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Background

The following information on physical characteristics of Prince George's County is based on descriptions in the 1967 Prince Georges County Soil Survey. This County is mostly located within the Atlantic Coastal Plain physiographic province, with a small area near Montgomery County located in the Piedmont province. The piedmont portion has gently rolling to hilly terrain with broad, shallow valleys. The northern portion of the Coastal Plain has gently rolling hills with broad valleys, the central portion has nearly level to gently sloping plateaus, and near the Patuxent and Potomac Rivers has plateaus with short steep valleys. Roughly eleven percent of the soils are poorly or very poorly drained. About half of the County drains into the Patuxent River, while the remaining water drains into the Anacostia and other tributaries of the Potomac River. The major streams within this County are slow moving, located in broad valleys, and have large amounts of silt. The southern portions of the Patuxent and Potomac are tidal. The tidal marshes are dominated by grasses and rushes, with some brackish-tolerant shrubs and small trees.

Based on MDP 2002 GIS land use data, Prince George County has 9,562 acres of open water and 309,225 acres of land. The land acres are divided as follows: urban 129,063 acres (42%), agriculture 43,039 acres (14%), forest 131,390 acres (42%), wetlands 3,040 acres (1%) and barren land 2,694 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed in the watershed sections of this document, are preferred.

There are some large concentrations of soil 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 three State-designated 6-digit watersheds and eleven 8-digit watersheds in this County. Patuxent River (021311) includes Patuxent River lower (02131101), Patuxent River middle (02131102), Western Branch (02131103) and Patuxent River upper (02131104); Lower Patuxent River (021401) includes Potomac River middle tidal (02140102), Zekiah Swamp (02140108) and Mattawoman Creek (02140111); Washington Metropolitan (021402) includes Potomac River upper tidal (02140201), Piscataway Creek (02140203), Oxon Creek (02140204), and Anacostia River (02140205).

Streams

The following information is based on the Maryland Tributary Strategies 2004 document entitled *Middle Potomac River Basin Summary*. Maryland's Middle Potomac River basin includes part of Montgomery and Prince George's Counties. This basin has the most percent urban land use of the three Potomac River Basins (55%). Agriculture (16%) and forest (28%) are largely at the northern and southern portions of the River. In 2002, the main nitrogen, phosphorus, and sediment sources within the Middle Potomac River basin were point sources (52%, 17%, and 0% respectively), urban sources (30%, 60%, and 46% respectively), and agriculture (13%, 15%, and 41% respectively). There are two major wastewater treatment plants in this County (Blue Plains and Piscataway) contributing roughly 99% of the total nitrogen and 80% of the total phosphorus load in the Middle Potomac River basin (with Blue Plains contributing the most). Tributary stations sampled in 2000-2002 had total nitrogen status of good to poor, with all sites improving over the period of 1985-2002. Higher nitrogen levels were found in the areas with more agriculture land use (Seneca Creek) and just below DC. Total phosphorus was ranked good to poor (the poor site was Seneca Creek). Phosphorus levels were either improving during the period 1985-2002 or had no trend. Algae abundance was ranked fair to good, but most sites were degrading since 1985. Total suspended solids was ranked fair to good with the trend being improving or no trend. Summer dissolved oxygen levels were good. In 2002, SAV in the downstream sections were all below the SAV goal, except the Mattawoman area. During 1994-2000, benthic monitoring in the tidal freshwater portion found a high abundance, suggesting organic overenrichment.

The Maryland Tributary Strategies document *Lower Potomac River Basin Summary Final Version for 1985-2002 Data: January 31, 2004* describes the basin (an area containing parts of Charles, St. Mary's and Prince George's Counties) as follows. For the entire basin, land use is dominated by forest (60%), followed by agriculture (24%) and urban (16%). In 2002, the main nitrogen, phosphorus, and sediment sources within the Lower Potomac River basin were agriculture (38%, 41%, and 68% respectively) and urban (22%, 34%, and 11% respectively). Point sources also contributed nitrogen and phosphorus (22% and 8%). Mixed open area contributed phosphorus (14%) and forested areas contributed suspended solids (17%). During the period between 1985 and 2002, water quality parameters at the tributary stations did not show a clear pattern based on location. Sites had poor to good total nitrogen levels with all sites having decreased nitrogen since 1985. Sites ranked poor for total nitrogen were at Indian Head and Morgantown Bridge – Route 301. Total phosphorus was poor to good, with some sites improving since 1985. The only site ranked poor was Morgantown Bridge – Route 301. Phosphorus was generally good at the northern Potomac section. Algae was ranked poor to good, with some stations showing a degrading trend since 1985. Total suspended solids were fair to good. During the period 1984 to 2002, of the five sites monitored for SAV abundance, four met SAV goals at least once during that period. In 2002, only Mattawoman Tidal Fresh site exceeded the goal. Benthic community sampling suggested an organic overenrichment in the oligohaline and tidal freshwater Potomac River and pollution (low dissolved oxygen) in the mesohaline Potomac River.

The Maryland Tributary Strategies document *Patuxent River Basin Summary Final Version for 1985-2002 Data: January 29, 2004* describes the Patuxent River Watershed (an area containing parts of St. Mary's, Anne Arundel, Prince George's, Calvert, Charles Howard, Montgomery). As of 1998, some BMP goals for this basin have been met (marine pumpouts, shore erosion, septic connections, and stormwater management retrofits) but some have not been met (controlling erosion and sediment, urban nutrients, septic pumping, enhanced stormwater management, forest practices). The Patuxent River receives water from the Little Patuxent, Middle Patuxent and Patuxent. This watershed has over 100 species of fish. Land use for the entire basin is dominated by forest (44%), followed by urban (30%), and agriculture (26%). About 70% of the houses are on municipal sewage and 81% are on public water. In 2002, the main nitrogen, phosphorus, and sediment sources within the Upper Potomac River basin were point sources (34%, 30%, 0%, respectively), urban (32%, 36%, 28%, respectively), agriculture (21%, 22%, and 55%, respectively). Tributary stations had total nitrogen levels mostly ranked as good and levels were generally improving since 1985. The two sites ranked poor were located at the northern portion (MD Route 97 and MD Route 4). Total phosphorus, total suspended solids, and algae were ranked poor to good, with most stations improving for phosphorus but not as much for the other parameters. Stations ranked poor were located in the middle portion of the river. Of the three sites sampled for SAV abundance, two (the upper and middle portion of the river) exceeded SAV goals during the period between 1984 and 2002.

Wetlands

Wetland Classification

The largest mapped wetland systems (based on DNR and NWI GIS data) are along the major waterways. According to Tiner and Burke (1995), in 1981-1982 there were 19,516 acres of wetlands (3.3% of the State's total). The wetland types were Estuarine (2,019 acres), Palustrine (17,309 acres), Riverine (174 acres), and Lacustrine (14 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 53%, or 22,131 acre, loss (MDE, 2002).

A 1992 study by the U.S. Fish and Wildlife Service (Tiner and Foulis) found that over 122 acres of vegetated nontidal wetlands were converted to upland from 1981 to 1988-89. Most of the wetlands that were lost were forested, temporarily flooded wetlands. Most losses were due to road and highway construction, development, and mining. There were over 34 acres of vegetated wetlands gained during this time period, primarily from emergent wetlands in new pond areas. There were also over 60 acres of wetlands that were altered by beaver activity, most of which resulted in the wetlands become wetter and changing from one dominat vegetation class to another. A small amount of wetland acreage was created from uplands due to beaver activity.

Nontidal wetland hydrology is supported by groundwater discharge, overbank flooding, or a combination of both sources. In some areas, increases in surface runoff has resulted

in the downcutting of stream channels, resulting in less frequent overbank flooding and less water to the wetland. Nontidal wetlands are primarily forested.

Isolated wetlands are also found in depressions in the County. Hydrology of these wetlands may be from impervious layers that impede infiltration, surface runoff, or groundwater seeps. Isolated wetlands may exist as vernal pools. Vernal pools are often seasonal ponds that dry up every year, or may be dry only in drought years. They may or may not be nontidal wetlands under State law, depending on the presence of vegetation, and extent and duration of ponding. Vernal pools are critical habitat for amphibians and certain invertebrates.

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.
    - 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.
        - 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).

This same 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). Prince Georges County had 2,801 acres of vegetated tidally-influenced wetlands (excluding SAV). A large amount of vegetated wetland is fresh marsh. There are smaller amounts of brackish high and low marsh, and shrub and wooded swamp. Due to the higher stress associated with higher salinity levels, brackish marsh often has lower species richness and species diversity than fresh tidal marsh. Brackish marsh may also have quite distinct plant zonation patterns.

There is a reference shrubland community dominated by *Alnus serrulata/Viburnum recognitum/.Impatiens capensis* (Smooth alder/Northern arrowwood/Jewelweed). The vegetative community is a daily inundated, freshwater system 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).

Table 1. Tidal wetland acreage within Prince Georges 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	263
	Red maple/Ash	40
Swamp forest *(fresh except pine, which is often brackish)*	Bald cypress	0
	Red maple/Ash	80
	Loblolly pine	0
Fresh marsh	Smartweed/Rice cutgrass	740
	Spatterdock	141
	Pickerelweed/Arrow arum	20
	Sweetflag	3
	Cattail	421
	Rosemallow	8
	Wildrice	105
	Bulrush	78
	Big cordgrass	108
	Common reed	183
Brackish High Marsh	Meadow cordgrass/Spikegrass	22
	Marshelder/Groundselbush	2
	Needlerush	0
	Cattail	171
	Rosemallow	0
	Switchgrass	0
	Threesquare	126
	Big cordgrass	274
	Common reed	8
Brackish Low Marsh	Smooth cordgrass	8
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	0

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.

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.

Storm surge protection is probably performed less effectively by wetlands in Prince George's County than at sites with broader expanses of tidal wetlands.

While isolated wetlands would not directly attenuate floodwaters, they may still intercept and hold surface runoff, reducing the amount of excess runoff that enters streams.

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.

Several wetlands have been created in retrofit projects for water quality improvement.

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). .

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.

Wildlife Habitat/Biodiversity

Wetlands provide important habitat for fish, wildlife, and plant species, including rare species. There are numerous vernal pool areas in the Patuxent Research Reserve and

Beltsville Agricultural Research Center. Vernal pools may be considered as seasonal ponds that dry up every year, or may be dry only in drought years. They may or may not be nontidal wetlands under State law, depending on the presence of vegetation, and extent and duration of ponding. Vernal pools are critical habitat for amphibians and certain invertebrates.

Wetland Restoration Considerations

Hydric soils suggest where wetlands are currently or were historically. There is a fair amount of hydric soil that is not mapped wetlands (based on MDP Natural Soil Groups GIS data and NWI/DNR wetlands) mostly occurring along waterways. There is a large area around U.S. Military Reservation Brandywine Communication Site. 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.).

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 adjacent to Scenic Rivers and 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 source water assessment found that community water systems in the County, withdrawing from confined aquifers, are not susceptible to land use contaminants, but are susceptible to naturally occurring radon.

Many portions of Prince Georges County (and Anne Arundel County) are underlain by sulfidic material at some depth. This material is found in many geologic formations in the County, so the location is hard to predict (Davis, 2005). Sulfidic material historically formed in soils that were continuously saturated, generally by brackish water. While they often occur in coastal marshes, near the mouths of the rivers, they may also occur in freshwater marshes. Upland areas may have buried sulfidic materials that formed in the past. While these materials are often deeper than in lower landscape positions, highly disturbed upland areas may have sulfidic material close to the surface. Two known locations where there are concentrations of sulfidic material near the surface include Crofton and Bowie. When these soils are exposed to aerobic conditions, sulfuric acid is formed and the pH drops significantly, even to below 3 (Davis, 1999). While they do often correlate with glauconite in the soil, they are not always found together. Since we will likely not be excavating very deeply for a wetland creation/restoration project and no good map exists of the location of sulfidic material present near the surface, soil borings should be taken before the wetland is excavated. Absence of sulfidic material should be verified before construction begins, using the identification fact sheet for sulfidic material. If sulfidic material does exist, a two foot depth soil buffer should be kept between the bottom of the excavation and the sulfidic material (Davis, 2005).

A WRAS has been completed for both the Upper Patuxent River watershed and Western Branch watershed. A WRAS for the Anacostia River is currently underway. The following studies have also been conducted (Prince Georges County, 2005):

- Anacostia River Basin Stormwater Retrofit Inventory study in 1989
- Beaverdam Creek Watershed study
- Oxon Run Watershed Water Quality and Stream Restoration Study
- Indian Creek and Paint Branch Water Quality and Stream Restoration Study (completed in 1996)
- Western Branch Study

The Prince George's County General Plan (MNCPPC, 2002) divides the County into three tiers: the developed tier, developing tier, and the rural tier. The developed tier is densest along the Washington, DC border, near the Capital Beltway. Environmental goals for this area are to preserve and restore sensitive features and provide open space. Since this area is highly urbanized, environmental features will often include innovative designs and technologies. The developing tier, within the middle section of the County, is where future development should be focused. Since many forests, streams, floodplains, and wetlands exist in this area, they are important parts of the area and can provide recreational opportunities for the community. Environmental preservation and enhancement is important in this area. The rural tier, in the eastern and southern portions of the County, should remain rural (including the watersheds Patuxent River, Potomac River, and Mattawoman Creek). Preservation/enhancement of the remaining environmentally significant areas, including the large amounts of woodland, wildlife habitat, and recreation should be a high priority. Additionally, agricultural preservation is also important here.

This plan made the following environmentally-related recommendations:

- Protect and enhance/restore areas within the Green Infrastructure
- Protect/restore ecological functions (including aquatic living resources)
- Protect and enhance water quality within each watershed
- Meet or exceed forest/tree cover goals, reduce forest fragmentation, and preserve mature forests
- Encourage environmental awareness
- Continue property acquisition or easements along key stream valleys
- Control flooding and reduce flood-related property damage

Other Relevant Programs

Green Infrastructure

DNR State-designated Green Infrastructure
Green Infrastructure hubs and corridors are scattered throughout the County, with main hubs located along the Patuxent River (including Patuxent Wildlife Research Center, Patuxent River Park, Merkle Wildlife Management Area, Bowen WMA), along Mattawoman Creek, Piscataway Creek, U.S. Military Reservation, and Cedarville State Forest. Areas within the Green Infrastructure network that are currently unprotected

should be protected. There are also sections of Green Infrastructure considered to be "gaps," currently in development, agriculture, or barren land. 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.

Prince George's Countywide Green Infrastructure Plan
The following is a summary from the 2005 MNCPPC document entitled *Approved Countywide Green Infrastructure Plan*. This plan has identified a contiguous network of environmentally sensitive areas in the County and set forth management goals and strategies to preserve, protect and enhance them by 2025. Under this plan, the Green Infrastructure network encompasses the County's most significant natural resource lands including streams, wetlands, buffers, 100-year floodplains, severe slopes, Interior Forest, colonial waterbird nesting sites, and unique habitats. This system of resources currently comprises approximately 168,000 acres, or 54% of the County. Of this, 33% is publicly-owned and 67% is privately-owned.

Under this plan, the Green Infrastructure network classifies these land resources into three groups: regulated areas, evaluation areas, and network gaps.

- Regulated areas include environmentally sensitive features, such as streams, wetlands, 100-year floodplains, severe slopes and their associated buffers that are protected during the land development process. These areas comprise 32% of the mapped Green Infrastructure network.
- Evaluation areas include features such as Interior Forests, colonial waterbird nesting sites, and unique habitats that are not protected during the land development process. These areas comprise 52% of the mapped GI network.
- Network gaps include areas that are critical to the connection of regulated and evaluation areas. These areas are suggested for evaluation of restoration opportunities to enhance ecological functioning of the network. They comprise 16% of the mapped GI network.

