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Background

This County is bordered in Maryland by Talbot, Caroline, and Wicomico Counties and in Delaware by Sussex County. The County is 423,100 acres, including 71,163 acres open water (USDA, 1998) and 1,700 miles of shoreline (Dorchester, 2005). Unless otherwise noted, the following information is summarized from the 1998 NRCS *Soil Survey of Dorchester County, Maryland*. The majority of the County has elevations below 25 feet above sea level, with a high of 57 feet in the northeastern section. Tidal and nontidal wetlands make up a large portion of the bottom two-thirds of the County. This extensive amount of wetlands limits agriculture and development. There are two large tidal rivers affecting this County: the Choptank and the Nanticoke. The upper part of the County has some rolling hills. Soils are generally very permeable, however a high water table is

present in a large portion. There are 60,000 acres of prime farmland and 30,000 acres of prime farmland when drained or irrigated, most located in the northern portion. Of the 146,135 forested acres in the County, a large portion is Chesapeake State Forest (Dorchester, 2005). Much of the commercial forest is loblolly pine.

The following information is based on the 1996 Comprehensive Plan (as of 2006, they are in the process of updating the plan). This County has a relatively small amount of developable land, with the majority being in North Dorchester and near Cambridge. These same areas also have significant amounts of prime farmland and non-tidal wetlands. Development Areas include Cambridge (west and south of Cambridge), Mount Holly to Secretary (north side of Rte. 16 between Mount Holly and Secretary), and North Dorchester west of Hurlock (west of Rte. 16 and Rte. 331, and north and east of Pine Top Road and Cabin Creek Road.

Based on MDP 2002 GIS land use data, land use in this watershed is fairly evenly divided between agriculture (34%), forest (36%) and wetland (26%), with some remaining land being developed (5%). Note that wetland cover may be grossly underestimated using this data, so other wetland acreage estimates are given below. The southern portion of this County is mostly wetland. The largest developed area is in Cambridge.

Sea level rise is a serious issue in this County. Studies are being conducted to predict land change based on sea level rise. These maps predict that mean high water will cover huge areas of the County, including large portions south of Cambridge. Wetlands are currently being lost due to sea level rise and subsidence. However, for the same reasons, uplands are also rapidly being converted to wetlands (Cole, 2006, pers. comm.). The climax communities for these new wetlands will likely be brackish high and low marsh. Due to this rapid loss of land in general from sea level rise, it is may not be desirable to turn upland into wetland. Additionally, it is likely that land converted to wetlands will be lost to sea level rise in the long term. Therefore, designs for wetland restoration should take this into account. One idea is to use dredged material to create barrier islands just off the shoreline. These could buffer the shoreline against storm surges and wind-driven waves, and provide some protection for wetland restoration behind them (Cole, 2006, pers. comm.)

Dorchester County drains into three different State-designated 6-digit watersheds: Nanticoke River (021303), Choptank River (021304), and Chesapeake Bay Proper (021399). The 8-digit watersheds within the Dorchester portion of the Nanticoke River watershed include: Nanticoke River (02130305), Marshyhope Creek (02130306), Fishing Bay (02130307), and Transquaking River (02130308). The 8-digit watersheds within the Dorchester portion of the Choptank River watershed include: Honga River (02130401), Little Choptank (02130402), Lower Choptank (02130403). The 8-digit watershed within the Dorchester portion of the Chesapeake Bay (Proper) watershed includes Lower Chesapeake Bay (02139998).

Streams

The following information is based on the Maryland Tributary Strategies 2004 document entitled *Maryland's Lower Eastern Shore*. Maryland's Lower Eastern Shore basin includes areas in Wicomico, Caroline, Somerset, Worcester, and Dorchester Counties and the waterways Pocomoke, Wicomico, Nanticoke and Big Annemessex Rivers, Fishing Bay, Pocomoke and Tangier Sounds. Land cover is 61% forest/wetlands and 32% agriculture. About 60% of the houses are on septic. Point sources are not a major source of pollution. In 2002, sources of nitrogen, phosphorus, and sediments were from agriculture (60%, 58%, 70% respectively). Based on water quality sampling, nitrogen was good or fair in the southern portion and poor in Wicomico and Nanticoke Rivers. Phosphorus was good or fair throughout. Total suspended solids (TSS) was poor in the majority of the area, with only three samples having fair or good TSS (South Tangier Sound, Big Annemessex River, and Pocomoke River). All areas were below the SAV restoration goal. Benthic communities were generally good, with the best communities located in Nanticoke and Wicomico Rivers. Degraded communities were likely impacted by high sedimentation. This document describes the success of implementing BMPs like this:

> Implementation of animal waste management plans, nutrient management plans, conservation tillage, treatment of highly erodible land, forest conservation and buffers, marine pumpouts, and structural shore erosion control and erosion and sediment control are all making good progress toward Tributary Strategy goals. For other issues, such as stormwater and urban nutrient management, cover crops, tree plantings and nonstructural shore erosion control, progress has been slower.

The following information is based on the Maryland Tributary Strategies 2004 document entitled *Choptank River Basin Summary*. The Choptank River basin includes land in Caroline, Dorchester, Queen Anne's and Talbot Counties. The basin supports over 80 fish species and the bottom section of the basin is important for waterfowl. This basin has a large amount of agriculture and a high number of agricultural ditches. Roughly half of the houses are on septic systems. Main water quality impairments are from non-point nutrients and sediments. In 2002, the main nitrogen, phosphorus, and sediment sources within the Choptank River basin were from agriculture (73%, 67%, and 87%, respectively). Based on tributary stations, nitrogen, phosphorus, and sediments were generally better at the mouth of the Little Choptank and Choptank Rivers than upstream Choptank River. In 2001, SAV along the Choptank River from Castle Haven Point to Bow Knee Point was much lower than the SAV goal, SAV in the outer Choptank River was roughly three-quarters of the SAV goal, and SAV in the Little Choptank River exceeded the SAV goal. The benthic community was generally good, but there were some differences in the different areas. Some samples within the lower mesohaline portion were slightly degraded, the upper mesohaline portion were moderately to severely degraded (due to nutrient enrichment, with many poor sites upstream of Cabin Creek), and the oligohaline portion was the best. This document describes the mixed success of BMP implementation as follows:

In some cases, such as shore erosion controls, forest conservation, forest buffers, and nutrient management plans, the goals set in the Choptank Tributary Strategy have nearly been met or have been exceeded. For other BMPs, notably those dealing with stormwater management, implementation is falling short of the Tributary Strategy goals.

MBSS nitrate/nitrite samples taken in the northeastern portion of the County had levels between 1 and >10 mg/L.

Wetlands

Wetland Classifications

Wetlands cover approximately 58% of the County. While most of the tidal and nontidal wetlands are located in the southern portion of the County, there are some wetlands along Marshyhope Creek and along the Choptank River and tributaries (Dorchester, 2005). According to Tiner and Burke (1995), in 1981-1982 there were 169,168 acres of wetlands (28.3% of the State's total). The wetland types were Estuarine (100,529 acres), Palustrine (68,259 acres) and Riverine (285 acres), and Lacustrine (95 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 33%, or 84,461 acres, loss (MDE, 2002). This County has the highest amount of tidal wetland acreage in the State, and the highest number of muskrats and bald eagles (Sipple, 1999). It is also very important for waterfowl.

The U.S. Fish and Wildlife Service conducted a study of wetland trends for 1981-82 to 1988-89 for selected areas in Dorchester County and the vicinity. Nearly 1,000 acres of wetlands were lost. Approximately 600 acres of palustrine forested wetlands were converted to uplands, primarily for development. There were over 96 acres of estuarine wetlands converted to upland, primarily for agriculture. The wetlands converted to agricultural land included regulated shooting areas with crops to attract wildlife. Another 2,248 acres of wetland were converted to another wetland type. Sea level rise, coastal subsidence, and controlled burning were the major causes of the wetland conversions, which primarily occurred (approximately 579 acres) in estuarine Loblolly pine *(Pinus taeda)* dominated wetlands. Many of the trees died due to increased inundation or salt stress. Some areas were converted to estuarine marsh. Many of the other wetland type changes resulted from timber harvest activities (Tiner and Foulis, 1994).

Thousands of acres of tidal marsh are estimated to have been lost due to grazing by the exotic and invasive nutria (*Myocastor coypus).* Nutria were introduced to Maryland in 1943 and since that time have destroyed by grazing over 7,000 acres of marsh in the Chesapeake Marshlands National Wildlife Refuge Complex, Blackwater Unit (USFWS, 2004). When vegetation is eaten out by nutria, the remaining marsh sediments have eroded away over extensive areas. A pilot effort to eradicate nutria, the Maryland Nutria Project, is a multi-federal, State, university and private partnership to determine if nutria could be eradicated. Trapping of nutria in the Blackwater Refuge and the surrounding area began in 2002 and over 50,000 acres of wetlands treated. Thousands of acres have

successfully revegetated. A pilot effort using sprayed dredge material also helped restore approximately 15 acres of marsh on the Refuge.

Wetland losses have been the worst in the middle of Blackwater NWR, around the confluence of Blackwater and Little Blackwater Rivers, while losses were the best downstream of Maple Dam Road. These losses were likely due to sea level rise outpacing levels of sediment accretion, with possible local affects by muskrat, geese, and nutria. (Sipple, 1999).

The following wetland plant community descriptions are based on Tiner and Burke (1995).

- Estuarine wetlands can be salt or brackish tidal wetlands. Vegetation is largely dependent upon salinity and hydrology, with plant diversity increasing with decreased salinity and decreased flooding. They can be classified into five groups:
    - Estuarine intertidal flats are mud or sand shores that are exposed twice a day (at low tide) or less. These areas have sparse macrophytic vegetation.
    - Estuarine emergent wetlands have vegetation composition that is strongly influenced by salinity level and duration/frequency of inundation.
        - Brackish marshes are the most common type of Maryland Estuarine wetland, found along the Chesapeake Bay and tidal rivers. Low brackish marsh is often dominated by smooth cordgrass-tall form and water hemp while the high brackish marsh is often dominated by salt hay grass, salt grass, black needlerush, smooth cordgrass-short form, Olney three-square, switchgrass, common three-square, big cordgrass, common reed, salt marsh bulrush, seaside goldenrod, rose mallow, and narrow-leaved cattail.
        - Oligohaline marshes are only slightly saline and are located in the upper tidal rivers. Low oligohaline marshes are often dominated by arrow arum, pickerelweed, spatterdock, wild rice, soft-stemmed bulrush, narrow-leaved cattail, water hemp, and common three-square while high oligohaline marshes are often dominated by big cordgrass, common reed, narrow-leaved cattail, wild rice, broad-leaved cattail, and sweet flag.
    - Estuarine scrub-shrub swamps are often dominated by high-tide bush and groundsel bush.
    - Estuarine forested swamps are often dominated by loblolly pine. Due to sea level rise bringing in more salinity, some of these systems are being converted into salt marshes. This situation is common in Dorchester.
    - Estuarine Aquatic beds generally contain submerged aquatic vegetation, including eelgrass and widgeongrass in high salinity areas and widgeongrass and other species in lower salinity areas.
- Palustrine wetlands can be classified into four major groups depending on the dominant vegetation type: forested, scrub-shrub, emergent, and aquatic. These wetlands were described for the Maryland Coastal Plain Province.

- Palustrine forested wetlands are the dominant palustrine wetland type on the Coastal Plain and are located in floodplains, depressions, and drainage divides. They can be classified into four main groups:
    - Tidally flooded wetlands are freshwater wetlands that are tidally influenced. Common tree species may include red maple, green ash, black willow and black gum.
    - Semipermanently flooded wetlands are nontidal wetlands that are flooded for much of the growing season. These are uncommon in Maryland. Some examples, dominated by bald cypress, are along Battle Creek and the Pocomoke River. Higher elevations may be dominated by red maple, black gum, sweet bay, swamp black gum, fringe tree, ironwood, and swamp cottonwood.
    - Seasonally flooded wetlands are nontidal wetlands that are flooded for generally longer than two weeks during the growing season. Some of the more common tree dominants include red maple, sweet gum, pin oak, willow oak, loblolly pine, or swamp chestnut oak. There is often a thick shrub understory. Atlantic white cedar swamps may have been located historically in Dorchester County (Nanticoke River; Dill et al., 1987). Few Atlantic white cedar swamps remain in Maryland since most have been converted to hardwood swamp.
    - Temporarily flooded wetlands are nontidal wetlands that are flooded the least of the four types, about a week. Seasonally saturated wetlands, wetlands having a high water table during the cooler months, are also included in this category. Some of these areas are managed for loblolly pine harvesting. Other tree dominants include red maple, sweet gum, black gum, willow oak, water oak, basket oak, swamp white oak, southern red oak, sycamore, black willow, American holly, sweet bay.
- Scrub-Shrub wetlands are less common than forested wetlands on the Coastal Plain. They are often dominated by buttonbush (in the wetter systems), silky dogwood, arrowwood, alder and tree saplings.
- Emergent wetlands are very diverse in the Coastal Plain region due to the occurrence of both tidal and nontidal wetlands. They can be categorized into several different types:
    - Tidal fresh marshes occur along the large coastal waterways, between the brackish marshes and tidal freshwater swamps. It is speculated that in addition to tidal flooding, temporary periods of salt water in these areas may discourage woody succession. These freshwater wetlands are often more diverse than wetlands with higher salinity levels. Vegetative dominance changes seasonally. There is often a distinct vegetative zonation pattern based on elevation. Some common dominance types according to McCormick and Somes (1982) are arrowheads, big cordgrass, bulrushes, bur-marigold, cattails, common reed, giant ragweed,

golden club, pickerelweed/arrow arum, purple loosestrife, reed canary grass, rose mallow, and smartweed/rice cutgrass
        - Interdunal wet swales have a very high water table, allowing hydrophytic plants to grow adjacent to dunes having xeric plant species. These sites are often dominated by common three-square, salt hay grass, and rabbit-foot grass.
        - Semipermanently flooded marshes are often dominated by cattail, spatterdock, arrow arum, water willow, and bur-reeds.
        - Seasonally flooded marshes include isolated depressional wetlands called "potholes" or "Delmarva Bays" (mostly in Caroline, Kent, and Queen Anne's)
        - Temporarily flooded wet meadows include areas recently timber harvested that will soon revert back to woody vegetation.
    - Aquatic beds include small ponds with vegetation on the bottom and/or surface. These are the wettest of the Palustrine types.
- Riverine wetlands are found within the channel and include nonpersistent vegetation.
- Lacustrine wetlands are associated with deepwater habitat (e.g. freshwater lakes, deep ponds, and reservoirs). They can be classified into lacustrine aquatic beds (wetlands are located in the shallow water) and lacustrine emergent wetlands (wetlands are located along the shoreline).

