 5).

For stations with continuous monitoring data, available continuous monitoring data will be pooled on an annual basis for each station. The UCL of the first percentile of the data will be calculated and compared to the minimum criteria in the same manner as the average comparison above for each year of the applicable five previous years. One or more years in which the upper confidence limit of the first percentile is below the minimum will be sufficient to determine that aquatic life use is not fully supported in the segment (Category 5). See the flow chart below for a graphical depiction of the dissolved oxygen assessment process.

Nutrient Enrichment Assessment

From a state-wide perspective, nutrient overenrichment is one of the leading causes of water quality impairment in Delaware. While nutrients are essential to the health of aquatic ecosystems, excessive nutrient loadings to surface waters can lead to an undesirable proliferation of aquatic weeds and algae, which in turn can result in oxygen depletion and associated impacts to fish and macroinvertebrate populations. Excessive aquatic plant growth can also preclude or seriously curtail water dependent activities such as fishing and boating when plant densities become so great that uses are not physically possible.

For tidal portions of the Indian River, Rehoboth Bay and Little Assawoman Bay watersheds, the water quality criterion for dissolved inorganic nitrogen is a seasonal average of 0.14 mg/l as N, and for dissolved inorganic phosphorus a seasonal average of 0.01 mg/l. For those stations where sampling events occurred on at least ten different days during the assessment period, the available data for the months of March to October from each station will be averaged. The averages will be compared to the above values to assess attainment of desired nutrient levels in these waters. Stations with fewer than ten different sampling days will be considered to have insufficient data and be placed in Category 3 for this assessment cycle. Segments with one or more stations whose seasonal average is above the criteria will be considered to be not fully supporting the aquatic life use (Category 5).

For the remaining waters of the State, the Department has been developing and implementing nutrient and dissolved oxygen TMDLs using target values for total nitrogen of 2-3 mg/l and total phosphorus levels of 0.1 to 0.2 mg/l. These target values were developed in order to implement the narrative provisions in the Surface Water Quality Standards. For those stations with sampling events on at least ten different days during the five-year assessment period the data will be averaged and compared to the maximum values above. Stations whose 5 year average total nitrogen or total phosphorus levels are above those levels will be considered to be not fully supporting the aquatic life use (Category 5). Stations with fewer than ten different sampling days will be considered to have insufficient data and be placed in Category 3 for this assessment cycle. Segments with one or more stations whose average nutrient concentrations are above the target values will be considered to be not fully supporting the aquatic life use (Category 5).

The following conditions will also result in segments being listed in Category 5:

1. There were documented cases of nuisance algal blooms or excessive macrophyte growth. These cases violate Section 4.1.1.3 of Delaware’s Standards which require waters of the State to be free from substances that may result in a dominance of nuisance species;
2. Detailed, site-specific monitoring studies indicated a strong linkage between nutrient levels and indicators of eutrophication such as high chlorophyll-a concentrations, extreme daily variation in dissolved oxygen levels, and high sediment oxygen demand; or
3. For ERES waters, a long-term trend analysis indicates a statistically significant increase in nutrient levels over time. Such increases are inconsistent with the short-term goal of “holding the line” on water quality in ERES waters. Such increases are also inconsistent with the long-term goal of restoring those waters, to the extent feasible, to their natural state.

Assessments of Aquatic Life Use Support Using Site-Specific Data That Results from Environmental Assessments and Other Programs

In the normal course of business, the Department requests, receives and evaluates water quality data for various environmental programs. Similar data may also come from other parties (e.g., State, Federal, or local agencies). The Department will use those site-specific studies to compare water quality data to the applicable water quality standard(s) and make assessment and listing decisions for the affected segments. If the data show no water quality criteria are exceeded and no uses are impaired, no further listing action will be taken. If the data are ambiguous or inconclusive, the segment will be listed in Category 3. If water quality criteria are exceeded or uses are impaired as a result of a contaminated site, and the owners of the site are making substantial progress (as determined by the Department) toward correcting the pollution problem, the segment will be listed in Category 4. If it appears that there is a water quality problem related to a contaminated site, and that substantial progress is not likely in the near future, the segment will be listed in Category 5.

Primary Contact Recreation Use Assessments

Generally, total enterococcus bacteria water quality samples are collected several times each year at each monitoring station. In addition, for all guarded beaches and many unguarded beaches, samples are collected much more frequently from mid-May through mid-September as part of beach monitoring activities pursuant to the Beaches Environmental Assessment and Coastal Health (BEACH) Act. Assessment of the above two situations for primary contact recreation use support will be as follows.

For segments with no beach monitoring, if sampling events occurred on at least ten different days during the assessment period, the geometric mean of the available enterococcus (colonies/100 ml)data for each station will be compared to the geometric mean values shown in the table below. Stations with fewer than ten different sampling days will be considered to have insufficient data (Category 3) to make a determination if the geometric mean criterion is met. Segments with one or more station geometric means above the values in the table will be considered to not be in support of the Primary Contact Recreation designated use (Category 5).

Water Type	Geometric Mean (Enterococcus colonies/100 ml) Criteria for Primary Contact Use
Fresh	100
Marine	35

Segments with beaches that are closed as a result of poor bacterial water quality data two or more times in a single calendar year will be considered not to support the primary contact designated use (Category 5). Some beaches are routinely closed after rain events without using water quality data to make the decision. These rainfall-based management plans are developed by statistically analyzing the relationship between rainfall amounts and Enterococcus levels. Regression analyses are used to determine the amount of rainfall that will cause exceedances of criteria. However, since the existing management plans are based upon outdated criteria, rainfall-based closures will not be considered for making designated use support decisions.

Listing Criteria for Waters with Fish Consumption Advisories

For purposes of developing Delaware’s Integrated 305(b) Report and 303(d) List, the issuance of a “no consumption” or “limited consumption” fish advisory will be interpreted as a violation of Section 4.6.3.2.3 and Section 4.1.1.3 of Delaware’s Surface Water Quality Standards. Those two narrative provisions provide, respectively, that 1) waters of the State shall be maintained to prevent adverse toxic effects on human health resulting from ingestion of chemically contaminated aquatic organisms; and 2) waters of the State shall be free from pollutants that may endanger public health. Any segment for which fish consumption advisories are in place as of December 2011 will be placed in Category 5 for each of the chemicals of concern included in each advisory. In the event that fish consumption advisories have been lifted, or any chemical of concern has been removed from an advisory, any requirements to develop a TMDL for that chemical in that segment will be removed if the fish tissue data was originally the sole cause for placement of the segment on the 303(d) list.

Ammonia assessments

In fresh waters, ammonia’s toxicity is known to be controlled by both the temperature and pH of the water. EPA recommended criteria are based on the presence or absence of early life stages of fish and specify that the criterion should not be exceeded more than one time in a three-year period. The applicable criterion is calculated for each sampling event.

For stations whose average salinity during the assessment period is below 5 ppt, total ammonia as nitrogen, temperature and pH data will be used to compare the total ammonia data to the criterion calculated according to the following formulas:

When fish early life stages are present:

$$\text{Criterion} = \frac{0.0577}{1 + 10^{7.688-\text{pH}}} + \frac{2.487}{1 + 10^{\text{pH}-7.688}} * \text{MIN}\,(2.85,\ 1.45 * 10^{0.028*(25-T)})$$

When fish early life stages are absent:

$$\text{Criterion} = \frac{0.0577}{1 + 10^{7.688-\text{pH}}} + \frac{2.487}{1 + 10^{\text{pH}-7.688}} * [1.45\ 10^{0.028*(25-\text{MAX}\,(T,7))}]$$

If two or more sampling events from the same station result in exceedances of the calculated criteria, the station will be deemed not supported for aquatic life use support based on ammonia toxicity.

Temperature Assessments

Delaware surface water quality criteria indicate that, in freshwaters, no human induced increase of the daily maximum temperature above 86^{o}F (30.0 ^{o}C) shall be allowed and in marine waters the maximum human induced temperature is 87 ^{o}F (30.6 ^{o}C). Stations for which two or more sampling events are above the criteria and whose segments receive thermal discharges will be deemed not in support of the aquatic life use.

Assessment of Harvestable Shellfish Waters Use Support

Delaware is a member of the Interstate Shellfish Sanitation Conference (ISSC), the administrative body of the National Shellfish Sanitation Program (NSSP). Delaware's Shellfish Sanitation Regulations are administered as per ISSC / NSSP standards and practices. Section 3.2.1.3 of said Regulations specifies data collection / closure criteria for Delaware shellfish waters, which include parameters constituting administrative closure of shellfish waters. Parameters that would trigger administrative closures in compliance with ISSC/NSSP standards may include theoretical pollution loading, sanitary shoreline survey information, and numerical total coliform data. No Delaware waters are closed to shellfish harvesting as a result of actual total fecal coliform data. All Delaware shellfish waters designated as other-than-Approved, which may include Prohibited, Seasonally Approved, Conditionally Approved, or restricted, are so designated on the basis of administrative decisions. Specifically, these criteria include: 1) theoretical pollution loading, which is determined to be the potential for intermittent pollution discharges, making detection of said theoretical releases non-detectable via conventional sampling methodology; 2) sanitary shoreline survey findings which indicate potential for theoretical pollution loading, also non-detectable via conventional sampling methodology; and 3) may include dilution of theoretical virus discharges from point sources; however, not corresponding to increases in total coliform levels. In order to comply with ISSC / NSSP requirements, Delaware samples all shellfish waters not administratively closed for other reasons for fecal coliform bacteria. Delaware's Shellfish Program is assessed under the auspices of the U.S. Food and Drug Administration, as per ISSC/NSSP standards and practices, and submits bacteriological water quality data to the U.S. Food and Drug Administration to demonstrate compliance.

To assess the harvestable shellfish designated use, the Department will consider the data and reports to FDA for waters that are not administratively closed. Waters that have been administratively closed for shellfish harvesting as a result of fecal coliform exceedances during the assessment period will be assessed as category-5.

Setting Priorities for Water Quality Limited Segments Still Needing TMDLs

Because there are more water quality issues and impacts than there are public and private resources to address those impacts, it is necessary to set priorities for water quality limited segments. This is true for Delaware as well as the country as a whole. With this in mind, and recognizing the need to provide a logical, deliberate, and reasonable path forward, it becomes necessary to organize and order the work at hand into different priorities based upon a number of factors.

In the past, the timetable for developing TMDLs for newly listed waters in Delaware was based on the Department's Whole Basin Management Program rotating basin schedule shown below.

Basin	Year for TMDL Development
Piedmont	2009
Chesapeake Bay	2010
Delaware Bay	2012
Delaware Estuary	2013
Inland Bays/Atlantic Ocean	2011

EPA guidance recommends up to 13 years from the date of initial listing to propose TMDLs for those waters. The Department will generally use that guideline for newly listed waters where resources and conditions allow.

The Department has successfully completed nutrient, dissolved oxygen, bacteria and zinc TMDLs in most waters of the State. The Watershed Approach to Toxics Assessment and Restoration (WATAR) plan in the appendix details how the State will address the remaining TMDL issues in the State.

Rationale Used to Designate a Lower Category for Segments Previously Designated for TMDL Development

The Department may move segments from prior 303(d) Lists (equivalent to Category 5) to another category based on any of the following factors, and will document the reasons for doing so on a case-by-case basis.

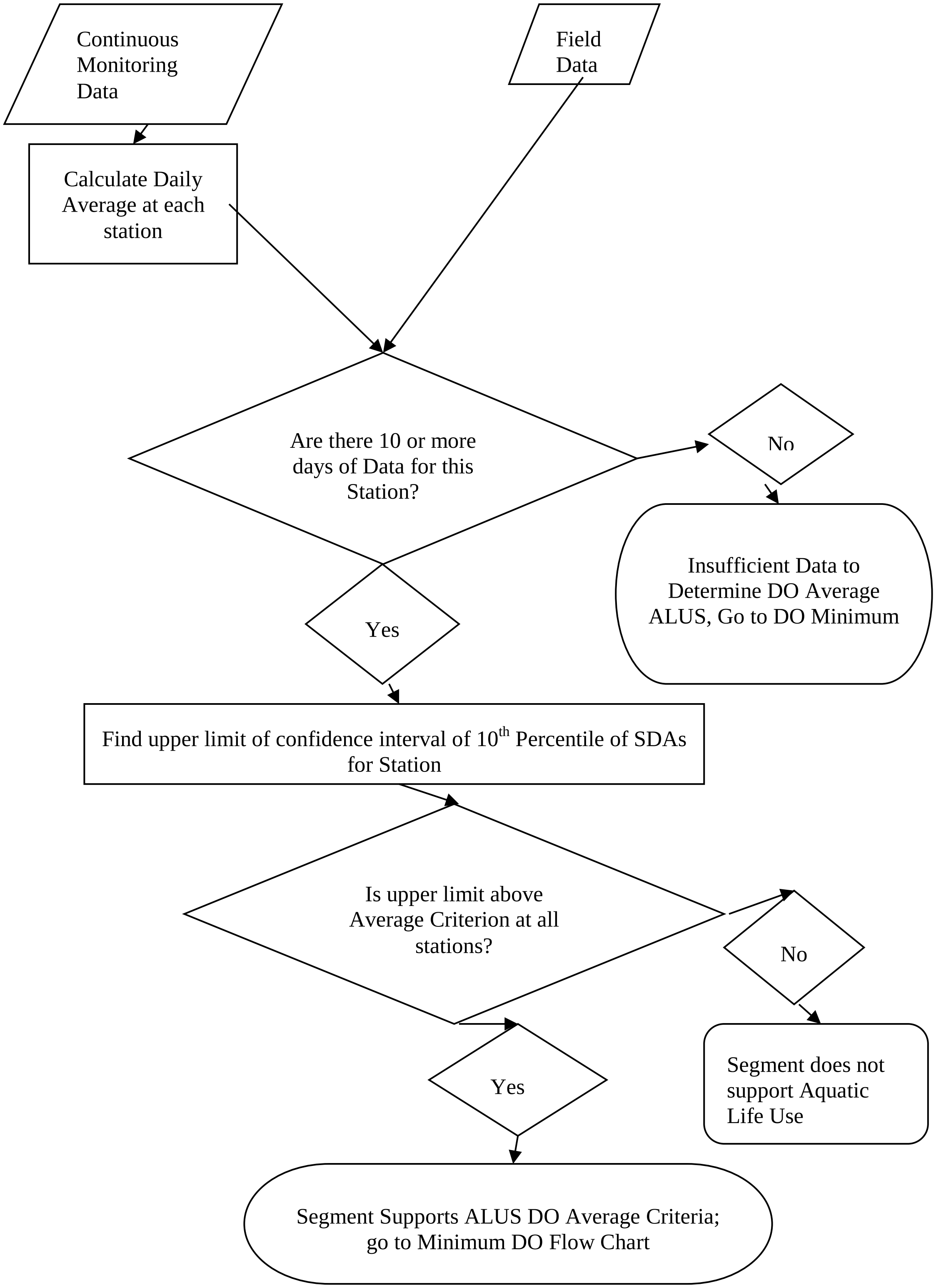
- The assessment and interpretation of more recent or more accurate data demonstrate that the applicable WQS(s) is being met. (Move to category 1)
- The results of more sophisticated water quality modeling demonstrate that the applicable WQS(s) is being met. (Move to category 1)
- Demonstration that flaws in the original analysis of data and information led to the water being incorrectly listed. (Move to category 1)
- The development of a new listing methodology, consistent with State WQSs and federal listing requirements, and a reassessment of the data that led to the prior listing, concluding that WQSs are now attained. (Move to appropriate category)
- A demonstration pursuant to 40 CFR 130.7(b)(1)(ii) that there are effluent limitations required by State or local authorities that are more stringent than technology-based effluent limitations required by the CWA and that these more stringent effluent limitations will result in the attainment of WQSs for the pollutant causing the impairment. (Move to category 4A or 4B until data and analysis support move to Category 1)
- A demonstration pursuant to 40 CFR 130.7(b)(1)(iii) that there are other pollution control requirements required by State, local, or federal authority that will result in attainment of WQSs for a specific pollutant(s) within a reasonable time. (Move to category 4A or 4B until data and analysis support move to Category 1)

- Documentation that the State included on a previous Section 303(d) List an impaired water that was not required to be listed by EPA regulations; e.g., waters where there is no pollutant associated with the impairment. (Move to category 1 or 4C as appropriate)
- Approval or establishment by EPA of a TMDL since the last Section 303(d) List. (Move to category 4A or 4B until data and analysis support move to Category 1)

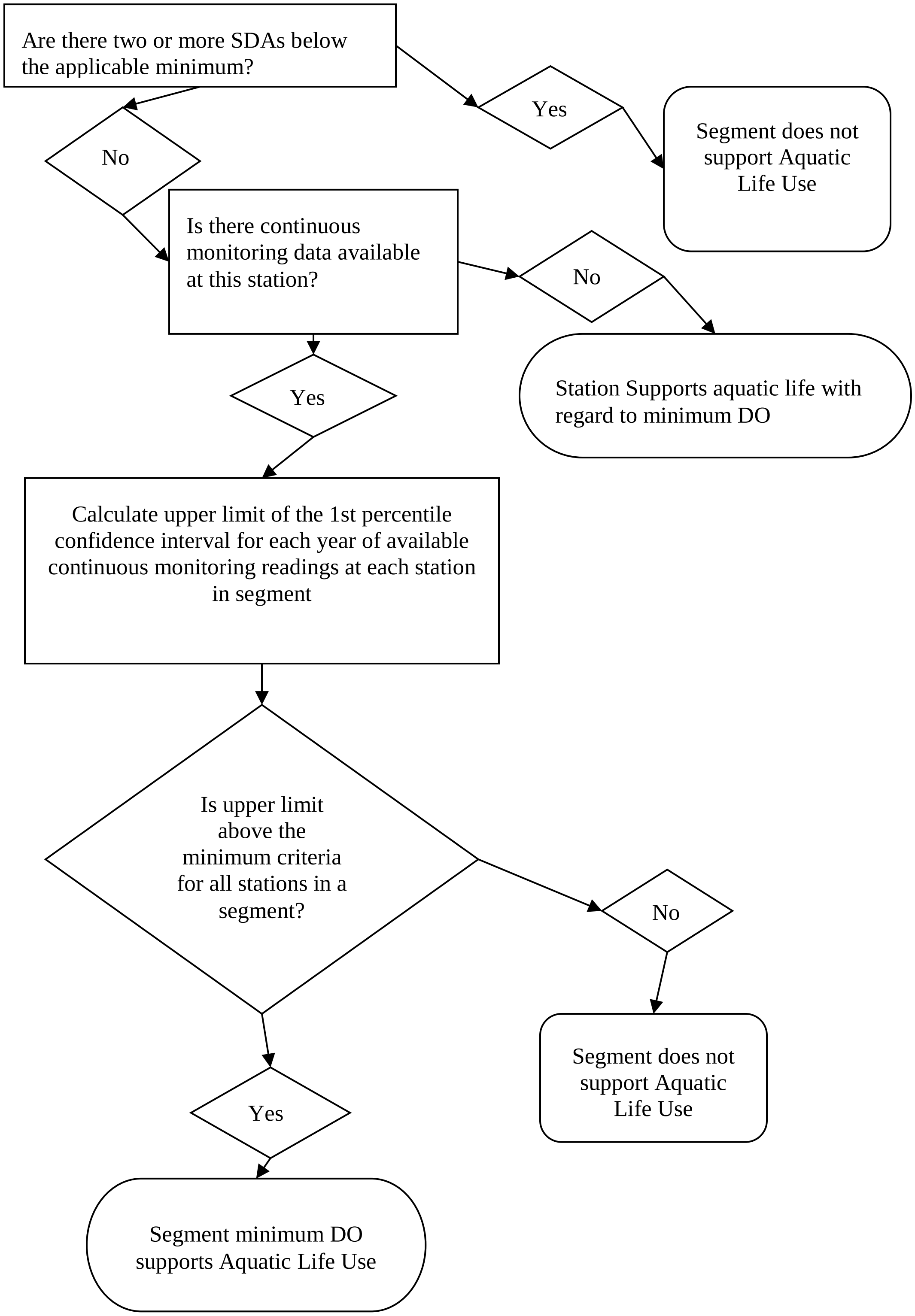
Other factors may also be used to change categories on a case by case basis, subject to EPA approval and appropriate stakeholder involvement.

Flow Charts for Designated Use Attainment

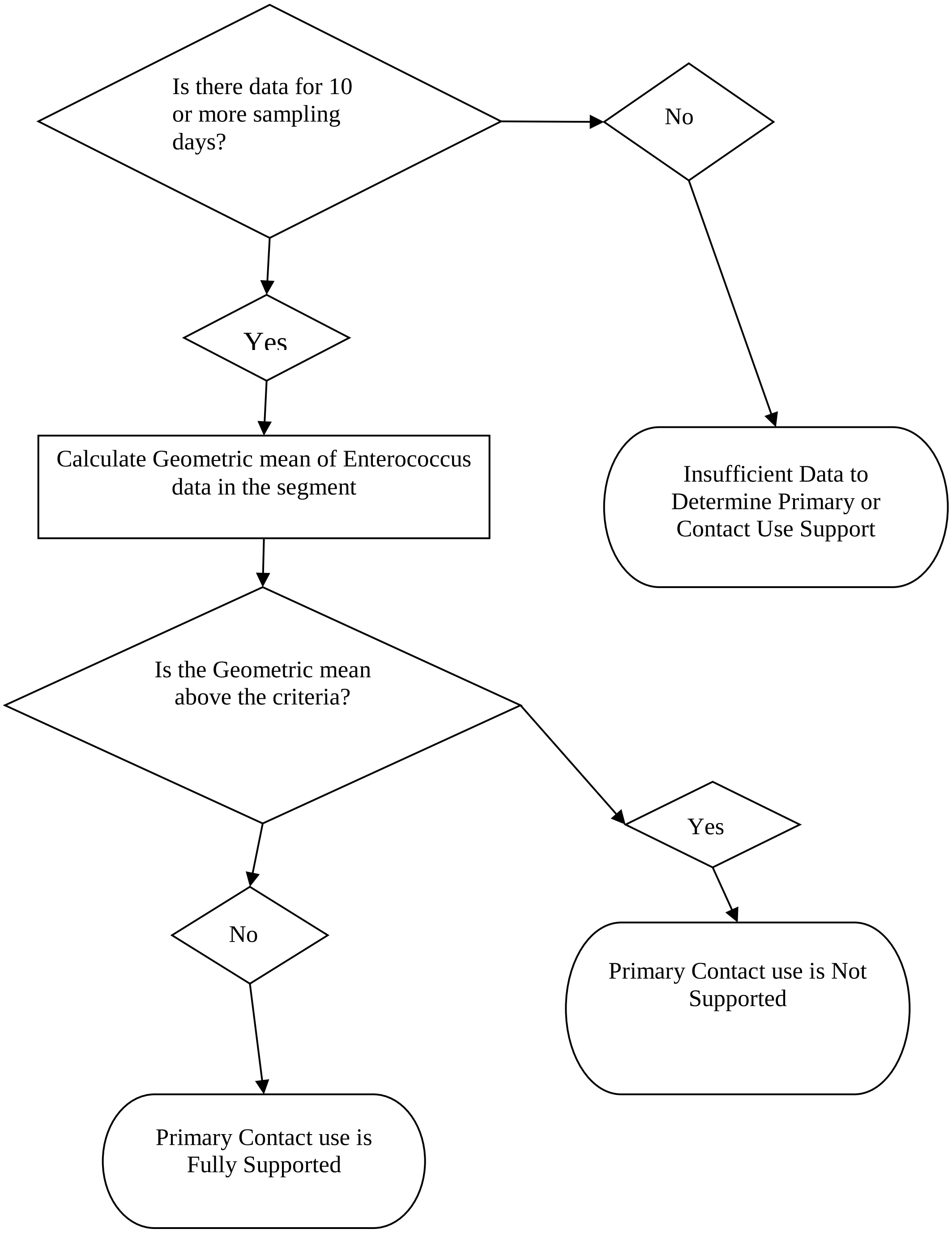
Assessment of Aquatic Life Use Support Using Average Dissolved Oxygen Criteria



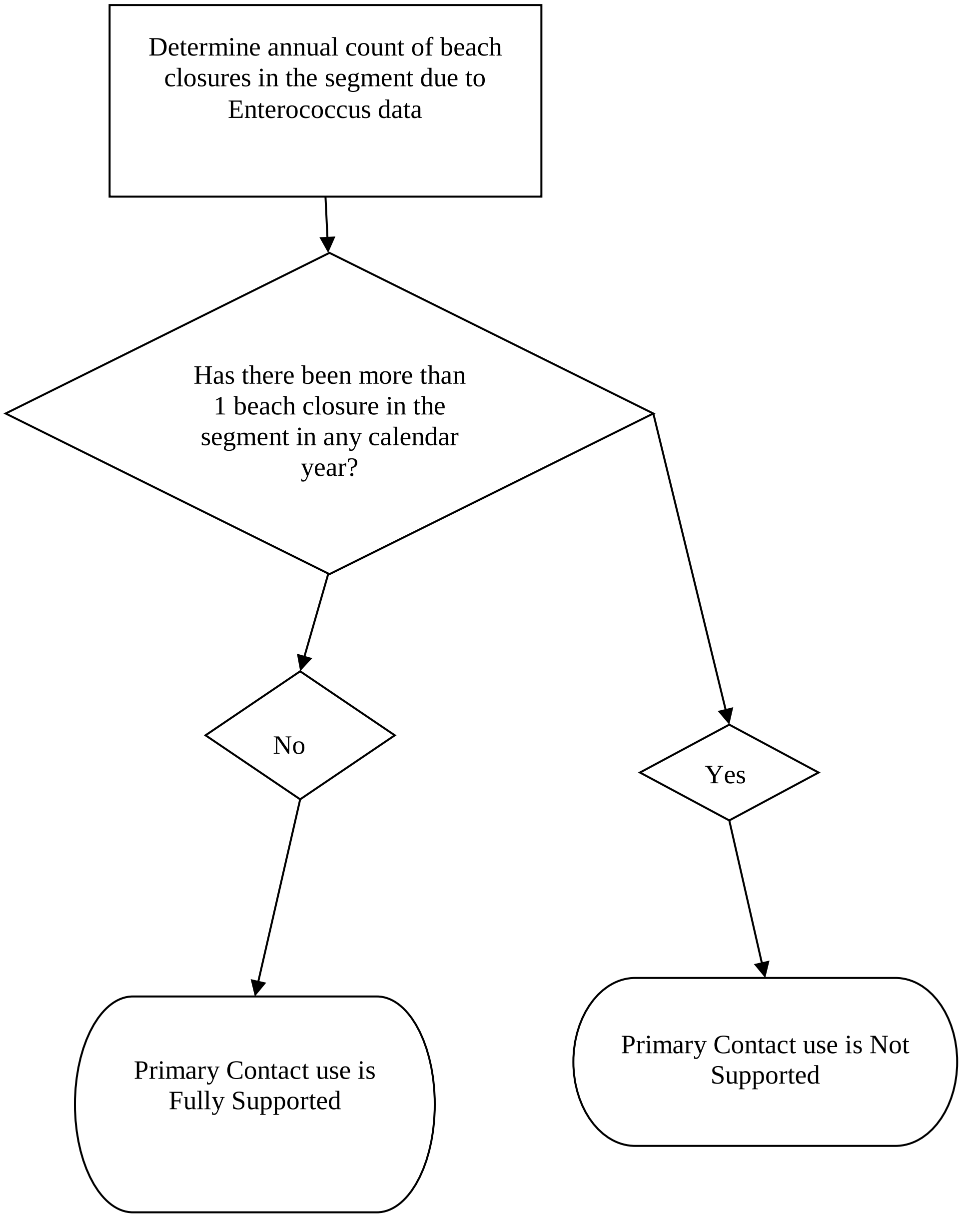
Assessment of Aquatic Life Use Support Using Minimum Dissolved Oxygen Criteria



Assessment of Primary Contact Use Support in Segments that do not have Beach Monitoring Programs



Assessment of Primary Contact Use Support in Segments with Beach Monitoring Programs



References:

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Chapter 3: Rivers/Streams, Estuaries and Lakes Water Quality Assessments and List of Waters needing TMDLs

Presented on the following pages are seven tables and summaries of use support for Harvestable Shellfish waters, ammonia toxicity assessments and continuous dissolved oxygen findings. Table III-1 is a summary of data collected by the Department in the period from September 1, 2002 through August 31, 2007, by station. For each monitoring station, the segment number, segment description and location are shown with the summary statistics. Table III-2 rolls up the stations into their segments and shows the current use attainment for each segment . Tables III-3, III-4, III-5 and III-6 are use support roll ups based on use of EPA's Assessment Data Base. Table III-7 is the Final Determination for the State of Delaware Clean Water Act Section 303(d) List of Waters Needing TMDLs. Table III-7 integrates current and past assessments into a list of waters needing TMDLs.

Assessment of Harvestable Shellfish Waters Use Support

Data collected pursuant to Interstate Shellfish Sanitation Conference/National Shellfish Sanitation Program requirements, as reported to the U.S. Food and Drug Administration, were evaluated for the Delaware Bay from the New Castle/Kent County Line to Cape Henlopen. In addition, Ocean waters from Cape Henlopen to the Maryland Line were evaluated, in addition to Delaware's Inland Bays, including Rehoboth Bay, Indian River Bay, and the Delaware portion of Assawoman Bay. Little Assawoman Bay is not monitored under Delaware's Shellfish Program, as it is not a productive molluscan bivalve growing area. All waters of the State classified as other-than-Approved (Seasonally Approved or Prohibited) are classified as such due to the potential for contamination (for example, an elicit discharge), a lack of bacteriological data, the need to provide enforceable boundaries, or other administrative reason. No closures (a downgrading of the shellfish harvesting use) have occurred over the past five years as a result of bacteriological water quality data. Therefore, bacteria TMDLs are not currently required for Delaware's shellfish waters.

Assessment of Ammonia Toxicity in Freshwaters

Total ammonia, pH, and temperature data during the assessment period for more than 3600 sampling events in freshwaters was evaluated. Of those sampling events there were eleven that showed expected toxicity to aquatic life at a single station, Browns Branch at Rt. 14 Bridge (see the table below). The Browns Branch station is in a watershed with a TMDL in place for nitrogen. The TMDL requires the nearby point source to control nitrogen and thus ammonia emissions. The current TMDL addresses the ammonia discharge indirectly by controlling the total nitrogen levels in the discharge of the point source. Two events occurred at Trap Pond on Hitch Pond Branch. A nitrogen TMDL is in place in this watershed too.

Station ID	Location	Date	Ammonia as N (mg/l)	pH	Temp	Criteria (mg/l)	% of Criteria
206041	Browns Branch at Rt. 14 Bridge	6/26/2007	4.44	7.17	19.71	3.92	113.3%
206041	Browns Branch at Rt. 14 Bridge	7/10/2007	4.12	6.93	23.6	3.37	122.1%
206041	Browns Branch at Rt. 14 Bridge	7/30/2007	13.4	6.69	22.13	3.95	339.1%
206041	Browns Branch at Rt. 14 Bridge	8/13/2007	13	6.58	22.04	4.06	320.5%
206041	Browns Branch at Rt. 14 Bridge	9/5/2007	12.1	7.03	20.37	4.01	302.1%
206041	Browns Branch at Rt. 14 Bridge	7/28/2008	5.77	7.44	20.86	3.05	189.3%
206041	Browns Branch at Rt. 14 Bridge	8/25/2008	6.94	7.03	20.76	3.91	177.7%
206041	Browns Branch at Rt. 14 Bridge	9/15/2008	8.48	6.91	22.25	3.70	228.9%
206041	Browns Branch at Rt. 14 Bridge	3/24/2009	3.64	8.08	6.39	3.51	103.7%
206041	Browns Branch at Rt. 14 Bridge	6/20/2011	4.36	8.26	19.7	1.17	374.2%
206041	Browns Branch at Rt. 14 Bridge	8/10/2011	10.6	6.63	22.52	3.90	271.9%
307081	Trap Pond on Hitch Pond Branch	7/21/2010	0.35	8.75	28.42	0.29	119.6%
307081	Trap Pond on Hitch Pond Branch	3/7/2011	0.659	9.03	10.1	0.62	106.4%

Causes/Stressors and Sources of Impairment of Designated Uses

Nutrients, low dissolved oxygen, and biology and habitat degradation were the leading cause of nonsupport of Aquatic Life uses. A direct correspondence was found between the trend in biological quality and the quality of physical habitat. Habitat degradation may result in exceedences of the dissolved oxygen and temperature criteria. Sources of biological and habitat impairment are due to nonpoint source pollution mainly from urban and agricultural runoff.

Pathogenic indicators (bacteria) are the most widespread pollutants impacting designated uses. The pathogen indicator monitored by the State for primary contact recreation is Enterococcus bacteria. Other pathogen indicators, such as total coliform and fecal coliform bacteria, are monitored to regulate shellfish harvesting areas. Indicator organisms are not a threat to human health or aquatic life, but their presence in abundant numbers signals an increased probability that disease causing organisms may be present.

Although pathogenic indicators are the most widespread contaminant in the State, nutrients and toxics pose the most serious threats to water quality, aquatic life, and human health. Most of the State’s estuarine waters are considered nutrient enriched. Water quality and aquatic life impacts from nutrient enrichment include eutrophication and low dissolved oxygen levels. A large portion of the nutrients are transported to the estuaries and lakes by the rivers and ground water. The presence of toxics has resulted in widespread fish consumption advisories within Delaware in both fresh and marine waters of the State.

Due to the ubiquitous nature of many pollutants such as pathogen indicators, positive identification of specific sources, and their relative impact, is difficult. Hence, multiple sources are cited for most cases. Agricultural runoff, nonpoint sources, urban runoff, and municipal and industrial point sources are the primary sources of nutrients and toxics.

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
109091	Delaware River (Appoquinimink at Mouth)	DE 010-001-01	Appoquinimink River	4.2	44	5.6	1	1	39	1.9	1	42	0.16
109121	Rt. 9 Bridge (East)	DE 010-001-01	Appoquinimink River	3.9	39	5.3	1	5	34	1.9	1	38	0.16
109141	Mouth of East Br. Drawyer Creek	DE 010-001-01	Appoquinimink River	3.9	12	6.0	0	1	10	1.7	1	12	0.17
109041	Rt. 13 Bridge below Odessa	DE 010-001-02	Appoquinimink River	2.2	40	5.7	1	1	36	2.2	1	38	0.17
109051	Rt. 299 Bridge, Odessa	DE 010-001-02	Appoquinimink River	2.7	19	6.7	0	1	15	2.3	1	19	0.17
109151	Above West Br. Drawyer Creek	DE 010-001-02	Appoquinimink River	3.6	12	5.9	0	1	10	1.8	1	11	0.16
109171	MOT Gut (Appo Gut) - West Bank	DE 010-001-02	Appoquinimink River	3.0	32	5.3	1	5	31	1.8	1	31	0.19
109071	Drawyer Creek, Rt 13	DE 010-001-03	Appoquinimink River	2.4	40	5.9	1	1	37	2.2	1	37	0.25
109251	Deep Creek Br of Appoquinimik River at Rt. 71 Bridge	DE 010-002-02	Appoquinimink River	0.2	40	7.9	0	1	37	4.4	5	36	0.05
110011	Road 463 East of RR Tracks	DE 010-002-02	Appoquinimink River	1.0	42	5.7	2	5	37	1.8	1	42	0.12
109131	Noxontown Pond Overflow, Rd 38	DE 010-L01	Appoquinimink River	0.2	39	8.0	0	1	31	1.8	1	38	0.06
109031	Silver Lake Overflow, Rd 442	DE 010-L02	Appoquinimink River	0.1	26	9.1	0	1	26	4.5	5	21	0.04
109191	Shallcross Lake Overflow, Dischrg Drawer Cr, Rd. 428	DE 010-L03	Appoquinimink River	0.1	39	8.7	1	1	35	2.9	1	37	0.05
114011	Rt. 9 Below Llangollen Wells	DE 020-001	Army Creek	0.8	38	6.1	2	5	36	1.4	1	38	0.14
114021	Rt. 13 Bridge	DE 020-002	Army Creek	0.2	19	6.1	1	1	19	2.1	1	19	0.10
110021	Rt. 13 (Northern Branch)	DE 030-001	Lower Blackbird	0.1	20	6.4	0	1	19	1.6	1	16	0.06
110031	Rd 455, Blackbird Landing	DE 030-001	Lower Blackbird	2.7	17	4.5	1	5	17	1.5	1	18	0.22
110041	Rt. 9 Taylors Bridge	DE 030-001	Lower Blackbird	3.8	38	5.2	2	5	36	1.5	1	37	0.17
104011	Footbridge in Brandywine State Park	DE 040-001	Brandywine Creek	0.2	50	8.7	0	1	46	3.4	5	45	0.09
104021	Rd. 279 Bridge (USGS guage 014)	DE 040-002	Brandywine Creek	0.2	62	9.0	0	1	58	3.2	5	60	0.10
104051	Smith Bridge	DE 040-002	Brandywine Creek	0.2	49	8.8	0	1	43	3.0	5	46	0.07
307031	Broad Creek at Main Street in Bethel (Rd 493)	DE 050-001	Broad Creek	0.1	28	6.2	1	1	27	4.2	5	25	0.10
307371	Raccoon Prong @ Pepperbox Rd. (Rd. 66)	DE 050-006-03	Broad Creek	0.1	32	4.5	5	5	31	1.7	1	32	0.09

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
307011	Records Pond at Rt. 13	DE 050-L04	Broad Creek	0.1	47	7.5	0	1	47	4.2	5	47	0.06
303041	Rt. 1 Bridge (Mainstem)	DE 060-001	Broadkill River	1.8	43	4.9	2	5	41	3.3	5	40	0.15
303061	0.10 Miles From Mouth	DE 060-001	Broadkill River	18.4	38	4.8	0	5	25	1.4	1	35	0.12
303171	Beaverdam Creek at Rd. 88	DE 060-002	Broadkill River	0.2	43	5.4	2	5	43	7.3	5	39	0.09
303181	Beaverdam Creek above Rd. 259, Hunters Mill Pond	DE 060-002	Broadkill River	0.4	43	6.2	0	1	42	8.7	5	41	0.13
303031	Rt. 5 Bridge	DE 060-003	Broadkill River	0.1	62	7.1	0	1	59	3.2	5	58	0.05
303311	Round Pole Branch at Rd. 88	DE 060-004	Broadkill River	0.2	43	6.0	0	1	40	4.0	5	39	0.05
303011	Ingram Branch, Savanah Ditch at Rd. 246	DE 060-005	Broadkill River	0.6	42	5.6	0	1	42	20.3	5	40	0.46
303021	Ingram Branch at Rd. 248	DE 060-005	Broadkill River	0.3	43	6.7	0	1	40	8.8	5	41	0.18
303341	Pemberton Branch at Rt. 30 above Wagamons Pond	DE 060-006	Broadkill River	0.2	43	6.9	0	1	43	4.6	5	34	0.03
303051	Red Mill Pond at Rt. 1	DE 060-007-01	Broadkill River	0.1	42	8.9	0	1	32	2.5	1	41	0.11
303481	Ingrams Branch at Rt. 30 above Waples Pond	DE 060-008	Broadkill River	0.1	13	1.0	4	5	13	0.8	1	13	0.10
303231	Trib. to Red mill Pond at Rd. 261	DE 060-L01	Broadkill River	0.2	19	8.4	0	1	17	4.1	5	19	0.06
303351	Wagamons Pond Outlet at County Rd. 250	DE 060-L02	Broadkill River	0.1	18	8.2	0	1	17	4.0	5	18	0.03
303331	Waples Pond at Rt. 1	DE 060-L03	Broadkill River	0.2	44	8.1	0	1	39	3.2	5	37	0.04
303381	Sowbridge Branch at Rd. 212, Waples Pond	DE 060-L03	Broadkill River	0.2	30	4.5	2	5	31	3.2	5	21	0.02
311041	Buntings Branch at Rt. 54	DE 070-001	Buntings Branch	0.1	42	5.2	3	5	40	4.0	5	40	0.20
301021	Rd. 212, Swiggetts Pond	DE 080-001	Cedar Creek	0.1	42	7.4	1	1	38	3.2	5	39	0.03
301031	Rt. 1 Bridge	DE 080-001	Cedar Creek	1.0	44	6.1	1	1	44	3.4	5	43	0.11
301091	Rt. 36 Bridge	DE 080-001	Cedar Creek	20.2	44	4.3	5	5	43	1.6	1	44	0.17
108021	St. Georges Bridge	DE 090-001	Chesapeake & Delaware Canal	2.8	40	6.5	0	1	38	1.9	1	39	0.14
108031	Summit Bridge	DE 090-001	Chesapeake & Delaware Canal	2.1	20	8.1	0	1	18	1.8	1	18	0.10
108051	Lum's Pond at Rt 71	DE 090-002	Chesapeake & Delaware Canal	0.1	21	4.2	3	5	21	1.6	1	21	0.08

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
108081	Lum's Pond Tributary Below Rt 54 Bridge	DE 090-L01	Chesapeake & Delaware Canal	0.1	24	6.2	0	1	22	1.2	1	24	0.11
108101	Lum's Pond Tributary above bridge at RD 403	DE 090-L01	Chesapeake & Delaware Canal	0.1	11	7.9	0	1	11	1.7	1	11	0.06
108111	Lums Pond Boat Ramp	DE 090-L01	Chesapeake & Delaware Canal	1.4	48	7.2	1	1	32	1.7	1	46	0.06
112021	Sewell Branch at Rd. 95	DE 100-002	Chesapeake Drainage System	0.1	49	3.8	8	5	46	2.1	1	46	0.21
207081	Tappahanna Ditch at Rd. 222	DE 110-001	Choptank	0.1	49	6.5	1	1	40	1.4	1	49	0.10
207091	Culbreth Marsh at Rd. 210	DE 110-002	Choptank	0.2	50	5.8	1	1	43	2.8	1	49	0.12
207021	Cow Marsh Creek at Rd. 208	DE 110-003	Choptank	0.2	50	6.2	0	1	48	1.6	1	50	0.09
207111	White Marsh Branch at Rd. 268	DE 110-003	Choptank	0.1	50	6.8	0	1	48	5.1	5	45	0.08
106011	Rt. 13/Rt. 9 Bridge	DE 120-001	Christina River	0.5	33	6.4	0	1	28	2.7	1	31	0.10
106291	Conrail Bridge (USGS tide gage 01481602) Up river from Port	DE 120-001	Christina River	0.5	57	7.2	0	1	50	2.6	1	56	0.11
106021	Rt. 141 Drawbridge, Newport (USGS tide gage 01480065)	DE 120-002	Christina River	0.3	49	6.5	0	1	42	2.4	1	47	0.10
106031	Smalley's Dam Spillway	DE 120-003	Christina River	0.2	50	6.2	0	1	43	1.5	1	48	0.06
106141	Rt. 72, Below Newark (USGS guage 01478000)	DE 120-004-01	Christina River	0.2	61	7.2	0	1	57	2.0	1	54	0.05
106191	Rt. 273, Above Newark	DE 120-006	Christina River	0.1	50	8.1	0	1	42	2.6	1	42	0.03
106281	Little Mill Creek at atlantic Avenue (USGS Gage 01480095)	DE 120-007-01	Christina River	0.3	50	8.8	0	1	48	1.5	1	47	0.05
111011	Rt. 9 Bridge	DE 130-001	Dragon Run Creek	0.4	40	2.8	10	5	36	1.1	1	38	0.09
111031	Rt. 13 Bridge (flow at Rd. 407), Dragon Creek	DE 130-002	Dragon Run Creek	0.1	37	3.0	11	5	36	1.7	1	34	0.05
312011	White Creek at the mouth of Assawoman Canal	DE 140-001	Indian River	22.9	45	4.9	2	5	38	1.0	1	45	0.06
308361	Blackwater Creek at Rd. 54	DE 140-002	Indian River	0.6	38	4.5	4	5	39	4.9	5	37	0.10
308091	Pepper Creek at Rt. 26	DE 140-003	Indian River	0.1	45	7.7	0	1	43	2.8	1	46	0.11
308461	Deep Hole Banch at Rd. 382	DE 140-003	Indian River	0.1	12	7.7	0	1	12	7.5	5	11	0.20
306181	Buoy 49, Indian River	DE 140-004	Indian River	17.4	40	5.6	1	1	39	2.2	1	40	0.16
306191	Buoy 55, Indian River	DE 140-004	Indian River	14.4	18	7.6	0	1	15	2.5	1	18	0.16
306341	Island Creek, upper third	DE 140-004	Indian River	18.5	39	5.6	1	1	34	2.2	1	36	0.14