The plan also identifies special conservation areas, which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include:

- Beltsville Agricultural Research Center – 7,000 acres
- Patuxent Research Refuge – 12,750 acres
- Greenbelt National Park – 1,100 acres
- Main Stem of the Anacostia River
- Belt Woods
- Suitland Bog – 60 acres of unique wetland habitat
- Patuxent River Corridor – 6,000 acres of marshes, swamps, and woodland
- Jug Bay complex: Jug Bay Natural Area of the Patuxent River Park and the Merkle Wildlife Sanctuary – 4,000 acres of marshland, woodland, and farm ponds
- Piscataway Park – 4,600 acres of forests, fields and wetlands

- Mattawoman Creek Stream Valley - unknown acreage of streams and wetlands
- Cedarville State Forest and Zekiah Watershed – 3,510 and 77,000 acres respectively watershed complex comprising of forest, shrub swamps, wetlands, open beaver ponds, and shallow pools

The management goals for these areas as they are outlined in the GI plan include:

- Preserving, enhancing, and restoring these environmentally sensitive features.
- Implementing desired development pattern throughout the County while protecting these sensitive areas.
- Restoring and enhancing water quality in areas that have been degraded by a high percentage of impervious surfaces, and preserving water quality in areas not degraded.
- Preserving some portions of the County from future development.

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 is a State-designated Natural Heritage Areas (NHA), called Upper Patuxent Marshes, located in the watersheds Patuxent River Middle and Western Branch. 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

Designated Rural Legacy land is located on the eastern portion of the County (along the Patuxent River). For detailed information about the program, refer to the individual watershed section.

Priority Funding Areas

Priority Funding Areas are focused in the northwest, and encompass a large portion of the County. Most of the southeast is excluded from PFAs.

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.

Agricultural Easements

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.

Patuxent River lower (02131101)

Background

Based on MDP 2002 GIS land use data, the Prince Georges County portion of the Patuxent River lower watershed has 1,981 acres of open water and 31,121 acres of land. The land acres are divided as follows: urban 3,809 acres (12%), agriculture 9,213 acres (30%), forest 16,509 acres (53%), wetlands 1,436 acres (5%) and barren land 155 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

Fresh tidal marsh are located along meandering portions along the Patuxent River. It likely took hundreds or thousands of years to create these wetlands. The tidal portion extends from Queen Anne's Bridge in Anne Arundel County to the discharge into the Chesapeake Bay, roughly forty-five miles. The freshwater tidal marsh section runs from Ferry Landing (in Calvert) to Waysons Corner (in Anne Arundel). Between Ferry Point and Cocktown Creek, there is a transition zone with fresh and brackish. South of Cocktown Creek is brackish marsh. It is believed that the Patuxent River was historically wider and deeper, but due to agricultural sedimentation in the 18th and 19th centuries, this open water converted into low marsh and eventually high marsh. It is also believed that common reed has been spreading along the Patuxent River, near Mataponi Creek, due to the heavy sedimentation occurring there. The common reed in the freshwater tidal marshes has replaced the once prevalent stands of wildrice. As of the early 1980s,

wildrice was still abundant around Ferry Point and between a mile below MD Rte. 4 and the southern end of Jug Bay (Sipple, 1999).

The Patuxent River was designated as a Scenic River by the Maryland General Assembly. The following is a summary from a document entitled *Patuxent River Policy plan: An update for 1984 to 1997.* The Patuxent River Commission supports, coordinates, and implements programs, policies, and projects of the Patuxent River. Among the management plans proposed for the Patuxent River include:

- Establishment of "a primary management area" delineating the area along the river and its tributaries to identify and manage land from which pollution is most likely to be transported into the river.
    - Prince George's County has established the Patuxent River Management Area, with criteria for stream and wetland buffers within the Patuxent watershed.
    - Montgomery County has adopted a master plan for Patuxent River, with guidelines for the protection of steep slopes, wetlands, reservoirs, and other sensitive areas in the Patuxent River watershed.
- Implementation of a comprehensive watershed management approach to control all sources of pollution and resource degradation.
- Continued restoration, improvement, and protection of the habitat functions of aquatic and terrestrial living resources. These include:
    - Riparian forest - to stabilize stream banks.
    - Stream quality - to improve spawning ranges.
    - Wetlands -protection and restoration.
    - Forest land - to enhance contiguous tracts of forest.
    - Submerged aquatic vegetation and tidal marsh.
    - Concentrating new development in and around existing developed areas and population centers while protecting the rural and agricultural landscape.
    - Enhancing the environmental quality and community design in new and existing communities.
    - Developing a sense of stewardship for the Patuxent River and its watershed through increased public education and participation programs.
    - Funding to support and meet the above plans.

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

- Estuarine
    - Emergent: 4,372 acres
    - Scrub shrub: 89 acres
    - Forested: 10 acres
    - Unconsolidated shore: 125 acres
- Palustrine
    - Aquatic bed: 73 acres

  - Emergent: 605 acres
  - Scrub shrub: 1,040 acres
  - Forested: 7,619 acres
  - Unconsolidated bottom: 687 acres
  - Unconsolidated shore: 7 acres
  - Farmed: 79 acres
- Total: 14,707 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 loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02131101	-11.56	9.98	0	0.15	-1.43

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. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows - Use II: Shellfish harvesting; all estuarine portions and tributaries.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource 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 low SAV abundance and habitat index, poor tidal and non-tidal benthic index of biological integrity (BIBI), poor non-tidal instream habitat index, and high amount historic wetland loss (42,599 acres). Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning area, high number of wetland-dependent species, high amount of headwater streams in Interior Forest, and high percent of the watershed being forested.

According to the 2002 305(b) report, a portion of the nontidal mainstem and tributaries fail to support all designated uses due to pesticides, nutrients, low oxygen, and bacteria from nonpoint sources, failing septics, natural sources (poor tidal flushing), eutrophication, and other sources. The nontidal, wadeable tributaries do support all designated uses. Lake Lariat does not support all designated uses due to Hg in fish due to atmospheric deposition and other 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:

- *Patuxent River lower* (tidal); fecal coliform, poor biological community, sediments, nutrients, chlorpyrifos (in water).
- *Mill Creek* (tidal); fecal coliform.
- *Mill Creek* (021311010884 tidal in Calvert County); fecal coliform.
- *Solomons Island Harbor* (021311010873 tidal in Calvert County); fecal coliform.
- *Harper and Parson Creeks* (021311010871 tidal in St. Mary's County); fecal coliform.
- *Goose Creek* (021311010871 tidal); fecal coliform.
- *Indian Creek* (021311010887 tidal in St. Mary's/Charles County); fecal coliform.
- *Town Creek* (021311010872 tidal in St. Mary's County); fecal coliform.
- *St. Thomas Creek* (021311010877 tidal in St. Mary's County); fecal coliform.
- *Island Creek* (021311010878 tidal in Calvert County); fecal coliform.
- *Washington Creek* (021311010884 tidal in St. Mary's County); fecal coliform.
- *Persimmons Creek* (021311010884 tidal in St. Mary's County); fecal coliform.
- *Battle Creek* (021311010879 tidal in Calvert County); fecal coliform.
- *Buzzard Island Creek* (021311010882 tidal); fecal coliform.
- *Buzzard Island Creek* (021311010882 non-tidal in Calvert County); poor biological community.
- *Summerville Creek Unnamed Tributary* (021311010894 non-tidal in Prince Georges County); poor biological community.
- *Fowler's Mill Branch* (021311010902 non-tidal in Calvert County); poor biological community.
- *Cuckold Creek* (021311010874 non-tidal in St. Mary's County); fecal coliform, poor biological community.
- *Swanson Creek* (021311010890 non-tidal in Prince Georges County); poor biological community.
- *Patuxent River Unnamed Tributary* (021311010895 non-tidal in Calvert County); poor biological community.
- *Cocktown Creek Unnamed Tributary* (021311010896 non-tidal in Calvert County); poor biological community.
- *Chew Creek* (021311010899 non-tidal in Calvert County); poor biological community.
- *Hall Creek* (021311010902 non-tidal in Anne Arundel County); poor biological community.

Multiple subbasins within this watershed are impaired by a April 7, 2000 PEPCO oil spill. Impaired areas include Swanson, Washington, Trent Hall, Persimmon, Indian, and Cremona Creeks, and Golden Beach. A TMDL is not required for these contaminants since other controls will results in water quality designation attainment.

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated fair in subwatersheds Black Swamp Creek, Spice Creek, and Swanson Creek and was rated poor in subwatershed Lower Patuxent River. Habitat was rated fair in subwatershed Black Swamp Creek, poor in Spice Creek and Swanson Creek, and very poor in Lower Patuxent River (MNCPPC, 2005).

Restoration/Preservation

A large portion of this watershed is State-designated Green Infrastructure, with a large hub along the Patuxent River (including Patuxent River Park) (DNR, 2000-3003). Some of this network is protected by Bowen WMA, Patuxent River NRMA, Full Mill Branch NRMA, Spice Creek NRMA, County-owned Patuxent River Park, and a MET. There are still some unprotected GI areas along the Patuxent River and throughout the watershed that should be high priority for protection. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Mattawoman Creek*.
- *Patuxent Regional Greenway*
- *Patuxent River Water Trail.*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. One of these areas is the Patuxent River Corridor – 6,000 acres of marshes, swamps, and woodland.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. The Patuxent River Rural Legacy Area contains approximately 34,984 acres. This area is currently largely undeveloped (86%). This area was chosen in order to protect a contiguous area along the Patuxent River including wildlife corridors, recreational areas, agriculture, forest, wetlands and other natural resources. The goal is to protect 10,000 acres (29%). Currently, 11,640 acres (33%) of this land is protected through various methods. The sponsors are Prince George's County. 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 adequate enough to support all of these requests, other programs should consider preservation of these sites.

There is one State-designated Nontidal Wetland of Special State Concern located within the Prince Georges County portion of this watershed: Magruder Ferry Seep (DNR name: Middle Patuxent Marshes). This area adjacent to the Patuxent River and is protected by the County-owned Patuxent River Park.

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
    - Restoration recommendations from the *Patuxent River Policy plan: An update for 1984 to 1997*:
        - Riparian forest - to stabilize stream banks.
        - Stream quality - to improve spawning ranges.

- Wetlands and SAV.
- Forest land - to enhance contiguous tracts of forest.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the Patuxent River and tributaries.
- Protect land within designated Rural Legacy area.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect the Scenic Patuxent River.

Patuxent River Middle (02131102)

Background

The Patuxent River Middle watershed is located in Anne Arundel, Prince George's, and Calvert Counties. We are basing our 8-digit watershed calculations on the most recent DNR 8-digit watershed delineation, having different borders for this watershed than the previous version. Based on MDP 2002 GIS land use data, the Prince Georges County portion of the Patuxent River middle watershed has 682 acres of open water and 23,067 acres of land. The land acres are divided as follows: urban 4,017 acres (17%), agriculture 6,185 acres (27%), forest 11,877 acres (51%), wetlands 908 acres (4%) and barren land 80 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

Fresh tidal marsh are located along meandering portions of the Patuxent River. It likely took hundreds or thousands of years to create these wetlands. The tidal portion extends from Queen Anne's Bridge in Anne Arundel County to the discharge into the Chesapeake Bay, roughly forty-five miles. The freshwater tidal marsh section runs from Ferry Landing (in Calvert) to Waysons Corner (in Anne Arundel). Between Ferry Point and Cocktown Creek, there is a transition zone with fresh and brackish. South of Cocktown Creek is brackish marsh. It is believed that the Patuxent River was historically wider and deeper, but due to agricultural sedimentation in the 18th and 19th centuries, this open water converted into low marsh and eventually high marsh. It is also believed that common reed has been spreading along the Patuxent River, near Mataponi Creek, due to the heavy sedimentation occurring there. The common reed in the freshwater tidal marshes has replaced the once prevalent stands of wildrice. As of the early 1980s, wildrice was still abundant around Ferry Point and between a mile below MD Rte. 4 and the southern end of Jug Bay (Sipple, 1999).

The Patuxent River was designated as a Scenic River by the Maryland General Assembly. The following is a summary from a document entitled *Patuxent River Policy plan: An update for 1984 to 1997*. The Patuxent River Commission supports, coordinates, and implements programs, policies, and projects of the Patuxent River. Among the managements plans proposed for the Patuxent River include:

- Establishment of "a primary management area" delineating the area along the river and its tributaries to identify and manage land from which pollution is most likely to be transported into the river.
    - Prince George's County has established the Patuxent River Management Area, with criteria for stream and wetland buffers within the Patuxent watershed.
    - Montgomery County has adopted a master plan for Patuxent River, with guidelines for the protection of steep slopes, wetlands, reservoirs, and other sensitive areas in the Patuxent River watershed.
- Implementation of a comprehensive watershed management approach to control all sources of pollution and resource degradation.
- Continued restoration, improvement, and protection of the habitat functions of aquatic and terrestrial living resources. These include:
    - Riparian forest - to stabilize stream banks.
    - Stream quality - to improve spawning ranges.
    - Wetlands - protection and restoration.
    - Forest land - to enhance contiguous tracts of forest.
    - Submerged aquatic vegetation and tidal marsh.
    - Concentrating new development in and around existing developed areas and population centers while protecting the rural and agricultural landscape.
    - Enhancing the environmental quality and community design in new and existing communities.
    - Developing a sense of stewardship for the Patuxent River and its watershed through increased public education and participation programs.
    - Funding to support and meet the above plans.

Extensive forest, wetlands, and streams are found in the Jug Bay Wetlands Sanctuary in Anne Arundel County and managed by the County, State-owned Patuxent River Park, Patuxent Natural Resources Management Areas, and Merkle Wildlife Sanctuary in Prince George's County. The State lands are collectively known as the Patuxent Watershed Park. The Merkle Wildlife Sanctuary is particularly noted as a wintering area for Canada geese.

Jug Bay is also a part of the National Estuarine Research Reserve. Based on the web site, Maryland Department of Natural Resources describes it like this:

> As a body of water, Jug Bay is something of an anomaly, appearing to be an appendage on a bend in the river. Jug Bay's 350 acres are very shallow - only about a foot deep beyond the river channel. The valley through which the Patuxent flows is actually no wider than the valley immediately upstream or downstream, but it has spread out over its floodplain, a marsh nestled between low river terraces. These sandy, gravelly terraces rise 20 to 50 feet above the present river level, remnants of an earlier floodplain formed before the last North American ice age. As huge ice sheets extended out of Canada southward as far as

> Pennsylvania and New Jersey, the sea level dropped roughly 350 feet below today's level. In response, the Patuxent River gradually cut down through its floodplain to reach the sea. Parts of that old, higher floodplain were left behind in the form of the terraces we see today. With the retreat of the continental ice sheets, the sea rose to its present level, and the river switched from downcutting to meandering, flooding the level lands beyond its channel to leave us with the present landscape (DNR, 2005).

The Upper Patuxent Marshes 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.

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 Anne Arundel County. One of the reference sites, the best example of a particular community type, is the *Salix nigra* tidal wetland on the Upper Patuxent River (south of Mill Creek and north of Jug Bay). This site is owned by The Nature Conservancy.

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

- Estuarine
  - Emergent: 1,225 acres
  - Scrub shrub: 13 acres
  - Unconsolidated shore: 17 acres
- Palustrine
  - Aquatic bed: 12 acres
  - Emergent: 343 acres
  - Scrub shrub: 347 acres
  - Forested: 2,400 acres
  - Unconsolidated bottom: 274 acres
  - Unconsolidated shore: 18 acre
  - Farmed: 10 acres
- Total: 4,658 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)
02131102	-3.11	3.77	9.00	0	9.66

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. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Use II: Shellfish harvesting; All estuarine portions of tributaries except Patuxent River and tributaries Above Ferry Landing

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource 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 high levels of the nutrients phosphorus and nitrogen, low SAV abundance and habitat index, poor benthic index of biological integrity (BIBI), poor instream habitat index, high population density, and high soil erodibility (0.29). Wetland loss was estimated to be 7,648 acres. Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning area, and high presence of wetland dependant species.

The 2002 305(b) report indicates that 0.1 square mile of the tidal mainstem and tidal tributaries meets designated uses. An additional 1.1 square mile of tidal mainstem and tributaries failed to meet all designated uses due to pesticides, low oxygen, and bacteria from natural conditions and unknown sources. In nontidal, wadeable tributaries, 44.8 miles of waters were found to meet all designated uses. Results were inconclusive for an additional 66.5 miles of nontidal, wadeable tributaries. (DNR, 2002). The 2000 305(b) report noted bank stability as a site-specific habitat issue that might affect the aquatic community.

