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## **Background**

Cecil County is roughly 14-24 miles wide and 16-25 miles long. Based on MDP 2002 GIS land use data, Cecil County has 47,423 acres of open water and 222,969 acres of land. The land acres are divided as follows: urban 35,962 acres (16%), agriculture 98,656 acres (44%), forest 84,854 acres (38%), wetlands 2,795 acres (2%) and barren land 703 acres (<1%) (Figure 1). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in the watershed sections of this document, are preferred.

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

Agriculture is mainly north of I-95 (running east-west) and south of the Chesapeake and Delaware Canal (Cecil, 2005). Much of the agricultural land is devoted to cash grain and dairy farms. Crops include corn, soybeans, wheat, hay, barley, tree fruits, vegetables and berries. Of the total farmland in Cecil County, over 17 percent are enrolled in agricultural districts through the Maryland Agricultural Land Preservation Foundation. During the 2000 U.S. Census, the population of Cecil County included 85,951 people. It is estimated to be 111,450 by 2020. Important minerals in the County include granite, sand, gravel, clay, marble and serpentine (Perazzo, 2005).

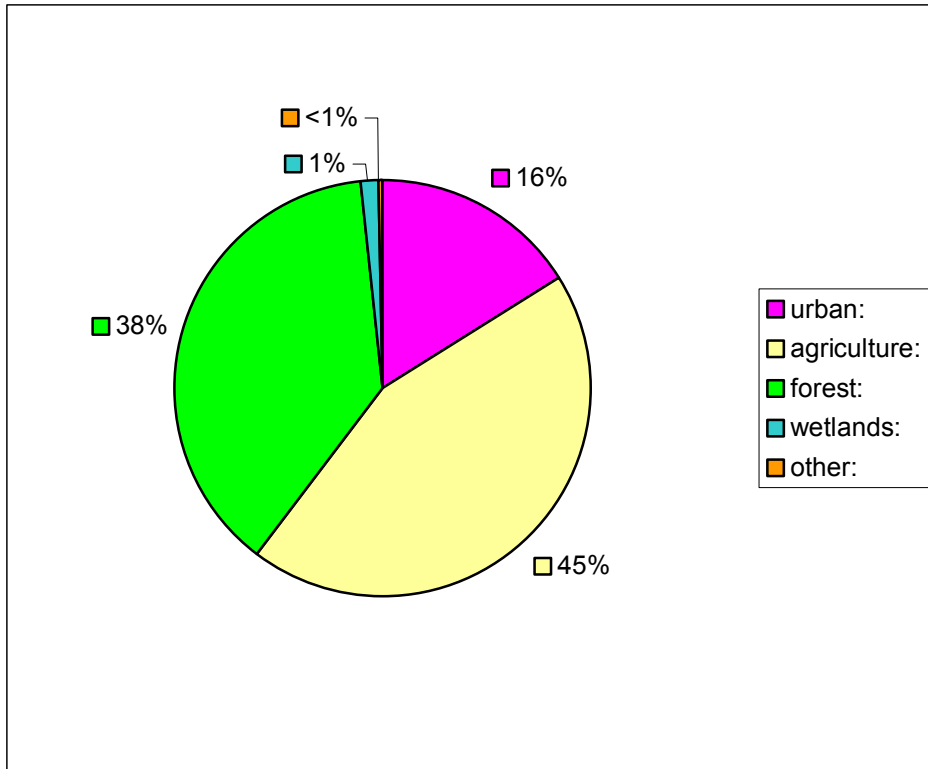


Figure 1. Land use in Cecil County

There are two State-designated 6-digit watersheds and thirteen 8-digit watersheds in this County. Lower Susquehanna River (021202) includes Lower Susquehanna River (02120201), Octoraro Creek (02120203) and Conowingo Dam (02120204); Elk River (021306) includes Lower Elk River (02130601), Bohemia River (02130602), Upper Elk River (02130603), Back Creek (02130604), Little Elk Creek (02130605), Big Elk Creek (02130606), Christina River (02130607), Northeast River (02130608), Furnace Bay (02130609), Sassafras River (02130610).

