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Background

Based on MDP 2002 GIS land use data, Howard County has 1,432 acres of open water and 160,736 acres of land. The land acres are divided as follows: urban 64,804 acres (36%), agriculture 45,894 acres (25%), forest 49,509 acres (39%), wetlands 46 acres (<1%) and barren land 484 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this section, are preferred.

The majority of the County is within the Piedmont Plateau physiographic province, and the remaining portion, along Anne Arundel County, is within the Atlantic Coastal Plain province. The topography is generally rolling. Elevations range from 20 to 875 feet, increasing as you go west. Main drainageways are the Patuxent, Little Patuxent, and Patapsco Rivers. Of the soils suitable for agriculture, roughly nine percent need artificial drainage. Only five percent of the soils are classified as poorly drained. The presence of water impoundments on the Patuxent and Patapsco Rivers makes good habitat for fish and waterfowl (Matthews and Hershberger. 1968).

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

The following information is based on the *Howard County General Plan 2000*. Howard County is bounded by the Patuxent and Patapsco Rivers. Public drinking water is largely from Baltimore City water system, located in Carroll and Baltimore Counties, and from the reservoirs along the Patuxent River. County streams are often located within narrow valleys having steep slopes. Wetlands are often associated with the streams. While much of the land along the main stem and main eastern tributaries are protected, protection gaps exist in the western tributaries and feeder streams. While anadromous fish spawning area once existed in the Patuxent and Patapsco Rivers, populations throughout the Chesapeake region declined in the 1970s and 1980s. Native trout populations are present in the upper Patuxent and Patapsco reaches, indicating good water quality and habitat.

The General Plan recommends the following:

- *Protect and restore streams and their buffers*. Many areas in the East have lost the forested riparian buffer and wetlands due to development. These areas should be restored where possible.
- *Protect wetlands*.

- *Protect the 100-year floodplain*.
- *Protect steep slopes*. Areas having both steep slopes and highly erodible soils, adjacent to waterways should be protected.
- *Protect habitats for threatened and endangered species*.
- *Protect the watershed of Patuxent Reservoirs*.
- *Protect and restore forest and other natural habitats*.
- *Conduct water quality and wildlife habitat restoration, creation and enhancement on County-controlled land*.

Based on the Howard County General Plan, regulations were as follows: A 75-foot undisturbed buffer should be maintained along perennial streams in areas zoned residential. A 50-foot buffer should be maintained along intermittent streams and along perennial streams in areas not zoned residential. Since the time of this General Plan, these regulations have been strengthened to include a 100 foot stream buffer for Use 3 and Use 4 streams. A 25-foot undisturbed buffer is required around all wetlands. Development is prohibited within the 100-year floodplain. There are also regulations that protect large areas of steep slopes (>25% slope).

There are two State-designated 6-digit watersheds and seven 8-digit watersheds in this County. Patuxent River (021311) includes Patuxent River upper (02131104), Little Patuxent River (02131105), Middle Patuxent River (02131106), Rocky Gorge Dam (02131107) and Brighton Dam (02131108). Patapsco River (021309) includes Patapsco River Lower North Branch (02130906) and South Branch Patapsco (02130908).

Streams

Stream corridor assessments and biological assessments (with habitat assessments) have been completed for all watersheds in the County. Biological assessments were completed by Howard County Department of Public Works Stormwater Management Division and Tetra Tech, Inc. Overall, the County had a benthic population score of poor and a habitat score of non-supporting. The subwatersheds were rated as follows:

- *Little Patuxent*: benthic – poor; habitat – nonsupporting
- *Upper Brighton Dam*: benthic – fair, habitat – partially supporting
- *Lower Brighton Dam*: benthic – fair, habitat – non-supporting
- *Cattail Creek*: benthic – fair; habitat – non-supporting
- *Middle Patuxent*: benthic – fair; habitat – nonsupporting
- *Rocky Gorge*: benthic – fair; habitat – nonsupporting
- *Hammond Branch*: benthic – poor; habitat – nonsupporting
- *Dorsey Branch*: benthic – poor; habitat – nonsupporting
- *Patapsco*: benthic – poor; habitat – partially supporting

Additional volunteer water quality (biomonitoring) sampling was completed for Cattail watershed, Patuxent, Middle Patuxent, Little Patuxent, Deep Run, Patapsco and Hammond (Howard, 2004).

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 Counties). 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.

The Maryland Tributary Strategies document *Patapsco/Back River Final Version for 1985-2002 Data: January 29, 2004* describes the success of BMPs in the Patapsco/Back River Watershed (an area containing Baltimore City and parts of Anne Arundel, Baltimore, Carroll, and Howard Counties) like this:

> BMP implementation for shore and soil erosion control, agricultural nutrient management plans, for buffers, marine pumpout installation, septic connections, and stormwater management are all making progress toward Tributary Strategy goals. Progress has been slower for other issues, such as stream protection, forest conservation and tree plantings, grassed buffers, animal waste management, runoff control, septic pumping, and urban nutrient management.

Land use for the entire watershed is dominated by urban (55%), followed by forest (24%) and agriculture (21%). About 95% of the houses are on public water and 93% are on municipal sewage. There are six municipal sewage plants in this basin. Of these, three have Biological Nutrient Removal (BNR) and two others are planned to get BNR installed by 2010. The main nitrogen, phosphorus, and sediment sources within the entire basin were point sources (75%, 51%, and 0%, respectively), urban sources (19%, 41% and 53%, respectively) and agriculture (4%, 4%, and 32%, respectively). Tributary stations sampled had total nitrogen generally ranked as poor to fair. Poor sites were located at North Branch Patapsco River (MD Rte. 91), Patapsco River, and Back River. Levels had improved at most stations during the period 1985-2002. Total phosphorus was ranked poor to good. Sites ranked poor were Patapsco River (mouth) and Back River. Most stations had improved during the period 1985-2002. Total suspended solids were ranked good except at Patapsco River (near the mouth) and Back River. Abundance of algae was ranked poor at the two sites sampled. Dissolved oxygen was ranked as poor at Patapsco River (near the mouth). SAV abundance was way below the SAV goals. In

1995-2000, benthic communities were severely degraded along Patapsco River and moderately degraded along Back River.

Wetlands

Wetland Classifications

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along waterways, with higher concentrations in the western portion of the County. According to Tiner and Burke (1995), in 1981-1982 there were 3,117 acres of wetlands (0.5% of the State's total). The wetland types were Palustrine (2,977 acres), Riverine (26 acres), and Lacustrine (114 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 64%, or 5,627 acre, loss (MDE, 2002).

Wetlands in Howard County occur in floodplains of streams, at the heads of drainageways, and on rare occasions in isolated depressions. The supporting hydrology of nontidal wetlands is primarily through groundwater or a combination of groundwater and overbank flooding. Wetlands may also occur at the bases of slopes, where they are supported by seepage from the hillside.

