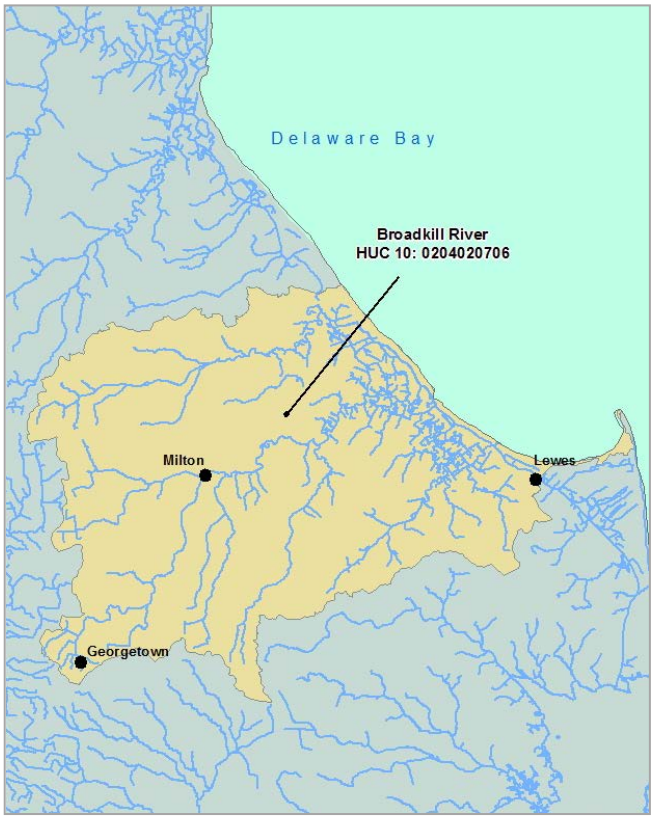
Broadkill River
Watershed Management Plan

Final Plan

January 2015



Prepared for:

Department of Natural Resources and Environmental Control (DNREC)

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List of Acronyms

BMP	Best Management Practices
CAFO	Concentrated Animal Feeding Operations
DNREC	Department of Natural Resources and Environmental Control
USEPA	United States Environmental Protection Agency
MS4	Municipal Separate Storm Sewer System
NMP	Nutrient Management Plan
NPDES	National Pollutant Discharge Elimination System
OWTDS	Onsite Wastewater Treatment and Disposal System
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WIP	Watershed Implementation Plan
WWTP	Wastewater Treatment Plant

List of Appendices

Appendix A: State of Delaware Ambient Surface Water Quality Monitoring Program – FY 2012

1 Introduction

The Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Watershed Stewardship is developing Watershed Plans to describe the conditions of major watersheds across the State and to present restoration measures aimed at meeting DNREC's watershed management goals, specifically for this current planning effort, meeting the goals associated with Total Maximum Daily Loads (TMDL).

The following Watershed Plan will target the Broadkill River watershed. The Broadkill River has several 303(d) impaired waters listings and a TMDL was approved in 2006 for total nitrogen, total phosphorus, and *enterococcus* bacteria and is, therefore, considered a high priority watershed.

Information synthesized and incorporated into this plan for the Broadkill River Watershed is pulled from several resources. The primary sources are:

- Broadkill River Watershed Pollution Control Strategy (DNREC, 2012a)
- Broadkill River Watershed Implementation Plan (Duffield Associates, Inc., 2009)
- Broadkill River Watershed Proposed TMDLs (DNREC, 2006)
- Code 7418 TMDLs for the Broadkill River Watershed, Delaware (State of Delaware, 2006)

This plans draws upon the analyses presented in these earlier planning efforts and places the results and recommendations into the context of the current TMDL requirements. The Broadkill River Watershed TMDL requires a 40% reduction in total nitrogen, 40% reduction in total phosphorus, and a 75% reduction in *enterococcus* bacteria loads from the 2002-2003 baseline levels. This plan has selected 2025 as the date to achieve these load reductions and proposes a 2017 interim milestone.

The load reductions from management strategies proposed in this Watershed Plan meet or exceed the allocations for the Broadkill in the local TMDL.

Table 1 presents a summary of the following:

- **Baseline Loads**:
  - **2002-2003 Baseline Loads**: Baseline levels (i.e., land use loads) from 2002-2003 conditions. These baseline loads were used to calculate the allocated loads for nitrogen, phosphorus, and *enterococcus* bacteria as published in the Broadkill River local TMDL.
  - **2007 Baseline Loads**: Significant changes in land use were observed in the Broadkill River watershed between 2002 and 2007. Land use loads from 2007 baseline levels were used to amend the absolute reductions of nitrogen and phosphorus necessary to achieve a 40% reduction of 2002-2003 baseline levels as stated in the local TMDL.
- **2012 Progress Loads and Reductions**: Progress loads and load reductions achieved from best management practice (BMP) implementation through 2012. Bacteria loads and reductions are not available at this time. Water quality samples are being collected to quantify bacteria loading and to ensure the required bacteria reductions are achieved based on the strategies implemented throughout the watershed.
- **Interim 2017 Milestone Goal**: 2017 Interim Milestone loads were calculated by subtracting 60% of the absolute reduction goal from 2007 baseline loads. 2012 Progress loads are less than 2017 Interim Milestone loads; therefore, the 2017 milestone has been achieved for nitrogen and phosphorus through the implementation of strategies through 2012.

- **2025 Planned Loads and Planned Reductions**: Loads and reductions that will result from implementation of this Watershed Plan. Although it is difficult to quantify bacteria sources, the Pollution Control Strategy states that bacteria load reductions from its nutrient management strategies proposed in this plan meet or exceed the allocations for bacteria in the Broadkill River local TMDL (DNREC, 2012a)
- **2025 Allocated Load**: Allocated loads published in the Broadkill River local TMDL that are reduced by 40% from 2002-2003 baseline levels for nitrogen and phosphorus loads and reduced by 75% from 2002-2003 baseline levels for *enterococcus* bacteria loads.

Table 1: Broadkill River Local TMDL Allocated and Planned Loads

	Nitrogen (lbs/day)	Phosphorus (lbs/day)	Bacteria (CFU/day)
2002-2003 Baseline Loads	**3,707.0**	**157.8**	**4E+11**
2007 Baseline Loads	**2,891.3**	**124.1**	**NA**
2012 Progress Loads	**2,357.9**	**99.2**	**-**
2012 Progress Reductions	**533.4**	**24.9**	**-**
Wastewater and Septic	18.5	1.9	-
Urban	16.6	3.0	-
Agriculture	498.3	20.0	-
2017 Interim Milestone Loads	**2,491.0**	**106.5**	**2.2E+11**
2025 Planned Loads	**2,223.9**	**94.7**	**1E+11**
2025 Planned Reductions	**122.0**	**4.0**	**-**
Wastewater and Septic	81.9	2.2	-
Urban	40.1	1.8	-
Agriculture	Maintain existing implementation rate		
2025 TMDL Allocated Loads	**2,224.2**	**94.7**	**1E+11**
Percent Reduction Achieved	40%	40%	75%
Percent Reduction Required	40%	40%	75%

1.1 Watershed Plan Structure

The primary goal is to prepare the Broadkill Plan in accordance with the United States Environmental Protection Agency's (EPA) nine essential elements for watershed planning. These elements, commonly called the 'a through i criteria' are important for the creation of thorough, robust, and meaningful watershed plans and incorporation of these elements is of particular importance when seeking implementation funding. The EPA has clearly stated that to ensure that Section 319 (the EPA Nonpoint Source Management Program) funded projects make progress towards restoring waters impaired by nonpoint source pollution, watershed-based plans that are developed or implemented with Section 319 funds to address 303(d)-listed waters must include at least the nine elements.

The Broadkill Plan is organized based on these elements, which include:

a. An identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the plan and to achieve any other watershed goals identified in the plan, as discussed in item (b) immediately below.

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below, recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time.

c. A description of the management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above as well as to achieve other watershed goals identified in the plan, and an identification of the critical areas in which those measures will be needed to implement this plan.

d. An estimate of the amount of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan.

e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the recommended management measures.

f. A schedule for implementing the management measures identified in this plan that is reasonably expeditious.

g. A description of interim, measurable milestones for determining whether management measures or other control actions are being implemented.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

The outcomes of the planning effort are to provide guidance for the strategic implementation of watershed protection and restoration efforts that will advance progress toward meeting Delaware's local TMDLs pollutant loading allocations, and ultimately meeting water quality standards. Successful implementation of the plan will lead to improvements in local watershed conditions and aquatic health.

1.2 Regulatory and Programmatic Environment

While many varied regulatory and volunteer programs exist to enforce environmental protection, the primary programs and regulations addressed by this plan are the Delaware local TMDLs and the National Pollutant Discharge Elimination System (NPDES) permit. Under the Federal Clean Water Act (CWA), the state of Delaware is required to assess and report on the quality of waters throughout the state. Where Delaware's water quality standards are not fully met, Section 303(d) requires the state to list these water bodies as impaired waters. States are then required to develop a TMDL for pollutants of concern for the listed impaired waters. Delaware's TMDLs will be referred to as local TMDLs in this Watershed Management Plan.

The Broadkill River watershed currently has a local TMDL for nitrogen, phosphorus, and bacteria (DNREC, 2005).

1.3 Watershed Priorities

Priorities are discussed in more detail in Section 8.3: Implementation Priorities. Critical watershed issues including current 303(d) listings for biology and habitat and active nutrient TMDLs should all be considered priority areas for project implementation in the Broadkill watershed. Highest priority should be given to impaired segments located in headwaters. Impairments to headwater streams are carried and experienced downstream; therefore, improvements made to headwater streams will maximize the length of implementation impacts.

Current 303(d) impairments located in the Broadkill watershed are discussed in Section 2.4.2 and active TMDLs are discussed in Section 2.4.3. Broadkill River stream segments that should be prioritized include the mainstem and tributaries of Beaverdam Creek, Round Pole Branch, Ingrams Branch, Pemberton Branch, Lower Red Mill Branch, Martin Branch, and Primehook Creek. Additionally, Red Mill Pond, Wagamons Pond, Waples Pond, and Reynolds Pond should be prioritized.

In addition to Broadkill 303(d) listings, the Broadkill River Watershed Pollution Control Strategy (DNREC, 2012a) and Broadkill River Watershed Implementation Plan (Duffield Associates, Inc., 2009) are both valuable resources which should be used as guidance for implementation efforts.

The Broadkill River Watershed Implementation Plan (Duffield Associates, Inc., 2009) recommends that the sub-watershed approach be the preferred implementation strategy with the Wagamons Pond sub-watershed, which includes Pemberton Branch, Ingram Branch, and Round Pole Branch, as the highest priority sub-watershed due to possible future stressors. It is also recommended to implement other high priority opportunities in other sub-watersheds as funding becomes available and willing land owners are identified. The Watershed Implementation Plan identifies and prioritizes potential restoration or preservation projects within the Broadkill and includes recommended site descriptions for potential implementation strategies including upland retrofits and watershed management water quality opportunities. Prioritization of each implementation strategy was ranked based on overall score and sub-scores for individual technology. The highest watershed management water quality and highest upland restoration opportunities include infiltration, buffering, stormwater storage, and wetland creation, preservation, and/or reforestation projects.

The Broadkill River Watershed Pollution Control Strategy utilized the Watershed Implementation Plan and the 2010 Pollution Control Strategy in the development of a set of actions that will result in required nutrient and bacteria reductions. Opportunities were organized by sector including agriculture, non-agriculture stormwater, wastewater, and targeted. These opportunities are further discussed in Section 8.3 Implementation Priorities.

2 Watershed Characteristics

2.1 Watershed Delineation and Planning Segments

Broadkill River is located in Sussex County, Delaware, with its eastern most boundaries adjacent to the Delaware Bay and the Atlantic Ocean and its western most boundaries adjacent to the Upper Nanticoke River watershed. The Broadkill River watershed is a part of the Delmarva Peninsula, and is a direct drainage to the Delaware Bay (Figure 1).

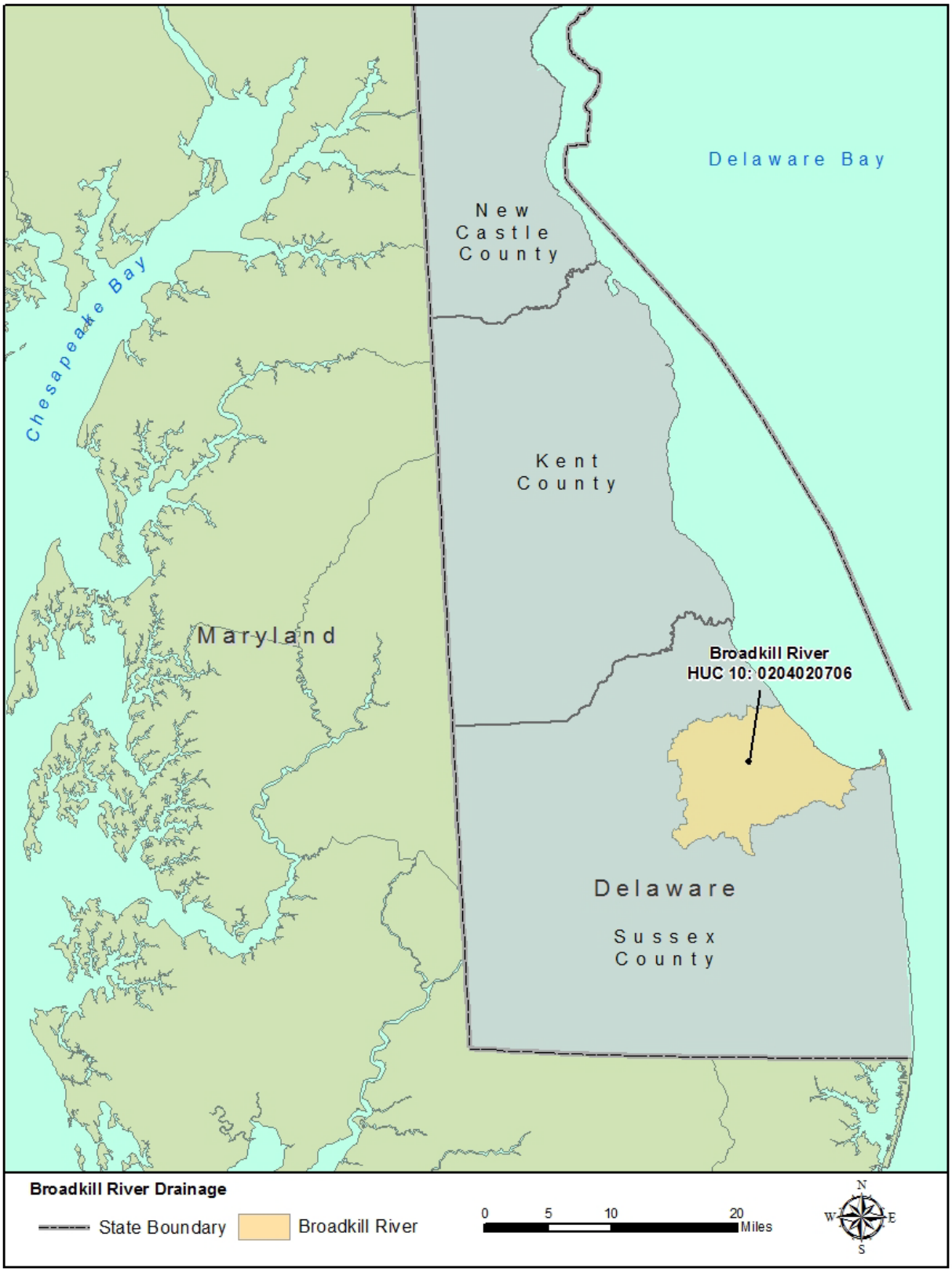

Figure 1: Broadkill River Planning Unit

2.2 Broadkill River

The Broadkill is 1 of 13 watersheds in Sussex County (HUC-10: 0204020706) and contains three major municipalities: Milton, Lewes, and Georgetown. The Broadkill includes 67,200 acres or 105 square miles of land area which drains east to the Delaware Bay and eventually the Atlantic Ocean (Table 2). Figure 2 shows the location of the Broadkill watershed in relation to major towns in the area. A portion of the Broadkill headwaters originates in Georgetown including Ingram Branch. Additional headwater segments include Martin Branch, Beaverdam Creek, Round Pole Branch, Pemberton Branch, and Primehook Creek.