The document *Wetlands of Maryland* provides numerous examples of various wetland communities found within each County and complete plant lists for certain wetland types.

Tidal wetland acreage was also estimated in *The Coastal Wetlands of Maryland* (Table 1). Dorchester County had 83,247 acres of vegetated tidally-influenced wetlands (excluding SAV). The majority of the vegetated wetlands are brackish. Brackish marsh often has lower species richness and species diversity than freshwater marsh and may have quite distinct plant zonation. Data from 1976 suggests that wildlife managers, private landowners, and arsons intentionally burn large sections of brackish marsh during November/December. Some of these marshes include Taylor's Island WMA, Bishops Head, Fishing Bay, Blackwater National Wildlife Refuge, Elliot Island, and other wetlands along Blackwater River.

Table 1 . Tidal wetland acreage within Dorchester County based on vegetation type (McCormick and Somes, 1982).

Major Vegetation Type	Vegetation Type	Acreage
Shrub Swamp *(Fresh)*	Swamp rose	0
	Smooth alder/Black willow	0
	Red maple/Ash	906
Swamp forest *(fresh except pine, which is often brackish)*	Bald cypress	0
	Red maple/Ash	5,727
	Loblolly pine	806
Fresh marsh	Smartweed/Rice cutgrass	173
	Spatterdock	430
	Pickerelweed/Arrow arum	283
	Sweetflag	12
	Cattail	934
	Rosemallow	11
	Wildrice	132
	Bulrush	1,038
	Big cordgrass	85
	Common reed	7
Brackish High Marsh	Meadow cordgrass/Spikegrass	12,728
	Marshelder/Groundselbush	3,361
	Needlerush	23,131
	Cattail	2,330
	Rosemallow	26
	Switchgrass	1,301
	Threesquare	14,891
	Big cordgrass	2,167
	Common reed	488
Brackish Low Marsh	Smooth cordgrass	12,280
Saline High Marsh	Meadow cordgrass/Spikegrass	0
	Marshelder/Groundselbush	0
	Needlerush	0
Saline Low Marsh	Smooth cordgrass, tall growth form	0
	Smooth cordgrass, short growth form	0
Submerged Aquatic Vegetation	Submerged aquatic plants	9,391

Brackish marshes are becoming wetter due to sea level rise, subsidence, erosion, and herbivore grazing. One example of vegetative community change within Somerset and Dorchester Counties include Loblolly Pine islands that are being replaced by more water-tolerant marsh vegetation (Sipple, 1999).

Wetland Functions

Stormwater and Flood Control

Wetlands are often credited with providing natural stormwater and flood control benefits. Inland wetlands adjacent to rivers, streams and creeks hold excess discharge and runoff during periods of increased precipitation such as tropical storms and hurricanes and during periods of rapid snow-melt in mountainous regions. Coastal wetlands also hold excess discharge from inland drainage networks as well as tidal waters during storms.

Several factors influence the effectiveness of a wetland in reducing adverse effects of stormwater and floods. Factors include the characteristics of the wetland, local land conditions, and landscape features in the surrounding larger watershed, as well as the type of storm itself. The physical structure of many wetlands, with dense vegetation, fallen trees, topography (hummocks, depressions), and complexity of stream channel systems serve as resistance features to slow flow of surface water from floods and surface runoff, the height of peak floods, and delay the timing of the flood crest. Wetlands are typically in topographically low position, which provides a natural basin for water storage. The depth of the basin and soil characteristics affect the wetland's storage capacity at surface and subsurface levels. Water is released more slowly from the wetlands, thereby reducing both erosion and damage to property and structures farther downstream. In the surrounding areas, the ability of the land to also reduce runoff may aid the wetland in its flow retention/reduction function. At the landscape level, the position of the wetland in the watershed and the ratio of size of the wetland to the size of the watershed also affect the function. Wetlands higher in the landscape and of large in size in relation to the watershed are most effective. While wetlands retain surface flows that enter the wetlands at a gradual rate, they are considered to be more effective at reducing damages from short duration storms.

Also, some water will be removed from the wetland through ground water recharge, soil retention and evapotranspiration.

The associated value of this function can be summarized as follows:

b. A decrease in the volume and velocity of flowing water.
   Value: Helps prevent stream channel and shoreline erosion, and habitat destruction.
c. Deposition and retention of fine sediment.
   Value: Helps maintain water quality and aquatic ecosystems.
d. Water storage by extending the period of time during which flood waters are released back into the drainage system.
   Value: Helps prevent the flooding of homes, property, agricultural lands, and structures such as dams, bridges, and roads.

While depressional wetlands often exhibit little elevation differences from surrounding uplands, water still moves slowly due to the generally flat topography and may thus provide retention times sufficient to transform or uptake nutrients.

The ditching and channelization of streams has reduced the ability of some floodplain wetlands to perform a flood attenuation function. However, due to the relatively limited

development in this County, there are opportunities to re-establish a more natural floodplain and wetland system, similar to the Town of Federalsburg project in the Marshyhope Creek watershed in Caroline County.

Groundwater Recharge and Discharge

Functions

Wetlands facilitate the flow of water between the ground water system and surface water system. Wetlands periodically perform different functions, depending on the gradient of the groundwater table and the topography of the land surface. The relationship of the groundwater table and the land surface dictates which function - groundwater recharge or discharge - a wetland performs.

Nearly all of Maryland's wetlands are ground water discharge areas, at least for some portion of the year (Fugro East, Inc., 1995). Variations in the depth of the ground water table, resulting from seasonal changes in climate, dictate which of these functions - discharge or recharge - a wetland will perform at a given time.

Values

Ground water discharge helps maintain a wetland's water balance and water chemistry. This wetland function is also critical to the formation of hydric soils and the maintenance of ecosystem habitats in different types of wetlands.
Ground water recharge is the primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Modification of Water Quality

Water Quality Improvement

Wetlands are valued for their ability to maintain or improve quality of adjacent surface waters. This ability is primarily accomplished by the following processes:

- Nutrient removal, transformation, and retention
- Retention of toxic materials
- Storage of the sediment transported by runoff or floods.

Hydrophytic vegetation (adapted to live in water) and microbial activity in soils help remove toxic substances and excess nutrients from surface water. Dissolved solids and other constituents may be removed or degraded, such that they become inactive, or incorporated into biomass. This occurs through adsorption and absorption by soil particles, uptake by vegetation and loss to the atmosphere through decomposition and exchange between atmosphere and water.

Nutrient Cycling: Addition, Removal and Transformation

Nutrients are carried into wetlands by hydrologic pathways of precipitation, river flooding, tides, and surface and ground water inflows. Outflows of nutrients are controlled primarily by outflow pathways of waters. The inflow and outflow of water and nutrients are important processes that effect wetland productivity.

Wetland biological and chemical processes remove suspended and dissolved solids and nutrients from surface and ground water and convert them into other forms, such as plant or animal biomass or gases. Debris and suspended solids (fine sediment or organic matter) may be removed by physical processes, such as filtering and sedimentation.

Soil characteristics, landscape position, and hydrology all contribute to the relative ability of a wetland to perform nutrient removal and transformation. Sufficient organic matter must be present for microorganisms in the soil to consume or transform the nutrients. Wetlands are often depressions in the landscape that hold water, transported sediment, and attached or dissolved nutrients for a longer period of time than a sloping area or areas with relatively higher elevations. A longer retention time allows for chemical interactions and plant uptake to occur.

Nitrogen undergoes some chemical transformations and may be taken up in soluble form, absorbed by plants through their roots, or consumed by anaerobic microorganisms that convert the nitrogen to organic matter (Mitsch and Gosselink, 2000). Anaerobic microbes may also convert the nitrogen from a nitrate form to nitrogen gas. Phosphorus is often bound to clay particles, and these fine sediments are transported into wetlands by riparian flooding and tidal action. Phosphorus may be stored in a wetland attached to the clay particles, however, phosphorus becomes available for plant uptake in its soluble form after flooding, saturation and anaerobic conditions typical of a wetland occur. Nutrient processes vary seasonally. Cooler temperatures slow microbial activity and plant uptake while higher flows of water transport more materials out of non-isolated wetland systems. The transported organic material is critical for downstream food chain support.

Tidal wetlands are highly effective sinks and/or transformers of nutrients, as nutrients are taken up and stored by plants or released as nitrogen gas into the atmosphere. However, the uptake and transformation occurs on a seasonal basis during the growing season. At the end of the growing season, as plants die and decompose, nutrients are released back into the aquatic system.

Wetlands are most effective at nutrient transformation and uptake when there are seasonal fluctuations in water levels (Tiner and Burke, 1995). Wetlands that are temporarily flooded (saturated or inundated for brief periods early in the growing season) and those that are permanently inundated would generally be less effective than seasonally wet areas (saturated or inundated for longer periods during the early-mid growing season but are drier by the end of the growing season).

The loss of marshes from erosion due to nutria herbivory and sea level rise may increase water quality problems as loose sediments and attached nutrients are released into the water column.

Toxics Retention

Retention of heavy metals has been reported most often in studies of tidal wetlands, though most wetlands are believed to serve as sinks for heavy metals. Accumulation is primarily in soils, with plants playing a more limited role (Mitsch and Gosselink, 2000). Plants such as cattails, bulrushes, and *Phragmites* are among the more effective and commonly used plants for uptake of toxic materials such as metals. As is the case for

nutrient transformation and sediment retention, soil characteristics, landscape position, vegetation, and hydrology all contribute the relative ability of a wetland to retain toxic materials. The longer the duration that water and transported materials remain in the wetland, the greater the likelihood that the materials will be retained. Many wetlands have been constructed as part of stormwater management facilities to treat surface runoff.

Sediment Reduction

Wetlands along rivers, streams and coastal areas are important for removing sediment from surface and tidal waters. During large flood events, rivers frequently overtop their banks and water flows through adjacent floodplains and wetlands. Flood waters carry large volumes of suspended sediment, mostly fine sand, silt and clay. Because floodplains and wetlands provide resistance to flow - from dense vegetation, microtopography, and woody debris - the flow of water is slowed and sediment is deposited and stored in these areas. Similarly, coastal marshes and estuaries retain sediment brought in by tides and residual suspended sediment from rivers.

Lack of dense vegetation in some floodplains, and narrow width of floodplains, would reduce the ability of wetlands to slow velocities of floodwaters and allow settling of transported sediments.

The ditching and channelization of streams has limited the access of flood waters to floodplains and adjacent wetlands in Dorchester County. Lack of dense vegetation in some floodplains, would also reduce the ability of wetlands to slow velocities of floodwaters and allow settling of transported sediments.

Wildlife Habitat/Biodiversity

Wetlands provide important habitat for fish, wildlife, and plant species, including rare species. Large contiguous areas of wetland, forest or other relatively undisturbed land are most likely to support sensitive species and diverse, microhabitats. Habitat and biodiversity are threatened not only by direct impacts such as filling, drainage, sediment, and land clearing, but by introduction of exotic and invasive species. Wetlands that are important for habitat and biodiversity often require a relatively undisturbed adjacent buffer to protect the species and habitat from direct and indirect disturbance.

Numerous tidal wetlands in Dorchester County have been identified as reference sites as the best examples of certain herbaceous, shrub, and forested community types. These wetlands range of tidal inundation and salinity from irregularly flooded, freshwater systems to wetlands flooded daily with slightly brackish, oligahaline waters. These wetlands are described in the sections for individual watersheds.

Wetlands in Blackwater National Wildlife Refuge, Fishing Bay Wildlife Management Area, and surrounding areas are a critical resting habitat for migrating waterfowl Large portions of these wetlands are already protected (14% of the land in southern Dorchester County) and many of the surrounding portions are privately owned and managed for hunting (Dorchester, 2005).