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

- 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 Piedmont Province.
    - Palustrine forested wetlands are often found in stream floodplains. They can be categorized into two main types.
        - Seasonally flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. greater than two weeks) during the spring. Common tree species include Red maple, Black willow, and Green ash. There is often a dense understory of shrubs (e.g. Spicebush and Southern arrowwood) and herbaceous species (e.g. Skunk cabbage). Tiner and Burke gave an example of a seasonally flooded forested wetland community within Frederick County. The example was a Silver maple-Black willow dominated community. Associate tree species were Red maple, shrub species were Alder and Dogwood, and herbaceous species were Jewelweed, Joe-Pye weed, Blue vervain, Lurid sedge, and Big arrowhead.
        - Temporarily flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. a week or less) during the spring, less than that in the seasonally flooded forested wetlands. These systems may contain Red maple, Sycamore, Green ash, Silver maple, Pin oak, Tulip poplar, Black walnut, Black locust, or Box elder. The shrub layer may be less dense than in the seasonally flooded system. Temporarily flooded forested wetlands along the

Potomac River floodplain are often dominated by Eastern cottonwood and Silver maple, with some Sycamore and Black willow. Tiner and Burke give two examples of wetland communities found within Frederick County. The first system, a Green ash-Sycamore-Box elder dominance, was found along Bennett Branch. Associate tree species were Pawpaw, Ironwood, Beech, Hackberry, and Tulip poplar. Associate shrubs species were spicebush and elderberry, herbaceous species were wood nettle, garlic mustard, wood sorrel, Lady's thumb, False nettle, and clearweed. Other associate vine-like species were Virginia creeper and poison ivy. The second example was a Red Maple dominance. Associates tree species were Sycamore, Box elder, and Silver maple. Shrub species were Multiflora rose, herbaceous species were Jewelweed and Goldenrod, and other species were Japanese honeysuckle and Blackberry.

  - Palustrine shrub wetlands contain shrubs and tree saplings. The wetter systems are often dominated by Bottonbush, while the drier seasonally flooded systems may be dominated by a number of different species. Herbaceous species may form an understory.
  - Palustrine emergent wetlands:
    - Semipermanently flooded marsh
    - Seasonally flooded marsh: These systems may be dominated by cattail, rice cutgrass, arrow arum, and rush.
    - Seasonally flooded meadow: This is the most common wetland type in the region. These systems would naturally be forested wetlands, but were cleared. Many have high plant diversity.
    - Temporarily flooded wet meadow: These systems may be adjacent to the seasonally flooded meadows, but they are flooded less often and for shorter durations.
  - Palustrine aquatic beds are small ponds with partial or total vegetative cover.
- 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).

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.

Land use changes have likely caused some alteration in Howard County wetlands' capacity and opportunity for providing some flood attenuation. Development and increases in impervious surfaces have resulted in stream channel erosion and downcutting of stream channels. This has in some instances resulted in less out of bank flooding for low intensity storm events, thus less opportunity for adjacent wetlands to provide the flood attenuation function. The downcutting of the stream also results in a lower elevation of the base flow, which is often paralleled by a lowering of groundwater levels in adjacent wetlands. In other instances, increased development that caused additional flashiness and higher peak flows may result in additional flooding and more opportunity for adjacent wetlands to reduce flood damages to property. Some floodplain wetlands are also found in pasture land with little natural vegetation. Lack of dense vegetation reduces the ability of a wetland to slow velocities of floodwaters, further reducing the flood attenuation function. Floodplains are relatively narrow, which is another limitation to the storage capacity of wetlands in the floodplain. In areas of less development, headwater streams still may provide some flood attenuation functions.

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.

Many Howard County wetlands exist in association with springs that provide baseflow to streams or are developed in water sources for livestock.

Modification of Water Quality

Water Quality Improvement

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

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

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

Nutrient Cycling: Addition, Removal and Transformation

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

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

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

with relatively higher elevations. A longer retention time allows for chemical interactions and plant uptake to occur.

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

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. Wetlands adjacent to coldwater streams in Howard County also aid in providing shade to maintain cool temperatures for aquatic species such as trout.

Nontidal Wetlands of Special State Concern (WSSC)

There are several State-designated Nontidal Wetlands of Special State Concern scattered through the County. These are described in the section for the individual watersheds.

Wetland Restoration Considerations

Hydric soils suggest where wetlands are currently or were historically. There are many "poorly drained" hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), especially along waterways. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

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 the small water systems in the County, withdrawing from unconfined aquifers, are susceptible to nitrates, VOCs, microbiological contaminants, and radon (MDE, 2003). Source water assessments were also completed for the Patuxent Reservoirs.

Howard County is part of the Patuxent Reservoirs Watershed Protection Program (Howard, 2004)

Other Relevant Programs

Green Infrastructure and Greenways
Long State-designated Green Infrastructure hubs run along the Patuxent and Patapsco Rivers. Other smaller hubs and corridors are located throughout the County. Areas within the GI network that are currently unprotected should be protected. There are also small 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 section on the individual watershed.

The 2005 Recreation, Parks and Open Space Plan identified several greenways, including two regional, the Patuxent and the Patapsco, and seven primary, Long Corner Connector, Cabin Branch, Cattail Creek, Middle Patuxent, Little Patuxent, Hammond Branch, and Deep Run.

Ecologically Significant Areas
DNR designates areas that contain habitat for rare, threatened and endangered species and rare natural community types. These areas are buffered to create the "sensitive species project review areas" GIS layer, intented to assist in assessing environmental impacts and reviewing potential development changes. This layer generally includes

designated Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.

Natural Heritage Areas
There are no State-designated Natural Heritage Areas (NHA) located in this County.

Priority Funding Areas
A large Priority Funding Area encompasses the entire Eastern portion of the County, with no PFAs in the remainder of the County. It may be less desirable to restore large wetland areas within the PFAs, unless they are incorporated into the park system or in areas that do not have high development potential (e.g. floodplains).

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.

Rural Legacy
Designated Rural Legacy land is located along the Upper Patuxent River, and includes the Patuxent River State Park. Land currently protected through Rural Legacy easements is located near, but not adjacent to the State Park. For detailed information about the program, refer to the individual watershed section.

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 the individual 8-digit watersheds is as follows:

Patuxent River Upper (02131104)

Background

Based on MDP 2002 GIS land use data the Howard County portion of the Patuxent River upper watershed has 1,753 acres of land. The land acres are divided as follows: urban 948 acres (54%), agriculture 100 acres (6%), forest 702 acres (40%), and barren land 3 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.

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 detailed information about sections of the watershed within those Counties, please refer to the sections on those Counties. The watershed contains the mainstem of the Patuxent River. 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. Brown and rainbow trout are stocked in the Patuxent River (Howard, 2004).

The entire Howard County portion of this watershed is within the designated Priority Funding Area. Wetland restoration that does occur should not compete with overall plans for development.

The main mapped wetland area (based on DNR and NWI GIS data) is along the Patuxent River. However, there are a few small scattered wetlands.

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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 (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
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. All stream segments within the Howard 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. This watershed also has 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 (DNR, 2002).

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).

In the Anne Arundel County portion of this watershed, Stocketts Run was sampled by the Maryland Biological Stream Survey during the 1995-1997 sampling period. Fish IBI scores were ranked as fair and benthic scores were rated as poor. The physical habitat score was ranked as fair. Five of nine physical habitat scores were ranked as sub-optimal, three were ranked as marginal, and one score (epifaunal substrate) was ranked as poor. Fish species found included American eel, Blacknose dace, Green sunfish, Least Brook Lamprey, Tesselated darter, Rosyside dace, Swallowtail Shiner, and White sucker.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are several areas containing hydric soils that are not mapped wetlands (based on NRCS SSURGO

GIS data and NWI/DNR wetlands). Hydric soils that are not currently wetlands may be good potential sites for wetland restoration. In the Howard County portion of this watershed, most of these areas appear to be developed, so restoration may not be realistic in all areas. However, some of these areas may still be possible (e.g. along the Patuxent River, near Rocky Gorge, at the northern portion of High Ridge Park).

There is only a small amount of Green Infrastructure within the Howard County portion of this watershed, along Rocky Gorge (DNR, 2000-2003).

There are no State-designated Nontidal Wetlands of Special State Concern in the Howard County portion of this watershed.

Specific recommendations for restoration:

- Restore areas along the scenic Patuxent River and tributaries.
- Restore wetlands and streams within the headwaters.

Specific recommendations for protection:

- Protect areas along the scenic Patuxent River and tributaries.
- Protect wetlands and streams within the headwaters.