Table 2: Broadkill River Watershed Drainage Area and Stream Miles

Watershed	Drainage Area (Acres)	Drainage Area (Square Miles)	Stream Miles
Broadkill River	67,200	105	204

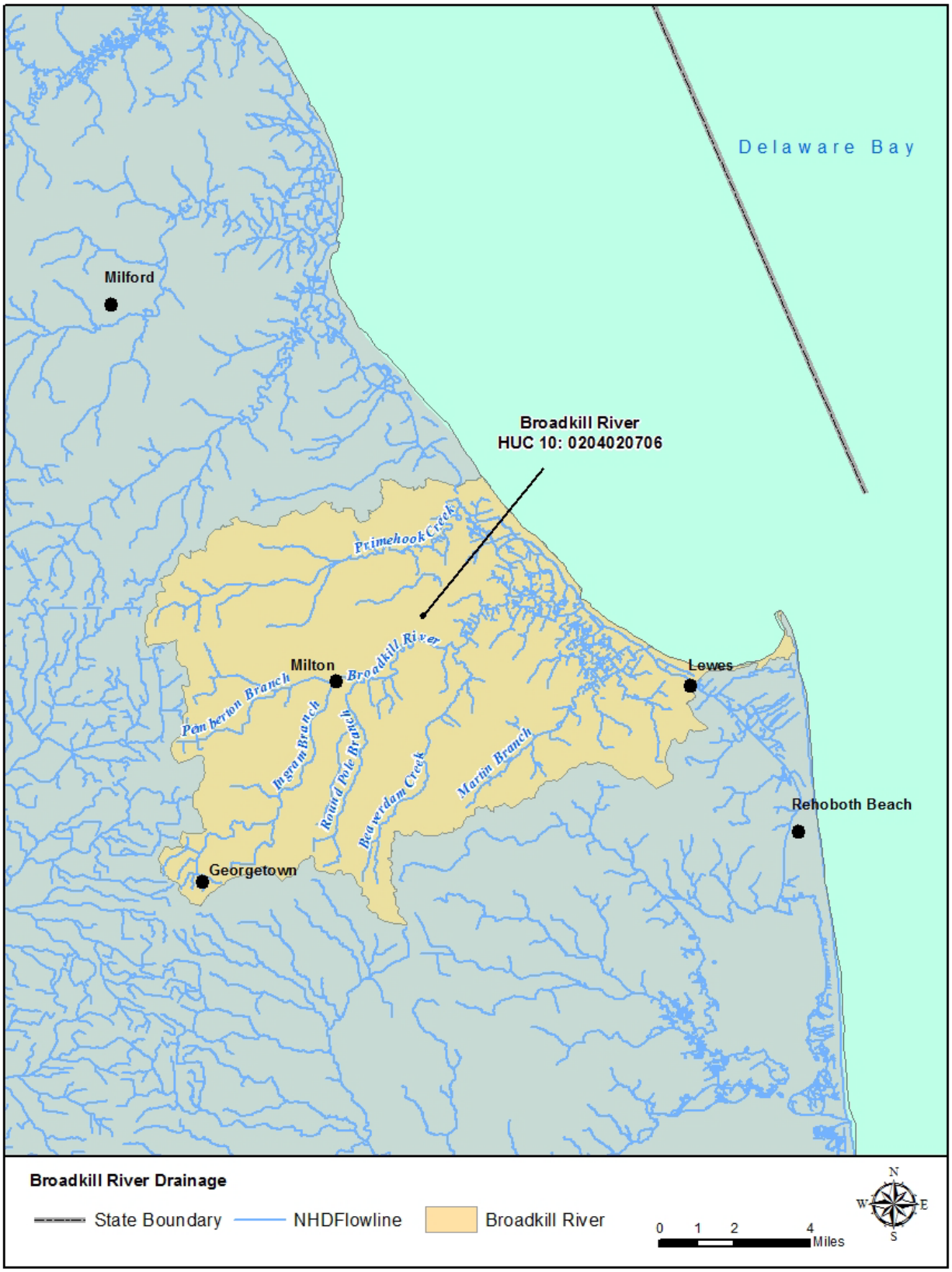

Figure 2: Broadkill River Planning Unit Watershed Location

2.3 Land Use

The type and density of various land uses can have a dramatic effect on water quality and stream habitat. Forested areas slow stormwater flow and allow water to gradually seep into soils and drain into streams. Vegetation and soils bind nutrients and pollutants found within stormwater—improving water quality as it infiltrates the ground. Developed areas, with a high percentage of impervious surfaces (buildings, paved roads, parking lots, etc.), do not slow stormwater flow—increasing the amount of pollutants entering streams. Increased stormflow can negatively affect stream habitat by increasing bank erosion and decreasing instream and riparian habitat. Agricultural land, if managed incorrectly, can also increase nutrients and bacteria in streams.

See Figure 4 for aerial imagery of the Broadkill watershed. 2007 land use data from the Delaware Office of State Planning Coordination (2008) and 2007 impervious surface data from the State of Delaware, Office of Management and Budget (2008) are presented in Figure 5. Land use data presented in the figures below were used to show potential sources and were not used in calculations.

2.3.1 Existing Land Use

According to 2007 land use data, water/marsh comprises 2.86% of the area in the Broadkill while the largest land use area in the Broadkill is agricultural lands (38.6%). Animal farming is common within the Broadkill. Animal counts within the Broadkill show that poultry is the most common, followed by, in decreasing order, dairy cattle, beef cattle, swine, and horses. Land use has changed significantly since 1984, and in decreasing order of areal extent, are agriculture; forest land; wetland urban; and lastly, barren lands (Figure 3). The order of these land uses has not changed from 1997 to 2007. Other land use changes from 1997-2007 include a 4.27% increase in residential area; a 2.44% loss of forested land; and a 3.18 % loss of agricultural land. Wetlands/water decreased slightly in the last decade by 0.8%.

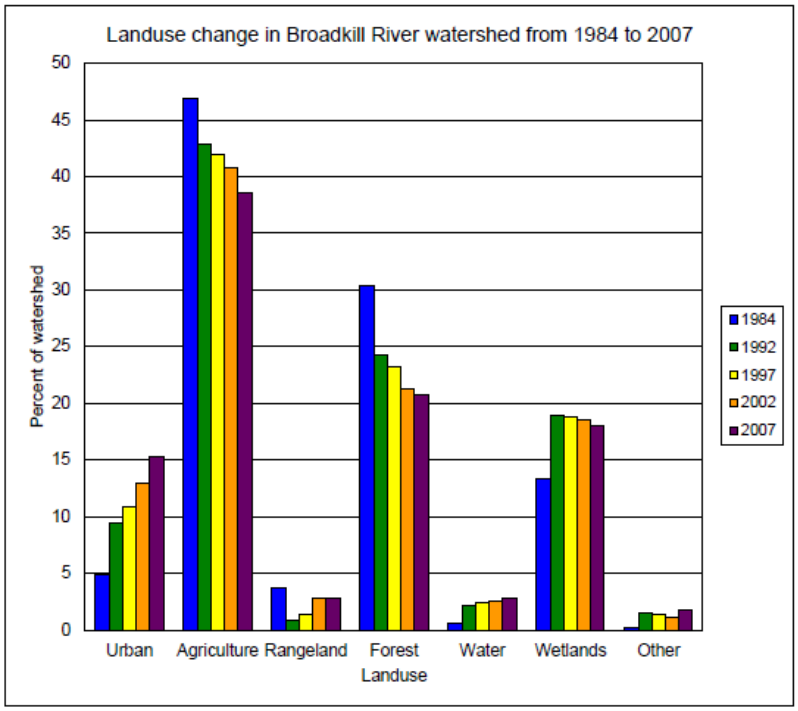

Figure 3: Change of Land use in the Broadkill River Watershed from 1984 to 2007 (DNREC, 2012a)

Impervious surfaces concentrate stormwater runoff, accelerating flow rates and directing stormwater to the receiving stream. This accelerated, concentrated runoff can cause stream erosion and habitat degradation. Runoff from impervious surfaces picks up and washes off pollutants and is usually more polluted than runoff generated from pervious areas. In general, undeveloped watersheds with small amounts of impervious cover are more likely to have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover. Impervious cover is a primary factor when determining pollutant characteristics and loadings in stormwater runoff.

The degree of imperviousness in a watershed also affects aquatic life. There is a strong relationship between watershed impervious cover and the decline of a suite of stream indicators. As imperviousness increases the potential stream quality decreases with most research suggesting that stream quality begins to decline at or around 10 percent imperviousness (Schueler, 1994; CWP, 2003). However, there is considerable variability in the response of stream indicators to impervious cover observed from 5 to 20 percent imperviousness due to historical effects, watershed management, riparian width and vegetative protection, co-occurrence of stressors, and natural biological variation. Because of this variability, one cannot conclude that streams draining low impervious cover will automatically have good habitat conditions and a high quality aquatic life.

Impervious surfaces make up 3.5% of the overall Broadkill drainage. See Figure 5, for mapped impervious surfaces. Impervious surface is highest in the towns of Georgetown, Milton, and Lewes as well as along Coastal Highway (e.g., shopping centers and parking lots) at the east side of the Broadkill watershed.

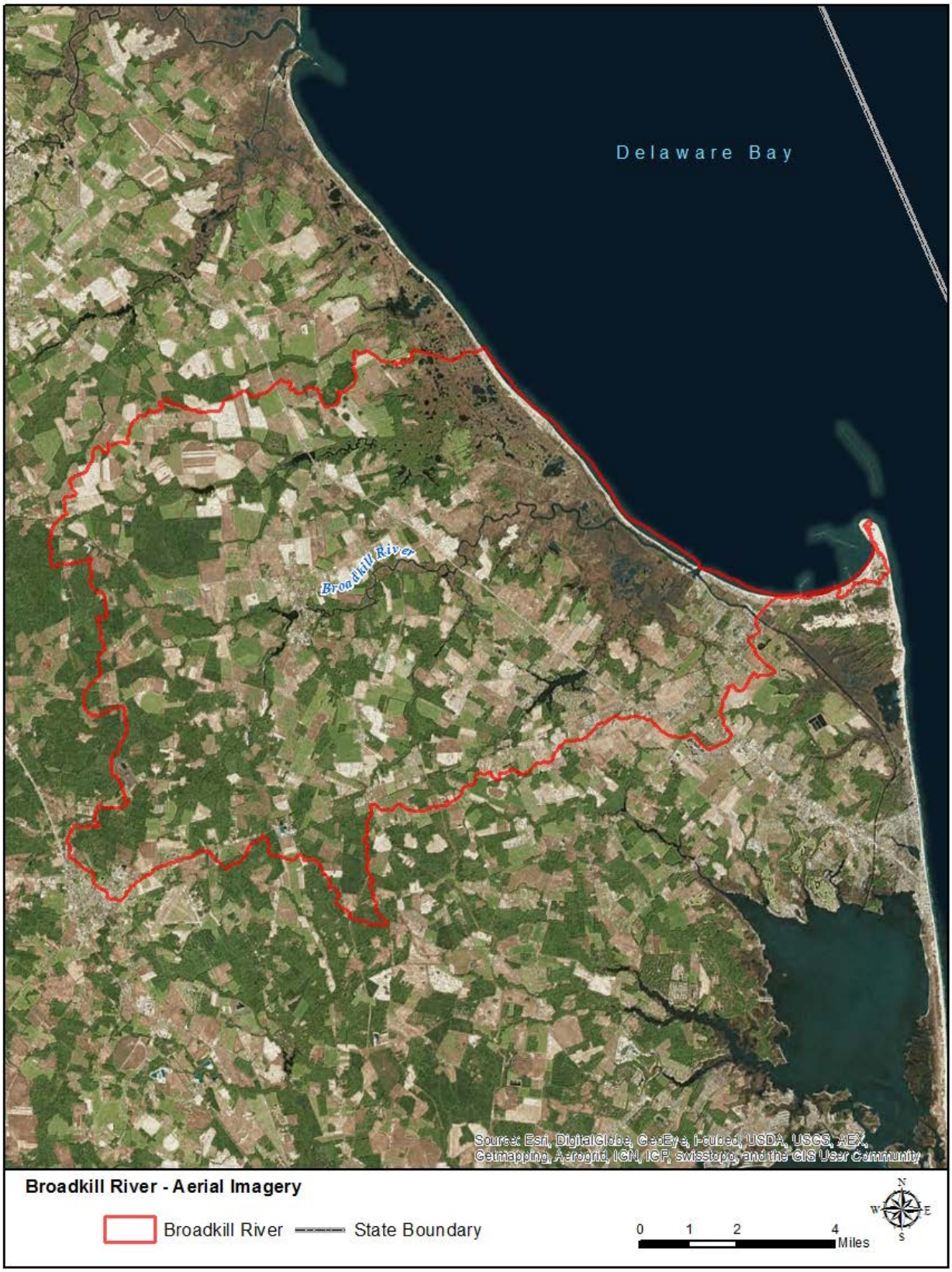

Figure 4: Broadkill River Watershed Aerial Imagery

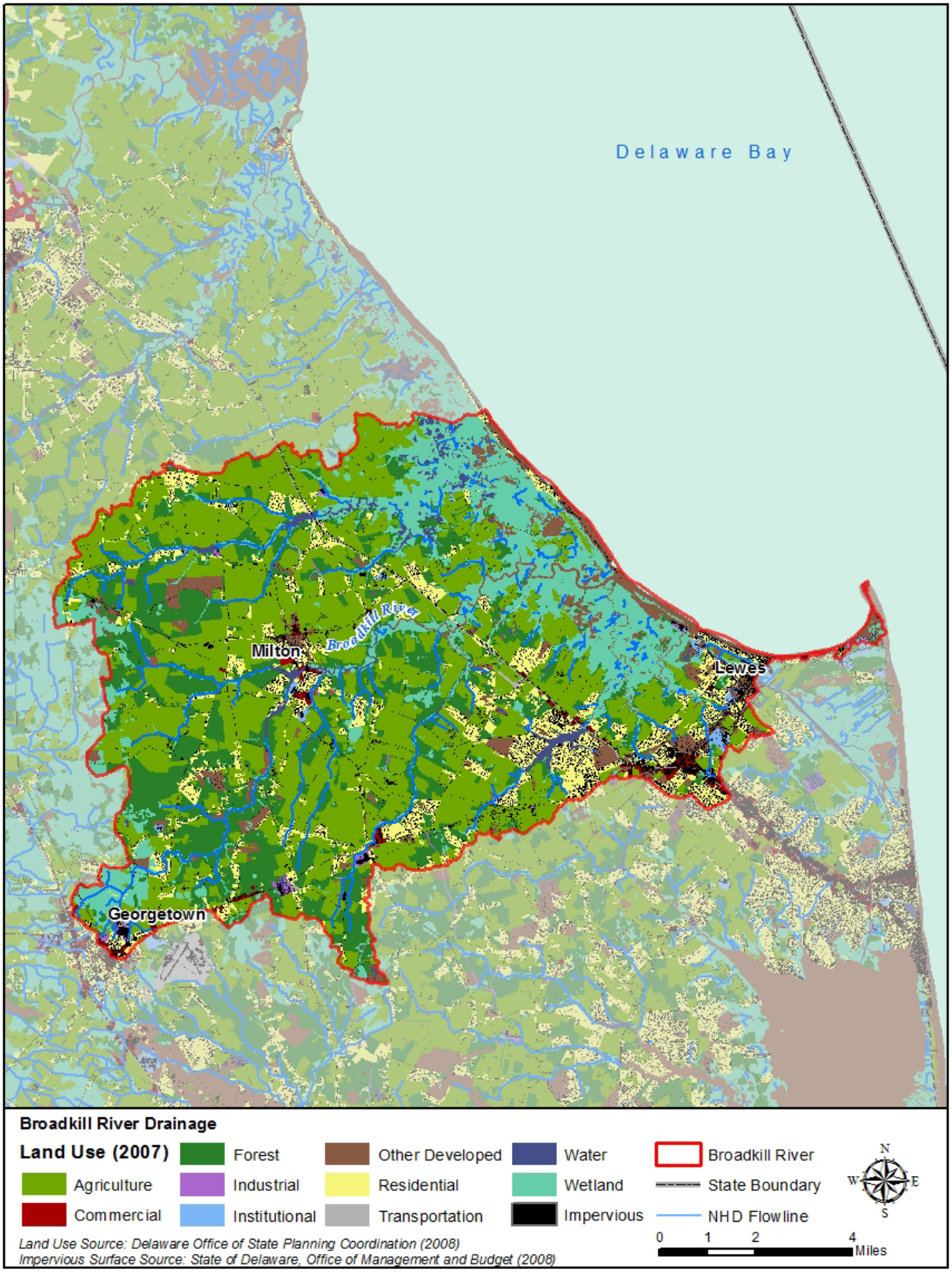

Figure 5: Broadkill River Watershed Land Use and Impervious Surface

2.4 Water Quality

2.4.1 Use Designations

Following Title 7 of Delaware's Administrative Code for Natural Resources & Environmental Control (7400 Watershed Assessment Section, 7401 Surface Water Quality Standards), the Use Designations for the Broadkill River are presented in Table 3. Designations include industrial water supply; primary contact recreation; secondary contact recreation; fish, aquatic life, and wildlife including shellfish propagation; and agricultural water supply in freshwater segments only.