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:

- *Patuxent River middle* (tidal); nutrients, sediments, chlorpyrifos (in water and sediment).
- *Swan Point Creek* (021311020908 non-tidal in Prince Georges County); poor biological community.
- *Swan Point Creek Unnamed Tributary* (021311020908 non-tidal); poor biological community.
- *District Branch* (021311020917 non-tidal in Prince Georges County); poor biological community.
- *Ferry Branch* (021311020915 non-tidal in Anne Arundel County); poor biological community.
- *Patuxent River Unnamed Tributary* (021311020915 non-tidal); poor biological community.

- *Patuxent River Unnamed Tributary* (021311020914 non-tidal in Anne Arundel County); poor biological community.
- *Pindell Branch* (021311020908 non-tidal); poor biological community.
- *Cabin Branch* (021311020906 non-tidal in Anne Arundel County); poor biological community.
- *Deep Creek* (021311020908 non-tidal in Anne Arundel County); poor biological community.
- *Lyons Creek* (021311020910 non-tidal in Anne Arundel/Calvert Counties); poor biological community.

Multiple subbasins within this watershed are impaired by a April 7, 2000 PEPCO oil spill. Impaired areas include Craney Creek and Buena Vista. A TMDL is not required for these contaminants since other controls will results in water quality designation attainment.

The Maryland Biological Stream Survey sampled 13 sites in Anne Arundel County in 2000-2002, and seven sites in Anne Arundel, Prince George's, and Calvert County in 1995-1997. Index scores for fish and benthic communities were generally poor or fair, with marginal or sub-optimal instream habitat scores. Only two sites, Lyons Creek in Calvert County and an unnamed tributary to Mataponi Creek in Prince George's County, received scores in the "good" range for fish and benthic communities. Other sampled streams included Deep Creek, Mataponi Creek, Charles Branch, Ferry Branch, tributaries to the Patuxent River, Pindell Branch, Cabin Branch, Swan Point Creek, and Southwest Branch. Common fish species included Blacknose dace, Rosyside dace, Eastern mudminnow, Tesselated darter, American eel, Bluegill, Least Brook lamprey, and Pumpkinseed.

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated poor. Habitat was rated poor in subwatershed Mattaponi Creek and very poor in subwatershed Middle Patuxent River (MNCPPC, 2005).

During 1985-2002, the Patuxent River watershed showed improvements in water quality by reductions in total nitrogen and total phosphorus concentrations at most sample points in the mainstem of the river. During the same period, abundance of algae increased at four of twelve sample points while the remainder of sites showed no trend. The total suspended solids increased at one site during 1985-2002 at one sample point (Jackson Landing), while at thirteen other sites there was no trend or a decrease in total suspended solids. Changes to water clarity showed no trend or a decline during the same period at ten sample sites (BST and CBP, 2004c).

Restoration/Preservation

Jug Bay and an adjacent extensive upstream and downstream wetland areas were also designated as an Area of Critical State Concern in 1981. Jug Bay follows the shorelines of the Patuxent in Prince Georges and Anne Arundel Counties and includes tidal wetlands, non-tidal wetlands and a buffer area. Jug Bay and surrounding wetlands contains some of the largest freshwater marshes in Maryland, and provides habitat for

abundant plants and animals. This system is within the Atlantic Flyway so is important to over 100 bird species, waterfowl, 16 species of breeding and wintering ducks, and the bald eagle and peregrine falcon. This site is important for anadromous fish spawning, This area is also the farthest good upriver area for anadromous fish spawning. Species include small-mouth bass, yellow perch, crappie, catfish, and white perch. A dominant plant species is wild rice, which is a good food source for many birds. Due to the relatively undisturbed natural State of this system, it has been used as a reference wetland in several research studies (Neff, 2000). These systems have also been studied to see the impacts of the Canada goose population on the vegetative community, including on the wild rice (MDP, 1981). As with many wetlands in the region, research is revealing that Canada goose grazing is negatively impacting the vegetative community. Jug Bay, upstream and downstream wetlands are also designated as the Upper Patuxent Marshes Natural Heritage Area, both as a Nontidal Wetlands of Special State Concern and a Natural Heritage Area (Anne Arundel County, 2004). The area is also part of Green Infrastructure as the Patuxent Regional Greenway, an ecological greenway through parts of Howard, Montgomery, Anne Arundel, Calvert, Charles, Prince George's, and St. Mary's Counties (MD Greenways Commission, 2000).

The area has received numerous designations due to its wetland and habitat resources. A portion of the Jug Bay Wetlands Sanctuary in Anne Arundel County and Patuxent River Park in Prince George's County have been part of the Chesapeake Bay National Estuarine Research Reserve (CBNERR) since 1990. There are plans to seek designation of the entire Sanctuary as part of the CBNERR in Maryland. The Jug Bay Wetlands Sanctuary was also named a Nationally Important Bird Area by the American Bird Conservancy and the National Audubon Society (Anne Arundel County, 2004; Audubon, 2001). The North Carolina Turtle Reserve also declared the Jug Bay Wetlands Sanctuary an official Turtle Sanctuary in 2000 (Anne Arundel County, 2004). Jug Bay Wetlands Sanctuary also contains several rare, threatened, and endangered plants. These may include the smooth tick trefoil, downy bushclover, downy milk pea, rynchosia, and turtlehead.

Sipple (1999) described the presence of the invasive plant purple loosestrife in freshwater tidal wetlands of Mataponi Creek and Lyon's Creek in the 1980's. Mataponi Creek flows in part through the Merkle Wildlife Sanctuary south of Jug Bay. Sipple also reported the presence of the extirpated southern naiad (*Najas gracillima*), previously thought to be endangered extirpated, along Lyon's Creek and the threatened shoreline sedge (*Carex hyalinolepis*) along Lyon's Creek and Mataponi Creek. The current status of the southern naiad is unknown. *Phragmites* and wildrice were identified as dominant plants in many areas of the freshwater tidal marsh, (Sipple, 1999) but there is concern that *Phragmites* is spreading.

Hundreds of acres of *Phragmites* in tidal wetlands have been treated with herbicides on the Prince George's County portion of Jug Bay, with hopes of increasing the wildrice stands. Eradication of *Phragmites* in the Anne Arundel County Jug Bay Wetlands Sanctuary has been prohibited, due to the benefits provided by *Phragmites* (AA Co, 2004). The Maryland Department of the Environment established a nontidal wetland

mitigation site on the Merkle Wildlife Sanctuary. An extensive wetland creation project for highway mitigation was also completed. The site is now known as Wooton's Landing Park.

A reference site for the forested tidal wetland community of Green Ash-Red Maple/Smartweed (*Fraxinus pennsylvanica-Acer Rubrum/Polygonum spp.)* is found along the Patuxent River. This vegetative community is found at the higher tidal limits. The soils are poorly drained and less saturated than other tidal communities. This site was found to contain the invasive vine species *Lonicera japonica* (honeysuckle) and *Clematis terniflora.*

There are a few Green Infrastructure hubs and corridors in this watershed, including a large GI hub along the Patuxent River. A portion of the GI network is protected by County-owned Patuxent River Park, Merkle NRMA, Cheltenham WMA, a MET, and other County-owned property. There are still some unprotected GI areas along the Patuxent River that should be high priority for protection. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Charles Branch*
- *Chesapeake Beach Rail Trail*
- *Western Branch*
- *Patuxent Regional Greenway*
- *Patuxent River Water Trail*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include:

- Patuxent River Corridor – 6,000 acres of marshes, swamps, and woodland.
- Jug Bay complex: Jug Bay Natural Area of the Patuxent River Park and the Merkle Wildlife Sanctuary – 4,000 acres of marshland, woodland, and farm ponds.

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Patuxent River Rural Legacy Area contains approximately 34,984 acres. This area is currently largely undeveloped (86%). This area was chosen in order to protect a contiguous area along the Patuxent River including wildlife corridors, recreational areas, agriculture, forest, wetlands and other natural resources. The goal is to protect 10,000 acres (29%). Currently, 11,640 acres (33%) of this land is protected through various methods. The sponsors are Prince George's County. 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 adequate enough to support all of these requests, other programs should consider preservation of these sites.

There is one large designated Nontidal Wetlands of Special State Concern located within the Prince Georges County portion of this watershed. Upper Patuxent Marshes NHA is along the Patuxent River, and includes Jug Bay and portions of Charles Branch, Western Branch, and Tavern Branch. It is partially protected by Jug Bay Wetlands Sanctuary, the County-owned Patuxent River Park, and House Creek NRMA. Some significant portions are still unprotected.

Specific restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Jug Bay Wetlands Sanctuary
    - Restore hundreds of acres of wildrice in tidal wetlands (AA CO, 2004)
    - Establish 300 foot buffers of natural vegetation around streams and nontidal wetlands (AA Co, 2004)
    - Control resident Canada geese to protect and restore wild rice stands
    - Manage for environmental research and education, passive recreation
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
    - Restoration recommendations from the *Patuxent River Policy plan: An update for 1984 to 1997*:
        - Riparian forest - to stabilize stream banks.
        - Stream quality - to improve spawning ranges.
        - Wetlands and SAV.
        - Forest land - to enhance contiguous tracts of forest.

Specific protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the Patuxent River and tributaries.
- Protect land within designated Rural Legacy area.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect wetlands used as reference sites in the DNR study of tidal wetland vegetative communities (along the Patuxent River).

<u>Western Branch (02131103)</u>

Background

We are basing our calculations on the most recent DNR 8-digit watershed delineation, having different borders for this watershed than the previous version. Based on MDP 2002 GIS land use data the Western Branch watershed has 328 acres of open water and 71,090 acres of land. The land acres are divided as follows: urban 30,231 acres (43%), agriculture 10,705 acres (15%), forest 29,214 acres (41%), wetlands 234 acres (<1%) and

barren land 706 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

Based on University of Maryland's Regional Earth Science Applications Center data, impervious area is highest in the subwatershed Upper Southwest Branch and Bald Hill and lowest in the Lower Western Branch subwatershed. Prime farmland covers 28% of the area, with some of this area located in the City of Bowie. Hydric soils represent roughly 15% of the area, mostly located along the stream valleys (Shanks, 2003).

The mainstem Western Branch is roughly 20 miles long. The upper nontidal portion is surrounded by urban and forested land use while the lower tidal portion is shallow freshwater marsh. The upper portion has relatively steep gradients with medium to high stream velocities while the lower portion is slow moving. The head of tide is near Route 301. Water depths are 1-2 feet in the headwaters and 3-4 feet in the tidal section (MDE, 1999).

Spawning habitat for herring, white perch, and yellow perch is along the Western Branch, lower Collington Branch, and lower Charles Branch. DNR stocks Western Branch with largemouth bass. Other fish frequently found include striped bass, smallmouth bass, chain pickerel, and bluegill sunfish. Ecologically significant areas follow most of Western Branch, lower Collington Branch, lower Charles Branch, and portions of Northeast Branch. This watershed contains a number of RTE plants or animals, including two fish which are vulnerable to effects of sedimentation in the stream. There are also large concentrations of forest interior dwelling bird species (Shanks, 2003).

Most urban areas within the watershed get public water through the Washington Suburban Sanitary Commission, which gets water from Patuxent River reservoirs and Potomac River intakes. Other areas withdraw from confined aquifers. Since the Aquia aquifer outcrops in this watershed and is the source of water for Southern Maryland and portions of the Eastern Shore, it is vulnerable to contamination and should be protected. The only wastewater treatment plant is Western Branch WWTP.

Upper Patuxent Marshes is a State-designated Natural Heritage Area. To get this designation, an area must contain threatened or endangered species and be the best Statewide example. A portion of Belt Woods Natural Environmental Area (610 acres) is included in the Maryland Wildlands Preservation System, suggesting the protected area has retained its wilderness character and/or contains rare species or habitat.

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

- Estuarine emergent: 198 acre
- Palustrine
    - Aquatic bed: 38 acres
    - Emergent: 246 acres
    - Scrub shrub: 296 acres
    - Forested: 2,071 acres

  - Unconsolidated bottom: 330 acres
  - Unconsolidated shore: 2 acres
  - Farmed: 36 acres
- Total: 3,218 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02131103	-21.45	21.34	0	4.16	4.05

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. Stream segments within this watershed are 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 resource 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 poor SAV abundance and habitat index, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal instream habitat index, high percent impervious surface (18%), high population density, and high soil erodibility (0.31). Wetland loss was estimated to be 10,479 acres. Indicators for Category 3 include high imperiled aquatic species indicator and presence of designated Wildland Acres.

According to the 2002 303(b) report, tidal mainstem and mainstem to Upper Marlboro fully supports all uses. Of the nontidal wadeable tributaries, a portion (9 miles) fails to support all uses due to municipal discharge and habitat alteration, a portion (5 miles) fully supports all uses, and the remainder (91 miles) had inconclusive results.

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

- *Western Branch* (tidal); sediments. A TMDL has been completed for nutrients.
- *Western Branch* (021311030925 non-tidal); poor biological community.
- *Black Branch* (021311030923 non-tidal); sediments, poor biological community.
- *Collington Branch Unnamed Tributary* (021311030927 non-tidal); poor biological community.
- *Collington Branch Unnamed Tributary* (021311030920 non-tidal); poor biological community.

- *Back Branch* (021311030919 non-tidal); poor biological community.
- *Folly Branch* (021311030929 non-tidal); poor biological community.
- *Folly Branch Unnamed Tributary* (021311030929 non-tidal); poor biological community.
- *Northeast Branch Western Branch* (021311030926 non-tidal); poor biological community.
- *Southwest Branch* (021311030922 non-tidal); poor biological community.
- *Southwest Branch Unnamed Tributary* (021311030924 non-tidal); poor biological community.
- *Ritchie Branch* (021311030924 non-tidal); poor biological community.
- *Lottsford Branch* (021311030929 non-tidal); poor biological community.
- *Charles Branch Unnamed Tributary* (021311020912 non-tidal in Prince Georges County); poor biological community.
- *Southwest Branch Charles Branch* (021311020911 non-tidal in Prince Georges County); poor biological community.

A Total Maximum Daily Load was completed for Biochemical Oxygen Demand (BOD) in Western Branch, as summarized here. Point sources are Western Branch WWTP and two smaller discharges of Croom Manor Housing WWTP and PG County Yardwaste Composting Facility. Most nonpoint sources are entering in the upstream portions of the waterway. DO occasionally drops below 5ug/l. Since this waterway is designated Use I, dissolved oxygen below 5ug/l is considered to be an impairment. Low DO and high chlorophyll a levels were occasionally found near the Patuxent confluence during summer months. High nutrients and BOD were found in the upper portions. While these conditions are minor in severity and not frequent, it will likely get worse in the future if things go unchecked. This study determined that BOD, rather than nutrients, is the main cause for the low DO.

There is a Statewide fish consumption advisory for impoundments within this watershed based on methylmercury in some fish species.

During MBSS fish sampling, some fish species considered to be intolerant of poor water quality or habitat were found, suggesting some areas have good conditions. Based on MBSS data, areas possibly in need of protection/enhancement and rated as good for benthics, fish, and/or habitat included: Western Branch (south of Rte. 214), near the confluence of Lottsford and Bald Hill Branches, Southwest Branch (near Rte. 214), and Black Branch (Shanks, 2003).

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated poor in subwatersheds Charles Branch, Western Branch, Collington Branch, and Northeast Branch and was rated very poor in subwatersheds Southwest Branch, Baldhill Branch, Lottsford Branch, and Folly Branch. Habitat was rated poor in subwatersheds Charles Branch, Collington Branch, Northeast Branch, Baldhill Branch, Lottsford Branch, and Folly Branch and very poor in Western Branch and Southwest Branch (MNCPPC, 2005).