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
308301	Swan Creek, Rd. 304	DE 140-005	Indian River	0.2	19	8.3	0	1	19	5.0	5	8	0.03
308341	Swan Creek at Rd. 297	DE 140-005	Indian River	0.2	44	7.5	0	1	43	2.4	1	32	0.05
308281	Cow Bridge Branch Rd. 48	DE 140-006	Indian River	0.2	45	7.2	0	1	41	1.4	1	46	0.06
306121	Buoy 20, Indian River Bay	DE 140-E01	Indian River	28.2	51	6.8	0	1	49	0.7	1	50	0.05
306131	Buoy 26, Indian River Bay	DE 140-E01	Indian River	26.6	18	6.6	0	1	17	0.8	1	16	0.06
306321	Indian River Inlet	DE 140-E01	Indian River	29.5	57	6.2	1	1	52	0.5	1	56	0.05
306161	Buoy 38, Indian River	DE 140-E02	Indian River	20.1	18	5.2	2	5	18	1.6	1	17	0.10
306331	Island Creek mouth	DE 140-E02	Indian River	20.6	40	6.0	1	1	34	1.7	1	40	0.10
308071	Millsboro Dam Overflow	DE 140-L01	Indian River	0.1	60	7.6	0	1	59	3.4	5	60	0.04
309021	Iron Branch at Rt. 113 Bridge	DE 150-001	Iron Branch	0.2	20	6.5	0	1	17	3.5	5	18	0.06
309041	Whartons Branch at Rt. 334 Bridge	DE 150-001	Iron Branch	0.1	44	6.7	0	1	40	3.9	5	41	0.10
202031	DE Rt. 9 Bridge	DE 160-001	Leipsic River	8.9	36	4.1	5	5	35	1.5	1	36	0.21
202041	Rt. 42	DE 160-002	Leipsic River	0.1	19	5.9	1	1	20	3.2	5	19	0.28
202191	Upstream of Masseys Millpond at Rt. 15	DE 160-002	Leipsic River	0.1	13	7.9	0	1	13	3.8	5	13	0.14
202021	Rt. 13 Bridge, Garrisons Lake	DE 160-L01	Leipsic River	0.1	37	7.8	1	1	32	2.0	1	38	0.20
202011	Rd. 42 Bridge at Masseys MIllpond	DE 160-L02	Leipsic River	0.1	19	7.7	0	1	16	2.9	1	18	0.16
305011	Canal Rt. 1	DE 170-001	Lewes and Rehoboth Canal	24.4	43	4.1	4	5	40	0.9	1	44	0.09
305041	Lewes and Rehoboth Canal at Rd. 18 Bridge	DE 170-001	Lewes and Rehoboth Canal	25.2	43	5.1	1	1	43	0.9	1	42	0.08
305081	Munchy Branch at Rd. 270a	DE 170-001	Lewes and Rehoboth Canal	0.2	20	3.6	6	5	20	1.4	1	20	0.07
312041	Assawoman Canal, Rd. 361 Bridge	DE 180-001	Little Assawoman Bay	18.8	24	4.9	4	5	20	1.2	1	22	0.07
310101	Beaver Dam Ditch, Rd. 363, Miller Branch	DE 180-002	Little Assawoman Bay	9.0	19	2.9	7	5	18	3.5	5	18	0.09
310121	Beaverdam Ditch at Rd. 368	DE 180-002	Little Assawoman Bay	0.2	50	5.6	1	1	48	3.9	5	47	0.08
310031	Dirrickson Creek, Rd. 381	DE 180-003	Little Assawoman Bay	7.7	44	5.6	1	1	43	2.9	1	41	0.25
310011	Little Assawoman Bay Ditch at Rd. 58 Bridge	DE 180-E01	Little Assawoman Bay	24.1	45	5.1	0	1	44	1.1	1	45	0.05

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
310071	Little Assawoman Bay, Mid-Bay	DE 180-E01	Little Assawoman Bay	22.4	45	5.6	2	5	42	1.2	1	43	0.05
204031	Rt. 9 Bridge	DE 190-001-01	Little River	10.1	38	4.5	4	5	35	2.6	1	37	0.34
204041	Rt. 8 Bridge	DE 190-001-02	Little River	0.2	38	3.6	9	5	37	2.0	1	38	0.13
204011	Pipe Elm Branch, Postles Corner Road (Rd. 348)	DE 190-001-03	Little River	0.1	18	6.2	1	1	19	0.8	1	19	0.06
302021	Rt. 404 Bridge, (Woodenhawk Bridge)	DE 200-001	Marshyhope Creek	0.2	19	7.8	0	1	19	3.7	5	19	0.06
302031	Rd. 308 Bridge	DE 200-001	Marshyhope Creek	0.2	80	7.6	0	1	88	3.1	5	79	0.11
208021	Rt. 1 Bridge	DE 210-001	Mispillion River	2.1	42	6.7	0	1	42	3.6	5	41	0.13
208061	1.09 miles from mouth at lighthouse	DE 210-001	Mispillion River	21.6	48	5.1	2	5	43	1.5	1	46	0.19
208101	3.85 miles from mouth, Revills Landing	DE 210-001	Mispillion River	12.3	14	4.7	2	5	13	2.0	1	15	0.14
208121	7.48 miles from mouth, mouth of Fishing Branch	DE 210-001	Mispillion River	5.7	36	3.8	7	5	34	2.9	1	36	0.16
208211	Rt. 36 Silver Lake	DE 210-L02	Mispillion River	0.1	44	7.8	0	1	40	3.9	5	42	0.04
208011	Haven Lake at Rt. 113	DE 210-L03	Mispillion River	0.1	20	7.4	0	1	17	4.5	5	20	0.04
208191	Blairs Pond off Rd. 443	DE 210-L05	Mispillion River	0.1	19	8.9	0	1	17	4.8	5	19	0.03
208231	Beaverdam Branch, Rd. 384	DE 210-L05	Mispillion River	0.1	44	6.8	0	1	43	4.5	5	41	0.05
208181	Abbotts Pond at Rd. 620	DE 210-L06	Mispillion River	0.1	42	6.6	1	1	43	4.1	5	42	0.05
206091	US Rt. 113 at Frederica By-Pass	DE 220-001	Murderkill River	5.0	63	4.1	8	5	57	3.0	5	62	0.27
206101	Bowers Beach Wharf	DE 220-001	Murderkill River	20.9	79	5.6	0	1	72	1.7	1	75	0.23
206131	1.25 miles from the mouth at Webs Landing	DE 220-001	Murderkill River	20.2	47	5.3	2	5	45	1.6	1	45	0.20
206141	3.25 miles from the mouth	DE 220-001	Murderkill River	12.9	61	3.9	10	5	59	2.1	1	61	0.24
206231	Confluence of Kent County STP trib.	DE 220-001	Murderkill River	6.7	59	3.4	15	5	57	3.3	5	55	0.80
206711	Murderkill River near power lines (4.45 river mile	DE 220-001	Murderkill River	10.9	39	3.3	7	5	37	2.2	1	38	0.28
206081	Spring Creek at Rt. 12 Bridge	DE 220-002	Murderkill River	5.3	46	4.6	5	5	44	2.8	1	42	0.28
206561	Double Run at Rd. 371	DE 220-002	Murderkill River	0.5	65	5.2	0	5	62	2.9	1	64	0.15
206641	Spring Creek, Pratt Branch at Canterbury Rd.	DE 220-002	Murderkill River	0.1	37	7.8	0	1	35	4.9	5	36	0.06

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
206041	Browns Branch at Rt. 14 Bridge	DE 220-004	Murderkill River	0.2	66	5.7	0	1	68	6.0	5	66	0.06
206051	Browns Branch at Rd. 384 Bridge	DE 220-004	Murderkill River	0.1	49	6.9	0	1	48	5.9	5	46	0.04
206011	US Rt. 13 Bridge below Felton	DE 220-005	Murderkill River	0.1	85	7.4	0	1	80	3.5	5	79	0.09
206461	Hudson Branch, McGinnis Pond, Rd. 378	DE 220-L01	Murderkill River	0.1	54	9.1	0	1	52	4.1	5	52	0.05
206071	Andrews Lake at Rd. 380 Bridge	DE 220-L02	Murderkill River	0.1	48	6.9	0	1	39	3.0	5	45	0.07
206451	Coursey Pond at Rd. 388 Bridge	DE 220-L03	Murderkill River	0.1	66	8.0	0	1	61	3.5	5	64	0.13
206361	McCauley Pond near spillway	DE 220-L05	Murderkill River	0.1	68	8.4	0	1	66	4.5	5	63	0.06
101021	Naamans Road	DE 230-001-02	Naamans Creek	0.2	50	8.0	0	1	42	1.8	1	40	0.04
101031	South Branch at Darley Rd.	DE 230-001-02	Naamans Creek	0.2	25	8.1	0	1	24	1.4	1	22	0.04
101041	Rt. 13A	DE 230-001-02	Naamans Creek	0.2	22	7.5	1	1	20	1.6	1	19	0.04
101061	South Branch at Marsh Rd.	DE 230-001-02	Naamans Creek	0.2	30	8.3	0	1	24	1.9	1	27	0.05
304011	Sharptown, Maryland Rt 313	DE 240-001	Nanticoke River	0.4	28	6.7	0	1	29	3.6	5	28	0.06
304041	Middleford Bridge	DE 240-001	Nanticoke River	0.1	26	6.7	0	1	24	4.6	5	22	0.06
304091	Buoy 51 (Conf. Broad Creek)	DE 240-001	Nanticoke River	0.4	18	7.2	0	1	16	3.7	5	14	0.06
304151	Buoy 66 (Conf DuPont Gut)	DE 240-001	Nanticoke River	0.1	46	6.7	0	1	41	3.4	5	43	0.07
304461	Seaford STP Discharge	DE 240-001	Nanticoke River	0.1	22	6.4	0	1	21	3.3	5	21	0.07
304471	Rt. 13 Bridge	DE 240-001	Nanticoke River	0.1	48	6.3	1	1	46	3.3	5	46	0.06
304191	Rd. 545 Mainstem Nanticoke	DE 240-002	Nanticoke River	0.2	88	6.9	0	1	88	5.0	5	85	0.08
304291	Rd. 600 Bridge	DE 240-002	Nanticoke River	0.1	20	7.3	0	1	19	5.2	5	17	0.06
304681	Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	DE 240-002	Nanticoke River	0.1	30	6.9	0	1	29	3.7	5	30	0.07
304381	Bucks Branch at Rd. 546	DE 240-003	Nanticoke River	0.1	50	7.1	0	1	50	9.9	5	44	0.07
304591	Deep Creek above Concord Pond, near Old Furnace at Rd. 46	DE 240-004	Nanticoke River	0.1	20	1.2	13	5	19	1.7	1	18	0.18
316011	Gravelly Branch at Rd. 525 Bridge	DE 240-005	Nanticoke River	0.1	49	7.7	0	1	45	2.5	1	39	0.02

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
316031	Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	DE 240-005	Nanticoke River	0.1	29	6.1	0	1	26	2.0	1	28	0.04
304311	Concord Pond overflow	DE 240-L02	Nanticoke River	0.1	50	7.9	0	1	38	2.6	1	47	0.04
304321	Williams Pond, below the pond at Rd. 535	DE 240-L04	Nanticoke River	0.1	48	7.4	1	1	44	3.8	5	46	0.11
313011	Rd. 419 Bridge	DE 250-001	Pocomoke River	0.2	49	5.8	1	1	42	2.5	1	48	0.13
103011	Stanton, Rt. 4 at Stanton Bridge (USGS gage 01480015)	DE 260-001	Red Clay Creek	0.2	51	8.5	0	1	50	3.5	5	50	0.09
103031	Wooddale, Rt. 48 (USGS gage 01480000)	DE 260-001	Red Clay Creek	0.2	61	9.1	0	1	59	3.7	5	56	0.10
103041	Ashland, Rd. 258a	DE 260-001	Red Clay Creek	0.2	49	8.4	0	1	48	4.3	5	47	0.14
103061	Burrough's Run at Creek Rd. (Rt. 82)	DE 260-002	Red Clay Creek	0.1	50	9.1	0	1	47	2.2	1	41	0.02
107031	Rt. 9 Bridge	DE 270-001-01	Red Lion Creek	0.2	40	5.4	2	5	36	1.9	1	40	0.11
107011	Rt. 7	DE 270-001-02	Red Lion Creek	0.1	40	6.9	0	1	35	1.1	1	38	0.04
308051	Guinea Creek at Rt. 298 Bridge	DE 280-001-01	Rehoboth Bay	9.8	44	5.4	3	5	41	2.2	1	40	0.08
308291	Love Creek, Rd. 277	DE 280-002	Rehoboth Bay	0.2	20	7.7	0	1	20	1.9	1	17	0.02
308371	Bundick's Branch at Rt. 23	DE 280-002	Rehoboth Bay	0.2	46	7.5	0	1	44	5.5	5	35	0.03
306071	Buoy 3, Rehoboth Bay	DE 280-E01	Rehoboth Bay	27.7	18	7.0	0	1	17	0.7	1	17	0.07
306091	Buoy 7, Rehoboth Bay	DE 280-E01	Rehoboth Bay	28.8	39	6.8	0	1	38	0.6	1	40	0.06
306111	Massey's Ditch at Bouy 17	DE 280-E01	Rehoboth Bay	29.2	43	6.7	0	1	42	0.5	1	42	0.05
308031	Burton Pond, Rd. 24	DE 280-L01	Rehoboth Bay	0.1	44	7.2	0	1	40	1.5	1	40	0.04
205041	3.5 miles from mouth at Barkers Landing	DE 290-001-01	Saint Jones River	12.5	40	3.8	10	5	38	1.9	1	36	0.26
205091	Rt. 10 Bridge near DAFB	DE 290-001-02	Saint Jones River	5.5	39	4.2	4	5	38	2.3	1	35	0.22
205571	Division Street (Dover)	DE 290-001-02	Saint Jones River	0.1	20	3.2	3	5	19	1.8	1	20	0.14
205241	Rt. 13 North Moores Lake, Issacs Branch	DE 290-002	Saint Jones River	0.1	20	6.4	0	1	20	4.5	5	19	0.06
205151	Rd. 69 State College, Fork Branch	DE 290-003	Saint Jones River	0.2	37	4.3	4	5	33	1.2	1	37	0.16
205181	Rt. 13 Alt. Moores Lake	DE 290-L01	Saint Jones River	0.1	40	8.2	0	1	38	4.2	5	38	0.08

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
205191	Silver Lake Spillway, Dover City Park	DE 290-L02	Saint Jones River	0.1	60	5.6	1	1	53	1.7	1	55	0.15
205211	Derby Pond at Rt. 13A	DE 290-L03	Saint Jones River	0.1	38	8.7	1	1	31	3.3	5	36	0.07
102041	Cherry Island at Rd. 501 Bridge	DE 300-001-01	Shellpot Creek	0.4	47	4.3	7	5	44	2.1	1	45	0.11
102011	US Rt. 13 Bridge (Gov Printz Blvd)	DE 300-001-02	Shellpot Creek	0.3	19	6.9	0	1	17	1.6		15	0.04
102051	Rt. 13 Bus (Market Street) Bridge	DE 300-001-02	Shellpot Creek	0.3	43	8.2	0	1	37	1.5	1	39	0.06
102081	Carr Road Bridge	DE 300-001-02	Shellpot Creek	0.3	31	8.2	0	1	26	1.5	1	28	0.04
102101	Stoney Creek @ Rt. 13	DE 300-001-03	Shellpot Creek	0.3	19	7.6	0	1	18	2.2	1	19	0.18
201011	Lake Como at US Route 13 Bridge	DE 310-001	Smyrna River	0.1	19	5.5	0	5	15	1.5	1	18	0.11
201041	Rt. 9 Fleming's Landing	DE 310-001	Smyrna River	5.8	38	5.0	2	5	34	1.8	1	36	0.26
201021	Rd. 137 Bridge, Mill Creek	DE 310-002	Smyrna River	0.1	39	8.3	0	1	34	2.0	1	37	0.12
201051	Rd. 485 Bridge at Smyrna Landing	DE 310-003	Smyrna River	1.8	39	5.0	1	5	33	2.2	1	37	0.22
201161	Rd. 38 Bridge, Providence Creek	DE 310-003	Smyrna River	0.1	33	7.5	0	1	33	3.2	5	33	0.04
105011	Stanton, Old Rt. 7 Bridge	DE 320-001	White Clay Creek	0.2	19	8.2	0	1	19	3.5	5	19	0.07
105031	Chambers Rock Rd. (Road 329) near Thompson	DE 320-001	White Clay Creek	0.2	50	8.1	0	1	49	4.5	5	49	0.09
105151	DE Park Race Track (USGS gage 01479000), 35ft downstream	DE 320-001	White Clay Creek	0.2	62	8.3	0	1	59	3.5	5	58	0.08
105171	McKee Lane in Newark	DE 320-001	White Clay Creek	0.2	49	7.5	0	1	46	4.1	5	46	0.08
105071	Mill Creek, Above Rt. 4 (DE Park)	DE 320-002	White Clay Creek	0.2	31	8.8	0	1	29	2.6	1	25	0.04
105101	Pike Creek Confluence, Upper Pike Creek Rd. (Rd. 322)	DE 320-003	White Clay Creek	0.1	31	9.0	0	1	30	2.6	1	25	0.05
105181	Pike Creek at Paper Mill Road	DE 320-003	White Clay Creek	0.1	32	9.7	0	1	30	3.4	5	27	0.04
105131	Middle Run Confluence, Possum Park Rd. (Rd. 303)	DE 320-004	White Clay Creek	0.1	32	9.2	0	1	28	2.0	1	27	0.04
307171	Horseys Pond 50 Yards Above Spillway 50% RB	DE050-L03	Broad Creek	0.1	48	7.2	0	1	39	3.1	5	44	0.07

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	Average Salinity	Dissolved Oxygen (DO) Count	DO Value	# DO Samples <4.0	DO Attainment	Total Nitrogen (TN) Count	5 Year Average TN (mg/l)	Average TN Attainment	Total Phosphorus (TP) count	5 Year Average TP (mg/l)
307081	Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	DE050-L07	Broad Creek	0.1	28	7.7	2	5	26	1.8	1	28	0.12

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
109091	Delaware River (Appoquinimink at Mouth)	DE 010-001-01	Appoquinimink River	1	45	67	1	--	--		--	--
109121	Rt. 9 Bridge (East)	DE 010-001-01	Appoquinimink River	1	39	73	1	--	--		--	--
109141	Mouth of East Br. Drawyer Creek	DE 010-001-01	Appoquinimink River	1	12	152	5	--	--		--	--
109041	Rt. 13 Bridge below Odessa	DE 010-001-02	Appoquinimink River	1	40	170	5	--	--		--	--
109051	Rt. 299 Bridge, Odessa	DE 010-001-02	Appoquinimink River	1	19	143	5	--	--		--	--
109151	Above West Br. Drawyer Creek	DE 010-001-02	Appoquinimink River	1	12	178	5	--	--		--	--
109171	MOT Gut (Appo Gut) - West Bank	DE 010-001-02	Appoquinimink River	1	32	213	5	--	--		--	--
109071	Drawyer Creek, Rt 13	DE 010-001-03	Appoquinimink River	5	40	151	5	--	--		--	--
109251	Deep Creek Br of Appoquinimik River at Rt. 71 Bridge	DE 010-002-02	Appoquinimink River	1	40	355	5	--	--		--	--
110011	Road 463 East of RR Tracks	DE 010-002-02	Appoquinimink River	1	43	101	5	--	--		--	--
109131	Noxontown Pond Overflow, Rd 38	DE 010-L01	Appoquinimink River	1	39	20	1	--	--		--	--
109031	Silver Lake Overflow, Rd 442	DE 010-L02	Appoquinimink River	1	25	8	1	--	--		--	--
109191	Shallcross Lake Overflow, Dischrg Drawer Cr, Rd. 428	DE 010-L03	Appoquinimink River	1	38	9	1	--	--		--	--
114011	Rt. 9 Below Llangollen Wells	DE 020-001	Army Creek	1	36	79	1	--	--		--	--
114021	Rt. 13 Bridge	DE 020-002	Army Creek	1	19	480	5	--	--		--	--
110021	Rt. 13 (Northern Branch)	DE 030-001	Lower Blackbird	1	20	143	5	--	--		--	--
110031	Rd 455, Blackbird Landing	DE 030-001	Lower Blackbird	5	18	160	5	--	--		--	--
110041	Rt. 9 Taylors Bridge	DE 030-001	Lower Blackbird	1	37	81	1	--	--		--	--
104011	Footbridge in Brandywine State Park	DE 040-001	Brandywine Creek	1	50	122	5	--	--		--	--
104021	Rd. 279 Bridge (USGS guage 014)	DE 040-002	Brandywine Creek	1	59	110	5	--	--		--	--
104051	Smith Bridge	DE 040-002	Brandywine Creek	1	48	95	1	--	--		--	--
307031	Broad Creek at Main Street in Bethel (Rd 493)	DE 050-001	Broad Creek	1	25	118	5	--	--		--	--
307371	Raccoon Prong @ Pepperbox Rd. (Rd. 66)	DE 050-006-03	Broad Creek	1	33	186	5	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
307011	Records Pond at Rt. 13	DE 050-L04	Broad Creek	1	47	53	1	--	--		--	--
303041	Rt. 1 Bridge (Mainstem)	DE 060-001	Broadkill River	1	42	251	5	--	--		--	--
303061	0.10 Miles From Mouth	DE 060-001	Broadkill River	1	37	55	5	--	--		--	--
303171	Beaverdam Creek at Rd. 88	DE 060-002	Broadkill River	1	43	216	5	--	--		--	--
303181	Beaverdam Creek above Rd. 259, Hunters Mill Pond	DE 060-002	Broadkill River	1	43	489	5	--	--		--	--
303031	Rt. 5 Bridge	DE 060-003	Broadkill River	1	62	32	1	--	--		--	--
303311	Round Pole Branch at Rd. 88	DE 060-004	Broadkill River	1	43	158	5	--	--		--	--
303011	Ingram Branch, Savanah Ditch at Rd. 246	DE 060-005	Broadkill River	5	40	274	5	--	--		--	--
303021	Ingram Branch at Rd. 248	DE 060-005	Broadkill River	1	43	489	5	--	--		--	--
303341	Pemberton Branch at Rt. 30 above Wagamons Pond	DE 060-006	Broadkill River	1	43	492	5	--	--		--	--
303051	Red Mill Pond at Rt. 1	DE 060-007-01	Broadkill River	1	42	20	1	--	--		--	--
303481	Ingrams Branch at Rt. 30 above Waples Pond	DE 060-008	Broadkill River	1	13	18	1	--	--		--	--
303231	Trib. to Red mill Pond at Rd. 261	DE 060-L01	Broadkill River	1	19	77	1	--	--		--	--
303351	Wagamons Pond Outlet at County Rd. 250	DE 060-L02	Broadkill River	1	19	16	1	--	--		--	--
303331	Waples Pond at Rt. 1	DE 060-L03	Broadkill River	1	41	22	1	--	--		--	--
303381	Sowbridge Branch at Rd. 212, Waples Pond	DE 060-L03	Broadkill River	1	30	101	5	--	--		--	--
311041	Buntings Branch at Rt. 54	DE 070-001	Buntings Branch	5	42	534	5	27	1.82	5	27	0.081
301021	Rd. 212, Swiggetts Pond	DE 080-001	Cedar Creek	1	43	13	1	--	--		--	--
301031	Rt. 1 Bridge	DE 080-001	Cedar Creek	1	45	102	5	--	--		--	--
301091	Rt. 36 Bridge	DE 080-001	Cedar Creek	1	45	46	5	--	--		--	--
108021	St. Georges Bridge	DE 090-001	Chesapeake & Delaware Canal	1	39	26	1	--	--		--	--
108031	Summit Bridge	DE 090-001	Chesapeake & Delaware Canal	1	20	27	1	--	--		--	--
108051	Lum's Pond at Rt 71	DE 090-002	Chesapeake & Delaware Canal	1	22	61	1	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
108081	Lum's Pond Tributary Below Rt 54 Bridge	DE 090-L01	Chesapeake & Delaware Canal	1	24	66	1	--	--		--	--
108101	Lum's Pond Tributary above bridge at RD 403	DE 090-L01	Chesapeake & Delaware Canal	1	10	63	1	--	--		--	--
108111	Lums Pond Boat Ramp	DE 090-L01	Chesapeake & Delaware Canal	1	47	33	1	--	--		--	--
112021	Sewell Branch at Rd. 95	DE 100-002	Chesapeake Drainage System	5	48	146	5	--	--		--	--
207081	Tappahanna Ditch at Rd. 222	DE 110-001	Choptank	1	48	125	5	--	--		--	--
207091	Culbreth Marsh at Rd. 210	DE 110-002	Choptank	1	48	134	5	--	--		--	--
207021	Cow Marsh Creek at Rd. 208	DE 110-003	Choptank	1	49	90	1	--	--		--	--
207111	White Marsh Branch at Rd. 268	DE 110-003	Choptank	1	49	184	5	--	--		--	--
106011	Rt. 13/Rt. 9 Bridge	DE 120-001	Christina River	1	33	162	5	--	--		--	--
106291	Conrail Bridge (USGS tide gage 01481602) Up river from Port	DE 120-001	Christina River	1	56	111	5	--	--		--	--
106021	Rt. 141 Drawbridge, Newport (USGS tide gage 01480065)	DE 120-002	Christina River	1	49	199	5	--	--		--	--
106031	Smalley's Dam Spillway	DE 120-003	Christina River	1	51	103	5	--	--		--	--
106141	Rt. 72, Below Newark (USGS guage 01478000)	DE 120-004-01	Christina River	1	61	217	5	--	--		--	--
106191	Rt. 273, Above Newark	DE 120-006	Christina River	1	50	218	5	--	--		--	--
106281	Little Mill Creek at atlantic Avenue (USGS Gage 01480095)	DE 120-007-01	Christina River	1	49	292	5	--	--		--	--
111011	Rt. 9 Bridge	DE 130-001	Dragon Run Creek	1	39	32	1	--	--		--	--
111031	Rt. 13 Bridge (flow at Rd. 407), Dragon Creek	DE 130-002	Dragon Run Creek	1	36	112	5	--	--		--	--
312011	White Creek at the mouth of Assawoman Canal	DE 140-001	Indian River	1	45	42	5	28	0.13	1	30	0.029
308361	Blackwater Creek at Rd. 54	DE 140-002	Indian River	1	39	322	5	25	3.11	5	26	0.045
308091	Pepper Creek at Rt. 26	DE 140-003	Indian River	1	46	278	5	30	1.42	5	29	0.029
308461	Deep Hole Banch at Rd. 382	DE 140-003	Indian River	5	12	188	5	7	4.55	5	7	0.151
306181	Buoy 49, Indian River	DE 140-004	Indian River	1	40	24	1	29	0.79	5	29	0.042
306191	Buoy 55, Indian River	DE 140-004	Indian River	1	18	51	5	12	0.82	5	11	0.056
306341	Island Creek, upper third	DE 140-004	Indian River	1	39	18	1	26	0.72	5	28	0.040

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
308301	Swan Creek, Rd. 304	DE 140-005	Indian River	1	19	438	5	11	4.38	5	10	0.018
308341	Swan Creek at Rd. 297	DE 140-005	Indian River	1	45	248	5	29	1.91	5	25	0.014
308281	Cow Bridge Branch Rd. 48	DE 140-006	Indian River	1	45	32	1	27	0.64	5	30	0.026
306121	Buoy 20, Indian River Bay	DE 140-E01	Indian River	1	49	3	1	32	0.08	1	36	0.032
306131	Buoy 26, Indian River Bay	DE 140-E01	Indian River	1	18	6	1	12	0.18	5	11	0.034
306321	Indian River Inlet	DE 140-E01	Indian River	1	56	3	1	35	0.08	1	37	0.039
306161	Buoy 38, Indian River	DE 140-E02	Indian River	1	18	17	1	12	0.42	5	11	0.038
306331	Island Creek mouth	DE 140-E02	Indian River	1	39	20	1	29	0.43	5	29	0.046
308071	Millsboro Dam Overflow	DE 140-L01	Indian River	1	61	20	1	42	2.30	5	39	0.018
309021	Iron Branch at Rt. 113 Bridge	DE 150-001	Iron Branch	1	20	156	5	12	2.30	5	12	0.017
309041	Whartons Branch at Rt. 334 Bridge	DE 150-001	Iron Branch	1	45	362	5	28	1.55	5	28	0.021
202031	DE Rt. 9 Bridge	DE 160-001	Leipsic River	5	38	108	5	--	--		--	--
202041	Rt. 42	DE 160-002	Leipsic River	5	19	319	5	--	--		--	--
202191	Upstream of Masseys Millpond at Rt. 15	DE 160-002	Leipsic River	1	13	125	5	--	--		--	--
202021	Rt. 13 Bridge, Garrisons Lake	DE 160-L01	Leipsic River	5	38	46	1	--	--		--	--
202011	Rd. 42 Bridge at Masseys MIllpond	DE 160-L02	Leipsic River	1	20	50	1	--	--		--	--
305011	Canal Rt. 1	DE 170-001	Lewes and Rehoboth Canal	1	43	32	1	30	0.10	1	29	0.050
305041	Lewes and Rehoboth Canal at Rd. 18 Bridge	DE 170-001	Lewes and Rehoboth Canal	1	43	15	1	30	0.14	5	29	0.039
305081	Munchy Branch at Rd. 270a	DE 170-001	Lewes and Rehoboth Canal	1	20	286	5	12	0.86	5	12	0.014
312041	Assawoman Canal, Rd. 361 Bridge	DE 180-001	Little Assawoman Bay	1	24	81	5	16	0.17	5	16	0.022
310101	Beaver Dam Ditch, Rd. 363, Miller Branch	DE 180-002	Little Assawoman Bay	1	18	142	5	12	1.41	5	12	0.024
310121	Beaverdam Ditch at Rd. 368	DE 180-002	Little Assawoman Bay	1	50	221	5	32	1.99	5	31	0.027
310031	Dirrickson Creek, Rd. 381	DE 180-003	Little Assawoman Bay	5	44	195	5	28	0.75	5	30	0.094
310011	Little Assawoman Bay Ditch at Rd. 58 Bridge	DE 180-E01	Little Assawoman Bay	1	44	17	1	25	0.14	1	30	0.026

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
310071	Little Assawoman Bay, Mid-Bay	DE 180-E01	Little Assawoman Bay	1	45	9	1	30	0.20	5	30	0.032
204031	Rt. 9 Bridge	DE 190-001-01	Little River	5	38	262	5	--	--		--	--
204041	Rt. 8 Bridge	DE 190-001-02	Little River	1	40	88	1	--	--		--	--
204011	Pipe Elm Branch, Postles Corner Road (Rd. 348)	DE 190-001-03	Little River	1	20	146	5	--	--		--	--
302021	Rt. 404 Bridge, (Woodenhawk Bridge)	DE 200-001	Marshyhope Creek	1	18	58	1	--	--		--	--
302031	Rd. 308 Bridge	DE 200-001	Marshyhope Creek	1	81	63	1	--	--		--	--
208021	Rt. 1 Bridge	DE 210-001	Mispillion River	1	42	77	1	--	--		--	--
208061	1.09 miles from mouth at lighthouse	DE 210-001	Mispillion River	1	49	23	1	--	--		--	--
208101	3.85 miles from mouth, Revills Landing	DE 210-001	Mispillion River	1	15	50	5	--	--		--	--
208121	7.48 miles from mouth, mouth of Fishing Branch	DE 210-001	Mispillion River	1	37	183	5	--	--		--	--
208211	Rt. 36 Silver Lake	DE 210-L02	Mispillion River	1	45	34	1	--	--		--	--
208011	Haven Lake at Rt. 113	DE 210-L03	Mispillion River	1	19	13	1	--	--		--	--
208191	Blairs Pond off Rd. 443	DE 210-L05	Mispillion River	1	20	24	1	--	--		--	--
208231	Beaverdam Branch, Rd. 384	DE 210-L05	Mispillion River	1	45	346	5	--	--		--	--
208181	Abbotts Pond at Rd. 620	DE 210-L06	Mispillion River	1	43	49	1	--	--		--	--
206091	US Rt. 113 at Frederica By-Pass	DE 220-001	Murderkill River	5	64	227	5	--	--		--	--
206101	Bowers Beach Wharf	DE 220-001	Murderkill River	5	78	33	1	--	--		--	--
206131	1.25 miles from the mouth at Webs Landing	DE 220-001	Murderkill River	5	47	42	5	--	--		--	--
206141	3.25 miles from the mouth	DE 220-001	Murderkill River	5	61	154	5	--	--		--	--
206231	Confluence of Kent County STP trib.	DE 220-001	Murderkill River	5	61	274	5	--	--		--	--
206711	Murderkill River near power lines (4.45 river mile	DE 220-001	Murderkill River	5	40	239	5	--	--		--	--
206081	Spring Creek at Rt. 12 Bridge	DE 220-002	Murderkill River	5	47	278	5	--	--		--	--
206561	Double Run at Rd. 371	DE 220-002	Murderkill River	1	65	325	5	--	--		--	--
206641	Spring Creek, Pratt Branch at Canterbury Rd.	DE 220-002	Murderkill River	1	38	391	5	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
206041	Browns Branch at Rt. 14 Bridge	DE 220-004	Murderkill River	1	68	153	5	--	--		--	--
206051	Browns Branch at Rd. 384 Bridge	DE 220-004	Murderkill River	1	49	198	5	--	--		--	--
206011	US Rt. 13 Bridge below Felton	DE 220-005	Murderkill River	1	85	263	5	--	--		--	--
206461	Hudson Branch, McGinnis Pond, Rd. 378	DE 220-L01	Murderkill River	1	52	28	1	--	--		--	--
206071	Andrews Lake at Rd. 380 Bridge	DE 220-L02	Murderkill River	1	46	21	1	--	--		--	--
206451	Coursey Pond at Rd. 388 Bridge	DE 220-L03	Murderkill River	1	64	44	1	--	--		--	--
206361	McCauley Pond near spillway	DE 220-L05	Murderkill River	1	68	21	1	--	--		--	--
101021	Naamans Road	DE 230-001-02	Naamans Creek	1	49	194	5	--	--		--	--
101031	South Branch at Darley Rd.	DE 230-001-02	Naamans Creek	1	23	273	5	--	--		--	--
101041	Rt. 13A	DE 230-001-02	Naamans Creek	1	21	230	5	--	--		--	--
101061	South Branch at Marsh Rd.	DE 230-001-02	Naamans Creek	1	30	173	5	--	--		--	--
304011	Sharptown, Maryland Rt 313	DE 240-001	Nanticoke River	1	29	40	1	--	--		--	--
304041	Middleford Bridge	DE 240-001	Nanticoke River	1	26	82	1	--	--		--	--
304091	Buoy 51 (Conf. Broad Creek)	DE 240-001	Nanticoke River	1	18	32	1	--	--		--	--
304151	Buoy 66 (Conf DuPont Gut)	DE 240-001	Nanticoke River	1	45	83	1	--	--		--	--
304461	Seaford STP Discharge	DE 240-001	Nanticoke River	1	23	67	1	--	--		--	--
304471	Rt. 13 Bridge	DE 240-001	Nanticoke River	1	46	69	1	--	--		--	--
304191	Rd. 545 Mainstem Nanticoke	DE 240-002	Nanticoke River	1	88	119	5	--	--		--	--
304291	Rd. 600 Bridge	DE 240-002	Nanticoke River	1	20	85	1	--	--		--	--
304681	Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	DE 240-002	Nanticoke River	1	29	49	1	--	--		--	--
304381	Bucks Branch at Rd. 546	DE 240-003	Nanticoke River	1	49	212	5	--	--		--	--
304591	Deep Creek above Concord Pond, near Old Furnace at Rd. 46	DE 240-004	Nanticoke River	1	19	65	1	--	--		--	--
316011	Gravelly Branch at Rd. 525 Bridge	DE 240-005	Nanticoke River	1	47	104	5	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
316031	Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	DE 240-005	Nanticoke River	1	28	33	1	--	--		--	--
304311	Concord Pond overflow	DE 240-L02	Nanticoke River	1	49	25	1	--	--		--	--
304321	Williams Pond, below the pond at Rd. 535	DE 240-L04	Nanticoke River	1	47	57	1	--	--		--	--
313011	Rd. 419 Bridge	DE 250-001	Pocomoke River	1	50	282	5	--	--		--	--
103011	Stanton, Rt. 4 at Stanton Bridge (USGS gage 01480015)	DE 260-001	Red Clay Creek	1	50	133	5	--	--		--	--
103031	Wooddale, Rt. 48 (USGS gage 01480000)	DE 260-001	Red Clay Creek	1	61	101	5	--	--		--	--
103041	Ashland, Rd. 258a	DE 260-001	Red Clay Creek	1	50	128	5	--	--		--	--
103061	Burrough's Run at Creek Rd. (Rt. 82)	DE 260-002	Red Clay Creek	1	48	103	5	--	--		--	--
107031	Rt. 9 Bridge	DE 270-001-01	Red Lion Creek	1	40	227	5	--	--		--	--
107011	Rt. 7	DE 270-001-02	Red Lion Creek	1	40	157	5	--	--		--	--
308051	Guinea Creek at Rt. 298 Bridge	DE 280-001-01	Rehoboth Bay	1	45	207	5	28	1.02	5	28	0.027
308291	Love Creek, Rd. 277	DE 280-002	Rehoboth Bay	1	19	9	1	12	1.11	5	12	0.009
308371	Bundick's Branch at Rt. 23	DE 280-002	Rehoboth Bay	1	44	316	5	30	5.00	5	30	0.016
306071	Buoy 3, Rehoboth Bay	DE 280-E01	Rehoboth Bay	1	17	2	1	11	0.01	1	12	0.021
306091	Buoy 7, Rehoboth Bay	DE 280-E01	Rehoboth Bay	1	39	3	1	22	0.03	1	29	0.030
306111	Massey's Ditch at Bouy 17	DE 280-E01	Rehoboth Bay	1	42	4	1	24	0.03	1	29	0.033
308031	Burton Pond, Rd. 24	DE 280-L01	Rehoboth Bay	1	45	22	1	28	0.47	5	28	0.016
205041	3.5 miles from mouth at Barkers Landing	DE 290-001-01	Saint Jones River	5	40	149	5	--	--		--	--
205091	Rt. 10 Bridge near DAFB	DE 290-001-02	Saint Jones River	5	39	150	5	--	--		--	--
205571	Division Street (Dover)	DE 290-001-02	Saint Jones River	1	20	96	1	--	--		--	--
205241	Rt. 13 North Moores Lake, Issacs Branch	DE 290-002	Saint Jones River	1	20	296	5	--	--		--	--
205151	Rd. 69 State College, Fork Branch	DE 290-003	Saint Jones River	1	37	96	1	--	--		--	--
205181	Rt. 13 Alt. Moores Lake	DE 290-L01	Saint Jones River	1	40	35	1	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
205191	Silver Lake Spillway, Dover City Park	DE 290-L02	Saint Jones River	1	59	54	1	--	--		--	--
205211	Derby Pond at Rt. 13A	DE 290-L03	Saint Jones River	1	38	31	1	--	--		--	--
102041	Cherry Island at Rd. 501 Bridge	DE 300-001-01	Shellpot Creek	1	47	216	5	--	--		--	--
102011	US Rt. 13 Bridge (Gov Printz Blvd)	DE 300-001-02	Shellpot Creek	1	19	326	5	--	--		--	--
102051	Rt. 13 Bus (Market Street) Bridge	DE 300-001-02	Shellpot Creek	1	43	126	5	--	--		--	--
102081	Carr Road Bridge	DE 300-001-02	Shellpot Creek	1	31	150	5	--	--		--	--
102101	Stoney Creek @ Rt. 13	DE 300-001-03	Shellpot Creek	1	19	381	5	--	--		--	--
201011	Lake Como at US Route 13 Bridge	DE 310-001	Smyrna River	1	19	37	1	--	--		--	--
201041	Rt. 9 Fleming's Landing	DE 310-001	Smyrna River	5	39	114	5	--	--		--	--
201021	Rd. 137 Bridge, Mill Creek	DE 310-002	Smyrna River	1	39	60	1	--	--		--	--
201051	Rd. 485 Bridge at Smyrna Landing	DE 310-003	Smyrna River	5	39	328	5	--	--		--	--
201161	Rd. 38 Bridge, Providence Creek	DE 310-003	Smyrna River	1	33	115	5	--	--		--	--
105011	Stanton, Old Rt. 7 Bridge	DE 320-001	White Clay Creek	1	19	133	5	--	--		--	--
105031	Chambers Rock Rd. (Road 329) near Thompson	DE 320-001	White Clay Creek	1	49	120	5	--	--		--	--
105151	DE Park Race Track (USGS gage 01479000), 35ft downstream	DE 320-001	White Clay Creek	1	62	227	5	--	--		--	--
105171	McKee Lane in Newark	DE 320-001	White Clay Creek	1	47	100	1	--	--		--	--
105071	Mill Creek, Above Rt. 4 (DE Park)	DE 320-002	White Clay Creek	1	31	247	5	--	--		--	--
105101	Pike Creek Confluence, Upper Pike Creek Rd. (Rd. 322)	DE 320-003	White Clay Creek	1	31	192	5	--	--		--	--
105181	Pike Creek at Paper Mill Road	DE 320-003	White Clay Creek	1	32	156	5	--	--		--	--
105131	Middle Run Confluence, Possum Park Rd. (Rd. 303)	DE 320-004	White Clay Creek	1	32	160	5	--	--		--	--
307171	Horseys Pond 50 Yards Above Spillway 50% RB	DE050-L03	Broad Creek	1	46	52	1	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	5 Year Average TP Attainment	Enterococcus (Ent.)Samples	Ent. Geomean	Ent. Attain	Dissolved Inorganic Nitrogen (DIN) Sample Count	DIN Average	DIN Attainment	Dissolved Inorganic Phoshporus (DIP)Sample Count	DIP Average
307081	Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	DE050-L07	Broad Creek	1	27	41	1	--	--		--	--