Table 3: Use Designations of the Broadkill River

Waterbody	Broadkill River
Public Water Supply Source	-
Industrial Water Supply	X
Primary Contact Recreation	X
Secondary Contact Recreation	X
Fish, Aquatic Life & Wildlife*	X
Cold Water Fish (Put-and-Take)	-
Agricultural Water Supply**	X
ERES Waters***	-
Harvestable Shellfish Waters	-

Source: http://regulations.delaware.gov/AdminCode/title7/7000/7400/7401.pdf
*waters of Exceptional Recreational or Ecological Significance
**freshwater segments only
*** Includes shellfish propagation

2.4.2 303(d) Impairments

According to Delaware's 2012 303(d) list of impaired waters (DNREC, 2012b), several segments within the Broadkill planning unit are listed for water quality impairments. The Broadkill watershed contains several Category 4a waters (i.e., streams and ponds) which include those waters that are not meeting their use designation but a TMDL has been developed to address the impairments. Category 4a waters include Lower Broadkill, Beaverdam Creek, Round Pole Branch, Ingrams Branch, Pemberton Branch, Heronwood Branch, Red Mill Pond, Wagamons Pond, Waples Pond, and Reynolds Pond. Pollutants included under Category 4a listings for Broadkill include nutrients (i.e., nitrogen and phosphorus), dissolved oxygen, and bacteria. Category 5 waters for the Broadkill watershed, which include those waters that are not meeting their use designation and require a TMDL, include 0.06 stream miles of Martin Branch for habitat, and 12.6 stream miles of Primehook Creek for mercury and dissolved oxygen.

2.4.3 TMDLs

The Broadkill watershed currently has local TMDL regulations for nutrients (i.e., nitrogen and phosphorus) and *enterococcus* bacteria; which, were established in 2006 in response to the several 303(d) listings mentioned in the previous section (Section 2.4.2; State of Delaware, 2006). The TMDL regulations for the Broadkill watershed include a 40% reduction of nonpoint source nitrogen and phosphorus loads and a reduction of 75% of nonpoint source bacteria load in the entire watershed.

2.4.4 NPDES

The Federal Clean Water Act requires a NPDES permit to discharge pollutants through a point source into a "water of the United States". In Delaware, New Castle County and the Delaware Department of Transportation (DelDOT) are co-permittees on the State's only MS4 NPDES permit. There are four active NPDES permitted point sources in the Broadkill watershed that originate from food and poultry processing facilities and municipal wastewater treatment plants (WWTPs).

2.5 Anticipated Growth

The Broadkill River watershed is 1 of 13 watersheds in Sussex County. The Sussex County Comprehensive Plan was last updated in 2007 and approved in 2008 (DWIC, 2012). The next update of the plan is due by October 2018. In the meantime, annual reviews of the plan, which began July 2012, are being submitted to the Cabinet Committee on State Planning Issues reporting on the progress of implementing the Plan. Sussex County is considered the fastest growing area in Delaware with the highest growth rate among the three counties occurring between the 2000 U.S. Census and 2008 (15%; SCCPU, 2008). The population in Sussex County is projected to grow to 253,226 people in 2030, which is an increase of 61.7% from 2000 census data of 156,638 people. However, while the population is projected to continually increase from 2000 to 2030, the rate of increase is projected to decrease markedly every ten years (e.g., 24% population change from 2000-2010 to a 12% population change projected from 2020 to 2030; SCCPU, 2008).

The primary developed areas included in this section of Sussex County are Georgetown, Milton, and Lewes. Milton, located in the center of the Broadkill, at elevation 30 feet above sea level has a land area of 1.06 square miles Milton's population is 1,792 (estimated in July 2006) and the population density is 1,692 people /square mile. Lewes, a coastal city on the eastern boundary of the Broadkill, is at elevation 18 feet above sea level. The land area of Lewes is 3.66 square miles, with a population of 3,119 (estimated in July 2006) and population density of 850 people/square miles. The northeastern portion of the City of Georgetown is located within the Broadkill. Georgetown is located on the western boundary of the Broadkill. Georgetown has a land area of 4.13 square miles, at elevation 52 ft. The population of Georgetown is 4,927 (estimated in July 2006) and has a population density of 1,186 people/ square mile.

Sussex County has a goal to expand regional and local wastewater treatment facilities for a large portion of the Bay watershed by 2017 through a 'Short Term Wastewater Expansion' program with additional expansions occurring between 2017 and 2025 as part of the 'Long Term Wastewater Expansion' program (DWIC, 2012). The City of Seaford, Town of Laurel, and Town of Georgetown are also committed to improving water quality and plan to continue to extend wastewater treatment services to their local residents. In addition, the City of Seaford plans to incorporate new technology to accommodate future growth in the area.

Sussex County continues to utilize strategies such as promoting low impact development and implementing stormwater retrofits for water quality treatment. The County will continue to work with The Department of the Office of State Planning and Coordination to refine short and long term wastewater and septic goals, in addition to long term grown projections in order to meet Delaware's TMDL goals (DWIC, 2012).

3 Causes and Sources of Impairment (a)

3.1 Impairments

High levels of bacteria and elevated levels of nutrients (i.e., nitrogen and phosphorus) impair the Broadkill River, its tributaries, and ponds. Eight years have passed since the revised TMDL for the Broadkill River was promulgated using pollution levels from 2002. Since that time, population and pressures from development have increased throughout the watershed. However, stormwater and wastewater regulations 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.

3.1.1 Nutrients

According to the "State of Delaware Surface Water Quality Standards (Amended July 11, 2004)", some site-specific or basin-specific standards exist for nutrients but acceptable nutrient levels are determined based on their ultimate effect on DO or algal levels through nutrient-algal-DO relationships (eutrophication) and/or threshold levels. The nutrient standards are currently in narrative form for controlling nutrient over enrichment and are stated as:

> "Nutrient over enrichment is recognized as a significant problem in some surface waters of the State. It shall be the policy of this Department to minimize nutrient input to surface waters from point sources and human induced nonpoint sources. The types of, and need for, nutrient controls shall be established on a site-specific basis. For lakes and ponds, controls shall be designed to eliminate over enrichment."

Although national numeric nutrient criteria have not been established in Delaware, DNREC has used threshold levels of 3.0 mg/L for total nitrogen (TN) and 0.2 mg/L for total phosphorous (TP) for listing water bodies on the State's 303(d) listings and 305(b) assessment reports and, therefore, will be used as the target nutrient levels for completing nutrient TMDLs in addition to considering nutrient endpoints such as DO and algal levels (chlorophyll-a). Nutrient related algal effects typically require sufficient time for impacts to be noticed (i.e., impacts are long term in nature rather than instantaneous), therefore, the nutrient targets will be assessed based on monthly average nutrient concentrations.

In general, water quality data analysis in the Broadkill River watershed indicates that the watershed experiences low DO levels less than the State minimum WQS of 4 mg/L with elevated chlorophyll-a levels at many stations throughout the watershed. Potential oxygen demands include sediment oxygen demand (SOD), BOD oxidation, ammonia nitrification and/or algal respiration. These oxygen demands can originate from point and nonpoint sources but also potentially from wetland/marsh loading of organic material. The data indicate sufficient nutrient concentrations at most of the stations to support algal growth (DNREC, 2006).

3.1.2 Bacteria

The State of Delaware water quality standard for *enterococcus* bacteria is a geometric mean of 100 CFU/100 ml. Enterococci are present in fecal material and are used as an indicator organism with which a correlation to illness rates can be established. The level of risk associated with primary contact recreation in waters with an *enterococcus* concentration of 100 CFU/100 ml has been deemed appropriate and is the basis for the current State of Delaware water quality standards for bacteria.

Water quality data analysis in the Broadkill River watershed indicates elevated bacteria concentrations with maximum *enterococcus* levels around 1,000 – 2,000 CFU/100 ml (DNREC, 2006).

3.2 Sources

Non-point sources are the probable source for the majority of 303(d) impaired water bodies listed for nutrients and bacteria in the Broadkill watershed with only a few nutrient and bacteria listings comprising probable point sources including Beaverdam Creek and Upper Broadkill River for nutrients and bacteria and Wagamons Pond for nutrients. The Broadkill is predominately agricultural in nature (39% of total land use) with a few major towns. It is assumed that the source of nutrients and bacteria is from animal manure and to a smaller extent, urban stormwater runoff.

3.2.1 Wastewater

There are four permitted WWTP, CSO, or Industrial facilities in the Broadkill watershed including Milton WWTP, Allen Family Foods Harbeson Plant, Perdue Georgetown Plant, and SAW Georgetown Plant (Figure 6). The City of Lewes WWTP is part of the Inland Bays watershed and is not included as part of the Broadkill.

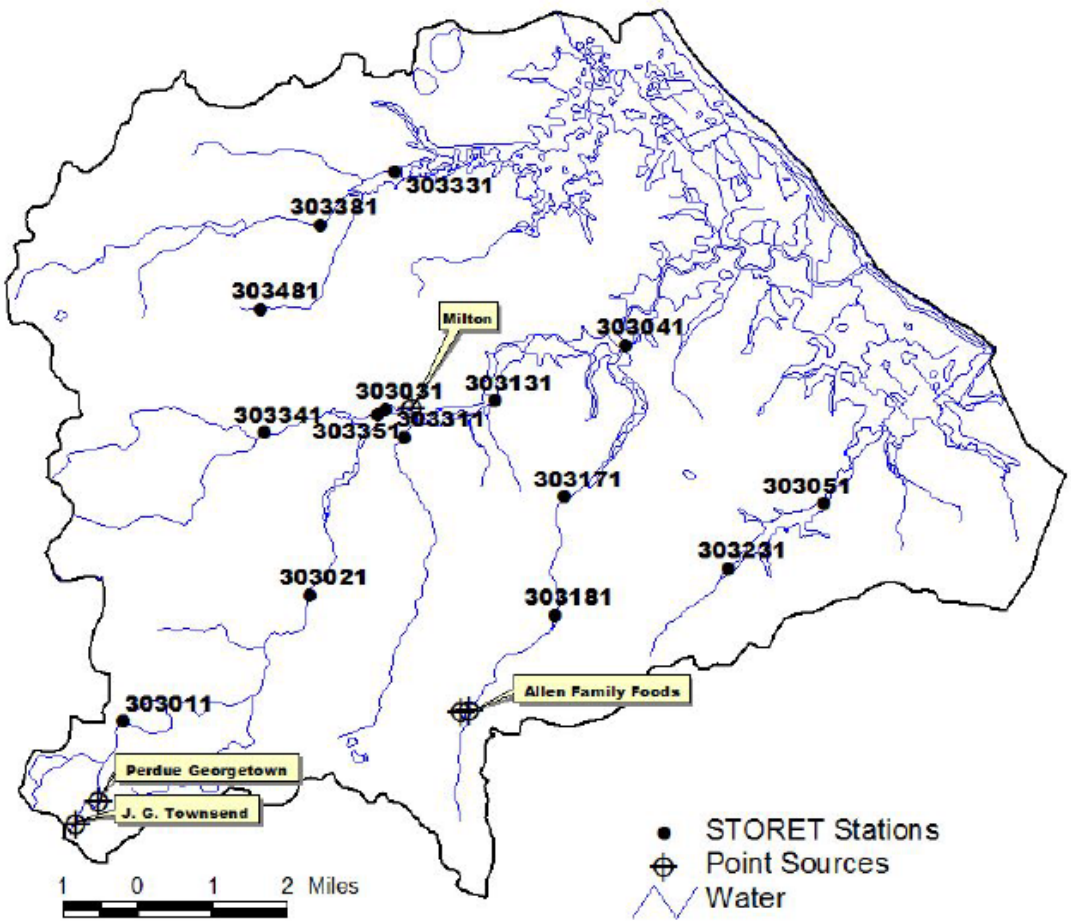

Figure 6: Point Source Discharges in the Broadkill River Watershed (DNREC, 2012a)

3.2.2 Urban

The nutrient loads from development are from urban stormwater runoff. The urban sector in the Broadkill watershed is comprised of nonregulated developed land. There are no regulated municipal separate storm sewer systems (MS4s). Although urban land use is not considered a significant source of nutrients or bacteria in the Broadkill watershed, the use of urban BMPs, such as wet and dry ponds, infiltration, and constructed wetlands, could reduce nutrient loads from development.

In June 1990, the Delaware Legislature passed the Sediment and Stormwater Law to help correct the State's water quality and quantity problems. Implementation was initiated in July of 1991, and addressed 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 (Table 4). 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, heightening awareness of green technology BMPs, and promoting stormwater management practices based on low impact development and conservation design.

Table 4: Implemented Stormwater BMPs as of Spring 2012

BMP	Current Acres	TN reduced (lbs/day)	TP reduced (lbs/day)
Dry Pond	268.3	0.4	0.10
Wet Pond	1,503.6	14.8	2.68
Infiltration Practices	80.9	1.3	0.20
Total Progress to Date		**16.6**	**2.97**

3.2.3 Agriculture

Agricultural land uses are dominant in this watershed. In the Broadkill, like many watersheds, polluted runoff from cropland, manure-disposal sites, and concentrated animal-feeding operations (CAFOs) are some of the important sources of phosphorus to surface waters. As of 2002, there were 29 poultry operations, which produce approximately 2,485,355 birds annually, 2 beef cattle operations, 1 equine and 1 goat operations in the Broadkill Watershed (DNREC, 2012a).

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 2010, multiple BMPs have been implemented and the Delaware Nutrient Management Act was passed (Table 5). 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. Since there are many USDA cost-shared practices to control these loads, cropland and animal production areas are a critical area with a high recovery potential.

Table 5: Implemented Agricultural BMPs as of 2012

BMP	Current Acres	TN reduced (lbs/day)	TP reduced (lbs/day)
Grassed Filter Strips	13.8	0.8	0.0

BMP	Current Acres	TN reduced (lbs/day)	TP reduced (lbs/day)
Wildlife habitat	118.3	4.8	0.1
Wetland restoration	87.4	7.5	1.7
Riparian Buffers	14.4	1.2	0.0
Grass Buffers	151.5	9.2	0.2
Forest Buffers	191.5	16.4	0.4
Cover Crops	4,563.1	106.6	0.3
Manure Relocation (tons)	1,265.0	14.3	1.0
Nutrient Management Plans	26,476.0	337.3	17.4
Phytase	-	-	0.4
Total Progress to Date		**498.3**	**20.0**

3.2.4 Septic

While major towns such as Georgetown and Milton are generally connected to central sewer systems, onsite wastewater treatment and disposal systems, or septic systems, exist throughout the watershed (Figure 7). The watershed currently has 8,328 septic systems (on-site wastewater disposal and treatment systems; OWTDS) within its boundaries. While the overall septic load likely is not substantial compared to other sources, a key management measure is to prevent growth in this load and by connecting septic systems to municipal systems, or using performance based systems.

