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Background

Based on MDP 2002 GIS land use data, Baltimore County has 57,036 acres of open water and 384,899 acres of land. The land acres are divided as follows: urban 151,698 acres (39%), agriculture 97,953 acres (25%), forest 129,459 acres (34%), wetlands 4,016 acres (1%) and barren land 1,773 acres (<1%). Baltimore City has 7,158 acres of open water and 51,728 acres of land. The land acres in Baltimore City are divided as follows: urban 47,520 (92%), agriculture 1 acre (<1%), forest 3,755 acres (7%), wetlands 21 acres (<1%) and barren land 431 acres (1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

The County's primary issues in the rural areas are protection of existing natural resources and in the urban areas are protection of remaining natural resources and restoration of ecosystem function (Baltimore County, 2000). Protection of existing wetlands is fairly strong due to development rights, including County easements in developed areas. When lots are subdivided, the stream valleys and floodplains are protected from development. Significant resources such as agriculture, reservoirs and their watersheds, and the Coastal Areas are designated as "Resource Conservation Zones," and growth is restricted. In the Owings Mills Growth Area, an extensive greenway/stream valley corridor is being protected. Acquisition and development of waterfront parks is a high priority of the Department of Recreation and Parks (Baltimore County DRP, 2000).

There are roughly 175 miles of Chesapeake Bay shoreline. Some of this shoreline has urban development while other sections are rural or protected by parkland (Baltimore County, 2005). It is predicted that sea level rise will impact wetland loss in Eastern Baltimore the most.

Soil classified as prime farmland (based on NRCS SSURGO GIS data) is scattered throughout the County. In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland. Additional areas along some of the waterways are classified as "prime farmland when drained." While it may not be desirable to exclude all soils classified as "prime farmland when drained" from consideration, these additional areas should be lower priority for wetland restoration/creation than soils not classified as prime farmland.

There are three 6-digit watersheds and fourteen 8-digit watersheds in this County. Gunpowder Falls (021308) includes Gunpowder River (02130801), Lower Gunpowder Falls (02130802), Bird River (02130803), Little Gunpowder Falls (02130804), Loch Raven Reservoir (02130805), Prettyboy Reservoir (02130806) and Middle River – Brown (02130807); Patapsco River includes Back River (02130901), Baltimore Harbor (02130903), Jones Falls (02130904), Patapsco River Lower North Branch (02130906), Gwynns Falls (02130905) and Liberty Reservoir (02130907); Lower Susquehanna River (021202) includes Deer Creek (02120202).

Streams

There are more than 2,100 miles of nontidal streams within this County, with 1,000 of these stream miles draining into one of the three reservoirs. Gunpowder Falls is one of the best quality fisheries in the east (Baltimore County, 2005).

The Maryland Tributary Strategies document *Maryland Upper Western Shore Final Version for 1985-2002 Data: February 2, 2004* describes the success of BMPs in the Upper Western Shore Watershed (an area containing all of Harford, and part of Carroll, Baltimore, and Cecil) like this:

> BMP implementation for animal waste management, nutrient management plans, conservation tillage and cover crops, forest conservation and buffers, shore erosion control, marine pumpouts, and stormwater management retrofits and conversion are making good progress toward Tributary Strategy Goals. For other issues, such as treatment and retirement of highly erodible land, runoff control, stream protection, erosions and sediment control, septic connections and pumping, and urban nutrient management, progress toward Tributary Strategy Goals has been slower.

Land use for the entire basin is dominated by agriculture and forest/wetlands (38% each), followed by urban (25%). Roughly 70% of the houses are on public water and 75% are on municipal sewer. In 2002, the main nitrogen, phosphorus, and sediment sources within the Upper Western Shore basin was agriculture (39%, 33%, and 69% respectively). Other important sources included point sources (21% N and 16% P) and urban sources (18% N, 30% P, and 14% sediment). Tributary stations sampled had total nitrogen ranked generally good. Two sites were ranked poor (Upper Gunpowder River – Prettyboy and Deer Creek) and one was ranked fair (Middle Gunpowder River - Glencoe). Levels were decreasing in some areas during the period 1985-2002. Total phosphorus was ranked fair or good, with some stations improving. Total suspended solids were generally good, but one site was ranked poor (Lower Gunpowder River – Cromwell) and two were ranked fair (Susquehanna River and Bush River). Of the three sites sampled for SAV abundance between 1984 and 2000, two of the sites exceeded SAV goals during portions of that period (Bush River and Gunpowder River Oligohaline). The Middle River Oligohaline did not meet the SAV goal but was close in 2000. In 1995-2000, benthic communities were generally good.

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

According to Tiner and Burke (1995), in 1981-1982 there were 6,492 acres of wetlands in Baltimore County (including 250 acres in Baltimore City). This is 1.0% of the State's total. The wetland types were Estuarine (2,555 acres), Palustrine (3,539 acres), Riverine (75 acres), and Lacustrine (323 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 76%, or 20,858 acre, loss.

Wetlands in Baltimore County occur along the shoreline as tidal wetlands, in floodplains of streams, at the heads of drainageways, and in isolated depressions. Tidal wetlands are not extensive, and transition into other wetland types or terminate at the steeper, adjacent upland slopes. The supporting hydrology of nontidal wetlands is primarily through groundwater or a combination of groundwater and overbank flooding. Most are located in the floodplains, though even in these areas the primary source of hydrology is

groundwater. Wetland and floodplain areas are generally more extensive in the Coastal Plain portion of the County, though the adjacent slopes and development limit the extent of these wetlands in comparison with lower Eastern Shore nontidal wetlands. Wetlands may also occur at the bases of slopes, where they are supported by seepage from the hillside. Wetlands have also developed at mined sites. There are also wetland areas, primarily in the Coastal Plain, that are supported by surface water ponding over soil with a fragipan that impedes drainage.

A 1993 report (Tiner and Foulis) in the Fall Zone of Maryland included an evaluation of wetland losses from 1981-82 to 1988- 89 in a study area of several Counties, including part of Baltimore County. The majority of losses occurred in temporarily flooded, forested nontidal wetlands.

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

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

- Palustrine wetlands can be classified into four major groups depending on the dominant vegetation type: forested, scrub-shrub, emergent, and aquatic. These wetlands were described for the Maryland Coastal Plain Province and the Piedmont Province.
    - Coastal Plain palustrine wetlands
        - Palustrine forested wetlands are the dominant palustrine wetland type on the Coastal Plain and are located in floodplains, depressions, and drainage divides. They can be classified into four main groups:
            - Tidally flooded wetlands are freshwater wetlands that are tidally influenced. Common tree species may include red maple, green ash, black willow and black gum.
            - Semipermanently flooded wetlands are nontidal wetlands that are flooded for much of the growing season. These are uncommon in Maryland. Some examples, dominated by bald cypress, are along Battle Creek and the Pocomoke River. Higher elevations may be dominated by red maple, black gum, sweet bay, swamp black gum, fringe tree, ironwood, and swamp cottonwood.
            - Seasonally flooded wetlands are nontidal wetlands that are flooded for generally longer than two weeks during the growing season. Some of the more common tree dominants include red maple, sweet gum, pin oak, willow oak, loblolly pine, or swamp chestnut oak. There is often a thick shrub understory.
            - Temporarily flooded wetlands are nontidal wetlands that are flooded the least of the four types, about a week. Seasonally saturated wetlands, wetlands having a high water table during the cooler months, are also included in this category. Some of these areas are managed for loblolly pine harvesting. Other tree dominants include red maple, sweet gum, black gum, willow oak, water oak, basket oak, swamp white oak, southern red oak, sycamore, black willow, American holly, sweet bay.
        - Scrub-Shrub wetlands are less common than forested wetlands on the Coastal Plain. They are often dominated by buttonbush (in the wetter systems), silky dogwood, arrowwood, alder and tree saplings.
        - Emergent wetlands are very diverse in the Coastal Plain region due to the occurrence of both tidal and nontidal wetlands. They can be categorized into several different types:
            - Tidal fresh marshes occur along the large coastal waterways, between the brackish marshes and tidal freshwater swamps. It is speculated that in addition to tidal flooding, temporary periods of salt water in these areas may discourage woody succession. These freshwater wetlands

are often more diverse than wetlands with higher salinity levels. Vegetative dominance changes seasonally. There is often a distinct vegetative zonation pattern based on elevation. Some common dominance types according to McCormick and Somes (1982) are arrowheads, big cordgrass, bulrushes, bur-marigold, cattails, common reed, giant ragweed, golden club, pickerelweed/arrow arum, purple loosestrife, reed canary grass, rose mallow, and smartweed/rice cutgrass

- Interdunal wet swales have a very high water table, allowing hydrophytic plants to grow adjacent to dunes having xeric plant species. These sites are often dominated by common three-square, salt hay grass, and rabbit-foot grass.
- Semipermanently flooded marshes are often dominated by cattail, spatterdock, arrow arum, water willow, and bur-reeds.
- Seasonally flooded marshes include isolated depressional wetlands called "potholes" or "Delmarva Bays" (mostly in Caroline, Kent, and Queen Anne's)
- Temporarily flooded wet meadows include areas recently timber harvested that will soon revert back to woody vegetation.

- Aquatic beds include small ponds with vegetation on the bottom and/or surface. These are the wettest of the Palustrine types.

- Piedmont Province palustrine wetlands
  - 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).

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

Tidal wetland acreage was also estimated in *The Coastal Wetlands of Maryland* (Table 1). Baltimore County had 2,103 acres of vegetated tidally-influenced wetlands (excluding SAV). The majority of the vegetated wetlands were freshwater marsh, with some brackish marsh, shrub swamp, and wooded swamp. Freshwater marsh often has higher species richness and species diversity than marsh with higher salinity levels. Freshwater marsh may also have taller plants and there may be less distinct plant zonation than found in brackish or saline marsh.

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

Major Vegetation Type	Vegetation Type	Acreage
Shrub Swamp *(Fresh)*	Swamp rose	0
	Smooth alder/Black willow	10
	Red maple/Ash	6
Swamp forest *(fresh except pine, which is often brackish)*	Bald cypress	0
	Red maple/Ash	3
	Loblolly pine	0
Fresh marsh	Smartweed/Rice cutgrass	147
	Spatterdock	3
	Pickerelweed/Arrow arum	129
	Sweetflag	25
	Cattail	835
	Rosemallow	81
	Wildrice	35
	Bulrush	431
	Big cordgrass	59
	Common reed	140
Brackish High Marsh	Meadow cordgrass/Spikegrass	47
	Marshelder/Groundselbush	20
	Needlerush	0
	Cattail	30
	Rosemallow	8
	Switchgrass	20
	Threesquare	39
	Big cordgrass	0
	Common reed	4
Brackish Low Marsh	Smooth cordgrass	31
Saline High Marsh	Meadow cordgrass/Spikegrass	0
	Marshelder/Groundselbush	0
	Needlerush	0
Saline Low Marsh	Smooth cordgrass, tall growth form	0
	Smooth cordgrass, short growth form	0
Submerged Aquatic Vegetation	Submerged aquatic plants	179

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 Baltimore 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, particularly in the Piedmont region in the County, 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.

Modification of Water Quality

Water Quality Improvement

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

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

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

Nutrient Cycling: Addition, Removal and Transformation

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

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

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

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

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

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

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

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 Baltimore County also aid in providing shade to maintain cool temperatures for aquatic species such as trout. Baltimore County contains a number of wetlands in pasture land that support the State and federally threatened bog turtle.

Nontidal Wetlands of Special State Concern (WSSC)
There are a few 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 is a fair amount of hydric soil that is not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands) mostly occurring along waterways. While the majority is classified as "poorly drained," there are some areas of "very poorly drained" soils. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration. While not classified as hydric soil, there are additional "somewhat poorly drained" soils that may be good areas for wetland creation.

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.

Many streams have become isolated from their historic floodplain. As part of stream restoration projects, the County has been working to reconnect streams with their floodplains. This restores the functions of the floodplain, including storm water quality improvement. A study is currently looking at denitrification rates within floodplain restoration projects (Outen, 2006 pers. comm.).