Little Patuxent River (02131105)

A large portion of this watershed is within Anne Arundel County. Please refer to the section on that County for additional watershed-specific information

Background

The Little Patuxent River watershed encompasses over 66,200 acres in Howard and Anne Arundel Counties. The watershed contains a variety of land uses, including residential, commercial, industrial, institutional, parks, open space and agriculture. Based on MDP 2002 GIS land use data, the Howard County portion of the Little Patuxent River watershed has 141 acres of open water and 37,854 acres of land. The land acres are divided as follows: urban 23,284 acres (62%), agriculture 4,748 acres (13%), forest 9,488 acres (25%), and barren land 334 acres (1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred. Urban lands are projected to expand by 2020 to 74% of the watershed, while agriculture and forest lands will decline. This land use shift is likely to increase the existing pressures on water quality and living resources in the watershed (Shanks, 2001).

Headwaters are in the northeastern portion of the County, largely in agricultural land (Tetra Tech, Inc, 2001). Some of the Howard County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland. Some of these areas have already been developed.

Since this watershed is largely within the County's Priority Funding Area, substantial development has occurred, much of which was prior to stormwater management and environmental protection regulations. This has resulted in degradation of terrestrial and aquatic habitat. 25% of the forest is publicly-owned, with many having existing pathways or trails for recreational use. Other portions of forest are owned by a homeowners association, which may also provide opportunities for protection and restoration. Many of the forests are within the stream valley corridors. A 2001 forest assessment in publicly-owned land found that forest health is poor. While the majority of surveyed forests were near 100 years old, there was little forest regeneration, due be deer browse, invasive species, and human disturbance. These forests also had low diversity. Aquatic species have been negatively impacted by habitat loss/degradation (wetland and forestry loss), stream erosion, and stream channelization. While few fish species are currently present, the State has designated the lower portion of the watershed as having moderately high potential to contain rare fish and mussels. The Little Patuxent stream valley corridor is a County-designated greenway (Howard County DPW, 2002).

Wetland restoration within the designated Priority Funding Areas should not compete with overall plans for development.

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 as 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.

Brown and rainbow trout are stocked in the Little Patuxent River and Centennial Lake (Howard County DPW, 2004).

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along waterways, including along the Little Patuxent River, Dorsey Run, Hammond Branch. There are additional smaller wetlands that are not directly associated with waterways.

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

- Lacustrine unconsolidated bottom: 54 acres
- Palustrine
    - Aquatic bed: 12 acres
    - Emergent: 202 acres
    - Scrub shrub: 158 acres
    - Forested: 2,648 acres
    - Unconsolidated bottom: 345 acres
    - Unconsolidated shore: 13 acres
    - Farmed: 4 acres
- Riverine unconsolidated shore: 3 acres
- Total: 3,439 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)
02131105	-23.33	35.52	2.75	0.71	15.65

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. All stream segments within the Howard County portion of this watershed are designated Use I, recreation contact and protection of aquatic life, unless designated below.

- Use I-P: Recreation contact, protection of aquatic life, public water supply; Little Patuxent River and all tributaries Above Old Forge Bridge (1 mi. south of MD Route 198).

Water Quality

The Little Patuxent River is part of the headwaters for the Patuxent River Basin. As a result of this hydrologic location, water quality issues in Howard County's portion of the Little Patuxent River watershed have mostly local origins that can be addressed by local action. Nutrients in the Little Patuxent River system are mostly generated within the watershed and related issues like eutrophication of local lakes may be addressed by local action to control nutrient loads. (A minority of the total load is from atmospheric deposition.) However, most nutrients in the Little Patuxent River are transported downstream to the Patuxent River estuary before the water flows slow down enough for water quality problems to arise. For example, excessive algae growth in the Patuxent estuary during warm months is caused by high nutrient loads that arise from upstream nutrient sources including the Little Patuxent River.

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 phosphorus and nitrogen loadings, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal fish index of biotic integrity, poor non-tidal instream habitat index, high percent impervious surface (26%), high population density, high percent unforested stream buffer (40%), and high soil erodibility (0.29). Wetland loss was estimated to be 10,022 acres. Indicators for Category 3 include high imperiled aquatic species indicator and the presence of a drinking water intake.

According to the 2002 305(b) report, approximately 93 miles on nontidal, wadeable tributaries failed to support all designated uses, though results for nearly 30 miles of tributaries was inconclusive. Sewerage systems, urban runoff, habitat alteration, hydromodification, and channelization were sources of the pollution to the biological community. Centennial Lake in Howard County also failed to support all uses due to nutrients and siltation from nonpoint, upstream, and natural 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:

- *Little Patuxent River* (non-tidal); cadmium, nutrients, sediments.
- *Little Patuxent River* (021311050946 non-tidal in Anne Arundel County); poor biological community.
- *Little Patuxent River* (021311050948 non-tidal); poor biological community.
- *Little Patuxent River* (021311050954 non-tidal in Howard County); poor biological community.
- *Little Patuxent River* (021311050957 non-tidal in Howard County); poor biological community.
- *Unnamed Tributary to Little Patuxent River* (021311050946 non-tidal in Anne Arundel County); poor biological community.
- *Unnamed Tributary to Little Patuxent River* (021311050948 non-tidal); poor biological community.
- *Unnamed Tributary to Little Patuxent River* (021311050954 non-tidal in Howard County); poor biological community.
- *Unnamed Tributary to Little Patuxent River* (021311050957 non-tidal in Howard County); poor biological community.
- *Franklin Branch* (021311050949 non-tidal to Anne Arundel County); sediment.
- *Midway Branch* (021311050949 non-tidal to Anne Arundel County); sediment.
- *Dorsey Branch* (021311050952 non-tidal to Anne Arundel County); poor biological community.
- *Dorsey Branch to Little Patuxent River* (021311050952 non-tidal to Howard County); poor biological community.
- *Unnamed Tributary* to *Plumtree Branch* (021311050956 non-tidal to Howard County); poor biological community.
- *Towsers Branch* (021311050947 non-tidal in Anne Arundel County); poor biological community.

A TMDL of sediments and phosphorus was completed for the 50-acre Centennial Lake, and is summarized below. Surrounding land use is 24% forest/herbaceous, 39% agriculture, 35% development, and 2% water. There are no permitted phosphorus point sources. The Use-I designation for this lake is not supported due to high sediment loads, seasonal algal blooms (due to nutrients), and low dissolved oxygen leading to fish kills. Since this lake is P-limited, and P binds to sediments, both sediments and phosphorus entering the lake should be reduced. In order to meet the TMDL, phosphorus loads need to be reduced by 51%. Important factors to achieve this reduction include implementation

of the Tributary Strategies, nutrient management plans for agriculture (implement BMPs), and future monitoring and TMDL evaluation.

Fish species and their relative abundance are reflective of the habitat in each section. Fish communities and physical habitat received fair to very poor rankings in Howard County sampling sites in 1997. Scores in Dorsey Run in Anne Arundel County were rated as good in this same sample period. Fish in general were scarce due, most likely, to poor habitat for most species. The species that were common or abundant tend to adapt well to sandy, low gradient streams. Northern hogsuckers and longnose dace are both adapted to rocky riffle habitat. Both species are found in low abundance because there are few sections like that in the 3 sites sampled. Longnose dace and hogsuckers could be more common in the fall-line section at Savage where the habitat is suitable for them. Based on observations by DNR Fisheries Service personnel, the main problems affecting fisheries in this watershed are related to urbanization and all its associated impacts. Uncontrolled runoff from old developments and excessive runoff from sites that need retrofitting are two problems that generate erosion, destabilize streambanks, and thermally pollute the river. In 2000-2002 MBSS sampling results for five stations in the Anne Arundel County portion of the watershed, all sites received poor scores for the benthic IBI. Three scores for the fish IBI were good, one site received a ranking of fair.