Dorchester County, having the highest acreage of wetlands in the State, mostly tidal, provide habitat for large populations of waterfowl, muskrat, bald eagles, otter, and mink. The southern portion of the County has the most extensive wetlands and associated wildlife, including the watersheds of Blackwater, Transquaking, and Chicamacomico. Since large areas of marsh are within public land, they can be visited (Sipple, 1999).

There are extensive freshwater tidal marshes located along meandering portions or on alluvial deposits along the Nanticoke River. The meanders of the Nanticoke River have resulted in extensive wetlands on the inside bends. The fresh and brackish estuarine marshes of the Blackwater-Nanticoke area have large numbers of waterfowl. The four major types of waterfowl habitat present are: fresh estuarine bay marsh (along upper Blackwater River), brackish estuarine bay marsh (around upper portion of Fishing Bay – also draining into bay – and upper estuarine bay of Nanticoke River from Ragged Point to Chapter Point), estuarine river marsh (upper portion of Transquaking River and Chicamacomico River, and Nanticoke River north of Chapter Point to near Riverton), and brackish estuarine bay (upper part of Fishing Bay and upper part of estuarine bay in Nanticoke River). Blackwater NWR has excellent wintering and transient concentration areas of black ducks (Sipple, 1999).

Nontidal Wetlands of Special State Concern

There are several State-designated Nontidal Wetlands of Special State Concern scattered through the County, including some fairly larges ones. These are described in the section for the individual watersheds.

Wetland Restoration Considerations

Hydric soils suggest where wetlands are currently or were historically. There are many hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands). Most of these are “poorly drained” and are located in the northern portion of the County. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

Wetland restoration and preservation may be another useful tool for achieving TMDL requirements. Wetland restoration designed to achieve maximum water quality benefits towards the TMDL should be focused at the head of tide and upstream. The headwater zone of tidal waterbodies tends to be the location of maximum algal concentrations for several reasons. The tidal headwaters are more stagnant because they tend to be shielded from the wind-generated mixing. This zone is also the depositional area of nutrients from the tidal river's primary nontidal stream system. Finally, this area tends to be shallow. As a consequence, the water tends to be slightly warmer, which increases the rate of algae growth. Additionally, less water volume is available to dilute nutrient fluxes from the bottom sediments (George, 2006, pers. comm.).

Since it is estimated that sea level rise will result in high amounts of land loss in this County, wetland restoration and preservation should consider the long-term effects, as discussed previously.

Vegetated stream buffers have the potential to intercept and remove nutrients, sediments, and other pollutants. Peterson et al. (2001) found that the smallest headwater streams, which are often found in association with springs and groundwater discharge wetlands, have the most rapid uptake and transformation of inorganic nitrogen (ammonium and nitrate) in comparison with other surface waters. The authors believed that the large surface to volume ratio in small streams resulted in rapid nitrogen uptake and processing. An excess of discharges to overload these systems would result in nitrogen being transported farther down the drainage systems to rivers and estuaries. Forested stream buffers can also improve down steam biodiversity by contributing organic matter to the food web, providing woody debris which increases diversity of physical habitat, and reducing stream temperature. Headwater streams are thought to be the most beneficial at these processes. Therefore, wetlands adjacent to streams should be high priority for restoration/preservation, with emphasis on headwater stream systems. Wetlands around all tributaries of waterways used for drinking water (COMAR Use P) should also be ranked higher.

DNR assessed the development risk for all land within Maryland. Wetlands within areas of high development risk should be higher priority for preservation.

In order to maintain water quality of surface water reservoirs, wetlands within the watersheds of surface water reservoirs should be higher priority for preservation.

Wetland restoration may be more desirable in land uses that contribute high pollution, currently provide relatively low amounts of biodiversity, and are easy to convert to wetlands. As a general rule, agriculture fits these criteria more than other land use types. Forested land is generally not as high of a pollutant source and it also provides better habitat for plants and wildlife. For these reasons, converting upland forest to wetland may provide fewer benefits than converting agriculture to wetlands. However, projects that have converted artificially drained forest to wetland have resulted in beautiful wetlands with diverse ecology. Additionally, wetlands may be built in urban land use, but they are generally much smaller and sometimes more costly. Urban areas may provide good potential for wetlands designed for storm water management.

MDE has designated some areas as Wellhead Protection Areas (WPAs). In some WPAs, the water table is near the surface, with only a few feet of soil to filter any water entering the ground. Excavation of a few feet would significantly reduce the filtering capacity of the soil, allowing the wetland to act as a direct pathway for nutrients and other pollutants to enter the groundwater. Therefore, wetland creation designs within WPAs should consider the impact to groundwater quality.

Sensitive Resources

The comprehensive plan recommended the following:

- *Protect the Chesapeake Bay*.
- *Protect groundwater*. Ground water is the sole source of drinking water in the County. Much of the surface water is brackish, so would not be suitable for drinking water in the future.
- *Protect streams and their buffers*. Based on a Maryland Forest Service report, 60% of Dorchester's stream buffers are inadequate (<50 feet of forested buffer on each side).
- *Protected floodplains*. Roughly 60% of the County is within the 100-year floodplain, with most of this being tidal floodplain.
- *Protect habitats of RTE species*. There are an estimated 20 animal and 61 plant species considered to be federal or State-listed rare threatened or endangered species within the County.
- *Protect steep slopes*. Since the County is very flat, only a small amount of land has slopes >15%. Of the 244-acre total area, much is located in a forested patch along the Marshyhope River.
- *Enhance public access to the Chesapeake Bay and tributaries*.
- *Encourage shoreline erosion control*.
- *Encourage conservation easements and other methods of protection within the Critical Area*.
- *Protect forest resources*.
- *Protect agriculture*.
- *Promote eco-tourism*.

The 2005 draft Dorchester County *Land Preservation, Parks, and Recreation Plan* made several recommends, some of which follow:

- Providing more access to the waterfront, especially along the Nanticoke River.
- Focus funds on developing the recreation sites.
- Create connections between the parks and other facilities.
- Preserve agriculture (focused in the northern portion of the County).

Other Relevant Programs

Green Infrastructure

This County has a huge amount of land, most of the southern section of the County, classified as Green Infrastructure hub (DNR, 2000-2003). Although a large portion of this Green Infrastructure is protected, many areas still remain unprotected. Areas within the Green Infrastructure network that are currently unprotected should be protected since these areas provide valuable wildlife habitat. There are some gaps, areas without natural vegetation, within this Green Infrastructure layer. These areas are mainly in the northeastern part of the County and are generally agriculture. It is desirable to restore these areas back to natural vegetation, as they can provide a wildlife corridor, a protective buffer, and may be especially important along the waterways. For more detailed information, refer to the section on the individual watershed.

Ecologically Significant Areas
DNR designates areas that contain habitat for rare, threatened and endangered species and rare natural community types. These areas are buffered to create the "sensitive species project review areas" GIS layer, intented to assist in assessing environmental impacts and reviewing potential development changes. This layer generally includes designated Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.

Natural Heritage Areas
There are State-designated Natural Heritage Areas (NHA) located in the Little Choptank River, Fishing Bay, and Nanticoke River watersheds. These areas 1) Contain species considered to be threatened, endangered, or in need of conservation; 2) Have unique geology, hydrology, climate or biology; and 3) Are among the best Statewide examples.

Rural Legacy Program
Designated Rural Legacy land is located along the Nanticoke River (north and south of Vienna) and along Marshyhope Creek (south of Federalsburg) in the watersheds Marshyhope, Transquaking, and Nanticoke. For detailed information on the program, refer to the individual watershed section.

Priority Funding Areas
There are several Priority Funding Areas located in the northern (e.g. Cambridge, East New Market, Hurlock) and southern (e.g. Upper Hooper Island, Fishing Point) portions of the County.

Stakeholders in wetland management may have conflicting goals for wetlands in Priority Funding Areas. Some may advocate preserving wetlands in these areas as greenways, for aesthetics, or as unique communities in a developing area. Other interests may seek flexibility and expedited review of proposals to impact wetlands due to other goals for growth and economic development in a designated area. There may be benefits to protecting and restoring wetlands for water quality in a growth area, particularly as an offset against future or existing TMDLs. Preservation of biodiversity may be more of a challenge due to possible increases in nonpoint source pollution and fragmentation. Stormwater management associated with growth may also reduce certain nonpoint source impacts to wetlands in PFAs.

Protected Areas
There is a fair amount of protected land in this County, with largest areas being Blackwater Wildlife Management Refuge and Fishing Bay WMA in the southern portion of the County. County residents already have good access to the Chesapeake Bay, with the exceptions of Marshyhope Creek and Nanticoke River (Dorchester, 2005).

Some properties are within agricultural easements. Some are permanent and some are shorter-term. There is some controversy about conducting wetland restoration within agricultural easements. Most would agree that it is desirable to preserve good farmland. However, properties within these easements may also contain spots of soil with lower

productivity due to wetness. These low productivity spots may be a hassle to the farmer and may be good areas for wetland restoration. First, the property owner may be able to benefit from an additional program for that low productivity area, resulting in the owner getting more money for the land and utilizing the land to its full extent. Since these property owners are already involved in a preservation program, they may be more likely to consider additional programs. Second, since some of these agricultural easements are temporary, after the agricultural easement expires, the land owner may decide to get out of agriculture, and a wetland program could help to preserve some of the land from development.

Watershed Information

Information on individual State-designated 8-digit watershed basins is as follows.

Nanticoke River (02130305)

Background

The Dorchester County portion of this watershed has about 36,185 land acres (based on MDP 2002 land use GIS data). The land use is fairly evenly divided between agriculture (39%), forest (31%), and wetland (28%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. More accurate wetland estimates, as discussed later, are based on GIS data from DNR. There is also a small amount of developed area (2%). Both the Chesapeake Bay Foundation and The Nature Conservancy are putting special emphasis on preserving the Nanticoke River watershed. The meanders of the Nanticoke River have resulted in extensive wetlands on the inside bends (Sipple, 1999).

Roughly two-thirds of the County drains into the Nanticoke River (Dorchester County, 1996). Upper Nanticoke River, Chicone Creek, Mill Creek, and Savanna Lake are designated Natural Heritage Areas within this watershed. To get this designation, an area must 1) Contain species considered to be threatened, endangered, or in need of conservation; 2) Have unique geology, hydrology, climate or biology; and 3) Be among the best Statewide examples.

Some of the Dorchester County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data), with the largest amounts around Wrights Millpond and Chicone Creek mouth. In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along the Nanticoke River, Peach Orchard Creek, and tributaries. However, there are also some large wetlands that do not appear to be directly associated with a waterway.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
    - Emergent: 14,050 acres
    - Scrub shrub: 345 acres
    - Forested: 523 acres
    - Unconsolidated bottom: 7 acres
    - Unconsolidated shore: 120 acres
- Palustrine
    - Emergent: 2,532 acres
    - Scrub shrub: 1,408 acres
    - Forested: 18,367 acres
    - Unconsolidated bottom: 241 acres
    - Unconsolidated shore: 5 acres
    - Farmed: 280 acres
- Total: 37,878 acres

Watershed-based Wetland Characterization Maryland's Nanticoke River and Coastal Bays Watersheds: A Preliminary Assessment Report (Tiner et al., 2000)

Tiner et al. (2000) classified wetlands in the 8-digit watersheds Nanticoke River, Marshyhope Creek, and the Coastal Bay watersheds using a classification scheme that bridged the NWI classification to the HGM classification. This method is described in the document entitled *Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors* (Tiner, 2003a). As a base map, they used the wetlands identified in the National Wetland Inventory (NWI). They modified this NWI map by photointerpretating 1998 1:40,000 black and white aerial photography and incorporating State digital wetland maps (from 1989 photography), digital submerged aquatic vegetation data, and Natural Resource Conservation Service digital hydric soil data. Additionally, investigators conducted a limited amount of field surveying. In the Tiner et al. (2000) document, they acknowledge that palustrine forested wetlands may be overestimated using this method due to difficultly in distinguishing between forests that are currently wetlands and ones that were drained but still have hydric soils.

These wetlands were classified into HGM types based on landscape position, landform, and water flow direction of the wetlands, determined by comparing the wetland maps with topographic maps and aerial photos. Wetlands in these watersheds were classified into five groups depending on their landscape positions, or their relationship to an adjacent waterbody: marine, estuarine, lotic (adjacent to freshwater streams and rivers), lenthic (associated with lakes), and terrene (isolated or headwater) (Figure 1). Within the Nanticoke and Marshyhope Creek watersheds, over half of the wetlands were classified as terrene (53%), a large percentage as estuarine (35%), and the remaining as lotic (13%) and lentic (<1%). These wetland types were further subdivided based on where they occur within these classifications and their water flow path.