### Streams

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 sources included point sources (21% N and 16% P), urban sources (18% N, 30% P, and 14% sediment), mixed open land (18% P and 7% sediment), and forest (10% 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 following information is from the Maryland Tributary Strategies 2004 document entitled *Maryland Upper Eastern Shore: Final Version for 1985-2002 Data*. This basin drains Kent County and portions of Talbot, Queen Anne, and Cecil Counties and includes the waterways Miles, Bohemia, Elk, Chester, Sassafras and Northeast Rivers, Eastern, Crab Alley, and Prospect Bays. Land use is dominated by agriculture (58%), forest/wetland (32%), and urban (10%). Roughly 60-70% of the houses are on septic and wells. Of the six major wastewater treatment plants, all either currently have or will have biological nutrient removal by 2005. The major source for nitrogen, phosphorus, and sediments is agriculture (74%, 73%, and 89% respectively). Water quality sampling found nitrogen, phosphorus, and total suspended solids to be good or fair, except in the Upper Chester River which had the worst water quality. In 2001, SAV coverage exceeded the SAV goal at Bohemia, Elk Neck, Sassafras, and Back Creek but was below the SAV goal at Northeast, Chester, and Eastern Bay. The benthic community was the worst at Northeast River, Bohemia River, and Eastern Bay. This document describes BMP implementation success as follows:

BMP implementation for conservation tillage, cover crops, retirement and treatment of highly erodible land, stream protection, and erosion and sediment control are all making good progress toward Tributary Strategy goals. For other BMPs, such as those for animal waste management systems, forested and grassed buffers, and stormwater management measures, progress has been slower, and in some cases, nonexistent.

## **Wetlands**

Wetlands in Cecil 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 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 small wetland areas, primarily in the Coastal Plain, that are supported by surface water ponding over soil with a fragipan that impedes drainage.

The northern part of the County is considered potential habitat for the endangered bog turtle. The turtles favor saturated, emergent wetlands such as those found in pastures.

### Wetland classifications

According to Tiner and Burke (1995), in 1981-1982 there were 9,018 acres of wetlands (1.5% of the State's total). The wetland types were Estuarine (2,184 acres), Palustrine (6,646 acres), Riverine (150 acres), and Lacustrine (38 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 65%, or 16,432 acre, loss (MDE, 2002).

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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 (Cecil County does not contain any brackish marsh).
    - 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 Buttonbush, 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). Cecil County had 2,346 acres of vegetated tidally-influenced wetlands (excluding SAV). A large amount of vegetated wetland is fresh marsh. There are smaller amounts of shrub and wooded swamp.

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

Major Vegetation Type	Vegetation Type	Acreage
Shrub Swamp ( <i>Fresh</i> )	Swamp rose	0
	Smooth alder/Black willow	124
	Red maple/Ash	157
Swamp forest ( <i>fresh except pine, which is often brackish</i> )	Bald cypress	0
	Red maple/Ash	77
	Loblolly pine	0
Fresh marsh	Smartweed/Rice cutgrass	305
	Spatterdock	10
	Pickernelweed/Arrow arum	413
	Sweetflag	61
	Cattail	904
	Rosemallow	60
	Wildrice	112
	Bulrush	25
	Big cordgrass	0
	Common reed	98
Brackish High Marsh	Meadow cordgrass/Spikegrass	0
	Marshelder/Groundselbush	0
	Needlerush	0
	Cattail	0
	Rosemallow	0
	Switchgrass	0
	Threesquare	0
	Big cordgrass	0
	Common reed	0
Brackish Low Marsh	Smooth cordgrass	0
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	861

### 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.

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. Some floodplain wetlands are also found in pastureland 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. The hydric soils Baile and Watchung, found in the Piedmont region, and Fallsington soil in the Coastal Plain of Cecil County, has some characteristics associated with ground water discharge. These soils are found in heads of drainages and at the base of slopes (Baile, Watchung) or on flats (Fallsington).

**Ground water recharge** is the primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use. Recharge would not be expected in a wetland with a hydric soil containing a fragipan, such as Leonardtown soils found in the Coastal Plain portion of the County.

### *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.

Tidal wetlands are not extensive in Cecil County, due to the steep adjacent slopes of the major rivers. The largest vegetated tidal wetlands are found along the tributaries of the Elk and Northeast Rivers. Due to the width of these areas, the area would likely be one of the most effective at stabilization of shoreline sediments.

#### *Wildlife Habitat/Biodiversity*

Wetlands provide important habitat for fish, wildlife, and plant species, including rare species. While vegetated wetlands are not extensive along the Susquehanna River shoreline due to the steep adjacent slopes, they provide supporting habitat to the unvegetated intertidal zone and several rare species found there. Vegetated wetlands also provide important shade to the natural cold water trout streams in the Piedmont region on Cecil County.

The northern part of the County is considered potential habitat for the endangered bog turtle. The turtles favor saturated, emergent wetlands such as those found in pastures.



There is a reference tidal shrubland community on Little Blackduck Creek in the Sassafras River drainage. The community is dominated by *Alnus serrulata/Viburnum recognitum/Impatiens capensis* (Smooth alder/Northern arrowwood/Jewelweed). The community is a daily inundated, freshwater system usually found between tidal emergent and tidal swamp forests. Species richness is high due to diversity of microtopography and variable durations of inundations from hummocks and hollows (Harrison and Stango 2003).