The Little Patuxent River is stocked at Savage Mill Park for a very popular recreational trout fishery. A tributary in Anne Arundel County was identified as a reference stream in 1997 MBSS sampling.

Based on requirements in the County's NPDES permit, the County has conducted long-term water sampling in a tributary to the Little Patuxent River in the Font Hill neighborhood. Based on these samples, pollutant loads for medium density residential land was below the State average for all pollutants except nitrate-nitrite and total phenols. Benthic macroinvertebrate sampling included five stations within the Font Hill tributary subwatershed. These samples found the biological communities to be moderately disturbed. These samples suggest nutrient inputs, possibly from upstream agriculture. Volunteer water quality sampling rated Little Patuxent as fair and Hammond as poor. Hammond Branch Tributary has disturbed geomorphology, physical habitat, and biological community (Howard County DPW, 2004).

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There is a fair amount of hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands). These include most of the main waterways and tributaries. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

Stream corridor assessments have been completed for the Little Patuxent, Hammond Branch, and Dorsey Run (Howard County DPW, 2004). The following is based on the stream corridor assessment for the Howard County portion of the Little Patuxent River.

Of the 88 stream miles surveyed, 1,090 potential problems were identified. While the problems were found throughout the watershed, the majority were in more developed portions of the watershed. Pipe outfalls were the most common (529 sites). There were many inadequate stream buffers (119 sites). Most of these had mowed lawn as the dominant land use, followed by some agriculture and park land use. It may be possible to establish forested buffers in some of these areas, especially parkland. The majority of these sites were rated low to moderate in severity. Another problem was stream bank erosion (103 sites, most ranked low to moderate severity). Many erosion problems were found near Columbia, along Jonestown Tributary, Columbia Tributary #3, and the Little Patuxent River mainstem. Many of the erosion sites were directly downstream of poor stream buffer sites. Some of the other most common reported concerns were fish migration barrier (66 sites) and channelized streams (45 sites).

Watershed restoration plans were completed in 2005 for Centennial Lake and Wilde Lake.

The 2002 document entitled *Little Patuxent River Watershed Restoration Action Strategy* defines some watershed goals:

- Maintain and improve water quality for aquatic species and human health.
- Protect and restore habitat including forests, wetlands, meadows, lakes/ponds, instream habitat, and other natural areas.
- Encourage public stewardship.

A high priority of the WRAS is to prepare subwatershed management plans for protection and restoration. The WRAS prioritized problems sites for restoration based on weighted criteria, resulting in a list of 157 priority problem sites. The criteria were as follows:

- Primary emphasis
    - Problem severity (excluded sites with low or minor severity)
    - Problem type with higher ranking for sites with greatest impacts to water and habitat quality. Did not include sites with fish blockages, channel alteration, or trash problems
    - Proximity to erosion sites
- Secondary emphasis
    - On a headwater stream
    - Within a wetland
    - In or near a sensitive species area
- Least emphasis
    - Percent existing impervious cover
    - Change in percent impervious cover
    - Within a greenway

An impervious cover assessment was completed for this watershed, excluding the Hammond Branch subwatershed. Based on impervious cover, Centennial Lake subwatershed is the only subwatershed currently classified as “sensitive,” due to the low amount of impervious surface. However, expected future increases in impervious cover will make it “impacted.” Ten of the fourteen subwatersheds are already classified as

"non-supporting," based on the high amount of current impervious cover. This assessment also prioritized subwatersheds for future restoration. Criteria used were: stable subwatersheds having moderate impervious cover, subwatersheds with a low expected future increase in impervious surface, where restoration would likely show improvements, high amounts of publicly owned or homeowners association owned land, and areas that would compliment planning efforts (e.g. Rte. 1 Corridor Revitalization Study, Rte. 40 Corridor Study, Little Patuxent WRAS, urban lake restoration efforts, and the Little Patuxent greenway land acquisition priority area). While the majority of subwatersheds are not expected to see high increases in impervious cover, an exception if the headwaters of the mainstem Little Patuxent watershed (including the Hammond Branch watershed) (Howard County DPW, 2002).

There are linear Green Infrastructure hubs and corridors throughout the watershed, with the largest hub in the southern portion of the watershed. Green Infrastructure is generally associated with riparian areas. Green Infrastructure hubs are located around David W. Force Park and Centennial Park. Links or corridors connecting Green Infrastructure hubs, both inside and outside the WRAS area, primarily follow the Little Patuxent River mainstem's riparian area. As shown in the map, some edge areas of the corridor are already developed, which potentially limits protection and expansion opportunities. The majority of the Little Patuxent WRAS watershed does not appear on the map as Green Infrastructure. Apparently, the majority of the natural areas in this watershed do not meet the 100-acre size threshold used to identify areas of State or regional significance. However, from a local perspective, there may be very important areas that are smaller than 100 acres. Compared to other major land use types in the Little Patuxent watershed, forest lands tend to be the most protective of water quality and the most conducive to high quality stream habitat. Forest land covers about one quarter of the Little Patuxent River watershed in Howard County overall. However, forest land is generally not present in large blocks that meet the size threshold used for Green Infrastructure. Smaller blocks of forest are located along the Little Patuxent tributary network. These conditions suggest several potential concerns and opportunities (Shanks, 2001):

- Fragmented forest / habitat characterizes the majority of the Little Patuxent watershed.
- Fragmentation tends to reduce habitat value for some wildlife, to limit species diversity, to reduce resilience to stresses like disease, etc.
- Most stream segments have stresses related to urban or agricultural land use affecting water quality and aquatic habitat.
- Several small stream headwater areas have local watersheds dominated by forest. These areas may have relatively high quality stream habitat if other stresses such as significant concentrated stormwater flows or intensive human activities are not present.
- Forested headwater stream areas may present opportunities to enhance or expand relatively high quality water and habitat to downstream areas.

Protected land, mainly outside of the Green Infrastructure network, is County-owned land. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation (DNR, 2000-2003). According to

the 2000 Maryland Greenways Commission document, there are three existing or proposed greenways including:

- *Hammond Branch Greenway.*
- *Little Patuxent Greenway.*
- *Middle Patuxent Greenway.*

There are two State-designated Nontidal Wetlands of Special State Concern in this watershed. Information about the specific sites is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*.

- *Old Guilford Ponds*. This pond contains a diverse herbaceous wet meadow shoreline with a rare plant species. This natural shoreline vegetation is surrounded by mowed grass and a apartment building recreation area. Main threats to this wetland include non-native species invasion, water quality impacts, and hydrologic alterations.
- *Upper Hammond Branch*. Although this site contains a RTE plant species, since it is not believed to contain wetlands, DNR recommended it be removed from the WSSC list.

A programmatic wetland mitigation site, Little Patuxent Ridge, is located in the watershed in Howard County.

Specific recommendations for restoration:

- Restore wetlands and streams within the headwaters.
- Remove fish blockages.
- Restore tributaries, rather than mainstem Little Patuxent River. Impervious surface is expected to increase significantly in the headwaters of the mainstem Little Patuxent River and may undermine progress of restoration activities (Howard County DPW, 2002).
- The subwatersheds Wilde Lake and Centennial Lake should be top priority for restoration. Watershed restoration plans for these two subwatersheds are being negotiated. Other expected restoration projects include: Wilde Lake Stream restoration (to restore two reaches of two Wilde Lake tributaries), Little Patuxent River's floodplain and riparian buffer restoration (Howard County DPW, 2004).
- Address specific problem sites identified during WRAS.
- Conduct stream restoration based on recommendations from Stream Corridor Assessments.
- Restore/create wetlands designed to remove phosphorus and sediment from the water column before entering Centennial Lake.
- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways.
- Enhance WSSC by control of invasive species.