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
109091	Delaware River (Appoquinimink at Mouth)	DE 010-001-01	Appoquinimink River	
109121	Rt. 9 Bridge (East)	DE 010-001-01	Appoquinimink River	
109141	Mouth of East Br. Drawyer Creek	DE 010-001-01	Appoquinimink River	
109041	Rt. 13 Bridge below Odessa	DE 010-001-02	Appoquinimink River	
109051	Rt. 299 Bridge, Odessa	DE 010-001-02	Appoquinimink River	
109151	Above West Br. Drawyer Creek	DE 010-001-02	Appoquinimink River	
109171	MOT Gut (Appo Gut) - West Bank	DE 010-001-02	Appoquinimink River	
109071	Drawyer Creek, Rt 13	DE 010-001-03	Appoquinimink River	
109251	Deep Creek Br of Appoquinimik River at Rt. 71 Bridge	DE 010-002-02	Appoquinimink River	
110011	Road 463 East of RR Tracks	DE 010-002-02	Appoquinimink River	
109131	Noxontown Pond Overflow, Rd 38	DE 010-L01	Appoquinimink River	
109031	Silver Lake Overflow, Rd 442	DE 010-L02	Appoquinimink River	
109191	Shallcross Lake Overflow, Dischrg Drawer Cr, Rd. 428	DE 010-L03	Appoquinimink River	
114011	Rt. 9 Below Llangollen Wells	DE 020-001	Army Creek	
114021	Rt. 13 Bridge	DE 020-002	Army Creek	
110021	Rt. 13 (Northern Branch)	DE 030-001	Lower Blackbird	
110031	Rd 455, Blackbird Landing	DE 030-001	Lower Blackbird	
110041	Rt. 9 Taylors Bridge	DE 030-001	Lower Blackbird	
104011	Footbridge in Brandywine State Park	DE 040-001	Brandywine Creek	
104021	Rd. 279 Bridge (USGS guage 014)	DE 040-002	Brandywine Creek	
104051	Smith Bridge	DE 040-002	Brandywine Creek	
307031	Broad Creek at Main Street in Bethel (Rd 493)	DE 050-001	Broad Creek	
307371	Raccoon Prong @ Pepperbox Rd. (Rd. 66)	DE 050-006-03	Broad Creek	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
307011	Records Pond at Rt. 13	DE 050-L04	Broad Creek	
303041	Rt. 1 Bridge (Mainstem)	DE 060-001	Broadkill River	
303061	0.10 Miles From Mouth	DE 060-001	Broadkill River	
303171	Beaverdam Creek at Rd. 88	DE 060-002	Broadkill River	
303181	Beaverdam Creek above Rd. 259, Hunters Mill Pond	DE 060-002	Broadkill River	
303031	Rt. 5 Bridge	DE 060-003	Broadkill River	
303311	Round Pole Branch at Rd. 88	DE 060-004	Broadkill River	
303011	Ingram Branch, Savanah Ditch at Rd. 246	DE 060-005	Broadkill River	
303021	Ingram Branch at Rd. 248	DE 060-005	Broadkill River	
303341	Pemberton Branch at Rt. 30 above Wagamons Pond	DE 060-006	Broadkill River	
303051	Red Mill Pond at Rt. 1	DE 060-007-01	Broadkill River	
303481	Ingrams Branch at Rt. 30 above Waples Pond	DE 060-008	Broadkill River	
303231	Trib. to Red mill Pond at Rd. 261	DE 060-L01	Broadkill River	
303351	Wagamons Pond Outlet at County Rd. 250	DE 060-L02	Broadkill River	
303331	Waples Pond at Rt. 1	DE 060-L03	Broadkill River	
303381	Sowbridge Branch at Rd. 212, Waples Pond	DE 060-L03	Broadkill River	
311041	Buntings Branch at Rt. 54	DE 070-001	Buntings Branch	5
301021	Rd. 212, Swiggetts Pond	DE 080-001	Cedar Creek	
301031	Rt. 1 Bridge	DE 080-001	Cedar Creek	
301091	Rt. 36 Bridge	DE 080-001	Cedar Creek	
108021	St. Georges Bridge	DE 090-001	Chesapeake & Delaware Canal	
108031	Summit Bridge	DE 090-001	Chesapeake & Delaware Canal	
108051	Lum's Pond at Rt 71	DE 090-002	Chesapeake & Delaware Canal	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
108081	Lum's Pond Tributary Below Rt 54 Bridge	DE 090-L01	Chesapeake & Delaware Canal	
108101	Lum's Pond Tributary above bridge at RD 403	DE 090-L01	Chesapeake & Delaware Canal	
108111	Lums Pond Boat Ramp	DE 090-L01	Chesapeake & Delaware Canal	
112021	Sewell Branch at Rd. 95	DE 100-002	Chesapeake Drainage System	
207081	Tappahanna Ditch at Rd. 222	DE 110-001	Choptank	
207091	Culbreth Marsh at Rd. 210	DE 110-002	Choptank	
207021	Cow Marsh Creek at Rd. 208	DE 110-003	Choptank	
207111	White Marsh Branch at Rd. 268	DE 110-003	Choptank	
106011	Rt. 13/Rt. 9 Bridge	DE 120-001	Christina River	
106291	Conrail Bridge (USGS tide gage 01481602) Up river from Port	DE 120-001	Christina River	
106021	Rt. 141 Drawbridge, Newport (USGS tide gage 01480065)	DE 120-002	Christina River	
106031	Smalley's Dam Spillway	DE 120-003	Christina River	
106141	Rt. 72, Below Newark (USGS guage 01478000)	DE 120-004-01	Christina River	
106191	Rt. 273, Above Newark	DE 120-006	Christina River	
106281	Little Mill Creek at atlantic Avenue (USGS Gage 01480095)	DE 120-007-01	Christina River	
111011	Rt. 9 Bridge	DE 130-001	Dragon Run Creek	
111031	Rt. 13 Bridge (flow at Rd. 407), Dragon Creek	DE 130-002	Dragon Run Creek	
312011	White Creek at the mouth of Assawoman Canal	DE 140-001	Indian River	5
308361	Blackwater Creek at Rd. 54	DE 140-002	Indian River	5
308091	Pepper Creek at Rt. 26	DE 140-003	Indian River	5
308461	Deep Hole Banch at Rd. 382	DE 140-003	Indian River	5
306181	Buoy 49, Indian River	DE 140-004	Indian River	5
306191	Buoy 55, Indian River	DE 140-004	Indian River	5
306341	Island Creek, upper third	DE 140-004	Indian River	5

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
308301	Swan Creek, Rd. 304	DE 140-005	Indian River	5
308341	Swan Creek at Rd. 297	DE 140-005	Indian River	5
308281	Cow Bridge Branch Rd. 48	DE 140-006	Indian River	5
306121	Buoy 20, Indian River Bay	DE 140-E01	Indian River	5
306131	Buoy 26, Indian River Bay	DE 140-E01	Indian River	5
306321	Indian River Inlet	DE 140-E01	Indian River	5
306161	Buoy 38, Indian River	DE 140-E02	Indian River	5
306331	Island Creek mouth	DE 140-E02	Indian River	5
308071	Millsboro Dam Overflow	DE 140-L01	Indian River	5
309021	Iron Branch at Rt. 113 Bridge	DE 150-001	Iron Branch	5
309041	Whartons Branch at Rt. 334 Bridge	DE 150-001	Iron Branch	5
202031	DE Rt. 9 Bridge	DE 160-001	Leipsic River	
202041	Rt. 42	DE 160-002	Leipsic River	
202191	Upstream of Masseys Millpond at Rt. 15	DE 160-002	Leipsic River	
202021	Rt. 13 Bridge, Garrisons Lake	DE 160-L01	Leipsic River	
202011	Rd. 42 Bridge at Masseys MIllpond	DE 160-L02	Leipsic River	
305011	Canal Rt. 1	DE 170-001	Lewes and Rehoboth Canal	5
305041	Lewes and Rehoboth Canal at Rd. 18 Bridge	DE 170-001	Lewes and Rehoboth Canal	5
305081	Munchy Branch at Rd. 270a	DE 170-001	Lewes and Rehoboth Canal	5
312041	Assawoman Canal, Rd. 361 Bridge	DE 180-001	Little Assawoman Bay	5
310101	Beaver Dam Ditch, Rd. 363, Miller Branch	DE 180-002	Little Assawoman Bay	5
310121	Beaverdam Ditch at Rd. 368	DE 180-002	Little Assawoman Bay	5
310031	Dirrickson Creek, Rd. 381	DE 180-003	Little Assawoman Bay	5
310011	Little Assawoman Bay Ditch at Rd. 58 Bridge	DE 180-E01	Little Assawoman Bay	5

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
310071	Little Assawoman Bay, Mid-Bay	DE 180-E01	Little Assawoman Bay	5
204031	Rt. 9 Bridge	DE 190-001-01	Little River	
204041	Rt. 8 Bridge	DE 190-001-02	Little River	
204011	Pipe Elm Branch, Postles Corner Road (Rd. 348)	DE 190-001-03	Little River	
302021	Rt. 404 Bridge, (Woodenhawk Bridge)	DE 200-001	Marshyhope Creek	
302031	Rd. 308 Bridge	DE 200-001	Marshyhope Creek	
208021	Rt. 1 Bridge	DE 210-001	Mispillion River	
208061	1.09 miles from mouth at lighthouse	DE 210-001	Mispillion River	
208101	3.85 miles from mouth, Revills Landing	DE 210-001	Mispillion River	
208121	7.48 miles from mouth, mouth of Fishing Branch	DE 210-001	Mispillion River	
208211	Rt. 36 Silver Lake	DE 210-L02	Mispillion River	
208011	Haven Lake at Rt. 113	DE 210-L03	Mispillion River	
208191	Blairs Pond off Rd. 443	DE 210-L05	Mispillion River	
208231	Beaverdam Branch, Rd. 384	DE 210-L05	Mispillion River	
208181	Abbotts Pond at Rd. 620	DE 210-L06	Mispillion River	
206091	US Rt. 113 at Frederica By-Pass	DE 220-001	Murderkill River	
206101	Bowers Beach Wharf	DE 220-001	Murderkill River	
206131	1.25 miles from the mouth at Webs Landing	DE 220-001	Murderkill River	
206141	3.25 miles from the mouth	DE 220-001	Murderkill River	
206231	Confluence of Kent County STP trib.	DE 220-001	Murderkill River	
206711	Murderkill River near power lines (4.45 river mile	DE 220-001	Murderkill River	
206081	Spring Creek at Rt. 12 Bridge	DE 220-002	Murderkill River	
206561	Double Run at Rd. 371	DE 220-002	Murderkill River	
206641	Spring Creek, Pratt Branch at Canterbury Rd.	DE 220-002	Murderkill River	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
206041	Browns Branch at Rt. 14 Bridge	DE 220-004	Murderkill River	
206051	Browns Branch at Rd. 384 Bridge	DE 220-004	Murderkill River	
206011	US Rt. 13 Bridge below Felton	DE 220-005	Murderkill River	
206461	Hudson Branch, McGinnis Pond, Rd. 378	DE 220-L01	Murderkill River	
206071	Andrews Lake at Rd. 380 Bridge	DE 220-L02	Murderkill River	
206451	Coursey Pond at Rd. 388 Bridge	DE 220-L03	Murderkill River	
206361	McCauley Pond near spillway	DE 220-L05	Murderkill River	
101021	Naamans Road	DE 230-001-02	Naamans Creek	
101031	South Branch at Darley Rd.	DE 230-001-02	Naamans Creek	
101041	Rt. 13A	DE 230-001-02	Naamans Creek	
101061	South Branch at Marsh Rd.	DE 230-001-02	Naamans Creek	
304011	Sharptown, Maryland Rt 313	DE 240-001	Nanticoke River	
304041	Middleford Bridge	DE 240-001	Nanticoke River	
304091	Buoy 51 (Conf. Broad Creek)	DE 240-001	Nanticoke River	
304151	Buoy 66 (Conf DuPont Gut)	DE 240-001	Nanticoke River	
304461	Seaford STP Discharge	DE 240-001	Nanticoke River	
304471	Rt. 13 Bridge	DE 240-001	Nanticoke River	
304191	Rd. 545 Mainstem Nanticoke	DE 240-002	Nanticoke River	
304291	Rd. 600 Bridge	DE 240-002	Nanticoke River	
304681	Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	DE 240-002	Nanticoke River	
304381	Bucks Branch at Rd. 546	DE 240-003	Nanticoke River	
304591	Deep Creek above Concord Pond, near Old Furnace at Rd. 46	DE 240-004	Nanticoke River	
316011	Gravelly Branch at Rd. 525 Bridge	DE 240-005	Nanticoke River	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
316031	Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	DE 240-005	Nanticoke River	
304311	Concord Pond overflow	DE 240-L02	Nanticoke River	
304321	Williams Pond, below the pond at Rd. 535	DE 240-L04	Nanticoke River	
313011	Rd. 419 Bridge	DE 250-001	Pocomoke River	
103011	Stanton, Rt. 4 at Stanton Bridge (USGS gage 01480015)	DE 260-001	Red Clay Creek	
103031	Wooddale, Rt. 48 (USGS gage 01480000)	DE 260-001	Red Clay Creek	
103041	Ashland, Rd. 258a	DE 260-001	Red Clay Creek	
103061	Burrough's Run at Creek Rd. (Rt. 82)	DE 260-002	Red Clay Creek	
107031	Rt. 9 Bridge	DE 270-001-01	Red Lion Creek	
107011	Rt. 7	DE 270-001-02	Red Lion Creek	
308051	Guinea Creek at Rt. 298 Bridge	DE 280-001-01	Rehoboth Bay	5
308291	Love Creek, Rd. 277	DE 280-002	Rehoboth Bay	1
308371	Bundick's Branch at Rt. 23	DE 280-002	Rehoboth Bay	5
306071	Buoy 3, Rehoboth Bay	DE 280-E01	Rehoboth Bay	5
306091	Buoy 7, Rehoboth Bay	DE 280-E01	Rehoboth Bay	5
306111	Massey's Ditch at Bouy 17	DE 280-E01	Rehoboth Bay	5
308031	Burton Pond, Rd. 24	DE 280-L01	Rehoboth Bay	5
205041	3.5 miles from mouth at Barkers Landing	DE 290-001-01	Saint Jones River	
205091	Rt. 10 Bridge near DAFB	DE 290-001-02	Saint Jones River	
205571	Division Street (Dover)	DE 290-001-02	Saint Jones River	
205241	Rt. 13 North Moores Lake, Issacs Branch	DE 290-002	Saint Jones River	
205151	Rd. 69 State College, Fork Branch	DE 290-003	Saint Jones River	
205181	Rt. 13 Alt. Moores Lake	DE 290-L01	Saint Jones River	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
205191	Silver Lake Spillway, Dover City Park	DE 290-L02	Saint Jones River	
205211	Derby Pond at Rt. 13A	DE 290-L03	Saint Jones River	
102041	Cherry Island at Rd. 501 Bridge	DE 300-001-01	Shellpot Creek	
102011	US Rt. 13 Bridge (Gov Printz Blvd)	DE 300-001-02	Shellpot Creek	
102051	Rt. 13 Bus (Market Street) Bridge	DE 300-001-02	Shellpot Creek	
102081	Carr Road Bridge	DE 300-001-02	Shellpot Creek	
102101	Stoney Creek @ Rt. 13	DE 300-001-03	Shellpot Creek	
201011	Lake Como at US Route 13 Bridge	DE 310-001	Smyrna River	
201041	Rt. 9 Fleming's Landing	DE 310-001	Smyrna River	
201021	Rd. 137 Bridge, Mill Creek	DE 310-002	Smyrna River	
201051	Rd. 485 Bridge at Smyrna Landing	DE 310-003	Smyrna River	
201161	Rd. 38 Bridge, Providence Creek	DE 310-003	Smyrna River	
105011	Stanton, Old Rt. 7 Bridge	DE 320-001	White Clay Creek	
105031	Chambers Rock Rd. (Road 329) near Thompson	DE 320-001	White Clay Creek	
105151	DE Park Race Track (USGS gage 01479000), 35ft downstream	DE 320-001	White Clay Creek	
105171	McKee Lane in Newark	DE 320-001	White Clay Creek	
105071	Mill Creek, Above Rt. 4 (DE Park)	DE 320-002	White Clay Creek	
105101	Pike Creek Confluence, Upper Pike Creek Rd. (Rd. 322)	DE 320-003	White Clay Creek	
105181	Pike Creek at Paper Mill Road	DE 320-003	White Clay Creek	
105131	Middle Run Confluence, Possum Park Rd. (Rd. 303)	DE 320-004	White Clay Creek	
307171	Horseys Pond 50 Yards Above Spillway 50% RB	DE050-L03	Broad Creek	

Table III-1 Station Summary Statistics

Station	Description	Segment Code	Watershed	DIP Attainment
307081	Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	DE050-L07	Broad Creek	

Table III-2: Segment Use Support

Segment Code	Segment	Watershed Name	Dissolved Oxygen Attainment	Average Total Nitrogen Attainment	Average Total Phosphorus Attainment	Ent. Attain	DIN Attainment	DIP Attainment
DE 010-001-01	Lower Appoquinimink River	Appoquinimink River	5	1	1	5	--	--
DE 010-001-02	Upper Appoquinimink River	Appoquinimink River	5	1	1	5	--	--
DE 010-001-03	Drawyer Creek	Appoquinimink River	1	1	5	5	--	--
DE 010-002-02	Deep Creek to Confluence with Silver Lak	Appoquinimink River	5	5	1	5	--	--
DE 010-L01	Noxontown Pond	Appoquinimink River	1	1	1	1	--	--
DE 010-L02	Silver Lake	Appoquinimink River	1	5	1	1	--	--
DE 010-L03	Shallcross Lake	Appoquinimink River	1	1	1	1	--	--
DE 020-001	Lower Army Creek	Army Creek	5	1	1	1	--	--
DE 020-002	Upper Army Creek	Army Creek	1	1	1	5	--	--
DE 030-001	Lower Blackbird	Blackbird Creek	5	1	5	5	--	--
DE 040-001	Lower Brandywine	Brandywine Creek	1	5	1	5	--	--
DE 040-002	Upper Brandywine	Brandywine Creek	1	5	1	5	--	--
DE 050-001	Lower Broad Creek	Broad Creek	1	5	1	5	--	--
DE 050-006-03	Raccoon Prong	Broad Creek	5	1	1	5	--	--
DE 050-L03	Horseys Pond	Broad Creek	1	5	1	1	--	--
DE 050-L04	Records Pond	Broad Creek	1	5	1	1	--	--
DE 050-L07	Trap Pond	Broad Creek	5	1	1	1	--	--
DE 060-001	Lower Broadkill	Broadkill River	5	5	1	5	--	--
DE 060-002	Beaverdam Creek	Broadkill River	5	5	1	5	--	--
DE 060-003	Upper Broadkill River	Broadkill River	1	5	1	1	--	--
DE 060-004	Round Pole Branch	Broadkill River	1	5	1	5	--	--
DE 060-005	Ingrams Branch	Broadkill River	1	5	5	5	--	--
DE 060-006	Pemberton Branch	Broadkill River	1	5	1	5	--	--
DE 060-007-01	Lower Red Mill Branch	Broadkill River	1	1	1	1	--	--
DE 060-008	Primehook Creek	Broadkill River	5	1	1	1	--	--
DE 060-L01	Red Mill Pond	Broadkill River	1	5	1	1	--	--
DE 060-L02	Waggamons Pond	Broadkill River	1	5	1	1	--	--
DE 060-L03	Waples Pond and Reynolds Pond	Broadkill River	5	5	1	5	--	--

Table III-2: Segment Use Support

Segment Code	Segment	Watershed Name	Dissolved Oxygen Attainment	Average Total Nitrogen Attainment	Average Total Phosphorus Attainment	Ent. Attain	DIN Attainment	DIP Attainment
DE 070-001	Buntings Branch	Buntings Branch	5	5	5	5	5	5
DE 080-001	Lower Cedar Creek	Cedar Creek	5	5	1	5	--	--
DE 090-001	C&D Canal	Chesapeake & Delaware Canal	1	1	1	1	--	--
DE 090-L01	Lums Pond	Chesapeake & Delaware Canal	5	1	1	1	--	--
DE 100-002	Sewell Branch, including tributaries	Chesapeake Drainage System	5	1	5	5	--	--
DE 110-001	Tappahanna Ditch	Choptank	1	1	1	5	--	--
DE 110-002	Culbreth Marsh Ditch	Choptank	1	1	1	5	--	--
DE 110-003	Cow Marsh Creek	Choptank	1	5	1	5	--	--
DE 120-001	Lower Christina River	Christina River	1	1	1	5	--	--
DE 120-002	Mid Christina River	Christina River	1	1	1	5	--	--
DE 120-003	Upper Christina River	Christina River	1	1	1	5	--	--
DE 120-004-01	Lower Christina Creek	Christina River	1	1	1	5	--	--
DE 120-006	Upper Christina Creek	Christina River	1	1	1	5	--	--
DE 120-007-01	Little Mill Creek and Willow Run	Christina River	1	1	1	5	--	--
DE 130-001	Lower Dragon Run Creek	Dragon Run Creek	5	1	1	1	--	--
DE 130-002	Upper Dragon Run Creek	Dragon Run Creek	5	1	1	5	--	--
DE 140-001	White Creek	Indian River	5	1	1	5	1	5
DE 140-002	Blackwater Creek	Indian River	5	5	1	5	5	5
DE 140-003	Pepper Creek, including tributaries	Indian River	1	5	5	5	5	5
DE 140-004	Indian River	Indian River	1	1	1	5	5	5
DE 140-005	Swan Creek	Indian River	1	5	1	5	5	5
DE 140-006	Stockley Branch	Indian River	1	1	1	1	5	5
DE 140-E01	Lower Indian River Bay	Indian River	1	1	1	1	5	5
DE 140-E02	Upper Indian River Bay	Indian River	5	1	1	1	5	5
DE 140-L01	Millsboro Pond	Indian River	1	5	1	1	5	5
DE 150-001	Iron Branch	Iron Branch	1	5	1	5	5	5
DE 160-001	Lower Leipsic River	Leipsic River	5	1	5	5	--	--
DE 160-002	Upper Leipsic River	Leipsic River	1	5	5	5	--	--

Table III-2: Segment Use Support

Segment Code	Segment	Watershed Name	Dissolved Oxygen Attainment	Average Total Nitrogen Attainment	Average Total Phosphorus Attainment	Ent. Attain	DIN Attainment	DIP Attainment
DE 160-L01	Garrisons Lake	Leipsic River	1	1	5	1	--	--
DE 160-L02	Masseys Mill Pond	Leipsic River	1	1	1	1	--	--
DE 170-001	Lewes and Rehoboth Canal	Lewes and Rehoboth Canal	5	1	1	5	5	5
DE 180-001	Little Assawoman Canal	Little Assawoman Bay	5	1	1	5	5	5
DE 180-002	Miller Creek	Little Assawoman Bay	5	5	1	5	5	5
DE 180-003	Dirickson Creek	Little Assawoman Bay	1	1	5	5	5	5
DE 180-E01	Little Assawoman Bay	Little Assawoman Bay	5	1	1	1	5	5
DE 190-001-01	Lower Little River	Little River	5	1	5	5	--	--
DE 190-001-02	Upper Little River	Little River	5	1	1	1	--	--
DE 190-001-03	Pipe Elm Branch	Little River	1	1	1	5	--	--
DE 200-001	Marshyhope Creek	Marshyhope Creek	1	5	1	1	--	--
DE 210-001	Lower Mispillion	Mispillion River	5	5	1	5	--	--
DE 210-L02	Silver Lake	Mispillion River	1	5	1	1	--	--
DE 210-L03	Haven Lake	Mispillion River	1	5	1	1	--	--
DE 210-L05	Blairs Pond	Mispillion River	1	5	1	5	--	--
DE 210-L06	Abbotts Mill Pond	Mispillion River	1	5	1	1	--	--
DE 220-001	Lower Murderkill	Murderkill River	5	5	5	5	--	--
DE 220-002	Spring Creek	Murderkill River	5	5	5	5	--	--
DE 220-004	Browns Branch	Murderkill River	1	5	1	5	--	--
DE 220-005	Upper Murderkill River	Murderkill River	1	5	1	5	--	--
DE 220-L01	McGinnis Pond	Murderkill River	1	5	1	1	--	--
DE 220-L02	Andrews Lake	Murderkill River	1	5	1	1	--	--
DE 220-L03	Coursey Pond	Murderkill River	1	5	1	1	--	--
DE 220-L05	McCauley Pond	Murderkill River	1	5	1	1	--	--
DE 230-001-02	North Branch and South Branch	Naamans Creek	1	1	1	5	--	--
DE 240-001	Lower Nanticoke River	Nanticoke River	1	5	1	1	--	--
DE 240-002	Upper Nanticoke River	Nanticoke River	1	5	1	5	--	--
DE 240-003	Clear Brook Branch	Nanticoke River	1	5	1	5	--	--

Table III-2: Segment Use Support

Segment Code	Segment	Watershed Name	Dissolved Oxygen Attainment	Average Total Nitrogen Attainment	Average Total Phosphorus Attainment	Ent. Attain	DIN Attainment	DIP Attainment
DE 240-004	Deep Creek Branch	Nanticoke River	5	1	1	1	--	--
DE 240-005	Gravelly Branch	Nanticoke River	1	1	1	5	--	--
DE 240-L02	Concord Pond	Nanticoke River	1	1	1	1	--	--
DE 240-L04	Williams Pond	Nanticoke River	1	5	1	1	--	--
DE 250-001	Pocomoke River	Pocomoke River	1	1	1	5	--	--
DE 260-001	Mainstem	Red Clay Creek	1	5	1	5	--	--
DE 260-002	Burroughs Run	Red Clay Creek	1	1	1	5	--	--
DE 270-001-01	Lower Red Lion	Red Lion Creek	5	1	1	5	--	--
DE 270-001-02	Upper Red Lion	Red Lion Creek	1	1	1	5	--	--
DE 280-001-01	Chapel Branch	Rehoboth Bay	5	1	1	5	5	5
DE 280-002	Love Creek, including tributaries	Rehoboth Bay	1	5	1	5	5	5
DE 280-E01	Rehoboth Bay	Rehoboth Bay	1	1	1	1	1	5
DE 280-L01	Burton Pond	Rehoboth Bay	1	1	1	1	5	5
DE 290-001-01	Lower Saint Jones	Saint Jones River	5	1	5	5	--	--
DE 290-001-02	Upper Saint Jones	Saint Jones River	5	1	5	5	--	--
DE 290-002	Isaac Branch	Saint Jones River	1	5	1	5	--	--
DE 290-003	Fork Branch	Saint Jones River	5	1	1	1	--	--
DE 290-L01	Moores Lake	Saint Jones River	1	5	1	1	--	--
DE 290-L02	Silver Lake	Saint Jones River	1	1	1	1	--	--
DE 290-L03	Derby Pond	Saint Jones River	1	5	1	1	--	--
DE 300-001-01	Lower Shellpot Creek	Shellpot Creek	5	1	1	5	--	--
DE 300-001-02	Upper Shellpot Creek	Shellpot Creek	1	1	1	5	--	--
DE 300-001-03	All other tributaries located in the waters	Shellpot Creek	1	1	1	5	--	--
DE 310-001	Lower Smyrna River	Smyrna River	5	1	5	5	--	--
DE 310-002	Mill Creek	Smyrna River	1	1	1	1	--	--
DE 310-003	Tributary of Smyrna River	Smyrna River	5	5	5	5	--	--
DE 320-001	Mainstem	White Clay Creek	1	5	1	5	--	--
DE 320-002	Mill Creek	White Clay Creek	1	1	1	5	--	--

Table III-2: Segment Use Support

Segment Code	Segment	Watershed Name	Dissolved Oxygen Attainment	Average Total Nitrogen Attainment	Average Total Phosphorus Attainment	Ent. Attain	DIN Attainment	DIP Attainment
DE 320-003	Pike Creek	White Clay Creek	1	5	1	5	--	--
DE 320-004	Middle Run	White Clay Creek	1	1	1	5	--	--

Summary Data Tables

The following summary tables (Table III-3- III-6) summarize 2010 Use Support determinations in Table III-2.

Individual Use Support Summaries

(National and State Uses)

Individual Use Support Summary for DE

Table III-3

Report for Water Type: RIVER; Units: MILES

USE	Size Assessed	Size Fully Supporting	Size Not Supporting
Fish, Aquatic Life, and Wildlife	2,478.17	152.8	2325.37
Primary Contact Recreation	2,479.38	366.1	2,113.28
Waters of Exceptional Recreational or Ecological Significance	867.25	190	677.25

Type of Waterbody: Freshwater Lake
Note: All numbers are in Acres

Table III-4

Report for Water Type: FRESHWATER LAKE; Units: ACRES

USE	Size Assessed	Size Fully Supporting	Size Not Supporting
Fish, Aquatic Life, and Wildlife	2,953.9	753.6	2200.3
Primary Contact Recreation	2,953.9	1741.7	1,212.2
Waters of Exceptional Recreational or Ecological Significance	757.8	256.7	501.1

Table III-5

Report for Water Type: ESTUARY; Units: SQUARE MILES

USE	Size Assessed	Size Fully Supporting	Size Not Supporting
Fish, Aquatic Life, and Wildlife	28.95	0	28.95
Primary Contact Recreation	29.54	28.95	0.59
Waters of Exceptional Recreational or Ecological Significance	29.54	3	26.54

Table III-6

Type of Waterbody: Coastal Waters
Note: All numbers are in Miles

Use	Size Assessed	Size Fully Supporting	Size Not Supporting
Aquatic Life Support	25	25	0
Primary Contact (Recr)	25	25	0

Table III-7 2012 303(d) List

FINAL DETERMINATION FOR THE STATE OF DELAWARE 2012 CLEAN WATER ACT SECTION 303(d) LIST OF WATERS NEEDING TMDLs

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Polllutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
Piedmont Basin													
DE230-001-01	Naamans Creek	Lower Naamans Creek	4a	From the mouth at the Delaware River, upstream to the first railroad bridge	0.30 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	2002	2004	2005	1	2006	Nutrients, Listed 2002, Delisted 2012
DE230-001-02	Naamans Creek	North Branch and South Branch	5	Upper Naamans Creek, including all tributaries on the North Branch and	7.8 miles	Nutrients	NPS	1996	2004	2005	1	2006	Nutrients, Listed 1996, Delisted 2012
						Bacteria	NPS	1996	2004	2005	4a	2006	
				First tributary after the headwaters of South Naamans Creek to the mainstem	1.15 miles	Biology and Habitat	NPS	1998	2009		5		
				From the confluence of Naamans Creek and West Branch Naamans Creek to the confluence of Naamans Creek and North Branch Naamans Creek	0.56 miles	Biology and Habitat	NPS	1998	2009		5		
DE300-001-01	Shellpot Creek	Lower Shellpot Creek	5	From the head of tide below the east set of railroad tracks to the mouth of the Delaware River	1.0 mile	Nutrients	NPS Del. River	1996	2004	2005	1	2006	Nutrients, Listed 1996, Delisted 2012
						DO		1996	2004	2005	4a	2006	
						Bacteria		2002	2004	2005	4a	2006	
						PCBs		2002	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Chlordane		2002	2017		5		TMDL Target date changed from 2009 to 2017, per the WATAR plan in the appendix
DE300-001-02	Shellpot Creek	Upper Shellpot Creek	5	From the headwaters to the head of tide below the east set of railroad tracks	7.7 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996	2004	2005	1	2006	Nutrients, Listed 1998, Delisted 2012
						Dieldrin	NPS	2012	2025				
				Western tributary of the headwaters to the confluence of the next larger stream order	1.4 miles	Biology and Habitat	NPS	1998	2009		5		
				From the headwaters of Matson Run to the confluence with mainstem Shellpot Creek	1.3 miles	Biology and Habitat	NPS	1998	2009		5		
DE300-001-03	Shellpot Creek	All other tributaries located in the watershed but NOT on the mainstem	5	Western tributary of the headwaters of Stoney Creek to the confluence with mainstem Stoney Creek	0.63 miles	Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Stoney Creek to the mouth of the Delaware River	1.2 miles	Biology and Habitat	NPS	1998	2009		5		
						Nutrients	NPS	2008	2005	2005	1		Nutrients, Listed 2008, Delisted 2012
						Bacteria	NPS	2010	2001		4a		
DE040-001	Brandywine Creek	Lower Brandywine	5	Mainstem Lower Brandywine	3.8 miles	Nutrients	PS, NPS, SF	1996		2000	4a	2004	
						PCBs		1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Bacteria		2002	2004	2005	4a	2006	
						Habitat	NPS	1998	2009		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE040-002	Brandywine Creek	Upper Brandywine	5	From State Line to Wilmington	9.3 miles	Bacteria	PS, NPS, SF	1996	2004	2005	4a		Bacteria, listed in 1996, delisted 2006 , relisted 2008
						Nutrients		1996		2000	4a		
						PCBs		1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Dioxin		2002	2017		5		Target date changed to 2017 in the 2012 Cycl, per the WATAR plan in the appendix
				From State line to the confluence with the Christina River	8.0 miles	Habitat	NPS	1998	2009		5		
DE040-003	Brandywine Creek	All tributaries on Brandywine Creek from the headwaters at PA-DE line to the confluence with the Christina River	5	Eastern tributary of Beaver Creek, from headwaters to the confluence with mainstem Beaver Creek	0.96 miles	Biology and Habitat	NPS	1998	2009		5		
				Tributary originating in Pennsylvania on the western side of Brandywine Creek	0.26 miles	Biology and Habitat	NPS	1998	2009		5		
				Tributary of Brandywine Creek, off Route 100 (near PA-DE border)	0.92 miles	Habitat	NPS	1998	2009		5		
				Tributary of Brandywine Creek just below Beaver Creek	0.85 miles	Habitat	NPS	1998	2009		5		
				Eastern tributary of the headwaters of Rocky Run(upper half)	1.16 miles	Habitat	NPS	1998	2009		5		
				Eastern tributary of the headwaters of Rocky Run(lower half)	1.16 miles	Biology and Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Wilson Run to the next larger stream order (lower half)	0.64 miles	Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Wilson Run to the next larger stream order (upper half)	0.64 miles	Biology and Habitat	NPS	1998	2009		5		
				Wilson Run, from start of the third order stream to the confluence with Brandywine Creek	0.88 miles	Biology	NPS	1998	2009		5		
				Tributary of Wilson Run on Montchanin Road from the headwaters to the first confluence	0.45 miles	Habitat	NPS	1998	2009		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE260-001	Red Clay Creek	Mainstem	5	From PA-DE line to the confluence with White Clay Creek	12.8 miles	Bacteria	PS, NPS, SF	1996	2004	2005	4a	2006	
						Nutrients		1996		2000	4a	2004	
						Zn		1996		1999	4a	2004	
						PCBs		1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Dioxin		2002	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Chlorinated Pesticides		2002	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
				From the confluence of West Branch Red Clay Creek to the confluence with White Clay Creek (lower half)	6.4 miles	Habitat	NPS	1998	2009		5		
				From the confluence of West Branch Red Clay Creek to the confluence with White Clay Creek (upper half)	6.4 miles	Biology and Habitat	NPS	1998	2009		5		
DE260-002	Red Clay Creek	Burroughs Run	5	From PA-DE line to the confluence with Red Clay Creek	2.6 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
					2.6 miles	Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
				From the confluence of the headwaters of Burroughs Run to the confluence with Red clay Creek	4.21 miles	Biology	NPS	1998	2009		5		
DE260-003	Red Clay Creek	All other tributaries located in the watershed but NOT on the mainstem	5	Second tributary below Burroughs Run to the confluence with Red Clay Creek	1.4 miles	Habitat	NPS	1998	2009		5		
				Western tributary of the headwaters of Hyde Run to the confluence with the next larger stream order	1.2	Biology and Habitat	NPS	1998	2009		5		
DE260-L01	Red Clay Creek	Reservoir	3	Hoopes Reservoir	200.0 acres	Bacteria	PS, NPS	1996			3	2004	This segment was listed in 1996, apparently based on earlier reports but no data were used for the listing. No data has been collected in the interim. The Department will study the segment to determine if a listing is appropriate.

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE320-001	White Clay Creek	Mainstem	5	White Clay Creek from the PA-DE line to the confluence with the Christina River	15.6 miles	Bacteria	PS, NPS	1996	2004	2005	4a	2006	
						Nutrients	PS, NPS	1996		2000	4a	2004	
						Zn (below Paper Mill Road)	PS, NPS	1996		1999	1	2004	Zinc, listed in 1999 delisted 2004 based on improved water quality
						PCBs	PS, NPS	1996, 2006	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
				From the confluence of East Branch White Clay Creek and West Branch White Clay Creek to the confluence with the Christina River	16.2 miles	Biology and Habitat	NPS	1998	2009		5		
DE320-002	White Clay Creek	Mill Creek	5	From the headwaters to the confluence with White Clay Creek	8.3 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
				From the confluence of the headwaters of Mill Creek to the confluence with the next larger stream order	0.27 miles	Biology and Habitat	NPS	1998	2009		5		
				Second western tributary-- From the headwaters of mainstem Mill Creek	0.04 miles	Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Mill Creek to the confluence with White Clay Creek (upper half)	1.64 miles	Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Mill Creek to the confluence with White Clay Creek (lower half)	1.64 miles	Biology and Habitat	NPS	1998	2009		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Polllutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE320-003	White Clay Creek	Pike Creek	5	From the headwaters to the confluence with White Clay Creek	5.4 miles	Nutrients	NPS	1996		2000	4a	2004	
						Bacteria	NPS	1996	2004	2005	4a	2006	
				Third eastern tributary after the headwaters of Pike Creek (upper half)	0.21 miles	Biology	NPS	1998	2009		5		
				Third eastern tributary after the headwaters of Pike Creek (lower half)	0.21 miles	Biology and Habitat	NPS	1998	2009		5		
				Second eastern tributary after the headwaters of Pike Creek	0.96 miles	Biology and Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Pike Creek to the confluence with White Clay Creek	4.7 miles	Biology and Habitat	NPS	1998	2009		5		
DE320-004	White Clay Creek	Middle Run	5	From the headwaters to the confluence with White Clay Creek	4.5 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
				Eastern tributary of the headwaters of Middle Run to the confluence of the next larger stream order (upper half)	0.89 miles	Biology	NPS	1998	2009		5		
				Eastern tributary of the headwaters of Middle Run to the confluence of the next larger stream order (lower half)	0.89 miles	Biology and Habitat	NPS	1998	2009		5		
				Western tributary of the headwaters of Middle Run to the confluence with the mainstem	1.3 miles	Habitat	NPS	1998	2009		5		
DE320-005	White Clay Creek	All tributaries from the headwaters to the confluence with the Christina River	5	First tributary after State line to the confluence of White Clay Creek, along Thompson Station Road	1.1 miles	Habitat	NPS	1998	2009		5		
				Tributary off The Hunt at Louviers	0.38 miles	Biology	NPS	1998	2009		5		
				Tributary off White Clay Creek that parallels Paper Mill Road-- Jennys Run	0.38 miles	Biology	NPS	1998	2009		5		
				First tributary after Pike Creek--from the headwaters to the confluence with White Clay Creek	1.1 miles	Habitat	NPS	1998	2009		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE120-001	Christina River	Lower Christina River	5	Mainstem Lower Christina River	1.5 miles	Nutrients	NPS, SF	1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
						DO	NPS, SF	1996			1	2002	DO, listed in 1996, delisted 2002
						PCBs	NPS, SF	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Bacteria	PS,NPS	2002	2004	2005	4a	2006	
						Dieldrin	PS, NPS	2002	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE120-002	Christina River	Mid Christina River	5	Between White Clay Creek and Brandywine River	7.5 miles	Nutrients	NPS	1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
						PCBs	SF	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Bacteria	PS, NPS	2002	2004	2005	4a	2006	
						Dieldrin	NPS	2002	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						DO	NPS	2008		2001	1		DO Listed 2008, Delisted 2010
DE120-003	Christina River	Upper Christina River	5	Mainstem Upper Christina River	6.3 miles	Nutrients	NPS, PS	1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
						PCBs	NPS, PS	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						Bacteria	NPS, PS	1996	2004	2005	1	2006	Bacteria, Listed 1996, Delisted 2010
						DO	NPS, PS	2004		2001	1	2006	DO, listed in 2004, delisted 2006
						Chlordane	NPS, PS	2006	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
				Segments from Smalley's Pond overflow to the confluence with White Clay Creek	5.77 miles	Biology and Habitat	NPS	1998	2009		5		
				Tributary downstream of Smalleys Pond on the Christina River	0.65 miles	Biology	NPS	1998	2009		5		
DE120-003-02	Christina River	Lower Christina Creek	5	Tributary from Smalleys Pond overflow to White Clay Creek	1.0 mile	Biology and Habitat	NPS	1998	2009		5		
						Nutrients	NPS	2002		2001	4a	2004	
						DO	NPS	2002		2001	4a	2004	
						Bacteria	NPS	2002	2004	2005	4a	2006	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE120-004-01	Christina River	Lower Christina Creek	5	Mainstem Lower Christina Creek	8.4 miles	Bacteria	NPS,	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
						PCBs	NPS, SF	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						DO	NPS	2002		2001	1	2006	DO, listed in 2002, delisted 2006
						Dieldrin	NPS	2006	2017		5		TMDL Target date changed from 2009 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
				From the confluence of West Branch Christina River to the confluence with the mainstem	6.0 miles	Biology and Habitat	NPS	1998	2009		5		
DE120-004-02	Christina River	Belltown Run	5	From the headwaters above Becks Pond to the confluence with the Christina River	3.8 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	2002	2004	2005	4a	2006	
						DO	NPS	2002	2004	2005	4a	2006	
				Eastern tributary of the headwaters of Belltown Run to the confluence with the Christina River	4.2 miles	Biology and Habitat	NPS	1998	2009		5		
				Western tributary of the headwaters of Belltown Run to its confluence	0.88 miles	Habitat	NPS	1998	2009		5		
DE120-004-03	Christina River	Muddy Run	5	From the headwaters above Sunset Pond to the confluence with Belltown Run below Becks Pond	8.0 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
				From the headwaters of Iron Hill Run to the next larger stream order	2.3 miles	Habitat	NPS	1998	2009		5		
				Eastern tributary of the headwaters of Iron Hill Run to the next larger stream order	0.71 miles	Habitat	NPS	1998	2009		5		
				Eastern tributary above Sunset Pond to the confluence of the next larger stream order	2.3 miles	Biology	NPS	1998	2009		5		
				Eastern tributary of the headwaters of Muddy Run to its confluence	0.63 miles	Habitat	NPS	1998	2009		5		
DE120-005-01	Christina River	West Branch	4a	West Branch including Persimmon Run and Stine Haskell Branch	5.3 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2001	4a	2004	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE120-006	Christina River	Upper Christina Creek	5	Mainstem Upper Christina Creek	8.3 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients		1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
				From the confluence of the headwaters of Upper Christina River to the confluence of West Branch	2.6 miles	Biology and Habitat		1998	2009		5		
				First western tributary after the headwaters of the Upper Christina River to mainstem Upper Christina River (upper half)	0.67 miles	Habitat		1998	2009		5		
				First western tributary after the headwaters of the Upper Christina River to mainstem Upper Christina River (lower half)	0.67 miles	Biology and Habitat		1998	2009		5		
DE120-007-01	Christina River	Little Mill Creek and Willow Run	5	From the confluence of Willow Run and Chestnut Run to the confluence with the Christina River	5.1 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2001	1	2004	Nutrients, Listed 1996, Delisted 2012
						DO		1996		2001	1	2002	DO, listed in 1996, delisted 2002
						PCBs	NPS	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
				First western tributary after the headwaters of Little Mill Creek to the confluence with mainstem Little Mill Creek	1.4 miles	Habitat	NPS	1998	2009		5		
				From the headwaters of Willow Run to the confluence with the Christina River	0.54 miles	Habitat	NPS	1998	2009		5		
				From the confluence of the headwaters of Little Mill Creek to the confluence of Chestnut Run	4.4 miles	Biology and Habitat	NPS	1998	2009		5		
				Little Mill Creek--from the confluence of Chestnut Run to the confluence with the Christina River	3.4 miles	Biology and Habitat	NPS	1998	2009		5		
DE120-007-02	Christina River	Chestnut Run	5	From the headwaters of Chestnut Run to the confluence with the Christina River	2.8 miles	Bacteria	NPS	1996	2004	2005	4a	2006	
				Eastern tributary of the headwaters of Chestnut Run to the confluence of the next larger stream order	1.1 miles	Habitat	NPS	1998	2009		5		
				Left tributary of the headwaters of Chestnut Run to the confluence of the next larger stream order	0.43 miles	Biology and Habitat	NPS	1998	2009		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE120-L01	Christina River	Smalleys Pond	5	Smalleys Pond east of Newark	30.0 acres	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996	2004	2004	4a	2006	
						PCBs	NPS	1996	2003	2003	4a	2012	EPA TMDL for PCBS in Delaware River Zone 5 and tributaries
						DO	NPS	2004	2004		4a	2006	
DE120-L02	Christina River	Becks Pond	5	Becks Pond southeast of Newark	25.6 acres	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	1996		2004	1	2002	Nutrients, listed in 1996, delisted 2002
						PCBs	NPS	2002	2003		1		Listed in 2002, Delisted 2010 due to removal of advisory. EPA TMDL for PCBS in Delaware River
						Mercury	NPS	2002	2009		1		
DE120-L03	Christina River	Sunset Pond	4a	Sunset Pond south of Newark	40.0 acres	Bacteria	NPS	1996	2004	2005	4a	2006	
						Nutrients	NPS	2002	2004	2004	4a		
						DO	NPS	1996	2004	2004	4a	2006	