Sensitive Resources

The Baltimore County Comprehensive Plan outlined many issues and related actions, with some relevant ones including:

- *Characterize and prioritize watersheds, prepare management plans, evaluate systems and functions*
    - Protect streams, wetlands, floodplains, woodlands from impacts of development.
    - Identify and protect remaining high value natural resources.
    - Restore wetlands and forests, and stabilize stream banks in impacted watersheds.
    - Reduce impervious surface, improve urban runoff management, and control sources of pollution.
    - Preserve/enhance greenways and wildlife habitat open spaces.
    - Reduce pollution.
- *Protect reservoirs* (Prettyboy, Liberty, and Loch Raven). These reservoirs are owned and maintained by Baltimore City. However, since only about 6% of the land within the watersheds of these reservoirs is managed by the city, the

remaining portion of the watersheds should be carefully managed by the County. Based on City of Baltimore monitoring data, these reservoirs are affected by nutrient over-enrichment, mainly phosphorus from sewage treatment plants, agriculture, and urban development.
    - Restrict development in reservoir watersheds.
    - Establish riparian buffers in these watersheds.
    - Implement non-point pollution control, stream restoration, and sewage improvements within these watersheds.
- *Protect/restore streams and non-tidal wetlands*
    - Identify areas for stream restoration, wetland creation/restoration, and storm water management.
- *Manage forest resources*
    - Increase riparian forested buffers.
    - Reforest priority forest corridors and gaps.
- *Protect and increase plant/animal habitat and biological diversity*
- *Protect the Chesapeake Bay, tidal waters and rivers*
    - Use natural vegetation for shoreline stabilization where feasible.
    - Improve water quality and habitat value of tidal wetlands.
    - Utilize beneficial uses for dredge spoil including shoreline stabilization and tidal marsh creation.
- *Improve water quality*

There are several relevant County projects:

- Area-wide wetland delineations were completed as part of the Special Area Management Plan (SAMP).
- A Countywide assessment for wetland restoration potentials was created in 2001. This GIS study considered hydric soils, land cover (e.g. grass land), and NWI/SAMP wetlands. To meet their criteria, the site must have hydric soil. They excluded forest and impervious land cover. If the area was forested, it was assumed to be wetland already and if it was impervious, it was assumed to have no potential for wetland restoration. Since our current study also includes many of these same criteria, we did not include this layer in our GIS maps.
- The County hopes to get a GIS layer of the wetlands that are protected through the development process, but there is currently no money for the project.
- A shoreline feasibility study was completed in 1998, which included some projects between Bear Creek and Gunpowder River. Some of the identified projects included shoreline enhancement and potential wetland creation projects.
- The County ranked forest patches for protection and restoration. This was largely based on patch size and the percentage already preserved (publicly owned or in a conservation easement).
- The County is nearly finished with a Land Preservation Prioritization study they are working on with the Conservation Trust Fund. Some of the components of this project are ecological values, agriculture, and water quality.
- DEPRM contracts out watershed management plans for the major watersheds. Restoration projects recommended based on these plans are funded through the Capitol Improvement Program. Many watershed plans have been completed

within this County, with most emphasizing water quality, including looking at pollutant loads for subwatersheds. Some include stream channel stability assessments. Watershed management plans have been developed for watersheds Baltimore Harbor, Middle River, Gunpowder Falls, Little Gunpowder River, Bird River, Back River, Lock Raven, Jones Falls, Patapsco River, and Lower Gunpowder River (Baltimore County, 2004).

- The U.S. Army Corps of Engineers, Baltimore City, and Baltimore County, in cooperation conducted a feasibility study for Gwynns Falls watershed. One goal of this plan was to prioritize sub-watersheds for restoration. Detailed restoration plans are being developed for the subwatersheds Dead Run and Maiden's Choice Run.
- The Department of Environmental Protection and Resource Management (DEPRM) Waterway Improvement Program, supported by Capitol Improvement Program, completed some projects involving stream restoration, stream reforestation, shore erosion, dredging, and/or stormwater retrofit.
- Lake Roland Watershed Restoration Project (Phase II) included several restoration projects initiated to reduce sediment loading to Lake Roland.

Baltimore County 2003 stream sampling ranked streams within the Back River watershed as the worst based on benthic index of biotic integrity.

Groundwater provides water for roughly 10% of the County's population. Groundwater is also used for agricultural, industrial, and commercial uses. Most of the groundwater users are in the northern half of the County. Agricultural preservation areas, intended to protect agriculture, natural resources, and scenic and historically significant areas are designated as follows (Baltimore County, 2000):

- Caves
- Upperco/Worthington/Sparks
- Parkton
- Monkton/Whitehall
- Bird River
- Greenspring
- Patapsco/Granite
- Freeland/Maryland Line
- Long Green

Designated Resource Preservation Areas include:

- Patapsco/Granite
- Gunpowder
- Chesapeake Bay
- Soldiers Delight
- Pretty Boy Reservoir
- Liberty Reservoir
- Loch Raven Reservoir

Source water assessments (SWA) were completed for numerous water systems in the County. A SWA of small community water systems, withdrawing from unconfined aquifers, found they were susceptible to nitrate, VOCs, microbiological contaminants, and naturally occurring radon. Main sources of contaminants were underground storage tanks and pasture/cropland. The SWAs for small non-community systems were susceptible to nitrate (from agriculture and septics), VOCs (from underground storage tanks), coliform, and naturally occurring radon. SWAs focusing on smaller areas are described within that watershed section.

Cockeysville Marble is in roughly 32,127 acres of the County. Since this is a carbonate area, it has high potential for sinkhole formation and groundwater contamination. These areas are located in central Baltimore County, in watersheds: Loch Raven, Lower Gunpowder River, Little Gunpowder River, Jones Falls, Gwynns Falls, and Patapsco River Lower North Branch.

Oregon Ridge Park and Dundee and Saltpeter Creeks Park include large natural areas and environmental education. The stream valley park system, including Gwynns Falls, is part of the County greenway program. The new regional parks will also include large areas of protected or restored natural area. There are numerous waterfront parks. Although the plan promotes increasing waterfront access to Chesapeake Bay and tributaries. Many of the local open spaces and neighborhood and community parks contains some natural areas. Gunpowder Falls contributes to drinking water supply, is very important for forest-dependent species, and is considered to be one of the top ten trout rivers in the eastern U.S. (Baltimore County, 2005).

Other Relevant Programs

Green Infrastructure

There are several Green Infrastructure hubs in the County, including around Liberty Reservoir/Patapsco River, Loch Raven Reservoir/Gunpowder Falls River and Prettyboy Reservoir. Areas within the Green Infrastructure network that are currently unprotected should be protected. Some areas are designated as vegetated Green Infrastructure corridors. 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.

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 two State-designated Natural Heritage Areas (NHA) located in the Jones Falls, Baltimore Harbor, and Back River watersheds. These areas 1) Contain species considered to be threatened, endangered, or in need of conservation; 2) Have unique geology, hydrology, climate or biology; and 3) Are among the best Statewide examples.

Rural Legacy
Designated Rural Legacy land is located south of Prettyboy Reservoir, north and east of Loch Raven Reservoir, and in the eastern coastal area. For detailed information about the program, refer to the individual watershed sections.

Priority Funding Areas
Priority Funding Areas (PFAs) are around Baltimore City, extending up Rte. 795 to Reisterstown, up Rte. 45 to Cockeysville, and the area in Eastern Baltimore south of Gunpowder Falls. Northern Baltimore County does not have any PFAs.

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

Agricultural Easements
Some properties are within agricultural easements. Some are permanent and some are shorter-term. There is some controversy about conducting wetland restoration within agricultural easements. Most would agree that it is desirable to preserve good farmland. However, properties within these easements may also contain spots of soil with lower productivity due to wetness. These low productivity spots may be a hassle to the farmer and may be good areas for wetland restoration. First, the property owner may be able to benefit from an additional program for that low productivity area, resulting in the owner getting more money for the land and utilizing the land to its full extent. Since these property owners are already involved in a preservation program, they may be more likely to consider additional programs. Second, since some of these agricultural easements are temporary, after the agricultural easement expires, the land owner may decide to get out of agriculture, and a wetland program could help to preserve some of the land from development.

Watershed Information

Gunpowder River (02130801)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of the Gunpowder River watershed has 6,435 acres of open water and 6,112 acres of land. The land acres are divided as follows: urban 1,973 acres (32%), agriculture 253 acres (4%), forest 2,797 acres (46%), and wetlands 1,088 acres (18%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Fresh tidal marsh is located on alluvial deposits of river deltas along the Gunpowder River (Sipple, 1999).

In a 1981 MDP document, Gunpowder Delta Marsh/Day's Cove was designated an Area of Critical State Concern. This scenic site is located at the confluence of the Gunpowder River and Little Gunpowder Falls and includes tidal and nontidal wetlands and the surrounding upland hardwood forest. The delta transitions from floodplain to shrub swamp to tidal marsh. Excluding some mineral extraction and local archeological digs, the system is relatively undisturbed. This site provides important bird habitat and spawning area. In 1981, the primary threat to the system was from potentially extensive mineral mining (MDP, 1981).

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

- Estuarine
    - Emergent: 1,751 acres
    - Unconsolidated shore: 114 acres
- Palustrine
    - Aquatic bed: 3 acres
    - Emergent: 79 acres
    - Scrub shrub: 14 acres
    - Forested: 253 acres
    - Unconsolidated bottom: 138 acres
    - Unconsolidated shore: 8 acre
- Total: 2,360 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)
02130801	-1.05	7.19	0	0	6.14

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

- Use I, recreation contact and protection of aquatic life: all waterways except those listed below.
- Use II, shellfish harvesting: All estuarine portions of tributaries except Gunpowder River and tributaries (above Oliver Point and Maxwell Point).

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include poor SAV abundance and habitat index, and high percent impervious surface (14%). Wetland loss was estimated to be 3,830 acres. Indicators for Category 3 include the presence of migratory fish spawning areas and trout spawning areas.

According to the 2002 303(b) report, tidal mainstem and tributaries fail to support all designated uses due to nutrients from natural sources and eutrophication. Results from nontidal, wadeable tributaries were inconclusive.

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

- *Gunpowder River* (tidal); poor biological community, nutrients, sediments.
- *Reardon Inlet Unnamed Tributary* (021308010293 non-tidal in Harford County); poor biological community.

Restoration/Preservation

The Gwynns Falls Watershed Association (1999) listed water quality and flooding as concerns for Scotts Level Branch. Water quality and lack of buffers were also concerns for Dead Run and Gwynns Run. Through 2003, numerous buffer enhancements and stream restoration projects were under design or construction along Dead Run (Baltimore County, 2003). Several stormwater pond conversions were also under design or construction in 2003. Numerous retrofit and stream restoration projects were also proposed along Gwynns Falls according to Baltimore County's 2002 and 2003 annual reports for their municipal NPDES permit.

A large portion of this watershed is within the designated Green Infrastructure network (DNR, 2000-2003). Much of this is protected by Gunpowder Falls State Park, Aberdeen Proving Grounds, and County-owned land. An unprotected hub still remains along Saltpeter Creek. This area should be protected. There are some small gaps in the Green Infrastructure hub, currently in agriculture, which should be restored to natural

vegetation. According to the Maryland Greenways Commission, there are two existing or proposed recreational greenways.

- *Gunpowder Falls, Little Gunpowder Falls, and Beetree Run*: This greenway runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.
- *Bengies Chase Greenway* (proposed): This trail would run through public land to connect many recreational amenities.

There is a designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There are no Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed.

Specific recommendations for restoration:

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

Specific recommendations for protection:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect the designated Area of Critical State Concern: Gunpowder Delta Marsh/Day's Cove (MDP, 1981).
- Protect unprotected Rural Legacy Area (Baltimore County Coastal).
- Protect wetlands and streams within the headwaters.

<u>Lower Gunpowder Falls (02130802)</u>

Background

Based on MDP 2002 GIS land use data the Lower Gunpowder Falls watershed has 88 acres of open water and 29,151 acres of land. The land acres are divided as follows: urban 10,771 acres (37%), agriculture 8,771 acres (30%), forest 9,373 acres (32%), wetlands 83 acres (<1%) and barren land 154 acres (1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Fresh tidal marsh are located on alluvial deposits of river deltas along the Gunpowder River (Sipple, 1999).

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls. Since the reservoirs Loch Raven and Prettyboy supply water to the City, during the dry season these reservoirs reduce the water flow into the Big Gunpowder, negatively impacting the aquatic resources and recreational opportunities on the river (DNR, 1983).

Cockeysville Marble is located in the western portion of this watershed, with a large portion following Glenarm Road. These carbonate areas are important because they have a potential for sinkhole formation and groundwater contamination. Designs for wetland restoration/creation in these areas should take this factor into account.

This watershed has incised streams within the Piedmont region, generally following rock fractures or weathered rock, and broader stream channels within the Coastal Plain portion. Shallow bedrock beneath some streams has provided some natural grade control and resistance to erosion, while streams underlain by alluvial sediments are more susceptible to erosion and downcutting. Soils within this watershed have moderate to slow infiltration (MDE, 2003d).

In a 1981 MDP document, Gunpowder Delta Marsh/Day's Cove was designated an Area of Critical State Concern. This scenic site is located at the confluence of the Gunpowder River and Little Gunpowder Falls and includes tidal and nontidal wetlands and the surrounding upland hardwood forest. The delta transitions from floodplain to shrub swamp to tidal marsh. Excluding some mineral extraction and local archeological digs, the system is relatively undisturbed. This site provides important bird habitat and spawning area. In 1981, the primary threat to the system was from potentially extensive mineral mining (MDP, 1981).

An extensive nontidal wetland assessment and delineation was conducted for part of the Middle River Neck peninsula as part of a Special Area Management Plan (SAMP). The SAMP was in two watersheds, the Lower Gunpowder Falls and Middle River. Functions assessed were ecological integrity, plant habitat, wildlife habitat, aquatic habitat, flood control potential, water quality functions, and heritage elements. The area delineated was 212 acres. The SAMP was initiated in response to proposed sewer expansion by Baltimore County, and potential cumulative wetland impacts. The New Hampshire method of wetland assessment was adapted for the study, using some elements of the WET II. Nine of the 24 wetland complexes assessed were found to be impactable with the remaining wetlands targeted for preservation.

A second nontidal wetland assessment was conducted in an expanded area of the Middle River Neck peninsula in 1998. There were 78 wetland complexes assessed in 51 sampling units. Thirty-four of the units were in the Lower Gunpowder Falls watershed. None were connected to nontidal intermittent or perennial streams. Some wetlands were connected to tidal waters. A State Threatened species, Arundinaria gigantean (Giant Cane) is located at wetland w-32 in Miami Beach Park. The species was also found in Wetland W-33, which connected to tidal waters.