Tiner et al. (2000) then assessed the potential ability of each wetland classification to provide a given function in the process called "Watershed-based Preliminary Assessment

of Wetland Function." This assignment of function based on wetland type is described in the document entitled *Correlating Enhanced National Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands* (Tiner, 2003b). The evaluated functions included: surface water detention, streamflow maintenance, nutrient transformation, sediment and particulate retention, coastal storm surge detention and shoreline stabilization, inland shoreline stabilization, fish and shellfish habitat, waterfowl and waterbird habitat, other wildlife habitat, and conservation of biodiversity. Wetlands along the Nanticoke River, Marshyhope Creek, and tributaries have a high potential for surface water detention, nutrient transformation, and sediment and particulate retention. The estuarine and lotic river portions had high potential for coastal storm surge detention and shoreline stabilization. Many of the terrene wetlands were estimated to have moderate to high potential for surface water detention. Wetlands along the Marshyhope Creek and tributaries had high potential for streamflow maintenance and inland shoreline stabilization. The Nanticoke River and lower tributaries had high potential for fish and shellfish habitat, and waterfowl and waterbird habitat. They also identified wetlands significant for other wildlife habitat: large wetlands ($\geq$20 acres) and small diverse wetlands (10-20 acres having $\geq$2 different covertypes). Many of the diverse wetlands were already designated as WSSC and were within Marshyhope Creek watershed (Dorchester and Caroline Counties) or associated with Chicone Creek (Dorchester County). They then identified wetlands thought to significant for biodiversity. These included: the large middle and upper estuarine wetlands of Nanticoke River (oligohaline in the middle), the large lotic river wetland along Marshyhope Creek, the large terrene wetland area near Finchville (Dorchester County), the large terrene wetland area between Chicone Creek and Marshyhope Creek (Dorchester County), the large terrene wetland just north of Mardela Springs (Wicomico County), the large terrene wetland important to forest breeding avifauna encompassing Athol, Rewastico, and Quantico (Wicomico County), and the large terrene wetland between Royal Oak, Head of the Creek, and Wetipquin (Wicomico County). More intensive fieldwork may produce different results, since some HGM types are difficult to distinguish from one another. In addition, some functions rely on characteristics only seen in the field, such as micro-topography.

For the combined Nanticoke River and Marshyhope Creek watersheds, the land cover for the 100m buffer around wetlands and waterbodies was estimated to be 34% natural vegetation, 59% agriculture, and 7% developed. There are a large number of channelized streams and ditches (Tiner et al., 2000).

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130305	-2.16	4.17	0	2.16	4.16

Dorchester County established a wetland mitigation bank to offset current and future regulated wetland losses.

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. Waterways not specifically designated within COMAR are classified Use I, water contact recreation and protection of aquatic life. All estuarine portions (except Nanticoke River and tributaries above Runaway Point and Long Point) are designated: Use II, shellfish harvesting.

Water Quality

The wellhead protection area for Vienna is located within this watershed. Based on the source water assessment, the water system for the town of Vienna is susceptible to nitrates (from fertilizers), and iron and manganese (naturally found in the Pleistocene aquifer).

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. It is also classified as a "Selected" Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include high nutrient concentrations, low SAV abundance, low SAV habitat index, poor non-tidal fish IBI and poor non-tidal instream habitat index, high amount of historic wetland loss (54,807 acres), and being on the 303(d) List for water quality impairment. Indicators for Category 3 include a high tidal fish IBI, a high imperiled aquatic species indicator, six migratory fish spawning areas, a high anadromous fish index, and a high amount of wetland-dependent species.

According to the 2002 Maryland Section 305(b) Water Quality Report, portions of the tidal Nanticoke River and tributaries fail to support all designated uses (22.0 $mi.^2$ supports, 6.3 $mi.^2$ fail to support) due to bacteria from nonpoint and natural sources. Nontidal wadeable tributaries fully support all designated uses (19.8 mi. support, 26.3 mi. inconclusive).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Nanticoke River* (tidal); fecal coliform, poor biological community.
- *Nanticoke River Unnamed Tributary* (021303050584 non-tidal in Wicomico County); poor biological community.
- *Rewastico Creek* (021303050581 non-tidal in Wicomico County); poor biological community.
- *Dennis Creek* (021303050587 non-tidal in Dorchester County); poor biological community.
- *Plum Creek* (021303050584 non-tidal in Wicomico County); poor biological community.

- *Plum Creek Unnamed Tributary* (021303050584 non-tidal in Wicomico County); poor biological community.
- *Chicone Creek* (021303050586 non-tidal in Dorchester County); poor biological community.
- *Chicone Creek Unnamed Tributary* (021303050586 non-tidal); poor biological community.
- *Cove Road Beach*; fecal coliform.
- *Barren Creek* (021303050583 non-tidal in Wicomico County); poor biological community.

Of the MBSS samples taken in the northern portion of the watershed, BIBI was fair to poor (two samples were taken) and FIBI was fair (only one sample was taken).

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are some hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands). These include large areas between Mill Creek and Peach Orchard Creek. There are other areas to the east and west of Chicone Creek and scattered throughout. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration. There are additional soils that are not classified as hydric but are "somewhat poorly drained." Since it may be fairly easy to create wetland hydrology in these soils, wetland creation may be successful here.

The majority of this watershed is designated Green Infrastructure hub, with the exception being a north-south strip radiating out from Vienna (DNR, 2000-2003). Large portions are protected by the State (Fishing Bay WMA and Chesapeake Forest land) and MET holdings. With this said, there are still large section of Green Infrastructure hub that are unprotected. Unprotected areas along the Nanticoke River should be high priority for protection. According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Fishing Bay*. This is an existing ecological greenway that extends from Taylor's Island WMA, through Blackwater National Wildlife Refuge to Fishing Bay WMA (on the southernmost tip of the County). Of the privately-owned land in this greenway, most is wetlands so is somewhat protected through regulations. The greenway then extends north (along the Nanticoke River greenway).
- *Nanticoke River*. This is a proposed ecological greenway that follows the Nanticoke River. Some of this land is protected by Fishing Bay WMA and Maryland Environmental Trust easement. The remaining proposed section will continue north along the Nanticoke River and past Marshyhope Creek confluence. Some of this land is owned by The Nature Conservancy and a Boy Scout Reservation. Other sections are not currently protected.
- *Hurlock Rail Trail*. This proposed trail would connect Hurlock and Vienna, following the railroad owned by Connectiv. It could also connect with the potential Wicomico County trail to Salisbury.

The following information is summarized from the document *Rural Legacy FY 2003: Applications and State Agency Review*. There are two Rural Legacy areas within this County, the Marshyhope section of the Agricultural Security Corridor and the Nanticoke Rural Legacy Area. The Marshyhope Rural Legacy Area is sponsored by Eastern Shore Rural Legacy Sponsor Board and Eastern Shore Land Conservancy, Inc. There are 7,737 acres land in the Rural Legacy area (based on GIS data). Of this area, 2,986 acres are protected. The goal of the protection effort is to preserve agriculture on prime soils and preserve the natural resources, including water quality of Marshyhope Creek and other waters, wetlands, and wildlife habitat. The Nanticoke Rural Legacy Area is in the eastern part of the County, adjacent to the Nanticoke River. It is fragmented by the Town of Vienna. Sponsors include The Nature Conservancy, The Conservation Fund, and Dorchester County. Some goals include protecting agriculture, forest, waterway buffers, and a greenbelt around Vienna. This area is 21,000 acres, with 33% already protected. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not always adequate enough to support all of these requests, other programs should consider preservation of these sites.

A partnership of the Nature Conservancy, Maryland Department of Natural Resources, U.S. Fish and Wildlife Service, and the Eastern Shore Land Conservancy has a goal to protect and restore habitat in the Nanticoke - Blackwater watershed in Wicomico and Dorchester Counties. Several thousand acres have been protected through the years. In March 2006, DNR submitted a FWS Section 6 (Endangered Species) Recovery Land Acquisition grant proposal to purchase a conservation easement on 1,429 acres of forest, forested wetland, and farmland in the Little Blackwater River watershed to protect habitat for the Delmarva Fox squirrel.

As part of an ongoing project to classify the vegetative communities in Maryland, DNR created the document entitled *Herbaceous Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they characterized 14 community types, with some being found in this County. One reference site, the best example of a particular community type, was a *Spartina cynosuroides* tidal herbaceous vegetation between the Nanticoke River and Rewastico Creek. This community type was designated S4, a community type being "secure under present conditions in Maryland." This site is located within Nanticoke Wildlife Management Area and is at risk for invasion by *Phragmites*.

Chicone Creek supports two reference tidal wetland communities. There is a shrubland community dominated by *Alnus serrulata/Viburnum recognitum/.Impatiens capensis* (Smooth alder/Northern arrowwood/Jewelweed). The community is a daily inundated, freshwater system found usually found between tidal emergent and tidal swamp forests. Species richness is high due to diversity of microtopography and variable durations of inundations from hummocks and hollows (Harrison and Stango 2003). A freshwater, daily to irregularly flooded tidal forested wetland community dominated by *Fraxinus profunda-Nyssa biflora-Ilex verticillata and Polygonum arifolium* (Pumpkin ash-Swamp blackgum-winterberry-halberd leaved tearthumb) is also found along Chicone Creek

(Harrison et al., 2004). This type of wetland also has pronounced hummocks among varying microtopography.

There are several State-designated Nontidal Wetlands of Special State Concern and one potential WSSC within this watershed.

- *Brookville Ponds*. This wetland complex contains nine natural seasonal ponds dominated by herbaceous vegetation and linear wetlands along roadside ditches, both containing RTE species. These ponds have a large amount of herbaceous vegetation, which is fairly uncommon as most Delmarva bays are forested or shrub swamps. These ponds contain thirteen RTE plant species, with nine being State Endangered. There is also an amphibian In Need of Conservation that uses these ponds for breeding. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species (DNR, 1991). Logging is acceptable in the protection area assuming BMPs are followed. The main threat to the system is the alteration of hydrology through further ditching or disturbance of existing ditches (Ludwig et al., 1987). This site is only partially protected DNR-owned Chesapeake Forest Land.
- *Chicone Creek (DNR name: Chicone Woods) and Chicone Creek Natural Heritage Area*. This site contains a variety of wetland types. This wetland is adjacent to Chicone Creek NHA. Preservation of this wetland is critical to protection of hydrology, water quality, and diversity within the NHA. This wetland provides water quality improvement (removing sediment and chemicals in the runoff), flood abatement, and increases species diversity. The nontidal wetlands are adjacent to upland circumneutral sand dunes, containing three State listed plant species. This site is utilized by at least seven forest interior dwelling bird species, including two species indicating good quality forest (DNR, 1991). This site is currently unprotected.
- *Gales Creek*. This site includes two millponds, Irving Millpond (which is no longer impounded) contains shrub swamp and bog habitat and Galestown Millpond contains open water habitat. Bogs are rare on Maryland's Eastern Shore. The open water habitat provided by Galestown Millpond is similar to that created historically by beaver. These areas contain at least nineteen RTE species. This site is upstream and adjacent to the Upper Nanticoke River NHA (DNR, 1991). The main threats include reduced water quality and shoreline habitat destruction from lake-side development and agriculture. The forested buffer between the pond and agricultural fields should be expanded. Landowners should be encouraged to reduce activities which may be detrimental to the pond. Another threat at Irving Millpond is the encroachment of woody plants into the open bog and mudflat areas (Ludwig et al., 1987). This site is currently unprotected.
- *Mill Creek Natural Heritage Area.* This area is around Mill Creek and Redfin Creek. This area is not protected.
- *Rhodesdale Powerline SE (DNR name: Brookview Ponds)*. This site includes a Delmarva bay with a State Endangered grass species. This species requires wetland forest canopy gaps. Historically, natural disturbances such as fires and

floods created these gaps. However, as humans suppress these natural disturbances, these habitats have become uncommon. Powerline right-of-way maintenance now provides this habitat. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species (DNR, 1991). This site is currently unprotected.

- *Savanna Lake and Savanna Lake NHA.* This site contains seasonally inundated and saturated palustrine forest. This wetland is utilized by three bird species In Need of Conservation, one bird species that is State Rare, and possibly an amphibian In Need of Conservation. It is adjacent to Savanna Lake NHA and provides the functions of maintaining hydrology, improving water quality, retaining floodwater, and increasing species diversity in the NHA. As this site acts as a buffer for the NHA, it is very important that it be protected (DNR, 1991). Some of this is protected by Fishing Bay WMA and Chesapeake Forest Land.
- *Upper Nanticoke River, Marshes, and Swamps NHA*. This is part of a large wetland complex along the Nanticoke River and Marshyhope Creek that has large unprotected areas. This site is partially protected by TNC Upper Nanticoke River Preserve.
- There are a two potential WSSC
    - along a tributary to the Nanticoke River within the Richard A. Henson Scout Reservation
    - east of Big Millpond WSSC, on the border of the watershed Nanticoke River and Transquaking River (partially protected by DNR-owned Chesapeake Forest Land).