#### Nontidal Wetlands of Special State Concern

There are several State-designated Nontidal Wetlands of Special State Concern (WSSC) and potential WSSCs in this County. These are described in the section for the individual watersheds.

#### General Considerations in Restoration/Mitigation

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

Most recent impacts are from road crossings and installation of water and sewer lines, with some development occurring in isolated wetlands. Historic impacts include drainage and conversion to pasture land and pond construction.

Hydric soils suggest where wetlands are currently or were historically. There is a fair amount of "poorly drained" hydric soil that is not mapped wetlands (based on NRCS SSURGO GIS data and NWI/DNR wetlands), especially in the northern portion of the County. While much of this appears to be along waterways, there are some areas not directly associated with a waterway. Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

Wetland mitigation depends on many factors. The County master or zoning plans need to be taken into account, since creating a wetland in an area that is designated as an urban development area may be counterproductive. Creating wetlands with their needed buffers in the middle of prime agricultural land might cause a lot of unnecessary strife with the farming community, while the cooperation of that community is essential. Since many of the natural areas are unprotected, and the State's Green Infrastructure is mostly unprotected, and sometimes unconnected (not all hubs are connected with green corridors), a new wetland next to a hub or within a proposed corridor would be an

important benefit. Another factor to consider is the design and location of a project to provide water quality functions. Wetlands may be created in areas that:

- Have hydric soils
- Are within the low density, open space, or similar land use zone
- Are close to, or connected to another wetland or protected green area
- Have clean source water (surface or ground, depending on hydrology)
- Are within the (proposed) green infrastructure

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 stream biodiversity by contributing organic matter to the food web, providing woody debris which increases diversity of physical habitat, and reducing stream temperature. Headwater streams are thought to be the most beneficial at these processes. Therefore, wetlands adjacent to streams should be high priority for restoration/preservation, with emphasis on headwater stream systems. Wetlands around all tributaries of waterways used for drinking water (COMAR Use P) should also be ranked higher.

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

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

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

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

to enter the groundwater. Therefore, wetland creation designs within WPAs should consider the impact to groundwater quality.

### **Sensitive Resources**

Numerous sourcewater assessments (SWA) were completed for water supplies within the County. The SWA for small water systems in the County found the wells withdrawing from unconfined aquifers were susceptible to nitrates, VOCs, SOCs, microbiological contamination, and naturally occurring radon. Other SWAs are discussed in the section for the watershed in which they are located.

The Comprehensive Plan recommends that future develop be located in Development, Town, and Suburban Districts, many of which are near I-95/US 40. Rural Conservation Districts (containing about 40% of the land) should be established north of the Chesapeake and Delaware Canal and on the Elk Neck peninsula. The goal of this area is to maintain the rural character through agriculture and forestry. A Resource Protection District (containing about 30% of the land) should be south of the Chesapeake and Delaware Canal. The goal of this district is to keep good agricultural soils in farm use. Development should also be discouraged in the mineral extraction districts. These areas and surrounding land use should be protected from the effects of mining. Through the Critical Area program, growth is limited in 25,000 acres (Cecil County, 2005).

Based on the Comprehensive Plan, sensitive areas needing protection include:

- Floodplains
- Limit development on steep slopes
- Sensitive areas: Protect water quality, plant and animal habitat
- Streams and their buffers: Establish a 110 foot perennial stream buffer and 25-foot intermittent stream buffer, with expansion to 160 feet in special conditions.
- Wetlands
- Sensitive soils
- Protect RTE species
- Forest cover, including afforestation in new subdivisions and forest protection.
- Habitat enhancement, including wildlife corridors
- Preserve farmland
- Establish greenways policy, including preserving open space in rural areas.

### **Other Relevant Programs**

#### Green Infrastructure and Greenways

There is a large amount of Green Infrastructure in this County, with the largest Green Infrastructure hub being in the center, around the North East River. Largest hubs are in the Elk Neck peninsula (which include Elk Neck State Park, Elk Neck State Forest, and Plum Creek Natural Heritage Area), west and north of Charlestown (the mineral extraction district), Fair Hill, along the larger streams (e.g. Octoraro Creek, Northeast Creek, Bohemia River, and Sassafras River) (Cecil County, 2005). Areas within the Green Infrastructure network that are currently unprotected should be protected. There are also

small sections of Green Infrastructure considered to be “gaps,” currently in development, agriculture, or barren land. It is desirable to restore these areas back to natural vegetation, as they can provide a wildlife corridor, a protective buffer, and may be especially important along the waterways. For more detailed information, refer to section on the individual watershed.