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

- Estuarine
  - Emergent: 42 acres
  - Scrub shrub: 9 acres
- Palustrine
  - Emergent: 13 acres
  - Scrub shrub: 8 acres
  - Forested: 126 acres
  - Unconsolidated bottom: 59 acres
  - Unconsolidated shore: <1 acre
- Total: 256 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)
02130802	-1.50	2.04	0	0.02	0.56

Code of Maryland Regulations

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

- Use I, recreation contact and protection of aquatic life: all waterways except those designated below.
- Use II, shellfish harvesting: all estuarine portions of tributaries except Gunpowder River and tributaries (above Oliver Point and Maxwell Point).
- Use III, natural trout waters:
  - Long Green Run and tributaries
  - Sweathouse Branch and tributaries

Water Quality

A source water assessment for Glen Meadows Retirement Community found the wells were susceptible to nitrate and naturally occurring radon (based on accepted maximum contaminant levels).

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a "Priority" Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include poor non-tidal benthic index

of biotic integrity (BIBI), high percent impervious surface (13%), high population density, and high soil erodibility (0.33). Wetland loss was estimated to be 2,589 acres. Indicators for Category 3 include presence of designated Wildlands acres (within Gunpowder Falls State Park).

According to the 2002 305(b) report, the mainstem river (mouth to Loch Raven Dam) fully supports all designated uses. A portion of the wadeable tributaries (45 miles) supports all designated uses while the remainder are inconclusive (11 miles).

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

- *Lower Gunpowder Falls* (non-tidal); nutrients, poor biological community.
- *Cowen Run* (021308020297 non-tidal); poor biological community.
- *Unnamed Tributary 1 to Cowen Run* (021308020297 non-tidal); poor biological community.
- *Long Green Creek* (021308020297 non-tidal); poor biological community.
- *Unnamed Tributary to Long Green Creek* (021308020297 non-tidal); poor biological community.
- *Jennifer Branch* (021308020297 non-tidal); poor biological community.

A Water Quality Analysis was completed for heavy metals in the Lower Gunpowder Falls. The non-tidal streams within this watershed were put on the 303d list for impairment of heavy metals and nutrients in 1996 and biological impairment in 2002. This report found no heavy metal impairment and suggests removal of heavy metals from the 303d list of impairments.

Restoration/Preservation

A watershed management plan was completed for this watershed in 1998. Numerous capitol improvement projects, including stream restorations and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

Stream restoration projects have been completed or are under construction or design on Minebank Run and Jennifer Branch.

There is a large Green Infrastructure hub in this watershed along Gunpowder Falls River, protected by Gunpowder Falls State Park (DNR, 2000-2003). There are some Green Infrastructure corridors that are not protected. Several METs are also present. According to the Maryland Greenways Commission, there are two existing or proposed recreational greenways.

- *Gunpowder Falls, Little Gunpowder Falls, and Beetree Run*: This greenway runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.
- *Minebank Run* (proposed): This potential greenway would run south from Gunpowder Fall River.

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Long Green Valley Rural Legacy Area includes approximately 6,000 acres. This area is currently largely undeveloped (90%). This area was chosen in order to protect contiguous productive agriculture and adjacent natural features (e.g. forests, streams, other greenways). The goal is to protect 5,400 acres (90%). Currently, 1,857 acres (31%) of this land are protected through various methods. The sponsor is Long Green Valley Conservancy. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. There is an additional designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There are two State-designated Nontidal Wetlands of Special State Concern within this watershed, as described below.

- *Big Gunpowder Falls - Forge Road Site (DNR name: Gunpowder Falls Central)*. This site contains an old diverse riparian forest and a seepage wetland with a healthy population of a rare plant species (DNR, 1991). This site is protected by Gunpowder Falls State Park.
- *Club Hill Forest (DNR name: Gunpowder Falls Central)*. This site contains a mesic bottomland forest with a healthy population of a rare plant species. This site is located in an area of rapid development (DNR, 1991). This site is protected by Gunpowder Falls State Park.

These sites should be investigated to determine if they still qualify as Nontidal Wetlands of Special State Concern due to a change in status of rare species on the sites.

Specific Restoration Recommendations:

- Restore “gaps” in designated Green Infrastructure hub to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect the designated Area of Critical State Concern: Gunpowder Delta Marsh/Day’s Cove (MDP, 1981).
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands and streams within the headwaters.

<u>Bird River (02130803)</u>

Background

Based on MDP 2002 GIS land use data, the Bird River watershed has 1,172 acres of open water and 16,564 acres of land. The land acres are divided as follows: urban 8,229 acres (50%), agriculture 2,059 acres (12%), forest 5,545 acres (33%), wetlands 458 acres (3%) and barren land 274 acres (2%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Bird River was designated as one of four "targeted watershed" in 1989. The watersheds were selected because they were threatened by multiple sources of degradation from urbanization or contributed disproportionately high nutrients to Chesapeake Bay (Lubbers and Bartholomew 1992). Monitoring, management, and restoration recommendations have been incorporated into overall water quality planning by Baltimore County.

Nontidal wetlands are predominantly forested and located adjacent to the stream channels. Significant flood attenuation is provided by wetlands along Windlass Run. The most extensive tidal wetland areas are located in Gunpowder Falls State Park.

Historic impacts have occurred from land development and sand and gravel mining. There are possible impacts from failing septic systems and agricultural activities in Windlass Run.

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls, with a portion located within this watershed.

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

- Estuarine
    - Emergent: 252 acres
    - Scrub shrub: 3 acres
    - Unconsolidated shore: 119 acres
- Palustrine
    - Aquatic bed: 2 acres
    - Emergent: 37 acres
    - Scrub shrub: 21 acres
    - Forested: 158 acres
    - Unconsolidated bottom: 79 acres
- Riverine unconsolidated shore: 8 acres
- Total: 679 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)
02130803	-16.60	29.19	0	0	12.60

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

- Use I, recreation contact and protection of aquatic life: all waterways except those designated below
- Use II, shellfish harvesting: All estuarine portions of tributaries except Gunpowder River and tributaries (above Oliver Point and Maxwell Point).
- Use IV, recreational trout waters: Whitemarsh Run and tributaries.

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 levels of nitrogen loadings, high percent impervious surface, high population density, and high soil erodibility (0.33). Wetland loss was estimated to be 6,673 acres. Indicators for Category 3 include presence of migratory fish spawning areas.

According to the 2002 305(b) report, the tidal embayment and tributaries fail to support all designated uses. Results for the nontidal, wadeable tributaries are 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:

- Bird River (tidal); nutrients, sediments.
- Honey Go Run (021308030295 non-tidal); poor biological community.
- White Marsh Run (021308030295 non-tidal); poor biological community.

The Bird River Watershed Water Quality Plan (Dames and Moore, 1995) ranked problems in the following order: stream channel instability, elevated pollutant loads, unforested riparian buffer, and man-made fish migration barriers. Sources of problems are: runoff from impervious surfaces, mining, agriculture, and unauthorized wastewater discharges.

Alewife is believed to be the only anadromous fish to migrate up Whitemarsh Run and its tributaries, though current use is uncertain. Blockages to fish passage were evaluated using alewife as an indicator.

Restoration/Preservation

A watershed management plan was completed for this watershed in 1996. Numerous capitol improvement projects, including stream restorations and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

Goals for the watershed have included the following:

- Restore stream stability, reduce erosion, and improve fish and wildlife habitat in nontidal portions of the watershed.
- Establish and protect riparian forest buffers.
- Reduce sediment and nutrient inputs to Bird River estuary and Chesapeake Bay.

Recommended restoration projects have included:

- Stream channel restoration.
- Reforestation of riparian buffers.
- Removal of fish blockages.
- Retrofit dry ponds with possible wetland plantings.
- Implement BMPs to reduce peak flows prior to stream restoration.
- Conduct restoration from upstream to downstream.

Numerous stormwater management facilities have been upgraded to provide additional water quality treatment. Several stream restoration projects, particularly in Whitemarsh Run and its tributaries, have been completed (Baltimore County, 2002). There were proposed stream restoration projects in 2003 at North Fork White Marsh Run, East Honeygo Run, South Fork Franklin Square, and at White Marsh Road. Additional restoration work in the Whitemarsh Run watershed is planned by the County (Baltimore County, 2003).

There are three small Green Infrastructure hubs within this watershed (DNR, 2000-2003), on the eastern portion of the watershed (protected by Gunpowder Falls State Park), northwest of White Marsh (protected by County-owned Honeygo Run Park), and along Windlass Run (unprotected). There are also some connecting Green Infrastructure corridors, which are unprotected. According to the Maryland Greenways Commission, there are two existing or proposed recreational greenways.

- *Gunpowder Falls, Little Gunpowder Falls, and Beetree Run*: This greenway runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.
- *White Marsh Run* (proposed): This greenway would preserve the White Marsh Run stream corridor.

There is a designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There is one Nontidal Wetlands of Special State Concern (WSSC) within this watershed. *Putty Hill Wetlands* is a diverse wetland complex, containing a shrub swamp and sphagnum seep associated with a high-quality stream. This site has three rare and two uncommon plant species. There are two State-Endangered plant species growing in the wetland openings created by powerline maintenance and one State-Rare plant species is in the forested acidic sphagnum seep. Upper Coastal Plain wetlands with this degree of natural integrity are very uncommon in the highly urbanized area (DNR, 1991). This site is unprotected.

Specific Restoration Recommendations:

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

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands and streams within the headwaters.

Little Gunpowder Falls (02130804)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of Little Gunpowder Falls watershed has 36 acres of open water and 17,001 acres of land. The land acres are divided as follows: urban 3,936 acres (23%), agriculture 7,116 acres (42%), forest 5,800 acres (34%), wetlands 133 acres (1%) and barren land 15 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

In a 1981 MDP document, Gunpowder Delta Marsh/Day's Cove was designated an Area of Critical State Concern. This scenic site is located at the confluence of the Gunpowder River and Little Gunpowder Falls and includes tidal and nontidal wetlands and the surrounding upland hardwood forest. The delta transitions from floodplain to shrub swamp to tidal marsh. Excluding some mineral extraction and local archeological digs, the system is relatively undisturbed. This site provides important bird habitat and spawning area. In 1981, the primary threat to the system was from potentially extensive mineral mining (MDP, 1981).

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls. The Little Gunpowder River ranges between 30-75 feet across (DNR, 1983).

Cockeysville Marble is located in a portion of this watershed, following Garrettsville Pike. These carbonate areas are important because they have a potential for sinkhole formation and groundwater contamination. Designs for wetland restoration/creation should take this into account.

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

- Estuarine emergent: 112 acres
- Palustrine
    - Emergent: 29 acres
    - Scrub shrub: 8 acres
    - Forested: 64 acres
    - Unconsolidated bottom: 127 acres
- Riverine unconsolidated shore: 10 acre
- Total: 349 acres

A reference site for the forested tidal wetland community of Green Ash-Red Maple/Smartweed(*Fraxinus pennsylvanica-Acer Rubrum/Polygonum spp.)* is found along Little Gunpowder Falls. This community is found at the higher tidal limits. The soils are poorly drained and less saturated than other tidal communities.

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)
02130804	-1.71	1.92	7.00	0	7.21

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

- Use I, recreation contact and protection of aquatic life: all waterways except those designated below
- Use II, shellfish harvesting: All estuarine portions of tributaries except Gunpowder River and tributaries (above Oliver Point and Maxwell Point).
- Use III, natural trout waters: Little Gunpowder Falls and tributaries (above B&O bridge ¾ mile south of Rte. 7).

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing

restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high population density and high soil erodibility (0.33). Wetland loss was estimated to be 2,572 acres. Indicators for Category 3 include presence of trout spawning areas and designated Wildland areas (within Gunpowder Falls State Park).

According to the 2002 305(b) report, the nontidal, wadeable tributaries fully support all designated uses. Results for the mainstem river are 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:

- *Little Gunpowder Falls* (non-tidal); nutrients.
- *Little Gunpowder Falls* (021308040298 non-tidal); poor biological community.
- *Little Gunpowder Falls Unnamed Tributary 2* (021308040298 non-tidal); poor biological community.
- *Little Gunpowder Falls Unnamed Tributary 3* (021308040298 non-tidal); poor biological community.
- *Wild Cat Branch Unnamed Tributary 1* (021308040298 non-tidal); poor biological community.
- *Overshot Branch* (021308040298 non-tidal in Baltimore County); poor biological community.

Restoration/Preservation

A watershed management plan was completed for this watershed in 2002 (Baltimore County DEP, 2004).

- Priority restoration activities for the watershed were determined to be stream channel restoration and riparian buffer enhancement. Stormwater retrofits were not considered priority restoration activities due to small drainage areas, ownership, and impact on receiving stream (Biohabitats, 2001). There were no stream restoration projects under design or construction as of 2003 as capital improvement projects. There were two stream restoration projects proposed for 2006 and 2008. Specific projects recommended as priority stream restoration were in the following sub-watersheds: Sawmill, Sweet Air, and Lower Little Gunpowder Falls. Some riparian planting was also recommended.
- Priority riparian buffer enhancement: Headwaters, Nelson, Hess, Parker subwatersheds.
- The Plan also made some general recommendations for preservation of all natural areas and open space.

There is a long Green Infrastructure hub along Little Gunpowder Falls River (DNR, 2000-2003), protected by Gunpowder Falls State Park and METs. There are also several unprotected Green Infrastructure corridors. According to the Maryland Greenways Commission, there is a recreational greenway called Gunpowder Falls, Little Gunpowder

Falls, and Beetree Run which runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Manor Rural Legacy Area has approximately 17,027 acres in Baltimore and Harford Counties. This area is currently largely undeveloped (92%). This area was chosen in order to protect "agriculture lands, the scenic and rural quality of the area, productive horse and cattle farms, and water quality of the Little Gunpowder Falls, a Class 3 trout stream." The goal is to protect 15,500 acres (91%). Currently, 7,689 acres (45%) of this land is protected through various methods. The sponsors are The Manor Conservancy. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. There is an additional designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are no Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed. However, there are some potential WSSC.