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
CHESAPEAKE BAY BASIN													
DE100-001	Chesapeake Drainage System	Cypress Branch, including tributaries	5	Mainstem	6.6 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	2002	2005	2005	4a	2006	
						DO	NPS	1996	2005	2005	4a	2006	
				Cypress Branch--from the confluence of Black Stallion Ditch to the MD-DE line	1.60 miles	Biology	NPS	1998	2010		5		
						DO	NPS	1998	2005	2005	4a	2006	
				Tributary of Cypress Branch--from the confluence of the headwaters to the confluence with the mainstem	0.35 miles	Biology	NPS	1998	2010		5		
DE100-002	Chesapeake Drainage System	Sewell Branch, including tributaries	5	Mainstem	7.2 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						DO	NPS	1996	2005	2005	4a	2006	
						Nutrients	NPS	1996	2005	2005	4a	2006	
				From the confluence of the headwaters to the confluence with Sewell Branch	8.20 miles	Biology and Habitat	NPS	1998	2010		5		
				From the confluence of the headwaters to the confluence with Sewell Branch		DO	NPS	1998	2005	2005	4a	2006	
DE100-003	Chesapeake Drainage System	Gravelly Run, including tributaries	5	Mainstem	7.7 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						DO	NPS	1996	2005	2005	1	2008	DO, Listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	4a	2006	
				Gravelly Run--from the confluence of Jamison Branch to the MD-DE line	1.08 miles	Habitat	NPS	1998	2010		5		
				Tributary of Gravelly Run--from the headwaters to the confluence with the mainstem	0.22 miles	Habitat	NPS	1998	2010		5		
				Tributary of Gravelly Run--first western tributary upstream of Gravelly Run	1.21 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary of Gravelly Run--second eastern tributary from the headwaters of Gravelly Run to the mainstem	1.25 miles	Habitat	NPS	1998	2010		5		
				Gravelly Run--from the start of the third order stream to the confluence with Jamison Branch	2.28 miles	Biology and Habitat	NPS	1998	2010		5		
				From the confluence of Gravelly Run and Jamison Branch to the MD-DE line	1.14 miles	Biology and Habitat	NPS	1998	2010		5		
DE100-004	Chesapeake Drainage System	Tributaries of Elk River	5	First eastern tributary after the headwaters of Great Bohemia Creek	1.55 miles	Habitat	NPS	1998	2010		5		
				Eastern tributary of the headwaters of Back Creek to its confluence	1.26 miles	Biology	NPS	1998	2010		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE100-005	Chesapeake Drainage System	Tributaries of Sassafras River	5	Western tributary of the headwaters of Sassafras River to its confluence	1.92 miles	Biology	NPS	1998	2010		5		
				From the confluence of the headwaters of Sassafras River to the next larger stream order	0.95 miles	Biology and Habitat	NPS	1998	2010		5		
DE110-001	Choptank	Tappahanna Ditch	5	Mainstem	7.5 miles	Bacteria	NPS	1996	2005	2006	1	2008	Bacteria, Listed 1996, Delisted 2010
						DO	NPS	1996	2005	2005	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	1	2006	Nutrients, Listed 1996, Delisted 2012
				From start of the fourth order stream to the confluence with Tidy Island Creek	6.58 miles	Biology and Habitat	NPS	1998	2010		5		
				Start of third order stream on Tappahanna Ditch to the confluence of the next larger stream order	1.12 miles	Biology and Habitat	NPS	1998	2010		5		
				First western tributary after the headwaters of Tappahanna Ditch to its confluence	0.40 miles	Habitat	NPS	1998	2010		5		
				Tidy Island Creek--from the confluence with Tappahanna Ditch to the MD-DE line	0.21 miles	Habitat	NPS	1998	2010		5		
				Choptank River--from the start of the third order stream to the confluence with Choptank River	2.31 miles	Biology and Habitat	NPS	1998	2010		5		
				Seventh eastern tributary upstream of Tappahanna Ditch	1.30 miles	Habitat	NPS	1998	2010		5		
						DO	NPS	1998	2005	2005	4a	2008	
				Tributary of Tappahanna Ditch--western tributary of the headwaters to its confluence	0.38 miles	Biology and Habitat	NPS	1998	2010		5		
				Second western tributary after the headwaters of Tappahanna Ditch to its confluence	0.88 miles	Biology and Habitat	NPS	1998	2010		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE110-002	Choptank	Culbreth Marsh Ditch	5	Mainstem	10.0 miles	Bacteria	NPS	1996	2005	2005	1	2008	Bacteria, Listed 1996, Delisted 2010
						DO	NPS	1996	2005	2005	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	1	2006	Nutrients, Listed 1996, Delisted 2012
				Luther Marvel Prong--from the confluence of the headwaters to the confluence with Culbreth Marsh Ditch	1.07 miles	Biology and Habitat	NPS	1998	2010		5		
				From the confluence of Powell Ditch to the confluence with Ross Prong	1.31 miles	Habitat	NPS	1998	2010		5		
				Culbreth Marsh Ditch--from start of the fourth order stream to the confluence with Mud Millpond (lower half)	1.79 miles	Habitat	NPS	1998	2010		5		
				Culbreth Marsh Ditch--from start of the fourth order stream to the confluence with Mud Millpond (upper half)	1.79 miles	Biology and Habitat	NPS	1998	2010		5		
						DO	NPS	1998	2010	2005	4a		
						Temperature	NPS	1998	2010		5		
				Culbreth Marsh Ditch--from the confluence of Ross Prong to the confluence with the next larger stream order	3.62 miles	Biology and Habitat	NPS	1998	2010		5		
				Culbreth Marsh Ditch--from the confluence of Mud Millpond to the confluence of Cow Marsh Creek	1.86 miles	Biology	NPS	1998	2010		5		
				Third western tributary upstream of Culbreth Marsh Ditch	1.99 miles	Biology and Habitat	NPS	1998	2010		5		
				Ross Prong--from the confluence of the headwaters to the confluence with Culbreth Marsh Ditch	2.61 miles	Biology and Habitat	NPS	1998	2010		5		

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DE110-003	Choptank	Cow Marsh Creek	5	Mainstem	15.1 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						DO	NPS	1996	2005	2005	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	4a	2006	
				First upstream tributary on Meredith Branch	0.46 miles	Habitat	NPS	1998	2010		5		
				From the confluence of the headwaters of Sangston Prong to the confluence Gravelly Branch	1.98 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary of Gary Mill Pond Branch--from the confluence of the headwaters to the confluence with Gary Mill Pond Branch	1.00 miles	Biology and Habitat	NPS	1998	2010		5		
				First eastern tributary after the headwaters of Wildcat Branch	1.21 miles	Biology and Habitat	NPS	1998	2010		5		
				Willow Grove Prong--from the start of the third order stream to the confluence with Cow Marsh Creek	1.24 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary of Cow Marsh Creek--first eastern tributary upstream of Cow Marsh Creek	1.32 miles	Biology	NPS	1998	2010		5		
				Cow Marsh Ditch--from start of third order stream to the confluence with Cow Marsh Creek	1.44 miles	Habitat	NPS	1998	2010		5		
				Cow Marsh Ditch--from the confluence of the headwaters to the confluence with the next larger stream order	1.49 miles	Habitat	NPS	1998	2010		5		
				Bullock Prong--mainstem to the confluence with Price Prong	3.12 miles	Habitat	NPS	1998	2010		5		
				Third tributary upstream of Cow Marsh Ditch--from the headwaters to the confluence with Cow Marsh Ditch	1.86 miles	Habitat	NPS	1998	2010		5		
				Iron Mine Prong--from the confluence of Black Swamp to the next larger stream order	2.02 miles	Habitat	NPS	1998	2010		5		
				Meredith Branch--from the start of the third stream order to the confluence with the next larger stream order	2.08 miles	Biology and Habitat	NPS	1998	2010		5		
				White Marsh Branch--from the start of the third order stream to the confluence with Gravelly Branch and Sangston Prong	2.92 miles	Biology	NPS	1998	2010		5		
				Cow Marsh Creek--from the confluence of Iron Mine Prong to the confluence with Choptank River	4.97 miles	Habitat	NPS	1998	2010		5		

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DE110-L01	Choptank	Mud Mill Pond	5	Pond south of Marydel	60.0 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						DO	NPS	1996	2005	2005	4a	2006	
						Nutrients	NPS	1996	2005	2005	4a	2006	
DE200-001	Marshyhope Creek	Marshyhope Creek	5	From the headwaters to the State Line	19.7 miles	Bacteria	NPS	1996	2005	2006	1	2008	Bacteria, listed 1996, delisted 2008
						DO	NPS	1996	2005	2005	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	4a	2006	
				Tributary to Black Arm Prong--third tributary upstream of Black Arm Prong	0.56 miles	Habitat	NPS	1998	2010		5		
				Marshyhope Creek--from the confluence of Prospect Branch to the confluence with the MD-DE line	8.78 miles	Habitat	NPS	1998	2010		5		
				From the confluence of Black Prong and Marshyhope Ditch to the confluence of Prospect Branch	4.50 miles	Biology and Habitat	NPS	1998	2010		5		
DE200-002	Marshyhope Creek	Tributaries from the headwaters to the State line	5	Marshyhope Ditch	6.26 Miles	DO	NPS	2002	2005	2005	4a	2006	
						Nutrients	NPS	2002	2005	2005	4a	2006	
						Bacteria	NPS	2002	2005	2006	4a	2008	
				First tributary upstream of Prong No. 2--from the eastern headwater to its confluence	0.55 miles	Habitat	NPS	1998	2010		5		
				Point Branch--from the headwaters to the confluence with the first tributary downstream	0.80 miles	Habitat	NPS	1998	2010		5		
				Tributary of Tomahawk Branch--third eastern tributary downstream of the headwaters	1.54 miles	Habitat	NPS	1998	2010		5		
				Tributary of Tomahawk Branch--first eastern tributary upstream	0.69 miles	Habitat	NPS	1998	2010		5		
				Tributary of Salisbury Creek--from the MD-DE line to the confluence with Salisbury Creek	0.82 miles	Biology and Habitat	NPS	1998	2010		5		
				Salisbury Creek--from the start of the third order stream to the confluence with Cattail Branch (upper half)	0.60 miles	Biology and Habitat	NPS	1998	2010		5		
				Salisbury Creek--from the start of the third order stream to the confluence with Cattail Branch (lower half)	0.60 miles	Habitat	NPS	1998	2010		5		

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	Marshyhope Creek	Tributaries from the headwaters to the State line	5	Prospect Branch--western tributary of the headwaters to its confluence	1.25 miles	Habitat	NPS	1998	2010		5		
				Prong No. 2--from the start of the third order stream to the confluence with Bright-Haines Glade Branch	1.50 miles	Biology and Habitat	NPS	1998	2010		5		
				From the confluence of the headwaters of Green Branch to the confluence with Marshyhope Creek	3.51 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary of Salisbury Creek--from the MD-DE line to the confluence with Salisbury Creek	1.21 miles	Biology and Habitat	NPS	1998	2010		5		
				Short and Hall Ditch--from the confluence of the headwaters of with Marshyhope Creek	1.45 miles	Habitat	NPS	1998	2010		5		
				Brights Branch--from the start of the third order stream to the MD-DE line	1.78 miles	Habitat	NPS	1998	2010		5		
				Bright-Haines Glade Branch--from the start of the fourth order stream and Prospect Branch to the confluence with	1.30 miles	Habitat	NPS	1998	2010		5		
						DO	NPS	1998	2010	2005	4a	2008	
						Temperature	NPS	1998	2010		5		
				Cattail Branch--from the start of the fourth order stream to the confluence with Salisbury Creek (upper half)	2.17 miles	Biology and Habitat	NPS	1998	2010		5		
				Cattail Branch--from the start of the fourth order stream to the confluence with Salisbury Creek (lower half)	2.17 miles	Habitat	NPS	1998	2010		5		
						DO	NPS	1998	2010	2005	4a	2008	
						Temperature	NPS	1998	2010		5		
				Tributary to Black Arm Prong--second tributary after the headwaters	0.52 miles	Habitat	NPS	1998	2010		5		
				Eastern tributary of the headwaters of Cattail Branch to its confluence	0.87 miles	Habitat	NPS	1998	2010		5		
				From the confluence of the headwaters of Green Branch to the confluence Marshyhope Creek	2.34 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary to Cattail Branch--fourth western tributary downstream of the headwaters of Cattail Branch	1.08 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary of Prong No. 2--from the start of the third order stream to the confluence with Bright-Haines Glade Branch	1.50 miles	Habitat	NPS	1998	2010		5		
				Tributary to Cattail Branch--third western tributary upstream of Salisbury Creek	1.06 miles	Habitat	NPS	1998	2010		5		
				Tributary to Tomahawk Branch--first western tributary after the headwaters	0.95 miles	Habitat	NPS	1998	2010		5		

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DE240-001	Nanticoke River	Lower Nanticoke River	4a	From the head of tide in Middleford to the MD-DE State line	15.1 miles	Bacteria	PS, NPS	1996		2006	1	2004	Bacteria, listed in 1996, delisted 2004
						Nutrients	PS, NPS	1996		1998	4a	2004	
						DO	PS, NPS	1996		1998	4a	2004	DO, Listed 1996, Delisted 2010
DE240-002	Nanticoke River	Upper Nanticoke River	5	From the headwaters of the Nanticoke River to the head of tide at Middleford	18.6 miles	Bacteria	PS, NPS	1996		2006	4a	2004	Bacteria, listed in 1996, delisted 2004, relisted 2012
						Nutrients	PS, NPS	1996		1998	4a	2004	
						DO		1996		1998	1	2002	DO, listed in 1996, delisted 2002 .
				Tributary of White Marsh Branch--first western tributary downstream of the headwaters of White Marsh Branch	0.49 miles	Habitat	NPS	1998	2010		5		
				Kent-Sussex Line Branch--from the start of the third order stream to the confluence with Nanticoke River (lower half)	1.33 miles	Habitat	NPS	1998	2010		5		
				Kent-Sussex Line Branch--from the start of the third order stream to the confluence with Nanticoke River (upper half)	1.33 miles	Biology and Habitat	NPS	1998	2010		5		
				Nanticoke Branch--from the confluence of Polk Branch to the confluence with Gum Branch	2.48 miles	Habitat	NPS	1998	2010		5		
				Grubby Neck Branch--from the confluence of Polk Branch to the confluence with Gum Branch	1.24 miles	Habitat	NPS	1998	2010		5		
				Nanticoke Branch--from the confluence of Kent-Sussex Line Branch to the confluence with Cart Branch	5.23 miles	Habitat	NPS	1998	2010		5		
				Nanticoke River--from the start of the third order stream to the confluence with Kent-Sussex Line Branch.	3.13 miles	Biology and Habitat	NPS	1998	2010		5		
				Tributary to Marsh Branch--first eastern tributary after the headwaters to its confluence	0.83 miles	Habitat	NPS	1998	2010		5		
DE240-003	Nanticoke River	Clear Brook Branch	4a	From the headwaters of Clear Brook, Friedel Prong, and Bucks Branch to the confluence with Williams Pond	12.9 miles	Bacteria	NPS	1996	2005	2006	4a	2006	Bacteria, listed in 1996, delisted 2006, relisted 2010
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	1996		2000	1	2006	DO, listed in 1996, delisted 2006.

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DE240-004	Nanticoke River	Deep Creek Branch	5	From the headwaters above Concord Pond to the confluence with the Nanticoke River, excluding Concord	5.5 miles	Bacteria	NPS	1996	2005	2006	4a	2008	Bacteria Listed 1996, Delisted 2012
						Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
						DO	NPS	2012		2000	4a		
				McColleys Branch--from the confluence of New Ditch to the confluence with Deep Creek	3.24 miles	Habitat	NPS	1998	2010		5		
				Deep Creek--from the start of the third order stream to the confluence with Deep Creek and McColleys Branch	2.51 miles	Habitat	NPS	1998	2010		5		
				Tyndall Branch--from the start of the third order stream on Stoney Creek to the confluence of Tyndall Branch and Deep Creek	5.00 miles	Habitat	NPS	1998	2010		5		
DE240-005	Nanticoke River	Gravelly Branch	5	From the headwaters of Gravelly Branch above Collins Pond to the confluence	6.5 miles	Bacteria	NPS	1996	2005	2006	1	2008	Bacteria, listed 1996, delisted 2008
						Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
				Gravelly Branch--from the start of the third order stream to the confluence with the next larger stream order	2.12 miles	Habitat	NPS	1998	2010		5		
				Prong No. 1--from the start of fourth order stream to the confluence with Gravelly Branch on Nanticoke River	0.73 miles	Habitat	NPS	1998	2010		5		
				Maple Branch-- from the start of the third order stream to the confluence with Prong No. 1	1.0 mile	Habitat	NPS	1998	2010		5		
DE240-006	Nanticoke River	Bridgeville Branch	5	From the headwaters of Bridgeville Branch to the confluence with Nanticoke River	7.2 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	1996		2000	4a	2004	
				Bridgeville Branch---from the start of the third order stream to the confluence with Nanticoke River	3.92 miles	Habitat	NPS	1998	2010		5		
DE240-007	Nanticoke River	Gum Branch	5	From the headwaters located northeast of Woodland Ferry to the confluence with	6.0 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
				Gum Branch.--from the start of the third order stream to the confluence with Nanticoke River	2.37 miles	Habitat	NPS	1998	2010		5		
DE240-008	Nanticoke River	Lewes Creek	4a	Lewes Creek, including Butler Mill Branch and Chapel Branch	10.3 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	2002		2000	4a	2004	
DE240-009	Nanticoke River	DuPont Gut	n/a	DuPont Gut has been determined by USEPA not to be Waters of the U.S. , therefore the prior listing was withdrawn in 2002. This information is provided for continuity with prior 303(d) lists.	1.0 mile	Temperature	PS	1996				2002	Temperature, listed in 1996, delisted 2002 based on new information and US EPA findings.

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DE240-010	Nanticoke River	Gum Branch on Upper Nanticoke River	5	Gum Branch--from the confluence of Stallion Head Branch to the confluence with West Branch Gum Branch	3.51 miles	Habitat	NPS	1998	2010		5		
				Toms Dam Branch--from the start of the third order stream to the confluence with Gum Branch	5.23 miles	Habitat	NPS	1998	2010		5		
DE240-L01	Nanticoke River	Craigs Pond	4a	Pond southwest of Seaford and below Butler Mill Branch	11.9 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	2002		2000	4a	2004	
DE240-L02	Nanticoke River	Concord Pond	4a	Pond east of Seaford on Deep Creek Branch	87.4 acres	Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
DE240-L04	Nanticoke River	Williams Pond	4a	Pond located in Seaford and below Middleford	100.0 acres	Nutrients	NPS	1996		2000	4a	2004	
						Bacteria	NPS	2002	2005	2006	1	2006	Bacteria, Listed in 2002, delisted 2006
DE240-L05	Nanticoke River	Hearns Pond	4a	Pond located north of Seaford on Clear Brook Branch	67.0 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
DE050-001	Broad Creek	Lower Broad Creek	5	Lower Broad Creek, including Collins and Culvert Ditch, Holly Ditch, and Rossakatum and Cooper Branches	24.8 miles	Bacteria	PS, NPS	1996	2005	2006	4a	2008	
						Nutrients	PS, NPS	1996		1998	4a	2004	
						DO	PS, NPS	2002		1998	1	2004	DO, listed 2002, Delisted 2010
				Cooper Branch--from the start of the third order stream on Rossakatum Branch to the confluence of Broad Creek	2.73 miles	Habitat	NPS	1998	2010		5		
DE050-002	Broad Creek	Tussocky Branch	5	Tributary west of Laurel, excluding Portsville and Tussock Ponds	7.9 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
				Tussocky Branch--from the confluence of Mill Creek to the confluence with Broad Creek	3.42 miles	Habitat	NPS	1998	2010		5		
DE050-003	Broad Creek	Little Creek	5	Tributary south of Laurel, excluding Horsey's Pond	2.4 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
DE050-004	Broad Creek	Chipman Pond Branch	5	Tributary northeast of Laurel, excluding Chipman Pond	6.7 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
				Jobs Ditch--from the headwaters to the confluence with Dukes and Jobs Branch	0.98 miles	Habitat	NPS	1998	2010		5		
				Mirey Branch--from the start of the third order stream to the confluence with Elliott Pond Branch	1.28 miles	Habitat	NPS	1998	2010		5		
				Dukes Ditch--from the headwaters to the confluence with Dukes and Jobs Branch	2.45 miles	Habitat	NPS	1998	2010		5		
DE050-005-01	Broad Creek	James Branch	4a	James Branch, including Pepper Pond Branch, Hitch Pond Branch, and Grays Branch	11.1 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	2002		2000	4a	2004	

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DE050-005-02	Broad Creek	Trussum Pond Branch	4a	From the headwaters to the confluence with James Branch, excluding Trussum Pond	3.5 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
				Wards Branch--from the confluence of the headwaters to the confluence with James Branch	3.18 miles	DO	NPS	1998		2000	4a	2004	
DE050-006-01	Broad Creek	Trap Pond Branch	4a	From the headwaters of Trap Pond including Saunders and Thompson	2.9 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
DE050-006-03	Broad Creek	Raccoon Prong	4a	Headwaters of Raccoon Pond and Trap pond	9.11 miles	Bacteria	NPS	2002	2005	2006	4a	2008	Bacteria, listed 2002, delisted 2006, relisted 2008
						Nutrients	NPS	2002		2000	1	2004	Nutrients, Listed 2002, Delisted 2012
						DO	NPS	2002		2000	4a	2004	
DE050-L01	Broad Creek	Portsville Pond	4a	Pond west of Laurel on Tussocky Branch	14.5 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
DE050-L02	Broad Creek	Tussock Pond	4a	Pond southwest of Laurel	8.6 acres	Bacteria	NPS	2002	2005	2006	4a	2008	
						Nutrients	NPS	2002		2000	4a	2004	
DE050-L03	Broad Creek	Horseys Pond	4a	Pond south of Laurel on Little Creek tributary	46.3 acres	Bacteria	NPS	1996		2006	1	2004	Bacteria , listed in 1996, delisted 2004
						Nutrients	NPS	1996		2000	4a	2004	
DE050-L04	Broad Creek	Records Pond	4a	Pond adjacent to Laurel	91.9 acres	Bacteria	PS, NPS	1996	2005	2006	1	2008	Bacteria, Listed in 1996, delisted 2008
						Nutrients	PS, NPS	1996		2000	4a	2004	
						DO		1996 / 2006		2000	1	2008	DO, listed in 1996, delisted 2002, relisted 2006, delisted 2008
DE050-L05	Broad Creek	Chipman Pond	4a	Pond located north of Laurel on Chipman Branch	47.0 acres	Nutrients	NPS	1996		2000	4a	2004	
						Bacteria	NPS	2002	2005	2006	4a	2008	
DE050-L06	Broad Creek	Trussum Pond	4a	Pond southeast of Laurel on James Branch	58.7 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	2002		2000	4a	2004	
DE050-L07	Broad Creek	Trap Pond	4a	Pond east of Laurel on Hitch Pond Branch	88.0 acres	Nutrients	NPS	1996		2000	1	2004	Nutrients, Listed 1996, Delisted 2012
						DO	NPS	2002		2000	4a	2004	
						Bacteria	NPS	1996		2006	1	2002	Bacteria, listed in 1996, delisted 2002
						Ammonia	NPS	2012		2000	4a		
DE050-L08	Broad Creek	Raccoon Pond	4a	Pond east of Laurel on Hitch Pond Branch	13.5 acres	Bacteria	NPS	1996	2005	2006	4a	2008	
						Nutrients	NPS	1996		2000	4a	2004	
						DO	NPS	2002		2000	4a	2004	
DE250-001	Pocomoke River	Pocomoke River	5	Pocomoke River, from headwaters to the MD-DE State line	11.8 miles	Bacteria	NPS	1996	2005	2006	4a	2008	
						DO	NPS	1996	2005	2005	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1996	2005	2005	1	2006	Nutrients, Listed 1996, Delisted 2012
				Pocomoke River--from the confluence of Bald Cypress Branch and Gum Branch to the MD-DE line	0.99 miles	Habitat	NPS	1998	2010		5		
				Pocomoke River--from start of the third order stream to the confluence with Bald Cypress Branch and Gum Branch	4.55 miles	Habitat	NPS	1998	2010		5		
DE250-002	Pocomoke River	Tributaries from the headwaters to MD-DE State line	5	Bald Cypress Branch--from the confluence of the headwaters to the confluence with the next larger stream order	3.5 miles	Habitat	NPS	1998	2010		5		
						Bacteria	NPS	2004	2005	2005	4a	2006	
						Nutrients	NPS	2004	2005	2005	4a	2006	
						DO	NPS	2006		2005	4a	2006	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
INLAND BAYS/ATLANTIC OCEAN BASIN													
DE170-001	Lewes and Rehoboth Canal	Lewes and Rehoboth Canal	4a	Tidal waters from the confluence of Delaware Bay to the confluence with Rehoboth Bay	8.9 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
						DO		1996 , 2004	2003	2004	4a	2006	DO, listed in 1996, delisted 2002 and relisted 2004.
DE280-001-01	Rehoboth Bay	Chapel Branch	5	From the headwaters of Chapel Branch to the confluence of Herring Creek, including Hopkins Prong, Unity Branch,	27.0 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996		2004	4a	2004	DO, listed in 1996, delisted 2004, Relisted 2012
				Chapel Branch--from the start of the second order stream to the confluence with Herring Creek	3.75 miles	Habitat	NPS	1998	2013		5		
DE280-002	Rehoboth Bay	Love Creek, including tributaries	4a	Love Creek, Bundicks Branch and Goslee Creek to the confluence with Rehoboth Bay	4.2 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO		1996		2004	1	2002	DO, listed in 1996, delisted 2002
DE280-E01	Rehoboth Bay	Rehoboth Bay	4a	Near coastal waters extending north from the confluence with Indian River Bay at Burton Island	12.0 sq. mi.	DO	PS, NPS	1996		1998	1	2006	DO, listed 1996, delisted 2006
						Nutrients	PS, NPS	1996		1998	4a	2004	
DE280-L01	Rehoboth Bay	Burton Pond	4a	Pond northeast of Millsboro	33.0 acres	Nutrients	NPS	1998	2003	2004	4a	2006	
DE140-001	Indian River	White Creek	4a	Saline tidal waters extending from the north end of Assawoman Canal to the Indian River Bay	4.9 miles	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, listed 1996, delisted 2008
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	4a	2008	DO, listed 1996, delisted 2008, Relisted 2010
DE140-002	Indian River	Blackwater Creek	4a	Saline tidal waters from the headwaters to the confluence with Indian River Bay	7.2 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2002	2003	2004	4a	2006	
						Nutrients	NPS	2002	2003	2004	4a	2006	
DE140-003	Indian River	Pepper Creek, including tributaries	4a	Pepper Creek including Vines Creek, McCrays Branch, and Deep Hole Branch	24.8 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	1	2006	DO, Listed 1996, Delisted 2010
DE140-004	Indian River	Indian River	4a	Saline tidal portion of river from Millsboro Pond to Power Plant intake	4.6 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996		1998	4a	2004	
						Temperature	PS, NPS	1996	1998	2004	4a	2004	EPA TMDL December 2004
						SS	PS, NPS	1996		1998	4a	2004	
						DO	PS, NPS	2002		1998	1	2004	DO, listed 2002, Delisted 2012

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE140-005	Indian River	Swan Creek	4a	Freshwater tidal river from the headwaters of Swan Creek to the confluence with Indian River	8.6 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
						Temperature							Temperature, listed in 1996, delisted in 2002 as sole point source discharger was removed
DE140-006	Indian River	Stockley Branch	4a	From the confluence of Alms House Ditch with Stockley Branch to the confluence with Millsboro Pond	8.23 miles	Bacteria	PS, NPS	1996	2006	2006	1	2008	Bacteria, listed 1996, delisted 2008
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
						DO	PS, NPS	2002		2004	1	2004	DO, listed in 2002, delisted 2004
DE140-007	Indian River	Eli Walls Tax Ditch	4a	From the headwaters of McGee Ditch, Eli Walls Tax Ditch, and Gills Branch to the confluence with Morris Millpond	13.6 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
DE140-008	Indian River	Deep Branch, including tributary	4a	Deep Branch, including Peterkins Branch, White Oak Swamp Ditch, Sockorockets Ditch, Welsh Branch, and Simpler Branch	16.9 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
						DO	PS, NPS	1996	2003	2004	4a	2006	
DE140-009	Indian River	Mirey Branch, including tributaries	5	Mirey Branch, including Sheep Pen Ditch, and Narrow Drain	23.5 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	2004	2003	2004	4a	2006	
				Mirey Branch-- from the confluence of the headwaters to the confluence with Sheep Pen Ditch	5.40 miles	Habitat	NPS	1998	2013		5		
DE140-010	Indian River	Betts Pond Branch	4a	From the headwaters of the tributaries of Ingrams Pond and Betts Pond to the confluence with Millsboro Pond,	17.5 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2002	2003	2004	4a	2006	
						Nutrients	NPS	2002	2003	2004	4a	2006	
DE140-E01	Indian River	Lower Indian River Bay	4a	From inlet to Pepper Creek	13.0 sq. mi.	Bacteria	PS, NPS	1996	2006	2006	1	2008	Bacteria, listed 1996, Delisted 2010
						Nutrients	PS, NPS	1996		1998	4a	2004	
						DO	PS, NPS	1996		1998	1	2008	DO, listed 1996, delisted 2008
DE140-E02	Indian River	Upper Indian River Bay	4a	Upper portion of estuary from power plant cooling water intake to Pepper Creek, including Island Creek	0.95 sq. mi.	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, listed 1996, Delisted 2010
						Nutrients	NPS	1996		1998	4a	2004	
						Temperature	NPS	1996	1998	2004	4a	2004	EPA TMDL December 2004
						DO	NPS	2002		1998	4a	2004	DO listed 2002, Delisted 2010, Relisted 2012
DE140-L01	Indian River	Millsboro Pond	4a	Pond north of Millsboro	126.0 acres	Bacteria	PS, NPS	1996		2006	1	2006	Bacteria, listed 1996, delisted 2006
						Nutrients	PS, NPS	1996	2003	2004	4a	2006	
						DO		1996 , 2004		2004	1	2006	DO, listed in 1996, delisted 2002 , relisted 2004 , delisted 2006

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE140-L02	Indian River	Betts Pond	4a	Pond northwest of Millsboro	80.0 acres	Nutrients	NPS	1996	2003	2004	4a	2006	
						Bacteria	NPS	1996		2006	1	2004	Bacteria, listed in 1996, delisted 2004
DE140-L03	Indian River	Ingrams Pond	4a	Pond west of Millsboro	48.0 acres	Bacteria	NPS	1996	2003	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
DE140-L04	Indian River	Morris Mill Pond	4a	Pond between Millsboro and Georgetown	44.0 acres	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
DE150-001	Iron Branch	Iron Branch	5	From the headwaters of Iron Branch and Whartons Branch to the confluence with Indian Rever	13.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	1	2008	DO, listed 1996, delisted 2008
				Whartons Ditch--from the start of the third order stream to the confluence with Whartons Branch	3.55 miles	Habitat	NPS	1998	2013		5		
						DO	NPS	1998	2013	2004	4a	2006	
						Temperature	NPS	1998	2013		5		
DE070-001	Buntings Branch	Buntings Branch	4a	From the headwaters to the MD-DE State line	4.6 miles	Nutrients	PS, NPS	1996	2003	2004	4b	2008	Delaware DNREC, EPA and MD Dept. of Environment are working cooperatively to implement the MD TMDL for the downstream portion in Delaware's portion of this shared waterbody for these
						DO	PS, NPS	1996	2003	2004	4b	2008	
						Bacteria	PS, NPS	2002	2006	2006	4a	2008	
DE350-E01	Assawoman Bay	Assawoman Bay	4a	Portion of the estuary up to the MD-DE State line	0.59 sq. mi.	Bacteria	NPS	1998	2006	2006	4a	2008	
DE180-001	Little Assawoman Bay	Little Assawoman Canal	4a	Saline tidal waters from the confluence with White Creek to the confluence with little Assawoman Bay	3.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	4a	2006	
DE180-002	Little Assawoman Bay	Miller Creek	5	From the headwaters of Miller Creek to the confluence with Little Assawoman bay	6.5 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2003	2004	4a	2006	
						Nutrients	NPS	1996	2003	2004	4a	2006	
				Beaver Dam Ditch--from the confluence of Blackwater Creek to the confluence with the next larger stream order	2.31 miles	Habitat	NPS	1998	2013		5		
DE180-003	Little Assawoman Bay	Dirickson Creek	5	From the headwaters of Dirickson Creek to the confluence with Little Assawoman bay	13.3 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	2002	2003	2004	1	2006	DO listed 2002, Delisted 2010
				Bearhole Ditch--from the confluence. of the headwaters to the confluence with Batson Branch	2.39 miles	Habitat	NPS	1998	2013		5		
				Agricultural Ditch--from the confluence of the headwaters to the confluence with Dirickson Creek	2.97 miles	Habitat	NPS	1998	2013		5		
DE180-E01	Little Assawoman Bay	Little Assawoman Bay	4a	Estuary from the confluence with Assawoman Canal to the confluence with Assawoman Bay	3.0 sq. mi.	Bacteria	NPS	1996	2006	2006	1	2006	Bacteria, Listed 1996, delisted 2006
						DO	NPS	1996	2003	2004	4a	2008	DO, listed 1996, delisted 2008, Relisted 2010
						Nutrients	NPS	1996	2003	2004	4a	2006	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DELAWARE BAY BASIN													
NA	Delaware River	DRBC Zone 5	5	From the Pennsylvania- Delaware line to Liston Point, Delaware.	59.0 sq. mi.	Bacteria	PS, NPS	1996	2005		1		Bacteria , listed in 1996, delisted 2004 based on 2004 DRBC 305(b) assessment
						PCBs	PS, NPS, SF	1996	2005	2003	4a	2006	
						Arsenic		2002			1	2006	Not a contaminant of concern in fish consumption advisories for these waters
						Dioxin		2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Mercury		2002	2016		5		TMDL Target date changed from 2011 to 2016 in the 2012 Cycle, per the WATAR plan in the appendix
						Chlorinated Pesticides		2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Chronic Toxicity (DRBC Zones 5a and 5b, 25 sq miles)	PS, NPS, SF	2002			1		Bioassays performed in 2005, 2007, and 2008 indicate no chronic toxicity in Zone 5 mainstem samples. Chronic toxicity, listed in 2002, Delisted in 2012 based on 2011 journal article.
						Iron		2004			3		Surface water levels of iron in the segment sometimes exceed the applicable criterion. The Department believes further study of surface water iron levels and a determination of whether a use impairment is resulting from those levels is an appropriate response to the available information.
NA	Delaware River	DRBC Zone 5c	5	Lower portion of DRBC Zone 5	31 sq. mi.	DO	PS, NPS	2006	2019		5		Delaware will work with the DRBC, EPA, other States and Stakeholders to develop and implement a TMDL in these waters.
DE020-001	Army Creek	Lower Army Creek	5	Segment from Route 13 to mouth at Delaware River tidal freshwater segment	3.0 miles	Nutrients		1996	2006	2006	1	2008	Nutrients, Listed 2006, Delisted 2012
						DO		1996	2006	2006	4a	2008	
						Bacteria		2002	2006	2006	1	2008	Bacteria, Listed 2002, Delisted 2010
						PCBs		2006	2015	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxin/Furans		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Dieldrin		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Toxaphene		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
				First tributary on Army Creek after the headwaters	0.73 miles	Habitat	NPS	1998	2011		5		
				Segment from Route 13 to the mouth of the Delaware River	2.00 miles	Biology and Habitat	NPS	1998	2011		5		
						Nutrients	NPS	1998	2006	2006	1	2008	Nutrients, Listed 1998, Delisted 2012
						DO	NPS	1998	2006	2006	1	2008	DO, Listed 2006, Delisted 2012
						Bacteria	NPS	2002	2006	2006	4a	2008	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE020-002	Army Creek	Upper Army Creek	5	Nontidal segment from headwaters to Route 13	1.1 miles	PCBs		2006	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxin/Furans		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Dieldrin		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Toxaphene		2006	2017		5		TMDL Target date changed from 2013 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE020-003	Army Creek	Tributary to Army Creek	4a	Unnamed Tributary to Army Creek, monitored by STORET station 114051	0.78 miles	Bacteria	NPS	2006	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
						DO	NPS	2006	2006	2006	1	2008	DO, listed 2006, delisted 2008
DE270-001-01	Red Lion Creek	Lower Red Lion	5	From U.S. Route 13 to the mouth at Delaware River	1.5 miles	DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
						Chlorinated Benzenes		1996			1	2002	Chlorinated Benzene, listed in 1996, delisted 2002 based on improved conditions.
						Bacteria	NPS	2002	2006	2006	4a	2008	
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxins	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Chronic Toxicity	NPS, PS	2012	2025		5		Listed Based on 2011 journal article. Likely cause is a federal superfund site. The Department is working with EPA on the cleanup and possible TMDL.
				First tributary downstream of Doll Run from the headwaters to the confluence with Red Lion Creek	0.91 miles	Biology	NPS	1998	2011		5		
DE270-001-02	Red Lion Creek	Upper Red Lion	5	From the headwaters to the location where Route 13 intersects Red Lion	1.9 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
				First tributary after the headwaters of Red Lion Creek	0.28 miles	Biology	NPS	1998	2011		5		
DE130-001	Dragon Run Creek	Lower Dragon Run Creek	4a	From dam at the water supply pond to the mouth of Delaware River	3.2 miles	Nutrients	NPS	1998	2006	2006	1	2008	Nutrients, Listed 1998, Delisted 2012
						DO	NPS	1998	2006	2006	4a	2008	
						Bacteria	NPS	2002		2006	1	2008	Bacteria, listed 2002, delisted 2006, relisted 2008, Delisted 2010

