APPOQUINIMINK RIVER WATERSHED PLAN

A SUMMARY OF THE KEY PARTS OF THE APPOQUINIMINK POLLUTION CONTROL STRATEGY

JANUARY 2012

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EXECUTIVE SUMMARY

Total Maximum Daily Loads (TMDLs) are the maximum amount of a pollutant that a waterbody can assimilate and still achieve water quality standards. They were established for the entire Appoquinimink River in December, 2003 (Appendix A). These TMDLs called for a 60% reduction in nonpoint nitrogen and phosphorus loading. An implementation plan, or a Pollution Control Strategy (Strategy), was to be developed by a Tributary Action Team, a diverse group of citizens and government agency personnel and presented to the Department for promulgation to reach the prescribed TMDLs (Appendix B). This document reflects those recommendations made by the Appoquinimink Tributary Action Team (Team) based on a consensus-seeking process.

The process used to generate this Strategy, "*Public Talk-Real Choices*", places importance on putting the public first in policy-making (Appendix C). The Tributary Action Team recommended a Pollution Control Strategy, a set of actions for achieving the TMDL, to the Department. This Strategy is based on general principles developed by the Team after a public forum and many meetings. These principles, or common ground, are the foundation that the Team used in building their Strategy. The following guiding principles were discussed and agreed upon during the June 2001 public forum. These principles served to guide the writing of the actions within the Pollution Control Strategy.

- Concurrence of all applicable laws, regulations and ordinances are needed to achieve the TMDL.
- Regulation must be fair and reasonable; rules must apply to everyone equally.
- Watershed residents need to be informed as to the problems and solutions of water quality. (education)
- Participation by residents will be necessary in order to achieve the required nutrient reductions.
- We need to use a combination of policy and management tools in the PCS.
- There needs to be a mechanism in place that measures progress towards achieving water quality goals and communicates it to the public at regular intervals.

The Strategy itself addresses several areas for nutrient loading reduction with nonpoint sources of pollution:

- Agriculture
- Development
    - Stormwater
    - Impervious Cover Limits
    - Open Space
- Wastewater
    - Inspection/Replacement
    - Performance Standards
    - Education

The Strategy is designed to reduce nutrient loadings from current and future land practices. This combination of actions will lead to the achievement of the TMDL. Scientific literature and experts in the pertinent fields were consulted and assisted the Department in estimating the nutrient reductions that would be achieved through the promulgation of this Strategy. These estimates are shown throughout this document and specific documentation is provided in Appendix D. In addition, the Strategy reviews the various costs associated with the recommended actions in Appendix E. The Strategy also recommends funding mechanisms and implementation schedules, where appropriate, as well as identifies responsible parties. Finally, the strategy reviews the agencies and programs that are charged with implementing elements of the Strategy.

The Department intends to review the Strategy in ten years to assure progress towards achieving water quality standards. Table 1 summarizes the various actions considered in this Pollution Control Strategy.

Table 1: Pollution Control Strategy Action Items

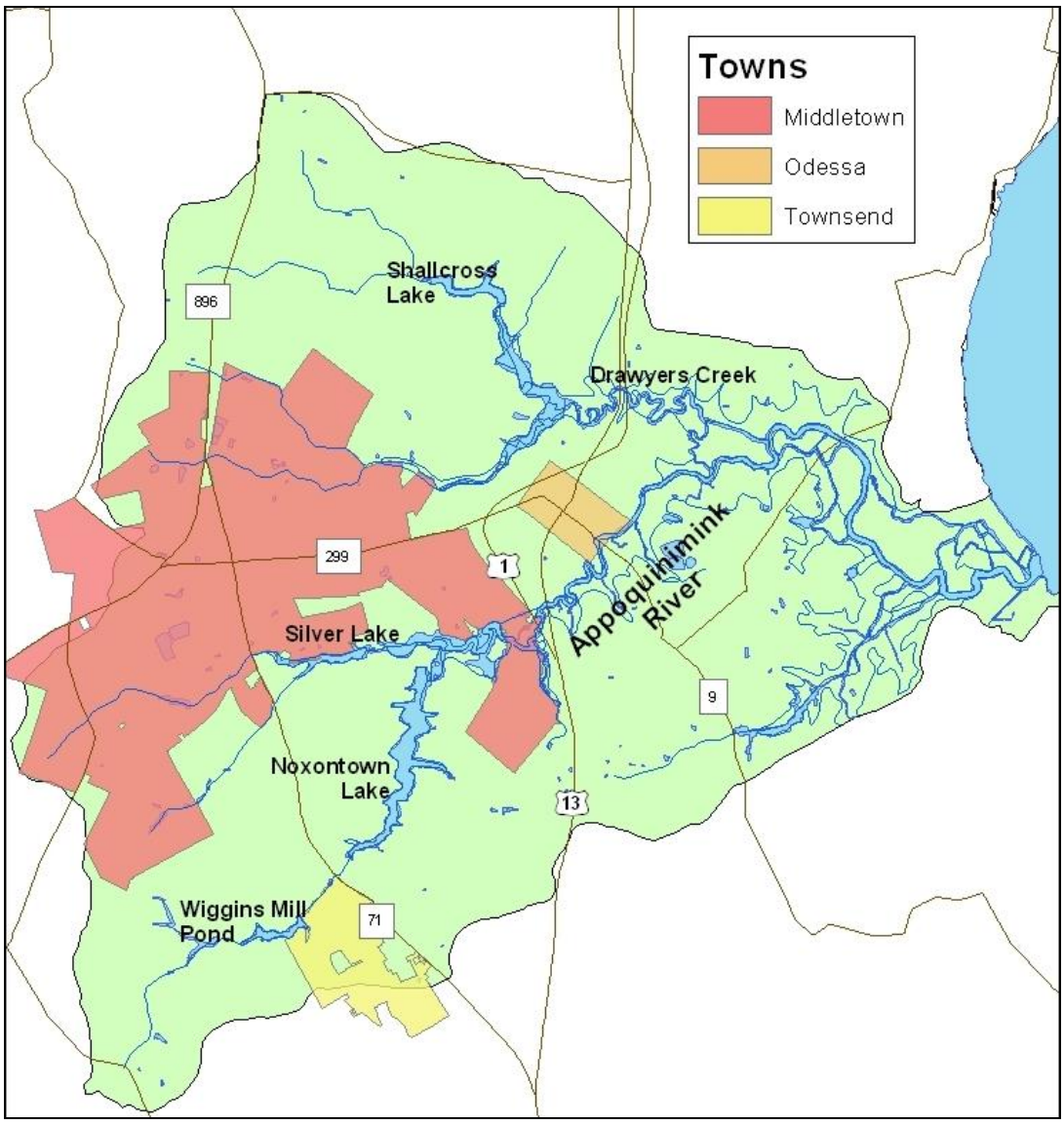
PCS Action	*Path Towards Implementation*
Agriculture	
The State should continue funding nutrient management planning.	**Voluntary**
The State should continue funding agricultural best management practices to ensure maintenance of current levels of implementation.	**Voluntary**
A recognition program should be created for farmers in the Appoquinimink watershed who do the most to protect water quality.	**Voluntary**
Development	
State, county and local governments should coordinate efforts with nonprofit organizations to provide an ongoing environmental education and outreach program for residents.	**Voluntary**
Stormwater	
All permanent sediment and stormwater management plans should be designed and implemented to include criteria that will reduce nutrient loading by the percentage required to meet TMDL-required nutrient load reductions of ground and surface waters to the maximum extent practicable.	**Regulatory – To be included in the updated State Sediment and Stormwater Regulations**

Local governments should establish a community stormwater runoff education and stormwater management area maintenance program for the watershed to provide resources to educate homeowners, homeowners' associations (HOAs), and groups that maintain stormwater structures.	**Voluntary**
Within 6 months from the promulgation of the PCS, DNREC should convene a group composed of representatives from the community and local, county, and state government to establish a stormwater retrofit process for the Appoquinimink watershed.	**Voluntary**
Impervious Cover Limits	
The State should promulgate a watershed-wide limit for impervious coverage with consideration for site-specific mitigation and emphasis on water resource protection areas.	**Regulatory – To be included in the updated State Sediment and Stormwater Regulations**
Open Space	
All open space land uses should be designed and managed for water quality protection, including reduced nutrient loading. Reforestation, meadow development, wetlands construction, and other natural resource preservation should be encouraged through increased outreach efforts by the appropriate jurisdictions and local nonprofit organizations.	**Voluntary**
Wastewater	
Seepage pits and cesspools should be prohibited within the watershed.	**Regulatory – To be included in the updated Regulations Governing the Design, Installation, and Operation of Onsite Wastewater Treatment and Disposal Systems**
Existing holding tanks must be operated in accordance with their permits and their conditions. In instances where central sewer service will become available within five years, temporary holding tanks will only be permitted after the Department receives a letter (with an approved Certificate of Public Convenience and Necessity (CPCN), where applicable) stating when central sewer will become available from New Castle County, the appropriate local government, or the wastewater utility**.**	**Regulatory – To be included in the updated Regulations Governing the Design, Installation, and Operation of Onsite Wastewater Treatment and Disposal Systems**

Inspection/replacement	
All properties utilizing an OWTDS that are sold or otherwise transferred to other ownership shall have their systems pumped out and inspected prior to the completion of the sale. These requirements can be filled by supplying (1) the certificate of completion, (2) documentation of a pump out and inspection within the previous 36 months, or (3) proof of a licensed operator or an annual service contract with a certified service provider.	**Regulatory – To be included in the updated State Regulations Governing the Design, Installation, and Operation of Onsite Wastewater Treatment and Disposal Systems**
Convert as many lots as feasible (of less than 2 acres each) currently on septic to sewer connection in an equitable manner whereby those systems of high priority and feasibility (where there is already infrastructure in place) are converted first. The State and DNREC should provide cost share and grant monies to these homeowners to help offset costs.	**Voluntary**
Performance Standards	
All new and replacement onsite wastewater disposal systems must be designed to achieve performance standards as specified in the PCS regulation. To provide proper operation and maintenance of the innovative and alternative onsite wastewater treatment and disposal system, the permittee is required to adhere to Department permit conditions. These permit conditions require mandatory operation and maintenance for the life of the system by maintaining a service contract with a certified service provider.	**Regulatory – To be included in the updated State Regulations Governing the Design, Installation, and Operation of Onsite Wastewater Treatment and Disposal Systems**
Education	
The State, County and local governments should work together to develop and disseminate homeowner education materials. The materials should inform septic system owners about proper maintenance of their septic systems, and be based on the system type that is used, such that nutrient loading from the system is minimized. The materials should emphasize the dual benefits of proper system maintenance to both homeowner and watershed.	**Voluntary**

BACKGROUND

The Appoquinimink River Watershed drains approximately 30,200 acres (47 sq miles) of coastal plain farmland in southern New Castle County, as well as the urbanized areas of Middletown, historic Odessa, and Townsend before discharging into the Delaware Bay. The topography is generally characterized by flat to gently sloping land which is typical of the coastal plain. The upland portion of the watershed is generally flat, but steep slopes can be found associated with stream valleys in the headwaters.



Notably, the expansive tidal wetlands at the mouth of the Appoquinimink River in conjunction with the Blackbird River to the south represent one of the largest undisturbed marsh systems in Delaware. These wetlands serve as important habitat for wildlife and waterfowl, spawning grounds for fish and other aquatic species, and passive recreation for local birdwatchers at the St. Augustine Wildlife Area. Noxontown Pond, Shallcross Lake, Silver Lake, and Wiggins Mill Pond are the four largest freshwater impoundments in the watershed. The Appoquinimink River

is tidal from the confluence with Delaware Bay to the dam at Noxontown Lake on the main stem, the dam at Silver Lake on Deep Creek, and the confluence with Drawyers Creek. Salinity intrusion from Delaware Bay typically reaches upstream past the Drawyers Creek confluence at river kilometer (Rkm) 8.5.

In addition to surface waters in the Appoquinimink watershed, groundwater plays an important role throughout the area. Groundwater is found within the surficial Columbia aquifer that is recharged directly by rainfall where soil permeability is high. Deeper groundwater aquifers commonly used for well water are recharged from upgrade areas of the County (TRC, 2004). Due to the highly permeable soil conditions, 30% of the upland area in the watershed has been designated by the Delaware Geological Survey (DGS) as a Water Resource Protection Area (WRPA). In these areas, subsurface flow can supply a significantly larger portion of water to surface streams than overland runoff (TRC, 2004).

LAND USE

More than half of the watershed is actively cultivated; however, as development spreads south of the Chesapeake and Delaware canal, these farmlands are rapidly converting into suburban residential uses.

Impervious cover is a revealing indicator of the extent and pattern of growth in the watershed. In 1992, watershed impervious cover was estimated to be 4%, but grew to 9% in 2007, and is projected to reach a maximum of 25% in the future. Hydrologic changes resulting from the urbanization of agricultural lands may result in increased flooding, channel erosion, and water quality impacts in the watershed (CWP, 2005b).