Specific recommendations for preservation:

- Protect wetlands and streams within the headwaters.

- Protect streams with rare fish and mussels.
- Protect Nontidal Wetlands of Special State Concern and surrounding buffers.
- Protect wetlands that function to remove phosphorus and sediment from the water column before it enters Centennial Lake.
- Protect areas within the Green Infrastructure network, especially along waterways.
- Protect areas designated as Ecologically Significant Areas that are not already protected.

Middle Patuxent River (02131106)

Background

Based on MDP 2002 GIS land use data, the Middle Patuxent River watershed has 35 acres of open water and 37,039 acres of land. The land acres are divided as follows: urban 14,538 acres (39%), agriculture 12,350 acres (33%), forest 10,089 acres (27%), and barren land 61 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along the Middle Patuxent River and tributaries. There are some additional smaller wetlands that do not appear to be directly associated with waterways.

A portion of this watershed is within the designated Priority Funding Area. Wetland restoration that does occur within the PFA should not compete with overall plans for development.

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

- Palustrine
    - Emergent: 88 acres
    - Scrub shrub: 54 acres
    - Forested: 234 acres
    - Unconsolidated bottom: 149 acres
    - Farmed: 7 acres
- Riverine unconsolidated shore: 2 acres
- Total: 534 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)
02131106	-6.05	14.11	0	0.01	8.06

The State Highway Administration has a mitigation bank in the floodplain of the Middle Patuxent River. The site includes both forested wetlands and riparian plantings.

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. All stream segments within the Howard 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. Failing indicators include high population density. Wetland loss was estimated to be 692 acres. This watershed also had a high non-tidal instream habitat index.

According to the 2002 305(b) report, of the nontidal wadeable tributaries, a portion (36 miles) fully supports all uses, while the remainder (24 miles) had inconclusive data. Data for the mainstem river 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:

- *Middle Patuxent River* (non-tidal); sediments, nutrients, zinc.
- *Middle Patuxent River Unnamed Tributary* (021311060962 non-tidal); poor biological community.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are many hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), mainly located along the waterways. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

A management plan was completed in 2000 for the 928-acre Middle Patuxent Environmental Area. Many of the projects and programs recommended in this plan have been implemented in the years since the plan completion (Howard County DPW, 2004).

A stream corridor assessments was completed for the Middle Patuxent watershed. Of the 180 stream miles surveyed, 322 potential problems were identified. The most common problem was erosion (106 sites). While many were rated as minor to moderate severity, there were several moderate to severe sites located in Harpors Choice Tributary. Several erosion sites were also located downstream of inadequately buffered areas. In some cases, buffering these areas may help with the downstream erosion. There were many inadequate stream buffers (93 sites). Most of these were rated as low to moderate severity. Five of the seven very severe ratings were located in pastures. Some other commonly reported concerns were fish migration barrier (64 sites) and channelized streams (18 sites).

Green Infrastructure hubs are around Benson Branch Environmental Area, Middle Patuxent Environmental Area, and Gorman Park. Corridors connect these hubs with other watersheds. In addition to the above-mentioned protected areas, there are a few County-owned properties and METs. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation (DNR, 2000-2003). According to the 2000 Maryland Greenways Commission document, one existing or proposed greenway is called Middle Patuxent Greenway.

There is one State-designated Nontidal Wetland of Special State Concern, called Benson Branch, in this watershed. Information about this site is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. Benson Branch is a seepage wetland and stream edge that contains two threatened or endangered plant species. The site is surrounded by maturing forest and some patches of abandoned or active farm fields. It is partially protected by Benson Branch Environmental Area. Main threats include increases in sediment, hydrologic alterations, and invasion by non-native plant species and deer.

Specific recommendations for restoration:

- Restore wetlands and streams within the headwaters.
- Restore “gaps” in the Green Infrastructure network to natural vegetation, especially along waterways and within Benson Branch Park (Site).
- Conduct stream restoration based on recommendations from Stream Corridor Assessments.
- Enhance WSSC by control of invasive species.

Specific recommendations for protection:

- Protect wetlands and streams within the headwaters.
- Protect areas within the Green Infrastructure network, especially along waterways.
- Protect Benson Branch WSSC and buffer.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.

<u>Rocky Gorge Dam (02131107)</u>

Background

A large portion of this watershed is located within Montgomery County. T. Howard Duckett Reservoir is located along the Patuxent River, between Howard and Montgomery Counties, formed by Rocky Gorge Dam.

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

Some of the Howard County portion of this watershed is within the designated Priority Funding Area. Wetland restoration that does occur within the PFA should not compete with overall plans for development.

Based on MDP 2002 GIS land use data, the Howard County portion of the Rocky Gorge Dam watershed has 674 acres of open water and 7,423 acres of land. The land acres are divided as follows: urban 2,678 acres (36%), agriculture 1,820 acres (25%), and forest 2,925 acres (39%). 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. Patuxent River State Park is included in the Maryland Wildlands Preservation System, suggesting the protected area has retained its wilderness character and/or contains rare species or habitat.

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along the Patuxent River and Rocky Gorge Reservoir. There are only a few small wetlands outside of this waterway.
Major fish blockages occur at the Rocky Gorge and Brighton dams.

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: 73 acres
    - Scrub shrub: 30 acres
    - Forested: 502 acres
    - Unconsolidated bottom: 122 acres
    - Unconsolidated shore: 1 acre
    - Farmed: 4 acres
- Riverine unconsolidated shore: <1 acre
- Total: 733 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)
02131107	-3.40	3.78	0	0	0.39

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. All stream segments within the Howard County portion of this watershed are designated Use I, recreation contact and protection of aquatic life, unless designated below.

- Use I-P: recreation contact, protection of aquatic life, public water supply; Patuxent River and all tributaries except those designated below as Use IV-P Above Rocky Gorge Dam
- Use IV-P: recreational trout waters and public water supply; Patuxent River and tributaries Between Rocky Gorge Reservoir and Triadelphia Reservoir, and including Triadelphia Reservoir

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 high population density and high soil erodibility (0.28). Wetland loss was estimated to be 1,337 acres. Indicators for Category 3 include a high imperiled aquatic species indicator and presence of a drinking water intake.

According to the 2002 303(b) report, data for the mainstem river (Duckett Reservoir to Tridelphia Dam) was inconclusive. Of the wadeable tributaries, a large portion (45 miles) fully support all uses, while the remainder (11 miles) had inconclusive data. Data for T. Howard Duckett Reservoir was also 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:

- *Rocky George Dam Impoundment*; nutrients.
- *Patuxent River* (021311070942 non-tidal); poor biological community.

Restoration/Preservation

The Howard County Department of Public Works conducted a Cherry Creek Watershed Study. Water quality sampling found poor water quality with high levels of nutrients,

sediments, metals, fecal coliform, and zinc. The biological sampling found severely to moderately impaired streams, likely due to excessive storm flow. This study aims to improve water quality and habitat within Cherry Creek (Howard County DPW, 2006). Project implementation has begun.

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

A large Green Infrastructure hub is located along the Patuxent River and smaller corridors connect this hub to neighboring watersheds. Protected land includes the Patuxent River State Park, land owned by Washington Suburban Sanitary Commission (adjacent to the reservoir), Schooly Mill Park, and METs. The Green Infrastructure hub around the Reservoir is unprotected on the Howard County side and should be high priority for protection. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation (DNR, 2000-2003). According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is Patuxent Regional Greenway.