Based on water quality sampling at two sites (Upper Marlboro near Water Street and Western Branch near confluence with Patuxent River) from 1995 through 2002, water quality is generally worse at the confluence site (Shanks, 2003)

A nutrient synoptic survey was completed in 2003 for three subwatersheds, Collington Branch, Northeast Branch and Lottsford Branch, as part of the Western Branch watershed WRAS. Nitrate/nitrite concentrations were baseline at all but two sites. One of the moderate nitrate/nitrite readings was found in the Lottsford Branch headwaters, in an areas where large lots may have contained some small agricultural operations. The subwatershed directly below this one also has moderate nitrogen, possibly related to a sod farm. Excessive orthophosphate concentrations were found in two subwatersheds, high in one, and moderate in ten. These elevated levels may have resulted from high spring rains discharging sediment-laden water from stormwater ponds and beaver ponds. Overall, the nutrients in these subwatersheds are not a significant concern. This is often the case in urban/suburban settings. Specific conductivity was elevated at six subwatersheds with intense development, and was likely due to road salt. At peak times and application rates, it may be possible that portions of the receiving stream may be severely impacted by these high salt levels. Benthic macroinvertebrate communities at the 18 sites were poor to very poor. Fish communities at the four samples sites were poor. These impaired biotic communities were attributed to the storm water flows resulting in degraded habitat.

Restoration/Preservation

A WRAS was conducted on this watershed, with the main focus being on using Low Impact Development and Green Building techniques. A Western Branch Study, involving the USACE, MDE, and the County, looked at possible water quality improvement projects, including wetland creation and LID projects (Prince Georges County, 2005).

A stream corridor assessment was competed for subwatersheds Collington Branch, Lottsford Branch, and Northeast Branch, within the larger Western Branch watershed. Crews surveyed about 113 stream miles. Of the 448 potential environmental problems encountered, the majority were pipe outfalls (128 sites) ranked as minor or moderate in severity. Other problems were fish barriers (117 sites), with most occurring in Collington Branch subwatershed and all rated as minor to moderate in severity. Another problem was stream erosion (60 sites), again mainly in Collington Branch subwatershed. While there were sites rated from minor to very severe, the majority was moderate severity. Inadequately vegetated buffers was another common problem (51 sites). Many of these were within Collington Branch subwatershed, with severity ranging from minor to very severe. Other problems included trash dumping, in/near stream construction, exposed pipes, channel alterations, and other conditions.

The USACE completed a study of the subwatershed Bald Hill Branch, Cabin Branch, Southwest Branch, and Western Branch. In this study, they identified possible restoration or mitigation sites for channelized streams, fish blockages, stormwater problems in the stream, wetland loss, and stream buffers with inadequate vegetation. The USACE proposed to build nine of these projects:

- Southwest Branch subwatershed
  - Improve aquatic habitat in three concrete channels
  - Stormwater retrofits in selected areas
- Western Branch mainstem subwatershed – floodplain near Upper Marlboro: restore 5.4 acres of wetlands and restore 6 acres of woodlands.

The City of Bowie is aggressively pursuing conservation initiatives including: green buildings, low-impact development, renewable energy, and conservation landscaping (City of Bowie, 2004). Potential restoration projects are being identified within the City of Bowie, and may include wetland restoration possibilities.

The WRAS strategy for Prince Georges County and the City of Bowie made several recommendations, including the following (Prince Georges County and the City of Bowie, 2004):

- Maintain and increase benthic IBI and habitat scores for the entire Western Branch.
- Target and protect sensitive watersheds.
- Protect State Endangered fish and rare plants
- Protect forests (including incorporating green infrastructure)
- Protected FIDS habitat
- Remove stream blockages
- Encourage low-impact development.
- Develop a stream mitigation bank (similar to a wetland mitigation bank) that would include developing an in-house list of possible projects.

Some stream buffer plantings have occurred within Western Branch watershed. (Shanks, 2003)

Based on the DNR Fish Passage Program data, some blockages are located along the Western Branch, between Upper Marlboro and the Patuxent River and near Rte. 214 (Shanks, 2003).

There are several linear Green Infrastructure hubs and corridors in this watershed, including hubs along Western Branch, Collington Branch, and around Rosaryville State Park. A portion of a large GI hub is located in the far-southern portion of the watershed (south of Upper Marlboro). Some of this network is protected by Rosaryville State Park, Belt Woods NEA, a Chesapeake Bay Foundation property, many County-owned properties (including Watkins Regional Park, Southwest Branch Park, Walker Mill Regional Park). There are still some unprotected GI areas along that should be priority for protection. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Piscataway Creek Greenway*
- *Collington Branch*
- *WB&A Trail*

- *Western Branch*
- *Chesapeake Beach Rail Trail*
- *Southwest Branch*
- *Charles Branch*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. One of these areas is Belt Woods.

There are several designated and proposed Nontidal Wetlands of Special State Concern located within this watershed.

- *Belt Woods*. This designated Wildlands site contains an old-growth upland forest, which is very rare because it may have never been logged. The circumneutral soils result in a diverse assemblage of species and two rare plant species. This site also contains forest interior dwelling bird species and important habitat for many other types of wildlife. While Belt Woods forest itself is protected from clearing, development of the surrounding area could destroy the wildlife corridors. Other threats are invasion from non-native woody species, due to the high amount of forest edge, and physical disturbance from humans and pets. It is important to protect the connecting forested corridors, possible through conservation easements, from future development. Road improvements to Church Road or Route 214 should not be allowed to impact any more forested land. Surrounding development should be restricted to low density housing. Access to the site should be very limited to reduce physical disturbance (McCarthy et al., 1988). This site is protected by Belt Woods Natural Environmental Area.
- *Southwest Branch Bottomland Forest* (*DNR name: Western Branch – Largo)*. This bottomland forest contains a diverse herbaceous layer including a healthy population of a rare plant species. This site also offers recreational/educational opportunities and provides water quality/quantity filtering for the Southwest Branch. Main threats include forest clearing, invasion by non-native plant species, change in water quality or hydrology. This site is surrounded by residential developments and roads (McCarthy et al., 1988). This site is partially protected by Southwest Branch Park.
- *Upper Patuxent Marshes.* This large wetland system follows Charles Branch and Horse Tavern Branch. It includes the areas adjacent to Chews Lake and connects with Jug Bay Wetlands Sanctuary. The portion along Charles Branch is partially within Charles Branch Stream Valley Park and Patuxent River Park. Chews Lake WSSC is described as follows (DNR, 1991). This site is a relatively undisturbed mature bottomland forest. Chews Lake is maintained by beaver activity. This site contains two State-Endangered plant species.
- *Watkins Regional Park (DNR name: Western Branch – Largo)*. This is one of the few large tracts of forest left in the County, and includes some old forest sections. This site contains two rare plant species and forest interior dwelling bird habitat. It provides great opportunity for recreation and education. Main threats include hydrological changes, forest clearing, and invasion by non-native plant species.

This site is surrounded by residential development on the north and west, farm to the south, and the park's picnic area to the east (McCarthy et al., 1988). This site is protected by Watkins Regional Park.

- *Seven small potential WSSC*. There are several small potential WSSC, including within Woodmore Road Park (adjacent to an existing WSSC, East of Woodmore Road Park, just east of Adventure World, within Watkins Mill Park (adjacent to Watkins Regional Park WSSC), within and adjacent to Western Branch Park, along East Branch, and just north of Prince Georges County Equestrian Center. These sites are only partially protected.

Specific restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
- Expand aquatic habitat along Bald Hill Branch and Southwest Branch (Shanks, 2003).
- Remove fish blockages based on the DNR Fish Passage Program data, [e.g. Western Branch, between Upper Marlboro and the Patuxent River and near Rte. 214 (Shanks, 2003)].
- Recommendations based on the WRAS strategy (Prince Georges County and the City of Bowie, 2004):
    - Improve Western Branch.
    - Remove stream blockages
    - Develop a stream mitigation bank (similar to a wetland mitigation bank) that would include developing an in-house list of possible projects.
- Potential restoration projects within the City of Bowie, including wetland restoration (City of Bowie, 2004).
- Recommendations based on the USACE study of the subwatershed Bald Hill Branch, Cabin Branch, Southwest Branch, and Western Branch: possible restoration or mitigation for channelized streams, fish blockages, stormwater problems in the stream, wetland loss, and stream buffers with inadequate vegetation.
- Recommendations based on the stream corridor assessment for subwatersheds Collington Branch, Lottsford Branch, and Northeast Branch: fish barriers, stream erosion, and inadequately vegetated buffers (mainly in Collington Branch subwatershed).
- Restore wetlands designed to provide water quality improvement (including for Biochemical Oxygen Demand) to Western Branch.

Specific protection recommendations:

- The remaining large forested areas should be protected (Prince Georges County, 2004).
- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the waterways.

- Protect land within designated Rural Legacy area.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect wetlands designed to provide water quality improvement (including for Biochemical Oxygen Demand) to Western Branch.
- Recommendations based on the WRAS strategy (Prince Georges County and the City of Bowie, 2004):
    - Maintain IBI and habitat scores for Western Branch.
    - Target and protect sensitive watersheds.
    - Protect State Endangered fish and rare plants.
    - Protect forests (including incorporating green infrastructure).
    - Protect FIDS habitat.

Patuxent River upper (02131104)

Background

The Patuxent River upper watershed extends from the southwestern tip of Howard County and much of the boundary between eastern Prince George's County and western Anne Arundel County. For more information about this watershed within those Counties, please refer to the sections on those Counties. The headwaters of the watershed are a transition area between the Piedmont and Coastal Plain provinces, with portions of underlying rock, gravels, and other unconsolidated sediments. Significant sediment deposition typically occurs in streams in the Piedmont-Coastal Plain transition area, (Prestegaard et al., 2000 draft) as the topography flattens and stream flows decrease in velocity. Stream channels and floodplains are also wider in the Coastal Plain than in the upstream Piedmont region. The southern end of the watershed is just north of the tidal limit of the Patuxent River at Queen Anne Bridge Road.

There are three major wastewater treatment plants within this watershed. Most hydric soils are along the streams and floodplains. Wetlands mostly occur along the waterways (Shanks, 2003). Steep slopes exist along the Patuxent River and some of the tributaries (e.g. Walker, Crow and Bear Branches) (MNCPPC, 2001).

The Anacostia Trails Heritage Area, which includes the Prince George's County portion of the Anacostia River watershed and portions of the Upper Patuxent River watershed, is part of a new heritage tourism program. The purpose of this heritage program is to devote resources to preserving the history, natural, and cultural resources of the area and encourage tourism (MNCPPC, 2001).

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Patuxent River upper watershed has 310 acres of open water and 31,870 acres of land. The land acres are divided as follows: urban 14,949 acres (47%), agriculture 2,907 acres (9%), forest 13,567 acres (43%), wetlands 91 acres (<1%) and barren land 356 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

The Patuxent River was designated as a scenic river by the Maryland General Assembly. The following is a summary from a document entitled *Patuxent River Policy plan: An update for 1984 to 1997.* (DNR, 1997). The Patuxent River Commission supports, coordinates, and implements programs, policies, and projects of the Patuxent River. Among the managements plans proposed for the Patuxent River include:

- Establishment of "a primary management area" delineating the area along the river and its tributaries to identify and manage land from which pollution is most likely to be transported into the river.
  - Prince George's County- has established the Patuxent River Management Area, with criteria for stream and wetland buffers within Patuxent watershed
  - Montgomery County- has adopted a master plan for Patuxent River, with guidelines for the protection of steep slopes, wetlands, reservoirs, and other sensitive areas in the Patuxent River watershed.
- Implementation of a comprehensive watershed management approach to control all sources of pollution and resource degradation.
- Continued restoration, improvement, and protection the habitat functions of aquatic and terrestrial living resources. These include:
  - Riparian forest- to stabilize stream banks.
  - Stream quality- to improve spawning ranges.
  - Wetlands-protection and restoration.
  - Forest land- to enhance contiguous tracts of forest.
  - Submerged aquatic vegetation and tidal marsh.
  - Concentrating new development in and around existing developed areas and population centers while protecting the rural and agricultural landscape.
  - Enhancing the environmental quality and community design in new and existing communities.
  - Developing a sense of stewardship for the Patuxent River and its watershed through increased public education and participation programs.
  - Funding to support and meet the above plans.

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

- Lacustrine unconsolidated bottom: 1 acre
- Palustrine
  - Aquatic bed: 8 acres
  - Emergent: 217 acres
  - Scrub shrub: 200 acres
  - Forested: 4122 acres
  - Unconsolidated bottom: 426 acres
  - Unconsolidated shore: 11 acres
  - Farmed: 45 acres
- Total: 5,030 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02131104	-3.57	12.06	0	0.05	8.54

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. Stream segments within the Prince Georges County portion of this watershed are 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 resource 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. Failing indicators include high nutrient concentrations, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal instream habitat index, high percent impervious surface (16%), high population density, and high soil erodibility (0.30). Wetland loss was estimated to be 10,106 acres. Indicators for Category 3 includes a high imperiled aquatic species indicator.

The 2002 305(b) report States that the mainstem river to Rocky Gorge Dam in Howard County meets all designated uses for 23.5 miles. In wadeable tributaries, 23.4 miles met all designated uses while results for 71.7 miles were 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:

- *Patuxent River* (non-tidal); nutrients, sediments
- *Patuxent River Unnamed Tributary* (021311050940 non-tidal in Howard County); poor biological community.
- *Patuxent River Unnamed Tributary* (021311050940 non-tidal in Prince Georges County); poor biological community.
- *Stockett's Run* (021311050930 non-tidal in Anne Arundel County); poor biological community.
- *Honey Branch* (021311050931 non-tidal in Prince Georges County); poor biological community.
- *Horsepen Branch* (021311050937 non-tidal in Prince Georges County); poor biological community.

- *Cash Lake* (impoundment in Prince Georges County); Methylmercury (in fish tissue).

MBSS sampling rated fish communities as very poor to good and benthic communities from very poor to fair. Most of the fish species found are tolerant species, but a few are intolerant. Sites with the lowest scores were in streams with urbanization and poor stream buffers. The lower portion of this river still supports herring and shad. Some of the fish species found included American eel, Blacknose dace, Green sunfish, Least Brook Lamprey, Tesselated darter, Rosyside dace, Swallowtail Shiner, and White sucker. The Upper Patuxent River historically provided spawning habitat for herring, shad, white perch, and yellow perch. There is potential to restore these habitats. DNR stocks trout for recreational fishing in Laurel Lake and on the Patuxent River just downstream of H.T. Duckett Dam (Shanks, 2003).

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated poor in subwatersheds Middle Patuxent River, Horsepen Branch, and Upper Patuxent River and very poor in subwatersheds Bear Branch, Crows Branch, and Walker Branch. Habitat was rated poor in subwatersheds Upper Patuxent River, Bear Branch, Crows Branch, and Walker Branch and very poor in subwatersheds Middle Patuxent River and Horsepen Branch (MNCPPC, 2005).

The following information is summarized from the nutrient synoptic survey. Nutrient concentrations and yields were low compared to other State watersheds. Orthophosphate concentrations were highest in Anne Arundel County, but this was possibly due to high amounts of rain prior to sampling. Most sites within Stocketts Run watershed had excessive concentrations. Orthophosphate yields were generally low. Macroinvertebrate communities were rated fair to very poor, with habitat assessment rated as suboptimal. Stream bank erosion and sedimentation within the stream likely led to these low rankings (Primrose, 2003). Most of the nutrients in the Upper Patuxent River flow downstream to the lower Patuxent, causing problems there (Shanks, 2003).

Restoration/Preservation

The WRAS strategy for the Anne Arundel County portion of this watershed discusses subwatershed characterization and possible restoration. Many of the specific improvement activities include improving stormwater management, reducing sediment load by stabilizing stream banks, implement BMPs, improve stream buffers, and improving fish passages. Specific wetland-related improvements include:

- Conducting wetland restoration on two hydric soil locations within Cox Branch watershed
- Possible large-scale restoration on US Military property within Unnamed Tributary to Patuxent (UPS3)
- Possible wetland restoration on agricultural hydric soils in Unnamed Tributary to Patuxent (UPS6)

During the Stream Corridor Assessment for the Anne Arundel County portion of this watershed, 50 stream miles were surveyed. From those streams surveyed, they found a total of 166 problems. There was a high amount of erosion (41 sites). While the erosion extended over long distances, most was rated as minor to moderate, with the exception of two sites rated very severe. Another reported problem was poor vegetated buffers (28 sites). Most sites were rates as minor to moderate in severity, with land use being small recently-planted trees or pasture. Other problems included pipe outfalls (21 sites), fish migration barriers (17 sites), channel alteration (12 sites), and addition identified problems.