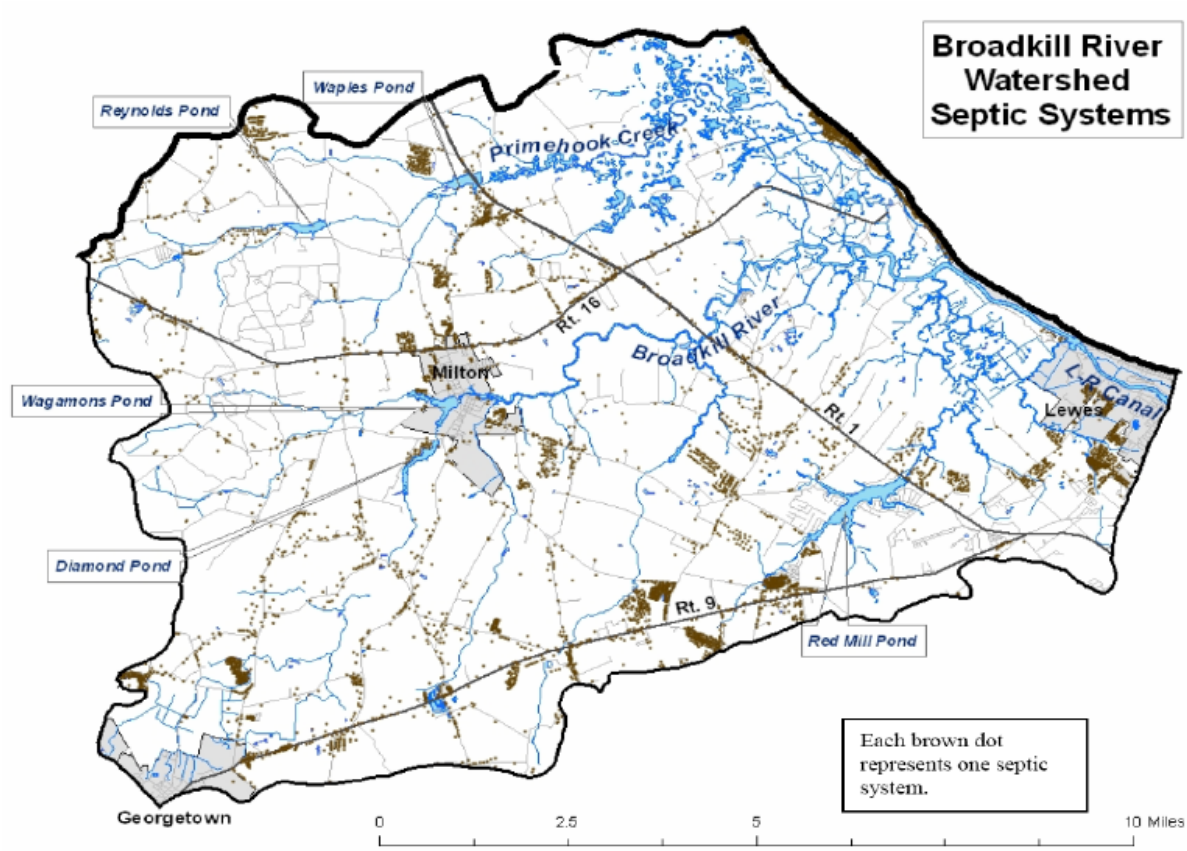

Figure 7: Septic systems in the Broadkill River Watershed (DNREC, 2012a)

Current septic system pump-outs and conversion of onsite wastewater systems to central sewer systems, while not extensive, have helped to decrease the nutrient pollution entering the Broadkill watershed. Twenty-one holding tanks in the watershed are currently being pumped out a year, while 350 properties in the watershed have been converted from septic systems to central sewer systems. Estimated nutrient reductions from septic system pump outs and conversion of onsite wastewater systems to central sewer systems includes 18.54 lbs/day (6,772 lbs/year) TN and 1.89 lbs/day (690.3 lbs/year) TP.

3.2.5 Forest

The forested land is a low loading land use. Many management measures seek to convert less productive land into forest, improve forest harvesting techniques, or to add a forested buffer down slope from a higher loading land use.

3.3 Summary

The critical sources of nitrogen, phosphorus, and bacteria in the Broadkill watershed are agricultural land uses. Manure is likely the dominant cause of both the nutrient and bacteria pollution. Fortunately, manure management is a targeted area by USDA cost-share programs. The overall goals of this watershed management plan and the Broadkill TMDL are presented in the following section.

4 Expected Load Reductions (b)

Originally, the TMDL values specified in the regulation was developed to address pollutant loads based on 2002 land use values with baseline loads for nitrogen and phosphorus equating to 3,707 lbs per day (1,353,833 lbs/year) and 157.8 lbs per day (57,650 lbs/year), respectively. The findings at that time targeted a nutrient reduction of 670.1 lbs per day (244,700 lbs/year) TN and 96 pounds per day (35,060 lbs/year) of TP. However, the land use had significantly changed between 2002 and 2007, as shown in Figure 3 of Section 2.3.1: Existing Land Use. As such, the Broadkill Pollution Control Strategy (DNREC, 2012a) amended the absolute reductions of nitrogen and phosphorus from 2007 land use conditions necessary to achieve a 40% reduction of 2002-2003 baseline levels as stated in the local TMDL. Using the Pollution Control Strategy targeted reductions; this plan will address a nutrient reduction goal of 667.1 lbs per day (243,700 lbs/year) for TN and 29.4 pounds per day (10,740 lbs/year) for TP from nonpoint sources (Table 6).

Table 6: Nutrient and Bacteria Loads Required for the Broadkill Local TMDL Nonpoint Sources

Source	Pollutant	2002-2003 Baseline Load	2007 Baseline Load	Required Reductions*	TMDL Load Allocation
Nonpoint	TN	3,707 lbs/day	2,891 lbs/day	667.1 lbs/day	2,224 lbs/day
Nonpoint	TP	157.8 lbs/day	124.1 lbs/day	29.4 lbs/day	94.7 lbs/day
Nonpoint	Bacteria	4.0E+11 CFU/day	NA	3.0E+11 CFU/day	1.0E+11 CFU/day

*Required reductions for nitrogen and phosphorus amended to account for 2007 land use change.

4.1 Nutrients

While the local TMDL did not specify the sector responsible for the nonpoint source loads, the Broadkill is dominated by agriculture and a few major towns which are assumed to be the sources. As such, the

source of impairment is dominated by nonpoint source agriculture and to a smaller extent, urban stormwater. The management measures discussed in following sections target the source of nutrients and bacteria from the nonpoint source agricultural and stormwater load.

Projected reductions in loads are a result of applying various BMPs at various levels to the nonpoint source agricultural and urban stormwater sectors. The suite of BMPs that produced the loads discussed in this section is discussed in detail in Section 5: Management Measures.

The expected load reductions are accurate assuming constant initial conditions. As land use changes from agriculture to developed, more of the nonpoint load will come from those developed source sectors (urban, septic).

The load reductions proposed in this section meet or exceed the allocations for the Broadkill in the local TMDL. The allocations were established to ensure that Delaware implements adequate pollution control practices to meet the water quality standards. These load reductions are specific to each source. While the TMDL did not split out pollutant loads by source sector, this watershed is dominated by agriculture and the load reductions are proposed to be reduced from the nonpoint source agricultural load.

Table 7 provides a summary of the projected TN and TP pounds per day reduced once all recommended management measures are implemented and take effect. That is, implementing a forest buffer may not take full effect for five to ten years, since the trees must approach maturity before the full nutrient reduction benefit is realized. However, the table reflects the load once the BMPs take effect. Also, there will be lag time related to groundwater and storage within the stream system. By targeting the most effective BMPs to the critical areas with the greatest recovery potential, the TN load can be decreased by 667.39 pounds per day (243,800 lbs/year) and the TP load can be decreased by 29.40 pounds per day (10,740 lbs/year). These projected loads are consistent with the local TMDL for the Broadkill watershed. The specific management measures that are used to decrease nutrients are presented in the following section: Management Measures (c).

Table 7: Projected Load Reductions by Sector to Meet the Broadkill Local TMDL for Nutrients

Future Load Reductions by Sector	Delivered Total Nitrogen Reduced (lbs/day)	Delivered Total Phosphorus Reduced (lbs/day)
Urban	40.3	1.9
Stormwater	6.1	1.03
Urban Buffer	34.2	0.85
Agriculture	Maintain existing implementation rate	
Onsite Wastewater	81.9	2.16
2013 – 2025 Implementation Sub-Totals	134.49	4.51
2012 Progress Reduction	533.41	24.89
Total Projected Reduction	**667.39**	**29.4**
TMDL Required Reduction*	**667.10**	**29.4**

*Based upon 2007 land use

4.2 Bacteria

The Broadkill local TMDL requires the watershed to reach target loads as defined in Table 6. The primary source of bacteria in this predominantly agricultural watershed is animal manure. Water quality samples will continue to be collected to ensure the required reductions are achieved. Although it is difficult to quantify bacteria sources, the Pollution Control Strategy states that bacteria load reductions from its nutrient management strategies proposed in this Watershed Plan meet or exceed the allocations for bacteria in the Broadkill local TMDL (DNREC, 2012a). The specific management measures that are used to decrease bacteria are presented in the following section: Management Measures (c).

5 Management Measures (c)

Best management practices (BMPs) are either already implemented or are planned for implementation to achieve the Broadkill local TMDL load reductions. These TMDL loads were discussed in the previous section, Section 4: Expected Load Reductions. The type and level of BMPs implementation included in this section will meet the reduction and loading goals of the Broadkill TMDL.

A preferred strategy for implementation will focus on project based strategies within subwatersheds. Targeted multi-faceted improvements can have significant impact on water quality improvement. This strategy has the benefit of providing a “holistic” approach to implementation and satisfies requirements for various funding sources.

As part of a sub-watershed basis strategy, a second level of prioritization is ranking/prioritizing the sub-watersheds for implementation. Based on existing impairment, projected/expected land use, and identified opportunities, the stream segments around Wagamons Pond and the Broadkill River through Milton are identified. These extended reaches provide the greatest gains in pollution control, while also meeting the goals of the stakeholders. Although a sub-watershed strategy is the recommended priority approach, it is also prudent to implement other high priority opportunities in other sub-watersheds as funding becomes available and willing landowners are identified. It is also recommended that specific sites for preservation in each sub-watershed be identified and subsequently evaluated for potential preservation/conservation opportunities.

To achieve allocation targets outlined in the Broadkill local TMDL, a pollution control strategy was developed by DNREC in concert with the Tributary Action Team, other stakeholders, and the public (DNREC, 2012a). The Team worked to improve the water quality of the Broadkill using sound science as a basis for decisions, developing solutions that are integrative, creative and innovative, with due consideration given for the private property rights of individuals in the community and for the welfare of present and future generations who live and work in the watershed. The Team operated by consensus, and effort was made to meet the interests of all the participating stakeholder groups.

Each BMP provides a reduction for nitrogen, phosphorus, or bacteria. An annual pollutant load that meets the TMDL allocations is estimated for each source sector with the indicated BMPs are implemented. Load reductions are not tied to any single BMP, but rather to a suite of BMPs working in concert to treat the loads. Section 9 presents information on how progress toward load reductions will be evaluated and management plans adapted on an on-going basis.

5.1 Nutrients

5.1.1 Wastewater

There are four permitted WWTP, CSO, or Industrial facilities in the Broadkill watershed. There are three point source discharges on Ingrams Branch near Georgetown (Perdue and SAW Georgetown Plant – 2 outfalls), one on Beaverdam Creek (Allen Family Foods) and one on the tidal portion of the Broadkill River (City of Milton). Discharge conditions for all four facilities are presented in Table 8 and allocated loads from the Broadkill local TMDL are presented in Table 9.

Table 8: Broadkill River NPDES Wasteload Allocations (Concentrations)

Facility	SAW Georgetown	Perdue Georgetown	Allen Family Foods	City of Milton
NPDES #	0000141	0000469	0000299	0021491
Outfall #	001	002	001	001
Major/Minor	Minor	Major	Major	Minor
Effluent Type	Vegetable processing facility	Poultry processing operation	Poultry processing operation	Municipal STP
Flow (MGD)	0.33	2.00	1.25	0.35
BOD5 (mg/L)	10.0	10.0	10.0	15.0
NH3 (mg/L)	1.0	1.0	1.0	1.0
TN (mg/L)	7.0	7.0	7.0	12.5
TP (mg/L)	0.5	0.5	0.5	4.5
Enterococcus (CFU/100 ml)	100	100	100	33

Table 9: Broadkill River NPDES Wasteload Allocations (Loads)

Facility	SAW 001 Georgetown	Perdue Georgetown	Allen Family Foods	City of Milton
BOD5 (lb/day)	27.5	166.8	104.3	43.8
NH3 (lb/day)	2.75	16.7	10.4	2.92
TN (lb/day)	19.3	116.8	73.0	36.5
TP (lb/day)	1.38	8.34	5.21	13.1
Enterococcus (CFU/day)	1.25E+09	7.57E+09	4.73E+09	4.37E+08

Delaware's Compliance and Enforcement Branch assesses wastewater treatment plants and recommends enforcement to protect surface water quality. All "major" and half of the "minor" plants are inspected annually statewide. An audit of their monitoring records is also conduced. These are in accordance with EPA form 3560-3.

Consideration of septic hookups to an existing wastewater treatment plant may be considered to reduce septic loads, where a facility is below capacity. Growth projections will inform if this is a cost effective approach to reducing septic loads.

5.1.2 Urban

In 2002, there were more than 8,867.4 acres of developed lands in the watershed. As of 2007, there is 10,462 acres of developed land. Any development that occurred prior to 1990 was not subject to the State's Sediment and Stormwater Law, which requires any land disturbing activities of a certain size to address water quantity and water quality issues specifically related to sediment. A conversion of agriculture to non-agricultural land uses can impact the nutrient reductions made by the urban stormwater sector. There are currently 15,000 (approximately) new residential units approved by municipal and county government in the watershed. The types of development and use of stormwater BMPs can have either positive or negative effects on nutrient reductions. The Broadkill River Watershed Implementation Plan (Duffield Associates, Inc., 2009) indicates that there are 2,367 acres of impervious surface that are not treated by any stormwater management practices and 602 acres of untreated impervious surface within the Wagamons Pond subwatershed.

Many stormwater BMPs address both water quantity and quality, however, some BMPs are more effective at reducing nutrients than others. The Sussex Conservation District, who oversees the planning, construction, and maintenance of stormwater facilities in the county, is in the process of updating a database that will track BMPs by type and location. Until that data is available, a visual reconnaissance of subdivisions in the Broadkill Watershed in spring 2007 revealed that approximately 268.33 acres are treated by dry ponds and that approximately 1,503.61 acres are treated by wet ponds. These BMPs produce reductions of 15.27 lbs/day (5,577 lbs/year) of TN and 2.78 lbs/day (1,015 lbs/year) of TP. These practices, in addition to the others listed here, keep the focus on "green technology" to reduce impervious surfaces. Redevelopment will make use of filtering practices and new development will make greater use of practices possible with low impact development. When cost-effective, the use of these practices will be expanded and refocused to assure recovery. These BMPs were selected specifically for three reasons: 1) effectiveness for water quality improvement, 2) willingness among the public to adopt, and 3) implementable in multiple facility types without limitations by zoning or other controls. The practices include:

- **Bioretention** — An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants.
- **Bioswales** —A bioswale is a stormwater conveyance that reduces loads because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function similarly to bioretention.
- **Buffers** – An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals.
- **Dry Detention Ponds** – Depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Hydrodynamic Structures are devices designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads that are designed to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.