There is one State-designated Nontidal Wetland of Special State Concern, called Browns Bridge Crossing, in the Howard County portion of this watershed. Information about this site is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. Browns Bridge Crossing is an alluvial floodplain wetland along an unnamed tributary to the Patuxent River. This site contains an endangered plant species. Main threats include competition by invasive weeds (including kudzu) and anthropogenic disturbance (causing disturbance that increases likelihood of plant invasion). Other threats include erosion, runoff and neighboring development.

Specific recommendations for restoration:

- Restore wetlands and streams within the headwaters.
- Restore “gaps” in the Green Infrastructure network to natural vegetation, especially along the Patuxent River and tributaries.
- Restore/create wetlands designed to provide water quality improvement function to water entering the Reservoir.
- Enhance WSSC by control of invasive species.

Specific recommendations for protection:

- Protect wetlands and streams within the headwaters.
- Protect areas within the Green Infrastructure network, especially along the Patuxent River.
- Protect the WSSC buffer.

<u>Brighton Dam (02131108)</u>

Background

A portion of this watershed is located within Montgomery County. Triadelphia Reservoir is located along the Patuxent River, between Howard and Montgomery Counties, formed by Brighton Dam.

Based on MDP 2002 GIS land use data, the Howard County portion of the Brighton Dam watershed has 582 acres of open water and 36,547 acres of land. The land acres are divided as follows: urban 8,115 acres (22%), agriculture 17,492 acres (48%), forest 10,900 acres (30%), wetlands 35 acres (<1%) and barren land 5 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

The Patuxent River was designated as a scenic river by the Maryland General Assembly. Patuxent River State Park is included in the Maryland Wildlands Preservation System, suggesting the protected area has retained its wilderness character and/or contains rare species or habitat.

Major fish blockages occur at the Rocky Gorge and Brighton dams. Mapped wetlands (based on DNR and NWI GIS data) are mainly located along waterways.

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

- Lacustrine unconsolidated shore: 1 acre
- Palustrine
    - Emergent: 346 acres
    - Scrub shrub: 143 acres
    - Forested: 1,151 acres
    - Unconsolidated bottom: 216 acres
    - Farmed: 48 acres
- Total: 1,906 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)
02131108	-0.40	0.43	0	0	0.03

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. All stream segments within the Howard County portion of this watershed are designated Use I, recreation contact and protection of aquatic life, unless designated below.

- Use I-P: recreation contact, protection of aquatic life, public water supply; Patuxent River and all tributaries except those designated below as Use III-P or Use IV-P Above Rocky Gorge Dam
- Use III-P: natural trout waters and public water supply; Patuxent River and tributaries Above Triadelphia Reservoir
- Use IV-P: recreational trout waters and public water supply; Patuxent River and tributaries Between Rocky Gorge Reservoir and Triadelphia Reservoir, and including Triadelphia Reservoir

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 high population density. Wetland loss was estimated to be 3,371 acres. Indicators for Category 3 include high non-tidal instream habitat index, presence of trout spawning areas, and designated Wildland Acres (within Patuxent River State Park).

According to the 2002 303(b) report, the mainstem river (above Tridelphia Reservoir) fully support all uses. Of the nontidal wadeable tributaries, a portion (48 miles) fails to support all uses due to poor biological community from habitat alteration, while the remainder (48 miles) had inconclusive data.

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:

- *Brighton Dam Impoundment*; sediments, nutrients.
- *Tridelphia Reservoir Unnamed Tributaries* (021311080967 non-tidal): biological.
- *Cattail Creek Unnamed Tributary* (021311080967 non-tidal): biological.

A 2001 stream biological assessment of Brighton Dam Watershed (divided into subwatersheds Upper and Lower Brighton Dam and Cattail Creek) rated the subwatersheds as "fair" for biological health. For physical health, Lower Brighton Dam and Cattail Creek subwatersheds were rated as "non-supporting," while Upper Brighton Dam was rated as "partially supporting" (Tetra Tech, Inc, 2001).

Restoration/Preservation

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

There is a large linear Green Infrastructure hub along the Patuxent River and smaller corridors connecting this hub to neighboring watersheds. The northern section of this hub is protected by Patuxent River State Park, land owned by Washington Suburban Sanitary Commission (adjacent to the reservoir), and METs. Additional land is protected by the County. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation (DNR, 2000-2003). According to the 2000 Maryland Greenways Commission document, there are several existing or proposed greenways including:

- *Cabin Branch Greenway.*
- *Cattail Creek.*
- *Long Corner Connector.*
- *Patuxent Regional Greenway.*
- *Middle Patuxent Greenway.*

There is one State-designated Nontidal Wetland of Special State Concern, called Hipsley's Mill Woods, in this watershed. Information about this site is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. Hipsley's Mill Woods is a beaver-dammed wetland complex along a tributary of Cabin Creek that contains two rare or endangered plant species. The area provides a diverse habitat for flora and fauna. It is protected by Patuxent River State Park. Main threats include invasive plant species and excessive deer populations. Additional impacts would potentially occur from development, agriculture, or logging within the buffer.

There is an additional potential WSSC along Cattail Creek (based on GIS data).

Specific recommendations for restoration:

- Restore wetlands and streams within the headwaters.
- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways.
- Restore/create wetlands designed to provide water quality improvement function to the reservoir.
- Enhance WSSC by control of invasive species.

Specific recommendations for protection:

- Protect wetlands and streams within the headwaters.
- Protect areas within the Green Infrastructure network, especially waterways.
- Protect the WSSC buffer.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.

Patapsco River Lower North Branch (02130906)

Background

Approximately half of the watershed is in Baltimore County, and the Patapsco River forms a boundary between Baltimore, Carroll, Howard, and Anne Arundel Counties. Portions of this watershed are also located within Baltimore City, and Anne Arundel and Carroll Counties.

This watershed is within the Piedmont and Coastal Plain Provinces. Based on MDP 2002 GIS land use data, the Howard County portion of the Patapsco River Lower North Branch watershed has 24,144 acres of land. The land acres are divided as follows: urban 11,627 acres (48%), agriculture 2,283 acres (9%), forest 10,153 acres (42%), 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.

Most of the Howard County portion of this watershed is within the designated Priority Funding Area. Wetland restoration that does occur within the PFA should not compete with overall plans for development. Development, especially that completed prior to stormwater management, degrades the environmental systems.

Some of the Howard County portion of this watershed is classified as prime farmland (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland. Some of this area may already be developed. While these soils are spread throughout the watershed, some concentrations do exist in Deep Run headwaters and near Rockburn Branch.

Anadromous fish spawning area has been documented in two locations: on the mainstem downstream of Rockburn Branch and in Deep Run. There are 40 sensitive species tracked in Maryland and 11 ecologically significant areas (Shanks, 2005).

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

- Estuarine
    - Emergent: 121 acres
    - Scrub shrub: <1 acre
    - Unconsolidated shore: 15 acres
- Lacustrine unconsolidated shore: 2 acres
- Palustrine
    - Aquatic bed 1 acre
    - Emergent: 222 acres
    - Scrub shrub: 40 acres
    - Forested: 564 acres
    - Unconsolidated bottom: 192 acres
    - Unconsolidated shore: 5 acres

    - Farmed: 1 acre
- Riverine
    - Emergent: 1 acre
    - Unconsolidated shore: 44 acres
- Total: 1,207 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)
02130906	-18.53	22.80	0	0.21	4.48

Most of the watershed is in the Piedmont Province. A small area near the Baltimore Harbor, Deep Run, and northern Anne Arundel County is in 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 as 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.