A watershed assessment was completed for Laurel Lakes.

There is a linear State-designated Green Infrastructure hub along Patuxent River and a large hub around Patuxent Wildlife Research Center. There is also a corridor connecting these hubs to other watersheds. The largest hub is protected by Fort Meade and the National Agricultural Research Center. The Patuxent River hub is partially protected by Patuxent River NRMA, Merkle NRMA, Honey Branch Park, and the Patuxent River Watershed Park. There are still some unprotected GI areas along the Patuxent River that should be high priority for protection. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Patuxent Regional Greenway*
- *Patuxent River Water Trail*
- *Beaverdam Creek*
- *Collington Branch*
- *WB&A Trail*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include:

- Patuxent Research Refuge – 12,750 acres.
    - Patuxent River Corridor – 6,000 acres of marshes, swamps, and woodland.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. The Patuxent River Rural Legacy Area contains approximately 34,984 acres. This area is currently largely undeveloped (86%). This area was chosen in order to protect a contiguous area along the Patuxent River including wildlife corridors, recreational areas, agriculture, forest, wetlands and other natural resources. The goal is to protect 10,000 acres (29%). Currently, 11,640 acres (33%) of this land is protected through various methods. The sponsors are Prince George's County. 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

adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are several designated Nontidal Wetlands of Special State Concern located within the Prince Georges County portion of this watershed.

- *Patuxent Maple Swamp*. This bottomland forest includes two rare plant species and a rare animal. In addition to providing important habitat, this site provide flood storage. Main threats include changes in hydrology, specifically changes in the essential regular flooding cycles, forest clearing, upstream development, invasion by non-native plant species, and reduced water quality entering the site (McCarthy et al., 1988). This site is only partially protected by Patuxent River Watershed Park.
- *Unknown NTWWSC in Bowie*. This site is located within Bowie and is protected by a small County-owned property.
- *Patuxent Wildlife Research Center*. This large site contains over 3,000 acres of mostly connected forest, including a large section of mature forest, and connects with large adjacent forests to create one of the largest forest regions within the Washington-Baltimore region. This site contains at least one rare plant species, forest interior dwelling species, and excellent educational/research opportunities. Threats include fragmentation from development or road expansion, forest clearing, changes in water quality or hydrology, and the large deer population (McCarthy et al., 1988). This area is protected by federal land.

Specific restoration recommendations:

- Recommendations based on WRAS strategy (for Anne Arundel County):
    - Wetland restoration on two hydric soil locations within Cox Branch watershed.
    - Possible large-scale restoration on US Military property within Unnamed Tributary to Patuxent (UPS3).
    - Possible wetland restoration on agricultural hydric soils in Unnamed Tributary to Patuxent (UPS6).
- Fix stream problems identified during the Stream Corridor Assessment (Anne Arundel County): erosion, poor vegetated buffers, fish migration barriers.
- Restore areas within Patuxent Research Refuge (based on PG County GI plan).
- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
    - Restoration recommendations from the *Patuxent River Policy plan: An update for 1984 to 1997*:
        - Riparian forest - to stabilize stream banks.
        - Stream quality - to improve spawning ranges.
        - Wetlands and SAV.
        - Forest land - to enhance contiguous tracts of forest.

Specific protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the Patuxent River and tributaries.
- Protect land within designated Rural Legacy area.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect the Scenic Patuxent River.

Potomac River middle tidal (02140102)

Background

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Potomac River M tidal watershed has 1,621 acres of land. The land acres are divided as follows: urban 224 acres (14%), agriculture 78 acres (5%), forest 1,299 acres (80%), and barren land 19 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

- Estuarine emergent: 227 acres
- Lacustrine unconsolidated bottom: 26 acres
- Palustrine
    - Aquatic bed: 23 acres
    - Emergent: 213 acre
    - Scrub shrub: 121 acres
    - Forested: 741 acres
    - Unconsolidated bottom: 83 acres
    - Unconsolidated shore: 19 acres
    - Farmed: 2 acres
- Total: 1,455 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 loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140102	-0.27	0	0	0	-0.27

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. Stream segments within the Prince Georges County portion of this watershed are designated Use I, recreation contact and protection of aquatic life.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource 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 nitrogen loadings, poor SAV abundance and habitat index, and high historic wetland loss (16,201 acres). Indicators for Category 3 include migratory fish spawning areas, high amount of wetland-dependent species, high percent headwater stream in Interior Forest (42%), and high percent watershed being forested.

According to the 2002 305(b) report, tidal mainstem and Maryland tributaries not identified below fail to support all designated uses due to PCBs. Of the nontidal, wadeable tributaries, a portion fails to support all uses (7 miles) due to poor biological community from habitat alteration and channelization and the remaining portion fully supports all uses (23 miles).

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:

- *Potomac River Middle Tidal*; poor biological community, cadmium, chromium, copper, lead, nutrients, sediments, PCBs (in fish tissue).
- *Reeder Run* (021401020789 non-tidal in Charles County); poor biological community.
- *Reeder Run Unnamed Tributary* (021401020789 non-tidal in Charles County); poor biological community.

A biological assessment was conducted for this County in 1999, 2000, and 2004. For the subwatershed Pomonkey Creek, benthic IBI was rated poor and habitat was rated fair (MNCPPC, 2005).

Restoration/Preservation

The majority of the Prince George's County portion of this watershed is designated Green Infrastructure. The Prince George's County portion is largely unprotected except Accokeek Foundation.

There are no designated WSSC within the Prince Georges County portion of this watershed.

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the waterways.

Zekiah Swamp (02140108)

Background

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Zekiah Swamp watershed has 8 acres of open water and 4,655 acres of land. The land acres are divided as follows: urban 538 acres (12%), agriculture 678 acres (15%), forest 3,370 acres (72%), and barren land 68 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

The Wicomico River and Zekiah Swamp were designated as scenic rivers by the Maryland General Assembly.

While the Zekiah Swamp is located in Charles County, it originates in Prince George's County. In a 1981 MDP document, this swamp was designated an Area of Critical State Concern. It is the largest natural hardwood swamp in Maryland, being roughly 20 miles long and three-quarters mile wide. This area received one of the highest ecological ratings by Smithsonian Institute. It provides diverse habitat for wildlife species such as beaver, osprey, herons, wood duck, mink, Wilson's snipe, bald eagle, woodpeckers, Zekiah stonefly, and Diamondback Terrapin. Historic wetlands above MD Rte. 234 bridge have been destroyed.

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

- Estuarine emergent: 72 acres
- Palustrine
    - Aquatic bed: 15 acres
    - Emergent: 207 acre
    - Scrub shrub: 321 acres
    - Forested: 7,532 acres
    - Unconsolidated bottom: 386 acres
    - Unconsolidated shore: 38 acres
    - Farmed: 85 acres
- Total: 8,656 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140108	-4.04	7.63	0	0.28	3.86

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. Stream segments within the Prince Georges County portion of this watershed are designated Use I, recreation contact and protection of aquatic life.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource 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 historic wetland loss (36,637 acres) and high soil erodibility (0.29). Indicators for Category 3 include high imperiled aquatic species indicator, high percent headwater streams in Interior Forest, and high percent watershed being forested.

According to the 2002 305(b) report, of the mainstem creek and tributaries, a portion (16 miles) fail to support all designated uses due to poor biological community from urban runoff, while the remaining portion (105 miles) fully supports all uses.

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:

- *Zekiah Swamp* (tidal); sediments, lead, zinc, selenium, copper.
- *Zekiah Swamp* (non-tidal); nutrients.
- *Zekiah Swamp Run* (021401080766 non-tidal in Charles County); poor biological community.
- *Zekiah Swamp Run Unnamed Tributary 4* (021401080754 non-tidal in Charles County); poor biological community.
- *Bowling Creek* (021401080755 non-tidal in Charles County); poor biological community.
- *Piney Branch Unnamed Tributary* (021401080764 non-tidal in Charles County); poor biological community.
- *Herbert Run* (021401080754 non-tidal in Charles County); poor biological community.
- *Mill Dam Run* (021401080767 non-tidal in Charles County); poor biological community.

A biological assessment was conducted for this County in 1999, 2000, and 2004. For the subwatershed Zekiah Swamp Creek, benthic IBI was rated poor and habitat was rated fair (MNCPPC, 2005).

Restoration/Preservation

The majority of the Prince George's County portion of this watershed is designated Green Infrastructure, with some being protected by Cedarville State forest. According to the 2000 Maryland Greenways Commission document, one existing greenway is called Mattawoman Creek greenway.

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include Cedarville State Forest and Zekiah Watershed – 3,510 and 77,000 acres respectively watershed complex comprising of forest, shrub swamps, wetlands, open beaver ponds, and shallow pools.

There is one designated Nontidal Wetlands of Special State Concern located within the Prince Georges County portion of this watershed. Zekiah Swamp is a large wetland system following Allens Fresh Run and Zekiah Swamp Run. The portion within this watershed is largely unprotected, with the exception of a small portion within Zekiah NEA.

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along waterways.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.

<u>Mattawoman Creek (02140111)</u>

Background

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Mattawoman Creek watershed has 28 acres of open water and 15,714 acres of land. The land acres are divided as follows: urban 2,317 acres (15%), agriculture 2,597 acres (17%), forest 10,533 acres (67%), wetlands 163 acres (1%) and barren land 104 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

This 13.5-mile waterway is a shallow tidally influenced embayment with an average depth of five feet (MDE, 2003b).

In a 1981 MDP document, Mattawoman Creek was designated an Area of Critical State Concern. This swamp forest/stream valley area, including the creek and tributaries, are very important spawning waters. The tidal wetlands provide a nursery for many fish species and results in a feeding ground for many large fish-eating birds like Great Blue Herons, Common Egrets, and Black-Crowned Night Herons. The tidal wetlands contain some rare and unusual plant species. Other species include otter, mink, beaver, osprey, and a large population of wood duck. Development in this watershed may result in increased runoff and sedimentation that would negatively impact this wetland system. (MDP, 1981).

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

- Estuarine
    - Emergent: 231 acres
    - Unconsolidated shore: 2 acres
- Palustrine
    - Aquatic bed: 10 acres
    - Emergent: 332 acre
    - Scrub shrub: 290 acres
    - Forested: 6,298 acres
    - Unconsolidated bottom: 241 acres
    - Unconsolidated shore: 6 acres
    - Farmed: 21 acres
- Total: 7,432 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140111	-24.75	44.52	0	0	19.77

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. Stream segments within the Prince Georges County portion of this watershed are 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 resource 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 "Selected" Category 3, a pristine or

sensitive watershed most in need of protection. Failing indicators include poor SAV abundance and habitat index, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal fish index of biotic integrity (FIBI), high population density, high historic wetland loss (47,616 acres), and high soil erodibility (0.34). Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning area, high anadromous fish index, high percent headwater streams in Interior Forest (34%), high percent watershed being forested, and the presence of designated Wildland Acres.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all designated uses due to nutrients. The nontidal mainstem creek fully supports all uses. Of the nontidal wadeable streams, a portion (68 miles) fails to support all uses due to poor biological community, a portion (5 miles) fully support all uses, while the remaining portion (20 miles) had inconclusive results. Results for Myrtle Grove Lake were 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:

- *Mattawoman Creek* (tidal); sediments, nutrients.
- *Mattawoman North Creek* (021401110781 non-tidal in Charles County); poor biological community.
- *Mattawoman North Creek* (021401110786 non-tidal); poor biological community.
- *Mattawoman North Creek* (021401110787 non-tidal); poor biological community.
- *Mattawoman North Creek* (021401110784 non-tidal); poor biological community.
- *Mattawoman North Creek Unnamed Tributary* (021401110786 non-tidal); poor biological community.
- *Mattawoman North Creek Unnamed Tributary* (021401110783 non-tidal in Charles County); poor biological community.
- *Mattawoman North Creek Unnamed Tributary* (021401110781 non-tidal in Charles County); poor biological community.

A TMDL for nitrogen and phosphorus was completed for Mattawoman Creek. This waterway has signs of eutrophication, high chlorophyll a levels, suspended sediments, and biological impacts. Eutrophication is often found during low flow conditions between the tidal and non-tidal water (between Harrison Cut and Route 225). Point sources include the Town of Indian Head WWTP, discharging into Harrison Cut (a tributary five miles from the mouth), and other smaller point sources like Lackey High School, Brandywine Air Force Facility, and Lingafelt Residence. Sources of total nitrogen are air deposition (5%), WWTPs (5%), urban sources (39%), forest (13%), and agriculture (40%). Sources of total phosphorus are air deposition (4%), WWTPs (16%), urban sources (49%), forest (2%), and agriculture (29%). Water sampling found a reading of high chlorophyll a and low dissolved oxygen between Town of Indian Head WWTP outfall and the confluence of Harrison Cut and Mattawoman Creek. Another reading of low DO was found not too far from this point. TMDL were set for low and average flow conditions.

A biological assessment was conducted for this County in 1999, 2000, and 2004. For the subwatershed Mattawoman Creek, benthic IBI was rated poor and habitat was rated fair (MNCPPC, 2005).

Restoration/Preservation

State-designated Green Infrastructure hubs cover a fair amount of Prince George's County portion of this watershed, including along Mattawoman Creek, around Green Acre Farms, and around a U.S. Military Reservation. A small portion of this watershed is protected by Cedarville State Forest, the U.S. Military Reservation, and County-owned properties. Most of the hubs still remain unprotected, including the hub along Mattawoman and the large hub around Green Acre Farms. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, one existing or potential greenway is called Mattawoman Creek greenway.

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. One of these areas is Mattawoman Creek Stream Valley.

There are three small proposed Nontidal Wetlands of Special State Concern located within the Prince Georges County portion of this watershed, all located within the US Military Reservation Globecom.

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
- Restore wetlands designed to provide water quality improvement for Mattawoman Creek (especially nitrogen and phosphorus reduction).

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the Mattawoman Creek and tributaries.
- Protect additional wetlands within designated Ecologically Significant Areas (including potential WSSC).
- Protect wetlands that provide water quality improvement for Mattawoman Creek (especially nitrogen and phosphorus reduction).
- Protect the designated Area of Critical State Concern: Mattawoman Creek

<u>Potomac River upper tidal (02140201)</u>

Background

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Potomac River U tidal watershed has 4,866 acres of open water and 25,666 acres of land. The land acres are divided as follows: urban 15,627 acres (61%), agriculture 1,277 acres (5%), forest 8,024 acres (31%), wetlands 51 acres (<1%) and barren land 687 acres (3%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

- Palustrine
    - Aquatic bed: 1 acre
    - Emergent: 96 acre
    - Scrub shrub: 22 acres
    - Forested: 602 acres
    - Unconsolidated bottom: 31 acres
    - Unconsolidated shore: 1 acre
    - Farmed: <1 acre
- Total: 752 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 loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140201	-5.32	1.00	0	0	-4.32

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. Stream segments within the Prince Georges County portion of this watershed are designated Use I, recreation contact and protection of aquatic life.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource 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 nitrogen loadings, poor SAV abundance and habitat index, high percent impervious surface (19%), and high population density. Wetland loss was estimated to be 10,919 acres. Indicators for Category 3 include high non-tidal instream habitat index and migratory fish spawning areas.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all designated uses due to PCBs. A portion of the nontidal wadeable tributaries (22 miles)

fails to support all uses due to poor biological community from urban runoff and hydromodification, while the other portion (10 miles) had inconclusive results.