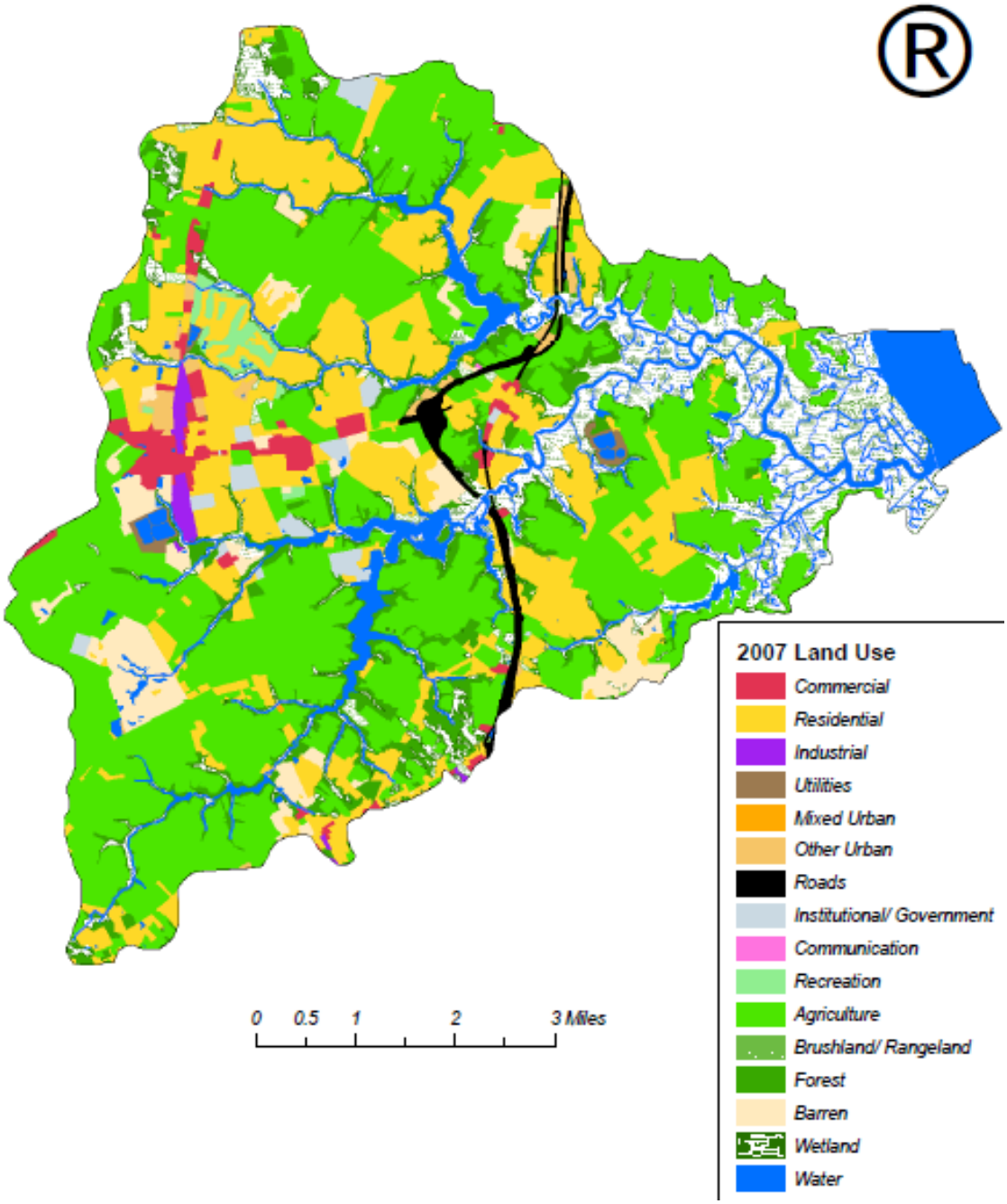
Less than 9% of the watershed remains forested, dominated by oak, hickory, pine, and species common to southern floodplain and mixed forest assemblages. Most forested areas are located along the stream valley, and very few large contiguous tracts of un-fragmented forest remain in the watershed (CWP, 2005b).

In 1992, less than 12% of the watershed was classified as urban land and the majority of the land was used for agriculture (63%). Based on 2002 land use data, just over half of the watershed was in agricultural use (51%) and almost a quarter of the watershed was classified as urban uses (20%). Current land use estimates from 2007 data show that the land use of the Appoquinimink continues to change with 27% of the land now considered urban and 42% agricultural. Table 2 summarizes the land use change in the Appoquinimink Watershed.

Table 2: Land Use Changes in the Appoquinimink Watershed

	Urban	*Agriculture*	*Water*	*Wetland*	*Forest*	*Other*
1992	11%	62%	4%	13%	9%	1%
1997	13%	59%	4%	13%	9%	2%
2002	20%	52%	4%	13%	8%	3%
2007	27%	42%	5%	13%	8%	5%

(Note: The category “Other” is made up of rangeland and barren lands which include the land found under utility lines.)



WATER QUALITY

The Appoquinimink River watershed has historic water quality problems with respect to nutrient and low dissolved oxygen concentrations. The aquatic ecosystem is most sensitive to water quality impairments during the summer months given the combined effects of low sediment oxygen demand levels induced by pollutant loads, hydrodynamics such as tidal influences, and the fact that oxygen becomes less soluble as water temperature increases (USEPA, 2003).

Historically, pollution from the agricultural land base, followed by septic systems and the Middletown-Odessa-Townsend Wastewater Treatment Plant (MOT WWTP) were the major contributing sources of nutrients within the watershed (Ritter and Levan, 1993). It was estimated that more than 75% of the nitrogen (N) and phosphorus (P) load was from cropland, whereas the WWTP largely made up the remaining P load. Septic systems contributed a minimal amount of P, but had the potential to have a large impact on the N load (Ritter and Levan, 1993).

Since that time, both direct and indirect measures have contributed to a decrease in nutrient loadings to the watershed such as the implementation of agricultural best management practices (BMPs) and a change from septic to sewered urban areas. However, at the same time nutrient loadings have increased from previously unimportant sources including nonpoint sources. Pollutant loads not associated with discrete discharges are categorized as nonpoint sources. In contrast to continuous discharge from treatment plans, loading from nonpoint sources is typically intermittent, diffuse, and difficult to track back to specific sources. Nonpoint sources of pollution can come from most land uses through overland flow. However, nonpoint source pollution can also leach into ground water and subsequently enter surface water. Major land use changes have recently occurred and continue to occur within the watershed as more agricultural land is converted to medium and high-density residential suburban land use.

The only non-stormwater point source in the watershed is the Middletown-Odessa-Townsend wastewater treatment plant (MOT WWTP). Although the MOT WWTP primarily uses spray irrigation to dispose of its effluent, it is also permitted to discharge to the surface waters of the Appoquinimink River (CWP, 2005b).

The Appoquinimink River currently is designated as a warm-water fishery and is subject to all water quality criteria specific to this designated use and those defined for general statewide water uses including primary and secondary contact recreation; fish, aquatic life, and wildlife; and industrial and agricultural water supply. Several stream segments of the Appoquinimink River basin have been cited on the State's 303(d) list of impaired waters for failing to attain their applicable criteria (DNREC, 2004).

In addition, the DGS reports water quality in most of the groundwater aquifers in the watershed as being "primarily calcium magnesium-bicarbonate type water indicating an anthropogenic/agricultural influence." Nitrate levels greater than natural background levels and pesticides were detected in most of the samples from the shallow aquifers. Of the 16 wells sampled in the Appoquinimink, 11 showed nitrate levels above 0.4 mg/L (background level), mostly in the shallow and unconfined aquifers (CWP, 2005b).

OVERVIEW OF THE TOTAL MAXIMUM DAILY LOAD (TMDL)

Section 303(d) of the Clean Water Act requires states to identify water quality impaired waterways and to develop Total Maximum Daily Loads (TMDLs) for the pollutants that impair those waterways. As such, the Division of Water (Division) determined that the water quality of the Appoquinimink River, and its tributaries are impaired by elevated nutrient levels and low dissolved oxygen concentrations. Symptoms of nutrient enrichment include excessive algae growth, large daily swings in dissolved oxygen levels, loss of submerged aquatic vegetation,

reduced populations of fish, shellfish, and other aquatic life, and fish kills. These symptoms threaten the future of the Appoquinimink River and its significant natural, ecological, and recreational resources, which may result in adverse impacts to the local and State economies through environmental degradation and habitat loss leading to reduced tourism, a decline in property values, lost revenues and a diminished quality of life. Hence, excessive nutrient levels pose a significant threat to the health and well being of people, animals, and plants living within the watershed.

An initial TMDL was prepared by DNREC in 1992 for the Appoquinimink to limit phosphorus loadings to the basin, but was limited to the upper freshwater tidal and lower tidal segments of the Appoquinimink River. As a result of the persistent water quality problems within the watershed, a TMDL was adopted by EPA Region III and DNREC for the Appoquinimink River on January 30, 1998 that expanded the geographic extent and water quality impairments of the 1992 TMDL. The 1998 TMDL addressed water quality impairments due to low dissolved oxygen concentrations violating the water quality standard of 5.5 mg/L. Additional TMDLs were developed for the remaining tributaries and ponds within the Appoquinimink River Basin. These segments were identified as impaired waters on the Delaware's 1996, 1998 and 2002 Section 303(d) lists for their failure to protect aquatic life due to violations of the water quality standard for dissolved oxygen, or nutrients.

In December 2003, EPA approved a TMDL for nutrients and dissolved oxygen impairments for the entire Appoquinimink watershed (Appendix A). In order for the Appoquinimink River to meet water quality standards, the TMDL calls for a 60% reduction in nutrient loadings from the land area within the watershed. The implementation tool was to be a Strategy initiated by the Department and developed by the public through the Appoquinimink Tributary Action Team. In total, the actions within the Strategy must achieve a reduction in nitrogen of 890.83 lb/day and 23.50 lb/day of phosphorus loading (Figures 1 and 2).

While point sources of pollution including the Middletown-Odessa-Townsend Wastewater Treatment Plant were included in the Appoquinimink TMDL, the data did not show reductions needed from the current loads allowed by the plant's stormwater permit.

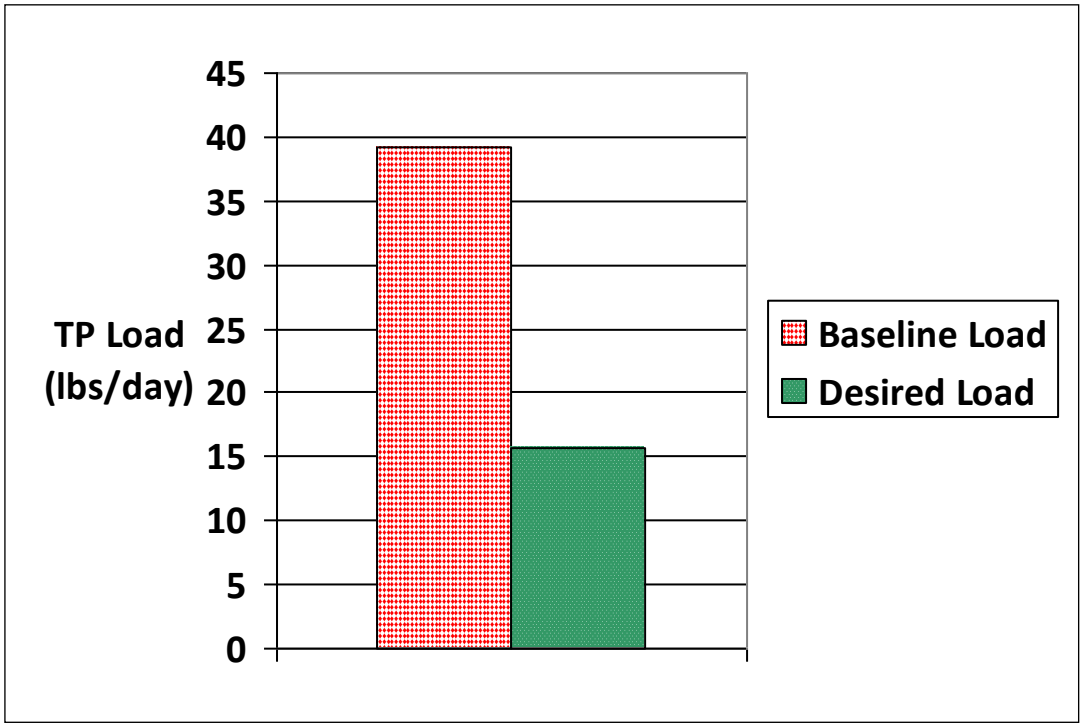


Figure 1: Total Phosphorus Load Reductions Required by the TMDL

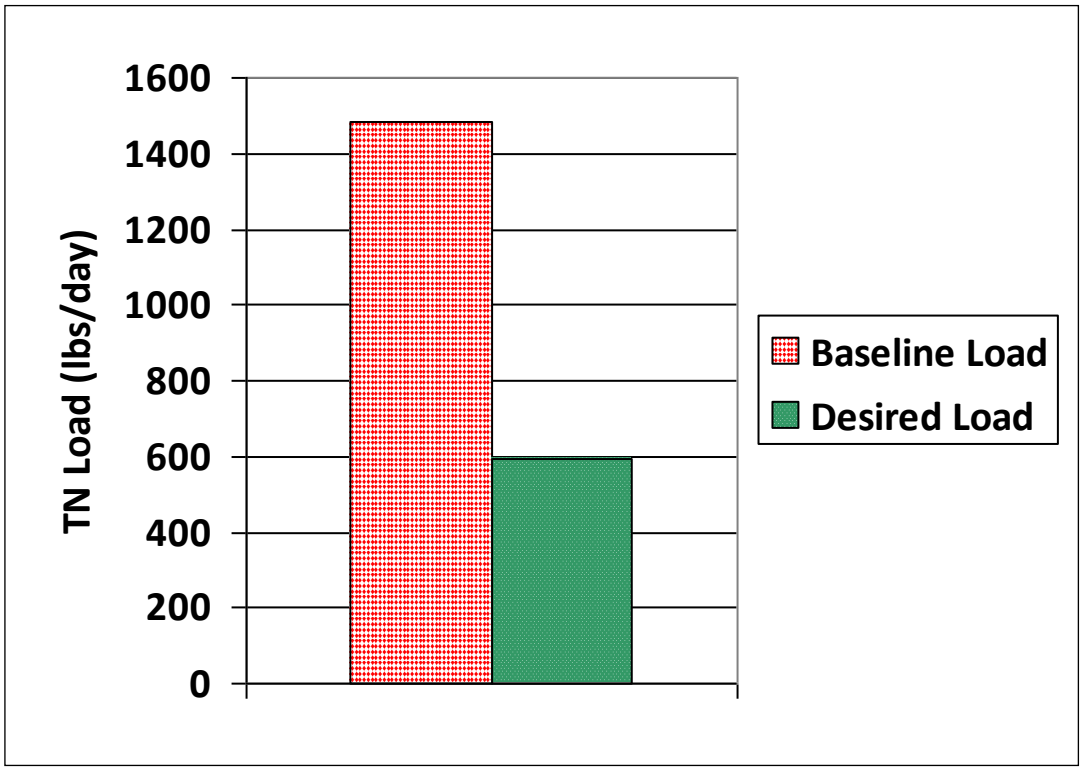


Figure 2: Total Nitrogen Load Reductions Required by the TMDL

THE POLLUTION CONTROL STRATEGY DEVELOPMENT PROCESS

In 2000, The Delaware Department of Natural Resources and Environmental Control (DNREC) approached the Appoquinimink School District's Science Curriculum Coordinator in order to solicit her assistance in forming and facilitating a Tributary Action Team (Team) for the Appoquinimink watershed. This Team was tasked with recommending a Pollution Control Strategy (PCS) to DNREC for meeting the nutrient and dissolved oxygen Total Maximum Daily Load (TMDL) established by EPA in January 1998 (for the tidal portion) and to meet the future TMDL for the tributaries. In December 2003, another TMDL (Appendix A) was established by EPA that included the entire watershed and required a more stringent reduction in nutrient loads. With the creation of the nonprofit organization the Appoquinimink River Association in April 2004 by members of the Team, they too became involved with creating additional recommendations to help strengthen the Pollution Control Strategy. This PCS recommends actions which will work towards achieving a 60% reduction in nonpoint source nutrient loadings to the River and its tributaries. It is based upon the guiding principles that were gleaned from a June 2001 public forum as well as meetings of the Association's Pollution Control Strategy Subcommittee in 2004 and 2005. The principles developed during this process include the following:

- Concurrence of all applicable laws, regulations and ordinances are needed to achieve the TMDL.
- Regulation must be fair and reasonable; rules must apply to everyone equally.
- Watershed residents need to be informed as to the problems and solutions of water quality. (education)
- Participation by residents will be necessary in order to achieve the required nutrient reductions.
- We need to use a combination of policy and management tools in the PCS.
- There needs to be a mechanism in place that measures progress towards achieving water quality goals and communicates it to the public at regular intervals.