- There is a potential WSSC along Nelson Branch and is partially protected by a MET.
- There is a potential WSSC along Little Gunpowder Falls (also within Harford County) and is unprotected.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Stream channel restoration within sub-watersheds: Sawmill, Sweet Air, and Lower Little Gunpowder Falls.
- Riparian buffer enhancement within: Headwaters, Nelson, Hess, Parker subwatersheds.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect the designated Area of Critical State Concern: Gunpowder Delta Marsh/Day's Cove (MDP, 1981).
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands and streams within the headwaters.

<u>Loch Raven Reservoir (02130805)</u>

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of Loch Raven Reservoir watershed has 2,090 acres of open water and 137,487 acres of land. The land acres are divided as follows: urban 33,802 acres (25%), agriculture 51,565 acres (38%), forest 51,798 acres (38%), wetlands 112 acres (<1%) and barren land 211 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Loch Raven Reservoir is owned by Baltimore City Department of Public Works and is a major source of water for the city. Prettyboy Reservoir drains into Gunpowder River and then into Loch Raven Reservoir. Soils have mainly moderate infiltration and are moderately well to well drained (MDE, 2003c).

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls. Since the reservoirs Loch Raven and Prettyboy supply water to the city, during the dry season these reservoirs reduce the water flow into the Big Gunpowder, negatively impacting the aquatic resources and recreational opportunities on the river (DNR, 1983).

Cockeysville Marble is located in a large portion of this watershed, mostly in the southern area. These carbonate areas are important because they have a potential for sinkhole formation and groundwater contamination. Designs for wetland restoration/creation should take this into account.

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Estimates of wetland acreage for the entire Maryland portion of the 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)
02130805	-1.27	1.23	0	0.08	0.05

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

- Use I, recreation contact and protection of aquatic life: all waterways except those designated below.
- Use III-P, natural trout waters and potable water supply: Gunpowder Falls and tributaries (above Loch Raven dam).

Water Quality

The source water assessment for Sunnybrook's found the water supply was susceptible to nitrate, viruses, and naturally occurring radon (depending on the approved maximum contaminant levels). The sourcewater assessment for Oldfields School found the water supply was susceptible to nitrates, VOCs, and naturally occurring radon (depending on the approved maximum contaminant levels).

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 (0.31). Wetland loss was estimated to be 2,261 acres. Indicators for Category 3 include trout spawning areas, presence of designated Wildlands (within Gunpowder Falls State Park), and the presence of a drinking water intake.

According to the 2002 305(b) report, the mainstem river (Loch Raven Reservoir to Prettyboy Dam) and the Loch Raven Reservoir fully support all designated uses. A portion of the wadeable tributaries (190 miles) supports all designated uses. Another portion fails to support all designated uses (31 miles) due to an impaired biological community from habitat alteration (bank instability and channelization) and changes in hydrology. The remainder of the wadeable tributaries were inconclusive (16 miles).

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

- *Loch Raven Reservoir Impoundment* (non-tidal); nutrients, sediments. Methylmercury in fish tissue also impairs water, but a TMDL has been completed for this contaminant.
- *Greene Branch* (021308050301 non-tidal in Baltimore County); poor biological community.
- *Unnamed Tributary to Carroll Branch* (021308050304 non-tidal in Baltimore County); poor biological community.
- *Little Falls* (021308050312 non-tidal in Baltimore County); poor biological community.

- *Oregon Branch* (021308050302 non-tidal in Baltimore County); poor biological community.
- *Loch Raven Reservoir Unnamed Tributary* (021308050300 non-tidal in Baltimore County); poor biological community.
- *Long Quarter Branch Unnamed Tributary* (021308050300 non-tidal in Baltimore County); poor biological community.
- *Piney Run* (021308050308 non-tidal); poor biological community.
- *Piney Run Unnamed Tributary 1* (021308050308 non-tidal); poor biological community.
- *McGill Run Unnamed Tributary* (021308050308 non-tidal in Baltimore County); poor biological community.
- *Second Mine Branch* (021308050309 non-tidal); poor biological community.
- *First Mine Branch* (021308050309 non-tidal); poor biological community.
- *Fourth Mine Branch* (021308050309 non-tidal in Baltimore County); poor biological community.

A Water Quality Analysis was completed for heavy metals in Loch Raven Reservoir, as summarized here. This watershed was put on the 303d list for impairment of heavy metals (impoundment), nutrients (impoundment), and suspended sediments (impoundment) in 1996, and fecal coliform (non-tidal streams), methylmercury (impoundment), PCBs (impoundment), and biological impairment (non-tidal streams) in 2002. This report found no heavy metal impairment and suggests removal of heavy metals from the 303d list of impairments.

A DRAFT Total Maximum Daily Load was completed for mercury in Loch Raven Reservoir. A high estimate of point source contribution is 7%. MDE issued a public fish consumption advisory due to the high mercury levels in fish tissue. This high mercury is mainly due to atmospheric deposition from out-of-state coal-fired electric power plants. This pollutant should be less than the total maximum daily loads when current and proposed Clean Air Act laws are established.

Restoration/Preservation

A watershed management plan was completed for this watershed in 1996. Numerous capitol improvement projects, including stream restorations and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

The Water Quality Management Plan for the watershed (Tetra Tech, 1997) recommended priority areas for four sub-watersheds. Protection of reservoir drinking water quality and quantity is highest priority.

- Highest Priority: Management Area 1 – protection of drinking water supply. Area in closest proximity to reservoir.
- High Priority:
    - Management Area 2 – retrofit in existing urban areas and management of new sprawl. High potential for stream restoration.
    - Management Area 3 – preservation of parkland and forest land.

  - Management Area 4 – agricultural management and protection of headwaters.
  - Protection of the headwater subwatershed to preserve a stable sediment protection zone and high water quality to inflow to 3rd order and higher streams.
  - Protection of living resources including aquatic and terrestrial habitat.
  - Preservation of rural character of watershed.

The Loch Raven Water Quality Management Plan identified 40 sites that may be suitable for restoration. Most of these were riparian restoration, though some areas contained Hatboro and Baile hydric soils, so there may be potential for wetland restoration as well. Stream reaches with restoration potential included those on Carroll Branch, Beaverdam Run, Oregon Run, Goodwin Run, Panther Branch. Baltimore County's 2002 and 2003 annual NPDES reports recorded the status of various projects, including those completed on Dulaney Valley Branch, East Beaver Dam Run, and Goodwin Run. Stream restoration projects under design or construction in 2003 were in Hampton Branch and Ashland Church. Several stream restoration projects and retrofits remain proposed, including a stream restoration project on Oregon Branch and a Gypsy Lane tributary.

There are a few Green Infrastructure hubs in this watershed (DNR, 2000-2003), with the largest being along Gunpowder Falls River just south of Prettyboy Reservoir (protected by Gunpowder Falls State Park) and around Lock Raven Reservoir (protected). Other protected areas include Oregon Ridge Park and numerous METs. There are still several Green Infrastructure hubs and corridors that are unprotected, with the largest being east of Grimesville, south of White Hall, and south of Pleasant Grove. There are some large gaps in the Green Infrastructure corridors, currently in agriculture, which should be restored to natural vegetation. According to the Maryland Greenways Commission, there are two existing or proposed greenways.

- *Gunpowder Falls, Little Gunpowder Falls, and Beetree Run* (recreational greenway): This greenway runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.
- *Jones Falls and Roland Run* (existing and proposed environmental greenway): This trail runs from Baltimore City north, paralleling the MTA light rail tracks, to connect with Lake Roland and Robert E. Lee Park..

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review.* There are three designated Rural Legacy areas within this watershed, Manor, Gunpowder, and Piney Run. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

- Manor Rural Legacy Area has approximately 17,027 acres in Baltimore and Harford Counties. This area is currently largely undeveloped (92%). This area was chosen in order to protect "agriculture lands, the scenic and rural quality of the area, productive horse and cattle farms, and water quality of the Little Gunpowder Falls, a Class 3 trout stream." The goal is to protect 15,500 acres

(91%). Currently, 7,689 acres (45%) of this land are protected through various methods. The sponsor is The Manor Conservancy.

- The Gunpowder Rural Legacy Area includes 5,468 acres. This area is currently largely undeveloped (93%). This area was chosen in order to protect: the Gunpowder River, the water quality for the Prettyboy Reservoir and Loch Raven Reservoir (supplying water to 1.8 million people), and the recreational aspects of the area. The goal is to protect 3,200 acres (59%). Currently, 1,623 acres (30%) of this land are protected through various methods. The sponsor is Gunpowder Valley Conservancy.
- Piney Run Rural Legacy Area contains approximately 32,320 acres. This area is currently largely undeveloped (96%). This area was chosen in order to improve water quality in the Piney Run Reservoir and Loch Raven Reservoir through stream buffers, and encourage agriculture and natural resources in the area. The goal is to protect 23,819 acres (74%). Currently, 11,519 acres (36%) of this land are protected through various methods. The sponsor is Land Preservation Trust.

Loch Raven watershed contains more Nontidal Wetlands of Special State Concern (WSSC) than any other watershed within Baltimore County. There are additional potential WSSC.

- *Beaverdam Run*. This is a spring-fed calcareous marsh. While this type of habitat was once common in the area, most similar habitat has been destroyed due to development, agriculture, and mining for marble. There are two State-Endangered plant species at the edge of this wetlands (DNR, 1991). This site is unprotected.
- *Beetree Run*. This wooded stream valley wetland contains a healthy population of a State-Rare plant species (DNR, 1991). This site is unprotected.
- *Glencoe/Gunpowder Falls*. This is a riverine floodplain site containing a State-Rare plant species. This species is at the edge of its range, meaning that it may contain slightly different genetic makeup than the rest of the species. This may be important to the survival of the species when environmental conditions change. Therefore, it is important to preserve this population (DNR, 1991). This site is unprotected. It may require further investigation to determine if the site still qualifies as a nontidal wetland of special State concern, due to a possible change in status of rare species.
- *Loch Raven – Hampton Area*. This site contains seasonally inundated fine silt and gravel shoreline with a large population of a State-Endangered plant species. This site is the only listed location for this species in the State. There is a State-Rare plant species in the calcareous shore above the high water mark. The State-Endangered species is vulnerable to changes in water level within the reservoir (DNR, 1991). This site is protected by the County-owned Loch Raven Reservoir.
- *Monkton Bog*. The site was described in 1991 as an alder and willow shrub swamp containing a bird listed as In Need of Conservation. This site is separated from the primary range of the bird, meaning that it may contain slightly different genetic makeup than the rest of the species. This may be important to the survival of the species when environmental conditions change or disease spreads. Therefore, it is important to preserve this population. This bird would be adversely impacted by changes in the wetland, including hydrologic or vegetative.

This site also provides habitat for many other bird species (DNR, 1991). This site is unprotected.

- *Phoenix Marsh*. This wetland is located at the edge of the reservoir and along the stream that feeds this marsh. This site contains a State-Rare plant species and two additional uncommon plant species. These rare species are vulnerable to further invasion by a dominant grass already present in the marsh (DNR, 1991). This site is protected by the County-owned Loch Raven Reservoir.
- *Potential WSSC*. There are several WSSC in the northern portion of this watershed that are unprotected.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Restore wetlands designed to improve water quality of Loch Raven Reservoir.
- Implement restoration recommendations based on the Water Quality Management Plan for the watershed (Tetra Tech, 1997).
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect WSSC and buffers.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands that function to improve water quality of Loch Raven Reservoir.
- Implement protection recommendations based on the Water Quality Management Plan for the watershed (Tetra Tech, 1997). Preservation areas: Stable parkland and forested areas, and headwaters (particularly in Management Area #3).
- Protect wetlands and streams within the headwaters.

Prettyboy Reservoir (02130806)

Background

Based on MDP 2002 GIS land use data, the Prettyboy Reservoir watershed has 1,502 acres of open water and 24,102 acres of land. The land acres are divided as follows: urban 2,563 acres (11%), agriculture 9,854 acres (41%), forest 11,632 acres (48%), wetlands 48 acres (<1%) and barren land 6 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Prettyboy Reservoir is owned by Baltimore City Public Works. It is along the Gunpowder River. It is surrounded by a park, allows fishing (including fish stocking), and has a boat launch. This water is a water supply to Baltimore City, through Loch Raven Reservoir (MDE, 2003e).

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls. Since the reservoirs Loch Raven and Prettyboy supply water to the city, during the dry season these reservoirs reduce the water flow into the Big Gunpowder, negatively impacting the aquatic resources and recreational opportunities on the river (DNR, 1983).

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

- Lacustrine unconsolidated shore: 133 acres
- Palustrine
    - Emergent: 280 acres
    - Scrub shrub: 55 acres
    - Forested: 186 acres
    - Unconsolidated bottom: 113 acres
    - Farmed: 48 acres
- Riverine unconsolidated shore: <1 acre
- Total: 815 acres

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

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130806	-0.12	0	0	0	-0.12

Code of Maryland Regulations

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

- Use I, recreation contact and protection of aquatic life: all waterways except those designated below.
- Use III-P, natural trout waters and potable water supply: Gunpowder Falls and tributaries (above Loch Raven dam).

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 nutrient concentrations, high population density, high percent unforested stream buffer (46%),

and high soil erodibility (0.29). Wetland loss was estimated to be 892 acres. Indicators for Category 3 include high non-tidal instream habitat index, high non-tidal fish index of biotic integrity (FIBI), trout spawning areas, and presence of designated Wildlands.