The County’s Comprehensive Plan identifies eight potential greenways and four Class II bikeways. The Lower Susquehanna Heritage Greenways is the primary greenways in the County. However, there is ongoing discussion about the possibility for several others that could link parks, trails, and greenways in Pennsylvania and Delaware, with corridor extensions into and through parts of northern Cecil County and along the Chesapeake and Delaware Canal.

#### 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, intended 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 Sassafras River and Upper Elk 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 Areas are the Fair Hill (in the northeastern portion of the County) and Sassafras Rural Legacy Areas (around the Sassafras River). For detailed information about the program, refer to the individual watershed sections.

#### Priority Funding Areas

The main Priority Funding Areas are located along Rte. 40 (e.g. Perryville, Charlestown, Northeast, Elkton). Smaller PFAs are located outside this corridor (e.g. Port Deposit, Rising Sun).

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

Stormwater management associated with growth may also reduce certain nonpoint source impacts to wetlands in PFAs.

### Agricultural Easements

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

### **Watershed Information**

Information on the 6-digit watersheds and individual 8-digit watershed basins is as follows:

#### Lower Susquehanna River (021202)

The larger 27,000 mi<sup>2</sup> Susquehanna River drainage area encompasses portions of New York, Pennsylvania, and Maryland. Originating in central New York, it flows roughly 477 miles before emptying into the Chesapeake Bay at Havre de Grace. Based on the total volume of water passing through the mouth of the Susquehanna River, it is the largest river on the east coast. It is also the largest tributary to the Chesapeake Bay, providing 45% of the freshwater, 40% of the sediment, 39% of the nitrogen, and 24% of the phosphorus to the Bay.

The 6-digit Lower Susquehanna basin is the second largest sub-basin of the larger Susquehanna River drainage. The Lower Susquehanna River basin is located within Harford, Cecil, and Baltimore Counties. Of the 5,809 mi<sup>2</sup> in the Lower Susquehanna River Basin, 275 mi<sup>2</sup> are in Maryland. The Maryland portion lies entirely within the Piedmont Upland Physiographic Province, characterized by rolling uplands with broad hills and steep-sided valleys. The Lower Susquehanna River, Deer Creek, Octoraro Creek, and Broad Creek are all within the basin. Eighty-five percent of the Lower Susquehanna basin are small nontidal headwater streams. The Lower Susquehanna River 6-digit watershed has four 8-digit watersheds in Harford County.

Land uses in the basin are primarily agriculture and forest.

Susquehanna State Park and Palmer State Park, along with other wilderness areas within the basin, provide many recreational opportunities including hiking, camping, fishing, swimming, picnicking, and nature watching.

According to the DNR 1999 document entitled *Lower Susquehanna Basin – Environmental Assessment of Stream Conditions*, the major impacts to non-tidal streams in this basin appear to be excessive nutrient enrichment and habitat degradation, likely due to a loss of riparian habitat. While all waterways met State water quality standards, fish and benthic Indices of Biotic Integrity showed evidence of biological impairment. Considering the continuing impacts to the system and the predicted changes in land use, population, and water demands, the streams will likely become more degraded with time. Implementation of best-management practices (BMPs), such as riparian zone protection and reforestation, may reduce, but not eliminate these impacts.

The Lower Susquehanna River 6-digit watershed has three 8-digit watersheds in Harford County. Information on the individual 8-digit watersheds is as follows:

#### Lower Susquehanna River (02120201)

##### *Background*

The 8-digit Lower Susquehanna River watershed is located in Harford and Cecil Counties. Perryville is the biggest city in the watershed, followed by Port Deposit. We are basing our calculations on the most recent DNR 8-digit watershed delineation, having different borders for this watershed than the previous version. Based on MDP 2002 GIS land use data, the Cecil County portion of the Lower Susquehanna River watershed has 2,296 acres of open water and 12,324 acres of land. The land acres are divided as follows: urban 3,702 acres (30%), agriculture 2,966 acres (24%), forest 5,586 acres (45%), wetlands 29 acres (<1%) and barren land 41 acres (<1%). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

The Susquehanna River originates in New York and drains an area of 27,548 mi<sup>2</sup>, with only 1% being in Maryland. This River and its tributaries contribute about 75% of the freshwater entering the Bay. Near the area of the Susquehanna State Park, the river is about one mile wide and is fairly shallow with a high velocity. The water level fluctuates with the opening and closing of the gates to the Conowingo dam (DNR, 1979).

A portion of Susquehanna State Park is located within this watershed. This park is located on the Susquehanna River, downstream of the Conowingo Dam. Most of this park is within Harford County, but a small portion resides in Cecil County.