PROGRESS TO DATE

Eight years have passed since the TMDL for the Appoquinimink River was promulgated based on 1992 pollution levels. Since that time, population and pressures from development have increased throughout the watershed. However, stormwater and wastewater have improved and farmers have increased their use of best management practices (BMPs). Increased use of BMPs in all sectors reduces nutrient loading and contributes to progress towards achieving water quality standards.

Estimated water quality improvement from the installation of best management practices, after the TMDL baseline, was calculated. Various databases were used to gather the number of practices in place. Scientists researched the nutrient load reduction efficiencies associated with these practices in order to estimate pollution reductions. Appendix D documents those calculations and Appendix E estimates the associated costs.

Agriculture

Since the baseline period, the agricultural community has reduced a significant amount of nonpoint source nitrogen and phosphorus, leading the efforts to curtail nonpoint source loadings. From the baseline to 2008, multiple BMPs have been implemented and the Delaware Nutrient Management Act was passed. As of January 2007, all farms that apply nutrients to 10 acres or more are required to have Nutrient Management Plans (NMPs). Subsequent Farm Bills have also led to increased funding levels of cost-share programs for BMPs that protect the environment, especially water quality.

Table 3: Implemented Agricultural Best Management Practices (BMP)

	Acres	*TN reduced (lb/day)*	*TP reduced (lb/day)*
Cover Crops	3,145	118.25	0.25
Ponds	3	0.11	0.00
Grassed Waterways	3	0.12	0.00
Grassed Filter Strips	20	0.82	0.01
Wildlife Habitat	1,414	58.10	0.77
Grassed Filter Strips	54	5.62	0.13
Forest Buffers	55	7.64	0.16
Riparian Buffers	5	0.67	0.01
Wetlands	2,461	343.91	7.38
Field Border (feet)	18,299	0.35	0.00
Critical Area Planting	36	N/A	0.00
Conservation tillage	4,182	N/A	0.01
Nutrient Management Plans	12,584	137.90	4.14

Total Progress to Date:

Estimated Nutrient Reductions: 673.49 lbs/day TN; 12.88 lbs/day TP
Estimated Full Strategy Implementation Cost: $24,201,000

Open Space

New Castle County and the local governments located in the Appoquinimink Watershed have furthered nutrient reductions by making open space and riparian buffer preservation a priority in these developing communities. By setting aside area during the development process that must remain grassed open space and protecting areas that are within the riparian buffer area, these entities are helping to protect waterways from nutrient pollution. In total, there are 1,256.67 acres of grassed open space preserved in the development process as well as 1,972 acres of riparian buffer preserved.

Total Progress to Date:

Estimated Nutrient Reductions: 260.19 lbs/day TN; 5.76 lbs/day TP
Estimated Full Strategy Implementation Cost: $6,631,000

Onsite Wastewater

Current septic system pump outs and conversion of onsite wastewater systems to central sewer systems, while not extensive, has helped to decrease the nutrient pollution entering the Appoquinimink watershed. An estimated average of 100 septic systems in the watershed are currently being pumped out a year while 11 properties in the watershed have been converted from septic systems to central sewer systems.

Total Progress to Date:

Estimated Nutrient Reductions: 1.04 lbs/ day TN; 0.24 lbs/day TP
Estimated Full Strategy Implementation Cost: $21,669,000

Stormwater

In June 1990, the Delaware Legislature passed the Sediment and Stormwater Law to help correct the State's water quality and quantity problems. The implementing program was initiated in July of 1991 and addresses sediment control during construction and post-construction, stormwater quantity and water quality control. Since this implementation, many BMPs for stormwater have been implemented and more are constructed each year. The Sediment and Stormwater Regulations are currently being revised to promote the use of stormwater management techniques that are more efficient at reducing nutrient loading and promote Green Technology BMPs or stormwater management practices based on low impact development and conservation design.

Table 4: Total Stormwater BMPs Implemented to Date

BMP	*Acres*	*TN Reduced (lb/day)*	*TP Reduced (lb/day)*
Dry Pond	566	3.49	0.184
Wet Pond	5,861	28.91	4.195
Filtering Practice	10	0.16	0.008
Infiltration Practice	86	2.31	0.079
Open Channel Practice	180	1.85	0.068
DelDOT Rt. 1 Practices	Not available	2.76	2.58

Total Progress to Date:

Estimated Nutrient Reductions: 39.47 lbs/day TN; 7.11 lbs/day TP
Estimated Full Strategy Implementation Cost: $160,632,000

Overall Nutrient Load Reduction Progress

All sectors have taken steps to improve water quality through the implementation of laws, regulations, and voluntary BMPs. Analysis using a basic land use loading rate model shows that, to date, nonpoint sources of TN and TP have been reduced by 109% and 111%, respectively, from the TMDL baseline levels. While land use modeling based on current practices predicts reductions exceeding that required by the TMDL, there is still a need for further reductions in areas that are currently lacking such as wastewater and stormwater. The total reduction and costs are discussed in more detail in the section entitled, "Analysis for TMDL Achievement and Costs".

THE POLLUTION CONTROL STRATEGY

To guide the writing of the actions within this Pollution Control Strategy (Strategy), the Appoquinimink Tributary Action Team (Team) adhered to the following guidelines:

- Concurrence of all applicable laws, regulations and ordinances are needed to achieve the TMDL.
- Regulation must be fair and reasonable; rules must apply to everyone equally.
- Watershed residents need to be informed as to the problems and solutions of water quality. (education)
- Participation by residents will be necessary in order to achieve the required nutrient reductions.
- We need to use a combination of policy and management tools in the PCS.
- There needs to be a mechanism in place that measures progress towards achieving water quality goals and communicates it to the public at regular intervals.

This Strategy is divided into four sections each outlining the voluntary and regulatory actions needed to achieve nonpoint source pollution reductions in the following areas:

- Agriculture
- Development
- Wastewater

Although changes have been made, this Strategy is substantially based upon the recommendations offered by the Team (Appendix B). In addition, the strategies are based on solid environmental science, but since the requirements also affect a wide range of stakeholders within the Appoquinimink watershed, they also take into consideration and accommodate a variety of factors. These factors include but are not limited to location within the watershed; proximity to water resources; site specific physical characteristics; subdivision, project, and system size; future activities planned by other agencies/entities; and best available technologies. These Regulations also contemplate the issues associated with those living on fixed incomes, people with serious illness, people facing financial hardship, and owners of small parcels of land. Every attempt has been made to provide predictability and flexibility for all activities contributing point and nonpoint source pollution affected by these Regulations.

AGRICULTURE

The State should continue to responsibly fund and enforce the requirements of nutrient management planning.

COMMENTARY

To reduce agriculture's impact on water quality, Delaware legislated a nutrient management program in 2002 to oversee nutrient applications within the State. In 2003, 20% of farmers applying nutrients to 10 acres or more or those who manage 8 or more animal units within the state were required by the Nutrient Management Act to create and submit a nutrient management plan (NMP) to the Nutrient Management Commission (NMC). Each year between 2004 and 2007, another 20% of eligible farmers were required to have NMPs, with 100% implementation by January 1, 2007. These plans are routinely updated and modified to meet the nutrient needs of the future cropping rotations and practices.

The Delaware Nutrient Management Commission runs a NMP cost-share program. Based upon water quality data and the load reductions required by TMDLs, the Delaware Nutrient Management Commission has classified the Appoquinimink Watershed as a nutrient management critical area high priority. Thus, the farmers from this priority watershed have an added advantage to be considered a priority for the cost-share program if funds are available. Additionally, farmers who apply for Environmental Quality Incentive Program funds for best management practices will receive more points in the Natural Resource Conservation Service ranking process if they are located in a watershed with TMDLs.

AUTHORITY

The Delaware Nutrient Management Law places the authority to run the Nutrient Management Plan program with the Delaware Nutrient Management Commission.

IMPLEMENTATION GOAL

The overall goal is for the Delaware Nutrient Management Commission to maintain 100% compliance by updating all nutrient management plans that cover all of the 12,584 residential agricultural acres (of which either 10 acres or more of nutrients are applied or contain 8 or more animal units) every 3 years. In addition, our goal is to have 100% compliance of nutrient management plan creation by those parcels that are not required under the Nutrient Management Law, those of less than 10 acres of nutrient application or containing less than 8 animal units.

IMPLEMENTATION SCHEDULE

2012 – Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of farming being accomplished and whether they are updated on their nutrient management plans. (100% compliance of agricultural acres of 10 acres or more with nutrient application or 8 or more animal units; 0% compliance of agricultural acres of less than 10 acres with nutrient application or less than 8 animal units)

2015 - Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of farming being accomplished

and whether they are updated on their nutrient management plans. (100% compliance of agricultural acres of 10 acres or more with nutrient application or 8 or more animal units; 30% compliance of agricultural acres of less than 10 acres with nutrient application or less than 8 animal units)

2018 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of farming being accomplished and whether they are updated on their nutrient management plans. (100% compliance of agricultural acres of 10 acres or more with nutrient application or 8 or more animal units; 60% compliance of agricultural acres of less than 10 acres with nutrient application or less than 8 animal units)

2021 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of farming being accomplished and whether they are updated on their nutrient management plans. (100% compliance of agricultural acres of 10 acres or more with nutrient application or 8 or more animal units; 100% compliance of agricultural acres of less than 10 acres with nutrient application or less than 8 animal units)

NUTRIENT REDUCTION

Extensive research has been done to determine the nutrient reduction efficiency of nutrient management plans – 16% reduction in TN and 20% reduction in TP due to implementing nutrient management plans. For information on the detailed analysis used to determine these efficiencies and reductions, refer to Appendix D.

COST

The costs of implementing nutrient management plans has been estimated using data gathered by United States Department of Agriculture (USDA), Natural Resource and Conservation Service (NRCS) at the county and state level. Details about this cost calculation can be found in Appendix E. Cost estimates were based on the size of the farm and the Appoquinimink Watershed contains farms that are mostly less than 500 acres. The cost of creating a nutrient management plan for a 3-year plan in a farm this size is $5.70, if they become eligible for the cost share program of the Nutrient Management Act.

POTENTIAL FUNDING SOURCES

Delaware Nutrient Management Commission

ACTION

The Department forwarded this recommendation to the Department of Agriculture along with a commitment to assist them with locating the funds necessary to run programs that encourage continued compliance with the Nutrient Management Law. The Team should work with the General Assembly to ensure that the DNMC and its programs are adequately funded.

The State should continue to responsibly fund agricultural best management practice installation to increase current levels of implementation.

COMMENTARY

The farmers of the Appoquinimink Watershed along with assistance from the USDA-NRCS, New Castle Conservation District, Farm Service Agency, Nutrient Management Commission and Department of Agriculture have done an impressive job of implementing best management practices. Maintaining the implemented amounts of agricultural best management practices found in Table 5 is very important to continue reducing nutrients throughout the watershed. Part of the reason for such successful implementation is the continued funding of best management practices through cost share programs at the federal, state and county levels.

Table 5: Current Area of Implemented Agricultural BMPs

	Acres
Cover Crops	3,145
Ponds	3
Grassed Waterways	3
Grassed Filter Strips	20
Wildlife Habitat	1,414
Grassed Filter Strips	54
Forest Buffers	55
Riparian Buffers	5
Wetlands	2,461
Field Border (feet)	18,299
Critical Area Planting	36
Conservation tillage	4,182

AUTHORITY

The United States Congress and Delaware General Assembly authorize the amount of money available for cost share programs run through the USDA-NRCS, New Castle Conservation District, Farm Service Agency, Nutrient Management Commission, and Department of Agriculture. In addition, these entities are critical to provide the expertise necessary to use this funding to maintain and even increase BMP implementation in the Appoquinimink watershed.

IMPLEMENTATION GOAL

The overall goal is to maintain current levels of agricultural BMP implementation as seen in Table 5 as well as to increase those levels of cover crop, forest and riparian buffer, and wildlife habitat by 10% on agricultural lands.