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:

- *Potomac River Upper Tidal*; copper, sediment, nutrients, high pH (nutrient driven), PCBs (in fish tissue).
- *Potomac River Unnamed Tributary* (021402010792 non-tidal); poor biological community.
- *Henson Creek* (021402010797 non-tidal in Prince Georges County); poor biological community.
- *Henson Creek* (021402010796 non-tidal in Prince Georges County); poor biological community.
- *Henson Creek Unnamed Tributary* (021402010797 non-tidal in Prince Georges County); poor biological community.
- *Henson Creek Unnamed Tributary* (021402010796 non-tidal in Prince Georges County); poor biological community.
- *Hunters Mill Branch* (021402010796 non-tidal in Prince Georges County); poor biological community.

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated poor in subwatersheds Lower Potomac River, Swan Creek, and Upper Potomac River and very poor for subwatersheds Broad Creek, Hunters Mill, and Henson Creek. Habitat was rated fair in subwatershed Lower Potomac River, Swan Creek, and Upper Potomac River and poor in Broad Creek, Hunters Mill, and Henson Creek (MNCPPC, 2005).

Restoration/Preservation

Most of the State-designated Green Infrastructure network is in the southern portion of the watershed, with the exception of a linear hub along Broad Henson Creek and a few connecting corridors. Most of the hubs are protected by Piscataway National Park, Fort Washington National Park, some smaller federal properties, Henson Creek Park, other small County-owned properties, and Accokeek Foundation. Small areas along this hub and the majority of the corridors are still not protected. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Potomac River Greenway*
- *Potomac River Water Trail*
- *Suitland Parkway*
- *Henson Creek*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are

reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include:

- Suitland Bog – 60 acres of unique wetland habitat.
- Piscataway Park – 4,600 acres of forests, fields and wetlands.

There are two designated Nontidal Wetlands of Special State Concern and one potential WSSC located within the Prince Georges County portion of this watershed.

- *Suitland Bog*. This relatively undisturbed bog is the only remaining in Prince Georges County. Bogs are rare in Maryland's Coastal Plain. Due to the uncommon harsh environment, this site has a diverse assemblage of plant species, including six rare plant species and 13 uncommon plant species. Many other species were reported here historically and may still be present. The urban location results in a high educational opportunity. Main threats include succession of the area to woody plans (McCarthy et al., 1988). This area is protected by a 20-acre MNCPPC property (MDP, 1981) but is surrounded by an intensely developed area.
- *Johnson's Gully (DNR name: Bryan Point)*. This steep ravine and mature forest contains a rare plant species. This site also provides important habitat for invertebrates and amphibians and may provide insight into the biological history of the area. Main threats are impacts to the moist shady habitat of the rare species, including forest clearing, invasion of non-native plant species, soil erosion, and streams sedimentation (McCarthy et al., 1988). This area is protected by Piscataway National Park.
- *Potential WSSC*. There is potential WSSC partly within Piscataway Park and partly south of the park.

The tidal and non-tidal wetlands called Broad-Henson Creek Marsh were designated as an Area of Critical State Concern in 1981 (MDP, 1981). This marsh is at the mouth of Broad Henson Creek and is considered by the Smithsonian Institute to be prime wildlife habitat. Additionally, it provides good anadromous fish spawning area. Recognizing this value, the land is now owned by the MNCPPC and the federal government. Upstream development is resulting in siltation of this fragile system. Further public land acquisition of areas surrounding the wetlands are desirable, in addition to following BMPs for new development.

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the waterways.
- Protect additional wetlands within designated Ecologically Significant Areas.

- Protect the designated Area of Critical State Concern: Broad-Henson Creek Marsh.

Piscataway Creek (02140203)

Background

The nontidal portion of Piscataway Creek watershed covers roughly 56 mi^2. The headwaters are around Andrews Air Force Base and it drains into the Potomac River (MDE, 2005b).

Based on MDP 2002 GIS land use data the Piscataway Creek watershed has 964 acres of open water and 43,513 acres of land. The land acres are divided as follows: urban 17,661 acres (41%), agriculture 5,538 acres (13%), forest 19,917 acres (46%), wetlands 110 acres (<1%) and barren land 287 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

- Palustrine
  - Aquatic bed: <1 acre
  - Emergent: 225 acres
  - Scrub shrub: 149 acres
  - Forested: 1,605 acres
  - Unconsolidated bottom: 145 acres
  - Unconsolidated shore: 3 acres
  - Farmed: 8 acres
- Total: 2,135 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140203	-8.43	14.14	2.20	0	7.91

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. Stream segments within the Prince Georges County portion of this watershed are 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 resource 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 high nutrient concentrations, poor SAV abundance and habitat index, poor non-tidal benthic index of biotic integrity (BIBI), high percent impervious surface (17%), high population density, and high soil erodibility (0.32). Wetland loss was estimated to be 15,504 acres. Indicators for Category 3 include high imperiled aquatic species indicator and migratory fish spawning areas.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all uses due to nutrients from poor tidal flushing and eutrophication. Nontidal mainstem fails to support all designated uses due to bacteria. Of the nontidal wadeable tributaries, a portion (21 miles) fully supports all uses, while the remainder (44 miles) had inconclusive results. Data for Cosca Lake was 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:

- *Piscataway Creek* (non-tidal); fecal coliform, nutrients, sediments.
- *Piscataway Creek* (021402030803 non-tidal); poor biological community.
- *Piscataway Creek* (021402030799 non-tidal); poor biological community.
- *Piscataway Creek Unnamed Tributary* (021402030803 non-tidal); poor biological community.
- *Piscataway Creek Unnamed Tributary* (021402030801 non-tidal); poor biological community.
- *Burch Creek Unnamed Tributary* (021402030801 non-tidal); poor biological community.
- *Paynes Branch* (021402030800 non-tidal); poor biological community.
- *Meetinghouse Branch* (021402030800 non-tidal); poor biological community.
- *Tinkers Creek Unnamed Tributary* (021402030800 non-tidal); poor biological community.
- *Butler Branch* (021402030801 non-tidal); poor biological community.
- *Pea Hill Branch* (021402030802 non-tidal); poor biological community.

A Draft Water Quality Analysis was completed in 2005 for fecal bacteria in the nontidal portion of Piscataway Creek. This study found that the current fecal bacteria levels did support the designated uses. Therefore, it is recommended that the nontidal portions of this watershed be removed from the 303(d) List for impairment by fecal bacteria.

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated fair in the subwatershed Piscataway Creek and was rated poor in subwatershed Tinkers Creek. Habitat was rated poor in subwatershed Piscataway Creek and was rated very poor in subwatershed Tinkers Creek (MNCPPC, 2005).

Restoration/Preservation

There are several State-designated Green Infrastructure hubs and corridors in this watershed, with the GI network being denser in the southern portion of the watershed, including along Tinkers Creek and Piscataway Creek. Some of this network is protected by Accokeek Foundation, Piscataway National Park, Rosaryville State Park, Fort Washington National Park, and many County-owned properties. Large federal properties, outside of the GI network, are Andrews Airforce Base and Naval Communication Unit. There are still some unprotected GI areas along Tinkers Creek and south of Piscataway Creek that should be protected. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Potomac River Greenway*
- *Potomac River Water Trail*
- *Piscataway Creek Greenway*
- *Tinkers Creek*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. One of these areas is
Piscataway Park – 4,600 acres of forests, fields and wetlands.

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

- *Mockley Swamp*. This freshwater tidal swamp, emergent marsh, and riparian tidal flats provide diverse habitat and contain three rare plant species. This site also provides important waterfowl and waterbird habitat, contains otter, and likely additional rare plant species. While this area is currently relatively free from threats, future threats may include development, forest clearing, alteration of hydrology, and shoreline stabilization (McCarthy et al., 1988). This site is protected by Piscataway National Park.
- *Fort Ravine*. The stream banks and lower slopes of this site contain a rare plant species. The mature forest provides migrating bird habitat and recreational opportunities. Threats include forest clearing, invasion by non-native plant species (currently near the mouth of the stream), and soil disturbance. There is an eroded gully upstream that has resulted in sediment covering the stream bottom. This erosion should be reduced (McCarthy et al., 1988). This site is protected by Fort Washington National Park.
- *Potential WSSC*. There are several small potential WSSC within the Piscataway National Park.

An extensive zone of tidal and non-tidal wetlands along Piscataway Creek, running from the mouth to the US Naval Reservation and Boys Village of Maryland (encompassing Mockley Swamp), was designated as an Area of Critical State Concern in 1981. This

stream is a very productive herring run and an excellent area for anadromous fish spawning. The surrounding areas are good plant and wildlife habitats. There are several large protected parcels. However, development in the Piscataway headwaters may result in erosion/sedimentation and hydrological changes to this system. (MDP, 1981).

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the waterways.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect the designated Area of Critical State Concern along Piscataway Creek.
- Protect the wetland areas used as references in the tidal vegetative study conducted by DNR (in the mouth of Piscataway Creek).

Oxon Creek (02140204)

Background

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Oxon Creek watershed has 67 acres of open water and 6,824 acres of land. The land acres are divided as follows: urban 4,899 acres (72%), agriculture 290 acres (4%), forest 1,533 acres (22%), and barren land 101 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

- Palustrine emergent: <1 acre
- Riverine unconsolidated shore: 3 acres
- Total: 3 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 loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140204	-0.47	0	0	0	-0.47

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. Stream segments within the Prince Georges County portion of this watershed are 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 resource 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. Failing indicators include high phosphorus and nitrogen loadings, poor SAV abundance and habitat index, high percent impervious surface (41%), high population density, high percent unforested stream buffer (56%), and high soil erodibility (0.36). Wetland loss was estimated to be 3,210 acres. Indicators for Category 3 include presence of migratory fish spawning areas.

According to the 2002 303(b) report, data for the tidal mainstem and tidal and nontidal wadeable tributaries was 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:

- *Oxon Creek* (tidal); sediments, nutrients.
- *Oxon Run* (021402040805 non-tidal); poor biological community.
- *Oxon Run Unnamed Tributary* (021402040805 non-tidal); poor biological community.

A biological assessment was conducted for this County in 1999, 2000, and 2004. For the subwatershed Oxon Creek, benthic IBI and habitat were rated as very poor (MNCPPC, 2005).

Restoration/Preservation

The Oxon Run Watershed Water Quality and Stream Restoration Study included watershed conditions, pollution problems, and recommendations (including some stream restoration, wetland mitigation and wetland banking) (Prince Georges County, 2005).

There is no State-designated Green Infrastructure within this watershed. According to the 2000 Maryland Greenways Commission document, one potential greenway is called Potomac River Greenway.

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

Restoration recommendations:

- Restore wetlands and streams within the headwaters.
- Recommendations based on The Oxon Run Watershed Water Quality and Stream Restoration Study, including some stream restoration, wetland mitigation and wetland banking (Prince Georges County, 2005).

Protection recommendations:

- Protect wetlands and streams within the headwaters.

Anacostia River (02140205)

Background

The Anacostia River is approximately 176 mi^2 and has one of the highest watershed population densities for the Chesapeake Bay. This watershed is within the Piedmont and Coastal Plain physiographic provinces, with the boundary between these two roughly following the County boundary. It has three major subwatersheds: Northwest Branch, Northeast Branch, and the tidal drainage portion. The Northeast and Northwest Branches converge in Bladensburg to form the tidal drainage portion. The Northwest Branch is roughly 32,000 acres and is highly developed land. Most of this subwatershed is within Montgomery County, with about a fifth in Prince George's County. The Northeast Branch is about 48,000 acres, with some urban and some being Agricultural Research areas. The majority of this subwatershed is within Prince George's County, with some of the headwaters in Montgomery County and D.C. This tidal portion, mainly in D.C. is over 8 miles long and feeds into the Potomac River (MDE, 2005a).

The Anacostia River watershed is located in Prince George's County (49%), Montgomery County (34%), and D.C. (17%). Of this entire watershed, about two thirds is in the Coastal Plain and one third is in the Piedmont. The tidal portion of the river is within the Coastal Plain, where they are influenced by a three-foot tidal cycle. The head-of-tide is located just outside of D.C., near Bladensburg (in Prince Georges County) (Shanks, 2005).

Based on the Natural Soil Groups, Roughly 16% of the Prince George's County portion of the watershed is prime agricultural land, with only a small portion of this actually in agricultural land use. About 15% of the soil area was hydric, mainly along streams (Shanks, 2005).

Areas that are not impervious may be acting as recharge areas for Potomac and Aquia aquifers. An impervious area assessment found that within the Prince George's portion of the Anacostia watershed, Upper Beaver Creek subwatershed was the only area with less than 10% impervious surface. The higher levels of impervious surface found in the other subwatersheds degrade water quality and aquatic habitat (Shanks, 2005).

DNR reported anadromous fish spawning in the Maryland portion of the Anacostia River, upstream into Lower Beaverdam Creek, lower Northwest Branch, and lower Northeast

Branch. DNR released young herring in an effort to reestablish the population. MBSS data found FIBI of good around USDA property, but other areas were ranked as fair to very poor. However, some fish species seem to be improving. Hickory shad has been increasing and after DNR stocking of smallmouth bass in the Upper Northwest Branch, they seem to be self-sustaining. There are 130 fish blockages identified by the Metropolitan Washington Council of Governments. There is a fish consumption ban in the DC portion of the Anacostia due to PCBs and pesticides. There is also a Statewide fish consumption advisory for methylmercury. BIBI were generally ranked poor or very poor. In the Prince Georges portion of this river, with the exception of sites around USDA, which ranked as fair and good. Maryland tracks 13 animal and 99 plant species within the Prince George's County portion of the Anacostia watershed (Shanks, 2005).

The Anacostia Trails Heritage Area, which includes the Prince George's County portion of the Anacostia River watershed and portions of the Upper Patuxent River watershed, is part of a new heritage tourism program. The purpose of this heritage program is to devote resources to preserving the history, natural, and cultural resources of the area and encourage tourism (ATHA).

The Northeast Branch, one of the two major tributaries to the Anacostia River, has a high riverscape diversity, traveling through rugged stretches of deep, narrow gorge with a relatively steep drop. A MNCPPC-owned stream valley park follows this tributary. The Anacostia Tributaries Trail System includes several tributaries of the Anacostia River and provides recreation to this highly urbanized area. the Northeast Branch has some of the most scenic locations in the Heritage Area. Indian Creek has shallow slopes that meander through wide stream valleys. The Paint Branch tributary has scenic views, especially upstream of Powder Mill Road. Most of this stream valley is within MNCPPC parkland. Sligo Creek is a well-used stream valley bordered by a narrow strip of parkland (ATHA).

The following information is based on the ICPRB document entitled *Anacostia The Other River*. The flushing time is slow from this river, so sediment, nutrients, and pollutants remain in the river for a long time. Historically, this river was an important anadromous fish spawning area and contained an abundant and diverse fish population. But, in recent times, the fishing is poor. This may be due to the water quality (mainly sedimentation), loss of habitat, and barriers to fish passage. Much of this sediment and some of the bacteria originate from the tributaries. Other water quality concerns include high bacteria levels, low dissolved oxygen (possibly due to the District's combined sewer system overflow), nutrients, heavy metals, and other pollutants. Extensive wetland restoration has been occurring along the tidal river in recent years. Subwatershed information is summarized below:

- Sligo Creek: water quality fair. Main problems are severe streambank erosion, sedimentation, flooding, poor aquatic life, and high amounts of bacteria. While attractive and highly used for recreation, this waterway is impacted by urbanization.

- Northwest Branch: water quality fair/good (upper), fair (lower). Main problems are sedimentation, unstable banks, bacteria, trash. This tributary is also very scenic in spots.
- Paint Branch: water quality good (upper), fair (lower). Main problems are local channel erosion, sediment deposition, unique resources (naturally reproducing brown trout) being threatened by urbanization.
- Little Paint Branch: water quality fair. Main problems are severe streambank erosion and sedimentation.
- Indian Creek: water quality poor/fair (upper), poor (lower). Main problems are severe sedimentation, inadequate riparian buffer, dump sites, trash, poor floodplain buffer. This subwatershed (along with Lower Beaverdam Creek) has the worst water quality in the Anacostia watershed.
- Beaverdam Creek: water quality fair. Main problems are fine sediment from dirt roads and agriculture.
- Northeast Branch: water quality poor. Main problems are severe streambank erosion, sedimentation, poor aquatic life.
- Lower Beaverdam Creek: water quality poor/fair. Main problems are high sedimentation, bacteria.