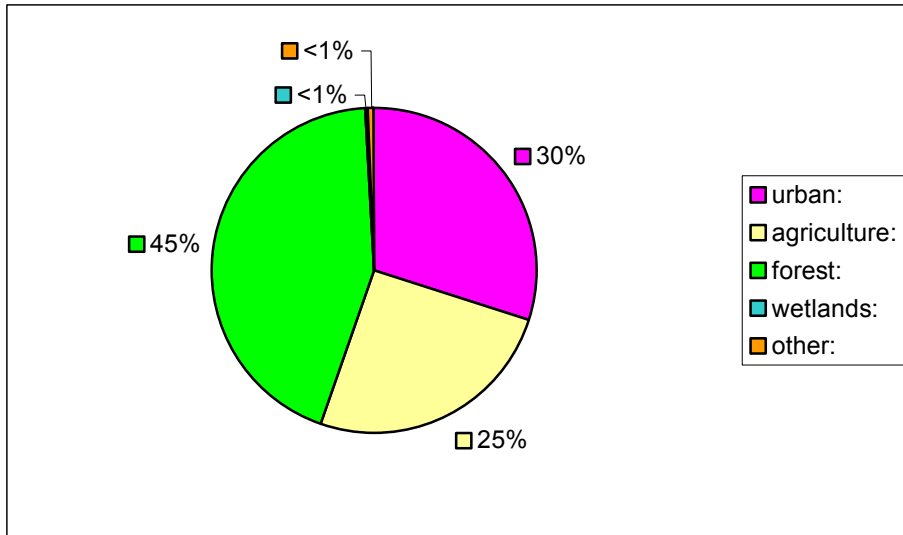


Figure 2. Land use in the Susquehanna River watershed.

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

- Estuarine
  - Emergent: 2 acres
  - Unconsolidated shore: 21 acres
- Palustrine
  - Aquatic bed: <1 acre
  - Emergent: 54 acres
  - Scrub shrub: 5 acres
  - Forested: 117 acres
  - Unconsolidated bottom: 44 acres
  - Unconsolidated shore: 3 acre
  - Farmed: 9 acres
- Riverine unconsolidated shore: 2 acres
- Total: 257 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)
02120201	-3.99	5.70	0	0	1.70

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically

listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Use I-P: water contact recreation, protection of aquatic life, and public water supply; Susquehanna River and all tributaries except those designated below From Mainstem from mouth to MD/PA line
- Use III: natural trout waters; Rock Run (Cecil County) Confluence with Susquehanna River to pond outlet at the headwaters.
- Mill Creek and tributaries (above U.S. Route 40): Use IP recreation contact and protection of aquatic life and potable water supply.
- All estuarine portions: Use II, shellfish harvesting.

### *Water Quality*

Source water assessments were completed for several water supplies within this watershed. The water supply name and susceptibility are as follows:

- *Woodlawn Mobile Home Park - New* (unconfined aquifer): high susceptibility - radon-222; moderate susceptibility – VOCs, coliform bacteria; low susceptibility – SOCs, other radionuclides, inorganic compounds.
- *Woodlawn Mobile Home Park - Old* (unconfined aquifer): high susceptibility - radon-222, coliform bacteria; moderate susceptibility – VOCs; low susceptibility – SOCs, other radionuclides, inorganic compounds.
- *Highlands Hills Mobile Home Park* (unconfined aquifer): low susceptibility – VOCs, SOCs, inorganic compounds, radiological compounds, microbiological contaminants.
- *Misty Meadows I Mobile Home Park* (unconfined aquifer): high susceptibility – radon-222; moderate susceptibility – VOCs, coliform bacteria; low susceptibility – SOCs, other radionuclides, inorganic compounds.
- *Benjamins Village/Homestead Mobile Home* (unconfined aquifer): high susceptibility – VOCs, radon-222; moderate susceptibility – nitrates; low susceptibility – SOCs, other inorganic compounds, other radionuclides, microbiological contaminants
- *Maple Hill Mobile Home Park* (unconfined aquifer): high susceptibility – VOCs; moderate susceptibility – nitrates, mercury, radon-222; low susceptibility – SOCs, other inorganic compounds, other radionuclides, microbiological contaminants

SWA and Protection Reports were completed for Perry Point Veteran's Medical Center, Perryville, and Port Deposit. Contaminants of concern for these water supplies were turbidity, sediment, microbial, disinfection byproducts, inorganic compounds, organic compounds, and radionuclides. The largest contaminant source is agricultural land use. A smaller contaminant source is urban/residential land use.

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 percent impervious surface (12%). Wetland loss was estimated to be 3,273 acres. Indicators for Category 3



include high imperiled aquatic species indicator, migratory fish spawning areas, trout spawning areas, and the presence of five drinking water intakes.