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE130-002	Dragon Run Creek	Upper Dragon Run Creek	5	From headwaters to water supply pond	4.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	Bacteria, Listed 1996, Delisted 2010, Relisted 2012
						DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
				From the confluence of the headwaters to the water supply dam	3.42 miles	Biology	NPS	1998	2011		5		
DE090-001	Chesapeake & Delaware Canal	C&D Canal	5	C&D Canal from the MD Line to Delaware River	15.0M	Nutrients	NPS	2002			1		Nutrients, Listed 2002, Delisted 2012
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxins	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Dieldrin	NPS	2006	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Chlordane	NPS	2006	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						DDT	NPS	2012	2017		5		
DE090-002	Chesapeake & Delaware Canal	Tributaries of Chesapeake & Delaware Canal	5	Scott Run-- from the headwaters to the confluence with Chesapeake & Delaware Canal	4.81 miles	Biology and Habitat	NPS	1998	2011		5		
						DO	NPS	1998	2006	2006	5		
				Crystal Run--from the headwaters to the confluence with Chesapeake & Delaware Canal	1.52 miles	Biology	NPS	1998	2011		5		
				Joy Run--from the headwaters to the confluence with Chesapeake & Delaware Canal	1.99 miles	Biology	NPS	1998	2011		5		
				Eastern tributary on Lums Pond--from the headwaters to the confluence with Lums Pond	1.04 miles	Biology and Habitat	NPS	1998	2011		5		
			4a	Unamed tributary referred to as "Southeast Creek", outflowing from Lums Pond to the C&D Canal	0.84 miles	DO	NPS	2012		2012	4a		
DE090-L01	Chesapeake & Delaware Canal	Lums Pond	4a	Pond south of Newark	189.3 acres	Bacteria	NPS	1996			1	2004	Bacteria, listed in 1996, delisted 2004
						Nutrients	NPS	2002		2012	1		Nutrients, Listed 2002, Delisted 2012
DE010-001-01	Appoquinimink River	Lower Appoquinimink River	5	Saline Tidal Reach, excluding Hangman’s Run	7.1 miles	DO	PS, NPS	1996		1998	4a	2004	
						Nutrients	PS, NPS	1996		1998	1	2004	Nutrients, Listed 1996, Delisted 2012
						Bacteria	NPS	2002	2006	2006	1	2006	Bacteria, listed 2002, delisted 2006
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxins	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE010-001-02	Appoquinimink River	Upper Appoquinimink	5	Freshwater Tidal Reach	6.1	Nutrients	PS, NPS	1996		1998	1	2004	Nutrients, Listed 1996, Delisted 2012
						DO	PS, NPS	1996		1998	4a	2004	
						Bacteria	PS, NPS	2002	2006	2006	4a	2008	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
		River			miles	PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxins	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE010-001-03	Appoquinimink River	Drawyer Creek	5	From the headwaters of Drawyer Creek to the confluence with the Appoquinimink River, including	8.2 miles	Bacteria	NPS	1996	2006	2006	4a	2008	Bacteria, listed 1996, delisted 2008, Relisted 2010
						Nutrients	NPS	1996		2003	4a	2004	
						DO	NPS	1996		2003	1	2008	DO, listed 1996, delisted 2008
				Tributary of Drawyer Creek--from the confluence of the headwaters to the confluence with the mainstem	2.30 miles	Biology and Habitat	NPS	1998	2011		5		
				Western tributary of the headwaters of Drawyer Creek to its confluence	2.20 miles	Habitat	NPS	1998	2011		5		
				Tidal Portion	5.45 miles	PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						DDT	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE010-002-01	Appoquinimink River	Wiggins Mill Pond to confluence with Silver Lake	5	From the headwaters of Wiggins Mill Pond to the confluence with Noxontown Pond	3.4 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996		2003	4a	2004	
						Nutrients	NPS	2002		2003	4a	2004	
				From the confluence of the headwaters of Wiggins Mill Pond to the confluence with Noxontown Pond	1.62 miles	Biology	NPS	1998	2011		5		
DE010-002-02	Appoquinimink River	Deep Creek to confluence with Silver Lake	5	From the headwaters of Deep Creek to confluence with Silver Lake, excluding Silver Lake	2.4 miles	Bacteria	NPS	2002	2006	2006	4a	2008	
						Nutrients	NPS	2002		2003	4a	2004	
						DO		1996		2003	4a	2002	DO, listed in 1996, delisted 2002 , relisted 2012
				First western tributary after the headwaters of Silver Lake	1.98 miles	Biology	NPS	1998	2011		5		
				Deep Creek.-- from the confluence of the headwaters to Appoquinimink River	1.84 miles	Biology	NPS	1998	2011		5		
DE010-L01	Appoquinimink River	Noxontown Pond	1	Pond southwest of Odessa	158.6 acres	Bacteria	NPS	1998		2006	1	2006	Bacteria, listed 1998, delisted 2006
						Nutrients	NPS	1998		2003	1	2004	Nutrients, Listed 1998, Delisted 2012
DE010-L02	Appoquinimink River	Silver Lake	5	Lake adjacent to Middletown, below Deep Creek	38.7 acres	Bacteria	NPS	1996			1	2006	Bacteria, listed in 1996, delisted 2006
						Nutrients	NPS	1996	2001		5		
						PCB	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dieldrin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						DDT	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Dioxin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE010-L03	Appoquinimink River	Shallcross Lake	4a	Lake above Drawyer Creek	43.1 acres	Nutrients	NPS	1996	2001	2003	1	2004	Nutrients, Listed 1996, Delisted 2012
						Bacteria	NPS	1996			1	2004	Bacteria, listed in 1996, delisted 2004
DE030-001	Blackbird Creek	Lower Blackbird	4a	Tidal segment from Route 13 to mouth of the Delaware River	13.8 miles	DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2002	2006	2006	4a	2008	
DE030-002	Blackbird Creek	Upper Blackbird	5	Nontidal segment from headwaters to Route 13	13.6 miles	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 1996, Delisted 2010
						DO	NPS	1996	2006	2006	4a	2008	DO, listed 1996, delisted 2008, Relisted 2010
						Nutrients	NPS	1996	2006	2006	4a	2008	
				First eastern tributary after the headwaters to the confluence with Blackbird Creek	2.19 miles	Biology	NPS	1998	2011		5		
				Upper Blackbird Creek--from the confluence of the headwaters to the confluence with Barlow Branch	2.11 miles	Biology	NPS	1998	2011		5		
				From the confluence of the headwaters to the confluence with Barlow Branch	2.27 miles	Biology	NPS	1998	2011		5		
DE030-003	Blackbird Creek	Tributaries on the mainstem	5	Sandom Branch to the confluence with Blackbird Creek (upper half)	1.16 miles	DO	NPS	2004	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	
						Biology and Habitat	NPS	1998	2011		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE310-001	Smyrna River	Lower Smyrna River	4a	From the head of tide to the Delaware River	10.2 miles	DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2002	2006	2006	4a	2008	
DE310-002	Smyrna River	Mill Creek	5	From the headwaters to Lake Como	5.2 miles	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 1996, Delisted 2010
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
						DO	NPS	2002	2006	2006	1	2008	DO, listed 2002, delisted 2008
				Providence Creek--from the confluence of the headwaters of Mill Creek to the confluence with Lake Como	2.18 miles	Biology and Habitat	NPS	1998	2011		5		
DE310-003	Smyrna River	Tributary of Smyrna River	5	Tributaries from the headwaters to the confluence with Delaware Bay	4.2 miles	Bacteria	NPS	1998	2006	2006	4a	2008	
						DO	NPS	2004	2006	2006	4a	2008	
						Nutrients	NPS	1998	2006	2006	4a	2008	
				From the confluence of the headwaters of Paw Paw Branch to the confluence with Providence Creek	2.68 miles	Biology and Habitat	NPS	1998	2011		5		
				First eastern tributary after the headwaters of Paw Paw Branch to the confluence with Smyrna River	0.86 miles	Habitat	NPS	1998	2011		5		
				Eastern tributary of the headwaters of Sawmill Branch to its confluence	0.67 miles	Biology and Habitat	NPS	1998	2011		5		
				Sawmill Branch--from the confluence of the headwaters to the next larger stream order	3.81 miles	Biology	NPS	1998	2011		5		
DE310-L01	Smyrna River	Lake Como and Duck Creek Pond	4a	Lake Como in Smyrna	82.0 acres	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2006	2006	2006	4a	2008	
DE160-001	Leipsic River	Lower Leipsic River	4a	From dam at Garrisons Lake to mouth at Delaware River	13.6 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	4a	2008	
DE160-002	Leipsic River	Upper Leipsic River	5	From headwaters to Garrisons Lake, excluding Masseys Mill Pond	5.8 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	1	2008	DO listed 1996, Delisted 2010
						Nutrients	NPS	1996	2006	2006	4a	2008	
				From the start of the third order stream on Pinks Branch to the confluence with	2.70 miles	Biology	NPS	1998	2011		5		
						DO	NPS	1998	2006	2006	4a	2008	
				Tributary of Leipsic River--from the confluence of the headwaters to the confluence with Leipsic River	0.93 miles	Biology	NPS	1998	2011		5		
DE160-003	Leipsic River	Tributary from the dam at Garrisons Lake to mouth at Delaware Bay	5	From the confluence of the headwaters of Alston Branch to the confluence Leipsic River	2.16 miles	Biology	NPS	1998	2011		5		
				Tributary of Leipsic River--eastern tributary of the headwaters to its confluence	0.91 miles	Habitat	NPS	1998	2011		5		
		Dyke Branch	4a	Dyke Branch from headwaters to confluence with Leipsic River	4.39 miles	DO	NPS	2004	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	
DE160-004	Leipsic River	Muddy Branch	4a	Muddy Branch from headwaters to the confluence with Leipsic River	5.59 miles	DO	NPS	2004	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE160-L01	Leipsic River	Garrisons Lake	4a	Lake south of Smyrna	85.9 acres	Bacteria	NPS	1996		2006	1	2006	Bacteria, Listed 1996, delisted 2006
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2002	2006	2006	1	2008	DO, Listed 2002, Delisted 2010
DE160-L02	Leipsic River	Masseys Mill Pond	1	Pond south of Clayton	30.0 acres	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 1996, Delisted 2012
						DO	NPS	1996	2006	2006	1	2008	DO, Listed 1996, Delisted 2012
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed in 1996, Delisted 2012
DE190-001-01	Little River	Lower Little River	4a	From the confluence of Upper Little River and Pipe Elm Branch with the Lower Little River to the mouth at	2.9 miles	DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2002	2006	2006	4a	2008	
DE190-001-02	Little River	Upper Little River	5	From the headwaters to the confluence with Lower Little River	5.5 miles	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 1996, Delisted 2010
						DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
				Morgan Branch--from the confluence of the headwaters to the confluence with the next larger stream order	0.60 miles	Habitat	NPS	1998	2011		5		
				Start of the third order stream near the headwaters of Little River to the confluence with Morgan Branch	4.14 miles	Biology and Habitat	NPS	1998	2011		5		
DE190-001-03	Little River	Pipe Elm Branch	4a	From the headwaters to the confluence with Little River	2.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	Bacteria, Listed 1996, Delisted 2010, Relisted 2012
						DO	NPS	1996	2006	2006	1	2008	DO, Listed 1996, Delisted 2010
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
DE290-001-01	Saint Jones River	Lower Saint Jones	5	From Old Lebanon Bridge to the mouth of Delaware Bay	8.3 miles	DO	NPS	1996	2006	2006	4a	2008	
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2002	2006	2006	4a	2008	
						Dioxin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Mercury	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Arsenic	NPS	2002			1	2006	Not a contaminant of concern in fish consumption advisories for these waters
DE290-001-02	Saint Jones River	Upper Saint Jones	5	From the dam at Silver Lake to Old Lebanon Bridge at Road 357	6.7 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	4a	2008	
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Dioxin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Mercury	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Arsenic	NPS	2002			1	2006	Not a contaminant of concern in fish consumption advisories for these waters
				Tributary of Silver Lake in Dover	0.32 miles	Habitat	NPS	1998	2011		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Polllutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
				Puncheon Branch--from the confluence of the headwaters to the confluence with the Saint Jones River	1.84 miles	Biology and Habitat	NPS	1998	2011		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE290-002	Saint Jones River	Isaac Branch	5	From the headwaters to the confluence with Saint Jones River, excluding Moores Lake	9.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO		1996		2006	1	2002	DO, listed in 1996, delisted 2002
				From the confluence of Allabands Mill Stream to the confluence with Saint Jones River	3.62 miles	Biology	NPS	1998	2011		5		
				From the confluence of the headwaters of Almhouse Branch to the confluence of Isaac Branch	2.50 miles	Biology	NPS	1998	2011		5		
				Second tributary upstream of Wyoming Lake on Isaac Branch	1.28 miles	Habitat	NPS	1998	2011		5		
				Wyoming Mill Pond	28.5 Acres	PCB	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						DDT	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE290-003	Saint Jones River	Fork Branch	5	From the headwaters to Silver Lake in Dover	7.7 miles	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 1996, Delisted 2010
						DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
				Cahoon Branch--from the confluence of the headwaters to the confluence with the next larger stream order	2.33 miles	Habitat	NPS	1998	2011		5		
				Maidstone Branch- from the confluence of the third order stream to the confluence with Cahoon Branch	3.09 miles	Biology	NPS	1998	2011		5		
				Tributary to Maidstone Branch---from the confluence of the headwaters to the confluence with Maidstone Branch	0.13 miles	Habitat	NPS	1998	2011		5		
				Fork Branch--from the start of the third order stream to the confluence with	6.24 miles	Habitat	NPS	1998	2011		5		
						DO	NPS	1998	2011	2006	4a	2008	
				From the start of the third order stream on Cahoon Branch to the confluence with Maidstone Branch	1.28 miles	Biology	NPS	1998	2011		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE290-004	Saint Jones River	Tidbury Branch	5	From below Derby Pond to the confluence with the Saint Jones River	3.8 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO		2002	2006	2006	4a	2008	
				From the confluence of the headwaters of Tidbury Creek to the confluence with Derby Pond	1.08 miles	Biology and Habitat	NPS	1998	2011		5		
				Tributary of Tidbury Creek--from the headwaters to the confluence with Tidbury Creek	0.75 miles	Habitat	NPS	1998	2011		5		
				Red House Branch--from the confluence of the headwaters to the confluence with Derby Pond	0.71 miles	Biology	NPS	1998	2011		5		
				Tidbury Creek--from the confluence with Derby Pond to the confluence with Lower Saint Jones River	4.53 miles	Biology	NPS	1998	2011		5		
DE290-L01	Saint Jones River	Moores Lake	5	Lake east of Camden	27.1 acres	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, listed 2006, delisted 2008
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	1	2002	DO, listed in 1996, delisted 2002
						DDT	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE290-L02	Saint Jones River	Silver Lake	5	Silver Lake at Dover	157.8 acres	Bacteria	NPS	1996	2006	2006	1	2008	Bacteria, Listed 2006, Delisted 2012
						Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
						PCBs	NPS	2002	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxin	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						Mercury	NPS	2002	2017		5		TMDL Target date changed from 2011 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
DE290-L03	Saint Jones River	Derby Pond	4a	Pond south of Wyoming	23.1 acres	Bacteria	NPS	1996		2006	1	2004	Bacteria, listed in 1996, delisted 2004
						Nutrients	NPS	1996	2006	2006	4a	2008	
DE220-001	Murderkill River	Lower Murderkill	4a	From the confluence with Spring Creek to the mouth at Delaware Bay	7.6 miles	Nutrients	PS, NPS	1996	2006	2001	4a	2004	
						DO	PS, NPS	1996	2006	2001	4a	2004	
						Bacteria	PS, NPS	2002	2006	2006	4a	2008	
DE220-002	Murderkill River	Spring Creek	5	From the headwaters to the confluence with Murderkill River , excluding Andrews Lake and McGinnis Pond	15.8 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						DO	PS, NPS	1996		2001	4a	2004	
						Nutrients	PS, NPS	1996		2001	4a	2004	
				Tributary of Hudson River--from the headwaters to the confluence with the next larger stream order	0.49 miles	Biology and Habitat	NPS	1998	2011		5		
				Pratt Branch--eastern tributary of the headwaters to its confluence	1.27 miles	Biology	NPS	1998	2011		5		

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE220-003	Murderkill River	Mid Murderkill River	5	From McCauley and Coursey Pond to the confluence with Spring Creek	9.2 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996		2001	4a	2004	
				Ash Gut-- from the headwaters to the confluence with the next larger stream order	1.04 miles	Biology and Habitat	NPS	1998	2011		5		
DE220-004	Murderkill River	Browns Branch	5	From the headwaters adjacent to Harrington to the confluence with McCauley Pond	8.8 miles	Bacteria	NPS	1998	2006	2006	4a	2008	
						DO	NPS	1998		2001	1	2008	DO, listed 1996, delisted 2008
						Nutrients	NPS	1998		2001	4a	2004	
						Ammonia	PS, NPS	2004		2001	4a	2004	
				Tributary of Browns Branch-- from the confuence of the headwaters wtot he confluence with Browns Branch	1.77 miles	Biology and Habitat	NPS	1998	2011		5		
DE220-005	Murderkill River	Upper Murderkill River	5	From the headwaters to the confluence with Coursey pond, excluding Killens and Coursey Ponds	7.4 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2004		2001	1	2006	DO, listed in 2004, delisted 2006
						Nutrients	NPS	1996		2001	4a	2004	
				Spring Branch--tributary on Coursey Pond	2.52 miles	Biology	NPS	1998	2011		5		
				Fan Branch--from the headwaters to the confluence with Murderkill River	2.31 miles	Habitat	NPS	1998	2011		5		
						DO	NPS	1998	2011		5		
						Temperature	NPS	1998	2011		5		
				Tributary of Black Swamp Creek--from the headwaters to its confluence	0.28 miles	Habitat	NPS	1998	2011		5		
				Beaver Dam Branch--from the confluence of the headwaters to the confluence with Murderkill River and Black Swamp Creek	2.96 miles	Biology	NPS	1998	2011		5		
				Black Swamp Creek--from the headwaters of Black Swamp to the confluence with the next larger stream	0.75 miles	Biology and Habitat	NPS	1998	2011		5		
						DO	NPS	1998	2011		5		
DE220-L01	Murderkill River	McGinnis Pond	4a	Pond east of Viola	31.3 acres	Bacteria	NPS	1998		2006	1	2006	Bacteria, listed in 1998, delisted 2006
						Nutrients	NPS	1998		2001	4a	2004	
						DO	NPS	2002		2001	1	2008	DO, listed 2002, delisted 2008
DE220-L02	Murderkill River	Andrews Lake	4a	Pond West of Frederica	17.5acres	Bacteria	NPS	2002	2006		1	2006	Bacteria, listed in 2002, delisted 2006
						Nutrients	NPS	2002		2001	4a	2004	
DE220-L03	Murderkill River	Coursey Pond	4a	Pond southwest of Frederica	58.1 acres	Nutrients	NPS	1996		2001	4a	2004	
						Bacteria	NPS	2002			1	2004	Bacteria, listed in 2002, delisted 2004

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE220-L04	Murderkill River	Killens Pond	4a	Pond southwest of Felton	75.1 acres	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996		2001	4a	2004	
DE220-L05	Murderkill River	McCauley Pond	4a	Pond northeast of Harrington	49.0 acres	Bacteria	NPS	1996			1	2004	Bacteria, listed in 1996, delisted 2004
						Nutrients	NPS	1996		2001	4a	2004	
DE210-001	Mispillion River	Lower Mispillion	4a	From dam at Silver Lake to mouth at Delaware Bay	13.2 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
DE210-002	Mispillion River	Upper Mispillion	5	From the headwaters to Silver Lake in Milford, excluding Silver, Haven, and Griffith Lakes; Blairs, Abbotts, and Tub	11.2 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996		2006	1	2006	DO, listed 1996, delisted 2006
						Nutrients	NPS	1996	2006	2006	4a	2008	
				Tantrough Branch--from the headwaters to the confluence with Blairs Pond	3.24 miles	Biology	NPS	1998	2011		5		
				Beaverdam Branch--western tributary of the headwaters to its confluence	2.69 miles	Biology	NPS	1998	2011		5		
DE210-003	Mispillion River	Johnson Branch including its tributaries	5	Johnson Branch--from the confluence of the headwaters to the confluence with Haven Lake	4.02 miles	Habitat	NPS	1998	2011		5		
						Bacteria	NPS	2006	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
DE210-004	Mispillion River	Tributary from the headwaters to Silver Lake	5	Lednum Branch---eastern tributary of the headwaters to its confluence	1.31 miles	Habitat	NPS	1998	2011		5		
						Bacteria	NPS	2006	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
DE210-005	Mispillion River	Mispillion Tributaries From Dam At Silver Lake	4a	King's Causeway Branch	2.45 miles	DO	NPS	2004	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
DE210-L01	Mispillion River	Tub Mill Pond	4a	Pond north of Milford	4.8 acres	Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2006	2006	2006	1	2008	DO, listed 2006, delisted 2008
DE210-L02	Mispillion River	Silver Lake	4a	Silver Lake at Milford	28.5 acres	Bacteria	NPS	1996			1	2006	Bacteria, listed 1996, delisted 2006
						Nutrients	NPS	1996	2006	2006	4a	2008	
DE210-L03	Mispillion River	Haven Lake	4a	Lake west of Milford; upstream of Silver Lake	82.5 acres	Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996		2006	1	2006	DO, listed 1996, delisted 2006
						Bacteria	NPS	2002		2006	1	2004	Bacteria, listed in 2002, delisted 2004
DE210-L04	Mispillion River	Griffith Lake	4a	Lake west of Milford; upstream of Haven Lake	32.2 acres	Nutrients	NPS	1996	2006	2006	4a	2008	
DE210-L05	Mispillion River	Blairs Pond	4a	Pond southwest of Milford	28.5 acres	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO		1996		2006	1	2002	DO, listed in 1996, delisted 2002
DE210-L06	Mispillion River	Abbotts Mill Pond	4a	Pond southwest of Milford	25.6 acres	Bacteria	NPS	1998		2006	1	2006	Bacteria, listed 1998, delisted 2006
						Nutrients	NPS	1998	2006	2006	4a	2008	
						DO	NPS	2002	2006	2006	1	2008	DO, Listed 2002, Delisted 2012
DE080-001	Cedar Creek	Lower Cedar Creek	4a	Tidal segment from Cedar Creek Mill Pond to mouth at Delaware Bay	8.8 miles	DO	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE080-002	Cedar Creek	Upper Cedar Creek	4a	From the headwaters to Cedar Creek Mill Pond, including Church Branch and Cedar Mill Pond, Cubbage Pond,	13.0 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	2004	2006	2006	4a	2008	
DE080-003	Cedar Creek	Slaughter Creek	4a	From the headwaters to The Confluence with Cedar Creek	7.91 Miles	DO	NPS	2004	2006	2006	4a	2008	
						Nutrients	NPS	2006	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	
						PCBs	NPS	2010	2006	2006	4a	2012	EPA TMDL for PCBS in Delaware River Zone 6 and tributaries
						Dioxin/Furans	NPS	2010	2023				
DE060-001	Broadkill River	Lower Broadkill	4a	From the confluence with Beaver Dam Creek to mouth at Delaware Bay, excluding Red Mill Pond	8.1 miles	Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2002	2006	2006	4a	2008	
DE060-002	Broadkill River	Beaverdam Creek	4a	From the headwaters to the confluence with Broadkill River	8.3 miles	Bacteria	PS, NPS	1996	2006	2006	4a	2008	
						Nutrients	PS, NPS	1996	2006	2006	4a	2008	
						DO	PS, NPS	2002	2006	2006	4a	2008	DO, listed 2002, delisted 2008, Relisted 2012
DE060-003	Broadkill River	Upper Broadkill River	5	Broadkill River from below Waggamons Pond to the confluence with Beaver Dam Creek	5.0 miles	Bacteria	PS, NPS	1998, 2006	2006	2006	1	2004	Bacteria, listed in 1998, delisted 2004 , relisted 2006, delisted 2012
						Nutrients	PS, NPS	1998	2006	2006	4a	2008	
						DO	PS, NPS	2006	2006	2006	1	2008	DO, Listed 2006, Delisted 2012
DE060-004	Broadkill River	Round Pole Branch	4a	Tributary from the headwaters to confluence with Upper Broadkill River	5.2 miles	Bacteria	NPS	1996		2006	4a	2008	Bacteria, listed 1996, delisted 2006, relisted 2008
						DO	NPS	1996	2006	2006	1	2008	DO, Listed 1996, Delisted 2012
						Nutrients	NPS	1996	2006	2006	4a	2008	
DE060-005	Broadkill River	Ingrams Branch	4a	From the headwaters to Waggamons Pond, including Diamond Pond	7.6 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	1	2008	DO, Listed 1996, Delisted 2012
						Nutrients	NPS	1996	2006	2006	4a	2008	
				Ingrams Branch-- western tributary of the headwaters	1.70 miles	DO	NPS	1998	2006	2006	4a	2008	
						Habitat	NPS	1998	2012	2006	4a	2008	
DE060-006	Broadkill River	Pemberton Branch	4a	From the headwaters to Waggamons Pond	5.0 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2006	2006	4a	2008	
DE060-007-01	Broadkill River	Lower Red Mill Branch	1	From Red Mill Pond to the confluence with Lower Broadkill River	5.3 miles	Nutrients	NPS	1996	2006	2006	1	2008	Nutrients, Listed 1996, Delisted 2012
						DO		1996		2006	1	2002	DO, listed in 1996, delisted 2002
						Bacteria	NPS	2002		2006	1	2004	Bacteria, listed in 2002, delisted 2004
DE060-007-02	Broadkill River	Martin Branch	5	From the headwaters to Red Mill Pond	1.5 miles	DO	NPS	1996		2006	1	2006	DO, listed in 1996, delisted 2006
						Nutrients	NPS	1996	2006	2006	4a	2008	
						Bacteria	NPS	2006	2006	2006	4a	2008	
				Tributary above Red Mill Pond--from start of the second order stream to the confluence with Red Mill Pond	0.06 miles	Habitat	NPS	1998	2011		5		
DE060-007-03	Broadkill River	Heronwood Branch	4a	From the headwaters to Red Mill Pond	1.0 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	4a	2008	
DE060-008	Broadkill River	Primehook Creek	5	Entire Creek	12.6 miles	Mercury	NPS	2010	2017		5		TMDL Target date changed from 2023 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix
						DO	NPS	2012	2025		5		
DE060-L01	Broadkill River	Red Mill Pond	4a	Pond located on Martin Branch	150.0 acres	Bacteria	NPS	1996		2006	1	2006	Bacteria , listed in 1996, delisted 2006
						Nutrients	NPS	1996	2006	2006	4a	2008	
						DO	NPS	1996	2006	2006	1	2008	DO, listed 1996, delisted 2008

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Polllutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DE060-L02	Broadkill River	Waggamons Pond	4a	Pond adjacent to Milton	35.0 acres	Nutrients	PS, NPS	1996	2006	2006	4a	2008	
DE060-L03	Broadkill River	Waples Pond and Reynolds Pond	4a	Ponds located on Sowbridge Branch of Primehook Creek	88.8 acres	Bacteria	NPS	1998		2006	4a	2006	Bacteria , listed in 1998, delisted 2006, Relisted 2012
						Nutrients	NPS	1998	2006	2006	4a	2008	
						DO	NPS	1998		2006	4a	2006	DO, listed 1998, delisted 2006, Relisted 2012
						Mercury	NPS	2010	2017				Mercury listing in Waples Pond Only. TMDL Target date changed from 2023 to 2017 in the 2012 Cycle, per the WATAR plan in the appendix

Table III-7 2012 303(d) List

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCE(S)	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	Year Changed from Category 5 Per 305(b) Assessment and Methodology	Notes
DELAWARE ESTUARY BASIN													
N/A	Delaware Bay	DRBC Zone 6	5	From Liston Point to the confluence with the Atlantic Ocean	782.0 sq. mi.	Bacteria	PS, NPS	1996			1		Bacteria , listed in 1996, delisted 2004 based on 2004 DRBC 305(b) assessment
						PCBs	PS, NPS, SF	1996	2005	2006	4a	2008	
						Mercury		2002	2016		5		TMDL Target date of 2012 changed to 2016 in the 2102 Cycle.
						Dioxin		2002			1	2006	Not a contaminant of concern in fish consumption advisories for these waters

KEY for Pollutant(s) or Stressor(s):

DO = Dissolved Oxygen

KEY for Probable Source(s):

NPS = Nonpoint Source(s)
PS = Point Source(s)
SF = Superfund Site(s)

KEY for CALM Code

1= Fully Supporting for this parameter
3= Information is insufficent to make a determination
4a= TMDL has been completed and approved by EPA
4b= Management Actions are expected to solve impairment
5= TMDL Needed

A WATERBODY ID highlighted in light grey is an indication no data was collected in that segment in the assessment period

Chapter Four: Public Health/Aquatic Life Concerns

State of Delaware Fish Consumption Advisory Update

Certain chemicals build up in the food chain to levels that can be harmful to human and ecological health. DNREC and DHSS collect and analyze fish from Delaware waters to monitor the extent that these chemicals accumulate in fish from Delaware waters. When elevated levels are detected, the information is shared with the public and consumption advisories are issued to notify the angling public, their families, and friends regarding contaminants in fish from affected waterways. The advisories include specific advice on the number of meals to be consumed annually and proper trimming and cooking. The goal of this advice is voluntary reduction of exposure until the contamination is sufficiently cleaned up.

The following table lists the current fish consumption advisories (recommended limitations on the consumption of particular fish species) issued jointly by the Delaware Department of Natural Resources and Environmental Control and the Department of Health and Social Services, as of 2009.

<table>
<tr><th colspan="5">2009 Delaware Fish Consumption Advisories</th></tr>
<tr><th colspan="5">Statewide Fresh Water, Estuarine & Marine Waters</th></tr>
<tr><th>Waterbody</th><th>Species</th><th>Geographical Extent</th><th>Contaminants of Concern</th><th>Advice*
One meal = 8-oz. serving for an adult and a 3-oz serving for children</th></tr>
<tr><td>All Waters NOT Specifically Listed Below</td><td>All Species NOT Specifically Listed Below</td><td>All Areas NOT Specifically Listed Below</td><td>All</td><td>No more than one meal per week</td></tr>
<tr><th colspan="5">Delaware Estuary and Tributaries</th></tr>
<tr><th>Waterbody</th><th>Species</th><th>Geographical Extent</th><th>Contaminants of Concern</th><th>Advice*
One meal = 8-oz. serving for an adult and a 3-oz serving for children</th></tr>
<tr><td>Delaware River</td><td>All Finfish</td><td>Delaware State Line to the C&D Canal</td><td>PCBs, Dioxin, Mercury, Chlorinated Pesticides</td><td>No Consumption</td></tr>
</table>

Lower Delaware River and Delaware Bay	Weakfish-all sizes; Bluefish-14 inches or less	Chesapeake & Delaware Canal to the Mouth of the Delaware Bay	PCBs	No more than one meal per month
	White Perch American Eel Channel Catfish White Catfish Bluefish-greater than 14 inches	Chesapeake & Delaware Canal to the Mouth of the Delaware Bay	PCBs, Mercury	No Consumption for women of child-bearing age and children. All others, eat no more than one meal per year
	Striped Bass	Chesapeake & Delaware Canal to the Mouth of the Delaware Bay	PCBs, Mercury	No Consumption for women of child-bearing age and children. All others, eat no more than two meals per year
Tidal Shellpot Creek	All Finfish	Governor Printz Blvd to Delaware River	PCBs	No Consumption
Non-tidal Shellpot Creek	All Finfish	All waters upstream of Governor Printz Boulevard	Dieldrin	No more than one meal per year
Army Creek and Pond	All Finfish	Entire Creek and Pond	PCB, Dioxin/Furans, Dieldrin, Toxaphene	No more than two meals per year
Red Lion Creek	All Finfish	Route 13 to the Delaware River	PCBs, Dioxin	No more than one meal per year
Chesapeake & Delaware Canal	All Finfish	Entire Canal in Delaware	PCBs, DDT, Dieldrin, Chlordane	No Consumption
Appoquinimink River	All Finfish	Tidal Portions	PCBs, Dioxin	No more than one meal per year
Drawyers Creek	All Finfish	Tidal Portions	PCBs, DDT	No more than one meal per year

Silver Lake Middletown	All Finfish	Entire Lake	PCBs, Dieldrin, DDT, Dioxin	No more than one meal per year
Saint Jones River	All Finfish	River Mouth to Silver Lake Dam	PCBs, Dioxin, Mercury	No more than two meals per year
Moores Lake	All Finfish	Entire Pond	PCBs, DDT	No more than two meals per year
Silver Lake Dover	All Finfish	Entire Pond	PCBs, Dioxin, Mercury	No more than two meals per year
Wyoming Mill Pond	All Finfish	Entire Pond	PCBs, Dioxin, DDT	No more than two meals per year
Prime Hook Creek	All Finfish	Entire Creek	Mercury	Women of child-bearing age and children should not eat more than one meal per month. All others, eat no more than two meals per month.
Waples Pond	All Finfish	Entire Pond	Mercury	Women of child-bearing age and children should not eat more than one meal per month. All others, eat no more than two meals per month
Slaughter Creek	All Finfish	Entire Creek	PCBs, Dioxin/Furans	No more than six meals per year
Christina Basin				
Waterbody	**Species**	**Geographical Extent**	**Contaminants of Concern**	**Advice*** **One meal = 8-oz. serving for an adult and a 3-oz serving for children**

Tidal Brandywine River	All Finfish	River Mouth to Baynard Blvd.	PCBs	No Consumption
Non-tidal Brandywine River	All Finfish	Baynard Blvd. To Pennsylvania Line	PCBs, Dioxin	No more than six meals per year
Tidal Christina River	All Finfish	River Mouth to Smalley's Dam	PCBs, Dieldrin	No Consumption
Non-tidal Christina River	All Finfish	Smalley's Dam to DE/MD Line.	PCBs, Dieldrin, Chlordane	No more than six meals per year
Tidal White Clay Creek	All Finfish	River Mouth to Route 4	PCBs	No Consumption
Non-tidal White Clay Creek	All Finfish	Route 4 to DE/PA Line	PCBs	No more than one meal per month
Red Clay Creek	All Finfish	State Line to Stanton	PCBs, Dioxin, Chlorinated Pesticides	No more than six meals per year
Little Mill Creek	All Finfish	Creek Mouth to Kirkwood Highway	PCBs	No Consumption

Stocked Trout				
Waterbody	**Species**	**Geographical Extent**	**Contaminants of Concern**	**Advice*** **One meal = 8-oz. serving for an adult and a 3-oz serving for children**
Christina Creek	Stocked Trout	Rittenhouse Park to DE/MD Line	PCBs, Dieldrin	No more than six meals per year

Designated Trout Streams and Ponds other than Christina Creek	Stocked Trout	Designated Trout Stocking Areas are listed in the Delaware 2009 Fishing Guide: http://www.fw.delaware.gov/Fisheries/Documents/2009fishingguidewebfinal.pdf	PCBs	No more than one per month
Delaware Atlantic Coastal Waters including Delaware Inland Bays				
Waterbody	**Species**	**Geographical Extent**	**Contaminants of Concern**	**Advice*** **One meal = 8-oz. serving for an adult and a 3-oz serving**
Delaware Atlantic Coastal Waters including Inland Bays	Bluefish-14 inches or less	Coastal Delaware from Mouth of the Delaware Bay Southward to MD/DE Line	PCBs	No more than one meal per month
	Bluefish-greater than 14 inches	Coastal Delaware from Mouth of the Delaware Bay Southward to MD/DE Line	PCBs, Mercury	No Consumption for women of child-bearing age and children. All others, eat no more than one meal per year
	Striped Bass	Coastal Delaware from Mouth of the Delaware Bay Southward to MD/DE Line	PCBs	No Consumption for women of child-bearing age and children. All others, eat no more than two meals per year

Notes:

1. The pollutant listed first is of the greatest concern in this system.

2. Proper trimming and cooking of fish can reduce but not eliminate the risk associated with PCBs, dioxins, and chlorinated pesticides. Trimming and cooking does not reduce the risk associated with mercury.

* Do not add meal restrictions together. The advice for different species and different water bodies should not be combined.

The contaminant of primary concern for these advisories is polychlorinated biphenyl (PCB). To a lesser degree chlorinated pesticides, dioxins and mercury have been identified as contaminants of concern. PCBs have been designated as probable human carcinogens by the EPA, are believed to affect the immune system and have been linked to developmental problems in infants. PCBs were banned in the 1970s but are extremely persistent in the environment. PCBs are found in bottom sediments and continue to enter Delaware waters from upland sources, though not at an increasing rate. Data collected to date show that PCBs in fish are not an imminent public health threat, though they are a significant, avoidable exposure. Exposure may be avoided by eating fish from uncontaminated waters. Delaware will continue to monitor the situation and coordinate work between and within agencies to coordinate remediation activities.

National Methylmercury Fish Consumption Advisory

On January 12, 2001, EPA and the Food and Drug Administration (FDA) issued concurrent national fish consumption advisories recommending restricted consumption of freshwater coastal and marine species of fish due to methylmercury contamination. EPA’s advisory targeted women of childbearing age and children who may be consuming noncommercial freshwater fish caught by family or friends. The advisory specifically recommends that women who are pregnant or could become pregnant, women who are nursing a baby, and their young children, should limit consumption of freshwater fish caught by family and friends to one meal per week unless the state health department has different advice for the specific waters where the fish are caught. For adults, one meal is six ounces of cooked fish or eight ounces uncooked fish; for a young child, one meal is two ounces of cooked fish or three ounces of uncooked fish.

The FDA issued advice on mercury in fish bought from stores and restaurants, which includes ocean and coastal fish as well as other types of commercial fish. The advice was that women who are pregnant or could become pregnant, nursing mothers, and young children, not eat shark, swordfish, king mackerel, or tilefish. FDA also advises that women who are pregnant or could become pregnant may eat an average of 12 ounces of fish purchased in stores and restaurants each week. EPA recommends that women who are or could become pregnant, nursing mothers, and young children follow the FDA advice for coastal and ocean fish caught by family and friends. EPA and FDA both recommend that the public check with state or local health authorities for specific consumption advice about fish caught or sold in the local area. The EPA and FDA advisories are available through the EPA fish advisory website.

Shellfish and Recreational Waters Program

Shellfish Program

Delaware, along with 26 other states, and nine foreign countries, is a member of the Interstate Shellfish Sanitation Conference (ISSC), administrative body of the National Shellfish Sanitation Program (NSSP). The ISSC is a tripartite organization, with the membership including state participants, the U.S. Food and Drug Administration, and the shellfish industry. Member-states / countries establish water quality and pollution source parameters for determining the safety of shellfish for human consumption. Additionally, parameters are established for sanitation in harvesting, processing, and shipping shellfish (molluscan bivalves).

DNREC's role is to maintain Delaware's NSSP conforming status, as per FDA scrutiny (annual Program evaluations), thereby allowing Delaware to ship and receive shellfish. This is necessary for the preservation of Delaware's shellfish industry. Additionally, and most importantly, this ensures a safe product for the shellfish consumer.

Recreational Water (beach monitoring) Program

DNREC also ensures that natural bathing beaches are safe for swimming. Of particular concern are viruses shed by humans. Delaware uses total enterococci as an indicator of possible human fecal contamination. As is the case with the Shellfish Program, there is a qualitative component in the assessment of the risk to swimmers. Enterococci in the presence of possible sources of human fecal contamination may represent an unacceptable health risk. However, there is an increasing body of evidence, including studies conducted in Delaware, that so-called indicator bacteria are ubiquitous in the environment. Delaware's standards are based on Delaware-specific bacteria and illness data, and reflect a threshold swimming advisory level of 12.5 illnesses per 1,000 swimmers. The actual prevailing risk may be in the range of two in 100,000. Guarded beaches are tested weekly from mid-May to Labor Day.

Part IV: Wetlands Assessment

Introduction

Wetlands comprise a significant portion of the water resources of Delaware covering over 300,000 acres of the state. Throughout the state a wide diversity of wetland types occur including both tidal and nontidal wetlands. While some wetlands are directly connected or adjacent to other surface waters such as salt marshes and floodplains, others occur as isolated areas surrounded by uplands such as forested flats and Delmarva Bays. Preserving the abundance, quality, diversity and proportion of different types of wetlands in the landscape is essential to protecting the natural resources and waters of Delaware. Currently the State of Delaware is actively working in each of these areas to protect our high quality wetland resources and restore degraded systems on the watershed scale.

Delaware Wetlands Conservation Strategy

The Delaware Wetlands Conservation Strategy is an initiative to protect and restore Delaware wetlands while continuing biological research and public education endeavors and was adopted by the Department in 2008. This strategy will guide the efforts of State agencies to improve Delaware's wetland resources through increased agency coordination, data availability, education, monitoring, and restoration efforts. Goals will be implemented over the next five years and will be reevaluated in 2013. Funding from federal grants, state sources, and cost-share opportunities will be vital and will serve as the catalyst for this strategy's success.

Access to the entire Delaware Wetlands Conservation Strategy in PDF format is available on the new Delaware Wetlands website at http://www.dnrec.delaware.gov/Admin/DelawareWetlands.

Functions and Values of Wetlands

Wetlands perform a variety of functions including surface and subsurface water exchange, surface and subsurface water storage, sediment retention, nutrient cycling, organic carbon export, providing faunal and flora habitat, maintaining intact food webs, and maintaining interspersion and connectivity in the landscape. Because wetlands are diverse and occur in a variety different ecosystems, they do not all perform the same functions therefore, it is generally difficult to determine a wetland's function without a specific site analysis. Variables to consider in assessing wetland function include: wetland type, landscape position, vegetation, soils, hydrology, size, adjacent land use, and human disturbance.

In contrast to function, wetland value is determined by the usefulness of the wetland and the functions it is performing to humans. According to Wohlgemuth (1991), wetlands offer three broad categories of values: fish and wildlife habitat values, environmental quality values and socioeconomic values. The location of the wetland, human pressures on it, or the size of the wetland may indicate the value of a functional ecological process (Mitch and Gosselink, 1986). For example, clean water associated with wetlands provides drinking water to upland species, and provides an uncontaminated environment necessary for many fish species, and ultimately, recreational value in the form of hunting and fishing for humans. Because wetland values are determined by their benefit to humans, a wetland in one locality may be more highly valued than a wetland performing the same function in another locality.

Fish and Wildlife Habitat

Wetlands provide food and habitat for a variety of terrestrial and aquatic species including fish, birds, mammals, amphibians, reptiles, and invertebrates. Some of these animals are either fully or partially dependent on wetlands to complete their lifecycles. Most Commercially important fish species, for example, are wholly dependent on wetlands for spawning and nursery areas. Wetlands also provide breeding, feeding, and nesting habitats for a variety of waterfowl species and furbearers. Some species of frogs, toads, and salamanders depend on wetland habitat for their survival, and provide food for animals in higher trophic levels. Reptiles, such as turtles and snakes, use these areas for the same reasons as the above. Invertebrates such as aquatic insects are important in the maintenance of the food web.

Environmental Quality Benefits

Wetlands are considered among the most productive ecosystems in the world. Wetland plants produce more plant material than most very productive cultivated farm fields. Wetland plant communities sustain a high diversity of plant species including a large number of rare and threatened species in Delaware. Additionally, when the plants die and are broken down into detritus by bacteria and other microorganisms, they form the base of the food web that supports higher animals such as commercial fish species. Wetlands also help maintain and improve water quality. The following are specific environmental quality benefits of wetlands:

Pollutant removal (heavy metals, pathogens)

Sediment trapping

Nutrient uptake and recycling

Oxygen production

Socioeconomic Values

Some of the functions that wetlands perform are economically valuable, such as protection from flood and storm damage. Because these benefits provide dollar savings, they tend to be more appreciated.

The following are some socioeconomic wetland values:

Flood and storm water damage protection

Erosion control

Water supply and ground water recharge

Natural products supply (e.g., timber, fish, wildlife, firewood… etc.)

Recreation (e.g., waterfowl, fishing, boating, nature study… etc.)

Wetland Quantity

Estimates of wetland acreages have changed as more technologically refined techniques have been developed over the last couple of years. Until the advent of this higher resolution color aerial infrared photography, it was found that much of the wetland land base was underestimated. In fact, previous estimates by Tiner (1985) assessed 221,800 total acres of tidal and nontidal wetlands in Delaware, while a recent estimate by the same author realized a more refined estimate of 353,868 (Tiner 2002). The higher figure reported in the latter estimate can, however, be attributed in part to the inclusion of 29,000 acres of nontidal agricultural wetlands that were intentionally omitted in the previous assessment effort (See table 1).

Table V-1. Current tidal and nontidal Delaware wetland acreage estimates (Tiner 2002).

Tidal wetlands	127,338
Nontidal wetlands*	226,530
Total wetland acreage	353,868

* Includes 29,000 acres of nontidal agricultural wetlands

I.2.1 The Statewide Wetland Mapping Project (SWMP) and Wetland Trends in Delaware (1981/2-1992)

In an attempt to improve existing wetland inventories, the State Wetlands Mapping Project (SWMP) was conceived as a collaborative effort between the Delaware Department of Natural Resources (DNREC), Delaware Department of Transportation (DELDOT), and the United States Fish and Wildlife Service (USFWS; Pomato 1994). Utilizing aerial color digital orthophotography, the SWMP maps (derived from same named project), employ a modified Cowardin et. al. (1979) hierarchical classification scheme for classifying Delaware's wetlands. These aerial color photographs provide higher level resolution "wetland signatures" than the older monochromatic National Wetlands Inventory (NWI) maps, which increases the precision and accuracy of wetland delineation, identification of vegetative types (e.g., broad-leaved deciduous, broad-leaved evergreen…etc), and the identification of hydrologic regimes (e.g., A, B, C…etc.).

Utilizing color infrared aerial photography for the decade-long time period (1981/2-1992), the service assessed statewide wetland losses, gains, and changes in wetland type by photo interpretation of "wetland signatures." Wetland trends were also assessed separately in the following four drainage basins: 1) Northern Piedmont, 2) Delaware Bay, 3) Chesapeake Bay and, 4) Inland Bays.

Statewide Wetland Losses (1981/2-1992)

Approximately 2000 acres of vegetated wetlands were destroyed from 1981/2 to 1992 time period. Most of the wetland losses were palustrine vegetated wetlands (1890 acres), while estuarine wetlands losses were minor. (106 acres; Tiner et al. 1999).

Agricultural activities had the greatest impact on Palustrine wetland losses (954 acres). Residential activities also destroyed significant amounts of wetlands (436 acres). The remaining wetland losses were derived from pond and road construction practices, with each being responsible for 7 percent of the losses. Palustrine vegetated wetlands accounted for 95 percent of all wetland losses in Delaware. Palustrine forested wetlands experienced the bulk of losses of all palustrine vegetated types (1505 acres; Tiner et al. 1999). Most of the losses to estuarine wetlands were due to saltwater impoundments (52.2 acres). Filling in wetlands also accounted for some significant acreage losses (32.7acres). Highway road projects and residential development accounted for the balance of estuarine wetland losses (11 acres; Tiner et al. 1999).

Northern Piedmont Drainage Wetland Losses

The Northern Piedmont drainage is the smallest and most urbanized drainage basin in the state. About 9 percent of the state's land area fall within this drainage basin, which contains approximately 3.2 percent of the state's wetlands.

During this decade-long study period (1981/2-1992), palustrine vegetated wetlands experienced the greatest losses. These wetland s declined by 137.8 net acres. Of all palustrine vegetated types, palustrine forested wetlands experienced the greatest losses, with about 110 acres or 75 percent of total palustrine vegetated wetland being converted to uplands. Residential and Industrial development were the leading causes attributed to their destruction of 70 percent and 18 percent, respectively. (Tiner et al. 1999).

Estuarine wetlands were not subject to the same degree of destruction as palustrine wetlands during the decade long study period. Approximately 1 acre of wetlands was destroyed by conversion to industrial development, or impounded estuarine deepwater habitat (Tiner et al. 1999).

Delaware Bay Drainage Wetland Losses

The Delaware Bay Drainage is the largest drainage in Delaware. About 41 percent of the state's land area fall within this drainage basin, which also contains approximately 34 percent of the state's wetlands. From 1981/2-1992, palustrine vegetated wetlands experienced the greatest losses (679.2 acres), though estuarine wetlands experienced lesser, though not insignificant losses (78.4 acres; Tiner et al. 1999).

The primary agent in palustrine vegetated wetland destruction was residential development, accounting for about 35 percent of the losses. Agriculture and Highway road construction accounted for the remainder of the losses – about 28 percent and 10 percent, respectively (Tiner et al. 1999).

From 1981/2-1992, estuarine wetlands experienced net losses only second to palustrine vegetated wetlands (78.4 acres). The primary cause of their losses was conversion to estuarine open water impoundments and dredged channels (36.8 acres), miscellaneous filling practices (37.4 acres; Tiner et al. 1999).

Chesapeake Bay Drainage

The Chesapeake Bay drainage is the second largest drainage in Delaware (approximately 32 percent), and contains the greatest percentage of wetlands (approximately 54 percent) of the four drainages. Palustrine vegetated wetlands are the predominant wetland system type found in this basin. About 712 acres of palustrine vegetated wetlands, or 84 percent of these wetlands, were lost due to agricultural expansion during the 1981/2-1992 study period. Significant acreages of estuarine vegetated wetlands are not found in this basin (Tiner et al. 1999).

Most of the palustrine vegetated wetland losses were palustrine forested wetlands. Approximately 701 acres of these wetlands were destroyed during the 1981/2-1992 study period. Agricultural operations were responsible for 82 percent of the losses of this wetland type (Tiner et al. 1999).

Inland Bays Drainage

The Inland Bays Drainage is comprised of three coastal bays: Indian River Bay, Rehoboth Bay, and Little Assawoman Bay. This drainage comprises about 18 percent of Delaware's surface land area and contains both Palustrine and Estuarine wetlands. Consistent with the other three drainages, Palustrine vegetated wetlands experienced the greatest losses (Tiner et al. 1999).

A loss of 271.3 acres of palustrine vegetated wetlands were recorded during the 1981/2-1992 time period, of which forty-eight percent were directly attributed to agricultural operations. The remainder of the losses were agricultural and residential – about 20 percent and 24 percent, respectively (Tiner et al. 1999).

Forested wetlands bore the brunt of these losses. About 254.3 acres of forested wetlands were lost during the 1980s, which represents 90 percent of the drainage's palustrine vegetated wetland base. Palustrine deciduous forests experienced the greatest losses, with 178.4 acres converted to uplands or 70 percent of the palustrine forested wetland base. Agricultural activities were responsible for 38 percent of the total losses. Residential development and pond construction accounted for remaining wetland losses, 33 percent and 26, respectively (Tiner et al. 1999).

Wetland Quality

The State of Delaware is committed to assessing its wetland resources to understand the current condition of the resource and how this condition is changing over time. Understanding the condition of wetlands will allow the State and other conservation partners to better direct resources aimed at restoration and protection efforts to avoid impacts that will further lower the condition of wetlands and promote restoration of impacted wetlands. The goal of the Wetland Monitoring and Assessment Program (WMAP) of the Delaware Department of Natural Resources and Environmental Control (DNREC) is to assess the condition or health of wetlands and the functions and ecosystem services that wetlands provide. This information is then be used to inform the citizens of Delaware and to improve existing education, restoration, protection, and land use planning efforts. The Delaware Wetland Monitroing Strategy guides future efforts of the WMAP in the areas of protocol development, wetland monitoring and assessment activities, research, and application of information.

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Wetlands and Total Maximum Daily Load (TMDL) Regulations

As noted above, wetlands processes can be important in the removal and mitigation of excessive sediment, nutrients, and other pollutants. These pollutants have a direct bearing on the quality of water in the receiving waterbody. Delaware has recently enacted TMDL regulations to improve water quality in waterbodies that are not meeting their designated uses. The Department believes active preservation and restoration of high quality wetlands will be important components of a successful TMDL implementation process.