According to the 2002 305(b) report, the mainstem river (above Prettyboy Reservoir) fails to support all designated uses due to bacteria. A portion of the nontidal wadeable tributaries (36 miles) fails to support all designated uses due to an impaired biological community. Prettyboy Reservoir fully supports all designated uses (DNR, 2002). Lack of stream cover has resulted in seasonally high water temperatures (DNR, 2000).

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:

- *Prettyboy Reservoir Impoundment*; nutrients. Methylmercury in fish tissue is causing impairment, but already has a completed TMDL.
- *Gunpowder River* (Reservoir to Falls Road); fecal coliform.
- *Compass Run* (021308060313 in Baltimore County); poor biological community.
- *Poplar Run* (021308060313); poor biological community.
- *Prettyboy Branch* (021308060313 in Baltimore County); poor biological community.
- *Prettyboy Branch Unnamed Tributary 1* (021308060313 in Baltimore County); poor biological community.

A Water Quality Analysis was completed for heavy metals in Prettyboy Reservoir, as summarized here. Among other things, this reservoir was on the 1996 303d list as being impaired by heavy metals, although the evidence backing up this listing was questionable. The 2003 study found no heavy metal impairment in the reservoir and recommends it be removed from the 303d list for impairment from metals.

A DRAFT TMDL was completed for mercury in Prettyboy Reservoir. There are not significant point sources of mercury. MDE issued a public fish consumption advisory due to the high mercury levels in fish tissue. This high mercury is mainly due to atmospheric deposition from out-of-state coal-fired electric power plants. This pollutant should be less than the total maximum daily loads when current and proposed Clean Air Act laws are established.

Restoration/Preservation

Prettyboy Reservoir is a holding reservoir for Loch Raven Reservoir. This means that when water levels are low in Loch Raven Reservoir, water is released from Prettyboy Reservoir to supplement Loch Raven. Water is also released from Prettyboy Reservoir to maintain low summer temperatures required for trout in Gunpowder Falls. Since this watershed is important for trout populations and for water supply, preservation and reforestation within this reservoir is important. In 2003, a study was completed that identified threats to the water supply (Baltimore County DEP, 2004).

There is a large protected Green Infrastructure hub within the Baltimore portion of this watershed, around Prettyboy Reservoir (DNR, 2000-2003). There are some naturally vegetated Green Infrastructure corridors in need of protection and some gaps in the Green Infrastructure corridors in need of restoration. According to the Maryland Greenways Commission, there is an existing recreational greenway called Gunpowder Falls, Little Gunpowder Falls, and Beetree Run which runs north along the Harford border and northwest past Loch Raven reservoir into Pennsylvania.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Piney Run Rural Legacy Area contains approximately 32,320 acres. This area is currently largely undeveloped (96%). This area was chosen in order to improve water quality in the Piney Run Reservoir and Loch Raven Reservoir through stream buffers, and encourage agriculture and natural resources in the area. The goal is to protect 23,819 acres (74%). Currently, 11,519 acres (36%) of this land is protected through various methods. The sponsor is Land Preservation Trust. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are no Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed. However, there are some potential WSSC that are all unprotected.

- This site is located near the intersection of Brick Store Road and Upper Beckleysville Road
- This site is located near the intersection of Cotter Road and Beckleysville Road
- This site is located along Clipper Mill Road, just outside of the protected Prettyboy Reservoir land.
- This site is in the headwaters of Walker Run.

Specific Restoration Recommendations:

- Restore “gaps” in designated Green Infrastructure hub to natural vegetation.
- Restore wetlands designed to improve water quality of Prettyboy Reservoir.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands that function to improve water quality of Prettyboy Reservoir.
- Protect wetlands and streams within the headwaters.

Middle River – Brown Creek (02130807)

Background

Based on MDP 2002 GIS land use data, the Middle River - Browns watershed has 2,686 acres of open water and 6,762 acres of land. The land acres are divided as follows: urban 4,317 acres (64%), agriculture 305 acres (5%), forest 1,889 acres (28%), wetlands 148 acres (2%) and barren land 102 acres (2%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Middle River is a wide shallow tidal estuary that runs through a largely suburban and urban watershed. The topography is gently rolling to flat. Most areas have an elevation of less than 50 feet, with the maximum elevation of near 1,000 feet (MDE, 2003a).

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

- Estuarine
    - Emergent: 107 acres
    - Scrub shrub: <1 acre
    - Unconsolidated bottom: 15 acres
- Palustrine
    - Emergent: 1 acre
    - Scrub shrub: 13 acres
    - Forested: 82 acres
    - Unconsolidated bottom: 3 acres
- Total: 221 acres

An extensive nontidal wetland assessment and delineation was conducted for part of the Middle River Neck peninsula as part of a Special Area Management Plan (SAMP). The SAMP was in two watersheds, the Lower Gunpowder Falls and Middle River. Functions assessed were ecological integrity, plant habitat, wildlife habitat, aquatic habitat, flood control potential, water quality functions, and heritage elements. The area delineated was 212 acres. The SAMP was initiated in response to proposed sewer expansion by Baltimore County, and potential cumulative wetland impacts. The New Hampshire method of wetland assessment was adapted for the study, using some elements of the WET II. Nine of the 24 wetland complexes assessed were found to be impactable with the remaining wetlands targeted for preservation.

A second nontidal wetland assessment was conducted in an expanded area of the Middle River Neck peninsula in 1998. There were 78 wetland complexes assessed in 51 wetland units. Seventeen of the units were in the Middle River watershed. None were connected to nontidal intermittent or perennial streams. Some wetlands were connected to tidal waters.

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

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130807	-2.45	1.90	0	0	-0.55

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

- Use I, recreation contact and protection of aquatic life: All waterways except those designated below.
- Use II: All estuarine portions of tributaries except Middle River above line from Log Pt. to Turkey Pt.

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 nitrogen concentrations, poor SAV abundance, high percent impervious surface (25%), high population density, and high percent unforested stream buffer (100%). Wetland loss was estimated to be 3,298 acres. Indicators for Category 3 include presence of fish spawning area.

According to the 2002 305(b) report, the tidal embayments and tributaries fail to support all designated uses due to metals and low pH from unknown sources.

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

- *Browns Creek* (tidal); nutrients, sediments.

A Water Quality Analysis was completed for cadmium and lead in Middle River, as summarized here. The tidal waters within this watershed were put on the 303d list for impairment of nutrients and suspended sediments in 1996, copper and nickel in 1998, and cadmium and lead in 2002. Copper and nickel were removed from the list in 2002, as it was determined they did not impair the waters. This report found that cadmium and lead were not impairing the waters, so it is recommended they be removed from the 303d list as well.

Restoration/Preservation

Goals listed in the Special Area Management Plan:

- Restoration
    - A site may be suitable for construction of a retrofit facility to improve water quality of Frog Mortar Creek, and there is a proposed project. In the expanded SAMP, several wetlands are identified that could be enhanced by removal of waste material. Potential mitigation sites may include a field between Bowleys Quarters Road, Galloway Road, and Susquehanna Avenue.
    - Baltimore County had completed several shoreline enhancements and retrofits as of 2002 (Baltimore County, 2002). A stormwater retrofit and stream restoration project was under design or construction at the Village of Tall Trees in 2003. Several additional retrofit projects (Old Eastern Avenue, Frog Mortar Creek, and Middle River) and a new extended detention pond at Riverdale are also proposed (Baltimore County, 2003).
    - Establish consolidated mitigation areas on Middle River and Back River Neck peninsulas and the Vincent Farms Study area.
- Preserve wetlands associated with perennial or intermittent streams in the first SAMP. Some preference should also be given to wetlands found to provide higher water quality functions. In the second expanded SAMP, wetlands that are part of larger complexes outside of the study area, and wetlands in the Critical Area are generally recommended for preservation. Forested areas and wetlands connected to tidal waters are also recommended for preservation. All but 22 wetlands in the expanded SAMP are proposed for preservation.

A watershed management plan was completed for this watershed in 2001. Numerous capitol improvement projects have been completed in this watershed. Many creeks have been dredged through DEPRM's capitol improvement program. The feasibility study for this dredging permit identified potential retrofit sites. Many projects completed through the capitol improvement project are shoreline improvements (Baltimore County DEP, 2004).

Portions of two unprotected Green Infrastructure hubs are within this watershed, north of Martin State Airport and east of Essex Skypark (DNR, 2000-2003). There are two small County-owned properties within this watershed.

There is a designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There are no Nontidal Wetlands of Special State Concern (WSSC) within this watershed.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Implement recommendations based on the SAMP.

- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Implement preservation recommendations based on the SAMP.
- Protect wetlands and streams within the headwaters.

Back River (02130901)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of Back River watershed has 4,252 acres of open water and 23,222 acres of land. The land acres are divided as follows: urban 17,079 acres (74%), agriculture 518 acres (2%), forest 5,199 acres (22%), wetlands 353 acres (2%) and barren land 73 acres (<1%). The Baltimore City portion of the Back River watershed has 75 acres of open water and 11,571 acres of land. The Baltimore City land acres are divided as follows: urban 10,803 acres (93%) and forest 768 acres (7%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Black Marsh is a State-designated Natural Heritage Area located within North Point State Park. To get this designation, an area must contain threatened or endangered species and be the best Statewide example.

The upper part of Back River watershed is within the Piedmont, while the remaining majority is within the Coastal Plain. Back River Sewage Treatment Plant discharges the largest amount of wastewater (MDE, 1999).

A programmatic wetland mitigation site is found in North Point State Park close to Black Marsh WSSC in the Baltimore Harbor watershed.

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

- Estuarine
    - Emergent: 314 acres
    - Scrub shrub: <1 acre
    - Unconsolidated shore: 72 acres
- Palustrine
    - Aquatic bed: 2 acres
    - Emergent: 41 acre
    - Scrub shrub: 17 acres

    - Forested: 236 acres
    - Unconsolidated bottom: 70 acres
    - Unconsolidated shore: 6 acres
- Riverine unconsolidated shore: 23 acres
- Total: 782 acres

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

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130901	-6.77	3.58	0	0.03	-3.16

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. For the Baltimore County portion they are as follows:

- Use I: water contact recreation and aquatic life; all portions except those described below.
- Use IV: recreational trout waters;
    - Herring Run and all tributaries above Route I-95
    - Stemmers Run and all tributaries above Route I-95

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a "Priority" Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high nutrient concentrations, high nitrogen loadings, poor SAV abundance and habitat index, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal fish index of biotic integrity (FIBI), high percent impervious surface (41%), high population density, and high percent unforested stream buffer (59%). Wetland loss was estimated to be 7,011 acres. Indicators for Category 3 include migratory fish spawning area and designated Wildlands acres.

According to the 2002 305(b) report, the tidal mainstem river/tributaries fail to support all designated uses due to chlordane, metals, PCBs, and nutrients. Sources of these pollutants are industrial and municipal discharges, urban runoff, natural sources, unknown sources, and eutrophication. A portion of the wadeable tributaries (39 miles) fails to support all designated uses due to impaired biological community, low oxygen, and siltation from municipal discharge, urban runoff, habitat alteration, changes in hydrology, channelization, sewage, 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:

- Back River (non-tidal); poor biological community.
- Back River (tidal); zinc, nutrients, sediments, PCBs (in sediments).
- Herring Run (non-tidal); fecal coliform.
- Herring Run (021309011041 non-tidal); poor biological community.
- Herring Run (021309011042 non-tidal); poor biological community.
- Herring Run Unnamed Tributary (021309011042 non-tidal); poor biological community.
- Bread and Cheese Creek (021309011038 non-tidal); poor biological community.
- Stemmers Run (021309011039 non-tidal); poor biological community.
- Moore's Run (021309011040 non-tidal); poor biological community.
- Redhouse Creek (021309011040 non-tidal); poor biological community.

A TMDL was completed for Chlordane in the Back River, as summarized here. Chlordane is a broad-spectrum pesticide that was used from 1940's until 1988, at which point it was banned. Since chlordane is found in fish tissue here, MDE issued a fish consumption advisory for this waterway. For this reason, this waterway it considered to be impaired. Chlordane historically accumulated in the sediment of the tidal reaches. Since there are no current sources of Chlordane, other than trace occasional amounts from urban runoff, there should be a slow decline in the concentration found in the fish tissue. Monitoring will allow MDE to determine when the fish consumption advisory can be removed.

A DRAFT TMDL was completed in 2004 for nitrogen and phosphorus in tidal segments of Back River, summarized as follows. This waterway had excessive algal blooms and very high chlorophyll a. Main point discharge sources are Back River WWTP and Eastern Stainless, both discharging into Back River. Total nitrogen sources are from point sources (94%), urban (5%), and non-urban (1%). Total phosphorus sources are from point sources (71%), urban (27%), and non-urban (2%). Total nitrogen and total phosphorus are generally higher upstream.

A DRAFT water quality analysis for zinc was completed for Back River. This report determined that the designated uses associated with zinc were being met, so a TMDL is not required.

Macroinvertebrate sampling for Moores Run (2 sites), tributaries to Moores Run (2 sites), and Bissison Run (2 sites) found very poor and poor index of biotic integrity. Baltimore County 2003 stream sampling of BIBI ranked 68% of the sites as poor and 33% of the sites as very poor. This watershed has the second highest percent impervious surface (23%) in the County (Baltimore County DEP, 2004).