IMPLEMENTATION SCHEDULE

2012 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of practices implemented. (3,145 acres of cover crops, 3 acres of ponds, 3 acres of grassed waterways, 20 acres of grassed filter strips, 1,414 acres of wildlife habitat, 54 acres of grassed filter strips, 58 acres of forest buffers, 5 acres of riparian buffers, 2,461 acres of wetlands, 18,299 feet of field border, 36 acres of critical area planting, 4,182 acres of conservation tillage)

2015 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of practices implemented. (3,250 acres of cover crops, 3 acres of ponds, 3 acres of grassed waterways, 20 acres of grassed filter strips, 1,461 acres of wildlife habitat, 54 acres of grassed filter strips, 60 acres of forest buffers, 5.3 acres of riparian buffers, 2,461 acres of wetlands, 18,299 feet of field border, 36 acres of critical area planting, 4,182 acres of conservation tillage)

2018 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of practices implemented. (3,355 acres of cover crops, 3 acres of ponds, 3 acres of grassed waterways, 20 acres of grassed filter strips, 1,508 acres of wildlife habitat, 54 acres of grassed filter strips, 62 acres of forest buffers, 5.6 acres of riparian buffers, 2,461 acres of wetlands, 18,299 feet of field border, 36 acres of critical area planting, 4,182 acres of conservation tillage)

2021 -- Work with Delaware Nutrient Management Commission and USDA-NRCS to create an updated list of agricultural acres in the watershed including type of practices implemented. (3,460 acres of cover crops, 3 acres of ponds, 3 acres of grassed waterways, 20 acres of grassed filter strips, 1,555 acres of wildlife habitat, 54 acres of grassed filter strips, 64 acres of forest buffers, 6 acres of riparian buffers, 2,461 acres of wetlands, 18,299 feet of field border, 36 acres of critical area planting, 4,182 acres of conservation tillage)

NUTRIENT REDUCTION

The nutrient reduction ability varies across the suite of BMPs implemented in the Appoquinimink watershed as seen in Table 6.

Table 6: Nutrient Reductions of Current and Future Agricultural BMPs

	TN efficiency	*TP efficiency*	*TN reduced (lb/day)*	*TP reduced (lb/day)*
Current Cover Crops	0.55	0.05	118.25	0.25
Future Cover Crops	0.55	0.05	11.84	0.03
Current and Future Ponds	N/A	N/A	0.11	0.00
Current and Future Grassed Waterways	N/A	N/A	0.12	0.00

Current and Future Grassed Filter Strips	N/A	N/A	0.82	0.01
Current Wildlife Habitat	N/A	N/A	58.10	0.77
Future Wildlife Habitat	N/A	N/A	5.79	0.08
Current and Future Grassed Filter Strips	0.46	0.54	5.62	0.13
Current Forest Buffers	0.62	0.62	7.64	0.16
Future Forest Buffers	0.62	0.62	1.26	0.027
Current Riparian Buffers	0.62	0.62	0.67	0.01
Future Riparian Buffers	0.62	0.62	0.14	0.00
Current and Future Wetlands	0.62	0.62	343.91	7.38
Current and Future Field Border (feet)	0.04	0.29	0.35	0.00
Current and Future Critical Area Planting	N/A	N/A	N/A	0.00
Current and Future Conservation tillage	N/A	N/A	N/A	0.01

COST

The costs of implementing BMPs have been estimated using data gathered by United States Department of Agriculture (USDA), Natural Resource and Conservation Service (NRCS) at the county and state level. Recently, changes in the state cost share program have required a Pollution Control Strategy for watershed residents to receive funding. Thus, the state cost share information found in Table 7 is based on a PCS approved for the Appoquinimink watershed. These are estimates, as costs for specific project may vary.

Table 7: Agricultural BMP Costs

	Installation Cost / Acre	*Lifespan (years)*	*Total Maintenance Costs over Lifespan*	*Total Cost/ Acre*
Cover Crops	$49.33	1	$5	$54.33
Ponds	$3,758.50	10	$5	$3,808.50
Grassed Waterways	$16,404.24	10	$5	$16,454.24
Filter Strips/Wildlife Habitat	$495.24	10	$5	$545.24
Forest Buffers	$495.24	15	$5	$570.24
Riparian Buffers	$502.00	15	$5	$577.00
Wetland Restoration	$4,374.50	15	$5	$4,449.50
Field Border	$495.24	10	$5	$545.24
Critical Area Planting	$7,229.24	10	$5	$7,279.24
Conservation Tillage	$17.33	4	$5	$37.33

POTENTIAL FUNDING SOURCES
Delaware Department of Agriculture
New Castle Conservation District
United States Department of Agriculture, Natural Resources Conservation Service
Farmers

ACTION
The Department forwarded this recommendation to the Department of Agriculture along with a commitment to assist them with locating the funds necessary to run programs that encourage adoption and maintenance of best management practices in the Appoquinimink Watershed. The Team should work with the General Assembly to ensure that the DNMC and its programs are adequately funded.

Create a recognition program for farmers in the Appoquinimink watershed who do the most to protect water quality.

COMMENTARY
In 2001, poultry integrators in cooperation with the Delaware Nutrient Management Commission established the Delaware Environmental Stewardship Award Program. The award recognizes farmers whose stewardship and general farm practices contribute to conservation of the environment, water quality, and farmland. This program is, however, focused to the poultry

growers and recognizes those growers by evaluating their nutrient management, best management practices, farm management, biodiversity and wildlife management.

Although most farmers in the Appoquinimink watershed would not be eligible for this award, as they are not poultry producers, a similar and relevant program for the Appoquinimink Watershed can be started.

AUTHORITY
This is not an issue with this recommendation.

IMPLEMENTATION GOAL
The overall goal is to implement a recognition program for exceptional farmers.

IMPLEMENTATION SCHEDULE
2012 – Convene group to develop a recognition program for farmers other than poultry producers.

2013 – Award first farmer and have ceremony

NUTRIENT REDUCTION
This program will benefit water quality through its promotion of nutrient reducing best management practices. Although the Department is unable to specifically attach nutrient reductions to the program, nutrient reductions can be estimated by tracking the BMPs that are utilized on all farms in the watershed.

COST
The cost would be minimal including the design and production of signs, a brochure on the program, and the winner's reward.

POTENTIAL FUNDING SOURCES
Delaware Department of Agriculture
Nutrient Management Commission
New Castle Conservation District

ACTION
The Department and the Team should work with partners such as the USDA-NRCS, Nutrient Management Commission, New Castle Conservation District and Farm Service Agency to implement this recommendation.

DEVELOPMENT

State, county and local governments should coordinate efforts with nonprofit organizations to provide an ongoing environmental education and outreach program for residents.

COMMENTARY

Nonpoint Education for Municipal Official (NEMO) is an education and outreach program that is specifically targeted at educating local landuse decision makers. Delaware NEMO is a statewide network of educators, resource managers, and planners working together to provide communities with educational programs and materials to help them plan where and how to develop while protecting their natural resources. NEMO promotes planning that considers a community's character, unique features and natural resources. The Delaware NEMO Program offers various free workshops which are open to anyone interested in better land use design.

Similarly, the Appoquinimink River Association is actively involved in promoting, developing and engaging in educational activities related to southern New Castle County watersheds including the Appoquinimink Watershed. One project that the Association uses to educate the public is open space and riparian buffer reforestation demonstrations. The Association has used this program to help several watershed communities and residents with maintaining their community's open space, riparian buffers, and stormwater management areas. The Association, in collaboration with Delaware Nature Society, has offered the "Smartyard" landscaping package to the residents of watershed as well as a "Most Welcoming Yard" contest in Townsend, both to teach about the benefits of native landscapes. They also conducted a Stream Watch Program, which provided a basic level of training on biological indicators of a healthy stream and simple chemical test used to assess water quality. Their education and outreach continues at public events such as the Middletown Peach Festival, Townsend Day, Odessa Halloween in the Park and the Blackbird Creek Fall Festival where the Association provides large amounts of material to help local communities maintain their backyards and neighborhoods in an environmentally friendly way. The Association also provides a newsletter and presentations to homeowners associations, local governments, and civic organizations on a variety of environmental topics that can help communities maintain the environmental aspects of their lives.

The Appoquinimink River Association (ARA) is doing an excellent job at establishing various outreach programs related to stormwater management as well. The Association gives presentations on the Appoquinimink Watershed and water pollution education to many local students, government officials, homeowner associations and civic groups. ARA has developed a document compiling information on all educational materials, activities, events and programs available to state residents on the topic of nonpoint source pollution. The ARA has also created educational materials and programs surrounding the topics of rain gardens and rain barrels. As part of their rain garden education program, they have created a large commercial demonstration rain garden at the Jean Birch MOT Senior Center in Middletown. This rain garden won an award from Region 3 EPA and the Low Impact Development Center for Leadership in Low Impact Development: Education and Outreach. Several workshops were held by the ARA for residents to learn backyard conservation including creating their own rain barrels for use at home to alleviate issues of stormwater runoff.

AUTHORITY

Land use issues are under the authority of counties and local governments. There are two programs that regulate stormwater in the Appoquinimink watershed. One is the National Pollution Discharge Elimination System (NPDES) permit program, through the Clean Water Act, which requires the County, the Department of Transportation, and the Town of Middletown to obtain permits for their stormwater program. This program is administered through the Division of Water. One of the permit requirements includes public outreach. Thus, the permittees may be interested in working with the Department to implement this action. Another is the State's Sediment and Stormwater Program, administered through the Division of Watershed Stewardship. This program is in the process of revising their regulations. These regulations address inspection and required maintenance on permitted structures through the respective delegated agency. The responsible inspection agency shall ensure preventive maintenance through inspection of all stormwater management practices and keep record of the inspection report. The inspection needs to be done at least once a year. Although the regulations do not specifically address education, the Department will take every opportunity to educate the regulated community. In addition, the Department will work with the Governor's office to find funds for increased inspection capabilities.

IMPLEMENTATION GOAL

The overall goal is to continue to work with the Appoquinimink River Association, New Castle County and the municipalities of Middletown, Odessa and Townsend to promote environmental education in the Appoquinimink watershed and increase the number of educational opportunities available.

IMPLEMENTATION SCHEDULE

2012 – Work with partners to update the catalog of environmental education opportunities available in the watershed.

2015 -- Have 3 more environmental educational opportunities available to watershed residents.

NUTRIENT REDUCTIONS

Although nutrient loading from development will likely be reduced by educating residents, the Department is currently unable to estimate this load reduction.

COST

Not available.

POTENTIAL FUNDING SOURCES

New Castle County
Town of Middletown
Town of Odessa
Town of Townsend
Delaware Department of Natural Resources and Environmental Control

ACTION
The Department will work with local governments and nonprofit organizations to provide guidelines, technical standards, and assistance to set up more environmental education and outreach.

Stormwater

All permanent sediment and stormwater management plans should be designed and implemented to include criteria that will reduce nutrient loading by the percentage required to meet TMDL-required nutrient load reductions of ground and surface waters to the maximum extent practicable.

COMMENTARY
The Delaware Sediment and Stormwater Regulations govern the plans and design criteria that are implemented in the State. Current regulations minimize water quality and quantity impacts due to land disturbing activities by preferring the use of "Green Technology BMPs". "Green Technology BMPs" are those practices that achieve stormwater management objectives by applying the principles of filtration, infiltration and storage most often associated with natural vegetation and undisturbed soils while minimizing a reliance on structural components. These BMPs have been shown to be effective in nutrient reduction.

Additionally, the report "Governor Minner's Task Force on Surface Water Management" recommends including nutrient reduction as an aspect of sediment and stormwater law. As part of recommendations 10 A and B, it is suggested that State Sediment and Stormwater regulations and plans be updated to include requirements for stormwater recharge, runoff volumes, land use cover conditions, turbidity limits, adequate conveyance and pollutant loads. The sediment and stormwater regulations are currently under revision and will be modified to better address volume management by increasing emphasis on recharge and infiltration of stormwater, where it is technically and environmentally feasible. In addition, regulations should include design criteria to reduce nutrient contributions through practices such as comparing post development conditions with and without stormwater quality controls, using treatment trains of stormwater controls, or reducing impervious cover.

IMPLEMENTATION GOAL
The overall goal to have all sediment and stormwater plans implemented to decrease nutrient pollution by the TMDL-required reductions will be implemented with the promulgation of the new Delaware Sediment and Stormwater Regulations in 2011.

IMPLEMENTATION SCHEDULE
2011 – Promulgation of the new Delaware Sediment and Stormwater Regulations

AUTHORITY

The Division of Watershed Stewardship is responsible for implementation of this requirement through the update of the Sediment and Stormwater Regulations.

NUTRIENT REDUCTION

The load reduction will be based upon the type of BMPs that have been adopted. The nutrient reduction efficiency of some of the most commonly used best management practices is depicted in Table 8.

Table 8: Qualitative Pollutant Removal Efficiencies

Relative Pollutant Removal Capabilities for Storm Water Treatment Practices						
	TSS	*TP*	*TN*	*Metals*	*Bacteria*	*Oil & Grease*
Dry Detention Ponds	○	○	○	○	○	○
Wet Ponds	●	●	◉	●	●	●
Stormwater Wetlands	●	●	◉	◉	●	●
Filtering Practices	●	●	●	●	○	●
Infiltration Practices	●	●	●	●	●	Don't Use
Water Quality Swales	●	◉	●	●	○	◉
● High Removal ◉ Medium Removal ○ Low Removal						

Source: CWP, 2005

COST

The cost varies with type of BMPs that are adopted. An average cost of BMPs is provided in Table 9.

Table 9: Base Costs of Typical Applications of Stormwater BMPs[1]

	Typical Cost ($/BMP)[1,2]	*Application*	*Data Source*
Retention Basin	$100,000	50-Acre Residential Site (Impervious Cover = 35%)	Adapted from Brown and Schueler (1997b)
Wetland	$125,000	50-Acre Commercial Site (Impervious Cover = 35%)	Adapted from Brown and Schueler (1997b)
Infiltration Trench	$45,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from SWRPC (1991)
Infiltration Basin	$15,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from SWRPC (1991)
Filtering Practices	$35,000-$70,000[3]	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from Brown and Schueler (1997b)
Bioretention	$60,000	5-Acre Commercial Site (Impervious Cover = 65%)	Adapted from Brown and Schueler (1997b)
Grass Swale	$3,500	5-Acre Commercial Site (Impervious Cover =35%)	Adapted from SWRPC (1991)
Filter Strip	$0-$9,000[3]	5-Acre Commercial Site (Impervious Cover = 35%)	Adapted from SWRPC (1991)

From EPA, 1999 –Urban Storm Water Best Management Practices Study

1 Base costs do not include land costs.

[2] Total capital costs can typically be determined by increasing these costs by approximately 30%.