- **Infiltration** — A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil; they are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approved to build is issued. Yearly inspections to determine if the basin or trench is still infiltrating runoff are planned.
- **Sand Filters** – Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.
- **Wet ponds or wetlands** — A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal, but phosphorus and sediment are reduced.

Table 10 compares implementation of existing BMPs with planned levels of implementation. This increase in implementation will achieve the loads shown in Table 6. These loads meet the TMDL required reductions for the Broadkill.

Table 10: Urban BMP implementation, actual 2012 and planned levels for the Broadkill

BMP	Units	2012 Actual Implementation	2025 Planned Implementation*
Urban Stormwater	acres	1,853	602.9
Urban Buffers	acres	0	400

*Treated acres goal over 10 years

The measured effectiveness for each of these practices may be found in Table 11.

Table 11: Typical Nutrient Reduction from Stormwater BMPs

BMP	Land Area Needed	Cost	TN % Reduction	TP % Reduction
Bioretention	N/A	N/A	25	34
Bioswales	Low	Medium	25	34
Buffer Strips	Low	Medium	20 – 60	20 – 60
Constructed Wetlands	N/A	N/A	20	45
Dry Detention Ponds	High	High	15	25
Infiltration Trenches	Low	Medium	45 – 70	50 – 75
Sand Filters	N/A	N/A	47	41
Stormwater Wetlands	N/A	N/A	30	49

BMP	Land Area Needed	Cost	TN % Reduction	TP % Reduction
Wet Ponds	Medium	High	50	50

Stormwater retrofits will play an integral part in achieving pollutant reductions. The establishment of stormwater retrofit requirements for direct discharge to the Broadkill River, ponds, and tributaries is recommended with a focus on volume management by increasing emphasis on recharge and infiltration of stormwater, where it is technically and environmentally feasible.

5.1.3 Agriculture

Agriculture is by far the largest land use in the watershed representing approximately 40% of the land area. BMPs installed through 2006 include: Nutrient Management Plans; cover crops; Conservation Reserve Program practices; Conservation Reserve Enhancement Program (CREP) practices; manure relocation/alternative use; and the use of Phytase in poultry feed. These BMPs have produced reductions of approximately 498.27 lbs/day of TN (80% of total target reduction) and 20.02 lbs/day of TP (90% of total target reduction). These reductions in N and P are impressive. These voluntary cost share programs seem to be accomplishing the intended purpose. In comparison to other pollution control strategies in urban sectors, these approaches are relatively inexpensive to implement.

Based upon the implementation rate of existing agricultural BMPs, that implementation rate must be maintained in order for the Broadkill watershed to achieve the required TMDL nutrient loading reductions. The use of the existing practices will be expanded and in some cases refocused. The agricultural sector is planning to make use of a suite of BMPs to reduce nitrogen and phosphorus loads including cover crops, riparian buffers, wetland restoration, and manure storage sheds. Each BMP included in this plan was evaluated to ensure that it met the following three criteria: 1) effectiveness for water quality improvement, 2) willingness among the public to adopt, and 3) implementable in a variety of types of operations. The entire suite of planned and existing practices includes:

- **Animal Waste Management System**—Practices designed for proper handling, storage, and utilization of wastes generated from confined animal operations. Reduced storage and handling loss is conserved in the manure and available for land application.
- **Barnyard Runoff Control**—Includes the installation of practices to control runoff from barnyard areas. This includes practices such as roof runoff control, diversion of clean water from entering the barnyard and control of runoff from barnyard areas. Different efficiencies exist if controls are installed on an operation with manure storage or if the controls are installed on a loafing lot without manure storage.
- **Cover Crop** —A winter crop planted at a specified time with a specified seeding method. The crop may be neither fertilized nor harvested. A commodity cover crop may be harvested.
- **Forest Buffers**—Agricultural riparian forest buffers are linear wooded areas along rivers, streams and shorelines. Forest buffers help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width for riparian forest buffers (agriculture) is 100 feet, with a minimum width of 35 feet required.
- **Grass Buffers; Vegetated Open Channel** —Agricultural riparian grass buffers are linear strips of grass or other non-woody vegetation maintained between the edge of fields and streams, rivers or tidal waters that help filter nutrients, sediment and other pollutants from runoff. The recommended buffer width for riparian forests buffers (agriculture) is 100 feet, with a minimum width of 35 feet required. Vegetated open channels are modeled identically to grass buffers.

- **Mortality Composters**—A physical structure and process for disposing of any type of dead animals. Composted material land applied using nutrient management plan recommendations.
- **Nutrient Management**—Nutrient management plan (NMP) implementation (crop) is a comprehensive plan that describes the optimum use of nutrients to minimize nutrient loss while maintaining yield. A NMP details the type, rate, timing, and placement of nutrients for each crop. Soil, plant tissue, manure and/or sludge tests are used to assure optimal application rates. Plans should be revised every 2 to 3 years.
- **Poultry Phytase** —Phytase is an enzyme added to poultry-feed that helps poultry absorb phosphorus. The addition of phytase to poultry feed allows more efficient nutrient uptake by poultry, which in turn allows decreased phosphorus levels in feed and less overall phosphorus in poultry waste.
- **Wetland Restoration**—Agricultural wetland restoration activities re-establish the natural hydraulic condition in a field that existed prior to the installation of subsurface or surface drainage. Projects may include restoration, creation and enhancement acreage. Restored wetlands may be any wetland classification including forested, scrub-shrub or emergent marsh.

Table 12 compares the implementation for existing BMPs and the planned levels of implementation. This increase in implementation will achieve the loads shown in Table 6. These loads are equivalent to the TMDL allocations for the Broadkill watershed.

Table 12: Agricultural BMP implementation, actual 2012 and planned levels for the Broadkill

Agricultural Practices	Units	2012 Actual Implementation	2025 Planned Implementation
Cover Crops	acres	4,563.1	5,200 (annually)
Forest Buffers	acres	191.5	191.5
Grass Buffers; Vegetated Open Channels	acres	179.7	165.3
Manure Relocation	acres	1,265	1,900
Nutrient Management Plans	acres	26,476	26,476 (annually)
Phytase	acres	0.0	0.4
Shallow Water Areas	acres	0.0	62.9
Structural BMPs (e.g., manure structures, pads, sheds, composters)	acres	0.0	TMD
Wildlife Plantings (field and drainage borders)	acres	118.3	87.4
Wetland Restoration	acres	87.4	165.9

The measured effectiveness for each of these practices may be found in Table 13.

Table 13: Agricultural BMP effectiveness

BMP	Nitrogen Effectiveness	Phosphorus Effectiveness
Animal Waste Management Systems	Applied as a change in the manure load on the production area	
Cover Crop (effectiveness varies depending	5-45	0-15

BMP	Nitrogen Effectiveness	Phosphorus Effectiveness
on variety, plant date, and plant method and if it is commodity or not)		
Forest Buffers (land use change plus efficiency)	0-65	0-45
Grass Buffers; Vegetated Open Channel - Agriculture	Land use change to a lower loading land use	
Mortality composting	Applied as a change in the manure load	
Nutrient Management	Land use change to a lower loading land use	
Poultry phytase	Applied as a change in the concentration of phosphorus in manure	
Wetland Restoration (land use change plus efficiency)	7-25	12-50

To provide added assurance of BMP effectiveness, Delaware has instituted a comprehensive Nutrient Management Law that controls the minimum set of management practices that are included in nutrient management plans. In regard to phosphorus in soils, it is important to note that Delaware's NMP's are p-based and have been for many years. The application of phosphorus is limited on high phosphorus soils, and utilizes a three year crop removal policy to restrict phosphorus application in certain conditions on high phosphorus soils. High phosphorus soils are determined based on the Phosphorus-Site Index analysis. In the absence of phosphorus data, yield based assessments are conducted using the four highest yield goals out of the last seven years. In addition to the phosphorus and nitrogen limiting plans, Delaware has a manure relocation program aimed at reducing phosphorus in soils. To obtain appropriate agronomic rates for application of manure, biosolids, and organic byproducts, the Nutrient Management Plan incorporates soil testing, manure testing, phosphorus index, and crop needs. Delaware allows three and one year NMPs, with the majority being one year plan. In addition, feedback from NMP writers indicates that most of Delaware's producers and NM Consultants are utilizing yearly soil test data regardless of plan length. Additional information on the enforcement of this law is specified in Delaware's Final Phase II Chesapeake Watershed Implementation Plan (WIP; DWIC, 2012) beginning on page 154.

5.1.4 Septic

The Department's Ground Water Discharges Section is developing revisions to its statewide onsite wastewater disposal regulations. The proposed changes would require new or replacement systems within 1,000 feet of tidal waters and associated tidal wetlands to comply with a 20mg/l limit for TN. There are no additional performance requirements for individual septic systems proposed in the regulations. Under the proposed regulations, all larger onsite wastewater treatment systems would be required to meet a performance standard based on the system size, age, and location.

Individual OWTDS are required by permit conditions to have the septic tank pumped out once every three years. Any OWTDS with a design flow of 2,500 gpd and above are required by the current Regulations Governing the Design Installation and Operation of OWTDS to have a licensed operator to oversee operations of the OWTDS, and submit compliance reports with monitoring data on a routine basis as established in the operating permit. All OWTDS's with a design flow of 2,500 gallons per day or greater are issued individual operating permits with a maximum 5-year term. The On-Site Regulations are currently open for review and several modifications resulting in increased nutrient reduction are

being proposed on a state-wide basis. Penalties for noncompliance include but are not limited to: voluntary compliance agreements, verbal warning, manager's warning letter, non-compliance notifications, Notice of Violation (NOV), and Secretary Order, which could include fines.

BMPs for septic systems (OWTDS) are encouraged and supported. The BMPs listed in Table 14 should be considered and this increase in implementation will achieve the loads shown in Table 6. These loads meet the TMDL required reductions for the Broadkill.

Table 14: Summary of Septic Recommendations

BMP	Planned Implementation
Inspection and Pump Out all OWTDS	As properties are sold
Require all OWTDS over 2,500 gpd to meet performance standards	8

The watershed currently has 8,328 septic (OWTDS) systems within its boundaries. If all systems are pumped once every three years, as required by state regulations, then 2,776 systems are pumped annually. The soils in the watershed are mostly well drained, so the 26 lbs actual TP reduction will likely be significantly less. Each system pumped out would reduce TP and TN surface and/or groundwater load by 1.40 lbs/system/year and 3.62 lbs/system/year, respectively.

5.1.5 Forest

Forest BMPs (e.g., buffers) are included in the suite of agricultural strategies for the Broadkill River watershed.

5.2 Bacteria

Bacteria survival is dependent on soil moisture, temperature, pH, availability of nutrients and antagonistic organisms. Under ideal conditions the bacteria is retained near the soil surface long enough for infiltration into unsaturated soil to occur resulting in bacteria die off within the first two feet. Under less than ideal conditions, BMPs are the most effective and practical means of preventing or reducing bacteria from entering surface waters.

BMPs reduce bacteria levels in many different ways. Non-structural BMPs are practices that mainly control bacteria at the source. These practices include routine septic inspections and pump-outs. Septic tanks should be inspected every three years and pumped as needed, usually every three years or when the tank is about 1/3 filled. By maintaining your septic system regularly, it is less likely to fail and contaminate surface or ground water. It also extends the longevity of your septic system, saving money for costly repairs or replacements. Another very inexpensive non-structural BMP is simply being a good neighbor and managing pet waste properly. Another example is managing livestock manure.

Structural BMPs usually involve building a structure and may have a higher cost associated with it. Examples include buffers, constructed wetlands, sand filters, infiltration trenches, low impact development, and stream fencing. Dense vegetative buffers facilitate conventional bacteria removal through detention, filtration by vegetation, and infiltration into soil. Other methods include the use of chemicals such as chlorine or even using ultraviolet lights. These methods can be costly and require

considerable oversight. Table 15 illustrates typical bacterial reductions from commonly used stormwater BMPs.

Table 15: Typical Bacteria Reduction from Stormwater BMPs

BMP	Land Area Needed	Cost	Bacteria % Reduction
Buffer Strips	Low	Medium	43 – 57
Constructed Wetlands	N/A	N/A	78 – 90
Sand Filters	N/A	N/A	36 – 83
Dry Detention Ponds	High	High	
Infiltration Trenches	Low	Medium	
Wet Ponds	Medium	High	44 – 99
Biofiltration	N/A	N/A	>99
Bioswales	Low	Medium	
Stormwater Wetlands	N/A	N/A	78 - 90

This Watershed Management Plan recommends multiple BMPs that are able to reduce bacteria through impressive removal efficiencies (Table 16). Some of these are also used to control nutrients, and the nutrient removal efficiencies are referenced in the appropriate nutrient source sector section.

Table 16: BMP Bacteria Removal Efficiencies and Source Sector Treated

BMP	Removal Efficiency	Source Sector Treated
Streamside Fencing[1]	100%	Agriculture
Improved Pasture Management[1]	50%	Agriculture
Conservation Tillage[1]	61%	Agriculture
Repaired Septic System[1]	100%	Septic
Rain Garden[1]	85%	Urban
Sand Filters[2]	36% - 83%	Urban
Biofiltration[2]	>99%	Urban
Pet Waste Control Program[1]	75%	Urban/Agriculture
Retention Pond[2]	44% - 99%	Urban/Agriculture
Vegetated Buffer[2]	43% - 57%	Urban/Agriculture
Constructed Wetlands[2]	78% - 90%	Urban/Agriculture/Forest

[1]MapTech, Inc., "Fecal Bacteria and General Standard TMDL Implementation Plan Development for Back Creek". 2006.
[2]Allison Boyer, DNREC. "Reducing Bacteria with Best Management Practices".

Manure is the dominant source of bacteria in these highly agricultural watersheds. Preventing manure from entering the waterways is the primary strategy for reducing bacteria. Septics are also a substantial source of bacteria and can be treated by septic system maintenance and replacement.

Although it is difficult to quantify bacteria sources, the Pollution Control Strategy states that bacteria load reductions from its nutrient management strategies proposed in this Watershed Plan meet or exceed the allocations for bacteria in the Broadkill local TMDL (DNREC, 2012a). Water quality samples will continue to be collected to ensure the required reductions are achieved.

5.3 Offsetting Nutrient and Sediment Loads from Future Growth

Growth is expected to occur throughout the State, and depending on when and where this growth occurs, pollutant loading may also increase (e.g., more residential septic systems, development of agricultural land, etc.). Delaware has determined that an offset program is a cost-effective means of controlling new or increased loads. "Offset" means an alternate to strict adherence to the regulations including, but not limited to trading, banking, fee-in-lieu, or other similar program that serves as compensation when the requirements of these regulations cannot be reasonably met on an individual project basis.

Delaware established Sediment and Stormwater Regulations that became effective January 1, 2014. These regulations provide for an offset program with three options to offset new and increased loads:

1. Revised stormwater regulations
2. Stormwater in-lieu fee if site constraints prevent achievement of water quality goals on a specific parcel
3. Offsetting residual nutrient loads on another site within the same basin.

5.3.1 Statewide Stormwater Regulations

The Department's Sediment and Stormwater Program implemented new statewide stormwater regulations in 2013, see Chapter 7 of the regulations. The new regulations contain the following language: Stormwater in-lieu fee: Working with the Center for Watershed Protection, Delaware's Sediment and Stormwater Program has developed a "common currency" for all shortfalls equivalent to the cost of treating unmanaged runoff volume. The cost of $23 per cubic foot of runoff volume is based on land acquisition, construction and maintenance costs for unmanaged volume.

5.3.2 Establish in-lieu fee for stormwater impacts

Under current state law, the Department has the authority to establish an in-lieu fee for erosion and sediment control. The Sediment and Stormwater Program will determine which entities may collect the fees, how the fees would be collected and spent, and how projects would be prioritized and implemented. Programs may be operated and money spent at the local government or conservation district level under guidelines established by DNREC. The Department will also determine specific uses for the in-lieu fee.