Restoration/Preservation

A watershed management plan was completed for this watershed in 1996. Preference was given to relatively undeveloped areas and areas adjacent to residential land and/or parkland rather than industrial/commercial land. Preference was also given to stream restoration projects that would be supported by water quality/quantity controls. Downstream mainstem projects were given higher rankings than upstream tributaries. Use IV streams were typically given a higher priority than Use I streams. High priority projects include sites on Herring Run, Stemmers Run, and Brien Run. Retrofit water quality facilities may offer potential for wetland creation. Several sites recommended for treatment by a wet detention facility could be located in Stemmers Run, Bread & Cheese Creek, Redhouse Run, and Northeast Creek. Opportunities for wetland creation by conversion of existing dry detention basins may also exist, primarily in Brien Run and Stemmers Run. Numerous capitol improvement projects, including stream restorations, stormwater management facilities, shoreline enhancements, and habitat enhancements have been completed in this watershed (Baltimore County DEP, 2004).

A stream corridor assessment was completed for Herring Run watershed. Of the 22 stream miles surveyed, 403 potential problems were identified. The most common problem was pipe outfalls (136 sites), followed by exposed pipes (76 sites), bank erosion (65 sites), channelized streams (46 sites), fish migration barriers (42 sites), poor stream buffers (29 sites), and other problems.

Examples of projects that have already been completed or are currently being implemented include (Baltimore City DEP, 2004):

- Moores Run wetland
- Moores Run stream restoration
- Biddison Run stream restoration

There are portions of small Green Infrastructure hubs in the eastern part of the watershed (along the mouth of Back River) (DNR, 2000-2003). These are partially protected by METs and North Point State Park. There are other County-owned properties that contribute to the Baltimore City urban open space. According to the Maryland Greenways Commission, there is a recreational greenway within Baltimore City called Herring Run. This greenway presently extends along Herring Run Park and would potentially connect to other local parks. Connections are needed between Herring Run Park and Mt. Pleasant Park, Morgan State University, Chinquapin Run stream valley, and Clifton Park. The greenway may connect to a proposed greenway along Herring Run in Baltimore County.

There is a designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There is one Nontidal Wetlands of Special State Concern (WSSC) within this watershed. *Black Marsh Natural Heritage Area* is partially protected by North Point State Park.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Restore streams based on recommendations from the stream corridor assessment for Herring Run watershed: bank erosion, fish migration barriers, poor stream buffers.
- Restore wetlands designed to remove nitrogen and phosphorus from water entering Back River.
- Implement recommendations based on the watershed management plan.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect the remaining portions of Green Infrastructure that are not currently protected.
- Protect Nontidal Wetland of Special State Concern and buffers. Black Marsh Nontidal Wetland of Special State Concern should continue to be protected.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands that function to remove nitrogen and phosphorus from water entering Back River.
- Implement recommendations based on the watershed management plan.
- Protect wetlands and streams within the headwaters.

Baltimore Harbor (02130903)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of the Baltimore Harbor watershed has 5,961 acres of open water and 11,597 acres of land. The land acres are divided as follows: urban 9,580 acres (83%), agriculture 340 acres (3%), forest 1,278 acres (11%), wetlands 397 acres (3%) and barren land 3 acres (<1%). The Baltimore City portion of the Baltimore Harbor watershed has 6,830 acres of open water and 13,572 acres of land. The Baltimore City land acres are divided as follows: urban 12,822 acres (94%), forest 359 acres (3%), wetlands 7 acres (<1%), and barren land 384 acres (3%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

The Baltimore Harbor watershed is located to the east of Baltimore City, and includes numerous small tributaries to the north side of the Patapsco River. The tributaries drain to tidal estuaries. The watershed is entirely within the Coastal Plain and streams tend to be short and tidally influenced. Many streams in the industrial area have been channelized and the natural drainage pattern has been altered (e.g., cooling water for Bethlehem Steel is withdrawn from Jones Creek and discharged to Bear Creek). It is estimated that 60% of the freshwater in the harbor originates from Patapsco River (MDE, 2000a). Smaller tributaries feeding the Harbor are the Gwynns Falls, Jones Falls, Bear Creek, and Curtis

Creek. This watershed has the highest percent impervious surface (26%) in the County (Baltimore County DEP, 2004).

The Harbor estuary is highly developed, being mainly urban residential, commercial, and industrial. Land use in the large tributaries shifts from industrial/commercial to residential and eventually rural/agricultural in the headwaters. The largest wastewater treatment plant is Baltimore City-owned Patapsco WWTP, discharging into the middle tidal region (MDE, 2000a).

A programmatic mitigation site was constructed in the North Point State Park in 1997. Black Marsh is a designated Natural Heritage Area within this watershed located within North Point State Park. To get this designation, an area must contain threatened or endangered species and be the best Statewide examples.

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

- Estuarine
    - Emergent: 383 acres
    - Scrub shrub: 5 acres
    - Unconsolidated shore: 107 acres
- Palustrine
    - Aquatic bed: 1 acre
    - Emergent: 289 acres
    - Scrub shrub: 54 acres
    - Forested: 280 acres
    - Unconsolidated bottom: 249 acres
    - Unconsolidated shore: 7 acres
    - Farmed: 1 acre
- Total: 1377 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)
02130903	-12.50	6.61	8.50	0	2.61

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. Waters in Baltimore County portion of Baltimore Harbor are designated as Use I: water contact recreation and aquatic life

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a "Priority" Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high phosphorus and nitrogen loadings, poor SAV abundance and habitat index, poor tidal benthic index of biotic integrity, poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal instream habitat index, high percent impervious surface (35%), high population density, and high percent unforested stream buffer (61%). Wetland loss was estimated to be 7,681 acres. Indicators for Category 3 include migratory fish spawning areas and designated Wildlands acres (within North Point State Park).

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:

- *Baltimore Harbor* (tidal); poor biological community, nutrients, sediments, PCBs (in sediments).
- *Furnace Creek* (021309031008 – tidal in Anne Arundel County); fecal coliform.
- *Marley Creek* (021309031008 - tidal); fecal coliform,
- *Marley Creek* (021309031008 – non-tidal); poor biological community.
- *Marley Creek Unnamed Tributary 2* (021309031008 – non-tidal in Anne Arundel County); poor biological community.
- *Marley Creek Unnamed Tributary 3* (021309031008 - non-tidal in Anne Arundel County); poor biological community.
- *Marley Creek Unnamed Tributary 5* (021309031008 - non-tidal in Anne Arundel County); poor biological community.
- *Northwest Harbor Unnamed Tributary 1* (021309031010 - non-tidal in Baltimore County); poor biological community.
- *Sawmill Creek* (021309031009 - non-tidal in Anne Arundel County); poor biological community.
- *Cabin Branch Unnamed Tributary 1* (021309031008 - non-tidal in Anne Arundel County); poor biological community.
- *Unnamed tributary to Sloop Cover* (021309031006 - non-tidal in Anne Arundel County); sediments.
- *Bear Creek* (tidal); chromium (in sediments), zinc (in sediments), PCBs (in sediments).
- *Northwest Branch Inner Harbor* (tidal); lead (in sediments), chromium (in sediments), zinc (in sediments), PCBs (in fish tissue).
- *Curtis Creek* (tidal); zinc (in sediments), PCBs (in sediments and fish tissue).
- *Furnace Branch* (tidal); PCBs (in fish tissue).
- *Middle Harbor* (tidal); zinc (in sediments), PCBs (in fish tissue).

A TMDL for chlordane was approved in 2000. Although Baltimore Harbor is also impaired mercury, copper, nickel, cyanide, a TMDL is not required since for these

pollutants since other controls will likely result in attainment of water quality standards in the near future.

There are other impairments from mercury, nickel, copper, and cyanide that do not require TMDLs because other pollution abatement requirements are expected to result in an attainment of water quality standards. According to the 2002 305(b) report, chlordane, PCBs, metal, low oxygen, and bacteria in the tidal waters were attributed to industrial and municipal discharges, nonpoint sources, poor tidal flushing, and unknown sources. In nontidal waters, siltation resulted in some areas failing to meet all designated uses due to urban runoff, habitat alteration, and channelization. Fish consumption advisories were issued in 1986 and expanded in 2001 for chlordane, PCBs, and dieldrin.

The Maryland Biological Stream Survey (MBSS) collected data from eight sites in Anne Arundel County and one site in Baltimore City in 2000-2002. Six sites were in Marley Creek, and one site each was sampled in Sawmill Creek, Northwest Harbor, and Cabin Branch. Two sampling sites in Marley Creek had benthic IBIs in the Fair category, two sites also had fish IBIs in the fair category, as did one site in Sawmill Creek. All other fish and benthic IBI scores were in the Poor category. Eight sites were sampled in the watershed in 1995-1997, all in Marley Creek, Sloop Cove, and Sawmill Creek in Anne Arundel County. The two sites in Marley Creek received scores of poor or very poor for both fish and benthics. Sloop Cove received a poor score for benthics. Three of the five sites sampled in Sawmill Creek received fair scores for the fish IBI, three of five sites also received poor benthic IBI scores. Two sites in Sawmill Creek received fair scores for benthic IBIs.

A TMDL was completed for Chlordane in the Baltimore Harbor, as summarized here. Chlordane is a broad-spectrum pesticide that was used from 1940s until 1988, at which point it was banned. Since chlordane is found in fish tissue here, MDE issued a fish consumption advisory for this waterway. For this reason, this waterway it considered to be impaired. Chlordane historically accumulated in the sediment of the tidal reaches. Since there are no current sources of Chlordane, other than trace occasional amounts from urban runoff, there should be a slow decline in the concentration found in the fish tissue. Monitoring will allow MDE to determine when the fish consumption advisory can be removed.

A DRAFT water quality analysis for lead was completed for the Inner Harbor/Northwest Branch and for zinc in the Inner Harbor/Northeast Branch and Bear Creek. While sediment toxicity was found in these waters, no water quality impairment due to zinc or lead was found.

A DRAFT water quality analysis for chromium was completed for the Inner Harbor/Northwest Branch and Bear Creek. No water quality impairment due to chromium was found.

Restoration/Preservation

A watershed management plan was completed for this watershed in 2001. Numerous capitol improvement projects, including shoreline enhancements and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

The only Green Infrastructure hub within the Baltimore portion is in the easternmost corner of this watershed (DNR, 2000-2003), protected by North Point State Park. There are other small County and city-owned properties. According to the Maryland Greenways Commission, there are three existing or proposed greenways.

- *Baltimore Waterfront Promenade*: This waterfront walkway connects area greenways to the Inner Harbor.
- *Gwynns Falls Trail*: This potential ecological and recreational greenway will follow Gwynns Falls stream and Patapsco River, connecting Gwynn Falls/Leakin Park and the Inner Harbor.
- *Patapsco Regional Greenway*: This partial ecological and recreational greenway connects the city with surrounding Counties.

There is a designated Rural Legacy area within this watershed, called Baltimore County Coastal Rural Legacy Area. Since the Rural Legacy Program funds may not be adequate enough to preserve sites of all interested property owners, other programs should consider preservation of these sites.

There is one Nontidal Wetlands of Special State Concern (WSSC) within this watershed. *Black Marsh Natural Heritage Area*, also within Back River watershed, is partially protected by North Point State Park (all the area within Baltimore Harbor watershed is protected). This tidal marsh and surrounding upland forest supports many bird species. As of 1981, the main threat was that the Bethlehem Steel Company's material stored around the wetland will impact stormwater runoff and reduce the upland buffer area (MDP, 1981).

A programmatic mitigation site was constructed in North Point State Park in 1997.

Numerous shoreline enhancement and stormwater facilities have been constructed on Bear Creek, Tabasco Cove, and North Point Creek (Baltimore County, 2002). There are additional retrofits under design or construction at Lynch Cove (Baltimore County DEP, 2004)

Specific Restoration Recommendations:

- Improve water quality around Sparrows Point/Bethlehem Steel facility
  BMPs for Bear Creek.
- Other retrofits, including (Weston, Inc et al., 2000):
  - Alleviate flooding in Tabasco Cove subwatershed
  - Retrofit north of I-695, south of I-695 to old North Point Road
  - Enhance wetland swale south of I-695
  - Construct water quality/flood retention wetland at Carpenter's Trailer Park
  - Restore wetland at I-695 and North Point Boulevard

    - Shoreline enhancements at Concrete Homes, North Point Park, West Inverness (Baltimore County, 2002)
- Baltimore Harbor Retrofits
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands and streams within the headwaters.

Jones Falls (02130904)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of the Jones Falls watershed has 48 acres of open water and 25,703 acres of land. The land acres are divided as follows: urban 17,647 acres (69%), agriculture 2,873 acres (11%), forest 5,057 acres (20%), wetlands 50 acres (<1%) and barren land 76 acres (<1%). The Baltimore City portion of the Jones Falls watershed has 54 acres of open water and 11,484 acres of land. The Baltimore City land acres are divided as follows: urban 10,537 acres (92%) and forest 947 acres (8%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

This watershed is within the Piedmont and Coastal Plain Physiographic Province, characterized by gentle to steep rolling topography and low hills and ridges. Surface elevations range from sea level (at the Chesapeake Bay) to 680 feet above sea level. Streams in the Piedmont are incised and follow rock fractures and weathered rock while stream channels in the Coastal Plain are broader. The majority of soils in the watershed have moderately well to well drained soils or a layer impeding downward water flow (MDE, 2002e). The 100-acre Lake Roland impoundment is located along Jones Falls. Other tributaries of this impoundment are Roland Run and Towson Run. Land use within the watershed is urban, residential, and commercial (MDE, 2000b).

Robert E. Lee Park is a designated Natural Heritage Area within this watershed. To get this designation, an area must contain threatened or endangered species and be one of the best Statewide examples.