[3] A range is given to account for design variations.

ACTION

With the promulgation of the new proposed Sediment and Stormwater Regulations in 2011, the Department believes that this recommendation will be met. If the new regulations are not promulgated as anticipated, the Department will promulgate stormwater regulations for the Appoquinimink watershed that meet this recommendation and the required TMDL reduction.

Within 6 months from the promulgation of the PCS, DNREC should convene a group composed of representatives from the community and local, county, and state government to establish a stormwater retrofit process for the Appoquinimink watershed.

COMMENTARY

This is an excellent, but resource intensive recommendation. This may be best implemented by having all parties collaboratively apply for federal grants to fund retrofit projects. The Appoquinimink Retrofit Assessment conducted by the CWP has identified three categories of retrofits (offsite storage, onsite nonresidential, and onsite residential) with the primary objective of increasing water quality treatment and recharge, and to mitigate localized flooding and channel erosion. The study has identified most of the retrofit opportunities in the Dove Nest Branch, Deep Creek, and Appoquinimink I sub-watersheds and have developed retrofit concepts for over 51 potential projects. The study further recommended installing at least three priority structural stormwater retrofits over the next few years. Since the Assessment was finished in 2005, the Appoquinimink River Association has helped to implement several priority projects as categorized by the CWP. The Association has completed a retrofit at the Jean Birch MOT Senior Center into a rain garden and is working on a retrofit on the Broad Street Drainage in Middletown. In addition, because of the Assessment, DelDOT has also been working on implementing several priority stormwater retrofits in the Appoquinimink Watershed including work at the Odessa Professional Park, Middletown Maintenance Yard, and Lakeside Drive and DE-71. The Town of Middletown has also retrofitted the old Acme site into their new Town Hall. The Appoquinimink School District also retrofitted Townsend Elementary School as part of their construction of the adjoining Townsend Early Childhood Center.

AUTHORITY

The Department has the authority to implement this recommendation. However, for greatest chance of success, all partners should work together to locate grant funds that could be used to implement projects where there is stakeholder interest.

IMPLEMENTATION GOAL

The overall goal is to prioritize stormwater retrofits in the Appoquinimink watershed for future funding.

IMPLEMENTATION SCHEDULE

2012 – Convene a group to develop and prioritize a list of potential stormwater retrofits in the watershed

2014 – Obtain funding to implement 2 stormwater retrofits

2017 – Obtain funding to implement 3 more stormwater retrofits

NUTRIENT REDUCTION
The benefits from retrofit projects are very site specific and depend on the type of the treatment practice adopted and the pollution load reduction potential. The pollutant removal efficiencies of various treatment practices determine pollution load reduction potential. This reduction in nutrient load can be imperative when deciding which BMP is best for a retrofit project. The nutrient reduction from retrofit projects can range from 15% to the 85%.

COST
Retrofits are costly and vary dramatically. Stormwater retrofits can be one of the most expensive urban restoration practices to implement as retrofit projects require design, permitting, construction, and long-term maintenance costs. Storage retrofits require more total capital dollars to construct, but are cost effective in terms of cost per unit treated whereas onsite practice particularly onsite residential practices are less expensive, but treat smaller areas.

Since retrofits are very expensive, willing partners and interested stakeholders should be identified for technical and financial assistance. In addition, small-scale, well-planned, and visible demonstration projects should be implemented to garner support (financial and public approval) for future efforts.

POTENTIAL FUNDING SOURCES
New Castle County
Town of Middletown
Town of Odessa
Town of Townsend
Delaware Department of Natural Resources and Environmental Control

ACTION
The Department will convene this group.

Impervious cover limits

The State should promulgate a watershed-wide limit for effective impervious coverage with consideration for site-specific mitigation and emphasis on water resource protection areas.

COMMENTARY
In 1992, watershed impervious cover was estimated to be 4% which grew to 9% in 2007 and is expected to reach 25% in the future (CWP, 2005). Recent research has revealed a strong relationship between impervious cover and various indicators of stream quality. When porous

land cover is converted to impervious cover, a greater fraction of annual rainfall is converted to surface runoff, and a smaller volume recharges the groundwater. This increased surface runoff volume causes higher peak flows that erode stream channels and lower baseflow, which ultimately results in in-stream habitat degradation. In addition, surface runoff carries a suite of pollutants that can degrade water quality.

Stream research generally indicates that at about 10% impervious cover, sensitive stream elements are lost from the system. A second threshold appears to exist at around 25-30% impervious cover, where most indicators of stream quality consistently shift to a poor condition. The Center for Watershed Protection has developed the following stream classification (Table 10) based on the relationship between impervious cover and stream health.

Table 10: Impervious Cover Classification

Classification	*Description*
Sensitive (≤10% IC)	• Typically high quality streams (though rurally-impacted watersheds will have low impervious cover) • Generally have stable channels, excellent habitat structure, good to excellent water quality, diverse communities of both fish and aquatic insects • Do not see frequent flooding and other hydrological changes associated with urbanization
Impacted (11%-25% IC)	• Show clear signs of degradation due to watershed urbanization • Greater storm flows begin to alter the stream geometry • Both erosion and channel widening are clearly evident • Stream banks become unstable, and physical habitat in the stream declines noticeably • Stream water quality shifts into the fair/good category during storms and dry weather • Stream biodiversity declines to fair levels, fewer sensitive fish and aquatic insects
Non-supporting (11%-25% IC)	• Streams essentially conduits for conveying stormwater flows • Stream channel becomes highly unstable, and many reaches experience severe widening, down-cutting and streambank erosion • Pool and riffle structure diminished or eliminated, and the stream substrate can no longer provide habitat for aquatic insects, or spawning areas for fish • Water quality often rated fair to poor, and water contact recreation not possible • Subwatersheds generally display increases in nutrient loads to downstream receiving waters, even if effective urban stormwater treatment practices are installed and maintained. • Biological quality is generally considered poor, dominated by pollution tolerant species

Source: CWP, 2005

Land use estimates from 2002 show that three subwatersheds of the Appoquinimink Watershed are classified as sensitive, three as impacted, and one as borderline sensitive/impacted (CWP, 2005). Future growth estimates project that except the Appoquinimink II subwatershed, all other all subwatersheds will shift to the impacted or non-supporting categories.

Water Resource Protection Areas (WRPAs) are defined as (1) surface water areas such as floodplains, limestone aquifers and reservoir watersheds, (2) wellhead areas, or (3) excellent recharge areas. Since 1991, WRPA ordinances have been a part of source water protection in New Castle County, Delaware. Source water is any aquifer or surface water body from which water is taken either periodically or continuously by a public water system for drinking or food processing purposes. The ordinance limits the amount of impervious cover to 20% by right for new development in mapped recharge and wellhead areas. The purpose of impervious cover thresholds in WRPAs is to balance the need to protect drinking water sources with the right to

economically develop land, minimize loss of recharge, and protect the quality and quantity or ground and surface water supplies.

In the Source Water Protection Guidance Manual for the Local Governments of Delaware, local governments are encouraged to adopt ordinances that protect ground and surface waters in WRPAs through a source water protection hierarchy (ranked in descending order of preference):

1. Preserve WRPAs as open space and parks by acquisition or conservation easement.
2. Limit impervious cover of new development to 20% within WRPAs.
3. Allow impervious cover of new development to exceed 20% within WRPAs (but no more than 50% impervious) provided the applicant develops recharge facilities that directly infiltrate rooftop runoff.
4. Allow impervious cover of new development to exceed 20% within WRPAs (but no more than 50% impervious) provided the applicant develops recharge facilities that infiltrate stormwater runoff from forested and/or grassed surfaces with pretreatment.

With the potential for future growth to affect the water quality of the rivers, streams, and ponds of the Appoquinimink Watershed, regulations need to include impervious cover limits for new subdivisions and major land disturbing activities. Regulations need to prevent impervious cover levels over 50% and for impervious cover levels over 20%, there needs to be an environmental impact assessment report and mitigation to ensure water quality protection.

The new State Sediment and Stormwater Regulations are expected to limit some of the negative effects of impervious cover by virtue of the requirement that stormwater must be infiltrated rather discharged through a conveyance system. If infiltration is not possible on the site, the stormwater treatment on site must have several best management practices designed to reduce the stormwater nutrient and bacteria load. As for existing property that will be redeveloped, unless new construction will be undertaken on the property, no reduction of impervious cover will result. The exact nature that impervious cover will be dealt with through the revised regulations will be unveiled in the spring of 2010.

The Department recommends that the effective impervious cover be reduced on redeveloped properties. Effective impervious cover is the portion of the total amount impervious cover that is directly connected to the storm drain system. Impervious cover that drains to vegetated areas where stormwater can infiltrate, or be filtered and stored, is not considered part of the effective impervious cover.

Current regulations exist in the watershed to protect impervious cover in source water protection areas. The New Castle County UDC limits the impervious cover of new developments within WRPAs to 20% by right or up to 50% provided the applicant prepares a climatic water budget to balance predevelopment and post development recharge and installs facilities to augment recharge. The Unified Development Code (UDC) also protects floodplains, floodways, wetlands, riparian buffers, water recharge areas, moderate steep slopes and critical natural area by limiting percentage of impervious cover in the area.

The Town of Townsend has also developed Environmental Protection Regulations, which includes a section that clarifies environmental constraints and requirements for development in environmentally sensitive areas. This section includes regulations for development and delineation of water resource protection areas including wellhead Class A and recharge areas. The Townsend WRPA ordinance permits new development within recharge WRPAs provided the impervious cover does not exceed 30% for residential uses in the outlying greenbelt and 50% for new development in the downtown district. Middletown's land area is classified as having excellent recharge capacity. The Town of Middletown recently passed a source water protection ordinance that does not contain impervious cover limits in WRPAs but does require secondary containment of above and underground storage tanks, requires the volume and quality of recharge in recharge areas to be equal to predevelopment levels, and protects the area 300 feet around public water supply wells. The Town of Odessa also has WRPA regulations that limit impervious cover. As a part of these regulations, there is no new development allowed in floodplains WRPAs, areas confirmed as recharge WRPAs are required to have 25% remain in open space with no impervious cover, and wellhead WRPAs have limits on impervious cover.

AUTHORITY

The State of Delaware Source Water Protection Law of 2001 requires local governments with year-round populations of 2,000 or greater to implement measures to protect the quality and quantity of public water supplies within delineated surface water, wellhead and groundwater recharge areas by 2007. This law requires New Castle County and Middletown to develop measures while Odessa and Townsend are not required. Also, the Division of Watershed Stewardship is responsible for implementation of this requirement through the inclusion of impervious cover limits in the update of the Sediment and Stormwater Regulations.

IMPLEMENTATION GOAL

The overall goal to limit effective impervious cover will be implemented with the promulgation of the new Delaware Sediment and Stormwater Regulations in 2011.

IMPLEMENTATION SCHEDULE

2011 – Promulgation of the new Delaware Sediment and Stormwater Regulations

NUTRIENT REDUCTION

By limiting impervious cover as lands are developed, the impacts on water quality will be reduced. A specific numeric reduction is not currently available.

COST

This recommendation would only apply for new proposed development so it is not possible to calculate implementation costs at this time.

ACTION

With the promulgation of the new proposed Sediment and Stormwater Regulations by the end of 2011, the Department believes that this recommendation to establish watershed-wide limit for impervious coverage will be met. The Department will work with New Castle County or any municipality to develop effective impervious cover reduction controls through ordinances on redeveloped properties.

Open Space

All open space land uses should be designed and managed for water quality protection, including reduced nutrient loading. Reforestation, meadow development, wetlands construction, and other natural resource preservation should be encouraged through increased outreach efforts by the appropriate jurisdictions and local nonprofit organizations.

COMMENTARY

Open space can have many valuable functions. In impaired watersheds, water quality protection should be a priority for developers when designing open spaces. Maintenance of these spaces is important not only for the people living in these communities but for their water quality benefits. To educate this importance, DNREC's Delaware Coastal Program recently developed a document entitled "Community Spaces, Natural Places" which provides communities with information on practical and successful open space management techniques.

In addition, the Appoquinimink River Association has been very active protecting open spaces through various projects and outreach programs. They worked with DNREC Coastal Programs to develop a reforestation plan for the Cantwell Ridge and Odessa Chase communities and planted over 4,000 small trees and 125 large trees in the two communities, reforesting 10.8 acres. They have also received grants for the implementation of pet waste collection stations with biodegradable bags, distributed to various homeowner associations for use in open spaces.

New Castle County's "Environmental First" ordinance addresses some of these concerns to all new development proposals. The ordinance aims at preserving fifty percent of total acreage in open space for developments of 50 or more acres in the suburban district. While Odessa currently does not contain subdivisions that would have required open space creation, future development is planned and open space is required to be a minimum of 12.5% of the area. Also, the intent of Odessa's open land classification is to preserve and protect the natural areas in the Town of Odessa, to provide refuge for wildlife, protection for scenic vistas, and preserve the natural elements of the town's history. The Town of Townsend has requirements that all residential development containing 10 or more dwellings must have a minimum of 10% open space in the development. The Town of Middletown also has regulations that govern the open space of subdivisions. Depending on the density of the proposed subdivision, the percent open space required could be anywhere from 10 - 33% and conservation of natural vegetation is required to be conserved in its natural state.

These ordinances that require open space creation as part of new development in Middletown, Townsend and New Castle County, have provided a total of 1,256.67 acres of existing grassed open space protection in the Appoquinimink watershed. In addition, New Castle County ordinances and protection practices have also protected 1,972 acres of existing riparian buffer.

AUTHORITY

Local governments oversee land use issues and as such, the Department will work with them to develop nutrient management plans for their open spaces. Additionally, the Department will work with the Nutrient Management Commission on including the prohibition of the application of nutrients to open space unless prescribed by a nutrient management plan and tracking of open spaces created as part of the development process.