5.3.3 Establish a statewide program that provides additional flexibility for offsets

Delaware's Sediment and Stormwater Regulations establish a state-wide program for offsets. EPA is currently preparing Technical Memorandums that will inform the development of this program.

Additional information on development of offset approaches is specified in the Final Phase 2 CBWIP 03301012A beginning on page 140.

5.3.4 Adaptive management

Adaptive management is a critical component of achieving any TMDL and this Watershed Management plan with two-year milestones providing interim planning targets. The planning targets are then reevaluated against progress and revised to ensure that Delaware is on track to meet its goals. Section 9: Load Reduction Evaluation Criteria (h) provides additional detail about evaluating load reductions using the Watershed Plan Tracker.

Progress assessments are scheduled for 2015, 2017, and 2021. At this time, multiple lines of evidence including: several models, monitoring data, and the most recent science on BMP effectiveness and water quality response will be evaluated. The milestones and progress assessments will contribute to constant reassessment of management plans, and adapting responses accordingly as technologies and efficiencies change, programs mature, credit trading is enacted, and regulations are put in place.

5.4 Summary

The practices and implementation levels proposed here meet the Broadkill local TMDL required reductions for nutrients and bacteria. The management measures outlined in this section are well within the capacity of Delaware to administer given existing funding programs, public will, and systems in place.

6 Technical and Financial Assistance Needs (d)

Technical Needs

Technical assistance to meet the reductions and goals of a TMDL takes on many forms including DNREC assistance to local governments, state and local partner assistance to both DNREC and municipalities, and technical consultants contracted to provide support across a wide variety of service areas related to BMP planning and implementation.

DNREC has and will provide technical assistance to local governments through training, outreach and tools, including recommendations on ordinance improvements, technical review and assistance for implementation of BMPs at the local level, and identification of potential financial resources for implementation (DWIC, 2012).

DNREC has many partners that provide outreach to homeowners and communities in the form of technical assistance, education, and funding for implementation of best management practices within local communities. Partners include, but are not limited to the Delaware Nature Society, Delaware Forest Service, University of Delaware Cooperative Extension, Sussex Conservation District, Kent Conservation District, New Castle Conservation District, Master Gardeners/Cooperative Extension Service, Delaware Center for Horticulture. These partners provide all levels of support for various programs (DWIC, 2012).

Consultants can be contracted to provide a variety of technical services. For example, Tetra Tech has provided the Local Governments with a review of local ordinances along with a set of recommendations for consideration as they review and update ordinances. Tetra Tech has also provided model ordinances for consideration. State and local governments can contract with consultants through standard means, or through grant and funding assistance programs such as the National Fish and Wildlife Foundation's (NFWF) Technical Assistance Program. DNREC may also hire consultants to provide assistance.

Technical assistance for the Broadkill watershed can take all of these forms; however as the Broadkill watershed is primarily forested and agricultural, and with a majority of load reductions anticipated from the agricultural section (See Section 4), it follows that technical assistance to farmers will be a focus. Support from the University of Delaware Cooperative Extension, Sussex County Conservation District, Delaware Department of Agriculture (DDA), Farm Service Agency (FSA) as well as federal assistance from the United States Department of Agriculture (USDA) Natural Resources Conservation District (NRCS) and

Farm Services Agency (FSA). The DDA oversees Delaware's Nutrient Management Plan program. The state has recently updated the Nutrient Management Program State Technical Standards, and the DDA will facilitate technical assistance to develop and implement Nutrient Management Plans. In 2011, two Strategic Watershed Action Team (SWAT) planners were hired by the Sussex Conservation District as part of an agreement between the USDA - NRCS, DNREC-Division of Watershed Stewardship, and the Kent and New Castle Conservation Districts. The SWAT planners were hired to complete 112 Comprehensive Nutrient Management Plans (CNMP) in the watershed over the next two years.

Technical assistance for Public Participation and Education and for Monitoring will also be necessary to fully implement and track progress towards meeting the goals of the local TMDL. These elements are discussed in sections 7 and 9 of this plan.

Financial Needs

Overall, this strategy costs close to $90,000,000 including capital expenditures plus annual operation and maintenance costs of various best management practices (DNREC, 2012a). Of this strategy total, about $29,000,000 has already been paid for the installation of current practices (Figure 8). Table 17 below includes a summary of annual costs per source sector. In this estimate, projected annual costs do not include current staff required for the various programs to implement programs. Anticipated BMPs and funding requirements for each sector are discussed in the sections below.

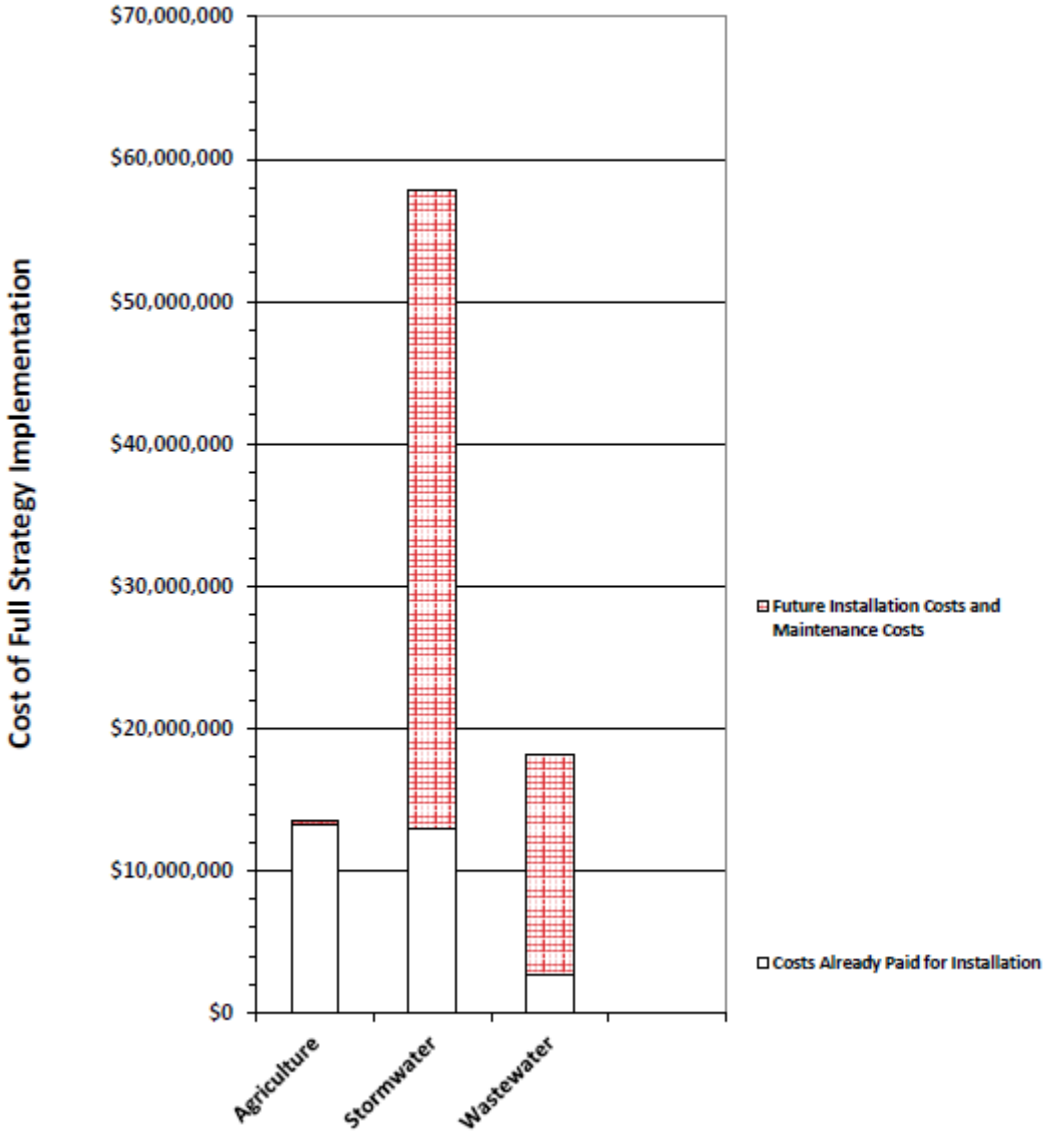

Figure 8: Total Strategy Implementation Costs (DNREC, 2012a)

Table 17: Summary of Annual Funding Needs per Source Sector (DNREC, 2012a)

Source Sector	Annual Cost*
Wastewater	$333,000
Urban	$455,000
Agriculture	$282,000
Septic	$0
Forest	$0

*Note that this cost is annualized over the life of the loan and/or BMP

6.1 Wastewater

Within the Broadkill Watershed, several initiatives have led to nutrient reductions to date. A state-wide Holding Tank Compliance Program assists the 21 holding tanks in the watershed with monthly pump-outs, which reduces the nutrients entering groundwaters. In addition, approximately 350 individual OWTDS in the Red Mill Pond area were eliminated when they were connected to a central sewer district. These actions have an annual cost of approximately $333,000 (note that this cost is annualized over the life of the loan and/or BMP).

6.2 Urban

Table 18 shows the overall funding requirements for the urban sector for the Broadkill watershed.

Table 18: Stormwater BMP Costs (DNREC, 2012a)

	Wet and Dry Ponds	Infiltration Structures	Filtering Practices	Biofiltration
Construction/acre	$2,982.00	$8,946.67	$17,008.41	$17,893.33
O&M (% of Construction)	4.5%	10.5%	12%	6%
Annual O&M per acre over a 25 year lifespan	$3,354.75	$23,485.00	$51,025.25	$26,840.00
Total Cost/acre	$6,336.75	$32,431.67	$68,033.66	$44,733.33

6.3 Agriculture

The projected costs of agricultural practices implemented within the Broadkill watershed from 2015 through 2025 are presented in Table 19. Funding sources are discussed in greater depth in Section 6.6.

Table 19: Agricultural BMP Costs (DNREC, 2012a)

BMP	Unit Cost	One Time Cost	Annual Cost*
Cover Crops	-	-	$14,973
Grass Buffers; Vegetated Open Channel	-	-	$17,385
Manure Relocation	$13/ton	-	-
Nutrient Management Plans	-	-	$93,900
Shallow Water Areas	-	-	$19,701
Structural BMPs (e.g., manure structures, pads, sheds, composters)	-	$100,000	-
Forest buffers	-	$81,388	$34,202
Wetland Restoration	-	$148,755	$12,498
Wildlife Plantings (field and drainage borders)	-	$49,770	$11,613

*Costs may include annual installation and/or land rental.

6.4 Septic

Septic system inspections and pump outs and enforcement of performance standards should require no additional cost or funding (Table 20).

Table 20: Projected Funding Requirements, Onsite Wastewater BMPs (2013-2025)

BMP	Total Cost
Inspection and Pump Out all OWTDS	$0
Require all OWTDS over 2,500 gpd to meet performance standards	$0
Total, 2013-2025	**$0**

6.5 Forest

Forest buffer BMPs are implemented in the agricultural source sector. Refer to Table 19 for implementation costs.

6.6 Funding Sources

Examples of current funding sources for BMP implementation in the Broadkill are presented in Table 21.

As stated in the Broadkill Pollution Control Strategy (DNREC, 2012a), Delaware will need to pursue increased funding for strategies in the agriculture sector through State programs such as the State of Delaware Conservation Cost Share Program, Delaware CREP Program, Delaware Nutrient Relocation, Delaware CAFO, and Delaware Nutrient Management Programs. Through the Delaware Conservation Partnership, responsible agencies meet quarterly to discuss issues, targeted or prioritized efforts, needs, and funding. The Partnership is made up of representatives from NRCS, DDA, DNREC, US Fish and Wildlife, the Conservation Districts, Nutrient Planning Companies, and others. An example of recent NRCS funding change that resulted from the Conservation Partnership is an amendment of the EQIP funding of the cover crop cost share program to an annual contract rather than through a three year contract. This simple amendment made the program more attractive to participants and garnered additional interest in 2010 cover crop planting.

As additional funding needs will certainly be warranted, private grants and/or exploratory grants will be additionally pursued. Lastly, to accommodate easier land owner participation by Private Landowners, the State of Delaware, Revolving Loan Fund Program should be review and expanded to allow additional BMP funding as applicable.

For the urban sector, the State Revolving Loan Fund (SRF) has recently been utilized for “green projects” of which stormwater is a major component. More projects may seek this funding in an effort to improve community drainage, and a strategy should be employed to assure that a water quality benefit is also a part of the project design. The state has utilized a special fund named the 21rst Century Resource Conservation and Development (RCD) fund to finance major and minor flooding and drainage projects throughout the state for the past 16 years. While these funds are limited, there should be a concerted effort to integrate water quality management in a retro-fit manner into projects funded through this revenue stream.

State cost share funds if enhanced, could be made available for funding more urban projects with a demonstrated water quality benefit in the future. These funds are made available to landowners and could be expanded to include municipalities with a plan for identifying and implementing water quality practices.

The Financial Assistance Branch (FAB) of DNREC through the leadership of the Clean Water Advisory Council (CWAC) is developing a program to deliver funding to municipalities through Stormwater Planning Grants which would require that priority water quality goals be met. In addition, the CWAC and FAB have developed funding through community water quality grants that serve to improve water quality through matching grants.

Other grant funding through Section 319 Grants as well as direct grant funds through other sources such as National Fish and Wildlife Federation will be used within the watershed, although most of these funds in the past have not been used in the urban corridors. This strategy is changing and more funding in the future will be directed toward the developed portion of the landscape.

Table 21: Summary of Sectors covered by Funding Sources

Funding Sources	Waste-water	Urban	Agricultural	Septic	Forest
Clean Water State Revolving Fund Program	•	•	•	•	•
Delaware Clean Water Advisory Council		•			
Delaware Confined Animal Feeding Operations (CAFO)			•		
Delaware Conservation Reserve and Enhancement Program (CREP)			•		•
Delaware Cost Share Program			•		
Delaware CREP Program			•		
Delaware Nutrient Management Programs			•		
Delaware Nutrient Relocation			•		
DNREC Watershed Assessment			•		
DNREC Wetland Restoration Program			•		
Financial Assistance Branch of DNREC	•	•	•	•	•
Kent County Conservation District Cost Share			•		•
National Fish and Wildlife (NFWF)		•	•		•
New Castle Conservation District Cost Share			•		•
Non-Federal Administrative Account (NFAA)	•			•	
NPS Program 319 Funding		•	•		
Resource Conservation and Development Fund		•			
Section 106 Grant		•	•		
State of Delaware Conservation Cost Share Program			•		
State of Delaware Cost Share			•		
Sussex Conservation District Cost-Share Program			•		•
The Delaware Nonpoint Source Program		•	•	•	•
U.S. Fish and Wildlife (USFW)			•		

Funding Sources	Waste-water	Urban	Agricultural	Septic	Forest
Federal USDA/NRCS Technical Assistance and Cost share programs					
Agricultural Management Assistance Program (AMA)			•		•
Conservation Reserve Enhancement Program (CREP) – USDA and FSA			•		•
Conservation Reserve Program (CRP) – USDA and FSA			•		•
Environmental Quality Incentives Program (EQIP)			•		•
Natural Resources Conservation Service (NRCS)			•		•
Wetland Reserve Program (WRP)			•		•
Wildlife Habitat Incentives Program (WHIP)			•		•

7 Public Participation / Education (e)

7.1 Public Participation

A variety of organizations throughout the State of Delaware have been identified for possible partnerships in education and outreach for the Broadkill watershed. The Delaware Nature Society (DNS) is the pre-eminent non-profit environmental organization in the state. DNS is unique in the way it integrates education as a vital element in its role in preservation, conservation and advocacy. Currently thousands of members support this important work and/or participate in programs, while more than 1,000 volunteers assist the 32 member core staff and interns.

The DNS has extensive experience with education and outreach efforts, which will help inform residents, businesses and visitors of actions that they can take to improve water quality. While the focus of the DNS as reported in the Delaware Phase II Watershed Implementation Plan (WIP; DWIC, 2012) is on the Nanticoke Watershed (Chesapeake Bay drainage), the statewide reach of the group makes it an attractive partner for Broadkill programs.