According to the 2002 305(b) report, the tidal mainstem (Chesapeake Bay to Rock Run) fails to support all uses due to PCBs, while the nontidal mainstem (Rock Run to Conowingo Dam) fully supports all designated uses. A portion of the wadeable tributary streams fails to support all designated uses due to poor biological community from urban runoff 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:

- *Susquehanna River* (tidal); cadmium, nutrients, sediments, PCBs (in fish tissue).
- *Susquehanna River Unnamed Tributary* (021302010319 non-tidal in Cecil County); poor biological community.
- *Herring Run* (021202010318 non-tidal in Harford County); poor biological community.

A Draft Water Quality Analysis was completed in 2005 for eutrophication in the Tidal Lower Susquehanna River. This analysis found no impact to the designated uses due to high levels of nutrients and the dissolved oxygen criteria was met. Therefore, they recommend removal of the tidal Lower Susquehanna River from the 303(d) List for eutrophication (MDE, 2005b).

#### *Restoration/Preservation*

There are small sections of Green Infrastructure hubs and corridors along the river (DNR, 2000-2003), largely unprotected. Protected land includes Susquehanna River State Park and County-owned Garrett Island. There is an unprotected Green Infrastructure hub (around Blythedale) and some Green Infrastructure corridors.

According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Lower Susquehanna Heritage Greenway*. The Greenways and Water Trails program is working in partnership with Harford and Cecil Counties and the Lower Susquehanna Heritage Greenway to develop a water trail guide for the Lower Susquehanna River Water Trail. This trail runs along both sides of the Lower Susquehanna River from Pennsylvania to Havre de Grace and the Mill Creek side of the Perryville Community Park.. The core of the Lower Susquehanna Heritage Greenways is a partially established greenway along the floodplain of the Susquehanna River below the Conowingo Dam.
- *Octoraro Creek*. This potential ecological greenway runs along the Octoraro Creek stream valley owned by Chester County Water Authority (from Susquehanna River to Pennsylvania).

There are two State-designated Wetlands of Special State Concern in this watershed and a potential WSSC.

- *Frenchtown Shore*. This site is along the Susquehanna River shore and is unprotected.
- *Port Deposit*. This wetland complex, along the Susquehanna River shore, contains forest, scrub/shrub, and emergent vegetation, including a rare plant species. This species is vulnerable to the continued spread of non-native invasive plants (DNR, 1991). This site is unprotected.
- There is a potential WSSC along the upper portion of this watershed, on the Susquehanna River. It is also unprotected.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the Susquehanna River.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

### Octoraro Creek (02120203)

#### *Background*

Some of this watershed is located in Pennsylvania. We are basing our calculations on the most recent DNR 8-digit watershed delineation, having different borders for this watershed than the previous version. Based on MDP 2002 GIS land use data, the Cecil County portion of Octoraro Creek watershed has 34 acres of open water and 22,180 acres of land. The land acres are divided as follows: urban 4,209 acres (19%), agriculture 11,084 acres (50%), forest 6,855 acres (31%), wetlands 26 acres (<1%) and barren land 5 acres (<1%) (Figure 3). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

This Creek flows into the Susquehanna River, before flowing into the Chesapeake Bay. The Susquehanna River originates in New York and drains an area of 27,548 mi<sup>2</sup>, with only 1% being in Maryland. This River and its tributaries contribute about 75% of the freshwater entering the Bay (DNR, 1979).

A portion of Susquehanna State Park is located within this watershed. This park is located on the Susquehanna River, downstream of the Conowingo Dam. Most of this park is within Harford County, but a small portion resides in Cecil County.

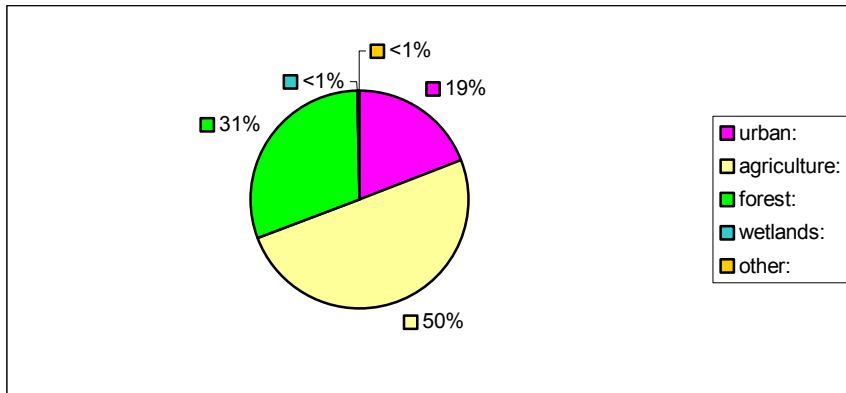


Figure 3. Land use in the Octoraro Creek watershed.