IMPLEMENTATION GOAL

The overall goal is to work with local governments and the Nutrient Management Commission every three years to obtain, where required, 100% compliance by updating nutrient management plans. In addition, our goal is to have 100% compliance of nutrient management plan creation by those open space parcels that are not required under the Nutrient Management Law, those of less than 10 acres of nutrient application.

IMPLEMENTATION SCHEDULE

2012 – Work with Delaware Nutrient Management Commission to create an updated list of open space acres in the watershed including whether they are updated on their nutrient management plans. (100% compliance of open space acres of 10 acres or more with nutrient application; 0% compliance of open space acres of less than 10 acres with nutrient application)

2015 - Work with Delaware Nutrient Management Commission to create an updated list of open space acres in the watershed including whether they are updated on their nutrient management plans. (100% compliance of open space acres of 10 acres or more with nutrient application; 30% compliance of open space acres of less than 10 acres with nutrient application)

2018 -- Work with Delaware Nutrient Management Commission to create an updated list of open space acres in the watershed including whether they are updated on their nutrient management plans. (100% compliance of open space acres of 10 acres or more with nutrient application; 60% compliance of open space acres of less than 10 acres with nutrient application)

2021 -- Work with Delaware Nutrient Management Commission to create an updated list of open space acres in the watershed including whether they are updated on their nutrient management plans. (100% compliance of open space acres of 10 acres or more with nutrient application; 100% compliance of open space acres of less than 10 acres with nutrient application)

NUTRIENT REDUCTION

Proper management of open space can help reduce the amount of nutrients entering waterways. Treating the creation of open space as a land use change from agricultural cropland to grassed open space, nutrient reductions can be calculated as seen in Table 11. For further explanation of the nutrient reduction calculation, refer to Appendix D.

Table 11: Nutrient Reductions due to Open Space Required in Developments

	Acreage	*TN Reduction (lb/day)*	*TP Reduction (lb/day)*
New Castle County	665.00 acres	27.33	0.36
Town of Middletown	489.02 acres	20.10	0.27

Town of Townsend	102.65 acres	4.22	0.06

The nutrient reductions can be further reduced by prohibiting the nutrient applications to open space unless prescribed by a nutrient management plan.

COST

The cost is entirely dependent on the type of project or outreach program that will be established to manage open space. For instance, reforestation protection will cost more than pollution prevention pet waste project. Costs have been calculated for the creation of grassed open spaces at $400/acre.

POTENTIAL FUNDING SOURCES

Nutrient Management Commission
New Castle County
Town of Middletown
Town of Odessa
Town of Townsend

ACTION

The Department will work with the Nutrient Management Commission, County and local governments to implement. The Department also requests communities to follow the guide developed by the Department's Coastal Program to restore, manage and maintain open space.

WASTEWATER

Seepage pits and cesspools should be prohibited within the watershed.

COMMENTARY
Cesspools and seepage pits directly discharge wastewater into ground waters. Currently, there is no information about existing cesspools and seepage pits with the Appoquinimink Watershed.

AUTHORITY
The Department's Groundwater Discharges Section in the Division of Water has the authority to implement this recommendation through the revision of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems.

IMPLEMENTATION GOAL
The overall goal to have all seepage pits and cesspools eliminated will be implemented with the promulgation of the revision of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems in 2011.

IMPLEMENTATION SCHEDULE
2011 – Promulgation of the revised Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems (0 seepage pits and cesspools)

NUTRIENT REDUCTION
Due to lack of data on seepage pits and cesspools, there is no way to predict whether there will be a reduction.

COST
The cost depends on the number of systems that need replacement and the types of systems that would be permitted in their place. Currently there are no cesspools or seepage pits known in the watershed so there is no cost associated with this recommendation.

ACTION
With the promulgation of the new revised Regulations Governing the Design, Installation, and Operation of On-site Wastewater Treatment and Disposal Systems Regulations by the end of 2011, the Department believes that this recommendation for prohibition of cesspool and seepage pits will be met. If the new on-site wastewater treatment and disposal systems regulations are not promulgated as anticipated, the Department will promulgate the necessary regulations for this recommendation.

Existing holding tanks must be operated in accordance with their permits and their conditions. In instances where central sewer service will become available within five years, temporary holding tanks will only be permitted after the Department receives a letter (with an

approved Certificate of Public Convenience and Necessity (CPCN), where applicable) stating when central sewer will become available from New Castle County, the appropriate local government, or the wastewater utility.

COMMENTARY

According to current data, there is one holding tank in the Appoquinimink watershed.

AUTHORITY

The Department's Groundwater Discharges Section in the Division of Water has the authority to implement this recommendation through the revision of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems.

IMPLEMENTATION GOAL

The overall goal to have all holding tanks pumped properly every year will be implemented with the promulgation of the revision of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems in 2011.

IMPLEMENTATION SCHEDULE

2011 – Promulgation of the revised Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems (1 holding tank pump out)

NUTRIENT REDUCTION

Proper operation of this holding would require it be pumped out approximately once a month, which can reduce 33 lb/yr of nitrogen and 12 lb/yr of phosphorus reaching the waterways.

COST

The cost of pumping out a holding tank averages around $250 per system per pump-out. Since it is pumped out 12 times in the year, annual pump-out equates to $3000 per system. In addition to this cost, there is an annual inspection cost of $60 per system. Thus, the total expenditure for holding tanks is $3,060 per system per year.

POTENTIAL FUNDING SOURCES

Delaware Department of Natural Resources and Environmental Control
Property Owners

ACTION

With the promulgation of the new revised Regulations Governing the Design, Installation, and Operation of On-site Wastewater Treatment and Disposal Systems Regulations by the end of 2011, the Department believes that this recommendation for holding tanks will be met. If the new on-site wastewater treatment and disposal systems regulations are not promulgated as anticipated, the Department will promulgate the necessary regulations for this recommendation.

Inspection/replacement

All properties utilizing an OWTDS that are sold or otherwise transferred to other ownership shall have their systems pumped out and inspected prior to the completion of the sale. These requirements can be filled by supplying (1) the certificate of completion, (2) documentation of a pump out and inspection within the previous 36 months, or (3) proof of a licensed operator or an annual service contract with a certified service provider.

COMMENTARY

A septic compliance program will assist in protecting water quality by ensuring that systems are properly functioning which limits the amount of nutrients reaching ground waters. Section 8:0000 of the State's "Regulation Governing the Design, Installation and Operation of On-site Wastewater Disposal and Treatment System (OWTDS)" states that owners are responsible for maintenance and operation of OWTDS.

Since 1985, permits for onsite wastewater disposal systems have required that they be pumped out every 3 years as governed by the regulations. The New Castle County Unified Development Code (UDC) requires that septic systems be inspected and maintained in accordance with the State's regulations.

Many people already pay for inspections prior to purchasing a home and this is sometimes required by lenders. The Ground Water Discharge Section maintains a list of all the permitted haulers and licensed inspectors and this information is available for review on the Department's website. Additionally, the Department has developed various educational brochures related to septic system maintenance.

AUTHORITY

The Department's Groundwater Discharges Section in the Division of Water has the authority to implement this recommendation through the revision of the regulations governing the design, installation and operation of on-site wastewater treatment and disposal systems.

Additionally, the Department has authority to regulate OSWDS. On July 11, 2003 the Governor signed House Bill 150 into law, which authorizes the Department to establish a license for persons who inspect systems and other OWTDS, and sets an annual license fee for septic system designers, installers, site evaluators, liquid waste haulers, inspectors and percolation testers, similar to other license fees charged by the Department. On January 1, 2006, DNREC developed and implemented Class H license for a septic system inspector.

IMPLEMENTATION GOAL

The overall goal to have all septic tanks pumped out and inspected prior to the completion of the sale will be implemented with the promulgation of the revision of the Regulations Governing the

Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems in 2011.

IMPLEMENTATION SCHEDULE

2011 – Promulgation of the revised Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems

NUTRIENT REDUCTIONS

There are currently around 1,436 onsite wastewater disposal systems permitted in the Appoquinimink watershed. Each day, these onsite treatment systems discharge around 75 pounds of nitrogen and 5 pounds of phosphorus to the groundwater of the Appoquinimink Watershed, assuming the systems are functioning properly (DNREC, 2009). After speaking with wastewater plant managers that accept septage from the watershed, it was estimated that around 100 tanks were pumped out during 2001. (The equivalent of septage from 53 tanks was taken to Wilmington. Kent County's WWTP also received some, but could not estimate a quantity. We are assuming less than 50, for a total of 100 tanks pumped). Using this information, a pump-out compliance rate was calculated at 12% in the Appoquinimink Watershed. Using this pump-out compliance rate, 156 lb/yr of nitrogen and 62 lb/yr of phosphorus is removed from the existing septic system nutrient load. This regulations will likely lead to an increase in the compliance rate and hence and increased nutrient load reduction, however the Department cannot currently quantify a specific value.

COST

The costs of the inspection will be covered through an agreement between the buyer and the seller. The cost of pumping-out OWTDS ranges from $185-200 per system, with an average cost of $192.50 per system (DNREC Small Systems Branch, personal communication, 2007). Permit conditions require that septic systems be pumped once every three years, which capitalizes this figure to $68.60/system/year. The proposed inspection will be performed at an estimated cost that range form $200 to $400 with an average cost of $300 at the time of pump-out (DNREC Small Systems Branch, personal communication, 2007). Thus, the inspection fee will only be incurred once every three years, so that annually it equates to $100. The total cost of the OWTDS inspection and compliance program will cost the system owner $169/system/year.

POTENTIAL FUNDING SOURCES

Property Owners

ACTION

With the promulgation of the new proposed Regulations Governing the Design, Installation, and Operation of On-site Wastewater Treatment and Disposal Systems Regulations by the end of 2011, the Department believes that this recommendation will be met. If the new on-site wastewater treatment and disposal systems regulations are not promulgated as anticipated, the Department will promulgate the necessary regulations for this recommendation.

Convert as many lots as feasible (of less than 2 acres each) currently on septic to sewer connection in an equitable manner whereby those systems of high priority and feasibility (where there is already infrastructure in place) are converted first. The State and DNREC should provide cost share and grant monies to these homeowners to help offset costs.

COMMENTARY

The Town of Middletown currently provides sewer services to approximately 4,900 residential customers and 550 commercial and industrial customers. The town's wastewater is treated at the town's new spray facility, the Frog Hollow spray facility, and the New Castle County Water Farm I (Middletown Comprehensive Plan, 2005). The Town of Odessa uses the New Castle County owned sewer system and disposal facility at Water Farm I. The facility receives untreated effluent and treats it in a series of storage lagoons and finally either sprays onto farm fields for hay crops or discharge to the Appoquinimink River. The 1990 census reported that 102 of the 146 housing units in Odessa are connected to the sanitary sewer. Additional units were connected during 1990s; however updated census information on the topic is not available (Odessa Comprehensive Plan, 2006). Recently, an agreement has been made between Town of Townsend and New Castle County to provide sewer services and a sewer easement along Wiggins Mill Pond Road. The sewer agreement covers all the existing town and businesses in addition to 800 new homes and 45,000 square feet of commercial development (Townsend Comprehensive Plan, 2003).

Although local governments within the watershed have access to sewer facilities, there are still several subdivisions present in the watershed that utilize on-site septic systems. According to GIS analysis of 2002 land use, around 72% of septic systems are found to be located on parcels less than 2 acres. This means that around 1,034 septic systems could be connected to the sewer connection, as this action item recommends.

Currently, DNREC's Septic Rehabilitation Loan Program provides a source of low interest financing for repairing or replacing failing septic systems or cesspools with on-site wastewater disposal systems that will function in an environmentally sound and cost effective manner.

This program is managed by the Financial Assistance Branch with technical assistance from the Groundwater Discharges Branch. Eligibility is open to property owners with on-site wastewater disposal systems that need rehabilitation in order to meet regulatory requirements, if they meet program income guidelines and the applicant demonstrates the ability to repay the loan. Financing is available at an interest rate of 3% or 6% depending on income, can be repaid over 20 years with no prepayment penalty. Loans are available for a minimum of $1,000 and a maximum of $15,000 for individual systems, and a maximum loan of $250,000 for community or mobile home park systems.

AUTHORITY

County and local governments have the authority to implement this recommendation.

IMPLEMENTATION GOAL

The overall goal is to work with funding sources and local governments to convert 402 of feasible properties with septic systems to sewer.

IMPLEMENTATION SCHEDULE

2012 – Work with partners to create an updated list of septic system conversions in the watershed. (0 new septic to sewer conversions)

2015 - Work with partners to create an updated list of septic system conversions in the watershed. (50 new septic to sewer conversions)

2018 -- Work with partners to create an updated list of septic system conversions in the watershed. (100 new septic to sewer conversions)

2021 -- Work with partners to create an updated list of septic system conversions in the watershed. (150 new septic to sewer conversions)

2024 – Work with partners to create an updated list of septic system conversions in the watershed. (200 new septic to sewer conversions)

2027 – Work with partners to create an updated list of septic system conversions in the watershed. (250 new septic to sewer conversions)

2030 -- Work with partners to create an updated list of septic system conversions in the watershed. (300 new septic to sewer conversions)

2033 – Work with partners to create an updated list of septic system conversions in the watershed. (350 new septic to sewer conversions)

2036 -- Work with partners to create an updated list of septic system conversions in the watershed. (402 new septic to sewer conversions)

NUTRIENT REDUCTION

Since, spray irrigation is more common in Appoquinimink watershed, we have assumed that all the treated effluent will used for spray irrigation. If 402 septic systems located on parcels of less than 2 acres are connected to sewer systems that use spray irrigation, the nutrient reduction from this conversion would be 6,918 pounds per year (18.95 lb/day) for total nitrogen and 496.06 pounds per year (1.36 lb/day) for total phosphorus.