Based on MDP 2002 GIS land use data for the Prince Georges County portion of the Anacostia River watershed has 274 acres of open water and 53,542 acres of land. The land acres are divided as follows: urban 34,628 acres (65%), agriculture 3,498 acres (7%), forest 15,240 acres (28%), wetlands 47 acres (<1%) and barren land 129 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

The Anacostia River was designated as a scenic river by the Maryland General Assembly. The following is a summary from a document entitled *Maryland Scenic Rivers: The Anacostia.* (DNR). The Maryland Scenic and Wild Rivers Act of 1968 designates and protect rivers of outstanding value in the State. The Act directs the Secretary of the Department of Natural Resources to provide wise management and preservation of the land resources as well as scenic and wild qualities of designated rivers. Among the designated rivers is the Anacostia, whose extensive network of streams flow through Montgomery and Prince George's Counties before forming the main stem of the river just two miles northeast of Washington, D.C.

The most significant negative impacts to the Anacostia watershed has been to the wetlands along the River. Most of these were lost to dredging and filling. Kenilworth Marsh is one of the last remaining wetland patches along the River, but many portions are unhealthy. Many of the river's tributaries have flashy hydrology.

Due to multijurisdictional nature of the Anacostia River watershed, a Joint Agency Committee (composed of Washington Suburban Sanitary Commission, and both Montgomery and Prince George's County branches of M-NCPPC) was formed to oversee the Anacostia scenic river study and implement the study's recommendations. From the

study done on the Anacostia river watershed, major problems that have been identified to affect the river include:

- Erosion and sedimentation.
- Malfunctioning sanitary sewers.
- Illegal and undesirable discharges.
- Trash and litter.
- Destruction of aquatic and riparian habitats.
- Deforestation along the stream banks due to flood control projects.
- Stormwater runoff.

In response to the above problems the study recommends the following management plans:

- Managing the Anacostia River as a whole rather than a series of separate jurisdictional responsibilities.
- Public education and information on attributes and problems of the Anacostia River.
- Stream valley park acquisitions.
- Increase considerations of environmental factors in land use plans.
- Maintain natural conditions along the river and its tributaries.
- Inspection and stricter enforcement of sediment control ordinances
- Provide a comprehensive stormwater management program for the Anacostia River watershed.

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

- Palustrine
  - Aquatic bed: 1 acre
  - Emergent: 209 acres
  - Scrub shrub: 119 acres
  - Forested: 1,682 acres
  - Unconsolidated bottom: 250 acres
  - Unconsolidated shore: 64 acres
- Riverine unconsolidated shore: 16 acres
- Total: 2,341 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	Permittee Mitigation	Programmatic Gains	Other Gains	Net Change
02140205	-28.23	32.33	0	1.11	5.21

The watershed is contained in both the Piedmont and Coastal Plain, although the Prince George's portion is entirely within the Coastal Plain. Channel morphology changes near

the boundary of the Piedmont/Coastal Plain physiographic regions. Significant sediment deposition normally occurs in the transition area downstream of the boundary. This is because the material which had been carried by the higher velocity flows from the Piedmont, settles out since it can no longer be transported by the slower flows of the flatter Coastal Plain province.

Wetlands are mainly around streams (Shanks, 2005). The Anacostia River watershed once had extensive areas of wetlands, particularly tidal freshwater wetlands. In its 1994 report, the U.S. Army Corps of Engineers, mentioned historical sources describing extensive marshes dominated by wild rice. There was an estimated 2,600 acres of tidal marsh in the Anacostia River extending to Bladensburg. The flood control projects in Prince George's County resulted in the loss of 800 acres of wetlands. This included 713 acres of wetlands along Northeast Branch and Northwest Branch and 134 acres along Indian Creek and Paint Branch. An additional 348 acres of area identified by the Corps of Engineers as bottomland hardwood, (USACE, 1994) which may also have included wetlands, was also lost. One Prince George's County flood control project was completed as recently as 1975. At the time of the 1994 report, an estimated 100 acres of vegetated tidal wetlands remained, primarily due to dredging and channelization of the entire tidal portion of the river in the 1920's and 1930's (USACE, 1994). The largest remaining tidal marsh is Kenilworth Marsh in the District of Columbia.

The elevation of the mud flats and their prolonged inundation during high tides are unfavorable conditions for supporting emergent vegetation. However, mudflats themselves may be important habitat for wildlife species such as shorebirds. Large debris is believed to abrade the shoreline and smother vegetation that may colonize the shoreline (USACE, 1994). However smaller sized debris piles often contain wetland seeds and vegetative propagules (Neff, 2002).

Remaining tidal wetlands in the Washington Metropolitan basin, which includes the Anacostia watershed, are of three major types: shrub swamp dominated by smooth alder and black willow, tidal swamp forest with red maple and ash, tidal fresh marshes with smartweed and rice cutgrass, and fresh marshes dominated by spatterdock. The estimated total acreage in the basin in Maryland is less than 300 acres (McCormick and Somes, 1982).

Native plants in the floodplains of Coastal Plain watershed include birch, elm, alder, willow, red maple, sycamore, and beech (USACE, 1994). However, extensive land clearing and landscaping has resulted in the introduction and spread of many non-native woody and herbaceous species.

Nontidal wetlands were likely historically supported by both overbank flooding and high ground water seepage as hydrology sources, as suggested by the description of hydric soils in the *Soil Survey of Prince George's County*. However, intense urbanization has resulted in incised stream channels, so that overbank flooding rarely occurs. Remaining wetlands may be drier than they were in times of less urbanization since the remaining hydrology is often from groundwater alone. Lack of overbank flooding would also reduce

the importance of the wetland as an area of floodwater attenuation. Remaining wetlands probably still provide water quality benefits by uptake and transformation of nutrients and sediment trapping. The nontidal wetlands most effective at nutrient transformation may be the wetlands on the very poorly drained Johnston soils with their high organic matter. The soil type is not common in the County, but there is an extensive area on the Beltsville Agricultural Research Center property. These wetlands are probably among the least disturbed in the watershed and include the Beltsville Bottomland Forest Nontidal Wetlands of Special State Concern.

Some wetlands on abandoned mine sites in the Little Paint Branch sub-watershed were found to support vernal pools and amphibian breeding habitat. Some vernal pools also exist as seeps from toes of slopes within the floodplain. A large wetland system of mature forest split by a utility right of way contains an area with bog conditions and a rare plant species. The site is known as McKnew Bog and may qualify as a Nontidal Wetlands of Special State Concern, though the site has not evaluated for formal designation. This site is also supported by seepage from adjacent slopes (Walbeck, 2004 Pers comm.).

In the Indian Creek sub-watershed, there are additional wetlands in sediment and wash ponds associated with a mining operation. The wetlands are largely dominated by *Phragmites*, and show little vegetative diversity. The major function provided by these wetlands is water quality improvement (Walbeck, 2004 Pers comm.). There is some evidence that *Phragmites* is one of the more effective plants for uptake of nutrients and some metals (Kobriger, et al., 1983). Some vernal pools, critical as amphibian breeding habitat, also exist in some of the mined areas. On the west side of I-95, a series of wetlands supported by groundwater seepage along the highway embankment contain a diverse bog plant community (Walbeck, 2004 Pers comm.). The site, Aitcheson's Bog, may also be considered for future listing as a Nontidal Wetlands of Special State Concern.

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. Stream segments within the Prince Georges County portion of this watershed are designated Use I, recreation contact and protection of aquatic life, unless designated below.

- Use III: natural trout waters; Paint Branch and all tributaries Above Capital Beltway (I-495)
- Use IV: recreational trout waters; Northwest Branch and all tributaries Above East-West Highway (Rt. 410)

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource 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 poor non-tidal benthic index of biotic integrity (BIBI), high impervious surface (33%), high population density, high historic wetland loss (16,720 acres), and high soil erodibility (0.31). Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning areas, trout spawning areas.

According to the 2002 303(b) report, data for the tidal mainstem and tributaries was inconclusive. The nontidal mainstem river fail to support all use due to bacteria. The nontidal wadeable tributaries fail to support all uses due to sewage, urban runoff, habitat alteration, and channelization. Data for Greenbelt Lake and Pine Belt was inconclusive.

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

- *Anacostia River* (non-tidal); poor biological community, heptachlor epoxide, PCBs in water, sediment, nutrients, biological oxygen demand.
- *Anacostia River* (tidal); sediments, nutrients, biological oxygen demand.
- *Beaverdam Creek* (non-tidal); poor biological community.
- *Lower Beaverdam Creek* (non-tidal); poor biological community.
- *Beaverdam Creek* (021402050816 non-tidal Prince Georges County); poor biological community.
- *Beaverdam Creek* (021402050823 non-tidal Prince Georges County); poor biological community.
- *Indian Creek* (non-tidal); poor biological community.
- *Northwest Branch* (non-tidal); poor biological community.
- *Northwest Branch* (021402050818 non-tidal); poor biological community.
- *Northwest Branch Unnamed Tributary* (021402050818 non-tidal); poor biological community.
- *Cattail Branch* (021402050816 non-tidal in Prince Georges County); poor biological community.
- *Paint Branch* (non-tidal); poor biological community.
- *Little Paint Branch* (non-tidal); poor biological community.
- *Little Paint Branch* (021402050825 non-tidal); poor biological community.
- *Sligo Creek* (non-tidal); poor biological community.
- *Sligo Creek* (021402050821 non-tidal); poor biological community.

TMDLs have not been completed yet for the Maryland portion of the river, but have been completed biological oxygen demand (BOD) and total suspended solids within the District of Columbia's portion. While the 2001 TMDL for BOD does recommend reductions in nitrogen and phosphorus loads, it does not establish a TMDL for these pollutants. The TMDL does conclude that water from both Maryland and DC contributes to the low summer DO. It also concludes that reducing the BOD would improve the DO levels. Sources of BOD in Maryland are nonpoint sources (e.g. stormwater outfalls) while in DC they are nonpoint (e.g. stormwater outfalls) and point sources (combined sewer overflows). This TMDL recommends a 50% BOD reduction and a 30% nutrient

reduction for stormwater pollutants in Maryland and DC and a 90% reduction in BOD from combined sewer overflow. The District of Columbia's TMDL for Total Suspended Solids (TSS) recommended a TSS reduction of 86% for Maryland, and 83% for both DC's combined sewer overflow and DC's stormwater. The largest amount of TSS is entering from Maryland (Shanks, 2005).

A Draft TMDL was completed in 2005 for fecal bacteria in the Anacostia River. The main sewage treatment plants are Blue Plains Advanced WWTP and BPA WWTP, both discharging outside of the watershed. There are some septic systems in the northern portion of the watershed, around Sandy Spring, Spencerville, Beltsville, and north of Beltsville. Sources of fecal bacteria were largely domestic animals, human, and wildlife, followed by livestock.

Overall watershed water quality problems include combined sewer overflows, urban runoff, construction and surface mining erosion, and localized point sources. Poorest water quality was located in the channelized Northwest Branch, followed by lower Beaverdam Creek and Little Paint Branch. Water quality has improved slightly in Indian Creek and declined slightly in upper Northwest Branch. Major water quality issues within this watershed include high amounts of sediment and bacteria, elevated water temperatures, and localized high nutrient or toxic contaminants (USEPA, 1989).

In 1989, Paint Branch still supported a trout population. However, this population is being stressed by channel scouring during storms, increased sediment, and general degradation of physical habitat within the main trout-stream – Good Hope tributary (a tributary of Paint Branch). It appears that watershed development is one of the greatest impacts. Another Paint Branch tributary – Upper Gum Springs – also supports trout, while mainly young-of-year trout. Several check dams were installed in this tributary to increase the number of pools and therefore the number of adult trout (USEPA, 1989).

Nine subwatersheds were selected as priority: Sligo Creek, Hickey Run, Indian Creek, Northwest Branch, Upper Paint Branch, Beaver Dam Creek, Northeast Branch, Watts Branch, and Tidal estuary. Sligo Creek is one of the most urbanized tributaries to the Anacostia. Flooding and severe streambank erosion are the main problems. Little aquatic life is present. Hickey Run, within the District of Columbia, is highly impacted by upstream commercial and industrial pollution, including oil spills, stormwater runoff of oil and grease, bacteria, BOD, trace metals, pH, DO, and phosphates. Indian Creek meanders through several active and abandoned sand and gravel mining areas, contributing large amounts of sediment to the waterway. The lower portion of Indian Creek, it is surrounded by urban, commercial, and residential areas, and turns into a concrete channel near its confluence with Paint Branch (USEPA, 1989).

A long-term water quality monitoring station near Alt Rte. 1 Bridge (near Bladensburg) shows that nitrogen decreased between 1986 and 2002, while phosphorus and sediment did not show this trend. The District of Columbia monitoring site, near the Maryland border, found low summer dissolved oxygen. Water sampling upstream conducted by Maryland found higher DO levels, but found elevated nitrogen, phosphorus, and bacteria.

Sedimentation is high on the Anacostia, near the Bladensburg Waterfront Park. Point source discharges contribute a relatively small amount of nutrients and bacteria to the waterway. Sources of bacteria are largely from stormwater runoff and leaks in the sanitary sewer system (Shanks, 2005).

A biological assessment was conducted for this County in 1999, 2000, and 2004. Benthic IBI was rated poor in subwatersheds Lower Northeast Branch, Brier Ditch, Upper Northeast Branch, Upper Beaverdam Creek, Indian Creek, and Paint Branch and was rated very poor in subwatersheds Northwest Branch, Sligo Creek, Upper Anacostia River, Lower Beaverdam Creek, and Lower Anacostia River. Habitat was rated poor in subwatersheds Upper Beaverdam Creek and Indian Creek and very poor in remaining subwatersheds (MNCPPC, 2005).

A nutrient synoptic survey was completed for the Anacostia River in 2004 (Primrose, 2005). Nutrients were generally low, as expected in a highly urbanized watershed. High nitrate/nitrite concentrations and yields were found at one station, likely due to a permitted discharge. Several other stations had moderately elevated nitrate/nitrite levels. Orthophosphate levels were low. High specific conductivity was found in the Beaverdam subwatershed and some of the other stations, likely due to road salt. Dissolved oxygen was marginal (<5 mg/L) in nine subwatersheds and supersaturated (>12 mg/L) in three other subwatersheds. Poor habitat scores were associated with these unusual dissolved oxygen levels.

Restoration/Preservation

Several watershed studies have been completed within this watershed.

- Anacostia River Basin Stormwater Retrofit Inventory study in 1989.
- Indian Creek and Paint Branch Water Quality and Stream Restoration Study was completed in 1996. This study ranks restoration sites.
- Beaverdam Creek Watershed study. Two wetland mitigation sites were chosen to compensate for wetland impacts from the Wilson Bridge project.
- Anacostia River watershed WRAS

A WRAS is currently underway for the Prince Georges County portion of this watershed. This WRAS will focus on minimizing surface water runoff through use of Low Impact Development techniques, Bayscaping, and Green Buildings, and addressing the issue of invasive plants. The WRAS will prioritize stream restoration projects. As part of the WRAS process, Stream Corridor Assessments have been completed for Indian Creek, Lower Beaverdam Creek, and the Upper Direct Anacostia River subwatersheds. Benthic macroinvertebrate monitoring and fish monitoring have occurred throughout the watershed. Nutrient monitoring occurred for selected subwatersheds (Prince Georges County, 2004 NPDES).

The WRAS characterization potential wetland restoration sites as those with: hydric soils within areas of inadequate riparian buffers (e.g., open land - agriculture, lawn, barren) (Shanks, 2005).

Based on a GIS assessment of vegetated stream buffer, 73% (132 miles) of the streams had some natural vegetation, 14% (24 miles) were lacking natural vegetation (e.g., they were mowed grass, agriculture, or barren land), and 13% were developed. Of the streams with inadequate natural vegetated buffers, about 10 miles were adjacent to hydric soils (Shanks, 2005). These might be good sites for wetland restoration.