Cockeysville Marble is located in the northern portion of this watershed, with a large section following Greenspring Valley Road. These carbonate areas are important because they have a potential for sinkhole formation and groundwater contamination. Designs for wetland restoration/creation should take this into account.

There is a high quality self sustaining brown trout population from the headwaters to Lake Roland. Anadromous fish such as alewife and river herring occurred historically in the Jones Falls watershed, but migration has been limited by fish blockages, including some in the Baltimore City portion of the watershed.

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

- Palustrine
    - Aquatic bed: <1 acre
    - Emergent: 68 acres
    - Scrub shrub: 7 acres
    - Forested: 77 acres
    - Unconsolidated bottom: 69 acres
- Total: 221 acres

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

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130904	-3.39	9.12	10.00	0.33	16.06

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. For the Baltimore County portion they are as follows:

- Use I: water contact recreation and aquatic life; all portions except those described below.
- Use III: natural trout water; Jones Falls and all tributaries above Lake Roland
- Use IV: recreation trout water.
    - Jones Falls from North Ave. to Lake Roland Dam
    - Stony Run and all tributaries

Water Quality

The source water assessment for St. Timothy's School found that this water supply is susceptible to nitrates and naturally occurring radionuclides.

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 poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal fish index of biotic integrity, high percent

impervious surface (35%), high population density, and high percent unforested stream buffer (58%). Wetland loss was estimated to be 1,691 acres. Indicators for Category 3 include presence of trout spawning areas.

According to the 2002 305(b) report, a portion of the mainstem river (8 miles; North Avenue to Brooklandville) fails to support all designated uses due to bacteria from agricultural and urban runoff, sewage, and natural sources. A portion of the wadeable tributaries (30 miles) fails to support all designated uses due to siltation from urban runoff, changes in hydrology, and channelization. Lake Roland also fails to supports all designated uses due to siltation, PCBs and pesticides – chlordane.

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:

- *Jones Falls* (non-tidal); fecal coliform, copper, lead, nutrients, sediments. Chlordane was also listed as an impairment, but a TMDL has been completed for this contaminant.
- *Jones Falls* (021309041032); poor biological community.
- *Jones Falls* (021309041036); poor biological community.
- *Jones Falls Unnamed Tributary 1* (021309041036); poor biological community.
- *Stoney Run* (021309041033); poor biological community.
- *Stoney Run Unnamed Tributary* (021309041033); poor biological community.
- *Towson Run* (021309041034); poor biological community.
- *North Branch* (021309041036); poor biological community.
- *North Branch Unnamed Tributary 1* (021309041036); poor biological community.
- *Lake Roland Impoundment*; PCBs (in fish tissue).

A Water Quality Analysis was completed for zinc in the Jones Falls, as summarized here. The streams within this watershed were put on the 303d list for impairment of nutrients, suspended sediments, zinc, copper, lead, and chlordane in 1996. This report found no zinc impairment and suggests removal of zinc from the 303d list of impairments.

A Water Quality Analysis was completed for copper and lead in the Jones Falls, as summarized here. This report found no impairment of water quality based on copper or lead, with the exception of copper in the lower-most 12-digit basin (021309041032). Therefore, it is recommended that the 8-digit watershed be removed from the 303d list for impairment from copper and lead, and the subbasin 021309041032 be listed for impairment by copper.

A TMDL was completed for Chlordane in the Lake Roland, as summarized here. Chlordane is a broad-spectrum pesticide that was used from 1940s until 1988, at which point it was banned. Since chlordane is found in fish tissue here, MDE issued a fish consumption advisory for this waterway. For this reason, this waterway it considered to be impaired. Chlordane historically accumulated in the sediment of the tidal reaches. Since there are no current sources of Chlordane, other than trace occasional amounts

from urban runoff, there should be a slow decline in the concentration found in the fish tissue. Monitoring will allow MDE to determine when the fish consumption advisory can be removed.

Baltimore County 2003 stream sampling of BIBI ranked 44% of the sites as good or fair, 44% of the sites as poor, and 13% of the sites as very poor (Baltimore County DEP, 2004).

Restoration/Preservation

Ranking of habitat and water quality problems according to the Jones Falls Water Quality Management Plan (1997) was based on stream channel stability, elevated percent imperviousness and pollutant loads, uncontrolled stormwater runoff, unforested riparian buffers, and fish migration barriers. The factors were weighted to place more emphasis on more significant water quality and habitat problems and ranked within eight sub-watersheds. Removal of fish migrations barriers was uniformly ranked last, because of the greater need to restore habitat and water quality. Restoration activities should take place in the following order of priority sub-watersheds: Towson Run, Slaughterhouse Run/Moores Branch, Roland Run, Dipping Pond Run, Lower Jones Falls, Jones Falls, Deep Run and North Branch. In sub-watersheds with viable trout populations, retrofits should be dry rather than wet facilities to reduce thermal discharges (Jones Falls, North Branch, Dipping Pond Run, Deep Run).

A watershed management plan was completed for this watershed in 1996. Numerous capitol improvement projects, including stream restorations and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

Examples of projects that have already been completed or are currently being implemented include (Baltimore City DEP, 2004):

- Upper Stony Run stream stabilization
- Middle Stony Run stream stabilization
- East Stony Run stream stabilization

There are linear Green Infrastructure networks (mostly classified as Green Infrastructure corridors) following Jones Falls and running north from Jones Falls (DNR, 2000-2003). This network is largely unprotected, with the exception of some County and city-owned properties and METs. According to the Maryland Greenways Commission, there are two existing or proposed greenways.

- *Jones Falls and Roland Run*: This environmental greenway runs north from Baltimore City, paralleling the MTA light rail, and connecting with Lake Roland.
- *Stony Run Trail*: This ecological and recreational greenway runs north from the Inner Harbor to the Baltimore County line, and will eventually connect with the Jones Falls Trail.

There is one Nontidal Wetlands of Special State Concern (WSSC) within this watershed. *Rockland Meadows* is a bottomland calcareous forest and a mesic old-field. This site was

reported to contain two rare plant species. While this habitat type was once common in the area, most were destroyed due to clearing for agriculture and development (DNR, 1991). DNR has proposed that this site be deleted from the WSSC list, likely because changes in classification of the species have resulted in the area not meeting the criteria of a Nontidal Wetland of Special State Concern. This site is unprotected.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Implement recommendations from the 1997 Jones Falls Water Quality Management Plan.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect WSSC and buffers.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Implement recommendations from the 1997 Jones Falls Water Quality Management Plan.
- Protect wetlands and streams within the headwaters.

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. 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.

Based on MDP 2002 GIS land use data, the Baltimore County portion of Patapsco River Lower North Branch watershed has 102 acres of open water and 34,417 acres of land. The land acres are divided as follows: urban 16,788 acres (49%), agriculture 4,155 acres (12%), forest 12,873 acres (37%), wetlands 306 acres (1%) and barren land 295 acres (1%). The Baltimore City portion of the Patapsco River Lower North Branch watershed has 42 acres of open water and 1,362 acres of land. The Baltimore City land acres are divided as follows: urban 1,113 acres (82%), forest 200 acres (15%), wetlands 14 acres (1%) and barren land 35 acres (3%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

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 the Howard County portion 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). The Howard County Soil Survey Stated in the 1968 report 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 and 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.

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 out, 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.

Soil Associations include Loamy and Clayey land-Lenoir-Beltsville Association and Legore-Aldino-Neshaminy Association. Most soils are moderately eroded, well drained to moderately well drained with a subsoil of silty clay loam and a fragipan in the Legore-Aldino-Neshaminy Association. Minor soils in this association that occur on the floodplain include Codorus and Hatboro. The Loamy and Clayey land-Lenoir-Beltsville Association is characterized by nearly level to steep land of sandy loam to clay loam over clay or a subsoil of silty clay loam and silt loam. Soils are moderately to somewhat poorly drained.

Cockeysville Marble is located in the northern portion of this watershed, following Falls Run. These carbonate areas are important because they have a potential for sinkhole

formation and groundwater contamination. Designs for wetland restoration/creation should take this into account.

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

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. Waters in Baltimore portion of Patapsco River LNB Lower are designated as follows.

- Use I: water contact recreation and aquatic life; all portions except those described below.
- Use III: natural trout water; Brice Run and all tributaries.
- Use III-P: natural trout water and public water supply; Glen Falls Run and all tributaries.

Water Quality

Based on the source water assessment for Woodstock Job Corps Center water supply, this well withdraws from an unconfined aquifer and is susceptible to VOCs and naturally occurring radon.

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.

According to the 2002 303(b) report, the nontidal waters (from the mainstem to Liberty Dam) fully supports all designated uses. The majority of the nontidal, wadeable tributaries (117 miles) failed to support all designated uses of the biological community due to urban runoff, habitat alteration, and channelization. Field surveys also noted siltation, streambank instability, agricultural runoff, and hydromodification as factors that may affect the aquatic community (DNR, 2000). There are some areas closed to shellfish harvesting due to pollution from nonpoint source runoff (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:

- *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.

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.

The Maryland Biological Stream Survey (MBSS) sampled one site (Deep Run) in the Anne Arundel County portion of the watershed during the 2000-2002 period. Fish species diversity was relatively high with 17 species and the Fish IBI ranking was "good." Species included Swallowtail shiner, Blacknose dace, Mottled sculpin, Tesselated darter, Green sunfish, Central stoneroller, White sucker, Rosyside and Longnose dace. Fewer than one-third of the species were found to be pollution tolerant. The Benthic IBI score was "poor." Two sites in the watershed, located on an unnamed tributary to Deep Run and on Stony Run (Anne Arundel County) were sampled in the MBSS in the 1995-1997 period. Fish IBI scores indicated that these stream reaches were generally comparable to the reference condition, particularly for Deep Run tributary, but the Stony Run reach showed some degradation to certain biological characteristics found in minimally impacted streams (DNR, 1995-1997; 2000-2002).

Baltimore County 2003 stream sampling of BIBI ranked 15% of the sites as fair, 54% of the sites as poor, and 31% of the sites as very poor (Baltimore County DEP, 2004).

Restoration/Preservation

A watershed management plan was completed for this watershed in 1998. Numerous capitol improvement projects, including stream restorations and stormwater management facilities, have been completed in this watershed (Baltimore County DEP, 2004).

Existing management goals:

- Maintain agricultural land that is in under agricultural protection/preservation programs.
- Prohibit land use changes in 100-year floodplains.

There is a large Green Infrastructure hub along the Patapsco River that is protected by Patapsco Valley State Park (DNR, 2000-2003). A small Green Infrastructure hub west of Western Area Park is still unprotected. North of this unprotected hub is a Green Infrastructure corridor largely in agricultural land use. This area may have the potential for restoration to natural vegetation. A few small County-owned parks are also in this watershed. According to the Maryland Greenways Commission, there are two existing or proposed greenways.

- *Patapsco Regional Greenway and Locust Run*: This ecological and recreational greenway follows the Patapsco River.
- *Number Eight Trolley Line trail and Catonsville Short Line Trail*.

There is one Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed. *Pikall Riverbank (DNR name: Hollofield Gorge)* is a riparian forest containing a healthy population of a rare plant species. This site is surrounded by old forest on the adjacent slopes (DNR, 1991). This site is protected by Patapsco Valley State Park.

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Five retrofit projects were proposed in residential subdivisions. Projects included wetland creation as part of the retrofits (KCI Technologies, Inc., 1999).
- Reforestation in the undeveloped floodplain of Patapsco Valley State Park (DNR,1981)
- Fish passage and fish habitat improvement (DNR,1981).
- Flooding does occur in the Ellicott City vicinity, however, there may not be opportunity to restore floodplain access due to infill development (Follweiler, 2004 pers comm.).
- 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.). Facilities are recommended in Bull Run, Dogwood Branch, Cooper Branch, Herbert Run and Powells Run.
- Stream restoration is recommended for sites on Ben's Run, Brice Run, Bull Run, Cedar Branch, Cooper Branch, Dogwood Branch, Falls Run, Herbert Run, Mardella Run, Patapsco River 149 sub-watershed with unnamed tributaries, and Powells Run. Upstream projects are preferred over downstream projects, and water quality controls should be implemented before stream restoration.
- 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 and plugging of ditches, if present (Boellner, 2004 pers comm.).
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Deep Run (in Howard County).
- Stony Run WSSC (in Anne Arundel County).
- Forested riparian corridors.
- Protect wetlands and streams within the headwaters.

<u>Gwynns Falls (02130905)</u>

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of Gwynns Falls watershed has 4 acres of open water and 27,812 acres of land. The land acres are divided as follows: urban 20,860 acres (75%), agriculture 1,253 acres (5%), forest 5,552 acres (20%), wetlands 35 acres (<1%) and barren land 112 acres (<1%). The Baltimore City portion of the Gwynns Falls watershed has 157 acres of open water and 13,739 acres of

land. The Baltimore City land acres are divided as follows: urban 12,244 acres (89%), agriculture 1 acres (<1%), forest 1,481 acres (11%), and barren land 12 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead. This watershed has the third highest percent impervious surface (21%) in the County. Owings Mills, located within this watershed, is an urbanized designated growth area (Baltimore County DEP, 2004).

Cockeysville Marble is located in the northern portion of this watershed, between Owings Mill and Randellstown. These carbonate areas are important because they have a potential for sinkhole formation and groundwater contamination. Designs for wetland restoration/creation should take this into account.