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Wetland Condition in the Nanticoke River Watershed (Maryland and Delaware)

The Maryland Department of Natural Resources (MD DNR) and the Delaware Department of Natural Resources and Environmental Control (DNREC) along with the Smithsonian Environmental Research Center, The Nature Conservancy and multiple other public and private groups collaborated to assess the condition of freshwater nontidal wetlands in the Nanticoke watershed. The goal of this project was to obtain baseline information on the condition of these wetlands and to gain an understanding of the stressors that are impacting wetland condition to target wetland protection and restoration activities.

The condition of nontidal wetlands in the Nanticoke River watershed was assessed using a probabilistic sampling design developed by EPA Ecological Monitoring and Assessment Program (EMAP). This approach allowed us to correct for biases due to access to sites and extrapolate the sample results to the entire population of wetlands in the watershed. We gained access to 67% of the privately owned sites to sample a total of 191 sites (54 riverine sites in 1999 and 2000, 89 flats in 2000 and 48 depressions in 2003). Additionally, we sampled 2 farmed wetlands and 4 excavated wetlands that were selected by EMAP but were not part of the target population and 29 restored wetlands that were randomly selected based on an inventory of restoration projects.

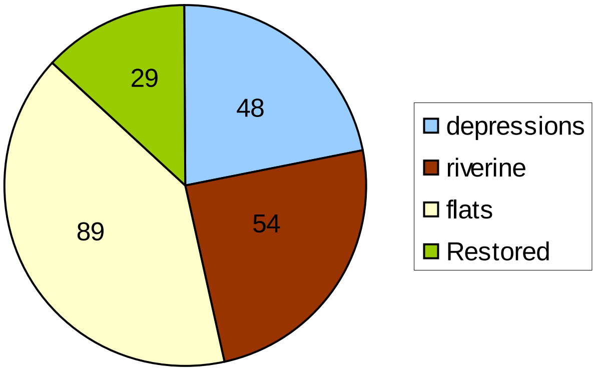

Figure 1 – number of random wetland sites sampled in the Nanticoke River watershed

Hydrogeomorphic (HGM) models were used to assess 5 functions for flat, riverine, and depressional wetlands.

> Maintenance of characteristic hydrology – the ability of a site to maintain typical water level fluctuations as compared reference sites of similar wetland type. Hydrology is the driver behind all other wetland functions and determines the capacity of a wetland to perform these functions.
>
> Biogeochemical cycling and storage – the ability of a wetland to perform biological and chemical processes such as nutrient cycling, carbon sequestration, and sediment storage as compared to reference sites of similar wetland type.

Plant community integrity – the ability of a wetland to support characteristic native vegetation as compared to reference sites of similar wetland type. The plant community in turn supports other processes and ecosystem services such as wildlife habitat, nutrient cycling and biodiversity.

Wildlife habitat integrity – the ability of a site to support characteristic wildlife species as determined by the structure of the vegetation and other physical characteristics of the site.

Buffer integrity – the condition of the adjacent habitat surrounding the wetland. Buffers in better condition provide protection of the wetland from stressors that can degrade all other functions and also provide linkages to other habitats such as uplands and streams to connect animal and plant populations and sustain processes that span large areas such as removal of nutrients.

HGM functions are composed of variables that are scaled to reference conditions in the Nanticoke River watershed and surrounding areas. Additionally, an index of wetland condition (IWC) was calculated that combines the strongest variables to produce an overall score of condition. Breakpoints in the IWC scores were determined to categorize sites into three condition classes: minimally or not stressed, moderately stressed, and highly stressed. To provide wetland protection and restoration recommendations, we used general patterns of wetland condition based on the scores of multiple functions at a site.

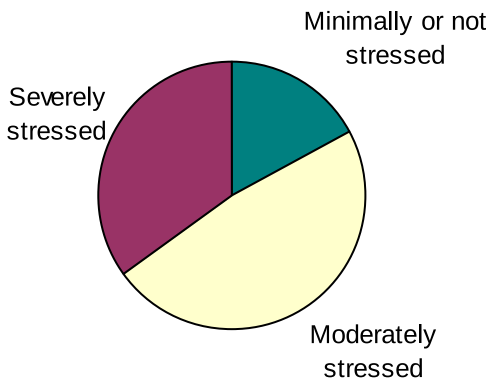

Figure 2. Condition of nontidal wetlands in the Nanticoke River watershed as determined by the Index of wetland condition

Overall, 17% of the nontidal wetlands in the Nanticoke River watershed are considered minimally or not stressed based on the IWC, 48% were moderately stressed and 35% were highly stressed. All wetland types had a low percent that were minimally altered for both hydrology and vegetation (16% of the riverine wetland area, 8% of flat wetland area, and 6% of depressions) indicating the need to prioritize protection efforts on the few minimally impacted wetlands that remain.

Flats are the dominant wetland type comprising 71% of the wetlands in the watershed. Fifteen percent of flats were minimally or not stressed and 34% were highly stressed. The average functional scores varied with the plant community integrity having the lowest of 51% of reference condition whereas the buffer integrity function was performing the best at 90% of reference condition. The average wildlife habitat function score was 63 and the average plant community integrity function score was 50. Dominant stressors impacting wetlands and lowering condition were hydrology alterations due to ditching and vegetative alterations due to forestry practices, which alter species structure and composition.

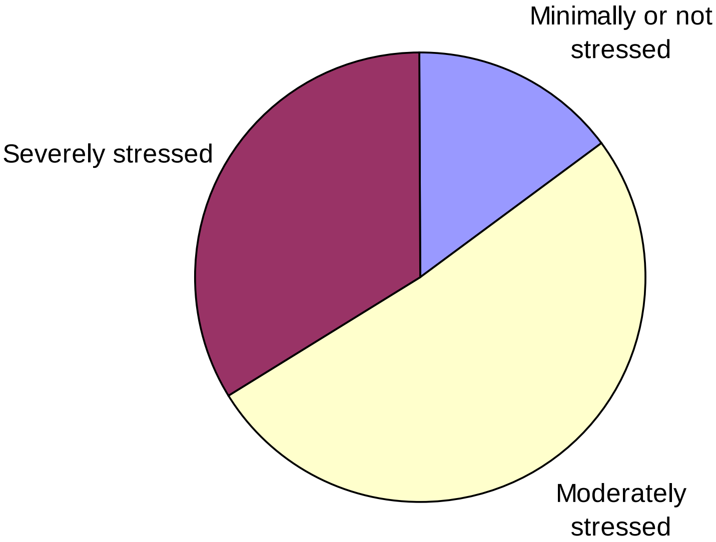

Figure 3. Condition of flat wetlands in the Nanticoke River watershed as determined by the Index of Wetland Condition.

Within flat wetlands, 58% of the wetland area has species composition and vegetative structure alterations that was not related to hydrologic alterations. Many of the vegetative alterations are due to the conversion of the native mixed hardwood forests to loblolly pine plantations, which alters species composition and structure of the vegetation community. Restoration for the flats subclass should focus on restoring a native vegetative community with a hydrology that is sustainable given current landscape level alterations. Enhancement of existing wetlands and re-establishment of former wetlands should focus on improving and increasing areas within and adjacent to large forest blocks.

The IWC for riverine wetlands averaged 69 with 30% of the riverine wetlands considered minimally or not stressed and 25% highly stressed. Biogeochemical cycling was functioning the lowest at an average of 45% of reference while the plant community integrity had the highest average function of 84. The wildlife habitat integrity and plant community integrity were functioning at higher levels compared to the flats because of lower incidence of direct alteration by agriculture, forestry, and development. The dominant stressor to riverine wetlands was hydrologic alteration due to stream channelization. In the watershed, 86% of the nontidal streams are either channelized or ditched.

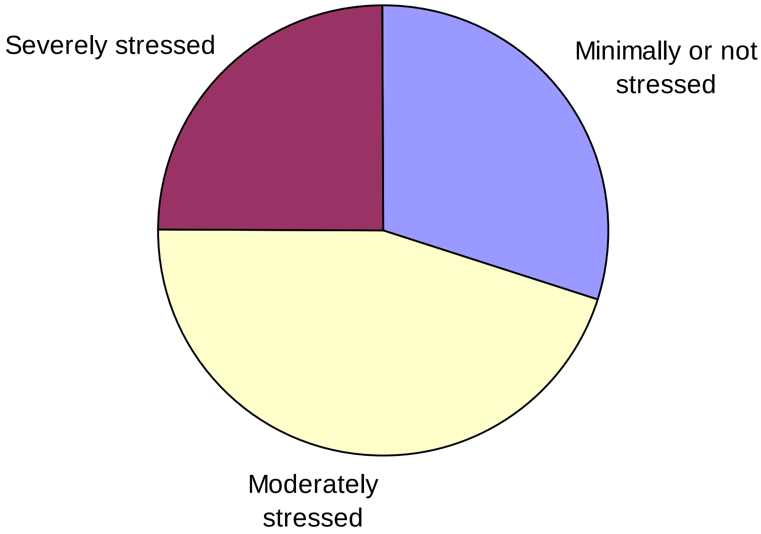

Figure 4. Condition of riverine wetlands in the Nanticoke River watershed as determined by the Index of Wetland Condition

The hydrology of 80% of the area of riverine wetlands is impacted primarily by channelization of streams, road crossings and dams. Of the riverine wetlands that had hydrologic impacts, 61% of these areas also had vegetative alterations. However, if the hydrology of the wetlands remained intact, only 4% of the wetlands had vegetative alterations. Therefore, riverine wetland restoration should focus foremost on hydrologic improvements. Sites that do not have species composition alterations (33%) should be targeted first to restore the hydrology before species composition shifts occur or non-native and invasive species become established.

Depressions had that highest levels of degradation compared to reference. They had an average IWC of 62 with only 22% of the wetlands minimally or not stressed and 44% highly stressed. The functions of depressions are significantly altered from reference standard condition with the average function values ranging from 58 for plant community integrity to 70 for buffer integrity. These low scores compared to reference standard condition for all functions are due to multiple stressors that are impacting depressions and affecting all parts of the system.

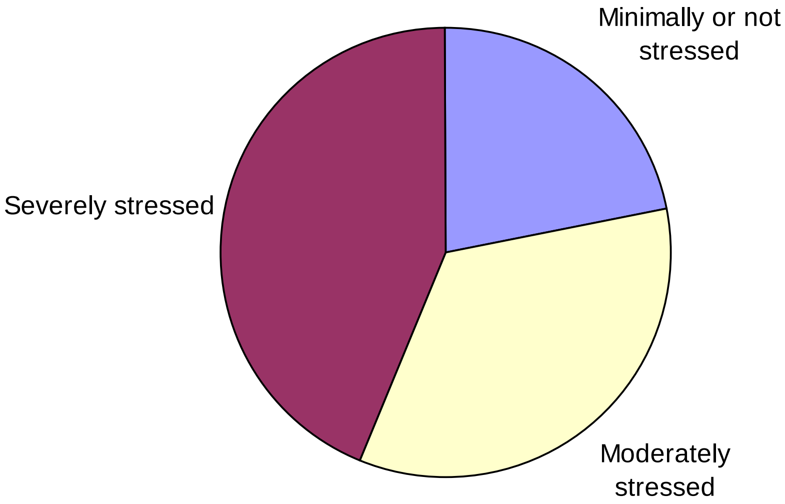

Figure 5. Condition of depressional wetlands in the Nanticoke River watershed as determined by the Index of Wetland Condition

Depressions have the highest levels of hydrologic and vegetative stressors and thus lowest condition of non-tidal wetlands in the watershed. Forty-two percent of the wetlands had altered hydrology and vegetative structure, and species composition shifts. Many of these wetlands are impacted by major stressors such as excavation, plowing, or extensive ditching. Restoration of depressional wetlands should be targeted on an individual site basis and within a larger landscape context to support the unique amphibian and bird species that rely on these unique wetland habitats.

All of the restored wetlands had increased function compared to farmed and excavated wetlands. However, the average IWC for restored wetlands was 26.5 and ranged from 10.0 to 47.8 which is a similar level of function as highly stressed natural wetlands. The low condition of restored wetlands reflects the lack of a mature vegetative community most notably trees due to the age of the sites (1 to 7 years post construction) or to the maintenance of early successional communities. We would expect the function scores to increase over time if natural successional processes are not inhibited.

Wetland restoration and protection activities need to be integrated into larger landscape level plans to ensure the ability of wetlands to perform functions and provide ecosystem services. To this end, three strategies are recommended in the following priority: protection, enhancement of existing wetlands, and restoration of former wetlands. These strategies are currently being combined into a restoration strategy for the Nanticoke Watershed by a multi-disciplinary team of wetland scientists and managers.

Protecting wetlands through fee simple acquisitions and conservation easements should be the highest priority strategy for maintaining wetland functions and services in the Nanticoke River watershed. Integrating protection of wetlands that are minimally or least stressed and their associated buffers with existing landscape conservation plans will ensure that these systems will remain in tact and be able to provide associated functions.

Enhancement activities should be used to increase the condition of these wetlands by reducing or eliminating the dominant stressors that are impacting different wetland types. These activities will likely produce a greater increase in function in the short term with less effort than attempting to restore former wetlands.

Restoring former wetlands is critical because it increases the acreage of wetlands in the watershed to recover functions from areas that have been effectively drained or changed to non-wetland habitats. Restoration of former wetlands also increases function from pre-restoration levels. More information is needed to understand the functions and services they provide and how these differ from natural wetlands. When restoring former wetlands, data from natural wetlands should be used as guidance during construction to ensure projects will be sustainable in the current landscape.

The full report, "Jacobs, A.D. and D.F. Bleil. 2008. Condition of nontidal wetlands in the Nanticoke River Watershed, Maryland and Delaware. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Dover, DE 78pp" downloadable at: http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Pages/NanticokeWatershed.aspx or can be obtained from DNREC/ Division of Water Resources, Watershed Assessment Section, 820 Silver Lake Blvd., Ste 220, Dover, DE 19904 or by calling 302-739-9939.

Wetlands Condition of the Inland Bays Watershed

Volume 1: NonTidal Wetlands

The Delaware Department of Natural Resources and Environmental Control (DE DNREC) and The Center for the Inland Bays assessed the condition of freshwater nontidal wetlands in the Inland Bays watershed. The goal of this project was to report on the condition of these wetlands across the watershed and identify the stressors that are impacting wetland condition in order to guide wetland protection and restoration activities. Tidal wetlands (meso- to polyhaline tidal fringe) were assessed in 2008 and will be included in Volume II of this report in 2009.

Wetlands perform a variety of functions related to hydrology, nutrient cycling and storage, and the plants and wildlife that inhabit these areas. These functions support ecosystem services to the watershed such as reducing flooding, maintaining stream flows, preventing erosion, improving water quality by removing nutrients and pollutants, providing habitat for wildlife, and sustaining globally rare plant species. Large portions of historic nontidal wetlands in the Inland Bays have been lost to date, over 60% in several subwatersheds, which makes existing wetlands even more important. Understanding the condition of wetlands on a local scale and how this affects the functions and services that they provide is needed to better direct the State and its conservation partners to allocate resources for wetland restoration and protection efforts across the Inland Bays watershed.

We assessed the condition of nontidal wetlands in the Inland Bays watershed using a probabilistic sampling design developed by EPA Ecological Monitoring and Assessment Program (EMAP). This approach allowed us to correct for biases due to site access and allowed us extrapolate the sample results to represent the entire population of wetlands in the watershed. We reported on the two most prevalent nontidal wetland subclasses (flats and riverine) in the

Inland Bays. Riverine wetlands adjacent to natural streams provide storage for overbank flow, subsurface water, and precipitation. Interactions with surface water improve water quality and reduce downstream flooding (DE DNREC 2001, NRCS 2008). Flat wetlands, are typically located at the headwaters of the watershed and the interfluvs between streams, have poor vertical drainage and are fed by precipitation and groundwater. In the Inland Bays watershed, the majority of flats are in the poorly drained southern portion. These wetlands can absorb heavy precipitation and filter water slowly to surface and groundwaters, prevent flooding downstream, improve water quality, and provide wildlife habitat in large forested areas (DE DNREC 2001, NRCS 2008).

From a pool of randomly selected wetlands across the watershed we attempted to access 386 riverine and flat nontidal wetland sites on public or private land in 2005 and 2006. Overall, we had a 66% rate of success for gaining access to

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the wetlands in the watershed. From 137 privately owned riverine sites we attempted to access, 9% were denied by the landowner, 41% of landowners did not respond to our request, and 50% granted access. Of our 50 sampled riverine sites, 84% were on private land and 16% were on public land. From 101 privately owned flats sites, 32% were denied by the landowner, 29% did not respond and 40% granted access. Of the 49 sampled flats sites, 51% were on private land, 37% were in a private conservation area known as the Cypress Swamp and 12% were on public land.

We sampled 50 nontidal riverine sites and 49 nontidal flats wetlands using the Delaware Rapid Assessment Protocol (DERAP). The DERAP takes a field crew of 2-4 people 30 minutes to 2 hours to complete and collects data on the presence and intensity of 41 stressors related to habitat, hydrology and buffer features (Jacobs 2007a). We also sampled 25 of the riverine sites and 24 of the flats sites with the Delaware Comprehensive Assessment Protocol (DECAP). The DECAP requires a field crew of 4-5 people and 3-6 hours of field work and collects more detailed, quantitative data on 20 variables related to vegetation, soils, hydrology, topography, and surrounding landuse (Jacobs et al. 2008). We summarized the condition of wetlands by subclass, using wetland functions and an Index of Wetland Condition (IWC) which ranged from 0 to 100 with 100 being closest to reference standard. We also isolated the common stressors affecting each wetland subclass in the watershed.

Hydrogeomorphic (HGM) models were used to assess 5 wetland functions for flats and riverine wetlands: maintenance of characteristic hydrology, biogeochemical cycling and storage, plant community integrity, wildlife habitat integrity, and buffer integrity. HGM functions are composed of DECAP variables that were scaled to reference conditions in the Nanticoke River and Inland Bays watershed and surrounding areas. Additionally, an index of wetland condition (IWC) was produced that combined the strongest variables to produce an overall score of condition for each subclass.

Flats wetlands in the Inland Bays watershed scored an average IWC value of 80.7±15; 18% were classified as highly stressed, 40% moderately stressed and 42% minimally or not stressed. Plant Community Integrity had the highest functioning average of 85.8%±13 and the highest scoring composition due to a low occurrence of invasive plants, high shrub species richness, and a high occurrence of wetland indicator tree species. Buffer Integrity was functioning well with an average of 82%±18 but had some channelized streams and ditches (30%), and trails (34%)

present. The Wildlife Habitat Integrity function averaged 77%±14 due to high scoring tree density, as well as shrub density and tree basal area, but had habitat stressors such as forestry activities within 50 years (34% of flats), and garbage and isolated dumping (26% of flats) present. The Maintenance of Characteristic Hydrology averaged 71%±34 and the scoring distribution highlighted that severe alterations to hydrology (e.g. ditching for agriculture or forestry) have been concentrated to a portion of flats wetlands, leaving other portions largely intact and few in the middle. The Biogeochemical Cycling and Storage function is based on the hydrology FCI and tree components, and averaged only 55%±29 which reflected low hydrology functioning in combination with low occurrence of deadwood.

Because the Cypress Swamp was owned by a conservation partner we considered if the condition of these wetlands would be different. We separated data for the Cypress Swamp flats sites and compared their condition scores and stressors to privately and publicly owned sites. We found that the average IWC (F23,1=9.34, P=0.044), Plant Community (F18,1=6.42, P=0.002) and Buffer Integrity (F16,1=9.34, P=0.001) function averages were greater in the Cypress Swamp. Also, on average sites in the Cypress Swamp had fewer stressors present (2.6) compared to the other flats sites (6.4). Common stressors found in both types were found less frequently at Cypress Swamp sites as well.

The IWC for riverine wetlands in the Inland Bays averaged 64.3±24. Based on the IWC, 32% of nontidal riverine wetlands were minimally or not stressed, 32% were moderately stressed and 36% were severely stressed. The presence of channelized streams in the assessment area and in the buffer, invasive plant species, garbage and isolated dumping, and fill or excavation in the wetland were the stressors most commonly affecting riverine wetlands in the Inland Bays watershed. Due to the pervasive hydrologic alterations through ditching and channelization, Hydrology and Biogeochemistry had the lowest functioning averages of 33.7±35 and 28.7±31, respectively. The Plant Community function averaged 67.6±23 and was affected by the presence of invasive species and shifted plant species composition. Buffer Integrity performed well with an average of 70.8±25, but was still affected by the presence of channelized streams and ditches, septic systems and row crops or nurseries within 100m of the wetland. Wildlife Habitat had the highest functioning average of 73.2±22.

An overall evaluation of all nontidal wetlands in the watershed including flats, riverine, ponds, and farmed wetlands found that 38% of the nontidal wetlands were minimally or not stressed, 37% were moderately stressed, and 25% were highly stressed. This perspective gives a simple view of nontidal wetland condition in the Inland Bays watershed; over a third of the nontidal wetlands are minimally stressed and are functioning relatively well, but one quarter have been severely altered and, as a result, are not able to function well and provide the caliber of ecological benefits to the residents of the State of Delaware.

Prioritizing wetland protection and restoration efforts on the watershed level will encourage a proactive approach to improving the condition of wetlands and provide direction for stakeholders performing restoration activities. This will ensure that projects are strategically targeted to maximize wetland performance and that resources and funding are effectively utilized. Protecting the condition and acreage of wetlands in the Inland Bays is critical. Because we have lost over 60% of the wetland resources and degraded many of those that remain, the functions and services that the remaining wetlands provide are essential to maintaining the ecological integrity of the Inland Bays watershed and the Bays. All wetlands need to be protected from conversion to other land uses or degradation to a lower condition due to activities within and surrounding the wetland. Funds for protection should be used for high condition wetlands and wetlands that are part of large intact areas first. We recommend that restoration focus first on improving the condition of existing wetlands by eliminating stressors and protecting healthy areas. Working with existing wetlands is more cost-effective, returns greater function improvements, and has a greater likelihood of success. Re-establishing wetlands is the only way to increase our wetlands acreage, but should be performed with funds that are designated for wetland re-establishment only and cannot be used for protection or enhancement of existing wetlands. We recommend the following specific objectives:

Improve protection of nontidal wetlands through state and local regulations, fee simple acquisitions and conservation easements, and outreach and community involvement.

Ensure that wetland functions are replaced before permitting the destruction or degradation of wetlands.

Prioritize restoring hydrology to riverine wetlands by removing stream channelization and reconnecting surface water flow to wetlands.

Encourage the use of best management practices to protect flats wetlands from additional stressors.

Focus protection and re-establishment of flats with the goal of increasing large forested wetlands.

Develop a watershed restoration plan based on the best available science to prioritize areas for protection, enhancement, and re-establishment of wetlands.

Use outreach within the watershed to better inform the general public about the status and value of their local wetland resources and ways in which they can reduce indirect wetland impacts.

Wetlands Condition of the Inland Bays Watershed

Volume 2: Tidal Wetlands

The Delaware Department of Natural Resources and Environmental Control (DE DNREC) assessed the condition of tidal wetlands in the Inland Bays watershed. The goal of this project was to determine the condition of estuarine intertidal emergent wetlands in the Inland Bays watershed and identify the presence of wetland stressors. This information will then be used to guide protection and restoration activities. Volume I of this report provides general watershed characteristics and information on nontidal wetlands in the Inland Bays watershed.

The Inland Bays watershed contains 9,825 acres of salt or brackish tidally-influenced wetlands along river and bay shorelines and behind barrier islands. High human population density especially near the coast has brought stressors associated with development that can impact wetlands and diminish the services and functions that they provide. Sudden wetland dieback (SWD) was first documented in Delaware in 2006 in the Inland Bays watershed. This condition is characterized by the rapid and partial or complete death of emergent saltmarsh vegetation or the failure of that vegetation to grow during one or several growing seasons.

We assessed the condition of wetlands using the MidAtlantic Tidal Rapid Assessment Method (MidTRAM) at 50 randomly selected sites in the watershed. We had an 89% success rate for gaining access to sites. Sites were equally dispersed between wetlands that had been affected versus not affected by SWD. At a subset of sites we also sampled vegetative biomass and the marsh bird community.

The average MidTRAM condition score was 70±10 on a scale of 0 to100; 28% were categorized as severely stressed, 56% moderately stressed and 16% minimally or not stressed. Hydrology was the highest scoring attribute group with an average of 74±10. The most common hydrology stressors across the watershed were wetland diking and tidal restriction mainly due to the Indian River Inlet, and wetland ditching and draining. The buffer attribute group averaged 68±21 and was most commonly scored down for landscape condition due to invasive plants and human disturbance. Also, we found that 30% of tidal wetlands had upland barriers to marsh migration such as bulkhead, houses or roads, with restrictions varying from 0 to 100% of the landward shoreline. The presence of development in the surrounding buffer was also a common stressor. The habitat attribute group averaged 70±16 and was most commonly scored down for the presence of *Phragmites australis*. Compared to the Murderkill and St. Jones watershed of the Delaware Bay, the Inland Bays had the greatest percent of wetlands that were severely stressed.

Overall, our comparison of MidTRAM scores to the marsh bird index of integrity and above and below ground vegetative biomass were inconclusive, likely due to small sample 2 sizes. However, there was a pattern of increasing marsh condition with higher amounts of below ground biomass which is concurrent with previous research.

Comparisons between the 20 assessment sites affected by SWD and the 30 sites unaffected by SWD did not show any differences in overall condition or between the buffer, hydrology, and habitat attributes. The similarity in scoring between affected and not affected sites indicated that, based on the rapid indicators of MidTRAM, SWD did not have a lasting effect on the overall condition of tidal wetlands 2 years after it was first detected. More intensive vegetative cover and elevation data at four monitoring stations from 2006 to 2008 suggested that the resilience of the marsh vegetation to recover after SWD may be related to surface elevation. The 4 sites showed varying levels of recovery with elevation trends.

Based on our observations of tidal wetland condition in the Inland Bays we offer recommendations to improve the management of wetlands and identify additional data needs. These actions will improve the future of tidal wetlands in the Inland Bays:

1. Protect tidal wetlands from further degradation by minimizing activity in wetlands and in the adjacent buffers. Even small permitted activities can have large cumulative impacts across the watershed.

2. Enforce buffer regulations and allow migration of wetlands with future climate change. Riparian buffers will maintain wetland condition, will allow wetlands to shift with sea level rise and will ensure continued wetland services into the future.

3. Determine the stressors that are having the greatest impact on tidal wetland condition and focus on these for restoration and enhancement activities. Determine the relationships between wetland stressors and wetland functions to help direct management activities.

4. Further evaluate the relationship between wetland condition, elevation, and biomass to make informed decisions to improve tidal wetland resiliency to future stressors. This, in addition to

more information on wetland subsidence and accretion rates, will provide information to understand how tidal wetlands will be affected by sea level rise, sudden wetland dieback and other future stressors as well as the best management action to limit negative impacts.

5. Monitor changes in wetland condition over time. Trends over time can then be used to implement adaptive management practices and adjust protection and restoration priorities and management actions.

The full reports, “Jacobs, A., A. Rogerson, D. Fillis, and C. Bason. 2009. Wetland condition of the Inland Bays watershed. Volume 1. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Dover, Delaware, USA” and “Rogerson, A., A. Howard, and A. Jacobs. 2009. Wetlands condition of the Inland Bays watershed. Volume 2. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Dover, Delaware USA”.are downloadable at: http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Pages/InlandBays.aspx

or can be obtained from DNREC/ Division of Water Resources, Watershed Assessment Section, 820 Silver Lake Blvd., Ste 220, Dover, DE 19904 or by calling 302-739-9939. Rogerson, A., A. Howard, and A. Jacobs. 2009. Wetlands condition of the Inland Bays watershed. Volume 2. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Dover, Delaware USA.

Condition of Wetlands in the St. Jones River Watershed

The Delaware Department of Natural Resources and Environmental Control (DE DNREC) assessed the condition of wetlands in the St. Jones River watershed in 2007-2008. The goal of this project was to determine the condition of both tidal and nontidal wetlands in the St. Jones River watershed and changes in wetland acreage, and to identify the presence of wetland stressors that are degrading wetlands. We will use wetland condition, stressor information and watershed wide trends to guide and improve future protection and restoration activities, education and effective planning to ensure the conservation Delaware’s wetland resources.

Located in Kent County Delaware, the St. Jones River watershed covers 23,327ha (57,643ac) of the Delaware Bay and Estuary Basin. The St. Jones River is dammed at Silver Lake in Dover and then winds 16km (10mi) through residential and commercially developed areas, the Delaware National Estuarine Research Reserve, and the Ted Harvey Wildlife Area before emptying into Delaware Bay. Flat wetlands, usually forested, exist mostly in the upper portion of the watershed and eventually drain into tributary creeks and streams. Nontidal riverine wetlands and tidal emergent wetlands line the banks of the river, sometimes up to 1km wide toward the mouth of the river. Wetlands comprise 3,913ha (9,669ac) of the watershed and provide critical services such as nutrient removal, erosion control, habitat for plants and wildlife, flood abatement, and storm water detention to the citizens of Delaware. The extent to which wetlands can perform these functions and thrive in the future depends on their condition.

We evaluated changes in acreage for major wetland subclasses by comparing the 1994 state wetland inventory to historic wetland acreage based on hydric soils. Our comparison indicated that 47% of the wetland acreage has been lost from the St. Jones River watershed since the time of settlement. The loss of 57% of nontidal wetlands was largely accounted for by conversion to cropland or residential development. Tidal wetland loss occurred mostly at tributary headwaters where the high tide line has risen and in coastal towns where development has increased.

To assess the condition of wetlands and identify the prominent stressors affecting wetland health, we applied a rapid assessment method to random sites across the watershed on nontidal flat, riverine, and depressions, as well as tidal wetlands on both private and public land. We used a probabilistic sampling design that allowed us to correct for site access and extrapolate sample results to represent the entire wetland population in the watershed.

We completed rapid assessments on 32 flats, 29 riverine, 5 depressions and 50 tidal sites. Each assessment method evaluated indicators of condition and stressors related to plant community, hydrology and wetland buffers. We also collected more intensive data from a subsample of sites, including detailed vegetation measurements, soil characterizations, surveys of the bird community and quantification of vegetative biomass.

Tidal wetlands were in fair condition with an average condition score of 76 out of 100. The highest condition sites scored over 90 and were characterized as having undisturbed hydrology, little to no development or barriers to marsh migration, extensive buffers and very little invasive plant cover. The most degraded wetlands scored as low as 39 and were characterized by severe wetland diking and tidal restrictions, disturbed buffer condition, and low density of below ground plant fragments. Overall, hydrology features appeared to be less impacted compared to habitat and buffer features. Compared to the nearby Murderkill and Inland Bays watersheds, the St. Jones River had the highest average tidal condition and the largest portion of tidal wetlands considered to be minimally or not stressed by disturbance.

Intensive surveys of the avian community and vegetative biomass indicated that tidal sites with higher wetland condition scores had lower avian species richness composed of primarily wetland specific species. Lower condition sites had greater species, but also included more upland species. We did not see a relationship between site condition scores and the marsh bird community index. Wetlands with greater condition scores had greater amounts of total below ground biomass and had a greater ratio of total above to total below ground biomass.

Historically, large areas of headwater flats have been lost, mostly to agricultural production and development. Thirty-five percent of wetlands across the watershed were flats and had an average condition of 81, ranging from 57 to 94. Using condition categories, 37% of flat wetlands were minimally stressed, 47% were moderately stressed, and 16% were severely stressed. Among the 1,385ha of flats, over half (53%) had not been forested (e.g. clear-cut, selective cut) in at least 50 years. Flats in higher condition had minimal garbage or dumping, low coverage by invasive plants, minimally altered microtopography, and had a low occurrence of wetland ditching. Forestry activity, such as cutting and harvesting, within wetlands as well as development and agriculture in buffers appeared to be the major source of stressors.

Riverine wetlands, found adjacent to streams and rivers, accounted for 24% of the watershed’s wetland acreage and had an average condition score of 72. Over half (55%) were considered minimally stressed, with low occurrences of invasive species, fill, and ditching, but frequently had dumping in addition to development and roads in the buffer. The severely stressed portion (10%) had condition scores as low as 27, related to the high prevalence of forestry activity, dumping, fill, storm water inputs and development within the buffer. The presence and intensity of development (residential, commercial and/or transportation) in the 100m *St. Jones River Watershed Report* 3

assessment site buffer were related to the prevalence of wetland stressors such as storm water inputs, invasive plants and garbage or dumping.

Based on our findings, we offer specific recommendations to improve wetland management, to maximize the natural benefits of tidal and nontidal wetlands, and encourage informed decisions concerning the future of wetlands.

1. Improve protection of nontidal wetlands through improved regulations on the state and municipal level, conservation easements and education of citizens and decision makers.

2. Protect tidal wetlands from further degradation and prepare for future changes by utilizing existing regulations and land use planning to their fullest extent. Track permitted impacts thoroughly.

3. Focus on restoring and re-establishing degraded and fragmented flat wetlands to improve wetland services such as improving water quality, providing wildlife habitat and maintaining native biodiversity.

4. Improve tidal wetland buffer regulations by consistently enforcing codes, promoting natural shorelines in lieu of shoreline stabilization and requiring natural plant communities and the removal of invasive plants.

5. Improve nontidal wetland buffer regulations by updating regulations to begin at the wetland-upland boundary, by protecting buffers from disturbances and by requiring forested buffers.

6. Collaborate with the Delaware National Estuarine Research Reserve and their Coastal Training Program to enhance education and outreach efforts and share our coastal wetland information with professionals and decision makers.

7. Design a restoration plan for the St. Jones River watershed that identifies restoration and protection priority areas pertinent to the county, state, federal and non-profit organizations.

8. Ensure that wetland functions are replaced before permitting the destruction or degradation of wetlands by adopting assessment methods into the Army Corps of Engineers review process and by strictly enforcing current guidelines.

9. Control the extent and spread of invasive plants to improve wetland condition, promote native communities and improve biodiversity.

The full report, "Rogerson, A.B., A.D. Jacobs, and A.M. Howard. 2010. Wetland condition of the St. Jones River Watershed. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment Section, Dover, USA. 66p. " can be downloaded from http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Pages/DataPortal.aspx.

Appendices

Appendix A: Watershed Approach to Toxics Assessment and Restoration

WATERSHED APPROACH TO TOXICS ASSESSMENT AND RESTORATION

DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL

DIVISION OF WATERSHED STEWARDSHIP
DIVISION OF WASTE AND HAZARDOUS SUBSTANCES

April 23, 2012
Revised March 27, 2013

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EXECUTIVE SUMMARY

This document presents a five (5) year plan to integrate and coordinate DNREC Watershed and Site Investigation and Restoration Programs with the goal of restoring Delaware watersheds impacted by toxic pollutants. The name of the plan is WATAR, which is an acronym for Watershed Approach to Toxics Assessment and Restoration. Key elements of the plan include compilation, assessment, and access to toxics data; assessing the need for, and if appropriate, developing total maximum daily loads (TMDLs) for toxics; preparation of guidance for the assessment and remediation of contaminated sediment through HSCA; site remediation and prioritization; and technology transfer. The total cost to implement the tasks outlined in this plan is approximately $1.57 million dollars to be derived from various funding sources over the course of the project. The cost to implement actual remediation and restoration actions at given sites within specific watersheds is not included in this plan. While the project is proposed to last for five (5) years, the process that will be implemented will become part of the way the Department addresses toxics in the environment for years to come.

INTRODUCTION

A watershed represents the area drained by a river, stream, or creek — in simplest terms, the area "shedding the water" (sources) to a given water body (sink). Because watersheds are defined by topographic and hydrologic boundaries, they represent the most natural and logical basis for assessing and managing the physical, chemical, and biological resources within the aquatic environment. Beginning in 1995, several programs within the Delaware Department of Natural Resources and Environmental Control (Department) began to utilize a watershed-based approach to assessing and managing Delaware's environment through the Whole Basin initiative. That work focused on conventional water quality parameters such as dissolved oxygen, temperature, nutrients, and bacteria, as well as improvements to physical habitat. Here we propose to build upon that work by applying the same approach to toxic substances.

One hallmark of the watershed approach is to consider the cumulative effect of all pollutant sources within a watershed. This not only provides a broader and more complete picture of conditions within a watershed, but the approach also permits an assessment of the relative importance of the individual sources or groups of sources which contribute to impacts. Having a more complete picture and knowing the relative importance of sources can lead to more effective problem solving.

Numerous programs benefitted from the Whole Basin watershed approach and continue to operate utilizing its fundamental principles and practices for assessing and managing the environment. One such program, DNRECs Total Daily Maximum Load (TMDL) program, has been utilizing the watershed approach to address the requirements of the Federal Clean Water Act (CWA) since the late 1990s. Like the Whole Basin initiative, efforts under Delaware's TMDL program have focused primarily on conventional water quality parameters. Delaware's experience with toxics TMDLs is far less extensive but noteworthy in that those TMDLs addressed long-standing, major contamination issues in Delaware waters (see text box below for examples of TMDLs for conventional and toxic pollutants in Delaware).

Noteworthy examples of the watershed approach for conventional pollutants include nutrient TMDLs for the Delaware Inland Bays, the Murderkill watershed, and the Saint Jones watershed (DNREC 1998, 2005, 2006). The Department has also participated in interstate TMDLs that also took a watershed approach for conventional pollutants. Examples of these include the low and high flow TMDLs for nutrients and oxygen-demanding substances in the tri-state (PA, DE, and MD) Christina Basin (EPA 2006a and 2006b).

With regard to toxics, the Department has established TMDLs for zinc in the Red and White Clay Creeks (DNREC 1999a, 1999b, and 2008). The Department also played a critical role in the development of the TMDL for polychlorinated biphenyls (PCBs) for the tidal Delaware River (EPA 2003) and the TMDL for PCBs for the Delaware Bay (EPA 2006c). Those TMDLs, developed jointly by the Delaware River Basin Commission (DRBC) and Basin States and formally established by the EPA, are arguably among the most scientifically robust in the United States, and are highlighted in the EPA publication "Integrating Water and Waste Programs to Restore Watersheds (EPA 2007).

In addition to zinc and PCBs, other contaminants that have impacted Delaware surface waters include chlorinated pesticides (e.g., chlordane, DDT, and dieldrin), mercury, and dioxins and furans (DxF). These last three contaminants or contaminant groups, plus PCBs, are classified as persistent, bioaccumulative, and toxic (PBT). PBTs concentrate and accumulate in the aquatic food chain, thereby posing a health risk to people, birds and wildlife that consume the tainted fish and other aquatic life. Indeed, the primary line of evidence that PBTs affect Delaware's surface waters is fish tissue contaminant data. Those data have been used by the Delaware DNREC and the Delaware Department of Health and Social Services to issue fish consumption advisories (http://www.dnrec.delaware.gov/fw/Fisheries/Pages/Advisories.aspx). Those advisories, which are generally more restrictive in the northern, more industrialized part of the State, are used in turn as a basis for listing the affected waterways on Delaware's impaired waters list, also referred to as the Clean Water Act Section 303(d) list. This list is updated every two years. Delaware's most recent list was compiled in 2012.

Although it is certainly not good that our waterways are impaired by these contaminants, there is reason for hope. Our best available scientific information suggests that the levels of several PBTs in the environment are decreasing with time (Greene, 2006, 2008a; Church et. al., 2006; Velinsky et. al., 2007, 2010, and 2011). Radiodated sediment cores indicate that the concentration of many PBTs peaked in the late 1970s/early 1980s and that concentrations have steadily decreased ever since. Furthermore, Delaware has been able to make several of the fish advisories less restrictive over the last half decade, signaling tangible evidence that conditions are trending in a positive direction. We believe these improvements are the result of a combination of broad-reaching statutory and regulatory bans and phase outs, source controls, site remediation, and natural attenuation. The fact remains, however, that these contaminants continue to persist in Delaware's environment and that additional work in needed to hasten improvement.

To provide focus for our efforts, it is instructive to consider watersheds appearing on Delaware's 2012 303(d) list for toxics (DNREC, 2013). They include: Delaware River (Zone 5), Delaware Bay (Zone 6), Christina River, Brandywine Creek, Red Clay Creek, White Clay Creek, Shellpot Creek, Army Creek, Red Lion Creek, the Chesapeake & Delaware Canal, the Appoquinimink River, the Saint Jones River, Slaughter Creek, Prime Hook Creek, and Waples Pond. All of the listed waters are part of the Delaware Estuary proper or are tributaries that drain to the Delaware Estuary. Further, in nearly every case, the primary risk driver and contaminant of concern is PCBs. This is based upon elevated concentrations in edible fish. Based on a determination by the EPA, tributaries that drain to the Delaware Estuary were considered during the development of the existing PCB TMDLs for the mainstem Delaware Estuary (EPA 2003 and 2006). Hence, individual PCB TMDLs for those tributaries may not be necessary. EPA has suggested, and DNREC agrees, that a decision to develop individual TMDLs for these tributaries can be informed by considering existing data, trends, and management programs which are providing for controls.

Few of the tributaries have up-to-date, comprehensive data on PCBs. We propose to fill that gap through implementation of this work plan. The collection of new data will permit comparison to older data and hence will provide for trend assessment. Finally, there are management programs in place and new initiatives being implemented which are focusing heavily on the assessment and control of PCBs in Delaware. The success of some of these programs is well documented, while others need broader public circulation. One noteworthy and highly relevant management program addressing PCBs in Delaware waters is the development of the Stage 2 PCB TMDL for the Delaware Estuary. That TMDL is being cooperatively developed by the DRBC, EPA, and the bordering States. It will use a uniform PCB criterion derived by the DRBC and DNREC using estuary-specific bioaccumulation factors and estuary-specific fish consumption rates (Fikslin and Greene, 2013). It will also provide specific allocations for the tributaries draining to the Estuary. The existing PCB TMDLs do not provide watershed-specific allocations but rather aggregate those loads among tributaries. The new approach will provide tighter geographic focus and a better way to track improvements going forward.

In support of the existing Stage 1 PCB TMDLs and the planned Stage 2 PCB TMDL for the Delaware Estuary, DNREC is proposing, through this work plan, to compile existing PCB data for the above-listed watersheds and to collect new, comprehensive, state-of-the-science ambient data in order to determine the status and trends in PCB contamination in the subject watersheds. The existing and new data, along with information on sources and programs in place to address them, will be used to update future 303(d) lists as appropriate. This may lead to the conclusion that separate PCB TMDLs are needed for individual watersheds in order to effectively control remaining sources.

In addition to PCBs, chlorinated pesticides, dioxins and furans, and mercury also contribute to the fish contamination problem for several of the watersheds noted above. Hence, those contaminants also appear on Delaware's 303(d) list and may therefore also need TMDLs. Before that conclusion is reached, however, we are proposing to examine the current status and trends for those pollutants. Radio-dated sediment cores, historic fish tissue data, and national trends all indicate that concentrations of these additional pollutants are falling. Further, the risk associated with these pollutants is generally marginal compared to PCBs. Hence, given the lower risk and expected trend, these pollutants may no longer be contaminants of concern worthy of continued listing and TMDL development. The only way to find out is to collect new data, as proposed.

STATEMENT OF NEED

The Department has been successfully assessing ambient conditions in the State's watersheds and has been remediating hazardous substances at individual sites for over two decades. The Department's regulatory programs have met their primary charge of dealing with toxics by focusing on evaluating, maintaining and controlling contaminants of concern within the impacted site's boundaries or areas proximal to the contaminant source. The risk of exposure to hazardous substances has been significantly reduced or eliminated by remedial actions implemented at sites across the State. Therefore, the Department's efforts continue to contribute to improvements to human health, welfare and environment in upland areas, and to an extent in the waterways of the First State. Still more can be done at Sites and in waterways utilizing the currently exist within the Department's well-established programs.

Just as traditional water resource management has focused heavily on individual point source discharges, traditional hazardous substance management programs have focused on remediating individual sites. Both programs individually fall short of acting on the broader cumulative effect of multiple intermingling sources that discharge to water bodies. Therefore, toxics continue to be released from upland source sites and impact surface water, sediment and biota within the State's waterways.

What the Department is lacking is a more rigorous and quantitative accounting of the links between the contamination in the State's waterways, transport pathways, and the source sites within a watershed. Quantitatively linking source sites with waterway receptors for toxics is not a trivial exercise. The evolution of existing programs towards this approach is essential to address remaining toxics problems in the State in a timely manner. The approach will require a refocus of some program priorities, the development of tools that will provide information useful for multiple regulatory programs and continued monitoring of the impacts. The goal of the WATAR approach is to remediate sources along with historically impacted waterways using a prioritized stepwise plan in order to achieve fishable, swimmable and eventually potable water in all of Delaware's waterways.