The DNS goals for 2012 included acquiring funding for the “We Choose Clean Water” campaign to:

- Build capacity for building the base of stakeholder support.
- Shape and promote local policy,
- Expand outreach to farmers, homeowners and businesses to increase adoption of best management practices,
- Initiate and actively manage on-the-ground implementation projects.

Additionally the group is expanding the Backyard Habitat ™ certification program which will:

- Educate the public about the connection of land use & water quality,
- Teach sustainable gardening practices to homeowners,
- Collect measurable data on nutrient reduction through the certification program.

These programs and others like them could be implemented in the Broadkill watersheds.

In addition to the DNS, the following organizations have been identified for possible partnerships education and outreach for the Broadkill:

- Master Gardeners
- Audubon Society
- Students for the Environment
- Delaware civic associations and service clubs:
  - Delaware Home Builders Assoc.
  - Sierra Club – Delaware Chapter Coalition for Natural Stream Valleys, Inc.
  - Delmarva Poultry Industry
  - Delmarva Power
  - Delaware Electric Cooperative
  - Delaware Farm Bureau
  - Nature Conservancy
  - AgroLab, Inc.
  - University of Delaware
  - Delaware State University
  - Delaware Technical and Community College

7.2 General Outreach and Education

The Broadkill Pollution Control Strategy (DNREC, 2012a) includes the following education recommendation strategies with pollutant reducing effectiveness being measured by the homeowners that received stormwater management education:

a) Develop a program or means to provide outreach/education to commercial property owners served by a stormwater management system. This program should address maintenance plans, funding obligations, legal obligations, resource agencies, etc.
b) Develop manuals on residential stormwater system maintenance to address new and older developments. Existing documents should be disseminated to homeowners.
c) Encourage municipal and county authorities to mail stormwater pollution prevention information.
d) Encourage municipal and state authorities to prevent or remediate the silting in of public pond systems to assure their ongoing existence.

DNREC's Sediment and Stormwater program developed and completed a handbook for homeowners associations that can be used to learn how to maintain their stormwater plan. DNREC, as well as the agencies with delegated authority from the Sediment and Stormwater program, are working with homeowners in forwarding this concept. The Sussex County Conservation Districts with cooperation from DNREC's Sediment and Stormwater Program and NEMO has held workshops for homeowners associations and residents in Sussex County.

The Team also suggests a comprehensive education plan to be implemented in the Broadkill River watershed that teaches the public how their actions impact water quality. Some suggestions include:

a) Public service announcements.
b) Brochures distributed through real estate agents, retailers, and school children
c) Face to face education with Home Owners Associations and other organizations
d) Coordination with Master Gardeners' education
e) Integration of education into the state and local permitting processes

f) Education on purchasing of water conserving appliances
g) Education of school children on water quality

7.3 Source Sector Outreach and Education

In addition, the Team recommends the following outreach and education opportunities for agricultural and urban stormwater source sectors.

7.3.1 Agriculture Outreach and Education

a) Farmers should be educated on the above mentioned BMPs.
b) The public should be educated on practices to discourage resident nuisance waterfowl.
c) Farm land and natural resource area preservation should be encouraged and promoted. New funding sources should be sought and financial incentives should be increased. The public should receive education on current programs, including:
    a. Farmland Preservation Act
    b. Kent County Transfer Development Rights
    c. Non-profit environmental groups
    d. Easements and donations

7.3.2 Urban Stormwater Outreach and Education

a) An education program for Home Owners Associations should be developed for stormwater BMP maintenance. Educational resources should be provided and ideally, face to face education that stresses the organizations' responsibility. Topics should include: proper use and application of fertilizer and use of salt and sand during periods of snow.
b) The Smartyard Program should be implemented in the watershed to assist homeowners in planting native landscaping to conserve water and reduce fertilizer and pesticide use.
c) Corporate environmental stewardship should be encouraged to provide corporations with the technical expertise to help them better manage and enhance their land through the use of native species and the restoration of natural habitat.
d) A comprehensive education program should be developed for the urban and suburban sector on issues of water quality and urban nutrients. This may include:
    a. Working with the University of Delaware to revise soil testing so they are more user friendly.
    b. Educating homeowners on the importance of cleaning up pet waste, water conservation, lawn care (and the use of fertilizers) and proper disposal of grass and yard waste.
    c. Working with the Delaware Nutrient Management Commission and the Master Gardeners to provide education and programs for homeowners on lawn and garden best management practices.

8 Implementation Schedule and Milestones (f & g)

This section presents the target loads and the activities required to achieve those targets based on milestones and the 2017 and 2025 interim and final loads and implementation targets. Load allocations and milestone targets for nutrients and bacteria in the Broadkill watershed are based on the local TMDL (State of Delaware, 2006). The following schedule and milestones follows Bay TMDL milestone date (60% progress by 2017) and end date (2025; USEPA, 2010). This schedule has previously been approved

by the CBP for the applicable Bay TMDLs and is believed to be a good option for tracking progress towards reduction goals of the Broadkill local TMDL.

8.1 Loading Allocations and Milestone Targets

Planning loads for 2017 and final loads for 2025 for the Broadkill watershed are presented in Table 22 below. As mentioned in Section 4: Expected Load Reductions (b) (see Table 7), progress is already underway with the implementation of strategies throughout the wastewater, urban, and agriculture source sectors. As a result of current implementation efforts, the 2012 Progress loads for nitrogen and phosphorus are less than the 2017 Interim Milestone.

Table 22: Broadkill Planning and Target Loads (delivered loads)

Load	Nitrogen Load (lbs/day)	Phosphorus Load (lbs/day)	Bacteria Load (CFU/day)
2002 – 2003 Baseline Load[1]	3,707	157.8	4.0E+11
2007 Baseline Load[2]	2,891	124.1	NA
2012 Progress Load	2,358	99.2	NA
2017 Interim Milestone (60% of reduction achieved)	2,491	106.5	2.2E+11
2025 TMDL Allocated Load	2,224	94.7	1.0E+11
Percent Reduction between 2002 Baseline and 2025 Loads	40%	40%	75%

[1]Baseline load for nitrogen, phosphorus, and bacteria based on 2002-2003 baseline levels, as stated in the published local TMDL.
[2]Baseline load for nitrogen and phosphorus amended to reflect 2007 land use changes.

8.2 Implementation Milestones

To meet the loading allocations and milestones outlined in the previous section, implementation of programs and BMPs must keep pace and meet planned implementation targets. Table 23 details the implementation for each tracked BMP, segregated by urban and agricultural type with the associated unit of measure. The 2012 data reflects existing BMPs while the 2017, 2021, and 2025 values reflect the planned implementation for those years.

Table 23: Broadkill Planning Milestones for Implementation

BMP	Unit	2012 Implemen-tation	2015 Planned	2017 Planned	2021 Planned	2025 Planned[1]
Urban						
Urban stormwater	acres	1,852.9	180.6	361.2	481.6	602.0
Urban buffers	acres	0.0	120.0	240.0	320.0	400.0
Agricultural						
Cover Crops	acres	4,563.1	15,600.0	26,000.0	46,800.0	473,200.0
Grass Buffers; Vegetated Open Channel	acres	179.7	49.6	99.2	132.2	165.3
Manure Relocation	tons	1,265.0	570.0		1,520.0	1,900.0

BMP	Unit	2012 Implemen-tation	2015 Planned	2017 Planned	2021 Planned	2025 Planned[1]
Nutrient Management Plans	acres	26,476.0	79,428.0	132,380.0	238,284.0	2,409,316.0
Shallow Water Areas	acres	0.0	18.9	37.7	50.3	62.9
Structural BMPs (e.g., manure structures, pads, sheds, composters)	acres	0.0	Full Imple-mentation	Full Imple-mentation	Full Imple-mentation	Full Imple-mentation
Forest buffers	acres	191.5	57.5	114.9	153.2	191.5
Wetland Restoration	acres	87.4	26.2	52.4	69.9	87.4
Wildlife Plantings (field and drainage borders)	acres	118.3	49.8	99.5	132.7	165.9

[1] Where "full implementation" is indicated, all animal manure or animals in the county are treated. Exact numbers of animals in the watershed are not reported because animal numbers are available only at the county scale, not the watershed scale.

8.3 Implementation Priorities

To meet the loading allocations and milestones outlined in the previous sections, implementation should be prioritized based on current 303(d) listings (i.e., categories 4a and 5) and TMDLs with highest priority given to listed segments located in headwaters. Impairments to headwater streams are carried and experienced downstream; therefore, improvements made to headwater streams will maximize the length of implementation impacts.

Stream segments that should be prioritized for implementation within the Broadkill watershed include the following (DNREC, 2012b):

- Tributaries of Broadkill River – Category 4a
  - Lower Broadkill
  - Beaverdam Creek
  - Round Pole Branch
  - Ingrams Branch
  - Pemberton Branch
  - Heronwood Branch
  - Red Mill Pond
  - Wagamons Pond
  - Waples Pond
  - Reynolds Pond
- Tributaries of Broadkill River – Category 5
  - Upper Broadkill River
  - Martin Branch
  - Primehook Creek

In Addition, the Pollution Control Strategy includes many recommendations covering all source sectors in the Broadkill watershed (DNREC, 2012a). This document should serve as guidance for implementation efforts. The Tributary Action Team worked to improve the water quality of the Broadkill River watershed using sound science as a basis for decisions, developing solutions that are integrative, creative and

innovative, with due consideration given for the private property rights of individuals in the community and for the welfare of present and future generations who live and work in the watershed. The Team operated by consensus, and effort was made to meet the interests of all the participating stakeholder groups. Examples of some of the recommendations included in the Pollution Control Strategy are listed below.

The Team recommends the following for the wastewater source sector:

- Require new and replacement onsite wastewater treatment and disposal systems (OWTDS) larger than 2,500 gpd to use technologies that achieve specific performance standards for TN and TP. Typically, phosphorus reducing technologies are only recommended where site specific conditions warrant.
- Investigate and report state-of-the-art best available technologies for the non-water management of waste, including pilot demonstration projects.
- Require enforcement of existing individual OWTDS regulations.
- Provide incentives and financial assistance when needed for repair and upgrade of individual OWTDS, (particularly for low income households).
- Develop a program or means to provide outreach/education to homeowners served by an OWTDS. This will require a dissemination strategy.

The Team notes that conversion of agriculture to non-agricultural land uses can impact the nutrient reductions made by the Agriculture sector. There are currently 15,000 (approximately) new residential units approved by municipal and county government in the watershed. The types of development and use of stormwater BMPs can have either positive or negative effects on nutrient reductions.

The Team recommends the following for the urban source sector:

- Development activities that are subject to Delaware's Sediment and Stormwater Law shall provide stormwater management that includes nutrient reductions consistent with TMDL load reductions, or shall utilize 'best available technologies' (BATs) in the project design where TMDL load reductions are not feasible.
- Enforce sediment control measures during construction phase using enforcement provisions that are adequate and appropriate. This may include larger penalties, such as fines and stop work orders, and require remediation in addition to mitigation. Review and approval of sediment control measures during the pre-construction phase, and enforcement responsibilities are recommended.
- Encourage site specific, streamside vegetated buffers throughout the watershed through open space designations and incentives, as well as through targeted outreach/education programs.
- Provide incentives for the use of pervious materials and strategies (to take the place of traditional impervious ones) for sidewalks, parking lots, and roadways should be provided to developers by all governmental entities.
- Encourage the use of conservation design principles that reduce surface water runoff of nutrients, such as those that promote infiltration, narrower roads and sidewalks, swales and grassed waterways, water conservation and recycling, natural resource protection, open space preservation, and park creation, among other practices.
- The County, State and local governments should create codes and regulations that provide for incentives that allow and promote "conservation design" principles with a goal of reducing nutrient loads. Require stormwater maintenance plans for new development.

- Develop manuals on residential stormwater system maintenance to address new and older developments. Existing documents should be disseminated to homeowners.
- Develop a program or means to provide outreach/education to homeowners served by a stormwater management system. This program should address maintenance plans, funding obligations, legal obligations, resource agencies, etc.
- Require Realtors to provide disclosure information regarding stormwater management requirements to the buyer in writing at time of contract
- Establish stormwater retrofit requirements for direct discharge to the Broadkill River, ponds, and tributaries.
- Develop a stormwater retrofit strategy for communities built before 1991 so they can reduce the quantity of nutrients, bacteria, and sediment that they deliver to ponds and streams (e.g. rain gardens, vegetative buffers).
- As part of DelDOT highway maintenance program, plant trees (vegetated buffers) along all roads and highways to absorb water and reduce run–off, consistent with highway safety standards
- Encourage county and municipal authorities to reduce the number of required parking spaces at shopping malls, break up the parking areas with planted islands, and use of porous surface.
- Encourage municipal and county authorities to mail stormwater pollution prevention information.
- Encourage municipal and state authorities to prevent or remediate the silting in of public pond systems to assure their ongoing existence.
- Investigate the possibility of converting ditches to shallow ponds that could remove nutrients from the runoff stream by holding up low flow rates to permit time for nutrient reduction.
- Investigate and propose modalities for financing future stormwater needs.
- Use cost-benefit analysis to help set priorities for stormwater management projects.
- Require stormwater maintenance plans for new commercial properties.
- Develop manuals on stormwater system maintenance to address commercial properties. Existing documents should be disseminated to commercial property owners.

The Team recommends the following for the agriculture source sector:
Some agricultural operations in the watershed are in environmentally sensitive areas and if further reductions are recommended, then the following criteria should be considered:

- Target BMP types and target locations based on farm (site) specific criteria (proximity to impaired waterbodies, soil types, BMPs in place, BMPs in compliance and BMPs needed).
- Because these BMPs may be cost prohibitive for the individual farmer to bear, increase cost share program funds for best management practice strategies that produce significant results in the most sensitive areas. These BMPs may include: cover crops, conservation tillage, riparian buffers, manure storage sheds, etc.
- Continue to refine Nutrient Management Plans for all agricultural operations in the watershed, such as providing more assistance with implementation for Pre-Sidedress Nitrogen Tests (PSNTs), NMP soil sampling, education, outreach, and measurable outcomes.
- Search for ways to improve real-time assistance to farmers. For example: email digital pictures of pests to farmer to improve efficiency/response time.
- The conversion of agricultural land for non- agricultural purposes will change nutrient runoff in ways that should be closely monitored.

Potential Targeted Opportunities

As identified in the Broadkill River Watershed Implementation Plan (Duffield Associates, Inc., 2009), the Wagamons Pond and Broadkill River through Milton sub-watershed could benefit from restoration/enhancement/preservation. The Wagamons Pond is projected to have the greatest potential urban growth in the future. This is due to the development anticipated in the upper portion of the sub-watershed associated with the City of Georgetown and in the lower portion of the sub-watershed associated with the City of Milton. This growth in urban land use will likely be accompanied by additional impervious cover and possible increase in pollutants entering the Watershed. The highest number (and greatest diversity in geographic location and type) of potential pollution control opportunities were identified for this sub-watershed.

Although the sub-watershed strategy is the recommended priority approach, it is also recommended to implement other high priority opportunities in other subwatersheds as funding becomes available and willing land owners are identified. It is also recommended that specific high priority sites for preservation in each of the sub-watersheds be identified and subsequently evaluated for potential preservation/conservation opportunities.

The Watershed Implementation Plan (Duffield Associates, Inc., 2009) has identified these water quality improvements for:

- Additional preservation targeted around Savannah Ditch;
- Retrofits in the urbanized sections of Cities of Milton and Georgetown;
- Retrofits in older neighborhoods around the Cities of Milton and Georgetown;
- Watershed Management Water Quality throughout the sub-watershed in non-urban areas.