In the document entitled *Watershed-based Wetland Characterization for Maryland's Nanticoke River and Coastal Bays Watersheds: A Preliminary Assessment Report*, Tiner et al., (2000) proposed wetland restoration sites in the Nanticoke River and Marshyhope Creek watersheds totaling 22,506 acres. These sites were classified into two categories: former wetlands (Type 1) and existing impaired wetlands (Type 2). Type 1 sites included filled wetlands (without any buildings on them), farmed wetlands, and those converted to deepwater. There were only 360 acres of Type 1 sites, scattered throughout the two watersheds. The Type 1 estimate is conservative because they did not include areas having hydric soils that were effectively drained, and now appeared to be productive farmland. These areas were indistinguishable from the surrounding land in aerial photographs and the likelihood of landowner interest is low. However, since identified Type 1 sites are generally surrounded by effectively drained areas, restoration potential acreage is larger than it may first appear. About a third of the existing wetlands within these two watersheds are designated as Type 2 sites, degraded wetlands. Most of these wetlands were ditched palustrine (98%), but some were tidally restricted, impounded, or excavated. There were 22,146 acres classified as Type 2 sites. While these sites are scattered throughout the watersheds, larger Type 2 wetland restoration opportunities include:

- Between the Chicone Creek and Marshyhope Creek (Marshyhope Creek and Nanticoke River watersheds - Dorchester County)

- East of Lecompte WMA (Dorchester County)
- North of Mardela Springs (Wicomico County)
- Between Athol, Rewastico, and Quantico (Wicomico County)
- Between Head of Creek and Royal Oak (Wicomico County)

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network, especially along the Nanticoke and tributaries.
- Protect WSSCs and buffers.
- Protect areas within the Rural Legacy Area.
- Protect designated Natural Heritage Area.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

Marshyhope Creek (02130306)

Background

The Dorchester County portion of this watershed has roughly 37,739 land acres (based on MDP 2002 land use GIS data). About half is agriculture (53%), a third is forest (34%), and the remaining land use is wetland (7%) and developed (6%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR. This waterway is roughly 38 miles long (from the confluence with the Nanticoke River to the headwaters). Headwaters originate in Sussex and Kent Counties, Delaware. For the whole basin, including the Delaware portion, land use is 46% agriculture, 45% forest, and 5% urban (as summarized by MDE TMDL based on data from 1997 Maryland Department of Planning, 1997 Delaware Office of State Planning, and 1997 Farm Service Agency).

Upper Nanticoke River is a designated Natural Heritage Area within this watershed. To get this designation, an area must contain threatened or endangered species and be the best Statewide examples.

A large portion of Marshyhope Creek and some of the tributaries, especially in upstream portions of Delaware, has been channelized with the spoil deposited in spoil banks parallel to the channel, dividing the creek from the historic floodplain swamp. This was done to expedite water movement. In addition to the standard loss of habitat and increase in downstream flooding caused by channelization, it has also resulted in the loss of

sediment and nutrient filtering function of the wetland. The stream can no longer flood over the banks to deposit sediment in the floodplain. Now, the sediments and nutrients are washed downstream, where they cause problems due to sedimentation and nutrient enrichment of those systems (Sipple, 1999).

Some of the Dorchester County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along the Marshyhope River and tributaries. However, there are also some fairly large wetlands that are not directly associated with a waterway.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
    - Emergent: 424 acres
    - Scrub shrub: 453 acres
    - Forested: 10,975 acres
    - Unconsolidated bottom: 254 acres
    - Farmed: 68 acres
- Total: 12,173 acres

Watershed-based Wetland Characterization Maryland's Nanticoke River and Coastal Bays Watersheds: A Preliminary Assessment Report (Tiner et al., 2000)

Tiner et al. (2000) classified wetlands in the 8-digit watersheds Nanticoke River, Marshyhope Creek, and the Coastal Bay watersheds using a classification scheme that bridged the NWI classification to the HGM classification. This method is described in the document entitled *Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors* (Tiner, 2003a). As a base map, they used the wetlands identified in the National Wetland Inventory (NWI). They modified this NWI map by photointerpretating 1998 1:40,000 black and white aerial photography and incorporating State digital wetland maps (from 1989 photography), digital submerged aquatic vegetation data, and Natural Resource Conservation Service digital hydric soil data. Additionally, investigators conducted a limited amount of field surveying. In the Tiner et al. (2000) document, they acknowledge that palustrine forested wetlands may be overestimated using this method due to difficultly in distinguishing between forests that are currently wetlands and ones that were drained but still have hydric soils.

These wetlands were classified into HGM types based on landscape position, landform, and water flow direction of the wetlands, determined by comparing the wetland maps with topographic maps and aerial photos. Wetlands in these watersheds were classified into five groups depending on their landscape positions, or their relationship to an adjacent waterbody: marine, estuarine, lotic (adjacent to freshwater streams and rivers), lenthic

(associated with lakes), and terrene (isolated or headwater) (Figure 3). Within the Nanticoke and Marshyhope Creek watersheds, over half of the wetlands were classified as terrene (53%), a large percentage as estuarine (35%), and the remaining as lotic (13%) and lentic (<1%). These wetland types were further subdivided based on where they occur within these classifications and their water flow path.

Tiner et al. (2000) then assessed the potential ability of each wetland classification to provide a given function in the process called "Watershed-based Preliminary Assessment of Wetland Function." This assignment of function based on wetland type is described in the document entitled *Correlating Enhanced National Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands* (Tiner, 2003b). The evaluated functions included: surface water detention, streamflow maintenance, nutrient transformation, sediment and particulate retention, coastal storm surge detention and shoreline stabilization, inland shoreline stabilization, fish and shellfish habitat, waterfowl and waterbird habitat, other wildlife habitat, and conservation of biodiversity. Wetlands along the Nanticoke River, Marshyhope Creek, and tributaries have a high potential for surface water detention, nutrient transformation, and sediment and particulate retention. The estuarine and lotic river portions had high potential for coastal storm surge detention and shoreline stabilization. Many of the terrene wetlands were estimated to have moderate to high potential for surface water detention. Wetlands along the Marshyhope Creek and tributaries had high potential for streamflow maintenance and inland shoreline stabilization. The Nanticoke River and lower tributaries had high potential for fish and shellfish habitat, and waterfowl and waterbird habitat. They also identified wetlands significant for other wildlife habitat: large wetlands ($\geq$20 acres) and small diverse wetlands (10-20 acres having $\geq$2 different covertypes). Many of the diverse wetlands were already designated as WSSC and were within Marshyhope Creek watershed (Dorchester and Caroline Counties) or associated with Chicone Creek (Dorchester County). They then identified wetlands thought to significant for biodiversity. These included: the large middle and upper estuarine wetlands of Nanticoke River (oligohaline in the middle), the large lotic river wetland along Marshyhope Creek, the large terrene wetland area near Finchville (Dorchester County), the large terrene wetland area between Chicone Creek and Marshyhope Creek (Dorchester County), the large terrene wetland just north of Mardela Springs (Wicomico County), the large terrene wetland important to forest breeding avifauna encompassing Athol, Rewastico, and Quantico (Wicomico County), and the large terrene wetland between Royal Oak, Head of the Creek, and Wetipquin (Wicomico County). More intensive fieldwork may produce different results, since some HGM types are difficult to distinguish from one another. In addition, some functions rely on characteristics only seen in the field, such as micro-topography.

For the combined Nanticoke River and Marshyhope Creek watersheds, the land cover for the 100m buffer around wetlands and waterbodies was estimated to be 34% natural vegetation, 59% agriculture, and 7% developed. There are a large number of channelized streams and ditches (Tiner et al., 2000).

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130306	-2.40	4.40	12.00	0	14.00

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated Use I, recreation contact and protection of aquatic life.

Water Quality

There are a few wellhead protection areas around Hurlock. Source water assessments have been completed for these areas. The water system and susceptibility are as follows:

- *Town of Hurlock*: nitrates (from fertilizers), VOCs, synthetic organic compounds. This system withdraws from both confined and unconfined aquifers).
- *Allen Family Foods Facility* (in Hurlock): nitrates (from fertilizers), VOCs, and synthetic organic compounds.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. It is also classified as a Category 3, a watershed in need of protection. Failing indicators include high modeled nitrogen and phosphorus loads, low non-tidal benthic IBI, high historic wetland loss (28,117 acres), and being on the 303(d) List for impaired water quality. Indicators for Category 3 include a high imperiled aquatic species indicator, six migratory fish spawning areas, and State-designated Wildlands (3,166 acres).

According to the 2002 Maryland Section 305(b) Water Quality Report, the lower portion of the tidal Marshyhope Creek supports all designated uses (0.6 $mi.^2$). Some portions of the nontidal wadeable tributaries (i.e. the subwatershed Tommy Wright Branch; DNR, 2000) fail to fully support all designated uses (9.6 mi. support, 6.4 mi. fails to support, 46.0 mi. inconclusive) due to poor biological community from siltation, and changes in habitat and hydrology. Chambers Lake fully supports all uses (9.4 acres), as does Smithville Community Pond (40 acres).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Marshyhope Creek* (tidal); suspended sediments. Nutrients are also impairing this waterway, but a TMDL has been completed for this pollutant.

- *Tommy Wright Branch* (021303060615 non-tidal in Caroline County); sedimentation.

The following information is based on the MDE document entitled *Total Maximum Daily Loads of Phosphorus for the Marshyhope Creek, Dorchester and Caroline Counties, Maryland*. In the upper watershed of Delaware, poultry farms are common and poultry waste is applied to row crops. There are also many channelized streams draining nontidal wetlands to be used as agricultural land. This waterway is not fully supporting the Use I designation due to dissolved oxygen that likely is <5.0ug/l at night, and high chlorophyll a (so eutrophic and has high amounts of algae) which limits recreational uses of swimming and fishing. Sources of nutrients include: nitrogen – agriculture (77%), urban (8%), points sources (7%), forest/herbaceous (7%), and atmospheric deposition (1%); phosphorus – agriculture (72%), point sources (24%), urban (3%), forest/herbaceous (0.5%), and atmospheric deposition (0.5%). Point sources include: Hurlock WWTP, Federalsburg WWTP, Col. Richardson High Scholl WWTP, and W.O. Whyteley and Sons Company (discharging insignificant amounts). Allen Foods, currently discharging into Hurlock WWTP, will have a separate discharge permit in the future. Analysis of water samples found chlorophyll a was higher in the downstream portions (between the mouth and 15 miles upstream). The TMDL requires a 40% decrease in phosphorus during low flow periods.

MBSS samples found BIBI and FIBI of good to fair.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are some hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), including around the intersection of 313 and 392. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration. There are additional soils that are not classified as hydric but are “somewhat poorly drained.” Since it may be fairly easy to create wetland hydrology in these soils, wetland creation may be successful here.

This watershed has a large Green Infrastructure hub encompassing Marshyhope Creek with several large DNR-owned properties (Idylwild WMA and Chesapeake Forest Land) and smaller TNC and MET land (DNR, 2000-2003). Many areas along Marshyhope Creek remain unprotected and should be high priority for protection. The Green Infrastructure corridors extending out from this hub are largely agricultural. These corridors may be good areas for restoration to natural vegetation. According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Marshyhope Creek*. This proposed ecological greenway follows Marshyhope Creek. Some of the land is Chesapeake Forest Land and The Nature Conservancy land. A the confluence with Nanticoke River, there is the Marshyhope Natural Heritage Area and the Nanticoke Boy Scout Reservation.
- *Nanticoke River*. This is a proposed ecological greenway that follows the Nanticoke River. Some of this land is protected by Fishing Bay WMA and

Maryland Environmental Trust easement. The remaining proposed section will continue north along the Nanticoke River and past Marshyhope Creek confluence. Some of this land is owned by The Nature Conservancy and a Boy Scout Reservation. Other sections are not currently protected.

- *Hurlock Rail Trail*. This proposed trail would connect Hurlock and Vienna, following the railroad owned by Connectiv. It could also connect with the potential Wicomico County trail to Salisbury.
- *East New Market/Hurlock Loop*. This is a proposed connector trail following Rte. 14 and Rte. 331.
- *East New Market-Secretary-Hurlock Rail Trail*. This proposed recreational trail would connect East New Market and Hurlock. It could potentially run from Cambridge (in the west) to Federalsburg (within Caroline County).

The following information is summarized from the document *Rural Legacy FY 2003: Applications and State Agency Review*. There are two Rural Legacy areas within this County, the Marshyhope section of the Agricultural Security Corridor and the Nanticoke Rural Legacy Area. The Marshyhope Rural Legacy Area is sponsored by Eastern Shore Rural Legacy Sponsor Board and Eastern Shore Land Conservancy, Inc. There are 7,737 acres land in the Rural Legacy area (based on GIS data). Of this area, 2,986 acres are protected. The goal of the protection effort is to preserve agriculture on prime soils and preserve the natural resources, including water quality of Marshyhope Creek and other waters, wetlands, and wildlife habitat. The Nanticoke Rural Legacy Area is in the eastern part of the County, adjacent to the Nanticoke River. It is fragmented by the town of Vienna. Sponsors include The Nature Conservancy, The Conservation Fund, and Dorchester County. Some goals include protecting agriculture, forest, waterway buffers, and a greenbelt around Vienna. This area is 21,000 acres, with 33% already protected. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not always adequate enough to support all of these requests, other programs should consider preservation of these sites.

A partnership of the Nature Conservancy, Maryland Department of Natural Resources, U.S. Fish and Wildlife Service, and the Eastern Shore Land Conservancy has a goal to protect and restore habitat in the Nanticoke - Blackwater watershed in Wicomico and Dorchester Counties. Several thousand acres have been protected through the years. In March 2006 DNR submitted a FWS Section 6 (Endangered Species) Recovery Land Acquisition grant proposal to purchase a conservation easement on 1,429 acres of forest, forested wetland, and farmland in the Little Blackwater River watershed to protect habitat for the Delmarva Fox squirrel.