OBJECTIVES

This initiative, a Watershed Approach to Toxic Assessment and Restoration (WATAR), intends to rekindle the watershed-based approach that once flourished within the Department but with a specific focus on toxics. While this effort recognizes that there are current limitations to the levels to which programs can become involved, the linking of some key programs will result in significant improvements to the Department's ability to assess and restore areas plagued by unacceptable and unaddressed levels of contamination.

Recent efforts that informally used this approach to meet multiple regulatory goals include: NVF groundwater remediation; Christina Basin PCB Site Loading Report; Christina Basin Sediment Coring Report; PCB cleanups at Diamond State Salvage, Howard Street, Former Carney Harris, and Meco Drive sites; Shellpot Creek Iron Rich evaluation and control; Mirror Lake restoration and remediation project; Burton Island Ash Landfill evaluation; Little Mill Creek Flood Abatement Project; City of Wilmington/NCC PCB PMP trackdown study; and ongoing work at the AMTRAK Wilmington Shops.

Key objectives of this initiative will be to:

- Formalize the Watershed Approach to Toxic Assessment and Restoration through implementation of this work plan;
- Compile existing toxics data for the State’s surface waters, sediments, and biota with the intent of providing access to Department staff and the public;
- Create a mechanism to maintain the data in “a clearing house” in order to continue use for remedial decision making and prioritization;
- Acquire new, comprehensive data on the concentrations of PBTs in priority watersheds;
- Assess the need for, and if appropriate, establish TMDLs for toxic substances in accordance with the State’s CWA Section 303(d) list;
- Develop guidance for the assessment and management of contaminated sediments in the State under HSCA, which incorporates modern principles of bioavailability;
- Identify high priority remediation projects that have the potential to significantly address toxics problems in State waterways;
- Facilitate technology transfer from experienced senior staff to junior staff within the Department to allow the WATAR initiative to become a well-established and permanent part of the way the Department does business into the future.

EXPECTED BENEFITS

This project is expected to yield numerous benefits to the public, the Department, water purveyors, and businesses. Benefits to the public will include better access and understanding of toxics in the environment, a cleaner environment, lower exposure to toxic substances, and better health. Benefits to the Department will include greater efficiency in locating and processing environmental data and data requests, a staff with a broader perspective and expanded skills, and the ability to make informed decisions on permits and clean-up plans. Benefits to water purveyors will include cleaner surface source water and improved customer satisfaction. Businesses that are likely to benefit from WATAR include ecotourism, the fishing and boating sector, and those with processes that require high purity water.

Additional specific benefits to the Department will include:

- Completion of TMDLs for toxics as necessary and justified by new, comprehensive ambient and site related data;
- An increase in regulatory scope to assess and remediate legacy contaminants in sediments within the State's waterways;
- Completion of the link between contaminant source and sink with the intent of using this as a compelling argument to require remediation of source areas on an accelerated schedule;
- A broader approach to the evaluation of contaminant sources, transport pathways, and receptors with the intent on implementing management actions to mitigate and/or eliminate the levels of toxins at individual sites and the levels of toxins that individual sites release to the State's waterways to acceptable Department and EPA standards;
- A mechanism to justifiably and transparently implement restoration actions (including Natural Resource Damage restoration) based upon site prioritization that considers the level of threat to public health, welfare and the environment and the expected resulting benefit to its watershed;
- Incorporation of state-of-the-art remediation and restoration technologies and methods that provide for long-term, cost effective solutions (e.g. sediment stabilization, carbon sequestration, etc.);
- Identification and engagement of key programs and/or personnel from within and outside the Department that are needed to define success;
- A shorter timeframe for removal of fish advisories throughout the State, which will serve as a positive and highly visible indicator to the public of successful Department efforts.

PROJECT PARTICIPANTS

The primary participants in this project include the Division of Watershed Stewardship's Watershed Assessment & Management Section and the Division of Waste & Hazardous Substance's Site Investigation and Restoration Section. Through the distribution and implementation of this work plan, we are soliciting the interest and participation of other groups within DNREC. There is no requirement or deadline for participation. Even without active participation, we believe that other groups within DNREC have the potential to benefit from this collaboration.

ACTION ITEMS

Specific actions that are proposed under this work plan are described below.

1. **Compile Existing Toxics Data:** Readily available and existing toxics data for surface water, sediment, and biota will be assembled and entered into the DNREC-SIRS Environmental Quality Information System (EQuIS) database. Data sources to be considered include: DNREC, EPA, DRBC, NOAA, USFWS, USGS, USCOE, USCG, USDA, DDA, UD, DGS, and County and Municipal government. Primary data sources

within DNREC will include: SIRS, Watershed Assessment Section, Solid and Hazardous Waste Management Section, NPDES Program, the Delaware Emergency Planning and Community Right-to-Know Program, and others. Data will first be compiled for toxics appearing on Delaware's 303(d) list for the affected watersheds. Data will be organized by watershed name, waterbody ID, and segment name per Delaware's 303(d) list. As a related activity, a catalogue of reports containing the toxics data and any associated technical evaluations of the data will also be produced.

In a related task, SIRS has already coordinated with the UD-WRA and the DNREC – WAS as they develop a Delaware Watershed Website that includes environmentally relevant information for each watershed in the State. SIRS has completed contaminant narratives for each of the basins and watersheds. This narrative includes a compilation of SIRS sites in the State organized by watershed, contaminants that drove the 303(d) listing, as well as fish advisories for each watershed (see http://www.delawarewatersheds.org/)

The ultimate goal is to develop a web-based interactive mapping tool that will link to the EQuIS database of sediment, surface water and biota toxics data, associated reports, and assessments, by stream reach. This tool will be available for DNREC staff and the public and can function as a clearinghouse of data and information for multi-scale analysis. DNREC will choose a pilot watershed to develop the web-based tool. Depending upon the success of the pilot, funding will be sought to carry the effort forward for other watersheds.

2. **Monitoring to Assess the Need for Toxics TMDLs or Other Management Actions:** The foundation of meaningful pollution control is high quality, up-to-date field data. Such data serve several purposes, including: a) characterization of current conditions; b) characterization of changes since previous sampling; c) understanding spatial patterns of contamination; d) understanding partitioning behavior and bioavailability; e) evaluating relationships between sources and in-stream response; f) filling critical data gaps; and g) calibrating/validating water quality models. The WATAR team proposes to collect data on the current concentrations of PCBs, DxF, organochlorine pesticides, and mercury (Hg) in water, sediment, and fish in impaired waters appearing on Delaware's 2012 CWA 303(d) list over the next five years. In certain waters, additional toxic pollutants will also be considered on a case-by-case basis (e.g., chlorobenzenes in Red Lion Creek and PAHs in the Saint Jones watershed).

   Table 1 that follows lists the watersheds, contaminants, and media to be monitored by calendar year and fiscal year during the period beginning in 2012 and ending in 2017.

Table 1. Proposed Schedule for Toxics Monitoring in Impaired Delaware Watersheds

Watershed	Contaminant(s)	Media	Calendar Year	Fiscal Year
Del Est. Zone 5	Hg	Water, sediment, biota	2012	2013
Del Est. Zones 5&6	PCBs, DxF, OC Pest, Hg	Biota only (striped bass)	2012	2013
Red Lion Creek	PCBs, DxF, OC Pest, Hg, Chlorobenzenes	Water, sediment, biota	2013	2013
C&D Canal	PCBs, DxF, OC Pest, Hg, Chlorobenzenes, PAHs	Water, sediment, biota	2013	2013
Saint Jones	PCBs, DxF, OC Pest, Hg, PAHs	Water, sediment, biota	2013	2014
Army Creek	PCBs, DxF, OC Pest, Hg, PAHs	Water, sediment, biota	2014	2014
Appoquinimink	PCBs, DxF, OC Pest, Hg, PAHs	Water, sediment, biota	2014	2015
Shellpot Creek	PCBs, DxF, OC Pest, Hg, PAHs	Water, sediment, biota	2015	2015
Christina Basin	PCBs, DxF, OC Pest, Hg, PAHs	Water, sediment, biota	2015	2016
Slaughter Creek	PCBs, DxF, OC Pest, Hg	Water, sediment, biota	2016	2016
Waples Pond & Primehook Creek	Hg	Water, sediment, biota	2016	2017
Saint Jones	Hg (if needed)	Water, sediment, biota	2017	2017
Del Est. Zones 5&6	PCBs, DxF, OC Pest, Hg	Biota only (striped bass)	2017	2017

As shown in the table above, mercury monitoring was performed in Zone 5 of the Delaware Estuary during 2012. Although that monitoring was initiated prior to the official start of the WATAR program, it is worth discussing here because it is a prime example of the science-driven, collaborative approach embraced by WATAR. Furthermore, that work will have a direct impact on the Zone 5 303(d) listing decision for mercury during the 2014 listing cycle. Mercury contributes to the fish consumption advisory for Zone 5, primarily based on concentrations detected in striped bass (Greene, 2011a). In an effort to gain further insight into the situation, an international expert on mercury, Dr. Robert Mason from the University of Connecticut, was contracted to investigate the sources, cycling and fate of methylmercury in Zone 5 (Mason, 2011). Sampling was conducted at multiple stations within Zone 5 and during multiple seasons. Dr. Celia Chen from Dartmouth University, another mercury expert, piggybacked on the Mason study by sampling lower trophic level aquatic life in the Delaware Estuary during the summer 2012 sampling campaign. That work was funded by the Federal Superfund

Basic Research Program. The UCONN and Dartmouth work was further supplemented by mercury analyses performed by DNREC on adult striped bass and mercury analyses performed by the DRBC on adult channel catfish and white perch from the Estuary. All of the mercury data just mentioned is expected to be available by the summer of 2013. Collectively, these data should place Delaware in an excellent position to assess whether mercury should be retained on its 303(d) list for Zone 5 of the Delaware Estuary as part of its 2014 303(d) listing cycle.

Additional work performed by Delaware during 2012 included the analysis of striped bass samples from Zones 5 and 6 of the Delaware Estuary for PCBs, DxF, and OC pesticides. That work is part of the longest running monitoring program for organic contaminants in striped bass in the Delaware Estuary. The PCB data collected on the 2012 striped bass samples helps to support implementation of the existing PCB TMDL for the Delaware Estuary and sets the stage for the Stage 2 PCB TMDL. The DxF data and OC pesticide data, in conjunction with other available information on these contaminants, will be used to affirm or remove these contaminants from Delaware’s 2014 303(d) list.

For CY2013, the WATAR team intends to collect comprehensive data on organic contaminants in water, sediment, and biota from the Red Lion Creek watershed, the Chesapeake & Delaware Canal watershed, and the Saint Jones watershed. Biota samples collected from all three of these watersheds will also be analyzed for mercury to maximize the use of the biota samples. To spread costs over time, the Red Lion Creek and C&D Canal sampling will be conducted in FY2013, while the Saint Jones sampling will be conducted in FY2014. A brief description of each of these three watersheds and the nature of toxics impairments appears in Appendix 1 of this work plan. Appendix 2 presents the tentative locations, types of samples, parameters, and sample matrices to be monitored in these three watersheds under WATAR. Because of the unique nature of the monitoring to be conducted, a project-specific Quality Assurance Project Plan (QAPP) will be prepared to guide the work.

Other toxics-related monitoring to be implemented during CY2013 includes an enhancement to Delaware’s Surface Water Quality Monitoring Program (SWQMP) for divalent metals. The enhancement will include the addition of parameters needed to run the Biotic Ligand Model (BLM). The additional parameters primarily include major cations, major anions, and alkalinity. The use of this state-of-the-science model will improve predictions of potential aquatic life impacts associated with divalent metals and will become part of a more transparent protocol for interpreting metals data under Delaware’s SWQMP. A decision concerning the locations and frequency of this enhanced monitoring will be made by July 1, 2013.

For CY2014, the WATAR team intends to collect toxics data in the Army Creek and Appoquinimink watersheds. Again to spread costs, the Army Creek sampling will be conducted during the end of FY2014, while the Appoquinimink sampling will be conducted during the first half of FY2015. In CY2015, we propose to collect toxics data from the Shellpot Creek watershed and the Christina Basin (includes the Christina watershed, Brandywine Creek watershed, White Clay Creek watershed, Red Clay Creek watershed, and Little Mill Creek watershed). The Shellpot will be sampled during the last half of FY2015 and the Christina Basin will be sampled during the first half of FY2016. In CY2016, we plan to investigate toxics in Slaughter Creek (part of the Cedar Creek watershed), as well as Waples Pond and Primehook Creek (both in the Broadkill River watershed). Slaughter Creek will be sampled during FY2016 and Waples/Primehook Creek will be sampled during FY2017. Finally, if mercury concentrations in fish from the Saint Jones watershed remain elevated (based on 2013 monitoring), we will do more extensive mercury sampling in the Saint Jones watershed in 2017. Regardless of conditions, we will cycle back to the Delaware Estuary mainstem in 2017 to collect updated information on toxics in striped bass.

Descriptions of the watersheds to be sampled between 2014 and 2017 appear in Appendix 1. Figures 1 and 2 also show where these watersheds are located within the State. Sampling stations and parameters will be finalized prior to each field season. This information will be incorporated into annual QAPP updates, as will any necessary adjustments based upon prior years' experience.

3. **Sediment Quality Guidance:** There has been growing awareness of the magnitude of the sediment contamination problem in the U.S. and the challenge this represents to restoring the integrity of the nation's waters (Bridges, et.al. 2011). Many toxic pollutants, particularly PBTs, strongly partition to sediments where they can serve as an on-going source or long-term sink of contamination in a watershed. Assessing the consequences of contaminants in sediments has been hampered by the lack of an overall evaluation framework, including sediment quality guidelines that account for site-specific bioavailability and bioaccumulation. Currently, the DNREC Surface Water Quality Standards (June 11, 2011) are limited to general narrative criteria to protect surface waters from contaminants that may be present in sediments. HSCA regulations, although broadly applicable to sediments, lack specific reference to sediment sample collection methods, data quality requirements, and data interpretation.

   DNREC Watershed Assessment and SIRS personnel are actively involved in utilizing advanced, modern techniques for evaluating the risks posed by contaminated sediments (e.g., Greene, 2010a; Ghosh and Greene, 2012; Burton and Greene, 2013). Although the science of sediment contamination will continue to evolve, the time has come to develop and implement Delaware-specific guidance which reflects the current state of practice in sample collection, assessment, and remediation. We propose to do this under the umbrella of HSCA over the next three years (2013 through 2015). We have taken the first administrative step in this process by commissioning a review of State sediment guidance that incorporates bioavailability concepts (Louis Berger, 2013).

4. **Tech Transfer:** The science of toxic contamination is highly specialized requiring detailed knowledge of physical/chemical property estimation, advanced sampling and laboratory methods, chemical fingerprinting, fate and transport mass balance modeling, plus traditional and emerging treatment and control technologies. DNREC staff acquire the knowledge and skills through various means, including: participation in training

seminars/webinars; enrollment in an accredited degree program; attendance at State, regional, and national conferences; participation in committees and workgroups such as the ITRC, ASTSWMO, and the DRBC Toxics Advisory Committee; and finally, through one-on-one or small group interactions among colleagues. Mentoring between less experienced and more experienced staff members is an example of this final means of tech transfer. All of the above approaches of tech transfer are being employed by the core group of staff members involved in advancing WATAR. We propose to continue, and actually expand the approach as interest and participation in WATAR grows with time. In short, we believe that tech transfer through WATAR represents a great opportunity for staff to grow and acquire the knowledge, skills and ability needed to understand and effectively address toxic contamination in Delaware's watersheds and communities.

5. **Public Awareness/Partnerships:** An important part of this initiative will be outreach to varied audiences across the State. There are many non-governmental agencies with goals similar to the Department that may want to support the WATAR approach. It will be important to engage these groups early and make them part the Department's solution. As progress is made in specific watersheds and basins, the Department will need to find ways to supplement funding for additional sampling and analysis and monitoring of effectiveness.

TIMETABLE

Five (5) years are required to fully implement this work plan. Key activities by year are listed below.

- 2012
  - ✓ Secure buy-in and support by senior DNREC management of the WATAR approach
  - ✓ Begin compiling existing toxics data and associated information into EQuIS
  - ✓ Measure status of PCB concentrations in striped bass from the Delaware Estuary to assess progress on Delaware Estuary PCB TMDLs
  - ✓ Continue methylmercury study in the Delaware Estuary
  - ✓ Begin researching sediment guidance that exist in other States in the US, especially those that incorporate bioavailability considerations
  - ✓ Complete the Meco Drive ditch remediation and Little Mill Creek flood risk mitigation projects (supports Delaware Estuary PCB TMDL implementation)
  - ✓ Provide technical assistance to the City of Wilmington and New Castle County Special Serves on the City of Wilmington's PCB trackback monitoring
  - ✓ Advance the Mirror Lake contaminant sequestration project through the design and permitting stages (supports Delaware Estuary PCB TMDL implementation)
  - ✓ Foster tech transfer
  - ✓ Progress Report and Accounting for items listed above

- 2013
  - ✓ Create WATAR “road show” for presentations to potential partner groups
  - ✓ Continue data compilation
  - ✓ Prepare a project-specific QAPP for 2013 toxics monitoring
  - ✓ Complete methylmercury study of the Delaware Estuary and compile additional mercury data for Zone 5
  - ✓ Perform toxics monitoring in the Red Lion Creek, C&D Canal, and Saint Jones watersheds in accordance with the QAPP
  - ✓ Enhance routine monitoring of divalent metals in Delaware surface water to include parameters needed to run the Biotic Ligand Model
  - ✓ Draft HSCA Sediment Guidance
  - ✓ Define and implement SIRS Brownfield policy to require high resolution sediment sampling at sites along waterways (reimbursable through HSCA fund
  - ✓ Continue to provide technical assistance to the City of Wilmington and New Castle County Special Services on the City’s PCB trackback
  - ✓ Begin development of pilot watershed web-based mapping utility
  - ✓ Proceed to construction on the Mirror Lake remediation/restoration project
  - ✓ Continue tech transfer
  - ✓ Progress Report and Accounting for items listed above

- 2014
  - ✓ Prioritize sites in pilot watershed for remediation
  - ✓ Continue data compilation
  - ✓ Update/clarify 303(d) listing protocols for toxics in advance of 2014 listing decisions. Use protocols and readily available and existing toxics data to update list of watersheds impaired by toxics.
  - ✓ Update QAPP for 2014 toxics monitoring
  - ✓ Perform toxics monitoring in the Appoquinimink and Army Creek watersheds in accordance with the QAPP
  - ✓ Conduct public workshop(s) on draft HSCA Sediment Guidance and prepare summary of public comments received
  - ✓ Continue to provide technical assistance to the City of Wilmington and New Castle County Special Services on the City’s PCB trackback
  - ✓ Continue development of web-based mapping utility
  - ✓ Continue tech transfer
  - ✓ Progress Report and Accounting for items listed above

- 2015
  - ✓ Continue data compilation
  - ✓ Update QAPP for 2015 toxics monitoring
  - ✓ Perform toxics monitoring in the Christina Basin and Shellpot watershed in accordance with the QAPP
  - ✓ Continue to provide technical assistance to the City of Wilmington and New Castle County Special Services on the City’s PCB trackback

- ✓ Finalize HSCA Sediment Guidance
- ✓ Roll out pilot web-based mapping utility
- ✓ Continue tech transfer
- ✓ Progress Report and Accounting for items listed above

- 2016
  - ✓ Continue data compilation
  - ✓ Update QAPP for 2016 toxics monitoring
  - ✓ Use existing and readily available toxics data to update list of watersheds impaired by toxics
  - ✓ Perform toxics monitoring for Slaughter Creek, Waples Pond, and Prime Hook Creek in accordance with the QAPP. If Saint Jones fish tissue mercury concentrations remain elevated (based on 2013 samples), perform more extensive, specialized mercury sampling in the Saint Jones watershed. This will be incorporated into the QAPP as necessary.
  - ✓ Continue tech transfer
  - ✓ Progress Report and Accounting for items listed above

- 2017
  - ✓ Continue data compilation
  - ✓ Update QAPP for 2017 toxics monitoring
  - ✓ Perform Delaware Estuary striped bass sampling to assess progress on Delaware Estuary PCB TMDL
  - ✓ Assess overall status of WATAR program and develop a work plan to carry forward
  - ✓ Continue tech transfer
  - ✓ Progress Report and Accounting for items listed above

BUDGET

The total cost to implement this plan is $1.57 million dollars to be derived from various funding sources over the course of the project. Funds needed to fully implement this work plan are detailed below and are organized based upon the major action areas.

1. Funding to Compile Existing Toxics Data:

A large body of data currently exists in varying degrees of quality and from varied multiple sources. The process of determining the value of the data, relevant analysis and reports then placing it into an organized accessible database is a multi-year task that would consume the time of a full time employee. SIRS intends to hire a “limited term employee” to compile the existing data into the established EQuIS (or equivalent) database. This limited term employee would work on WATAR data compilation as an employee at SIRS. This funding structure has already been approved for 2012 with money routed through HSCA. Two more years of approvals would be sought as needed. Half of the employee's time would be committed to WATAR tasks so the funding need would be around $17, 000 for each year for three years Therefore, total =$54,000.

In order to properly serve the data that will be compiled we propose hiring an outside web design service or to fund UD or other State agency to provide web design service to develop a web-based mapping system pilot. The utility would be used by DNREC first during testing but the intent is to eventually release it to the general public for use and analysis across the state. Estimated cost: $10,000/year beginning in 2012 and ending in 2017. Therefore, total = $50,000. Over the 5 years of the plan the total cost for compilation of existing toxics data is $104,000.

2. Funding to Monitor Toxics on a Watershed Basis:

To support the WATAR initiative, we propose to perform monitoring of toxics in water, sediment, fish tissue and upland areas on a watershed-scale basis during the period of 2013 through 2017. Final costs are still being negotiated with the laboratories and will not be finalized until purchase orders are executed. The following preliminary estimates are provided for planning purposes and include labor, laboratory services, and miscellaneous equipment and supplies. Further details concerning the tentative locations to be monitored, the types of samples to be collected, and the parameters to be analyzed by watershed can be found in Appendix 2 of this work plan. Again, a Quality Assurance Project Plan (QAPP) will be developed to guide the overall conduct of the WATAR monitoring.

Table 2. **Preliminary Estimates for Ambient Monitoring of Toxics under WATAR**

Watershed	Sampling/Analysis Cost	Calendar Year	Fiscal Year
Red Lion Creek Watershed	$98,781	2013	2013
C&D Canal Watershed	$144,425	2013	2013
Saint Jones Watershed	$185,803	2013	2014
Army Creek Watershed	$98,781	2014	2014
Appoquinimink Watershed	$185,803	2014	2015
Shellpot Creek Watershed	$98,781	2015	2015
Christina Basin	$200,000	2015	2016
Slaughter Creek	$50,000	2016	2016
Waples Pond/Primehook Mercury	$34,000	2016	2017
Saint Jones Watershed Mercury	$38,000	2017	2017
Delaware Estuary	$50,000	2017	2017

3. SIRS Supplemental Sediment Sampling

SIRS proposes to collect additional sediment samples in the areas of HSCA sites within each watershed impaired by toxics. Knowing that the vast majority of sediment samples historically collected during Remedial Investigations or Brownfield Investigations under HSCA (if collected at all) are only analyzed for bulk sediment concentrations, it is anticipated that numerous data quantity and certainly data quality gaps will exist within each watershed. These data quantity and quality gaps associated with HSCA sites will become very apparent during the database development work highlighted in Item #1 above and, along with institutional knowledge about HSCA site related activities, will direct the need for additional sample collection.

Aside from filling data gaps as described, other benefits of collecting HSCA site related samples in conjunction with the watershed samples are improvement of the cumulative sediment dataset, and most importantly the potential identification of links to sources of PBT contaminants within a watershed. Once potential sources are identified, SIRS will be able to more effectively engage responsible parties and require sediment cleanup activities and/or require best management practice (BMP) improvements to eliminate point sources of pollution to the water body.

Costs estimates for HSCA site related sampling have been estimated for each watershed, and are listed below.

Table 3. **Site-Related Sampling Costs by Watershed in Support of WATAR**

Watershed	Sampling/Analysis Costs	Calendar Year Needed
Red Lion Creek Watershed	$10,000	2013
C&D Canal Watershed	$25,000	2013
Saint Jones Watershed	$25,000	2013
Army Creek Watershed	$25,000	2014
Appoquinimink Watershed	$25,000	2014
Shellpot Creek Watershed	$25,000	2015
Christina Basin	$50,000	2015
Slaughter Creek	$10,000	2016
Waples Pond/Primehook Mercury	$5,000	2016
St. Jones Watershed Mercury	$10,000	2017
Delaware Estuary	$43,500	2017

4. Funding to Develop Sediment Quality Guidance:

Sediment guidance for toxic compounds has already been identified as a need under HSCA. In fact, SIRS personnel have committed to completing sediment related guidance under HSCA within the first three years of this plan. Approaching sediment assessment and remediation activities from a watershed and risk-based standpoint is logical, scientifically defensible, and cost effective. The promotion of a watershed-based approach is the reason for this work plan, so the development of guidance is very timely.

In order to generate effective and meaningful guidance, a review of what exists, and is successful, throughout the country is warranted. Specifically, an assessment of which states utilize assessment principles based upon watershed scale variables and bioavailability considerations will prove helpful as an outline for Delaware’s regulations. It is proposed that SIRS hire a contractor to review existing state regulations/guidance and recommend the 3 best sets of regulations for Delaware to consider in preparing its own regulations/guidance. The estimated cost for this exercise is $25,000, and will be needed in 2012 or 2013.

5. **Funding for Tech Transfer:**

   Many of the tasks associated with tech transfer do not require a separate allocation of funding beyond existing programmatic funds since knowledge is often transferred though direct project work. This method is effective for the staff members involved on those projects but falls short of being able to create a global change in knowledge base and programmatic effectiveness within DNREC and other agencies tasked with addressing toxics in Delaware watersheds. Funding for tech transfer would be for formalized training through participation in local seminar series often hosted by individual programs in DNREC, training courses in methods to evaluate and address toxics as well as continued participation in regional and national workgroups. Beginning in 2013, the WATAR "roadshow" will reach out to a broader audience for the purposes of peer review and knowledge sharing. This funding would also be used for education by staff members that have expressed interest and commitment to being an active part of the WATAR. The funding request is $20,000 / year for three years for the purposes of travel, conference registration and, presentation materials. Therefore the total = $60, 000.

6. **Funding for Public Awareness/Partnerships**

   Public awareness and partnerships are an important part of the WATAR because communities and businesses will be given the tools to understand what is going on in their area. Also, public outreach will increase the positive pressure from the communities to encourage dischargers to lessen their impacts. For example, DNREC has partnered with the City of Wilmington, New Castle County, the DRBC and other organizations in order to provide technical assistance for the PCB trackback effort being implemented as part of the City of Wilmington's PCB Pollutant Minimization Plan (City of Wilmington, 2010).

   As part of public awareness, WATAR should be presented at Envirothon and the DE State Fair on an annual basis, with a focus on different watersheds each year. It will be possible to create kits for each watershed that can easily be distributed to communities as well as educators. The funding request is $10,000 / year for five years for educating and partnering with dischargers to decrease their impacts, creating watershed specific kits for distribution, and being involved with Envirothon and the DE State Fair. The total will be $50,000.

The combined funding needs (from Items 1 thorough 6 above) are summarized in Table 4 below.

Table 4. Funding Needs to Implement WATAR by Action Item, Program and Calendar Year

Action	2012	2013	2014	2015	2016	2017
Compile Data						
WAS						
SIRS		$27,000	$27,000	$27,000	$10,000	$10,000
Toxics Monitoring						
WAS	$35,000	$417,779	$256,879	$256,879	$77,000	$38,000
SIRS		$99,780	$62,705	$116,902	$15,000	$10,000
Sediment Guidance						
WAS						
SIRS	$25,000					
Tech Transfer						
WAS						
SIRS		$20,000	$20,000	$20,000		
Public Outreach						
WAS						
SIRS		$10,000	$10,000	$10,000	$10,000	$10,000
Totals	$60,000	$574,559	$376,584	$430,781	$112,000	$68,000

The total financial need for the WATAR program for the period CY2013 through CY2017 is $1,569,924, or roughly $1.57M. This does not include CY2012 which has already past. Note that the greatest need exists in the first three calendar years, with a particularly large need in CY2013. This front end demand will be spread out over fiscal years to dampen the initial annual peak. Also note that the total expected contribution from the Watershed Assessment Section is approximately $1M, while that from the Site Investigation and Restoration Section is approximately $0.57M, again not counting CY2012.

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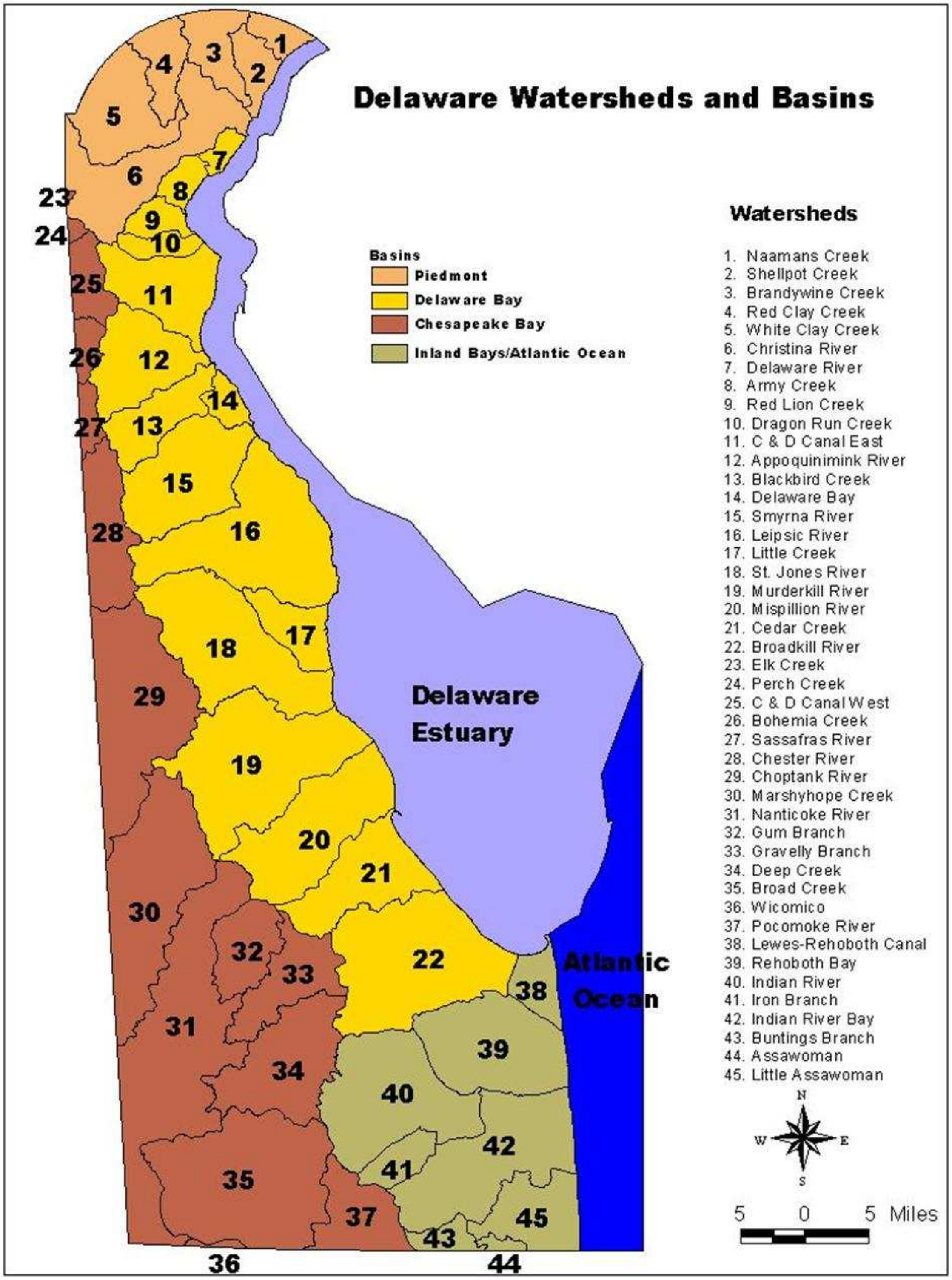

Figure 1. Delaware Watersheds and Basins

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Figure 2. Christina Basin Pennsylvania, Maryland and Delaware (map adapted from University of Delaware Water Resources Agency)

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Appendix 1

Profiles for Delaware Watersheds Impaired by Toxics

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Red Lion Creek Watershed: The Red Lion Creek watershed (~28 sq. km) is located in New Castle County, DE where it empties into the Delaware River through a tide gate structure. Its lower reach forms the northern border of the Delaware City industrial complex. It has been impacted by multiple Federal Superfund Sites and other industrial facilities. The primary contaminants of concern in the Red Lion Creek are PCBs, dioxins/furans, and chlorinated benzenes. PCBs and dioxins/furans are drivers for elevated human health risk through fish consumption (DNREC, 2012a), while chlorinated benzenes are drivers for ecological risk to benthic aquatic life (EPA, 1995).

A catastrophic spill at the now shuttered MetaChem (a.k.a. Standard Chlorine of Delaware) chemical manufacturing facility in 1986 released approximately 650,000 gallons of chlorinated benzenes to the environment, including to Red Lion Creek and associated wetlands. Following an immediate fish kill and closure, testing revealed some of the highest concentrations of chlorinated benzenes in fish in the entire United States (EPA, 1992). Subsequent testing over the years showed that concentrations of these compounds have fallen in the fish but that levels of PCBs and dioxins/furans are still sufficient to warrant a fish advisory. As an aside, the Red Lion Creek is one of the only tributaries to the Delaware Estuary between the head of tide at Trenton, NJ and the top of Delaware Bay at Liston Point, DE that was confirmed to be toxic to aquatic life in multiple surface water bioassay tests (MacGillivray, et.al. 2011). Although not certain, it is certainly possible that the toxicity observed in the water column bioassays is associated with elevated concentrations of chlorobenzenes in the sediments along with pore water to surface water exchange.

The MetaChem property is now a Federal Superfund site. EPA and the State of Delaware have spent a staggering amount of money cleaning up this site. Initial efforts focused on dismantling process equipment and containing the spread of contamination from the upland plant area to groundwater resources. One of the final challenges is how best to deal with the contamination that has entered the adjacent Red Lion Creek wetlands. The EPA has conducted extensive testing of the sediments in an effort to define the extent of the contamination, its fate, and whether it may be amenable to bioremediation.

Key members of the WATAR team are working closely with EPA Superfund personnel on additional testing and appropriate cleanup goals for the wetlands and Red Lion Creek. The EPA is planning to do additional testing of PCBs, chlorobenzenes, and dioxins and furans in 2013. That work, as proposed, is limited to wetlands sediments in a fairly small geographic area. The WATAR team is proposing to supplement the EPA testing with samples of surface water, sediment, and fish from locations upstream and downstream from the EPA's sampling to provide a watershed-scale perspective on toxics in the Red Lion watershed. It is our intent to coordinate the substance and timing of EPA's and DNREC's sampling.

Locations tentatively targeted for sampling under WATAR include: Route 7; Route 1; Route 9; and the pool immediately upstream of the tide gate at the confluence with the Delaware River. In addition, we intend to collect sediment samples at two headwater locations within the Red Lion Creek watershed: one in the vicinity of Porter Road and one in the vicinity of Road 384. These locations are typically wet in the spring but may not be in the summer when sampling is planned. At a minimum, sediment samples will be collected at these two headwater locations. If there is sufficient water, water samples will also be collected.

Finally, Delaware is also coordinating with the DRBC who has expressed interest in collecting water samples from the Red Lion Creek for toxicity bioassays to compliment the sampling planned by the EPA and DNREC.

The estimated cost for the Red Lion Creek watershed ambient toxics monitoring is $98,781 ($80,231 from WAS and $18,550 from SIRS). In addition, $10,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Red Lion Creek watershed. This brings the estimated cost associated with the Red Lion sampling and analyses to $108,781. These funds will be needed in CY2013.

Chesapeake & Delaware Canal: The C&D Canal (~159 sq. km in Delaware) is a man-made waterway that connects the upper Chesapeake Bay and the tidal Delaware River. The portion of the Canal in Delaware separates northern New Castle County from southern New Castle County. There are several Delaware HSCA sites in the C&D Canal watershed and one Delaware NPDES point source discharge. The principal contaminants of concern in the C&D Canal are PCBs, DDT, dieldrin and chlordane based on elevated concentrations in fish (Greene, 1999). Dioxins and furans are also known to be present in the fish, although they aren't believed to be major risk drivers. Finally, sediments collected from the C&D Canal are known to contain PAHs (Versar, 1998).

Based on the available information, target analytes for the 2013 C&D Canal survey will include PCBs, DxF, OC pesticides, and PAHs in water, sediment and fish. Furthermore, to assess the possible spread of chlorobenzenes away from the Red Lion Creek and into the C&D, water, sediment, and fish samples will also be collected at some but not all of the C&D Canal sampling locations. As currently planned, 5 separate ambient stations will be sampled, including 1 from the lower Delaware River and 4 from the C&D Canal proper between Reedy Point and the DE/MD border. Both a bottom feeding fish (e.g., channel catfish) and a pelagic species (e.g., white perch) will be separately collected at each station. As a goal, each fish sample will consist of 5 similarly-sized individual fish at the station. Sediment samples will consist of a cross-sectionally averaged composite of 3 to 5 surface grabs to ensure representative results.

In addition to the sampling at the 5 ambient stations, a single small volume municipal NPDES discharge (Lums Pond State Park) will also be sampled during the survey, as will selected samples associated with hazardous substance sites located within the C&D Canal drainage area. Further, because the C&D Canal is an interstate waterway, we will contact our counterparts in Maryland to determine if they have an interest in supplementing Delaware's sampling with sampling on the Maryland side of the Canal.

The estimated cost for the C&D Canal watershed ambient toxics monitoring is $144,425 ($132,350 from WAS and $12,075 from SIRS). An additional $25,000 is also allocated for SIRS to collect and analyze samples associated with sites under their purview within the C&D Canal drainage. This brings the estimated cost associated with the C&D Canal sampling and analyses to $169,425. These funds will be needed in CY2013.

New data for the C&D Canal will not only help to support TMDL efforts for the Delaware Estuary, but should also be of interest to our Federal partners who have recently assessed the extent and severity of toxic contamination in the Chesapeake Bay and its watershed (EPA et. al., 2012). WATAR sampling of the C&D Canal is tentatively scheduled for the summer of 2013.

Saint Jones Watershed: The Saint Jones watershed (~233 sq. km) is located in Kent County, DE. It flows through the City of Dover, the State's capital, and eventually empties into the Delaware Bay. The Saint Jones watershed has extensive freshwater wetlands in its upper reaches and extensive tidal wetlands in its lower reaches. Several Federal Superfund Sites and Delaware HSCA sites are located in the Saint Jones watershed. There is one individual NPDES permitee in the Saint Jones watershed. The primary contaminant of concern in the Saint Jones is PCBs based on fish contamination. Dioxins and furans, mercury, and DDT also contribute to the fish contamination problem in several reaches of the Saint Jones watershed. Monitoring for organic contaminants is proposed for 2013, while monitoring for mercury, which will involve different sampling considerations, is proposed for 2016. Monitoring for organics is discussed below while monitoring for mercury is covered later in this work plan.

Fairly extensive monitoring for parts of the Saint Jones watershed is already being proposed as part of an innovative restoration/remediation project being advanced for Mirror Lake in Dover, DE (Ghosh and Greene, 2012). That project involves using activated carbon to sequester contaminants in sediments with the intent of reducing bioavailability and food chain bioaccumulation. Delaware will be the first State in the country to implement this type of project, which we believe holds great promise for reducing the adverse effects of residual legacy contaminants in sediments and watersheds. For planning purposes, this work plan assumes that monitoring for the Mirror Lake project area, which encompasses the area between Division Street and Court Street, is covered by separate funding. Additional funds under WATAR will be needed to cover areas beyond the Mirror Lake project area.

Toxics sampling for the Saint Jones under the WATAR program will involve the collection of surface water, surface sediment, and biota at the following locations: Fork Branch; McKee Run; Silver Lake; the Saint Jones mainstem at Route 13, Route 10, Route 1, and Bowers Beach (confluence with Delaware Bay); Wyoming Mill Pond; and Moores Lake. PCBs, DxF, OC pesticides, and PAHs will be measured in all media from all stations following methods previously described. In order to assess the effect of the carbon treatment, baseline data on the contaminants of concern in water, sediment, and biota will be collected in the Fall of 2013 immediately prior to a November 1, 2013 Mirror Lake remediation/restoration project.

Some HSCA funds have also been allocated for post-remediation monitoring. We have also submitted a grant application to the Federal Strategic Environmental Research and Development Program (SERDP) to evaluate the impact of any ongoing residual contaminant inputs on Mirror Lake following activated carbon amendment (Ghosh, et.al., 2013). Sediment cores will not be collected from the Saint Jones watershed as a part of the WATAR work since coring work has already been performed in the Saint Jones watershed (Sommerfield, 2005; Velinsky et. al., 2007). Those data are reviewed elsewhere (Greene, 2011c).

We have estimated that $185,803 will be needed to cover sampling and analysis of the ambient samples for the Saint Jones watershed ($176,648 from WAS and $9,155 from SIRS). An additional $25,000 is allocated for SIRS to collect and analyze samples associated with sites under their purview within the Saint Jones watershed. This brings the estimated cost associated with the Saint Jones toxics sampling and analyses to $210,803. These funds will be needed in CY2013, but will be drawn down in FY2014.

As a final note, the single NPDES point source in the Saint Jones watershed, McKee Run, has already been directed to monitor for PCBs in their stormwater discharge.

Army Creek: Army Creek drains a small (~26 sq. km) watershed in New Castle County, DE south of the historic Town of New Castle. It flows into the Delaware River through a tide gate. There are several federal and Delaware HSCA sites located within the Army Creek watershed. The primary contaminants of concern for Army Creek are PCBs and dioxins/furans based upon elevated concentrations in fish. Sites tentatively targeted for sampling include: Route 13; Army Pond; the reach to the west of Route 9; and the area between Route 9 and the tide gate. Surface water, sediment, and biota (if available) will be sampled at each site.

The estimated cost for the Army Creek ambient toxics monitoring is $98,781 ($80,231 from WAS and $18,550 from SIRS). This estimate is based on that for the Red Lion Creek watershed, which is of similar size and complexity to the Army Creek watershed. In addition, $25,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Army Creek watershed. This brings the estimated cost associated with the Army Creek watershed to $123,781. These funds will be needed in CY2014.

Appoquinimink Watershed: The Appoquinimink watershed (~120 sq. km) is located in southern New Castle County, DE. The watershed encompasses the Middletown, Odessa, Townsend (MOT) development region. The drainage pattern of the Appoquinimink watershed is complex with several impoundments located in headwater tributaries and extensive braided tidal wetlands in its lower reaches. The Appoquinimink is a tributary to the Delaware Estuary. There are several State HSCA sites within the Appoquinimink watershed. There is also a single NPDES point source discharge which discharges on a seasonal basis. The primary contaminants of concern, based on fish contamination, are PCBs, dioxins and furans, and organochlorine pesticides.

We propose to collect surface water and surface sediment from seven ambient stations located throughout the Appoquinimink watershed. The locations targeted for sampling include: Noxontown Pond, Silver Lake, Shallcross Lake (outflow only), Dove Nest Branch (at Brick Mill Rd or Marl Pit Rd), Drawyers Creek at Route 13, Appoquinimink mainstem at Route 299, Appoquinimink mainstem at Route 9, and Appoquinimink mainstem at its confluence with the Delaware River. Largemouth bass will be collected from Noxontown Pond and Silver Lake, while channel catfish and white perch will be collected from the Drawyers Creek and three Appoquinimink mainstem stations. In addition, we will also collect a sample of the NPDES discharge. All of the samples will be analyzed for PCBs, dioxins and furans, organochlorine pesticides, and ancillary parameters using methods previously described.