Examples of existing stream restoration projects within the watershed include (Prince Georges County, 2004 NPDES): 7th Street, Glenarden; Cabin Branch 24; Wynnleigh Road Place; Capitol Heights; Calmos Street; and Quincy Manor Run. Proposed projects include: Quincy Manor Run stream restoration and Wetland Creation for Wilson Bridge Mitigation.

Examples of basinwide pollution controls that have been implemented include (USEPA, 1989):

- Improving combined sewage systems
- Stormwater retrofits (e.g. Wheaton Branch stormwater retrofit)
- Point source controls (e.g. at Mineral Pigments Plant on Indian Creek and at Hickey Run METRO site)
- Controls on new development (including urban BMPs to control stormwater runoff and construction sediment)
- Surface mine reclamation (e.g. Magruder/Rawklins)

The Migratory Fish Barrier Working Group identified sites where there were barriers to herring migration (USEPA, 1989). Since the publication of this report, these sites have likely already been restored:

- Northwest Branch weir behind PG-MNCPPC offices (restoration was scheduled to begin in 1990)
- Northwest Branch 38th Street dam in Hyattsville
- Northwest Branch sewer encasements (200 yards upstream from 38th Street dam).

To reduce flooding, around 1949, the USACE channelized 14,400 feet of Anacostia River and built 28,000 feet of levees between US Rte. 50 and Riverdale Road. This resulted in the loss of 178 acres forest, 620 acres wetlands, and 37,000 linear feet of stream aligned. The Anacostia Watershed Restoration Committee developed a Six Point Action Plan to protect and enhance existing wetlands and create new wetlands to provide filtering. Prince George's County is working to environmentally and economically restore Bladensburg waterfront. This will include creating tidal and non-tidal wetlands along the Anacostia River and the Northeast and Northwest Branches with the objectives of increasing wetlands acreage, improving water quality, enhancing wildlife habitat, and maximizing waterfront views (Prince Georges County, 2004 NPDES).

State-designated Green Infrastructure is scattered though this watershed, with most hubs being around Greenbelt and most corridors being south and west of these. The hubs are mostly protected by National Agricultural Research Center, Greenbelt Regional Park, Paint Branch Park, and Northwest Branch Park, and other County-owned properties.

Other areas, especially along the corridors, are unprotected. Since some areas within the GI network are considered as gaps, areas currently in a land use other than natural vegetation, these may be desirable locations for restoration. Other smaller, locally important potential forest interior habitat is located in Capitol Heights, Glenarden, College Park, and Riverdale Park (Shanks, 2005). According to the 2000 Maryland Greenways Commission document, there are several existing or potential greenways including:

- *Anacostia Tributary Trails System*
- *Beaverdam Creek*
- *Indian Creek*
- *Little Paint Branch*
- *Northeast Branch*
- *Northwest Branch*
- *Sligo Creek*
- *Cabin Branch*
- *Chesapeake Beach Rail Trail*
- *DC Trolley Right-of-Way Rail Trail*

The Prince George's Countywide Green Infrastructure Plan identifies several specific areas which should be carefully considered when land development proposals are reviewed in the vicinity to ensure that their ecological functions are protected or restored. These areas include:

- Beltsville Agricultural Research Center – 7,000 acres.
- Greenbelt National Park – 1,100 acres.
- Main Stem of the Anacostia River.

There are designated Nontidal Wetlands of Special State Concern within the Prince Georges County portion of this watershed.

- *Beck Woods*. These pine-oak forests have some of the highest densities of neotropical migrant breeding birds, including many forest interior dwelling bird species. This site is part of a large contiguous forest land owned by the federal government. This site contains a rare plant species near the lake. There is also a high quality wetland that provides important habitat for amphibians, songbirds, and waterfowl. It is likely that other rare wetland plants still occur at this site. Beck Woods, Beltsville Bottomland Forest, Beltsville Airport Bog, and Beltsville Forest and Meadow are nearly contiguous Nontidal Wetlands of Special State Concern (DNR, 1991). The wetlands have often been used for research. Main threats include forest fragmentation or forest clearing, which would lead to invasion of non-native plant species and would change the quality/quantity of the water. The use of heavy machinery to maintain the powerline right-of-way should be minimized. Automotive traffic on the near-by dirt road should also be minimized. This site is within USDA land. (McCarthy et al, 1988).
- *Beltsville Airport Bog*. This diverse unforested wetland complex includes a large shrub bog, open water channels, hummocks, and wet meadow. Non-forested wetlands of this size are unusual in central Maryland. There are two rare plant species and a rare insect. Additional rare plant species may be present at this site.

The dense shrub wetland is excellent habitat for birds. In addition to providing unique habitat, this system is part of a larger contiguous forest system. The main threat is upland development. Recent grading by (USDA) on the east side has resulted in a steep bank adjacent to the wetland and a drainage pipe draining directly into the wetland, which may be having a negative impact on the system. Forest clearing should not be permitted within the site. Some trees have already been cleared on the east side. A better forest buffer should be established around the wetland complex, including a 50foot buffer along streams feeding the wetlands. Any upstream alterations should be designed to not impact water quality/quantity. This site is located within USDA land. Agencies should be contacted regarding the significance of this site. (McCarthy et al, 1988).

- *Beltsville Bottomland Forest*. This bottomland deciduous forest contains a diverse array of birds, including forest interior dwelling birds. This site is located within a USDA research forest and is part of a large contiguous forest owned by the federal government. Main threats include forest clearing, upstream pollution, and forest fragmentation (including of forest corridors). (McCarthy et al, 1988).
- *Beltsville Forest and Meadow*. This site contains habitat for forest interior dwelling species, major ecological research, and rare plant species. Most of this site is within a designated USDA Research Forest. A powerline right-of-way contains three rare plant species, both in upland and wetland areas. An addition species is known here historically, but was not found during this survey. Beck Woods, Beltsville Bottomland Forest, Beltsville Airport Bog, and Beltsville Forest and Meadow are nearly contiguous Nontidal Wetlands of Special State Concern. The wetlands have often been used for research (DNR, 1991). Main threats include forest clearing and fragmentation. Currently, trash in the southeast corner presents the risk of water pollution and there is evidence of recent bulldozer activity near the wetland. Powerline right-of-way maintenance should be sensitive to the rare species there (e.g. mowing after fruiting but before germination). (McCarthy et al, 1988).
- *Beltsville Seasonal Ponds.* This site contains two seasonal ponds, with no inflowing or outflowing streams. These ponds are uncommon in the upper Coastal Plain and provide unique habitat for drawdown species, including one rare species. The site has often been used for research and provides excellent breeding habitat for salamanders and breeding habitat for migratory songbirds (DNR, 1991). More visits may result in the identification of more rare species. The main threats are alteration of groundwater hydrology. (McCarthy et al, 1988). This site is within USDA land.
- *Buck Lodge Road Bog*. Woody vegetation suppression within a powerline right-of-way has resulted in an acidic sphagnous seep, a rare habitat in current times. This site contains four rare species and an additional uncommon plant species. Since the rare species are poor competitors, they are only found in habitats within stressful conditions (e.g. low nutrients, acidic), such as this site. Main threats include changes to the water quality/quantity. Maintenance to the powerline right-of-way should be designed to be least damaging to the rare plant species. Recreational vehicles should be prohibited and other access should be limited.

Adjacent forest clearing should be discouraged. (McCarthy et al, 1988). This site is not currently protected.

- *Route I-95 Bog*. This powerline right-of-way supports rare wetland (acidic sphagnous bog) and upland plant communities. Of the several historical bogs having similar characteristics, this may be one of the few remaining in the County (with Suitland Bog being the other). There are two rare wetland plant species and one rare upland species. Powerline maintenance should be designed to support the sensitive nature of the plants. Additionally, water quality/quantity should not be degraded. (McCarthy et al, 1988). This site is protected by County-owned land.
- *Potential WSSC*. There are several WSSC locate as follows: just east of US Naval Surface Weapons Center, in Beltsville Heights, near Old Gunpowder Road, along Indian Creek (south of Beltsville Bottomland Forest WSSC), adjacent to Beltsville Forest and Meadow WSSC, and adjacent to Route I-95 bog (just to the south of Route I-95 bog WSSC). Some of these sites are not protected.

A Stream Corridor Survey was completed for the Anacostia River in 2003 through 2004 (Pellicano and Yetman, 2005). Of the 76 miles of stream and 197 miles of the Anacostia River surveyed, 756 potential problem sites were identified. The most frequent potential problems were pipe outfalls (378 sites). There were many inadequate stream buffers (85 sites), often ranked severe or very severe. Many of these sites along the Anacostia River have paved surfaces on one or both sides of the waterway. Livestock was present at one site (157101). Some areas with inadequate forest buffers also fall within green infrastructure gaps (sites 129201, 174102, 174103, 190201, 510202). Planting these areas is especially desirable. Another problem was erosion (69 sites), with some sites threatening infrastructure, including parking lots and roads. Fish barriers (68 sites) ranged from minor to moderate in severity. Other problems included channel alteration (62 sites), exposed pipes (58 sites), trash dumping (18 sites), unusual conditions (15 sites), and in- or near- stream construction (3 sites). This survey also estimates how easily the problem can be corrected.

Stream restorations and wetland creation/restoration/enhancement projects have been completed in this watershed, with some examples including (Prince Georges County, 2005):

- Wetland and stream restoration at Northwest Branch/Fordham Street
- Quincy Manor Run Stream Restoration
- Oxwell Lane Stream Restoration
- Capitol Heights Stream Restoration

In the northern part of the Indian Creek sub-watershed, some wetlands have developed or been expanded as a result of mining activities. There are also some disturbed areas that may be suitable for creation, restoration, or enhancement. There are other areas along Indian Creek that were investigated for mitigation purposes, though these were primarily for stream restoration. There were opportunities noted for riparian buffer enhancement, removal of fish blockages, but opportunity to re-establish floodplain connections were fair to poor. Small areas of filled wetlands were also noted (Walbeck, 2004 Pers comm.).

Despite the extensive development, a number of partially forested stream valley parks and several Nontidal Wetlands of Special State Concern remain. Enhancement opportunities may exist in the stream valley park, though wetlands may be limited. Parks to be investigated under the Corps study include Northwest Branch, Paint Branch and Beltsville Community Park. Some opportunity may exist also on Beltsville Agricultural Research Center (BARC) property. Several sites on BARC property have been used for wetland mitigation, and other opportunities may exist. Opportunities for expanding, enhancing, or increasing protection of the Nontidal Wetlands of Special State Concern are encouraged.

In 1993, approximately 32 acres of tidal wetlands were created using dredged material at Kenilworth Marsh in the District of Columbia. In 2000, 27 acres were restored at Kingman Marsh in the District of Columbia using dredged material. In order to measure success, one of the reference sites for comparison was at Dueling Creek in Prince George's County. This site is one of the few remaining marshes in the Anacostia system. Prior to channelization however, the marsh may have part of the Anacostia River bottom. The site has also been used or recommended as a reference site for other tidal restoration projects. In restoring tidal freshwater wetlands, critical factors for success include establishing correct elevations, excluding goose predation by mechanical means or selection of plant species not preferred by geese, and consideration of natural revegetation potential and whether or not planting is appropriate (Neff, 2002).

The goal for restoration in Prince George's County in the Corps project was to restore fish and wildlife habitat. Potential sites were investigated in Prince George's County in Bladensburg, but were rejected as it was considered infeasible to restore wetlands maintaining the integrity of the flood control project (USACE, 1994). In the 1994 Corps of Engineers feasibility report, 34 sites in the entire watershed were evaluated as possible wetland creation sites. Additional sites were evaluated for wetland creation as part of retrofit stormwater projects. Some of these projects have since been constructed. Several wetland/stormwater retrofit were constructed in Montgomery County in the Paint Branch watershed in 2000, and three similar projects were completed in the Prince George's County portion of the watershed in 2001-2002: Indian Creek Stormwater Management Facilities Nos. 10 and 5, and the Greenleaf Road Stormwater Management Facility. The three projects created 1.1 acres of wetlands. Approximately 3.5 acres of wetlands were created in the floodplain of Northwest Branch near Fordham Street.

Restoration recommendations:

- Restore gaps in green infrastructure areas (both State and County-designated) to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Enhancement opportunities may exist in the stream valley parks Northwest Branch, Paint Branch and Beltsville Community Park, and Beltsville Agricultural Research Center (BARC) property.
- Encourage expanding, enhancing, or increasing protection of the Nontidal Wetlands of Special State Concern.

- In the northern part of the Indian Creek sub-watershed, there are also some disturbed areas that may be suitable for creation, restoration, or enhancement. Indian Creek subwatershed also has some possible sites for stream restoration, including riparian buffer enhancement and removal of fish blockages (Walbeck, 2004 Pers comm.).
- Recommendations based on the Stream Corridor Survey for the Anacostia River (Pellicano and Yetman, 2005): inadequate stream buffers, especially when they are also green infrastructure gaps (sites 129201, 174102, 174103, 190201, 510202), erosion, fish barriers.
- Recommendations based on The Anacostia Watershed Restoration Committee's Six Point Action, including by restoring tidal and non-tidal wetlands along the Anacostia River and the Northeast and Northwest Branches with the objectives of increasing wetlands acreage, improving water quality, enhancing wildlife habitat, and maximizing waterfront views (Prince Georges County, 2004 NPDES).
- Recommendations based on watershed studies:
    - Anacostia River Basin Stormwater Retrofit Inventory study in 1989.
    - Indian Creek and Paint Branch Water Quality and Stream Restoration Study was completed in 1996.
    - Beaverdam Creek Watershed study.
    - Anacostia River watershed WRAS when completed.
- Restore/create wetland designed for water quality improvement (especially for biological oxygen demand (BOD), total suspended solids, nitrogen, and phosphorus loads – based on TMDL for DC).
- The Joint Agency Committee recommends stream valley park acquisitions.
- Priority subwatersheds: Sligo Creek, Hickey Run, Indian Creek, Northwest Branch, Upper Paint Branch, Beaver Dam Creek, Northeast Branch, Watts Branch, and Tidal estuary.
- Recommendations based on the ICPRB document entitled *Anacostia The Other River*:
    - Sligo Creek: Main problems are severe streambank erosion, sedimentation, flooding, poor aquatic life, and high amounts of bacteria.
    - Northwest Branch: Main problems are sedimentation, unstable banks, bacteria, trash.
    - Paint Branch: Main problems are local channel erosion, sediment deposition, unique resources (naturally reproducing brown trout) being threatened by urbanization.
    - Little Paint Branch: Main problems are severe streambank erosion and sedimentation.
    - Indian Creek: Main problems are severe sedimentation, inadequate riparian buffer, dump sites, trash, poor floodplain buffer. This subwatershed (along with Lower Beaverdam Creek) has the worst water quality in the Anacostia watershed.
    - Beaverdam Creek: Main problems are fine sediment from dirt roads and agriculture.
    - Northeast Branch: Main problems are severe streambank erosion, sedimentation, poor aquatic life.

    - Lower Beaverdam Creek: Main problems are high sedimentation, bacteria.
- Recommended Environmental Stewardship. The following options were described in the Draft Environmental Impact Statement/Draft Section 4(f) Evaluation: InterCounty Connector I-270 to US 1. Vol. 1 (2004). A portion of the Anacostia River watershed is in the study corridor for the proposed highway.
    - Improve water quality and instream habitat.
    - Increase acreage of wetlands and forest.
    - Decrease stream channel erosion.

Protection recommendations:

- Protect wetlands and streams within the headwaters.
- Protect green infrastructure areas (both State and County-designated) especially along the waterways.
- Protect Nontidal Wetlands of Special State Concern and their buffers.
- Protect additional wetlands within designated Ecologically Significant Areas.
- Protect vernal pools and amphibian breeding habitat.
- Protect McKnew Bog (Walbeck, 2004 Pers comm.).
- Protect Aitcheson's Bog (Walbeck, 2004 Pers comm.).