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

- Estuarine emergent: <1 acre
- Palustrine
    - Aquatic bed: <1 acre
    - Emergent: 27 acres
    - Scrub shrub: <1 acre
    - Forested: 55 acres
    - Unconsolidated bottom: 58 acres
    - Unconsolidated shore: 6 acres
- Riverine unconsolidated shore: 4 acres
- Total: 150 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)
02130905	-5.93	7.21	0	0.50	1.77

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

- Use I: water contact recreation and aquatic life; all portions except those described below.
- Use III: natural trout water;
    - Red Run and all tributaries
    - Gwynns Falls and all tributaries above Reisterstown Road
- Use IV: recreation trout water; Dead Run and all tributaries

Water Quality

The 1998 Clean Water Action Plan classified this watershed as "Priority" Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a "Priority" Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a "Selected" Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include poor non-tidal benthic index of biotic integrity (BIBI), poor non-tidal fish index of biotic integrity (FIBI), high percent impervious surface (42%), high population density, and high percent unforested stream buffer (55%). Wetland loss was estimated to be 3,394 acres. Indicators for Category 3 include high non-tidal instream habitat index, high imperiled aquatic species indicator, trout spawning areas, and the presence of designated Wildland Acres (within Soldiers Delight NEA).

According to the 2002 303(b) report, the nontidal mainstem fail to support all designated uses due to bacteria. The nontidal, wadeable tributaries also fail to support all designated uses due to siltation from urban runoff, habitat alteration, sewage, and channelization.

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:

- Gwynns Falls; fecal coliform, poor biological community, nutrients, sediments.
- Gwynns Falls (021309051044); poor biological community, sediments.
- Gwynns Falls (021309051045); poor biological community.
- Gwynns Falls Unnamed Tributary (021309051044); poor biological community, sediments.
- Dead Run (021309051044); poor biological community.
- Red Run (021309051045); poor biological community.
- Scotts Level Branch (021309051044); sediments.

Baltimore County 2003 stream sampling of BIBI ranked 3% of the sites as fair, 70% of the sites as poor, and 27% of the sites as very poor (Baltimore County DEP, 2004).

Restoration/Preservation

A watershed management plan was completed for this watershed. Numerous capitol improvement projects, including stream restorations, stormwater management facilities, and buffer enhancements have been completed in this watershed (Baltimore County DEP, 2004).

The City of Baltimore developed a Gwynns Falls Watershed Management Plan with Baltimore County.

Examples of projects that have already been completed or are currently being implemented include (Baltimore City DEP, 2004):

- Gwynns Run Wetland

- Beechfield Elementary School wetland creation
- Maidens Choice Run stabilization
- Biddison Run Stream Restoration
- Maidens Choice Creek Wetlands Restoration/Enhancement

There are two Green Infrastructure hubs in this watershed, around Leakin/Gwynns Falls Park (protected) and around Soldiers Delight Natural Environment Area (mostly protected by the State) (DNR, 2000-2003). Other protected areas include Gwynnbrook WMA, County-owned land, and city-owned land. There is also a Green Infrastructure corridor running east to west (just north of Randallstown) that could be restored to natural vegetation. According to the Maryland Greenways Commission, there are two existing or proposed recreational greenways.

- *Gwynns Falls Greenway* (existing and proposed). This trail follows Gwynns Falls from the Inner Harbor to south of Reisterstown.
- *Red Run* (proposed).

There are three Nontidal Wetlands of Special State Concern (WSSC) within this watershed, as described below:

- *Gwynns Falls North*. This is a small swamp containing a small population of a State-Threatened plant species. Most of the remaining populations are in Western Maryland. This species is vulnerable to habitat alteration (DNR, 1991). This site is unprotected.
- *Gwynns Falls South*. This site contains a marsh, wet meadow, and bog with a small population of a State-Threatened plant species. Most of the remaining populations are in Western Maryland. This species is quite vulnerable to habitat destruction, natural disturbances, and collection. These species take several year to flower. An additional endangered plant species was historically seen at this site, but was not found in recent surveys (DNR, 1991). This site is unprotected.
- *Red Run Branch (DNR name: Soldiers Delight)*. This is a small Red maple swamp containing a healthy population of a State-Threatened plant species. This species is quite vulnerable to hydrological changes, including changes in the recharge area. A proposed impoundment may lead to the demise of this local population (DNR, 1991). Part of this site is protected by DNR-owned Soldiers Delite NEA.

Specific Restoration Recommendations:

- Restore “gaps” in designated Green Infrastructure hub to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect WSSC and buffers.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect wetlands and streams within the headwaters.

Liberty Reservoir (02130907)

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of the Liberty Reservoir watershed has 1,213 acres of open water and 16,548 acres of land. The land acres are divided as follows: urban 3,492 acres (21%), agriculture 4,875 acres (29%), forest 8,158 acres (49%), and wetlands 23 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

The Liberty Reservoir impoundment is owned by Baltimore City Department of Public Works, and is used for recreation and public water (MDE, 2003b). This reservoir is a drinking water source for portions of Carroll, Howard, Baltimore, and Anne Arundel Counties and Baltimore City (Baltimore County DEP, 2000). Inflows are Patapsco River, Morgan Run, and several tributaries. It discharges into Lower North Branch of the Patapsco River. The watershed has elevations ranging from 420 to 980 feet. Stream channels are generally well-incised and tend to follow rock fractures and weathered rock. Soils have mostly moderate to high infiltration and are moderately well to excessively drained (MDE, 2003b).

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

- Lacustrine unconsolidated shore: 387 acres
- Palustrine
    - Emergent: 855 acres
    - Scrub shrub: 399 acres
    - Forested: 1,610 acres
    - Unconsolidated bottom: 269 acres
    - Farmed: 78 acres
- Total: 3,599 acres

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

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130907	-2.91	1.91	0	0	-1.00

Code of Maryland Regulations
All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. For the Baltimore County portion they are as follows:

- Use I: water contact recreation and aquatic life; all portions except those described below.
- Use I-P: water contact recreation and aquatic life, public water supply; Liberty Reservoir above Liberty Dam
- Use III-P: natural trout waters and public water supply;
    - Norris Run and all tributaries
    - Cooks Branch and all tributaries
    - Keysers Run and all tributaries
    - Locust Run and all tributaries

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 nutrient concentrations and high soil erodibility (0.28). Wetland loss was estimated to be 3,987 acres. Indicators for Category 3 include high non-tidal fish index of biotic integrity (FIBI), high non-tidal instream habitat index, trout spawning areas, presence of designated Wildlands (outside of Baltimore County), and presence of four drinking water intakes.

According to the 2002 303(b) report, the mainstem (above Liberty Reservoir) fully supports all designated uses. The majority of the tributaries (115 miles) fail to support all designated uses due to agricultural runoff, habitat alteration, and channelization. Liberty Reservoir failed to support all designated uses due to Hg from atmospheric deposition.

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:

- *Liberty Reservoir Impoundment*; nutrients, sediments. This impoundment is also impaired by methylmercury in fish tissue, for which a TMDL has been completed.
- *Cranberry Branch* (021309071061 in Carroll County); fecal coliform.
- *Unnamed Tributary to Liberty Reservoir* (021309071046); poor biological community.
- *Morgan Run Unnamed Tributary* (021309071047 in Carroll County); poor biological community.
- *Morgan Run* (021309071054 in Carroll County); sediments.
- *Beaver Run* (021309071057 in Carroll County); poor biological community.
- *Beaver Run Unnamed Tributary* (021309071057 in Carroll County); poor biological community.
- *East Branch Patapsco* (021309071059 in Carroll County); poor biological community.

- *West Branch Patapsco* (021309071062 in Carroll County); poor biological community.

A water quality analysis was completed in 2003 for chromium and lead in Liberty Reservoir Impoundment. This impoundment was on the 1996 303d list for water quality impairment due to chromium (Cr) and lead (Pb). The 2003 analysis found this impoundment was not impaired by Cr or Pb, so should be removed from the 303d list for impairment by these pollutants.

A DRAFT Total Maximum Daily Load was completed for mercury in Liberty Reservoir. MDE issued a public fish consumption advisory due to the high mercury levels in fish tissue. This high mercury is mainly due to atmospheric deposition from out-of-state coal-fired electric power plants. This pollutant should be less than the total maximum daily loads when current and proposed Clean Air Act laws are established.

Baltimore County 2003 stream sampling of BIBI ranked 70% of the sites as good or fair and 30% of the sites as poor (Baltimore County DEP, 2000).

Restoration/Preservation

Since Liberty Reservoir is an important drinking water supply, preservation and reforestation is important (Baltimore County DEP, 2000).

There is a large Green Infrastructure hub around Liberty Reservoir (DNR, 2000-2003) that is largely protected for Baltimore water supply, through METs, and Soldiers Delight NEA. There are still some unprotected areas within this Green Infrastructure hub (north of Soldiers Delight NEA) and a connecting Green Infrastructure corridor. According to the Maryland Greenways Commission, there is one ecological and recreational greenway running on the border of Baltimore County.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Piney Run Rural Legacy Area contains approximately 32,320 acres. This area is currently largely undeveloped (96%). This area was chosen in order to improve water quality in the Piney Run Reservoir and Loch Raven Reservoir through stream buffers, and encourage agriculture and natural resources in the area. The goal is to protect 23,819 acres (74%). Currently, 11,519 acres (36%) of this land are protected through various methods. The sponsor is Land Preservation Trust. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are two State-designated Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed, as described below.

- *Lower Chimney Branch (DNR name: Soldiers Delight)*. This is a deciduous floodplain forest containing a small reproductively-successful population of a

State-Threatened plant species. This site currently lacks the usual non-native invasive species which threatened many other rare species (DNR, 1991). The upstream portion is protected within Soldiers Delight NEA, while the lower portion may not be protected, as it is within Liberty Road Fish and Game Association land.

- *Soldiers Delight*. This site contains nine rare wetland plant species. There are two State-Endangered grasses, requiring serpentine soils, growing along the stream banks. The remaining rare species grow in the wetlands, including three State-Threatened and one State-Endangered plant species. There are two additional rare insect species that live in the wetlands, including one that is a candidate for listing under the Federal Endangered Species Act. This site is within Solders Delight Natural Environmental Area, a 2,000 acre preserve that contains a serpentine ecosystem. Serpentine soils contain high levels magnesium and naturally occurring heavy metals. Since these levels are toxic to most plants, only specially adapted plants survive in these soils. There are 32 known RTE plant species in this NEA (DNR, 1991).

Specific Restoration Recommendations:

- Restore "gaps" in designated Green Infrastructure hub to natural vegetation.
- Restore wetlands designed to improve water quality of Liberty Reservoir.
- Restore wetlands and streams within the headwaters.

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect WSSC and buffers.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected.
- Protect unprotected Rural Legacy Area, starting with properties ranked as high priority.
- Protect wetlands that function to improve water quality of Liberty Reservoir.
- Protect wetlands and streams within the headwaters.

<u>Deer Creek (02120202)</u>

Background

Based on MDP 2002 GIS land use data, the Baltimore County portion of Deer Creek watershed has 7 acres of open water and 7,078 acres of land. The land acres are divided as follows: urban 659 acres (9%), agriculture 4,016 acres (57%), forest 2,391 acres (34%), and wetlands 13 acres (<1%). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

Some of the wetlands provide habitat for the federally listed bog turtle. Deer Creek has been used as spawning habitat by anadromous fish, shad and river herring. The lower two

miles of Deer Creek in Harford County has been designated as critical habitat for the Maryland darter, an endangered fish species. Deer Creek also supports an important trout fishery.

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: 88 acres
  - Scrub shrub: 8 acres
  - Forested: 29 acres
  - Unconsolidated bottom: 264 acres
  - Unconsolidated shore: 1 acre
  - Farmed: 6 acres
- Riverine unconsolidated shore: 5 acres
- Total: 402 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)
02120202	-0.97	2.11	0	0	1.14

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. Waters in Baltimore portion of Deer Creek are designated as follows:

- Use I: Water contact recreation and aquatic life; All portions except those designated below.
- Use III-P: Natural trout waters and public water supply; Deer Creek and tributaries above Eden Mill Dam.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a "Selected" Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include high nutrient concentrations, high population density, high percent unforested stream buffer (51%), and high soil erodibility (0.30). Wetland loss was estimated to be 4,665 acres. Indicators for Category 3 include high non-tidal instream habitat index, high non-tidal fish index of biotic integrity (FIBI), migratory fish spawning areas, trout spawning areas, and the presence of one drinking water intake.

According to the 2002 305(b) report, the lower mainstem creek fails to support all uses due to bacteria from agricultural runoff, natural sources, and unknown sources. The wadeable tributaries fully support all designated uses.

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

- *Plumtree Branch* (021202020332); poor biological community.
- *Deer Creek* (021202020332); poor biological community.
- *Deer Creek Unnamed Tributary 1* (021202020330); poor biological community.
- *Deer Creek Unnamed Tributary 2* (021202020330); poor biological community.
- *Ebaugh's Creek* (021202020332 in Baltimore County); poor biological community.

Restoration/Preservation

The Baltimore portion of this watershed contains some Green Infrastructure network (all unprotected), largely Green Infrastructure corridors currently in agriculture (DNR, 2000-2003). These areas may be restored to natural vegetation.

While there are no State-designated Nontidal Wetlands of Special State Concern (WSSC) within the Baltimore County portion of this watershed, there are several potential WSSC, all of which are unprotected.

- This site is near Lentz Road.
- There are several small sites located near the intersection of West Liberty Road and Kirkwood Shop Road.
- This site is located in the headwaters of Plumtree Branch.

Specific Restoration Recommendations:

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

Specific Preservation Recommendations:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional DNR-designated Ecologically Significant Areas containing wetlands that are not already protected, including the potential WSSCs.
- Protect wetlands and streams within the headwaters.