COST

The average cost of constructing a sewer system is $8,500 per equivalent dwelling unit (EDU). In the future, the cost is expected to rise and reach $10,000/EDU (DNREC's Financial Assistance Branch, personal communication, 2007). The cost of financing these systems at an average 2% rate is currently $1,867/EDU and will be $2,194/EDU for future septic eliminations and sewer connection. Additionally system owners need to pay final septic system pump-out, crushing and filling the tank, and connection cost associated with building lateral line running

from building to the right of way. These three expenditures equates to approximately $1000/EDU. All these cost are summed together and annual cost for 20 year period is calculated. Besides this, around $200 will be spent for operation and maintenance (O&M) costs including repair fees.

POTENTIAL FUNDING SOURCES
New Castle County
Town of Middletown
Town of Odessa
Town of Townsend
Delaware Department of Natural Resources and Environmental Control
Property Owners

ACTION
County and local governments need to establish ordinances that encourage the conversion of septic systems to sewer districts. The Department can assist with implementing this recommendation.

Performance Standards

All new and replacement onsite wastewater disposal systems must be designed to achieve performance standards as specified in the PCS regulation. To provide proper operation and maintenance of the innovative and alternative onsite wastewater treatment and disposal system, the permittee is required to adhere to Department permit conditions. These permit conditions require mandatory operation and maintenance for the life of the system by maintaining a service contract with a certified service provider.

COMMENTARY
While a portion of watershed is sewered, there are areas in the Appoquinimink Watershed that rely on onsite wastewater treatment and disposal systems for sewage disposal. The unsewered area of the Appoquinimink watershed falls outside of denoted urban boundaries. The County and local governments are doing their best to connect every possible subdivision with the sewer line, however due to remoteness of location, it may not be feasible. There are many subdivisions that rely on on-site septic systems as their wastewater management practice.

The Ground Water Discharges Section and the Watershed Assessment Section contracted with an expert in North Carolina to develop and recommend performance standards for all sizes of onsite systems. The permit applicant can select an approve technology from a list maintained by the Ground Water Discharges Section. Since alternative systems are more expensive than standard systems, the Department wants to ensure that they are functioning in order to ensure the nutrient reductions and protect the investment, and therefore will require a service contract with

a certified service provider. The Inland Bays Pollution Control Strategy has already successfully implemented performance standards in southern Delaware.

AUTHORITY

The Department's Groundwater Discharges Section in the Division of Water has the authority to implement this recommendation through the revision of the regulations governing the design, installation and operation of on-site wastewater treatment and disposal systems.

IMPLEMENTATION GOAL

The overall goal to use performance standards in the permitting of septic tanks will be implemented with the promulgation of the revision of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems in 2011.

IMPLEMENTATION SCHEDULE

2011 – Promulgation of the revised Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems (0 septic systems meeting performance standards)

2014 – Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (156 septic systems meeting with performance standards)

2017 — Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (312 septic systems meeting with performance standards)

2020 -- Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (468 septic systems meeting with performance standards)

2023 -- Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (624 septic systems meeting with performance standards)

2026 – Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (780 septic systems meeting with performance standards)

2029 – Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (936 septic systems meeting with performance standards)

2032 -- Work with partners to create an updated list of septic systems meeting performance standards in the watershed. (1,034 septic systems meeting with performance standards)

NUTRIENT REDUCTIONS

Technologies are available to reduce the nutrients in OWTDS effluent and are defined by the following performance standards: Performance Standard Nitrogen level 1 (PSN1) to achieve 5 mg/l at the end-of-pipe of the pretreatment unit; PSN2 10 mg/l at the end-of-pipe of the pretreatment unit; PSN3 20 mg/l at the end-of-pipe of the pretreatment unit; PSP1 4 mg/l at the end-of-pipe of the pretreatment unit; PSP2 8 mg/l at the end-of-pipe of the pretreatment unit.

There are currently no large systems greater than 2,500 gpd within the watershed. As existing systems less than 2,500 gpd fail and require replacement, PSN3 will be required and will result in a reduction of 9,884 pounds of nitrogen per year. All new systems that are required to use enhanced-nutrient removing technologies will actually add nutrients to the system.

COST

DNREC's Small Systems Branch (personal communication, 2006) revealed that the installation of best available technologies (BATs) to existing small (<2,500 gallon per day (gpd)) OWTDSs for advanced nitrogen removal would cost between $3500 and $6000 per system with an average of $4,750. These technologies require a service contract by a certified service provider with an estimated annual cost that ranges from $150 to $300, with an average cost of $225/system/year. In addition, the systems will still require pump-outs, which cost $64/system/year (DNREC small System Branch, personal communication, 2007), and they will need periodic mechanical parts repaired, estimated to cost $50/system/year and the electric cost of running the system is likely to also cost about $50/system/year (DNREC Financial Assistance Branch, personal communication, 2007). Costs are not currently available for the retrofit of larger systems.

POTENTIAL FUNDING SOURCES

Property Owners
Delaware Department of Natural Resources and Environmental Control

ACTION

With the promulgation of the new revised Regulations Governing the Design, Installation, and Operation of On-site Wastewater Treatment and Disposal Systems Regulations by the end of 2011, the Department believes that this recommendation on performance standards will be met. If the new on-site wastewater treatment and disposal systems regulations are not promulgated as anticipated, the Department will promulgate the necessary regulations for this recommendation.

Education

The State, County and local governments should work together to develop and disseminate homeowner education materials. The materials should inform septic system owners about proper maintenance of their septic systems, and be based on the system type that is used, such that nutrient loading from the system is minimized. The materials should emphasize the dual benefits of proper system maintenance to both homeowner and watershed.

COMMENTARY

The Department agrees that education will be an important aspect to septic system maintenance and has already worked on outreach materials. The Department has developed a brochure "Simply Septic" to educate homeowners on the operation of septic systems. In order to change the behaviors of the public on septic systems, they need to be informed about how these systems

function and how they need to be maintained. The brochure provides valuable information on good housekeeping of septic system and also provides handy tips to increases the longevity of septic system. The brochure is available on DNREC's webpage and is easily accessible for anyone.

AUTHORITY
Not an issue for this recommendation.

IMPLEMENTATION GOAL
The overall goal is to work with County and municipal governments to disseminate educational materials to all the households currently on septic systems in the watershed.

IMPLEMENTATION SCHEDULE
2012 – 50% of households receive educational materials

2013 – 100% of households receive educational materials

NUTRIENT REDUCTIONS
Good housekeeping of septic systems helps reduce nutrient loadings; however the Department is currently unable to estimate nutrient reduction from this activity.

COST
The cost for the implementation depends on the level of outreach program and staff time needed to implement program. The outreach programs can be workshops, educational brochures/ materials, fact sheets and/or trainings.

POTENTIAL FUNDING SOURCES
New Castle County
Town of Middletown
Town of Odessa
Town of Townsend
Delaware Department of Natural Resources and Environmental Control

ACTION
The Department will continue to work with the county and local governments on providing educational outreach.

ANALYSIS FOR TMDL ACHIEVEMENT AND COST

Promulgation of this Pollution Control Strategy and full implementation of its elements should lead to the achievement of the TMDLs for Total Nitrogen (TN) and Total Phosphorus (TP). Because of the lag time between seeing improvements in ground and surface water quality, estimated to be up to 30 years, improved water quality conditions will not be realized immediately. The Department will continue to monitor water quality as will many citizen volunteers. The Department is committed to revisit this Pollution Control Strategy in 10 years to ensure that water quality is improving with implementation of the regulations and voluntary practices called for within this document.

Analysis using a basic land use loading rate model shows that, to date, nonpoint sources of TN and TP have been reduced by 109% and 111%, respectively (Figure 3). Thus, voluntary programs for installation of agricultural best management practices have been extremely successful as well as the County's and local governments' efforts to protect open space and riparian buffers. Implementation of the Sediment and Stormwater Law has also led to decreases in nutrient loading, however, the full impact is not shown here because some sediment and stormwater practices, known to be in place, are not yet captured in a database and therefore, not considered in these calculations.

Figure 3: TMDL Progress Current and Future

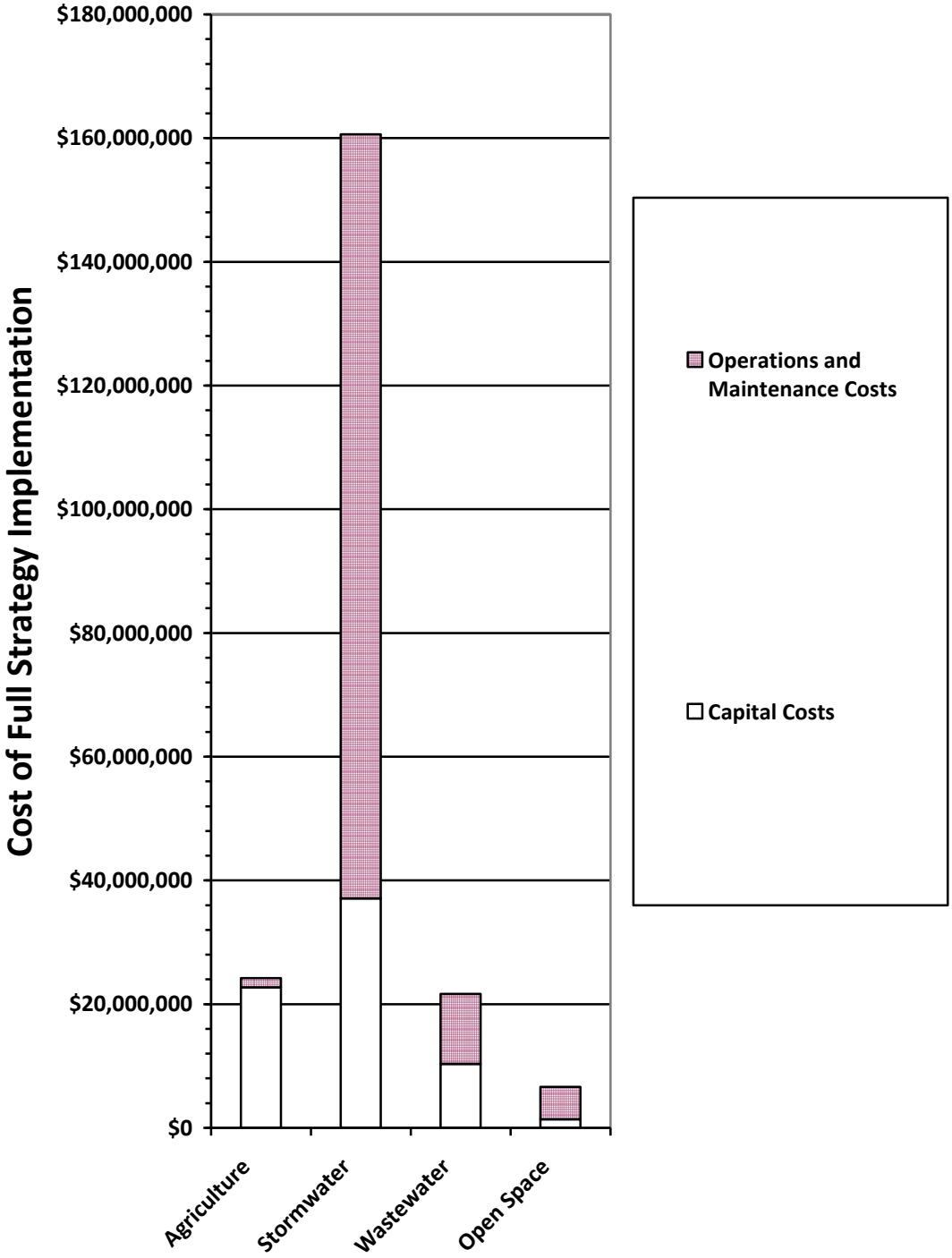
BMP	*Acres/Systems*	*TN Reduced (lb/day)*	*TP Reduced (lb/day)*
AGRICULTURAL BMPS			
Current Cover Crops	3,145	118.25	0.25
Future Additional Cover Crops	315	11.84	0.03
Current and Future Ponds	3	0.11	0.00
Current and Future Grassed Waterways	3	0.12	0.00
Current and Future Grassed Filter Strips	20	0.82	0.01
Current Wildlife Habitat	1,414	58.10	0.77
Future Additional Wildlife Habitat	141	5.79	0.08
Current and Future Grassed Filter Strips	54	5.62	0.13
Current Forest Buffers	55	7.64	0.16
Future Additional Forest Buffers	9	1.26	0.027
Current Riparian Buffers	5	0.67	0.01
Future Additional Riparian Buffers	1	0.14	0.00

Current and Future Wetlands	2,461	343.91	7.38
Current and Future Field Border (feet)	18,299	0.35	0.00
Current and Future Critical Area Planting	36	N/A	0.00
Current and Future Conservation Tillage	4,182	N/A	0.01
Current and Future Nutrient Management Plans	12,584	137.90	4.14
STORMWATER BMPS			
Current Dry Pond	566	3.49	0.184
Current Wet Pond	5,861	28.91	4.195
Current Filtering Practice	10	0.16	0.008
Current Infiltration Practice	86	2.31	0.079
Current Open Channel Practice	180	1.85	0.068
DelDOT Rt. 1 Practices	Not available	2.76	2.58
Future Additional Pond BMPs	1,578	7.95	1.08
Future Additional Non-Pond BMPs	1,578	24.61	0.88
OPEN SPACE BMPS			
Current and Future Grassed Open Space	1,256.67	208.55	5.07
Current and Future Riparian Buffer	1,972	51.64	0.69
WASTEWATER BMPS			
Current Holding Tank Pump Outs	1	0.09	0.03
Current and Future Additional Septic System Pump Outs	1034	4.42	1.76
Current Septic to Sewer Conversion	11	0.52	0.04
Future Additional Septic System Conversions to Sewer	402	18.95	1.36
Future Additional Septic System Nutrient Removals	1,034	27.08	0.00

TOTAL NUTRIENT REDUCTIONS (Current and Future BMP Implementation)	**1,072.87**	**29.85**
TOTAL NUTRIENT REDUCTIONS (Current BMP Implementation)	**974.19**	**25.99**
TMDL Required Reductions	890.83	23.50
Percent Reduction of Nutrients Reached by Current BMP Implementation	109%	111%
Percent Reduction of Nutrients Reached by Current and Future BMP Implementation	120%	127%

While current implemented practices have been shown to reach the required reductions, it is important to note that there are practices that are still necessary to keep the watershed healthy and meeting it's TMDL. The most important area for future implementation is wastewater. This includes requiring existing septic tanks to be pumped out at time of property transfer and preferably once every three years, continuing to connect existing septic tanks to sewer systems and implementing technologies that will allow systems to meet performance standards to remove nutrients. In addition, realizing that development is still occurring throughout the watershed and stormwater best management practices are required, future BMP implementation must move away from practices that only deal with water quantity, but also provide significant water quality benefits. Also, the strategy is based on the maintenance and addition of agricultural practices currently in place as well as the continued push towards open space and riparian buffer preservation.