As part of an ongoing project to classify the vegetative communities in Maryland, DNR created the document entitled *Shrubland Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they categorize nine shrubland tidal wetland communities, including some in Dorchester County. This watershed contains two of the reference sites, the best example of a particular community type. The reference site *Alnus maritima/Acorus calamus* (Seaside alder/Sweetflag) tidal wetland on the Marshyhope

Creek was ranked S3.1: "a 'watch list' community that is actively tracked by the Natural Heritage Program based on global significance of Maryland occurrences." The wetland is subject to daily tidal inundation with hummocks and hollows for microtopography. This site is surrounded by tidal swamp forest followed by upland agriculture. Another reference site is the *Morella cerifera-Rosa palustris/Thelypteris palustris* tidal wetland on the Big Creek (NE of Vienna). This community type is ranked S3S4: "a designation meaning that more than 100 occurrences are known in the State or fewer occurrences if they contain a large number of individuals." Both sites are threatened from invasion by *Phragmites*.

During this same project, DNR also created the document entitled *Herbaceous Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they characterized 14 community types, with some being found in this County. Four reference sites, the best examples of particular community types of tidal herbaceous vegetation, are *Nuphar lutea ssp. advena* (Broadleaf pondlily), *Acorus calamus* (Sweetflag) and *Zizania aquatica* (Wild rice) along Marshyhope Creek (the first two are southeast of Brookview and the third one is south of Federalsburg near the confluence with Skinners Run). The first two community types were designated S4, a community type being "secure under present conditions in Maryland." The third community type (*Zizania aquatica*) is designated S3: "currently rare to uncommon in Maryland with the number of occurrences typically in the range of 21 to 100." These sites are generally bordered by tidal swamp forest and are at risk for invasion by *Phragmites*. The *Zizania aquatica* community type is also sensitive to sedimentation and increased salinity. *Peltandra virginica/Pontedaria cordata* (Arrow arum/pickerelweed) is the fourth community, with fresh to slightly brackish tidal inundation.

A freshwater, daily to irregularly flooded tidal forested wetland community dominated by *Fraxinus profunda-Nyssa biflora-Ilex verticillata and Polygonum arifolium* (Pumpkin ash-Swamp blackgum-winterberry-halberd leaved tearthumb) is also found along Chicone Creek (Harrison et al., 2004). This type of wetland also has pronounced hummocks among varying microtopography.

There are several Nontidal Wetlands of Special State Concern and one potential WSSC in the Dorchester County portion of this watershed.

- *Brookville Ponds*. This wetland complex contains nine natural seasonal ponds dominated by herbaceous vegetation and linear wetlands along roadside ditches, both containing RTE species. These ponds have a large amount of herbaceous vegetation, which is fairly uncommon as most Delmarva bays are forested or shrub swamps. These ponds contain thirteen RTE plant species, with nine being State Endangered. There is also an amphibian In Need of Conservation that uses these ponds for breeding. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species (DNR, 1991). Logging is acceptable in the protection area assuming BMPs are followed. The main threat to the system is the alteration of hydrology through further ditching or

disturbance of existing ditches (Ludwig et al., 1987). This site is only partially protected DNR-owned Chesapeake Forest Land.

- *Marshyhope Seasonal Pond (DNR name: Marshyhope Sand Ridge Complex)*. This site contains a large seasonal pond dominated by herbaceous vegetation, including a State Rare sedge. It also harbors an amphibian In Need of Conservation. Nontidal wetlands dominated by herbaceous vegetation are rare on the Delmarva peninsula. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species. Surveys conducted during different seasons would likely reveal additional rare species (DNR, 1991). This site is protected by DNR-owned Chesapeake Forest Land.
- *Rhodesdale Powerline*. This site contains a healthy population of a State Endangered plant species. This species requires wetland with canopy gaps. Historically, natural disturbances such as fires and floods created these gaps. However, as humans suppress these natural disturbances, these habitats have become uncommon. Powerline right-of-way maintenance now provides this habitat. Since this species occurs in so few wetland gaps, it likely has an additional habitat requirement that this site provides (DNR, 1991). This site is mostly protected by DNR-owned Chesapeake Forest Land.
- *Upper Nanticoke River, Marshes, and Swamps NHA*. Some of this site is protected by TNC-owned land (Upper Nanticoke River Preserve) and DNR-owned Chesapeake Forest land.
- *Potential WSSC*. There is a potential WSSC located near Williamsburg along a tributary of Marshyhope Creek that is unprotected.

In the document entitled *Watershed-based Wetland Characterization for Maryland's Nanticoke River and Coastal Bays Watersheds: A Preliminary Assessment Report*, Tiner et al., (2000) proposed wetland restoration sites in the Nanticoke River and Marshyhope Creek watersheds totaling 22,506 acres. These sites were classified into two categories: former wetlands (Type 1) and existing impaired wetlands (Type 2). Type 1 sites included filled wetlands (without any buildings on them), farmed wetlands, and those converted to deepwater. There were only 360 acres of Type 1 sites, scattered throughout the two watersheds. The Type 1 estimate is conservative because they did not include areas having hydric soils that were effectively drained, and now appeared to be productive farmland. These areas were indistinguishable from the surrounding land in aerial photographs and the likelihood of landowner interest is low. However, since identified Type 1 sites are generally surrounded by effectively drained areas, restoration potential acreage is larger than it may first appear. About a third of the existing wetlands within these two watersheds are designated as Type 2 sites, degraded wetlands. Most of these wetlands were ditched palustrine (98%), but some were tidally restricted, impounded, or excavated. There were 22,146 acres classified as Type 2 sites. While these sites are scattered throughout the watersheds, a large Type 2 wetland restoration opportunity is located between the Chicone Creek and Marshyhope Creek (Marshyhope Creek and Nanticoke River watersheds – Dorchester County).

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways and within the large GI hub following the Marshyhope.
- Restore/create wetlands designed to reduce phosphorus entering the Marshyhope Creek.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network, especially along the Marshyhope Creek.
- Protect WSSCs and buffers.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Protect designated Rural Legacy Area.
- Protect designated Natural Heritage Area.
- Protect wetlands that function to reduce phosphorus entering the Marshyhope Creek.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

Fishing Bay (02130307)

Background

There are approximately 98,038 land acres in this watershed (based on MDP 2002 land use GIS data). Land use is dominated by forest (41%) and wetland (42%), followed by agriculture (15%) and developed land (2%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR. There is extensive wetland area around Fishing Bay.

Savanna Lake and Upper Blackwater River are designated Natural Heritage Areas within this watershed. To get this designation, an area must 1) Contain species considered to be threatened, endangered, or in need of conservation; 2) Have unique geology, hydrology, climate or biology; and 3) Be among the best Statewide examples.

There is a small amount of area classified as prime farmland (based on NRCS SSURGO GIS data), mostly in the northern portion of the watershed. In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

Mapped wetlands (based on DNR and NWI GIS data) cover the majority of this watershed. Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
  - Emergent: 37,466 acres
  - Scrub shrub: 749 acres
  - Forested: 6,685 acres
  - Unconsolidated shore: 34 acres
- Lacustrine aquatic bed: 10 acres
- Palustrine
  - Aquatic bed: 16 acres
  - Emergent: 959 acres
  - Scrub shrub: 2,419 acres
  - Forested: 16,851 acres
  - Unconsolidated bottom: 272 acres
  - Farmed: 49 acres
- Total: 65,511 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130307	-3.89	5.84	0	0.59	2.55

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- Blackwater River and tributaries: Use I, recreation contact and protection of aquatic life.
- All non-estuarine portions: Use I, recreation contact and protection of aquatic life.
- All estuarine portions except the above: Use II, shellfish harvesting.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high monitored nutrient concentrations, low SAV abundance, low tidal fish IBI, low anadromous fish index, and a high historic wetland loss (56,129 acres). Indicators of Category 3 include three migratory fish spawning areas and a high number of wetland-dependent species.

According to the *2002 Maryland Section 305(b) Water Quality Report*, Fishing Bay and tidal tributaries fully support all designated uses (34.4 $mi.^2$). Water quality results from the nontidal wadeable tributaries were inconclusive (13.4 mi.).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. No waterway within Fishing Bay watershed was on the 303(d) List.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are many hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), mostly in the northern portion of the watershed. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

The majority of this watershed is designated Green Infrastructure hub (DNR, 2000-2003). There are extensive areas that are protected (Blackwater NWR and Fishing Bay WMA), but many other opportunities for protection still remain. According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Fishing Bay*. This is an existing ecological greenway that extends from Taylor's Island WMA through Blackwater National Wildlife Refuge to Fishing Bay WMA (on the southernmost tip of the County). Of the privately-owned land in this greenway, most is wetlands so is somewhat protected through regulations. The greenway then extends north (along the Nanticoke River greenway).
- *Fishing Bay Water Trail*. This existing water trail is within Fishing Bay WMA, one around Guinea Island and the other along Island Creek. These are intended to be wildlife and natural resource-focused recreation.
- *East New Market-Secretary-Hurlock Rail Trail*. This proposed recreational trail would connect East New Market and Hurlock. It could potentially run from Cambridge (in the west) to Federalsburg (within Caroline County).
- *Cambridge to Blackwater Pedestrian Path*. This proposed recreational trail would follow the Blackwater River to connect Cambridge with Blackwater National Wildlife Refuge.

A partnership of the Nature Conservancy, Maryland Department of Natural Resources, U.S. Fish and Wildlife Service, and the Eastern Shore Land Conservancy has a goal to protect and restore habitat in the Nanticoke - Blackwater watershed in Wicomico and Dorchester Counties. Several thousand acres have been protected through the years. In March 2006, DNR submitted a FWS Section 6 (Endangered Species) Recovery Land Acquisition grant proposal to purchase a conservation easement on 1,429 acres of forest, forested wetland, and farmland in the Little Blackwater River watershed to protect habitat for the Delmarva Fox squirrel.

A 400-acre project to restore hydrology and a high freshwater tidal marsh by plugging ditches is planned at the Fishing Bay WMA by MDE, DNR, and USFWS.

As part of an ongoing project to classify the vegetative communities in Maryland, DNR created the document entitled *Herbaceous Tidal Wetland Communities of Maryland's Eastern Shore.* In this document, they characterized 14 community types, with some

being found in this County. A reference site, the best example of a particular community type, *Spartina alterniflora* tidal herbaceous vegetation is located in Grays Island Marsh (along the northeast side of Elliott Island and the east side of Fishing Bay). This community type was designated S5, a community type being "demonstrably secure under present conditions in Maryland." The main threats are Nutria and invasion by *Phragmites*. The watershed also contains reference communities for two additional community types of regularly flooded, brackish marshes. One type is dominated by *Spartina alternaflora* (Smooth cordgrass) and the other is dominated by *Juncus roemerianus* (Black needlerush).

Reference communities for certain vegetative communities of tidal shrub and tidal forested wetlands are also found in the watershed. These include the regularly flooded, *Morella cerifera/Rosa palustris* (Wax myrtle/Swamp rose) slightly brackish community type along Hughs Dam Creek, Little Blackwater River, and Pitcher Dam Creek. One of the reference sites, the best example of a particular community type, is the *Morella cerifera/Baccharis halimifolia/Eleocharis fallax* (Wax myrtle/Groundsel tree/Creeping spikerush) tidal wetland on Buttons Creek. This community type is ranked S3: "a designation meaning that this community is rare to uncommon with the number of occurrences typically ranging from 21 to 100 in Maryland" (Harrison and Stango, 2003).

A reference site for a tidal forested wetland community is also found in the watershed. The community is dominated by *Pinus taeda/Morella cerifera/Spartina patens* (Loblolly pine/Wax myrtle/Saltmeadow cordgrass). There is some uncertainty regarding the long term stability of this community type, as it may represent a transitional community due to reflecting changes from sea level rise (Harrison et al., 2004).

There are several Nontidal Wetlands of Special State Concern and one potential WSSC in the Dorchester County portion of this watershed.

- *Gum Swamp (DNR name: Upper Blackwater River)*. This site is partially protected by Blackwater National Wildlife Refuge.
- *Little Blackwater River*. This site is currently unprotected.
- *Savanna Lake and Savanna Lake NHA*. This site contains seasonally inundated and saturated palustrine forest. This wetland is utilized by three bird species In Need of Conservation, one bird species that is State Rare, and possibly an amphibian In Need of Conservation. It is adjacent to Savanna Lake NHA and provides the functions of maintaining hydrology, improving water quality, retaining floodwater, and increasing species diversity in the NHA. As this site acts as a buffer for the NHA, it is very important that it be protected (DNR, 1991). This site is partially protected by Fishing Bay WMA and Chesapeake Forest Land.
- *Upper Blackwater River and Upper Blackwater River NHA*. Only a small portion of this site is partially protected by Blackwater National Wildlife Refuge.
- *Potential WSSC*. There is a potential WSSC along Blackwater Road that is unprotected.

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network..
- Protect WSSCs and buffers.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

Transquaking River (02130308)

Background

There are approximately 69,185 land acres in this watershed (based on MDP 2002 land use GIS data). This is dominated by agriculture (45%) and forest (36%), followed by wetland (18%) and developed land (2%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR. The area closest to Fishing Bay is all classified as wetland.