There are relatively few mapped wetlands (based on DNR and NWI GIS data). While most of these small areas are scattered throughout the watershed, there is a larger area along Deep Run (on the Anne Arundel County border). Wetlands are typically found in relatively narrow floodplains of streams. The primary source of hydrology in the wetlands is high ground water. Overbank flooding, though it does occur, apparently is not of sufficient duration to be the primary source of hydrology in wetlands. The concentrated development in this part of Howard County has also often resulted in incised stream channels, further reducing the likelihood of overbank flooding (Follweiler, 2004 pers comm.). Some wetlands are also supported by seepage of water from the bases of slopes adjacent to the floodplains. A few wetlands may be found in upland depressions. In the small Coastal Plain portion of the watershed in Howard County, wetlands may be found on relatively wide, flat landscapes in comparison with wetlands in the Piedmont region.

Most wetlands are forested, dominated by oak, sweetgum, red maple, and in some places willow and alder (Matthews and Hershberger, 1968).

In comparison with the very poorly drained soils most often found on lower Coastal Plain, soils in this watershed are seasonally wet for shorter periods of time, and have less organic matter. Wetlands in the Patapsco watershed are thus likely to have a lower capability to transform nutrients than wetlands with lengthy periods of saturation and inundation. However, vegetated wetlands on floodplains still may reduce flood flows and retain surface waters, allowing some sediments and nutrients to settle, providing some

water quality improvement. The high ground water and seepage from slopes may also contribute to base flow maintenance and food chain support for streams. Wetlands that extend up the side of slopes, in contrast to depressions in floodplains, do not significantly retain water, thus providing only limited flood attenuation and water quality improvement functions. Wetlands associated with Deep Run probably provide important support for fisheries habitat.

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. All stream segments within the Howard County portion of this watershed are designated Use I, recreation contact and protection of aquatic life.

Water Quality

According to the 2002 305(b) report, a portion of nontidal wadeable tributaries fail to support all uses, shown by a poor biological community, due to urban runoff, habitat alteration, and channelization. Field surveys also noted siltation, streambank instability, and agricultural runoff as factors that may affect the aquatic community (DNR, 2000 305b). There are some areas closed to shellfish harvesting due to pollution from nonpoint source runoff (DNR, 2002 305b)

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 poor non-tidal benthic index of biotic integrity (BIBI), high percent impervious surface (22%), high population density, and high soil erodibility (0.31). Wetland loss was estimated to be 8,422 acres. Indicators for Category 3 include high imperiled aquatic species indicator and migratory fish spawning area.

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:

- *Patapsco River* (non-tidal); metals, nutrients, sediments.
- *Patapsco River Unnamed Tributary 1* (021309061017 non-tidal); poor biological community.
- *Patapsco River Unnamed Tributary 3* (021309061019 non-tidal); poor biological community.
- *Patapsco River Unnamed Tributary* (021309061012 non-tidal); poor biological community.
- *Deep Run* (021309061014 non-tidal); poor biological community.
- *Deep Run Unnamed Tributary* (021309061014 non-tidal); poor biological community.
- *Deep Run Unnamed Tributary 1* (021309061015 non-tidal in Howard); poor biological community.

- *Deep Run Unnamed Tributary 2* (021309061015 non-tidal in Howard); poor biological community.
- *Soapstone Branch* (021309061016 non-tidal in Baltimore County); poor biological community.
- *Tiber Run* (021309061017 non-tidal); poor biological community.
- *Falls Run* (021309061019 non-tidal in Baltimore Run); poor biological community.

Field surveys also noted siltation, streambank instability, channelization, agricultural runoff, and hydromodification as factors that may affect the aquatic community. (DNR, 2000 305b) There are some areas closed to shellfish harvesting due to pollution from nonpoint source runoff (DNR, 2002 305b)

A Draft Water Quality Analysis was completed for metals in Lower North Branch Patapsco River. Metal levels are not exceeding those required based on water quality designations, except Herbert Run (021309061012), with a single exceedance of copper. It is recommended that Lower North Branch Patapsco River (except Herbert Run) be removed from the 303d list for impairment by heavy metals.

Sampling in 2000 found water quality in Deep Run to be better than mainstem conditions. For the mainstem, total nitrogen is elevated. Both total phosphorus and total suspended sediments are closely associated with storm water pulses (Shanks, 2005).

MBSS nontidal fish IBI sampling ranked Deep Run and its tributaries, Rockburn Branch, and one site on Tiber Branch as good or fair. MBSS nontidal sampling of BIBI rated most sites as fair to very poor. A fish consumption advisory was issued due to PCBs or pesticides for Patapsco River channel catfish, white perch, American eel. An advisory was also issued for large and small mouth bass from any waterbody and bluegill from impoundments (Shanks, 2005).

A more detailed assessment was conducted on two subwatershed: Rockburn Branch and Sucker Branch (as summarized in Howard, 2006). The Rockburn Branch subwatershed is about 5.8 sq miles, with over half being parkland or open space. Of the 10 sites sampled, biological scores ranged from poor to very poor and physical habitat scores ranged from partially supporting to non-supporting. The average score was poor biological and non-supporting habitat. The results suggest the subwatershed is more degraded that expected for a watershed with just under 10% impervious surface. Sucker Branch subwatershed is roughly 4.2 sq miles, with 29% in parkland or open space. Of the 12 sites sampled, biological scores ranged from poor to very poor and habitat scores ranged from supporting to non-supporting. The average score was very poor biological and non-supporting habitat.

A nutrient synoptic survey was completed in the Howard County portion of the Lower Patapsco watershed in 2004 (Primrose, 2005). Of the 37 subwatersheds sampled, nitrate/nitrite concentrations were excessive in one, high in one, and moderately elevated in twenty-two subwatersheds. The subwatersheds with excessive or high nitrate/nitrite concentrations were associated with a sewer line (possibly failing). Orthophosphate

concentrations were high in four subwatersheds and moderately elevated in four subwatersheds. The high orthophosphate is associated with fine suspended phosphorus-rich sediment in the water column, possibly contributed through construction and sediment control facilities. Overall, nutrients are not a problem in this watershed. Road salts seem to be contributing to high specific conductivity throughout and are negatively impacting the stream.

Restoration/Preservation

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

The study *Deep Run and Tiber-Hudson Watersheds Final Ecosystem Restoration Report and Integrated Environmental Assessment,* conducted by the County and the USACE, identified potential restoration projects within these watersheds. A recently completed project is Deep Run stream bank stabilization (Howard, 2004).

Wetland restoration for flood control would be desirable. Flooding does occur in the Ellicott City vicinity, however, there may not be opportunity to restore floodplain access due to infill development. Wetlands in stormwater retrofits may present the best opportunity to re-create wetlands in the watershed. Permittees have found it difficult to locate mitigation sites to replace lost wetlands and some stream restoration projects have been proposed as an alternate form of mitigation (Follweiler, 2004 pers comm.).

DNR completed a stream corridor assessment for Deep Run and portions of the Patapsco River (within Howard County) (Pellicano and Yetman, 2005). Of the 57 miles of stream walked in Deep Run and the 21 miles of stream walked in the mainstem Patapsco watershed, 314 potential environmental problems were identified. The most common problem was pipe outfalls (123 sites), eroding banks (56 sites), inadequate stream buffer (48 sites), tree blockages (36 sites), fish barriers (23 sites), exposed pipes (9 sites), channel alteration (7 sites), construction sites (7 sites), trash dumping (4 sites) and one unusual condition.

DNR completed a stream corridor assessment for Patapsco River (Patterson et al., 2003). This survey included areas within the watersheds Patapsco River Lower North Branch and South Branch Patapsco River. Of the over 200 stream miles surveyed, 800 potential environmental problems were identified. The most common probem identified was inadequately forested buffers (191 sites). Inadequate stream buffers are spread throughout the watersheds, and are a major concern. Five of the seven very severe inadequate stream buffers are located along mowed lawn, and the two others are along pasture and golf course. Of those rated severe, half are along mowed lawns and the other half are along agriculture. Some of the other most frequently encountered problems were pipe outfalls (157 sites), erosion (115 sites), and fish barriers (108 sites).