Overall, this strategy costs over $213,000,000 including capital expenditures plus annual operation and maintenance costs of various best management practices. Of this strategy total, about $45,000,000 (about 25%) has already been paid for the installation of current practices and $168,000,000 is just for the installation and maintenance of future practices. Figure 4 shows the total strategy costs for each category of BMP including current and future practices.
Figure 4: Total Strategy Implementation Costs



Every effort has been made to make the Strategy fair and equitable. It impacts everyone in the watershed given that all activities contribute to nutrient loading. And, it attempts to take cost into consideration through promoting the least expensive actions and cost-share for those actions that are more expensive. The Department intends to review the Strategy in 10 years and update it if further actions are needed to improve water quality.

IMPLEMENTATION PROGRAMS

Pollution of the Appoquinimink River did not happen over a short period of time, nor did it only happen due to the actions of a few people. Thus, implementing the Pollution Control Strategy will necessitate participation from a broad variety of programs, agencies, nonprofit, and community organizations. These programs will provide technical, financial, and administrative assistance in the effort to clean up these waters.

Appoquinimink River Association

In order to allow any interested citizen to participate in the process of reducing pollution in their neighborhood waters, DNREC created the Appoquinimink Tributary Action Team in 2000. Comprised of local educators, scientists and landowners, this group spent the next couple of years discussing and developing detailed recommendations on how the 20% nutrient reduction required by the TMDL could be achieved in the watershed.

Following the issuance of the second Appoquinimink TMDL in December 2003, the Team initiated further discussion of ways to reach the TMDL that now required a 60% nutrient reduction. As a result of the intensive dialogue, the team decided that it was necessary to transition the group into a separate nonprofit organization to be able to best address the needs of the watershed. Thus, in April 2004 the Appoquinimink River Association was incorporated in the State of Delaware under the mission of working to preserve, protect and enhance the rivers and related natural resources of the Appoquinimink region.

As the Association began to work more on projects throughout the watershed, they realized the benefits of expanding into a organization that helps preserve, protect and enhance the water resources and natural areas of all the watersheds of southern New Castle County. To begin implementing this vision, in 2009 the Association increased their education, outreach and project implementation throughout southern New Castle County.

Coastal Nonpoint Program – 6217

The Coastal Nonpoint Program was established by Congress in 1990 under section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) to ensure that coastal states have the tools needed to address polluted runoff. A consistent set of management measures was established for states to use in controlling polluted runoff. Management measures are designed to prevent polluted runoff resulting from a variety of sources. The program includes enforceable policies and mechanisms to ensure implementation of the measures. The Delaware Coastal Nonpoint Program is administered in the State of Delaware by the Delaware Coastal Programs of the Department of Natural Resources and Environmental Control. Delaware's Coastal Nonpoint Program is a networked program with implementation responsibilities distributed throughout the State. The Delaware Coastal Programs receives an annual award used to aid in the implementation of management measures, program initiatives and the funding of grants for projects designed to preserve and protect Delaware's waterways from the degradation of nonpoint source pollution. Through cooperative efforts will both government agencies and local organizations, numerous projects have been designed and funded to help address issues concerning nonpoint source pollution in Delaware.

The Delaware Forest Service

The Delaware Forest Service is a section of the Delaware Department of Agriculture and is charged to improve and enhance the state rural and urban forest resources. Delaware's Forest Service staff, through the Urban and Community Forestry Program, provides technical, educational and financial assistance to cities, towns, communities, developers and local governments to develop a community forestry management plans and resource evaluation studies. Foresters also review new planned subdivisions in order to conserve forest resources. Additionally, the program provides annual grant assistance to a variety of partners to provide both tree planting and tree care activities. Also, the professional foresters help private and public landowners to improve their forest resources through a variety of services. This technical assistance encompasses a wide range of forest management activities including reforestation, timber stand improvements, timber harvesting and forest management plan development.

DNREC -- Groundwater Discharges Section

Located within the Division of Water, the Groundwater Discharges Section is responsible for overseeing all aspects of the siting, design and installation of on-site wastewater treatment and disposal systems. This is a three step process which includes the site evaluation, the design/permit application and the construction/installation of the system. The Small Systems Permitting Branch reviews and approves site evaluations, permit applications and conducts inspections of system installations. Experimental/alternative technologies and advanced treatment units are approved and permitted for use by the Large Systems Permitting Branch. The Section is also responsible for the permitting of underground injection wells, large spray irrigation wastewater systems, and other means associated with land application wastewater treatment. The Section also issues waste transporter permits and licenses to designers, percolation testers, site evaluators and system installers.

DNREC – Nonpoint Source Program

The Delaware Nonpoint Source Program (NPS) administers a competitive grant made possible through Section 319 of the Clean Water Act. It is housed under the Division of Watershed Stewardship within the Department of Natural Resources and Environmental Control. The grant provides funding for projects designed to reduce nonpoint source pollution in Delaware. NPS pollution may be defined as any pollution that originates from a diffuse source (such as an open field or road) and is transported to surface or ground waters through leaching or runoff. Reduction of NPS pollution, but most frequently involve agriculture, silvilculture, construction, marinas and septic systems. 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.

DNREC-Sediment and Stormwater Program

The Sediment and Stormwater Program is managed by the Division of Watershed Stewardship in the Department of Natural Resources and Environmental Control. Delaware's stormwater management program requires sediment control during construction and post-construction, stormwater quantity and water quality control. This program functions from the time

construction begins through a project's lifespan. It requires construction and development projects to obtain sediment control and stormwater plan approval, be inspected during construction, and a post-construction inspection of permanent stormwater facilities and education and training. The program's initial emphasis is to prevent existing flooding or water quality from worsening and limit further degradation until more comprehensive, watershed approaches (as detailed in State legislation and regulations) are adopted. Current regulations require stormwater management practices to achieve an 80 percent reduction in total suspended solids load after a site has been developed. This is achievable with present technology. Long-term removal rates over 80 percent may require other measures, such as water re-use, which may be required locally. In Delaware, day-to-day inspection responsibilities are handled by the delegated local agency, but projects where site compliance is not possible are handled by the State with progressive and aggressive enforcement, including civil and criminal penalty provisions.

DNREC - Surface Water Discharges Program

The Surface Water Discharges Program is delegated to the Division of Water in the Department of Natural Resources and Environmental Control. Program administrators are responsible for eliminating pollutant discharges into State surface waters by issuing regulatory permits under the National Pollutant Discharge Elimination System (NPDES). An NPDES permit legally sanctions the discharge of substances that may become pollutants. However, the NPDES permit is designed to limit the discharge of those substances so that there will be no adverse effect on the quality of the receiving waters or interference with the designated uses of those waters. The health of a water body is measured by its attainment of designated uses. If potential pollutants in a NPDES discharge are reduced to levels that allow receiving waters to meet applicable designated uses, then, in effect, the pollutant discharge has been eliminated.

Municipal sewage treatment or industrial plants that discharge wastewater to surface waters of Delaware are issued permits specifying discharge limitations, monitoring requirements and other terms and conditions that must be met to be allowed to discharge. In addition to wastewater, wastewater facilities often generate a waste sludge solid that is also an NPDES discharge under federal and State regulations. The NPDES General Permit for "stormwater discharges associated with industrial activities," a single permitting regulation with requirements that apply to a group of similar dischargers is also issued to industrial sites that discharge only stormwater.

DNREC – Water Supply Section – Groundwater Protection Branch

This program is responsible for providing technical review of permit applications for non-hazardous waste sites (i.e. large septic, wastewater spray irrigation, sludge application) and for water well permit applications where wells are located near problem sites. Staff hydrologists conduct investigations based on public complaints of groundwater quality, often associated with domestic water wells.

The Source Water Protection Program (SWPP) has been delegated to DNREC and is managed by the Water Supply Section, Groundwater Protection Branch of the Division of Water. This program was created from the 1996 Amendments from the Safe Drinking Water Act. The SWPP is responsible for determining the locations of water supplies used for public drinking water. The program is also responsible for mapping the wellhead protection areas (those areas around a well or group of wells from which a source obtains within those delineated areas, and

determining the susceptibility of the drinking water source to contamination. The SWPP is required to make this information available to the public and does so through the program's website: www.wr.udel.edu/swaphome/index.html.

Through the Source Water Protection Law of 2001, the SWPP was charged with the development of a guidance manual for the protection of source water areas. This manual was development to give the counties and those municipalities containing 2000 or more persons) ideas on methods that could be used to protect those areas by 2007.

Local Governments

County and local governments have the authority to enact ordinances to further the goals of this Pollution Control Strategy. They are all required to complete Comprehensive Plans and address how they intend on assisting in the implementation of the TMDLs. Many of these entities have ordinances that require buffers, open space and maximum impervious coverage – ordinances that work towards achieving water quality standards. Local governments within the TMDL watershed include: New Castle County, Town of Middletown, Town of Townsend and Town of Odessa.

Nutrient Management Commission

The Delaware Nutrient Management Program was established as a result of the Delaware Nutrient Management Law. The Delaware Nutrient Management Commission (DNMC) was established to direct the program and develop regulations pertaining to nutrient management, waste management for Animal Feeding Operations (AFOs) and National Pollutant Discharge Elimination System (NPDES) permits for concentrated animal feeding operations (CAFOs). The DNMC manages activities involving the generation and application of nutrients in order to help maintain and improve the quality of Delaware's ground and surface waters to help meet or exceed federally mandated water quality standards in the interest of the overall public welfare. All persons who operate an animal feeding operation in excess of 8 animal units (1 AU = 1,000 pounds) and/or control/manage property in excess of 10 acres where nutrients are applied must develop and implement a nutrient management or animal waste plan. The DNMC provides cost assistance programs, certifications and investigation of complaints.

Office of State Planning Coordination

The mission of the Office of State Planning Coordination (OSPC) is "the continuous improvement of the coordination and effectiveness of land use decisions made by state, county and municipal governments while building and maintaining a high quality of life in the State of Delaware." Under the new PLUS (preliminary land use service) process, the OSPC will bring together State agencies and developers early in the development process in order to try to identify and mitigate potential impacts. The OSPC also supports the Governor's "Livable Delaware" initiative and has published *Better Models for Development in Delaware* that includes many best management practices which will be needed in order to achieve the TMDL.

Soil and Water Conservation Districts

County Conservation Districts were created by State law and are administer through Delaware Natural Resources and Environmental Control. They operate the State Conservation Cost Share Program which provides funds for installation of agricultural management practices, promote the State Revolving Loan Fund Program for poultry producers (low-interest loans to implement best

management practices) and are the delegated agencies for the Sediment and Stormwater Management Program carrying out plan review and field inspections in their respective counties. Watersheds prioritized by Delaware's Nonpoint Source (Section 319) Pollution Program can be targeted by these activities.

REFERENCES

Center for Watershed Protection (CWP), 2003. *Impacts of Impervious Cover on Aquatic Systems*. Ellicott City, MD

Center for Watershed Protection (CWP), 2005. *Appoquinimink River Watershed Implementation Plan*. Ellicott City, MD.

Center for Watershed Protection (CWP), 2005b. *Appoquinimink River Watershed Baseline Assessment*. Ellicott City, MD.

Chesapeake Bay Program Scientific and Technical Advisory Committee, 2007. *Understanding Fertilizer Sales and Reporting Information Workshop.* Frederick, Maryland. STAC publication 07-004.

DNREC, 2004. *State of Delaware Surface Water Quality Standards, as Amended July, 1, 2004.* Department of Natural Resources and Environmental Control, Dover, DE.

Fixen, Paul, 2005. *Understanding Nutrient Use Efficiency as An application of Information Technology.* Proceedings of the Symposium on Information Technology in Soil Fertility and Fertilizer Management. Beijing, China.

McGowan, W. and W. Milliken. 1992. *Nitrogen Usage and Nutrient Management in the Inland Bays Hydrologic Unit*. Cooperative Extension, College of Agricultural Sciences, University of Delaware, Georgetown, DE.

MDNR. 1996. Technical Appendix for Maryland's Tributary Strategies. Prepared by the Maryland Department of Natural Resources, Maryland Department of the Environment, Maryland Department of Agriculture, Maryland Office of Planning, University of Maryland, and Office of the Governor. pp86.

Nelson, J., 2008. *Results from the Delaware Nutrient Management Survey*. Delaware Conservation Partnership published in conjunction with DNREC 319 Nonpoint Source Program. Dover, DE.

Ritter, W. F. and M. A. Levan, 1993. *Nutrient Budgets for the Appoquinimink Watershed.* Delaware Department of Natural Resources and Environmental Control.

Sims, J.T., J. McGrath, and A.L. Shober. 2007. *Nutrient Mass Balances for the State of Delaware: Final Project Report, Submitted to the Delaware Nutrient Management Commission*. University of Delaware, Newark, DE.

TRC Omni Environmental Corporation (TRC), 2004. *Work Plan for Wetlands Development Program. Southern New Castle County, DE.*

University of Delaware Institute for Public Administration, 2006. *2006 Update to the 2001 Town of Odessa Comprehensive Plan.*

University of Delaware Institute for Public Administration, 2003. *Town of Townsend Comprehensive Plan.*

University of Delaware Institute for Public Administration, 2005. *Town of Middletown Comprehensive Plan.*

USEPA, 2003. *Nutrient and Dissolved Oxygen TMDL Development for Appoquinimink River, DE*. USEPA Region 3.

Water Resources Agency for New Castle County (WRA), 1986. *Appoquinimink River Basin Project Rural Clean Water Program – Final Report.*