Some of the Dorchester County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

There are some extensive mapped wetlands (based on DNR and NWI GIS data), with large areas located along the mouths of the Transquaking River, Chicamacomico River, and tributaries. There are additional large wetlands located in the interstream divides and depressions. Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
    - Emergent: 8,398 acres
    - Scrub shrub: 103 acres
    - Forested: 679 acres
    - Unconsolidated shore: 11 acres
- Palustrine
    - Aquatic bed: 1 acres
    - Emergent: 556 acres
    - Scrub shrub: 1,112 acres
    - Forested: 10,465 acres
    - Unconsolidated bottom: 355 acres
    - Farmed: 50 acres
- Total: 21,731 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130308	-0.78	6.15	0	0.19	5.56

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated Use I, recreation contact and protection of aquatic life.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. Since it is a "Priority" Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include a low non-tidal benthic IBI, high historic wetland loss (37,925 acres), high soil erodibility (0.30), and being on the 303(d) List for water quality impairment. Indicators of Category 3 include a high imperiled aquatic species indicator, three migratory fish spawning areas, and a high number of wetland-dependent species.

According to the *2002 Maryland Section 305(b) Water Quality Report*, Transquaking River and tidal tributaries fail to support all designated uses (0.7 $mi.^2$) due to low oxygen from municipal discharge, agricultural runoff, poor tidal flushing, and natural and nonpoint sources. A portion of the nontidal wadeable tributaries (unnamed tributary to Transquaking River; DNR, 2000) fail to support all uses (0.4 mi. fail to support, 26.6 mi. inconclusive) due to poor benthic community from low dissolved oxygen and other unknown sources.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Transquaking River* (tidal); suspended sediment. A TMDL has been completed for nutrients within this waterway.
- *Unnamed tributary to Transquaking River* (021303080597); poor biological community.

The following information was summarized from the MDE document entitled *Total Maximum Daily Loads of Nitrogen and Phosphorus for the Chicamacomico River Dorchester, Maryland*. The Chicamacomico River starts southeast of East New Market

and drains into Transquaking River. Its watershed is 33,017 acres and consists of forest/herbaceous (64%), agriculture (33%), water (2%), and urban (1%) (based on 1997 Maryland Department of Planning data). It is designated as a Use I waterway, but the dissolved oxygen drops below 5.0ug/l and there are algal blooms from high nitrogen and phosphorus. Nutrient sources include: nitrogen – agriculture (60%), forest/herbaceous (36%), atmospheric deposition (3%), and urban (1%); phosphorus – agriculture (80%), forest/herbaceous (17%), atmospheric deposition (2%), and urban (1%). There are no point sources. Water samples show low occasional dissolved oxygen levels (<5.0ug/l) in the lower reaches (between Transquaking River and 3 miles upstream), acceptable dissolved oxygen levels in the middle reaches (3-12 upstream), but low levels of dissolved oxygen (<5.0ug/l) in the upper reaches (12-15 miles upstream). Big Millpond, in the upstream section, has dissolved oxygen levels as low as 2.1ug/l. The TMDL requires a 35% reduction in controllable nitrogen and phosphorus.

The following information is summarized from the 1999 MDE document entitled *Total Maximum Daily Loads of Nitrogen and Phosphorus for the Transquaking River Dorchester County, MD*. The Transquaking River starts south of East New Market and has a drainage area of 70,922 acres. This river flows into Fishing Bay, and then into the Chesapeake Bay. It has low dissolved oxygen and algae blooms. Sources of nutrients are as follows: nitrogen – point sources (40%), agriculture (37%), forest/herbaceous (20%), atmospheric deposition (2%), and urban (1%); phosphorus – agriculture (79%), forest/herbaceous (14%), point sources (4%), atmospheric deposition (3%), and urban (1%). A major point source is Darling International, Inc. Water quality sampling found that the upper reaches are impaired. Chlorophyll a levels are > 50ug/l upstream of 9.3 miles. Dissolved inorganic nitrogen is high above 12.4 miles. Dissolved inorganic phosphorus is high in Higgins Millpond. The TMDL requires a 35% reduction in annual controllable nitrogen and phosphorus.

Of the one MBSS sample taken in this watershed, BIBI was very poor and FIBI was fair.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are many hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), including along many interstream divides. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration. There are additional soils that are not classified as hydric but are “somewhat poorly drained.” Since it may be fairly easy to create wetland hydrology in these soils, wetland creation may be successful here.

This watershed is mostly within the Green Infrastructure network and has many unprotected areas (DNR, 2000-2003). Some land is protected by DNR (Fishing Bay WMA, Chesapeake Forest land, etc.), METs, and TNC (Dorchester Pond Preserve). According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Fishing Bay*. This is an existing ecological greenway that extends from Taylor's Island WMA, through Blackwater National Wildlife Refuge to Fishing Bay WMA (on the southernmost tip of the County). Of the privately-owned land in this greenway, most is wetlands so is somewhat protected through regulations. The greenway then extends north (along the Nanticoke River greenway).
- *Fishing Bay Water Trail*. This existing water trail is within Fishing Bay WMA, one around Guinea Island and the other along Island Creek. These are intended to be wildlife and natural resource-focused recreation.
- *East New Market-Secretary-Hurlock Rail Trail*. This proposed recreational trail would connect East New Market and Hurlock. It could potentially run from Cambridge (in the west) to Federalsburg (within Caroline County).
- *East New Market/Hurlock Loop*. This is a proposed connector trail following Rte. 14 and Rte. 331.

The following information is summarized from the document *Rural Legacy FY 2003: Applications and State Agency Review*. There are two Rural Legacy areas within this County, the Marshyhope section of the Agricultural Security Corridor and the Nanticoke Rural Legacy Area. The Marshyhope Rural Legacy Area is sponsored by Eastern Shore Rural Legacy Sponsor Board and Eastern Shore Land Conservancy, Inc. There are 7,737 acres land in the Rural Legacy area (based on GIS data). Of this area, 2,986 acres are protected. The goal of the protection effort is to preserve agriculture on prime soils and preserve the natural resources, including water quality of Marshyhope Creek and other waters, wetlands, and wildlife habitat. The Nanticoke Rural Legacy Area is in the eastern part of the County, adjacent to the Nanticoke River. It is fragmented by the town of Vienna. Sponsors include The Nature Conservancy, The Conservation Fund, and Dorchester County. Some goals include protecting agriculture, forest, waterway buffers, and a greenbelt around Vienna. This area is 21,000 acres, with 33% already protected. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not always adequate enough to support all of these requests, other programs should consider preservation of these sites.

A partnership of the Nature Conservancy, Maryland Department of Natural Resources, U.S. Fish and Wildlife Service, and the Eastern Shore Land Conservancy has a goal to protect and restore habitat in the Nanticoke - Blackwater watershed in Wicomico and Dorchester Counties. Several thousand acres have been protected through the years. In March 2006, DNR submitted a FWS Section 6 (Endangered Species) Recovery Land Acquisition grant proposal to purchase a conservation easement on 1,429 acres of forest, forested wetland, and farmland in the Little Blackwater River watershed to protect habitat for the Delmarva Fox squirrel.

As part of an ongoing project to classify the vegetative communities in Maryland, DNR created the document entitled *Shrubland Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they categorize nine shrubland tidal wetland communities, including some in Dorchester County. One of the reference sites, the best example of a particular community type, is the *Morella cerifera-Baccharis*

halimifolia/Eleocharis fallax tidal wetland on the Upper Transquaking River. This community type is ranked S3: "a designation meaning that this community is rare to uncommon with the number of occurrences typically ranging from 21 to 100 in Maryland." This site is threatened from invasion by *Phragmites* and Nutria.

During this same project, DNR also created the document entitled *Herbaceous Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they characterized 14 community types, with some being found in this County. Two reference sites, the best example of two particular community types, are *Spartina patens-Distichlis spicata* (Saltmeadow cordgrass-Saltgrass) tidal herbaceous vegetation and *Schoenoplectus americanus-Spartina patens* (Olney bulrush-Saltmeadow cordgrass) tidal herbaceous vegetation in Thorofare Marsh (south of Bestpitch and north of Fishing Bay along the Transquaking River). The first community type was designated S5 "demonstrably secure under present conditions in Maryland" and the second type was designated S4 "secure under present conditions in Maryland." These sites are threatened by Nutria and invasion by *Phragmites*. They are within the Fishing Bay Wildlife Management Area.

There are several Nontidal Wetlands of Special State Concern and one potential WSSC in the Dorchester County portion of this watershed.

- *Big Millpond*. This diverse wetland complex contains a 50-acre pond created from damming the Chicamacomico River. The wetland complex consists of three distinct wetland areas: non-persistent broadleaf vegetative community, persistent emergent plants with a few shrubs, and diverse forested wetlands (DNR, 1991). The pond contains two State Endangered plant species. There is only a narrow forested buffer around the pond. The main threats include agricultural runoff from the surrounding farms to the east and west and physical disturbance to the plants by fisherman. The surrounding landowners should be encouraged to reduce land use activities that create polluted runoff. Forested buffers should be protected around the pond and in the headwaters (Ludwig et al., 1987). This site is currently unprotected.
- *Dorchester Pond*. This 15-acre Delmarva bay is dominated by herbaceous vegetation and contains eight rare plant (seven State Endangered and one State Threatened) and two rare animal species (a amphibian listed as In Need of Conservation and a State Rare bird). The pond has the highest species richness of any other Maryland pond. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species. This site is owned and managed by TNC (DNR, 1991).
- *Messick Pond*. This 5-acre seasonal pond in the headwaters of Chicamacomico River contains five RTE plant species. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species (DNR, 1991). Surveys conducted during different seasons would likely reveal additional rare species. A 120-foot buffer of hardwood forest separates it from the

surrounding farm fields. The main threat is alteration of hydrology through drainage or water withdraw by wells. The wooded buffer should also be protected (Ludwig et al., 1987). This site is currently unprotected.

- *Ocean Gateway Pond*. This seasonal pond contains three rare or uncommon plant species, including two State Endangered plants. Delmarva bays are groundwater fed, being inundated in the winter and spring and drying up during the summer. Many Delmarva bays have been destroyed due to draining and filling for agriculture and development. Delmarva bays provide habitat for rare plant and animal species (DNR, 1991). This site is currently unprotected.
- *Potential WSSC*. There are a few potential WSSC, including east of Big Millpond WSSC (partially protected by DNR-owned Chesapeake Forest Land).

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation.
- Restore/create wetlands designed to remove phosphorus and nitrogen from the Transquaking River and Chicamacomico River.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network.
- Protect WSSC and buffers.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Protect the designated Rural Legacy Area.
- Protect wetlands that function to remove phosphorus and nitrogen from the Transquaking River and Chicamacomico River.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

<u>Honga River (02130401)</u>

Background

There are approximately 23,464 land acres in this watershed (based on MDP 2002 land use GIS data). This is dominated by wetland (52%) and forest (34%), with small amounts of agriculture (8%) and developed land (6%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR.

The majority of this watershed are mapped wetlands (based on DNR and NWI GIS data). Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
    - Emergent: 12,378 acres
    - Scrub shrub: 118 acres

  - Forested: 2,074 acres
  - Unconsolidated shore: 162 acres
- Palustrine
  - Aquatic bed: <1 acres
  - Emergent: 114 acres
  - Scrub shrub: 118 acres
  - Forested: 2,997 acres
  - Unconsolidated bottom: 98 acres
  - Farmed: 10 acres
- Total: 18,070 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130401	-0.42	0	0	0.01	-0.42

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All non-estuarine portions: Use I, recreation contact and protection of aquatic life.
- All estuarine portions: Use II, shellfish harvesting.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include being on the 303(d) List for water quality impairment. Indicators of Category 3 include a migratory fish spawning area and a high number of wetland-dependent species.

According to the *2002 Maryland Section 305(b) Water Quality Report*, a small portion of the Honga River and tributaries fail to support all designated uses (0.1 $mi.^2$ fail, 34.7 $mi.^2$ inconclusive) due to bacteria from industrial discharge.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Honga River* (tidal); nutrients, sedimentation.
- *Back Creek* (021304010446 tidal); fecal coliform.

A Draft TMDL was completed in 2005 for fecal coliform in the restricted shellfish harvesting areas in Back Creek of the Hongo River Basin. The Back Creek restricted shellfish harvesting area has a drainage of 113 acres. The sources of fecal coliform in this area are as follows: wildlife (81%), domestic animals (17%), humans (3%).

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are only a few small spots of hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands). Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

This watershed is entirely within the Green Infrastructure network, with very little protected.

As part of an ongoing project to classify the vegetative communities in Maryland, DNR created the document entitled *Shrubland Tidal Wetland Communities of Maryland's Eastern Shore*. In this document, they categorize nine shrubland tidal wetland communities, including some in Dorchester County. One of the reference sites, the best example of a particular community type, is the *Baccharis halimifolia-Iva frutescens/Panicum virgatum* tidal wetland on Barren Island. This community type is ranked S5: "a designation meaning that this community is demonstrably secure in Maryland under the present conditions." This site is threatened from the invasion by *Phragmites*. Another reference site in the watershed is the *Iva frutescens/Spartina patens* (Marsh elder/Saltmeadow cordgrass) community.

A reference site for a tidal forested wetland community is also found in the watershed. The community is dominated by *Pinus taeda/Morella cerifera/Spartina patens* (Loblolly pine/Wax myrtle/Saltmeadow cordgrass). There is some uncertainty regarding the long term stability of this community type, as it may represent a transitional community due to reflecting changes from sea level rise (Harrison et al., 2004).

There are no designated or proposed Nontidal Wetlands of Special State Concern within this watershed.