A Watershed Rrestoration Action Strategy was completed for this watershed in 2006 (Howard County, 2006), and is summarized below. The 2001 NPDES prioritized subwatersheds within the County for restoration to improve water quality, based on an impervious area assessment. Of the top ten subwatersheds, three are within this watershed: Rockburn Branch, Elkridge, Deep Run.

There is a large Green Infrastructure hub along the Patapsco River and smaller hubs and corridors in the southern portion of the watershed. Most of the large hub is protected by Patapsco Valley State Park. Other protected land is County-owned land and METs. Some gaps in the hubs occur on agricultural land in the Howard County (East) side of the Patapsco River (DNR, 2000-2003). It may be desirable to restore these sites to natural vegetation. According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Deep Run.*
- *Patapsco Regional Greenway.*

There is one State-designated Nontidal Wetland of Special State Concern, called Landing Road Seep (DNR name: Avalon Woods), in this watershed. Information about this site is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. Landing Road Seep was originally listed as a WSSC due to the presence of a RTE plant species. It is unclear whether this site still harbors this species, since the site has been in decline. Therefore, a decision to keep or remove this site from the WSSC list will be made after the next field visit.

Specific sites for restoration:

- Restore wetlands and streams within the headwaters.
- Five retrofit projects were proposed in residential subdivisions. Projects included wetland creation as part of the retrofits (KCI Technologies, Inc., 1999).
- Reforestation in undeveloped floodplain of Patapsco Valley State Park (DNR, 1981).
- Fish passage and fish habitat improvement (DNR, 1981).
- Create wetlands designed to provide stormwater management and flood control.
- There are several identified fish blockages: Bloade Dam, Simkins Dam, Union Dam, Daniels Dam and three dams on Rockburn Branch (Shanks, 2005). Fish blockages along the Patapsco main stem have either been breached or fish ladders have been installed.
- The 1968 Howard County Soil Survey reported that some wetlands were drained to create pasture land. These areas would represent opportunities for restoration, though the extent of any converted pasture area is probably very limited. There is a wetland on pasture formerly operated as a University of Maryland Horse Farm that may benefit from enhancement such as removal of multiflora rose, any plugging of ditches, if present (Boellner, 2004 pers comm.). There appears to be limited areas to restore floodplain access in much of the watershed due to adjacent development.

- Restore "gaps" in the Green Infrastructure network to natural vegetation, especially along waterways.
- Conduct stream restoration based on recommendations from Stream Corridor Assessments.
- Restore wetlands within the Rockburn Branch and Sucker Branch subwatersheds.

Specific recommendations for protection:

- Protect wetlands and streams within the headwaters.
- Protect areas within the Green Infrastructure network.
- Protect additional unprotected areas that are designated Ecologically Significant Areas.
- Deep Run (in Howard County)
- Stony Run WSSC (in Anne Arundel County)
- Forested riparian corridors

South Branch Patapsco (02130908)

Background

A portion of this watershed is also within Carroll County. Based on MDP 2002 GIS land use data, the Howard County portion of the South Branch Patapsco watershed has 15,977 acres of land. The land acres are divided as follows: urban 3,613 acres (23%), agriculture 7,101 acres (44%), forest 5,252 acres (33%), and wetlands 11 acres (<1%). Since the MDP wetland acreage is often underestimated, DNR wetland data estimates, as discussed later in this document, are preferred.

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

Mapped wetlands (based on DNR and NWI GIS data) are mainly located along waterways.

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

- Palustrine
    - Aquatic bed: 6 acres
    - Emergent: 105 acres
    - Scrub shrub: 56 acres
    - Forested: 162 acres
    - Unconsolidated bottom: 355 acres
    - Unconsolidated shore: 1 acre
    - Farmed: 2 acres
- Riverine unconsolidated shore: 14 acres
- Total: 700 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)
02130908	-2.51	2.04	3.00	0	2.53

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. All stream segments within the Howard County portion of this watershed are designated Use I, recreation contact and protection of aquatic life, unless designated below.

- Use III: natural trout waters;
    - South Branch Patapsco and all tributaries Above confluence with Gillis Falls tributaries
    - Unnamed tributary to the South Branch Patapsco River at Henryton and all tributaries to this unnamed tributary
- Use IV: recreational trout waters; South Branch Patapsco River Mainstem only

Water Quality

The 1998 Clean Water Action Plan classified the watershed as Category 3, a pristine or sensitive watershed in need of protection. Failed indicators included high nitrogen loading. Indicators suggesting need for preservation included a high non-tidal in-stream habitat index, high non-tidal fish index of biotic integrity, a high imperiled aquatic species indicator, and presence of trout spawning areas.

According to the 2002 303(b) report, a portion of the wadeable tributaries (47 miles) fail to support all designated uses due to habitat alteration. Piney Run Reservoir failed to support all designated uses due to nutrients, low dissolved oxygen, and aquatic plants.

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:

- *Patapsco River*; nutrients, sediments.
- *Piney Run* (021309081023 in Carroll County); poor biological community.
- *Piney Run Unnamed Tributary* (021309081024 in Carroll County); poor biological community.
- *Hay Meadow Branch Unnamed Tributary* (021309081027 in Howard County); poor biological community.

Restoration/Preservation

Hydric soils suggest where wetlands are currently or were historically. There are a fair amount of hydric soils that are not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), mainly along the waterways. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

DNR completed a stream corridor assessment for Patapsco River (Patterson et al., 2003). This survey included areas within the watersheds Patapsco River Lower North Branch and South Branch Patapsco River. Of the over 200 stream miles surveyed, 800 potential environmental problems were identified. The most common probem identified was inadequately forested buffers (191 sites). Inadequate stream buffers are spread throughout the watersheds, and are a major concern. Five of the seven very severe inadequate stream buffers are located along mowed lawn, and the two others are along pasture and golf course. Of those rated severe, half are along mowed lawns and the other half are along agriculture. Some of the other most frequently encountered problems were pipe outfalls (157 sites), erosion (115 sites), and fish barriers (108 sites).

There is a portion of a large Green Infrastructure hub in the eastern side of the watershed, along Patapsco River and other smaller corridors connecting this to neighboring watersheds (DNR, 2000-2003). The hub is protected by Patapsco Valley State Park and Hugg-Thomas WMA. There are additional protected properties, MET holdings, outside of the Green Infrastructure network. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation. According to the 2000 Maryland Greenways Commission document, there are several existing or proposed greenways including:

- *Long Corner Connector.*
- *Cabin Branch Greenway.*
- *Cattail Creek.*
- *Patapsco Regional Greenway.*
- *Little Patuxent Greenway.*

There is one State-designated Wetland of Special State Concern, called Henryton Woods, in this watershed. Information about this site is summarized from the document *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. Henryton Woods is an alluvial floodplain wetland along an unnamed tributary of the Patapsco River that contains an endangered plant species. It is protected by Patapsco Valley State Park. Main threats include impacts to the floodplain, sedimentation, invasion by weed species and excessive deer populations. Additional threats may develop from development, agriculture, or logging within the buffer.

Specific recommendations for restoration:

- Restore wetlands and streams within the headwaters.
- Restore “gaps” in the Green Infrastructure network to natural vegetation, especially along the South Branch Patapsco River.
- Enhance WSSC by control of invasive species.

- Conduct stream restoration based on recommendations from Stream Corridor Assessments.

Specific recommendations for protection:

- Protect wetlands and streams within the headwaters.
- Protect areas within the Green Infrastructure network, especially along the South Branch Patapsco River.
- Protect the WSSC buffer.