Table 24: Recommended Upland Sites by Rank and Project Status for Wagamons Pond Sub-watershed (DNREC, 2012a)

Rank for Water Quality Improvements	Project ID	Name	Project Status
High	N21	Briggs Development	
	N1	Shipbuilders Village 1	
	N2	Shipbuilders Village 2	
	N113	Harvest Run	
	N19	Laurel Street	
	N15	Su Sax Acres (aka Diamond Overlook)	
	N20	Race Street	
	N109	Sandhill Acres	
Medium		Delmarva Christiana	**Initiated**
	R18d	High School	
	R07a	H.O. Brittingham Elementary	**Completed**
	R17b	Georgetown Square	
	H700	Sherman Heating Oil	
Low		Ace Hardware	
	H701	Shipping	
		Downtown Public	
	R02a	Parking	
	R702a	Town Hall	

Rank for Water Quality Improvements	Project ID	Name	Project Status
	R701c	Sussex County Library	**Completed**
	R17c	Georgetown Square	
	R17a	Georgetown Square	
	R701b	Sussex County Library	**Completed**
	R701d	Sussex County Library	**Completed**
	R701a	Sussex County Library	**Completed**
	R10a	Milton Firehouse/Police Auxiliary Parking	**Grant Funding Obtained**
	R34a	ACE Hardware/Strip Mall/Recycling Center	
	R700a	Iguana Grill	
	N20	Race Street	
	N109	Sandhill Acres	
	N24	Harborview	
	N28	Devries Circle	
	N14	Cannery Village	

9 Load Reduction Evaluation Criteria (h)

Adaptive management is a critical component of achieving the local Broadkill TMDL and this Watershed Management plan. The milestones proposed in Section 8: Implementation Milestones (2015, 2017, and 2021) provide interim planning targets. These are reevaluated against progress and revised to ensure that Delaware is on track to meet its goals. Progress evaluation will be measured through three approaches: tracking implementation of management measures, estimating load reductions through modeling, and tracking overall program success through long term monitoring.

Implementation will be measured by determining whether the targets for implementation shown in Table 23 are being met according to the milestone schedule presented. For both urban and agricultural BMPs, the Watershed Assessment Section of DNREC currently collects this information annually.

Overall program success will be evaluated using trends identified through the long term monitoring program described below in Section 10. TMDL compliance status will be evaluated to determine if the Watershed Management Plan needs to be updated. If it is found during the evaluation of BMP implementation and load reductions that the milestone targets are not being met, a revision of the plan may be necessary.

Watershed Plan Tracker

The Delaware NPS Program will enter and track implementation actions (including the number of BMPs, BMP types, and associated costs) and load reductions can be performed using EPA's Watershed Plan Tracker (WPT) at the watershed scale to accommodate the diverse nature of information contained in the watershed plans. BMPs will be tracked at the smaller scale of either the HUC12 or the subsheds identified in Table 6 of the August 2006 TMDL. In addition, the WPT will track data by year, action, and individual pollutants. The WPT is embedded into the existing web-based national Grants Reporting and Tracking System (GRTS). Emphasis is placed on exploring and documenting the unique aspects and valuable assets of the watershed, adherence to EPA's watershed-based plan criteria introduces valuable standardization among the plans. This standardization enables the generation of a body of information

for the impaired watershed that is in need of being restored to meet an acceptable water quality. To utilize this information as a management tool, and to make strategic planning decisions, the information, once entered into a database, can easily be reviewed and monitored for timely and effective decision-making.

DNREC will work with EPA to track Bacteria Load reductions from BMP that are implemented.

10 Monitoring (i)

A robust and comprehensive monitoring program will be necessary to document that implemented strategies are having the desired effect and that water quality goals are being met. Water quality monitoring has provided evidence of changes in water quality and necessary data to develop models and TMDLs to meet the Clean Water Act goals for restoring the physical, chemical, and biological properties of the Delaware's waters. Monitoring will be needed to document changes as the Delaware TMDLs are implemented.

Delaware's Surface Water Quality Monitoring Program (DNREC, 2012c) is the primary program to be used in monitoring TMDL compliance. The program is used to calculate annual loads and determine water quality trends over time in major water bodies. Delaware follows a five-year rotating basin scheme to monitor all surface waters of the State. During every five-year cycle, each watershed within the State is monitored monthly for two years and every other month for the remaining three years.

As DNREC's 2012 statewide monitoring plan states, because monitoring budgets are limited, the numbers and locations of monitoring sites are being prioritized based on critical needs. Sites retained from previous years, or added as funding becomes available, fall into two categories:

- C1 – high priority monthly stations co-located with USGS gages for loading analysis and long term trends, generally positioned stations at the mouth of a tidal river
- C2 – stations monitored monthly or bi-monthly on a five-year rotating basis.

Surface waters of the State, are monitored for a suite of 24 parameters including nutrients, bacteria, chlorophyll a, turbidity, organics, pH, dissolved oxygen, etc. In 2012, there were 15 sites with two duplicate samples and field blanks that were sampled six times in the Broadkill watershed. Sampling locations included sites located on Ingram Branch, Broadkill mainstem, Beaverdam Creek, Round Pole Branch, Waples Pond, and Pemberton Branch above Waples Pond (Figure 7). These same sites are continuing to be monitored. Fiscal year costs for Broadkill water quality sampling and analysis including analytical chemistry and field costs is $28,512 (costs from FY2011 – 2012 sampling efforts).

Analytical results from the stations are promptly published in the EPA STORET system and are available as part of the STORET network. DNREC also publishes the data on the Delaware Water Quality Portal http://demac.udel.edu/waterquality/. More details for the Surface Water Quality Monitoring Plan (SWQMP) are available on DNREC's website.

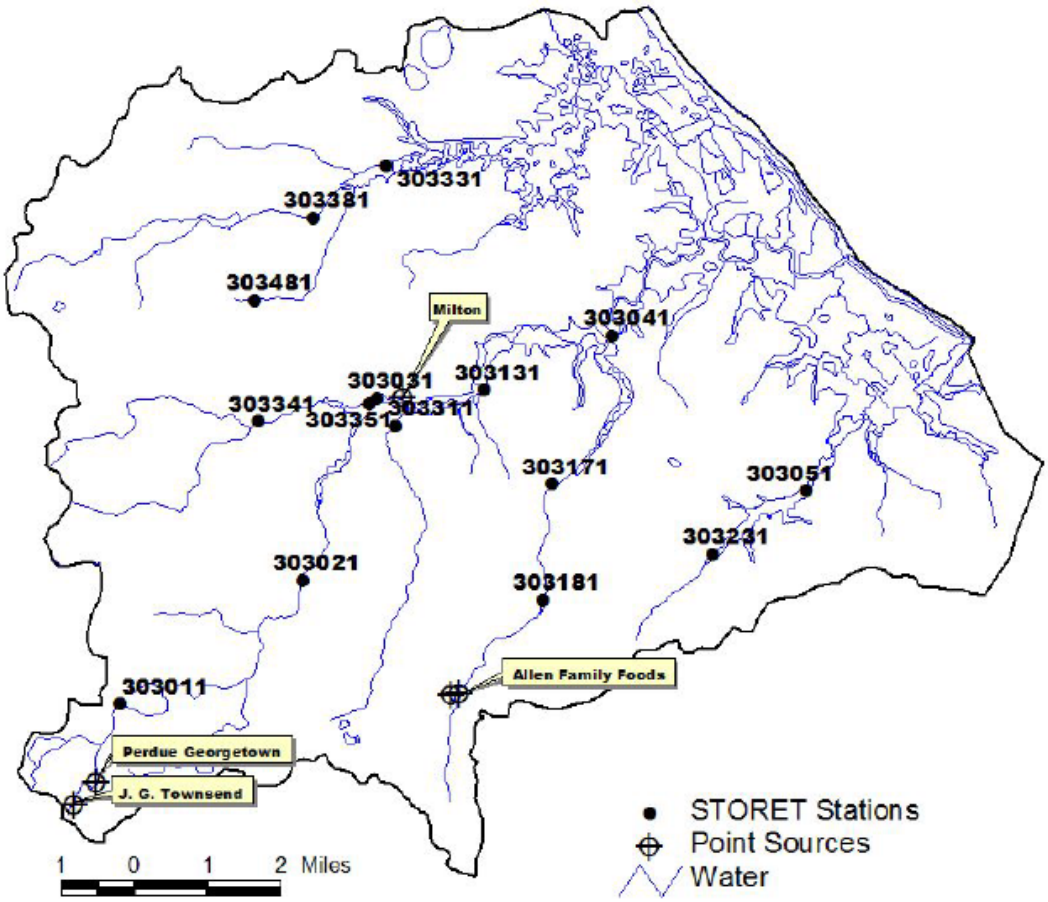

Figure 9: Storet Stations in the Broadkill River Watershed (DNREC, 2012a)

Citizen monitoring in the Broadkill River is conducted by the University of Delaware Citizen Monitoring Program. Initiated in 1991, the Citizen Monitoring volunteers routinely take water samples throughout Delaware's costal watersheds collecting important data including dissolved oxygen, nutrient concentrations, water clarity, bacteria levels, and other environmental data. The monitoring group publishes water quality reports on a semi-monthly basis throughout each summer. DNREC is currently coordinating with citizen monitoring groups and is providing technical assistance.

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Program Field Office. Annapolis, MD.
http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html

Appendix A: WIP Communications – 2014

WIP Communications Updates from 3/1/12 to Present

Videos

- Water Quality Monitoring on the Nanticoke (Reach: 187 and counting)
- Septics 101 (Reach: 134 and counting)
- Managing Stormwater: Roads to Rivers (Reach: 78 and counting)
- Explore Your Nanticoke (Reach: 216 and counting)
- Monitoring the Murderkill with UD DNREC and Kent County Wastewater Treatment Facility (Reach: 283 and counting)
- Certified Wildlife Habitats (Reach: 338 and counting)
- Seaford Schoolyard Habitats (Reach: 438 and counting)
- What's a septic system got to do with it? (Currently shooting)

Social Media

- New Delaware Watersheds Facebook Account
- New Delaware Watersheds Twitter Account
- New Delaware Watersheds Quarterly Newsletter
- Email Blasts
- Social Media Releases
- New Social Media monthly promotion (Rain Barrel Giveaway)
- Race for Our Rivers Facebook page for event that DNREC will now be organizing

Events, Presentations and Demonstrations

- 2012 DOWRA's Annual Conference. Presentation on Septic Rehabilitation Loan Program (Reach: 300)
- 2012 Nanticoke Riverfest exhibit and demonstrations (Reach: 60)
- 2012 Ellendale Family Fun Day (Reach: 53)
- 2012 Coast Day (Reach: 1750)
- 2012 Delmarva Chicken Festival (Reach: 60)
- 2012 Delaware State Fair exhibit and demonstrations (Reach: 25,000)
- 2012 Event to highlight funds received by Greenwood, Bethel and Laurel from the National Fish and Wildlife Foundation for WIP related projects (Reach: 40)
- 2013 Nanticoke Riverfest exhibit and demonstrations (Reach: 200)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in New Castle (Reach: 90)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in Harrington (Reach: 90)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in Lewis (Reach: 90)
- 2013 Earth Day at R&R outreach event and rain barrel sale/presenting pledge campaign (Reach: 55)

- 2013 Nanticoke River Park Festival: Demonstrations on how to reduce stormwater runoff by building rain barrels, planting rain gardens, using pervious surfaces, creating certified wildlife habitats, etc. (Reach: 65)
- 2013 Delaware State Fair exhibit and demonstrations (Reach: 25,000)
- 2013 Race for Our Rivers (Reach: 75)

Workshops

- 2012 Kickoff of event/Workshop for Septic Rehabilitation outreach initiative. (Reach: 60)
- 2012 Septic Rehabilitation Loan Program Workshop at Coverdale Community Center in Bridgeville, DE (Reach: 24)
- 2012 Septic Rehabilitation Loan Program Workshop at Coverdale Community Center at Mt Joy Civic Association in Millsboro. (Reach: 22)
- 2012 Presentation to DOWRA's planning committee (Reach: 31)
- 2013 Presented information at a Nanticoke Watershed Alliance "Homeowners workshop" on DNREC's Septic Rehabilitation Loan Program and other efforts individuals can take to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 25)
- 2013 Nanticoke Watershed Alliance Rain Barrel Workshop: Presented information on DNREC's pledge campaign- Individuals pledge to take specific efforts to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 29)
- 2013 Nanticoke Rotary Club: Presented information on DNREC's video series as a resource for individuals looking for information pertaining to efforts that help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 24)
- 2013 Local Govt. Workshop- Delaware's Chesapeake Bay Communities: Action Today for Tomorrow's Healthy Water: Topics include funding mechanisms for local governments; sources of grant funding; matching your project concept to potential funding sources; conceiving, organizing, and costing a project; grant writing tips. (Reach: 75)
- 2013 Sussex County Strong Communities Initiative Meeting: Presented information on DNREC's "Rain Barrel Building Workshop" opportunities and other information on reducing stormwater runoff. (Reach: 27)
- Spring and Twig Garden Club: Presentation on things people can do to reduce nutrient and sediment pollution

Promotional Materials

- 2012 Septic Rehabilitation loan program large display
- 2012 Septic Rehabilitation loan program mini display
- 2012 Septic Rehabilitation Loan Program brochure
- 2012 Septic Rehabilitation Loan Program lawn signs
- 2013 New WIP Messaging Branding Strategy developed: Delaware Watersheds brand and logo - to be used on new promotional materials and social media accounts, and for events.
- 2013 New homeowners brochure: An invitation to a healthy home and yard

- 2013 New mini display: An invitation to a healthy home and yard

Advertising

- 2012 radio advertising campaign for the Septic Rehabilitation Loan Program on WDSD 94.7
- 2012 Printed advertising campaign for the Septic Rehabilitation Loan Program: The Guide
- 2012 Printed advertising campaign for the Septic Rehabilitation Loan Program: Placemat advertising.
- 2013 Radio advertising for Septic Rehabilitation Loan Program: WDSD 94.7
- 2013 radio advertising for Septic Rehabilitation Loan Program: WXDE 105.9

WIP Committee/Subcommittee Meetings

- WIP Implementation team meets quarterly
- A WIP Communications Subcommittee meets quarterly with new partners being encouraged to attend and strengthening existing partnerships with groups such as the Nanticoke Watershed Alliance, the Delaware Nature Society, DelDOT, USDA, DE Forestry and DOA. The subcommittee is working to develop new branding strategies including a WIP mascot and slogan.
- Bi-weekly Chesapeake Bay staff meetings
- Monthly Chesapeake Bay Program Communications Workgroup meetings

Websites

- 2012 New webpage has been made to be used as an area where individuals, agriculture, businesses and organizations can find resources of information, support, and guidance for reducing nutrient and sediment pollution.
- New homepage for Watershed Stewardship (Release TBD)
- New webpage for Wetland Advisory Committee (Release TBD)
- 2013 Updates to Delaware Watersheds website
- 2013 Updates to partnering Delaware Invasive Species Council website
- 2013 Updates to Watershed Assessment and Management website

Television/Radio Interviews

- 2012 Interview by 94.7 WDSD: promotion of The Septic Rehabilitation Loan program (Reach: Delaware)
- 2013 Featured on WBOC TV's Delmarva Life discussing how individuals can help protect Delaware's waterways that lead to the Chesapeake Bay (Reach: Delmarva)
- 2013 DNREC Earth Day Event: Presented information to WBOC TV on DNREC's Septic Rehabilitation Loan Program, rain barrels, rain gardens, and other efforts individuals can take to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: Delmarva)

Databases

- A database of available funding resources and sources for which various publics can apply has been compiled. The list is being updated continuously and will is available online and used in marketing materials and presentations.
- A database of brochures pamphlets and videos has been created, and a new webpage has been made to be used as an area where individuals, agriculture, businesses and organizations can find resources of information, support, and guidance for reducing nutrient and sediment pollution.

Pledge Campaign

- 180 pledges collected at events throughout the Chesapeake Bay Watershed
- Approximately 1,700 pledges collected at the 2013 Delaware State Fair

BMP Displays in Home Improvement stores

- How to build a rain barrel out of simple supplies from your local hardware store

KCI Technologies, Inc.
1352 Marrows Road, Suite 100
Newark, DE 19711