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation.
- Restore/create wetlands designed to remove fecal coliform from the water of Back Creek.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network.
- Protect areas that are designated Ecologically Significant Areas.
- Protect wetlands that function to remove fecal coliform from Back Creek.

- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

Little Choptank (02130402)

Background

This watershed has roughly 47,472 land acres (based on MDP 2002 land use GIS data). It is dominated by forest (48%) and agriculture (33%), with smaller amounts of wetland (13%) and developed land (7%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR.

Upper Blackwater River is a designated Natural Heritage Area within this watershed. To get this designation, an area must contain threatened or endangered species and be the best Statewide examples.

The southern portion of this watershed is dominated by mapped wetlands (based on DNR and NWI GIS data). Additional large wetlands are also located along the Little Choptank, tributaries, and in interstream divides. Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
  - Emergent: 6,593 acres
  - Scrub shrub: 126 acres
  - Forested: 1,197 acres
  - Unconsolidated shore: 160 acres
- Palustrine
  - Aquatic bed: 14 acres
  - Emergent: 699 acres
  - Scrub shrub: 1,820 acres
  - Forested: 7,406 acres
  - Unconsolidated bottom: 199 acres
  - Farmed: 126 acres
- Total: 18,338 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130402	-10.34	14.11	3.00	12.72	19.49

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All non-estuarine portions: Use I, recreation contact and protection of aquatic life.
- All estuarine portions: Use II, shellfish harvesting.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. Failing indicators include a low SAV habitat index, high historic wetland loss (47,585 acres), and being on the 303(d) List for water quality impairment.

According to the *2002 Maryland Section 305(b) Water Quality Report*, a portion of the tidal Little Choptank River and tidal tributaries does not fully support all designated uses (28.0 $mi.^2$ fully support, 3.7 $mi.^2$ fail to fully support) due to low dissolved oxygen and bacteria from eutrophication, water from the Bay, poor tidal flushing, and nonpoint sources. Water quality results from the nontidal wadeable tributaries were inconclusive (2.3 mi.).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Little Choptank River* (tidal); nutrients.
- *Church Creek* (021304020452 tidal); fecal coliform.

A TMDL for fecal coliform was completed for Church Creek within the Little Choptank River Basin. Fecal coliform sources were wildlife (83%), human (<1%), pets (14%), and livestock (3%) (MDE, 2004b).

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. Most of the soils that are not mapped wetlands are classified as hydric soils (based on NRCS SSURGO GIS data and NWI/DNR wetlands). Therefore, largest areas are in the northern portion of the watershed, but they are located throughout. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

A wetland restoration/programmatic mitigation project of freshwater marsh is planned for construction in 2006 at Parson's Creek in Blackwater NWR. Partners include MDE, DNR, U.S. Geological Survey (USGS) and USFWS.

This watershed is mostly within the Green Infrastructure network (DNR, 2000-2003) and is mostly unprotected, with the exception of several METs in the northern section, TNC land (Robinson Neck), Federal land (Blackwater NWR) and DNR land (Chesapeake

Forest land and Taylors Island WMA). According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Choptank River Greenway*. This potential ecological corridor following the Choptank River includes sections owned by various groups including Maryland Environmental Trust easement, University of Maryland, County parks, and a country club.
- *Fishing Bay*. This is an existing ecological greenway that extends from Taylor's Island WMA, through Blackwater National Wildlife Refuge to Fishing Bay WMA (on the southernmost tip of the County). Of the privately-owned land in this greenway, most is wetlands, so is somewhat protected through regulations. The greenway then extends north (along the Nanticoke River greenway).

There are three State-designated Nontidal Wetlands of Special State Concern in this watershed (WSSC), as described below.

- *Bar Neck Oxbow*. This site contains a seasonal oxbow pond and a year-round wet pond, harboring a State-Endangered aquatic plant and an uncommon sedge. The year-round wet pond is similar to those created historically by beaver. Now these ponds are fairly rare on the Eastern Shore due to the decline in beaver activity. The oxbow pond was created when the stream changed its course, isolating this channel bend. The water source for the oxbow pond is now runoff and groundwater. Seasonally dry ponds have also become rare due to draining, filling, and other human activity. These seasonal ponds provide unique habitat for RTE species (DNR, 1991). DNR has suggested this site be delisted as a WSSC. This site is partially protected by a MET.
- *Robinson Neck*. This site is mostly protected by TNC Robinson Neck Preserve and Taylors Island WMA.
- *Upper Blackwater River and Upper Blackwater River NHA*. This site is partially protected by Blackwater National Wildlife Refuge.

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation.
- Restore wetlands designed to remove fecal coliform from Church Creek.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network.
- Protect WSSC and buffers.
- Protect additional unprotected areas that are designated Ecologically Significant Areas (there are many in this watershed).
- Protect wetlands that function to remove fecal coliform from Church Creek.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

<u>Lower Choptank (02130403)</u>

Background

The Dorchester County portion of this watershed has roughly 37,893 land acres (based on MDP 2002 land use GIS data). Over half is agriculture (60%), followed by forest (19%), developed land (17%), and wetland (3%). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR. The main developed area is around Cambridge.

Some of the Dorchester County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data), with a fair amount in the eastern portion of this watershed. In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

There are extensive freshwater tidal marshes located along meandering portions or on alluvial deposits along the Choptank River. Some of the regions highest densities of transient and wintering waterfowl are located in the Choptank River (Sipple, 1999).

Tidal marsh portions along the Choptank River, north of Cambridge, have had very large areas of marsh vegetation destroyed due to overly dense muskrat populations. While it changed the vegetative structure, it also resulted in loss of peat (Sipple, 1999).

Relatively small scattered mapped wetlands (based on DNR and NWI GIS data) are located along waterways, interstream divides, and depressions. Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
    - Emergent: 3,459 acres
    - Scrub shrub: 6 acres
    - Forested: 6 acres
    - Unconsolidated shore: 320 acres
- Palustrine
    - Aquatic bed: 5 acres
    - Emergent: 292 acres
    - Scrub shrub: 661 acres
    - Forested: 3,686 acres
    - Unconsolidated bottom: 665 acres
    - Unconsolidated shore: 4 acres
    - Farmed: 32 acres
- Riverine unconsolidated shore: 4 acres
- Total: 9,140 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130403	-14.34	5.53	14.00	11.58	16.77

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a "designated use" in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- Choptank River and tributaries above Bow Knee Point and Wright Wharf: Use I, recreation contact and protection of aquatic life.
- Tred Avon River and tributaries above Easton Point: Use I, recreation contact and protection of aquatic life.
- All non-estuarine portions: Use I, recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

Water Quality

A portion of the wellhead protection area for Hurlock is located in this watershed. Based on the source water assessment, the water supply for the Town of Hurlock is susceptible to nitrates (from agriculture), VOCs, and synthetic organic compounds.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. Failing indicators include high monitored nutrient concentrations, poor SAV habitat index, a low tidal benthic IBI, a low non-tidal benthic IBI, high historic wetland loss (56,918 acres), high percent unforested stream buffer (62%), and being on the 303(d) List for water quality impairment. Indicators of Category 3 include five migratory fish spawning areas.

According to the *2002 Maryland Section 305(b) Water Quality Report*, a portion of the tidal Lower Choptank River and tributaries fail to fully support all designated uses (93.1 $mi.^2$ supports, 33.8 $mi.^2$ fails to support) due to low oxygen, bacteria, and poor benthic community from nonpoint, eutrophication, industrial, and natural sources. Portions of the nontidal wadeable tributaries (i.e. East Branch Bolingbroke Creek subwatershed; MDE, 2000) fail to support all designated uses (3.5 mi. support, 2.3 mi. fail to support, 20.9 mi. inconclusive) due to poor fish and benthic community from siltation, agricultural runoff, bank instability and stream alteration.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Lower Choptank* (tidal); fecal coliform, nutrients, suspended sediments, poor biological community.

- *Unnamed tributary to Trappe Creek* (021304030463 non-tidal in Talbot); poor biological community. This waterway is also impaired by biochemical oxygen demand and phosphorus, but TMDLs have been completed for these pollutants.
- *Tred Avon River* (021304030462 tidal in Talbot); fecal coliform.
- *Tar Creek* (021304030461 tidal in Talbot); fecal coliform.
- *San Domingo Creek* (021304030457 tidal in Talbot); fecal coliform.
- *Jenkins Creek* (021304030458 tidal in Dorchester County); fecal coliform.
- *Indian Creek* (021304030458 tidal in Dorchester County); fecal coliform.
- *Warwick River* (021304030466 tidal in Dorchester County); fecal coliform.
- *Cummings Creek* (021304030455 tidal in Talbot); fecal coliform.
- *Northeast Branch* (021304030455 tidal in Talbot); fecal coliform.
- *Whitehall Creek* (021304030458 tidal in Dorchester County); fecal coliform.
- *Goose Creek* (021304030458 tidal in Dorchester County); fecal coliform.
- *Town Creek*; This waterway is impaired by biochemical oxygen demand, but a TMDL has been completed for this pollutant.
- *Unnamed tributary to Windmill Branch* (021304030464 non-tidal in Talbot); poor biological community.
- *Eastern Branch Bolingbroke Creek* (021304030459 non-tidal in Talbot); poor biological community.
- *Hunting Creek* (021304030471 non-tidal in Caroline); poor biological community.

A TMDL and Water Quality Analysis for fecal coliform were completed for some areas within the lower Choptank basin. The sources of fecal coliform follow:

Waterway	Wildlife %	Humans %	Pets %	Livestock %
San Domingo Creek	26	<1	33	40
Ted Avon River	6	<1	12	83
Tar Creek	1	0	<1	99
Northeast Branch	63	1	12	25

Water quality designations based on fecal coliform were met in Jenkins Creek and Cummings Creek (MDE, 2004c).

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are many hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), with large areas in the western portion of the watershed (around the mouth of the river). Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

This watershed, while not having extensive Green Infrastructure hubs, does have many Green Infrastructure corridors mainly following the Choptank River and tributaries (DNR, 2000-2003). Most of these are unprotected with main exceptions being METs.

According to the Maryland Greenways Commission, existing or proposed greenways include:

- *Cambridge Waterfront*. This is a small waterfront area in Cambridge that includes recreation, open space, and commercial.
- *Choptank River Water Trail*. This existing water trail follows the Choptank River from the mouth of the Choptank upstream to the town of Secretary. There is potential to connect this trail to other potential water trails in the northern Choptank River and Tuckahoe River.
- *Choptank River Greenway*. This potential ecological corridor following the Choptank River includes sections owned by various groups including Maryland Environmental Trust easement, University of Maryland, County parks, and a country club.
- *East New Market-Secretary-Hurlock Rail Trail*. This potential recreational trail would connect East New Market and Hurlock. It could potentially run from Cambridge (in the west) to Federalsburg (within Caroline County).

There is one State designated Nontidal Wetland of Special State Concern within the Dorchester County portion of this watershed. *Cabin Creek Seep* is a sphagnous seep contains a State Endangered plant species, also Federally listed as Threatened. An additional uncommon tree species grows on the upland buffer to the east (DNR, 1991). A youth camp is located to the west. The main threats include any disturbance to the rare plant species including alteration of hydrology/, logging, or physical disturbance by horses or humans (Ludwig et al., 1987). The forested buffer should be protected to reduce runoff from upland farms (DNR, 1991). This site is currently unprotected.

Specific recommendations for restoration:

- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways.
- Restore wetlands designed to remove fecal coliform from San Domingo Creek, Ted Avon River, Tar Creek, and Northeast Branch.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network, especially along waterways.
- Protect WSSC and buffers.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Protect wetlands that function to remove fecal coliform from San Domingo Creek, Ted Avon River, Tar Creek, and Northeast Branch.
- Protect tidal wetlands used as reference sites in DNR's study of wetland vegetative communities (Harrison and Stango, 2003).
- Protect wetlands and streams within the headwaters.

<u>Lower Chesapeake Bay (02139998)</u>

Background

The Dorchester County portion of this watershed has roughly 5,173 land acres, the majority of which is classified as wetlands (based on MDP 2002 land use GIS data). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
    - Emergent: 13,362 acres
    - Scrub shrub: 9 acres
    - Unconsolidated shore: 408 acres
- Palustrine
    - Scrub shrub: 17 acres
    - Forested: 6 acres
    - Unconsolidated bottom: 7 acres
    - Unconsolidated shore: <1 acres
- Total: 13,809 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. For the time period of January 1, 1991 through December 31, 2004, there has been no regulated activity in this watershed (Walbeck, 2005).

Water Quality

The 1998 Clean Water Action Plan classified this watershed as a Category 2 watershed, meeting clean water or natural resource goals.

According to the *2002 Maryland Section 305(b) Water Quality Report*, a portion of the Lower Chesapeake Bay (VA line to the Bay bridge) fails to fully support all designated uses (53.3 $mi.^2$ fully supports, 726 $mi.^2$ fails to supports) due to low oxygen, elevated levels of bacteria, and poor biological communities from sources of non-point and natural eutrophication and deep water.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Lower Chesapeake Bay* (tidal); nutrients, poor biological community.

Restoration/Preservation

Bloodsworth Island and Adam Island are within the Green Infrastructure hub, but are unprotected. These areas should be high priority for protection.

Specific recommendations for protection:

- Protect areas within the Green Infrastructure network.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.