In addition to the samples discussed above, we also propose to collect a single (36” or 91.4 cm) deep sediment core from the low tidal marsh adjacent to the Appoquinimink mainstem near

Route 299. The purpose of this core is to confirm the expected long-term time trend of contaminant loading in the watershed. Obtaining pollution histories from sediment cores normally entails age-dating small increments or slices along a core using cesium and lead isotopes and then analyzing the individual slices for contaminants. This is considered the best way to determine the relationship between sediment depth, date, contaminant concentration, and past loading. However, this approach is quite time consuming and expensive. Fortunately, we have a reasonable idea of sediment accretion rates and down core PCB distributions for tide marshes throughout the entire Delaware Estuary (Velinsky et.al. 2011). We know for instance that the average accretion rate is 0.65 cm/yr (± 0.22 cm/yr). We also know from these cores that the onset of PCB appearance generally occurred in the 1930s to early 1940s; a peak PCB concentration typically falls between 1960 and 1980; and that concentrations generally decrease gradually to the sediment/water interface.

We hypothesize a similar profile in the Appoquinimink marsh. To test this hypothesis, we propose to analyze the following intervals of a sediment core collected from the low marsh adjacent to the Appoquinimink River at Route 299. The computed intervals and dates in Table 2 assume an average accretion rate of 0.65 cm/yr and that sampling will occur in 2013.

Table 1_A. Proposed Depth Intervals for Sediment Core at Appoquinimink Marsh

Depth Interval (inches)	Expected Period of Sediment Accumulation	Comment
0 -2	2005 – 2013	Biologically active layer
2 – 8.5	1980 – 2005	Decreasing gradient to surface
8.5 – 13.5	1960 – 1980	Expected peak
13.5 - 20	1935 – 1960	Increasing gradient to peak
20 - 36	Pre- 1935	Expected onset

Each of the five intervals will be analyzed for PCBs, dioxins and furans, organochlorine pesticides, and ancillary parameters. To provide sufficient sediment to analyze all parameters and to create a representative sample, multiple cores will be collected at the site with like intervals being composited.

The estimated cost for the Appoquinimink Creek watershed ambient toxics monitoring is $185,803 ($176,648 from WAS and $9,155 from SIRS). This estimate is based on that for the Saint Jones watershed, which is of similar size and complexity to the Saint Jones watershed. In addition, $25,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Appoquinimink watershed. This brings the estimated cost associated with the Appoquinimink watershed to $210,803. These funds will be needed in CY2014, but will be drawn down in FY2015.

Shellpot Creek: The Shellpot Creek watershed drains approximately 39 sq. km of land in northeastern New Castle County, DE. Most of the watershed is located in the Piedmont Province and is characterized by steep slopes, rocky bottom, and flashy hydrology. Land use in this part of the watershed is primarily medium to high density residential. The very lower end of the watershed is in the Coastal Plain Province and is subject to the tides. This part of the watershed is highly industrialized and impacted by PCBs and other contaminants. The Shellpot discharges to Zone 5 of the Delaware Estuary through a tide gate. Detailed sampling of water, sediment, and fish within the Shellpot watershed was last performed in 2007 (Greene, 2009a). We propose to revisit the Shellpot for intensive sampling of toxics in CY2015/FY2015. At a minimum, all stations sampled in 2007 will be resampled in 2015.

The estimated cost for the Shellpot Creek watershed ambient toxics monitoring is $98,781 ($80,231 from WAS and $18,550 from SIRS). This estimate is based on that for the Red Lion Creek watershed, which is of similar size and complexity to the Shellpot Creek watershed. In addition, $25,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Army Creek watershed. This brings the estimated cost associated with the Army Creek watershed to $123,781. These funds will be needed in CY2015.

Christina Basin: The Christina Basin originates in southeastern Pennsylvania and northeastern Maryland and flows into northern New Castle County, Delaware. The total drainage area of the basin is approximately 1464 sq. km, which includes the Christina River proper (197 sq. km), the Brandywine Creek (847 sq. km), the White Clay Creek (280 sq. km), and the Red Clay Creek (140 sq. km). The Red Clay Creek is a tributary of the White Clay Creek which is a tributary to the Christina River. The Brandywine Creek is also a tributary of the Christina River. These tributaries and the Christina River flow into Zone 5 of the Delaware Estuary in the vicinity of Wilmington, DE. Approximately two-thirds of the total area of the basin lines in Pennsylvania and Maryland, with the balance falling in Delaware. All but the lower part of the basin is within the Piedmont Physiographic Province. The lower portion of the basin lies in the Atlantic Coastal Plain, where it is subject to tidal flows from the Delaware Estuary. Land use/land cover in the Christina Basin consists of a mixture of rural, residential, agricultural, urban, commercial and industrial with the lower reaches consisting largely of urban use associated with the City of Wilmington. The primary contaminant of concern in the Christina Basin is PCBs based upon elevated concentrations in fish. Other contributors to the fish contamination problem include dioxins and furans and organochlorine pesticides.

A detailed study of PBTs in the Delaware portion of the Christina Basin was conducted in the Fall of 2007 (Greene, 2009a). Since that time, the following noteworthy and relevant efforts have occurred to better understand and control toxics in Delaware’s part of the basin:

- An assessment of PCB mass loading from tributaries in the Christina Basin to the Delaware Estuary (Greene, 2008b);

- An assessment of PCB mass loading from hazardous substance release sites to surface waters of the Christina Basin (Brightfields, 2009; Greene, 2012a);

- Assessment and remediation of PCBs and PAHs in Meco Ditch adjacent to the Meco Drive site (Greene, 2011b);

- Assessment and remediation of PCBs at the Howard Street and the Former Carney-Harris waste sites in Wilmington, DE;

- Development of a procedure to document compliance with the Red Clay Creek Zinc TMDL (Greene, 2010b) and demonstration of compliance (Greene, 2009b).

- Radiodating and chemical analysis of sediment cores to assess long-term trends in PBTs in the Christina Basin (Velinsky, et.al., 2010);

- Fundamental research on the chemical partitioning behavior of PCBs in water, sediment, and the foodchain in the Christina Basin (Greene, 2009c).

- Development of a new water quality model describing the role of black carbon in binding PCBs in the water column using data from the tidewater portion of the Christina Basin (Greene et.al., 2013a);

- An assessment of PBT uptake in stocked trout in the Red Clay Creek (Greene and Stangl, 2012b);

- An evaluation of contemporary DDT exceedances in the Red Clay Creek (Greene, 2012c);

- An evaluation of lead and copper chronic aquatic life criteria exceedances in the White Clay Creek watershed (Greene, 2012d).

- Technical assistance to the City of Wilmington and New Castle County Special Services on the City's NPDES sewershed PCB trackback (Greene, 2013b and 2013c).

The Christina Basin continues to be a high priority for the WATAR team. We propose to cycle back into the Christina Basin in the Fall of 2015 for intensive sampling of water, sediment, biota, and sites. The estimated cost for the ambient portion of the toxics monitoring is $200,000 ($176,648 from WAS and $23,352 from SIRS). This estimate is based on and slightly higher than that for the Saint Jones watershed, which is of similar size and complexity. In addition, $50,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Christina Basin watershed. This brings the estimated cost associated with the Christina Basin toxics monitoring to $250,000. Sampling will be done in the Fall of 2015 but funds will be drawn during FY2016.

Slaughter Creek: Slaughter Creek is a tributary of the Cedar Creek watershed in northeastern Sussex County, DE. Fish sampling performed in 2006 at a single location had a PCB concentration marginally above a level of concern (Greene, 2007b). The WATAR team proposes to resample Slaughter Creek in CY2016/FY2016, including surface water, sediment, and fish samples at multiple locations. Because of the marginal nature of the toxics problem in Slaughter Creek, it has been placed toward the end of the five year WATAR work plan.

The estimated cost for the Slaughter Creek ambient toxics monitoring is $50,000 ($40,000 from WAS and $10,000 from SIRS). In addition, $10,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Slaughter Creek watershed. This brings the estimated cost associated with the Slaughter Creek toxics sampling to $60,000. These funds will be needed in CY2016/FY2016.

Monitoring to Assess the Need for Mercury TMDLs: As discussed previously, DNREC is currently overseeing a major study within the tidal Delaware River to quantify the seasonal release of methyl mercury from subtidal, nearshore sediments (Mason, 2011). The study is a collaboration between the Watershed Assessment Section, SIRS, the Environmental Laboratory Section, the DRBC, the University of Connecticut, and Dartmouth University. SIRS provided funding for the study and the Watershed Assessment Section is providing technical oversight and logistical support for sample collection. Information from the study will be available in the summer of 2013 in time to be used for Delaware's 2014 CWA 303(d) listing cycle.

a.) Waples Pond/Prime Hook Creek: Fish samples collected at several locations in 2006 revealed mercury concentrations above Delaware's criterion of 0.3 ug/g (Greene, 2007b). All organic contaminants were low. We propose to collect new mercury data in the Fall of 2016 under this work plan. Surface water, sediment, and fish samples will all be collected. Target sampling stations include: Outflow of the private pond at Route 30 (Isaacs Road); Cedar Creek Road; Waples Pond; Prime Hook Creek near the shooting range; Prime Hook Creek near the "shop", and Prime Hook Creek at the end of Turkle Pond Road. The last 3 stations are located within the Prime Hook Wildlife Refuge. We will coordinate with refuge personnel on obtaining samples. Total and dissolved mercury will be analyzed in the water samples by a specialty lab using Method 1631E with an MDL on the order of 0.15 ng/L. Total and dissolved methylmercury will also be analyzed in the surface water samples by a specialty lab, in this case using Method 1630. We propose to use an ultra-low level procedure for the methylmercury analyses (MDL = 0.01 ng/L). Ancillary measures for the surface water samples will include: TSS, POC, DOC, and sulfate. Specific conductivity, dissolved oxygen, temperature and pH will be measured in the field. Surface sediment will be collected at all stations, access permitting, and will be analyzed for total mercury, moisture, grain size and acid volatile sulfide (AVS). Finally, biota will also be collected at all stations, again, access permitting. To more fully utilize fish that are sacrificed, archives will be saved for possible future analysis of organic contaminants.

For Waples Pond/Prime Hook Creek watershed mercury sampling and analysis, we estimate a need of $34,000. An additional $5,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Waples Pond/Prime Hook Creek watershed. This brings the estimated cost associated with the Waples Pond/Prime Hook Creek watershed mercury sampling and analyses to $39,000. These funds will be needed in CY2016/FY2017. Training of sampling personnel on the proper methods for collecting mercury samples for low-level analysis is also needed. We will attempt to arrange that training through the United States Geological Survey (USGS), who has extensive experience in "clean hands – dirty hands" sampling methods for mercury. A nominal amount of $3,000 is set aside to cover travel and other miscellaneous expenses for the training. This brings the total cost associated with the Waples Pond/Prime Hook Creek mercury monitoring to $42,000.

b) Saint Jones watershed: Mercury concentrations in fish from some but not all locations within the Saint Jones watershed exceed Delaware's criterion of 0.3 ug/g. We propose to review the fish tissue mercury results for samples collected in the Fall of 2013 to decide whether a more detailed study of mercury in water, sediment, and fish is needed. If it is, that work will be done in 2017. Field and lab procedures will follow those just outlined for Waples Pond/Prime Hook Creek. The Saint Jones mercury sampling, if needed, will be done at the following locations: Fork Branch at State College Road; McKee Run; Silver Lake; and the Saint Jones mainstem at Court Street, Route 10, Route 1, and at Bowers Beach (confluence with Delaware Bay).

We estimate the cost of mercury sampling and analysis in the Saint Jones watershed at $38,000, again provided there is a need to proceed with this work. An additional $10,000 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within the Saint Jones watershed. This brings the estimated cost associated with the Saint Jones mercury sampling and analyses to $48,000.

Delaware Estuary Zones 5 and 6: In support of the PCB TMDLs for the Delaware Estuary, Delaware will cycle back into the mainstem Delaware Estuary to collect striped bass for PBT analyses in the spring and summer of 2017. Based on similar efforts in the past, we estimate this work to cost roughly $50,000. An additional $43,500 is budgeted for SIRS to collect and analyze samples associated with sites under their purview within Zones 5 and 6 of the Delaware Estuary.

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Appendix 2

2013 WATAR Samples

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Table 2a. 2013 WATAR Samples, Red Lion Creek Watershed

Watershed	Station	Surface Water, Field Parameters	Surface Water, General Parameters	Surface Water, PCB Congeners, 20-L	Surface Water, Dioxins & Furans, 20-L	Surface Water, OC Pesticides, 20-L	Surface Water, PAHs & Alkyl Homologs, 20-L	Surface Water, PCB Congeners, 2.5-L	Surface Water, Chlorobenzenes, 2.5-L	Surface Sediment, General Parameters	Surface Sediment, PCB Congeners	Surface Sediment, Dioxins & Furans	Surface Sediment, OC Pesticides	Surface Sediment, PAHs & Alkyl Homologs	Surface Sediment, Chlorobenzenes	Fish Tissue, PCB Congeners	Fish Tissue, Dioxins & Furans	Fish Tissue, OC Pesticides	Fish Tissue, PAHs & Alkyl Homologs	Fish Tissue, Chlorobenzenes	Fish Tissue, Total Mercury	Fish Tissue, Lipids
Red Lion	Upstream of Tide Gate	√	√	√	√	√		√	√	√	√	√	√		√	√	√	√	√	√	√	√
	Route 9	√	√	√	√	√		√	√	√	√	√	√		√	√	√	√	√	√	√	√
	Route 1	√	√	√	√	√			√	√	√	√	√		√	√	√	√	√	√	√	√
	Route 7	√	√	√	√	√			√	√	√	√	√		√	√	√	√	√	√	√	√
	Rd 384								√	√	√	√	√		√							
	Porter Rd								√	√	√	√	√		√							
	Equipment Blank			√	√	√			√	√	√	√	√		√							
	Lab Duplicate		√							√	√	√	√		√	√	√	√	√	√	√	√
	Totals	4	5	9	9	9		4	9	8	8	8	8		8	5	5	5	5	5	5	5

See Notes below Table 2c.

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Table 2b. 2013 WATAR Samples, Chesapeake & Delaware Canal Watershed

Watershed	Station	Surface Water, Field Parameters	Surface Water, General Parameters	Surface Water, PCB Congeners, 20-L	Surface Water, Dioxins & Furans, 20-L	Surface Water, OC Pesticides, 20-L	Surface Water, PAHs & Alkyl Homologs, 20-L	Surface Water, PCB Congeners, 2.5-L	Surface Water, Chlorobenzenes, 2.5-L	Surface Sediment, General Parameters	Surface Sediment, PCB Congeners	Surface Sediment, Dioxins & Furans	Surface Sediment, OC Pesticides	Surface Sediment, PAHs & Alkyl Homologs	Surface Sediment, Chlorobenzenes	Fish Tissue, PCB Congeners	Fish Tissue, Dioxins & Furans	Fish Tissue, OC Pesticides	Fish Tissue, PAHs & Alkyl Homologs	Fish Tissue, Chlorobenzenes	Fish Tissue, Total Mercury	Fish Tissue, Lipids
C & D Canal	Del R, East of Reedy Point	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√√	√√	√√	√√	√√	√√	√√
	Reedy Point Bridge	√	√	√	√	√	√			√	√	√	√	√		√√	√√	√√	√√		√√	√√
	Saint Georges Bridge	√	√	√	√	√	√			√	√	√	√	√		√√	√√	√√	√√		√√	√√
	Summit Bridge	√	√	√	√	√	√			√	√	√	√	√		√√	√√	√√	√√		√√	√√
	MD/DE Border	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√√	√√	√√	√√	√√	√√	√√
	Equipment Blank			√	√	√	√		√	√	√	√	√	√	√							
	Lab Duplicate		√							√	√	√	√	√		√	√	√	√	√	√	√
	Totals	5	6	11	11	11	11	4	5	7	7	7	7	7	3	11	11	11	11	5	11	11

See Notes below Table 2c.

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Table 2c. 2013 WATAR Samples, Saint Jones Watershed

Watershed	Station	Surface Water, Field Parameters	Surface Water, General Parameters	Surface Water, PCB Congeners, 20-L	Surface Water, Dioxins & Furans, 20-L	Surface Water, OC Pesticides, 20-L	Surface Water, PAHs & Alkyl Homologs, 20-L	Surface Water, PCB Congeners, 2.5-L	Surface Water, Chlorobenzenes, 20-L	Surface Sediment, General Parameters	Surface Sediment, PCB Congeners	Surface Sediment, Dioxins & Furans	Surface Sediment, OC Pesticides	Surface Sediment, PAHs & Alkyl Homologs	Surface Sediment, Chlorobenzenes	Fish Tissue, PCB Congeners	Fish Tissue, Dioxins & Furans	Fish Tissue, OC Pesticides	Fish Tissue, PAHs & Alkyl Homologs	Fish Tissue, Chlorobenzenes	Fish Tissue, Total Mercury	Fish Tissue, Lipids
Saint Jones	Fork Branch, State College Rd	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	McKee Run	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Silver Lake, Upstream of Dam	√	√	√	√	√	√	√		√	√	√	√	√		√	√	√	√		√	√
	St. Jones, Route 13	√	√	√	√	√	√	√		√	√	√	√	√		√	√	√	√		√	√
	St. Jones, Route 10	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Saint Jones, Route 1	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Saint Jones, Mouth	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Wyoming Mill Pond	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Moores Lake	√	√	√	√	√	√			√	√	√	√	√		√	√	√	√		√	√
	Equipment Blank			√	√	√	√			√	√	√	√	√								
	Lab Duplicate		√							√	√	√	√	√		√	√	√	√		√	√
	Totals	9	10	19	19	19	19	4		11	11	11	11	11		10	10	10	10		10	10

See Notes below.

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Appendix 2 Notes:

1. Surface water field measurements include: water temperature, dissolved oxygen, pH, specific conductivity, and salinity. These measurements will be made by the DNREC ELS.

2. Surface water general lab parameters include: total suspended solids (TSS), particulate carbon (PC), particulate organic carbon (POC), dissolved organic carbon (DOC), and chlorophyll-a. These analyses will be performed by the DNREC ELS.

3. High volume (20-L) surface water samples will be analyzed by AXYS for polychlorinated biphenyls (PCBs), dioxins and furans (DxF), and organochlorine pesticides (OC pesticides). Twenty liter (20-L) water samples will be collected into stainless steel soda cans that have been pre-proofed by AXYS. The 20 liters will be formed by combining two 10-L Niskin grab samples. Following sample collection, the soda cans will be stored in DNREC's walk-in cooler and will be shipped to AXYS as soon as practicable, but no more than 1 week after collection. AXYS will use a benchtop Infiltrex system to remove particles on a 1 micron quartz fiber filter and then pass the filtrate through XAD-2 resin. Solid phase contaminants will be co-extracted from the filter and the dissolved phase will be co-extracted from the resin. Hence, each 20-L water sample will be analyzed for solid phase PCBs, dissolved phase PCBs, solid phase DxF, dissolved phase DxF, solid phase OC pesticides, and dissolved phase OC pesticides. The extracts will be analyzed using high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS). The combination of the patented Infiltrex system for phase separation, co-extraction of target analytes, and high resolution analytical methods makes the overall analytical approach unique among environmental laboratories and will provide DNREC with data of unparalleled quality and utility.

4. Prior to extracting the filter as described in 3 above, AXYS will cut the filter in half, retaining one-half for their contaminant analysis and shipping the other half to TestAmerica in Burlington, VT for total organic carbon (TOC) and black carbon (BC) analysis.

5. PAHs shall include: parent and alkyl homologs per AXYS' List 2. AXYS will analyze PAHs in water, sediment, and fish tissue samples collected from the C&D Canal and Saint Jones watersheds but not the Red Lion Creek.

6. To provide an independent check on the efficiency of the Infiltrex system at separating and retaining particulate phase and dissolved phase PCB, a limited number of 2.5-L water samples will be collected at selected stations at the same time that the 20-L samples are collected. For shallow water sites, two 2.5-L samples will be collected directly into factory-sealed, certified amber glass bottles equipped with Teflon screw caps. For deep water sites, water will be collected into a 20-L Niskin and then transferred into two separate 2.5-L glass bottles. In both cases, the 2.5-L samples will be handled, stored, and shipped in an identical fashion as the 20-L samples. Upon receipt, AXYS will extract one of the 2.5-L samples for the station on a whole water basis. AXYS will filter the other 2.5-L sample for the station through a 1 micron quartz fiber filter identical to the type used for the 20-L samples. A separate extract will be produced for the filtrate. AXYS will analyze the whole water extract and the extract from the filtrate for PCB congeners using method 1668A.

7. Chlorobenzenes shall include: monochlorobenzene; dichlorobenzenes (1,2-DCB, 1-3-DCB, and 1,4-DCB); trichlorobenzenes (1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, 1,3,5-trichlorobenzene); tetrachlorobenzenes (1,2,3,4-tetrachlorobenzene, 1,2,3,5-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene); pentachlorobenzene; and hexachlorobenzene. Chlorinated benzenes in surface water, sediment, and biota shall be analyzed by TestAmerica using GC/MS. All water samples from the Red Lion Creek will be analyzed for chlorobenzenes, while only 2 water samples from the C&D Canal will be analyzed for chlorobenzenes. No samples from the Saint Jones watershed are to be analyzed for chlorobenzenes. For the stations where water samples are to be analyzed for chlorobenzenes, two, 2.5-L water samples will be collected in a manner described above in note 6. Upon receipt, TestAmerica will extract one of the 2.5-L samples for the station on a whole water basis. TestAmerica will filter the other 2.5-L sample for the station through a 1 micron quartz fiber filter of the same specification as used at AXYS for their filtrations.

8. Surface sediment general parameters include: TOC and BC, moisture content, grain size, bulk density, and specific gravity of solids. These analyses will be performed by TestAmerica.

9. Total mercury in fish tissue will be analyzed by DNREC's ELS.

10. A rinsate (equipment) blank will be prepared for the 10-L Niskin bottle by pouring hi-purity lab water supplied by AXYS into the Niskin bottle and then from the Niskin bottle back into the original bottle. The resulting rinsate blank will be analyzed by AXYS for PCBs, dioxins and furans, and organochlorine pesticides on a whole water basis. The source of the hi-purity lab water used for the rinsate will be the same as that used for laboratory method blank analyses. A separate rinsate blank of the Niskin bottle will be analyzed by TestAmerica for chlorobenzenes. In this case however the source of the rinsate water shall be hi-purity lab water supplied by TestAmerica. Equipment blanks will also be prepared for the sediment grab sampling equipment, one for PCBs, dioxins and furans, and organochlorine pesticides to be analyzed by AXYS and one for chlorobenzenes to be analyzed for chlorobenzenes.

11. A lab duplicate will be analyzed for all target organic compounds for 1 sediment sample and 1 fish sample per watershed. A lab duplicate will also be analyzed for mercury for 1 fish sample per watershed.

Appendix B: Citizens Monitoring Reports

UD Citizen Monitoring Program
Total Suspended Solids, Chlorophyll a, Nutrients (DIP and DIN) and Total Enterococcus Statistics
9/1/06 - 8/31/11

Test Site Code	Test Site Location	# of TSS Samples	Average TSS (mg/L)	# of Chl a Samples	Average Chl a (µg/L)	# of DIP Samples	Average DIP (mg/L) [Std=0.01]	# of DIN Samples	Average DIN (mg/L) [Std=0.14]	# of TE Samples	Marine Water TE geomean (MPN/100ml) [Std=35]	Fresh Water TE geomean (MPN/100ml) [Std=100]
	Delaware Bay											
DB01	End of Cape Shores pier									82	8	
	Broadkill River Watershed - Fresh											
BR06	Ingram Ditch at the intersection of Rds 212 and 231.	71	6.2	71	2.2	54	0.03	54	6.83	68		234
BR10	Ingram Branch at Rt 319	77	3.7	78	2.9	60	0.43	60	15.75	77		418
BR44	Wagamon's Pond, Milton	56	10.9	57	35.8	39	0.03	39	1.70	55		54
BR48	Diamond Pond	78	5.5	78	13.8	60	0.02	60	2.96	76		11
	Broadkill River Watershed - Tidal											
BR01/01B	Broadkill river @ PEL dock or, by boat	77	79.9	78	10.8	65	0.02	65	0.24	79	11	
BR02	Prime Hook NWR Petersfield Ditch water control structure, 50m N of R	32	35.1	32	38.5	32	0.01	32	0.85	33	55	
BR03	Prime Hook Creek at Boat Ramp at Refuge Headquarters	71	37.6	72	78.2	60	0.02	60	0.34	71	61	
BR04	Prime Hook NWR Walls Island water control structure, 400m SE of Rt.	13	230.8	14	190.0	14	0.32	14	4.50	14	246	
BR132	Deep Hole Creek	14	93.7	14	21.8	15	0.03	15	0.82	13	87	
BR19	Canary Creek at New Road	62	35.3	62	35.2	51	0.03	51	0.40	60	211	
BR20	Broadkill River at Milton tidal pond	78	3.8	78	9.8	59	0.01	59	2.83	76	27	
BR21	Old Mill Creek downstream from Red Mill Pond	72	26.6	73	38.4	61	0.02	61	0.58	70	179	
BR40	Canary Creek at Pilottown Rd	74	60.8	74	10.5	62	0.02	62	0.18	72	14	
	Rehoboth Bay Watershed											
ML	Massey's Landing	78	83.4	78	7.5	78	0.01	78	0.07	74	7	
RB02	Lewes - Rehoboth Canal at Lewes	45	91.5	45	8.9	45	0.02	45	0.24	43	15	
RB04	Herring Creek, Mid-Section	41	51.2	42	22.7	42	0.00	42	0.45	37	36	
RB05	Mouth of Guinea Creek (Pot Nets Creekside)	78	80.0	78	13.9	78	0.00	78	0.23	74	13	
RB06	Guinea Creek (Winding Creek Village)	77	44.8	77	20.2	77	0.01	77	0.65	74	167	
RB06A	Guinea Creek @ Rd 298 Bridge	37	32.7	37	29.6	37	0.02	37	1.29	46	320	
RB07	West Bay Park	77	75.7	78	12.6	78	0.01	78	0.12	74	17	
RB10	Guinea Creek at Rt 5, upstream of Baywood									13		840
RB34	Love Creek at Rt 24 Bridge	76	40.9	77	40.8	76	0.01	76	0.76	72	107	
	Indian River Bay Watershed											
IR04	Warwick Cove	79	59.6	78	24.9	79	0.02	79	0.68	73	19	
IR11	Pot Nets Seaside Pier	77	69.8	77	7.8	77	0.01	77	0.09	73	9	
IR20	Bay Colony	70	52.9	70	12.7	70	0.03	70	0.52	67	18	
IR21	Entrance to Boat House Pond, Indian River Bay									42	14	
IR32	Holly Terrace Acres Canal Dead End, White Creek	70	59.6	73	38.9	72	0.01	72	0.39	68	55	
IR36/36B	James Farm, Pasture Point, Knee deep 150 yds from shore or by boat	51	63.9	51	8.9	52	0.01	52	0.19	47	15	
IR38	Vines Lane	52	62.3	52	28.9	52	0.01	52	0.72	53	34	
IR39	Indian River Inlet at Wheelchair fishing pier			54	7.5							
	Little Assawoman Bay Watershed											
LA03	Mulberry Landing	76	51.7	76	14.2	76	0.00	76	0.25	72	14	
LA09	Dirickson Creek at Road 381 bridge.	76	25.4	78	35.5	77	0.06	77	1.01	73	252	
LA10	Assawoman Canal @ Kent Ave Bridge	58	52.4	58	9.3	58	0.01	58	0.26	59	244	
LA43	Feniwck Island Lagoon									21	193	
LA44	Fenwick Island Cove									21	131	
LA45	Fenwick Island Bayside	71	62.3	71	8.3	71	0.01	71	0.18	68	162	
LA46	Fenwick Island Tide Gauge									22	8	
LA47	Fenwick Island Lagoon, Dagsboro Street, south side									22	20	
SB01	Anchorage Canal @ Rt 1	51	37.0	51	23.6	51	0.01	51	0.29	59	59	
SB02	Anchorage Canal near elbow									16	13	
SB04	Petherton canal/rt1									59	82	
SB07	Layton Canal, South Bethany	52	52.3	52	9.7	52	0.00	52	0.24	63	20	
SB09	Carlisle canal									16	20	
SB10W	Russell Canal west dead end									19	16	
	Assawoman Bay Watershed											
BA01	Keenwick on Bay, Roy Creek	74	65.7	74	9.8	74	0.00	74	0.16	70	14	

UD Citizen Monitoring Program
Total Suspended Solids, Chlorophyll a, Nutrients (DIP and DIN) and Total Enterococcus Statistics
9/1/06 - 8/31/11

Test Site Code	Test Site Location	# of TSS Samples	Average TSS (mg/L)	# of Chl a Samples	Average Chl a (µg/L)	# of DIP Samples	Average DIP (mg/L) [Std=0.01]	# of DIN Samples	Average DIN (mg/L) [Std=0.14]	# of TE Samples	Marine Water TE geomean (MPN/100ml) [Std=35]	Fresh Water TE geomean (MPN/100ml) [Std=100]
	Delaware Bay											
DB01	End of Cape Shores pier									82	8	
	Broadkill River Watershed - Fresh											
BR06	Ingram Ditch at the intersection of Rds 212 and 231.	71	6.2	71	2.2	54	0.03	54	6.83	68		234
BR10	Ingram Branch at Rt 319	77	3.7	78	2.9	60	0.43	60	15.75	77		418
BR44	Wagamon's Pond, Milton	56	10.9	57	35.8	39	0.03	39	1.70	55		54
BR48	Diamond Pond	78	5.5	78	13.8	60	0.02	60	2.96	76		11
	Broadkill River Watershed - Tidal											
BR01/01B	Broadkill river @ PEL dock or, by boat	77	79.9	78	10.8	65	0.02	65	0.24	79	11	
BR02	Prime Hook NWR Petersfield Ditch water control structure, 50m N of R	32	35.1	32	38.5	32	0.01	32	0.85	33	55	
BR03	Prime Hook Creek at Boat Ramp at Refuge Headquarters	71	37.6	72	78.2	60	0.02	60	0.34	71	61	
BR04	Prime Hook NWR Walls Island water control structure, 400m SE of Rt.	13	230.8	14	190.0	14	0.32	14	4.50	14	246	
BR132	Deep Hole Creek	14	93.7	14	21.8	15	0.03	15	0.82	13	87	
BR19	Canary Creek at New Road	62	35.3	62	35.2	51	0.03	51	0.40	60	211	
BR20	Broadkill River at Milton tidal pond	78	3.8	78	9.8	59	0.01	59	2.83	76	27	
BR21	Old Mill Creek downstream from Red Mill Pond	72	26.6	73	38.4	61	0.02	61	0.58	70	179	
BR40	Canary Creek at Pilottown Rd	74	60.8	74	10.5	62	0.02	62	0.18	72	14	
	Rehoboth Bay Watershed											
ML	Massey's Landing	78	83.4	78	7.5	78	0.01	78	0.07	74	7	
RB02	Lewes - Rehoboth Canal at Lewes	45	91.5	45	8.9	45	0.02	45	0.24	43	15	
RB04	Herring Creek, Mid-Section	41	51.2	42	22.7	42	0.00	42	0.45	37	36	
RB05	Mouth of Guinea Creek (Pot Nets Creekside)	78	80.0	78	13.9	78	0.00	78	0.23	74	13	
RB06	Guinea Creek (Winding Creek Village)	77	44.8	77	20.2	77	0.01	77	0.65	74	167	
RB06A	Guinea Creek @ Rd 298 Bridge	37	32.7	37	29.6	37	0.02	37	1.29	46	320	
RB07	West Bay Park	77	75.7	78	12.6	78	0.01	78	0.12	74	17	
RB10	Guinea Creek at Rt 5, upstream of Baywood									13		840
RB34	Love Creek at Rt 24 Bridge	76	40.9	77	40.8	76	0.01	76	0.76	72	107	
	Indian River Bay Watershed											
IR04	Warwick Cove	79	59.6	78	24.9	79	0.02	79	0.68	73	19	
IR11	Pot Nets Seaside Pier	77	69.8	77	7.8	77	0.01	77	0.09	73	9	
IR20	Bay Colony	70	52.9	70	12.7	70	0.03	70	0.52	67	18	
IR21	Entrance to Boat House Pond, Indian River Bay									42	14	
IR32	Holly Terrace Acres Canal Dead End, White Creek	70	59.6	73	38.9	72	0.01	72	0.39	68	55	
IR36/36B	James Farm, Pasture Point, Knee deep 150 yds from shore or by boat	51	63.9	51	8.9	52	0.01	52	0.19	47	15	
IR38	Vines Lane	52	62.3	52	28.9	52	0.01	52	0.72	53	34	
IR39	Indian River Inlet at Wheelchair fishing pier			54	7.5							
	Little Assawoman Bay Watershed											
LA03	Mulberry Landing	76	51.7	76	14.2	76	0.00	76	0.25	72	14	
LA09	Dirickson Creek at Road 381 bridge.	76	25.4	78	35.5	77	0.06	77	1.01	73	252	
LA10	Assawoman Canal @ Kent Ave Bridge	58	52.4	58	9.3	58	0.01	58	0.26	59	244	
LA43	Feniwck Island Lagoon									21	193	
LA44	Fenwick Island Cove									21	131	
LA45	Fenwick Island Bayside	71	62.3	71	8.3	71	0.01	71	0.18	68	162	
LA46	Fenwick Island Tide Gauge									22	8	
LA47	Fenwick Island Lagoon, Dagsboro Street, south side									22	20	
SB01	Anchorage Canal @ Rt 1	51	37.0	51	23.6	51	0.01	51	0.29	59	59	
SB02	Anchorage Canal near elbow									16	13	
SB04	Petherton canal/rt1									59	82	
SB07	Layton Canal, South Bethany	52	52.3	52	9.7	52	0.00	52	0.24	63	20	
SB09	Carlisle canal									16	20	
SB10W	Russell Canal west dead end									19	16	
	Assawoman Bay Watershed											
BA01	Keenwick on Bay, Roy Creek	74	65.7	74	9.8	74	0.00	74	0.16	70	14	

UD Citizen Monitoring Program
Dissolved Oxygen Statistics
9/1/06 - 8/31/11, Sites with >4 Measurements

Aquatic Life Use is not supported if 2 or more DO Samples are less than 4.0 mg/L				
Test Site Code	Test Site Description	# of DO Samples	Average DO (mg/L)	# of DO Samples less than 4.0 (mg/L)
	Delaware Bay			
DB01	End of Cape Shores pier	113	8.32	
	Broadkill River Watershed - Fresh			
BR06	Ingram Ditch at the intersection of Rds 212 and 231.	52	6.90	5
BR10	Ingram Branch at Rt 319	102	6.53	3
BR48	Diamond Pond	128	9.73	2
BR54	Red Mill Pond outlet at Rt 1	7	12.71	
BR56	Red Mill Pond - Sycamore Drive	6	9.78	
	Broadkill River Watershed - Tidal			
BR01/01B	Broadkill river @ PEL dock, or by boat	121	6.56	6
BR02	Prime Hook NWR Petersfield Ditch water control structure, 50m N of Rt 16.	16	7.96	
BR03	Prime Hook Creek at Boat Ramp at Refuge Headquarters	142	5.38	50
BR19	Canary Creek at New Road	103	4.07	59
BR20	Broadkill River at Milton tidal pond	103	7.92	
BR21	Old Mill Creek downstream from Red Mill Pond	182	4.30	99
BR40	Canary Creek at Pilottown Rd	148	6.71	14
	Rehoboth Bay Watershed			
AC2S	DNREC Site, Arnell Creek, surface sample	20	7.07	2
ML	Massey's Landing	62	7.52	
RB02	Lewes - Rehoboth Canal at Lewes	82	6.06	6
RB03	Lewes - Rehoboth Canal at Harbor View Road	11	4.67	3
RB04	Herring Creek, Mid-Section	25	6.75	
RB05	Mouth of Guinea Creek (Pot Nets Creekside)	172	6.14	30
RB06	Guinea Creek (Winding Creek Village)	128	5.95	16
RB06A	Guinea Creek @ Rd 298 Bridge	28	7.07	8
RB06B	Guinea Creek (Winding Village) by boat	11	4.76	2
RB07	West Bay Park	155	6.41	6
RB08	Lewes City Dock	11	3.95	5
RB10	Guinea Creek above golf course	13	5.16	4
RB34	Love Creek at Rt 24 Bridge	57	6.80	8
RB46	Torquay Canal at East bulkhead on Land's End.	36	5.65	12
RB63	Upper Love Creek near Webb Landing	35	5.43	3
RB64	Torquay Canal, west side of Land's End near UD Site #1	44	3.84	27
RB69	Torquay Canal DNREC site. TC1	19	7.70	1
RB75B	Junction of Guinea and Herring Creeks, by boat	13	4.25	6
RB76B	Herring Creek at Rehoboth Bay, by boat	12	4.63	4
RB77B	Lower Central Rehoboth Bay, by boat	13	6.40	
RB78B	Mid Central Rehoboth Bay, by boat	12	6.36	
RB79B	Upper Central Rehoboth Bay, by boat	12	6.14	
RLC1W	Shellfish site, mouth of Love Creek, by boat	6	5.30	1
RLC2S	DNREC site, upper Love Creek	20	8.75	
	Indian River Bay Watershed			
IR03	Yellow Bank	49	6.08	7
IR04	Warwick Cove	97	7.26	3
IR07	Holt's Landing State Park	67	6.20	3
IR11	Pot Nets Seaside Pier	102	7.17	
IR12	Broken marshes, 1/4 mile SE of Quillens Point - 300 Bayfront Drive	95	6.75	6
IR20	Bay Colony	114	5.13	42
IR21	Entrance to Boat House Pond, Indian River Bay	102	6.17	18
IR23	Bethany Marina	7	8.71	
IR29	Holly Terrace Acres Canal, White Creek	124	4.51	59

UD Citizen Monitoring Program
Dissolved Oxygen Statistics
9/1/06 - 8/31/11, Sites with >4 Measurements

Aquatic Life Use is not supported if 2 or more DO Samples are less than 4.0 mg/L

Test Site Code	Test Site Description	# of DO Samples	Average DO (mg/L)	# of DO Samples less than 4.0 (mg/L)
IR32	Holly Terrace Acres Canal Dead End, White Creek	87	4.64	46
IR36/36B	James Farm, Pasture Point - shoreline and by boat	16	7.13	
IR38	Vines Lane	154	5.77	38
IR39	North side of Inlet at Wheelchair fishing platform under new bridge.	70	7.38	
IR41B	Indian River buoy #1, by boat	8	6.30	
IR42B	Indian River buoy #R26, N of Grey's Pt, by boat	9	5.97	
IR43B	Indian River buoy #R22; N of Holt's Lnd, by boat	9	6.14	
IR46B	Pepper Creek Buoy #1, by boat	9	5.83	
IR48B	Indian River green buoy #G5 west of White Creek, by boat	9	5.90	
IR50	Assawoman Canal at N end, marina dock	45	5.71	14
IR51	Pepper Creek, Creekside	33	5.88	3
IR59	White Creek - west prong near Food Lion	13	4.06	8
IR60A	Ocean View; E Branch of White Creek	13	3.72	9
IR62	Loop Canal, Pa Ave terminus, Bethany Beach	48	3.03	32
IR64	Bethany Beach canal off dead end at 3rd street East of Evans Rd.	13	2.78	10
IR73	Western edge of Salt Pond	55	4.33	25
	Little Assawoman Bay Watershed			
JC08B	SB, Jefferson Creek Basin between Assawoman canal extensions, by boat	18	5.30	2
LA03	Mulberry Landing	75	6.85	9
LA09	Dirickson Creek at Road 381 bridge.	63	5.58	22
LA10	Assawoman Canal @ Kent Ave Bridge	85	5.02	33
LA15B	Near red channel marker #12, by boat	17	5.88	
LA19B	Mid Dirickson Creek off Swann Keys, by boat	18	5.02	3
LA20	Swann Keys: boat ramp at S end of Blue Teal Rd	11	3.17	9
LA21	Williams Creek tributary, bridge on Rd 364a	14	3.05	12
LA31	Double Bridges road bridge at Plantation Park	13	3.44	9
LA38	Hamlet at Dirickson Pond	15	7.32	
LA42B	Narrows, South of state beach at point, by boat	18	5.15	1
LA43	Fenwick Island Lagoon	149	6.05	25
LA44	Fenwick Island Cove	146	6.45	17
LA45	Fenwick Island Bayside	150	6.53	14
LA46	Fenwick Island Tide Gauge	21	6.34	1
LA47	Fenwick Island Lagoon, Dagsboro Street, South Side	21	6.01	4
LA48	Fenwick Island, W. Georgetown St.	12	4.48	4
SB01	Anchorage Canal @ Rt 1	112	4.42	57
SB02	Anchorage Canal near elbow	99	5.76	24
SB04	Petherton canal/rt1	110	4.61	57
SB05	Petherton canal, between lots 156 and 162	76	5.68	17
SB07	Layton Canal, South Bethany	145	5.84	30
SB09	Carlisle canal	107	4.91	52
SB10E	Russell Canal east dead end	110	4.19	56
SB10W	Russell Canal west dead end	132	4.40	63
SB12	Jefferson Canal West side @ tidal gage	109	5.79	25
	Assawoman Bay Watershed			
BA01	Keenwick on Bay, Roy Creek	54	6.44	6

Appendix C: Response to Comments

Response to Comments:

Commenter: US EPA Region 3

- *As a policy matter, EPA has requested that states provide a long-term schedule for TMDL development for all waters on the State's list (see memorandum from Robert Perciasepe, Assistant Administrator for Water, to Regional Administrators and Regional Water Division Directors, "New Policies for Developing and Implementing TMDLs," 8/8/1997). DNREC has provided such a schedule in the past, staying within EPA's recommended time period of 8 to 13 years from initial listing. In the draft 2012 list, DNREC has modified its schedule for many of the waters still in need of TMDLs for toxic pollutants, many now going beyond the 13 year pace guidance recommendation. EPA has reviewed the April 23, 2012 DNREC document "Watershed Approach to Toxics Assessment and Restoration," and understands DNREC's plans and schedule for completing the TMDLs for toxics. However, EPA would like to see the yearly "key activities" in the document reflected in the State's 106 commitments, and all of the target dates identified on the list as "2017+" should be modified to be simply "2017."*

- *The PCBs listings that indicate were listed in 1996 should note that the EPA established PCB TMDL for Zone 6 of the Delaware Estuary (December 2006) assigned loads to the major tributaries of Zone 6 at a level that would attain applicable water quality standards. It was anticipated that, due to the more stringent water quality standards for PCBs for the estuary, when the tributaries meet the allocations established for Zone 6 then the individual tributary segments would meet the water quality standards applicable to them as well. To confirm this assumption, DNREC was to continue to monitor those waters and commit to complete individual TMDLs for the water segments if needed.*

- *EPA notes that the Hoopes Reservoir is still listed as Category 3, i.e., insufficient data to determine whether any designated uses are met, and has been since 2004. EPA encouraged DNREC to resolve the status of this waterbody in the last listing cycle, and would like an update on DNREC's study "to determine if a listing is appropriate." On the same note, DNREC should indicate its progress on its study of iron in the Delaware River (DRBC Zone 5).*

The Department worked with Region 3 to address these comments and others that came about in the interim between publication of the draft documents and this final document. The revised “Watershed Approach to Toxics Assessment and Restoration” document has been attached as an appendix to the final document. In addition, the Department is working with the Region to reflect the plans in the State’s 106 commitments.

DNREC is committed to monitoring PCBs and updating or implementing TMDLs as needed in the future in cooperation with stakeholders and EPA.

DNREC plans to work through the issues in Hoopes Reservoir and DRBC Zone 5 in the near future in cooperation with stakeholders and EPA.

Commenter : Center for Biological Diversity

The Commenter submitted a 13 page letter and CD of supporting documents requesting that Delaware list Coastal Waters and the Delaware Bay as threatened or impaired waterbodies due to Ocean Acidification under Section 303(d) of the Clean Water Act. Copies of the letter and CD are available for review on request at the Watershed Assessment Branch office.

The Department is aware of research being conducted by US EPA into the issues raised. EPA has web pages at the following URLs related to the questions raised by the commenter:
http://www.epa.gov/waterscience/criteria/aqlife/marine-ph.html
http://www.epa.gov/owow/TMDL/oceanfrMarch_2010/

The Department is not convinced it is appropriate to list all ocean waters for pH at this time for the following reasons:
1.The submission had no Delaware specific data or information.
2 No evidence was submitted showing that Delaware's applicable pH standards were not being attained.
3. Information submitted related to scientific studies of the Chesapeake Bay are not necessarily applicable in the Delaware Bay.

At this time, the Department feels it is most appropriate to work with EPA and stakeholders to determine what course to proceed on this issue.