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

- Palustrine
  - Emergent: 30 acres
  - Scrub shrub: 23 acres
  - Forested: 49 acres
  - Unconsolidated bottom: 127 acres
- Riverine unconsolidated shore: 2 acres
- Total: 231 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)
02120203	0	0	2.00	0	2.00

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

- Use I-P: water contact recreation, protection of aquatic life, public water supply; Susquehanna River and all tributaries except those designated below as Use III-P or Use IV-P From Mainstem from mouth to MD/PA line
- Use III-P: natural trout waters and public water supply;
  - Basin Run and all tributaries
  - Love Run and all tributaries
  - Stone Run and all tributaries

- Use IV-P: recreational trout waters and public water supply; Octoraro Creek Mainstem only

### *Water Quality*

Source water assessments were completed for several water supplies within this watershed. The water supply name and susceptibility are as follows:

- *Maple Hill Mobile Home Park* (unconfined aquifer): high susceptibility – VOCs; moderate susceptibility – nitrates, mercury, radon-222; low susceptibility – SOCs, other inorganic compounds, other radionuclides, microbiological contaminants
- *Town of Rising Sun* (unconfined aquifer): VOCs, radon-222 (depending on approved maximum contaminant level).

The 1998 Clean Water Action Plan classified this watershed as Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high soil erodibility (0.31). Wetland loss was estimated to be 1,897 acres. Indicators for Category 3 include high non-tidal instream habitat index, migratory fish spawning areas, and trout spawning areas.

According to the 2002 305(b) report, a portion of the wadeable tributary streams (26 miles) fully supports all designated uses due, while the remaining portion (10 miles) had inconclusive data.

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

- *Stone Run* (021202030347 non-tidal); poor biological community.

### *Restoration/Preservation*

There are a few small Green Infrastructure hubs in this watershed and several Green Infrastructure corridors (DNR, 2000-2003). The only protected land are a few METs, small portions of Susquehanna State Park, and County-owned land. Since many of the Green Infrastructure corridors are currently in agriculture, these may be good areas for restoration to natural vegetation.

According to the 2000 Maryland Greenways Commission document, there are several existing greenways including:

- *Octoraro Creek*. This potential ecological greenway runs along the Octoraro Creek stream valley owned by Chester County Water Authority (from Susquehanna River to Pennsylvania). The majority (over 200 acres) of the Octoraro Creek stream valley is owned by the Chester County Water Authority, including an 11-mile mostly wooded corridor along the creek in Maryland with a significant buffer (~ 40 feet) on either side. Additional land along the corridor in Pennsylvania is also protected by the water authority. This corridor connects to the Lower Susquehanna Heritage Greenways.

- *Octoraro Rail Trail*. This potential recreation greenway would follow an old scenic railroad line to connect Rising Sun with the Lower Susquehanna greenways. The County owns about five miles of the corridor from the Mason-Dixon line to just south of Colora and plans to acquire more through the subdivision process.

There are two State-designated Wetlands of Special State Concern in this watershed and eight potential WSSCs.

- *Octoraro Slopes (DNR name: Horseshoe Woods)*. This site has steep forested slopes and ravines with soils ranging from dry serpentine to rich loamy. Wetland seeps and floodplain forest create diverse habitat. A rare plant species is present on the serpentine soils (DNR, 1991). This site is located within Camp Horseshoe. Main threats include logging/forest clearing and development. Some logging has already occurred, creating canopy opening that allow non-native plant species to establish. Existing hiking trails are eroding, which an increase in foot traffic would aggravate (McCarthy et al., 1988).
- *Roaring Woods*. This site includes seeps, small streams, and floodplain forest on the slopes of this area. They contain thick herbaceous vegetation, including uncommon and State Threatened plant species. This wetland and forest area provides flood control and water quality improvement for Octoraro Creek and are some of the last remaining scenic forest tracts in the watershed. Since this area contains unusual chrome-rich soils, it is likely additional rare species are also present in the vicinity (DNR, 1991).
- *Stone Run Millpond*. This site is located on the northern border of the town of Rising Sun. This site contains a variety of habitats including open water, emergent marsh, shrub swamp, and forested swamp. It contains diverse wetland vegetation, one species classified as State Threatened. As beaver have become less common, freshwater ponds and associated wetlands have also become less common (DNR, 1991). The site is unprotected. Main threats include changes in water quality from the existing development north of the pond, possible future development on the other sides of the pond, current logging activities (in 1988), invasion of non-native plant species, and possible dam failure. Local landowners should be educated about their impacts to the system (McCarthy et al., 1988), since paths traversing the site suggest it is an important passive recreation area (DNR, 1991).
- There are several additional WSSCs proposed in 2002, with all but one site being unprotected. The sites are located along the Susquehanna River, near Liberty Grove, north of McCauley Road, west of Richardsmere, along Stone Run, around West Nottingham, and along Basin Run.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, within hubs and along waterways.

- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

### Conowingo Dam (02120204)

#### *Background*

Portions of this watershed are also located in Harford County and Pennsylvania. The main stream within Cecil County is Conowingo Creek. This flows into the Susquehanna River, which is then dammed up by the Conowingo Dam, forming what is referred to as the Conowingo Reservoir. The main function of this 8,563 acre reservoir is hydroelectricity (Reger, 2005). Based on MDP 2002 GIS land use data, the Cecil County portion of the Conowingo Dam watershed has 1,406 acres of open water and 4,882 acres of land. The land acres are divided as follows: urban 512 acres (10%), agriculture 1,259 acres (26%), and forest 3,112 acres (64%) (Figure 4). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

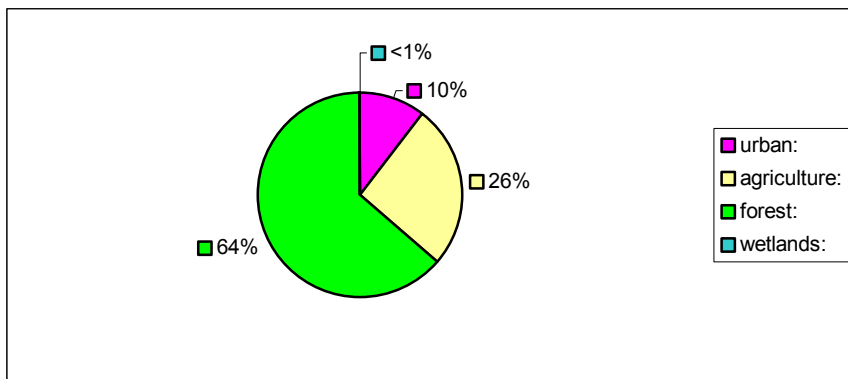


Figure 4. Land use in the Conowingo Dam watershed

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

- Palustrine
  - Emergent: 3 acres
  - Forested: 4 acres
  - Unconsolidated bottom: 25 acres
- Total: 31 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)
02120204	-0.07	0	0	0	-0.07

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Use I-P: recreation contact, protection of aquatic life, and public water supply; Susquehanna River and all tributaries From Mainstem from mouth to MD/PA line

*Water Quality*

A sourcewater assessment was completed for Conowingo Mobile Home Park. The wells withdraw from an unconfined aquifer that has moderate susceptibility to nitrates and radon-222 and has a low susceptibility to VOC, SOC, other inorganic compounds, other radionuclides, and microbiological contaminants.

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. Wetland loss was estimated to be 895 acres. Indicators for Category 3 include high non-tidal instream habitat index, high fish index of biotic integrity (FIBI), high imperiled aquatic species indicator, and the presence of three drinking water intakes.

According to the 2002 305(b) report, a portion of the wadeable tributary streams (1 mile) fails to support all designated uses due to nutrients, bacteria, and poor biological community from sewage problems in Scotts Creek. There are plans to control this sewage problem (DNR, 2000 305b). The remainder of the wadeable tributaries fully support all designated uses (6 miles) or had inconclusive data (8 miles). Conowingo Pool fully supports 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:

- *Conowingo Dam Susquehanna River* (non-tidal); nutrients, sediments.
- *Conowingo Creek* (021202040335 non-tidal in Cecil County); poor biological community.
- *Scotts Creek* (non-tidal); While this waterway is also listed for fecal coliform impairment, it does not need a TMDL since other controls will likely result in attainment of water quality standards.

*Restoration/Preservation*

The Cecil County portion of this watershed has a large Green Infrastructure hub, but only a small amount is protected: the TNC property known as Pilot Serpentine Barren. Unprotected Green Infrastructure corridors follow the Susquehanna River (DNR, 2000-2003). According to the 2000 Maryland Greenways Commission document, a proposed greenway is the Lower Susquehanna Heritage Greenway.

Also found in this watershed is the 90-acre Pilot Serpentine Barren, which is one of only four remaining examples of this natural community in Maryland. An open, dry grassland surrounded by forest, Pilot is an excellent example of how an area's geology determines a natural community's character. Soils here are thin and nutrient poor but rich in minerals. This environment combined with a dry, hot microclimate results in an unusual community of plants adapted to the serpentine barren. Three plant species which are rare or only found on serpentine soils are found there.

There are four State-designated Nontidal Wetlands of Special State Concern (WSSC) and one potential WSSC in this watershed.

- *Bald Friar Ravine*. This site contains circumneutral soil with streambank, slope, marsh, and pond habitat. It is largely in deciduous forest with a diverse herbaceous layer and one rare plant species. This site is unprotected. The pond is used for limited recreational fishing. Main threats include logging/forest clearing (McCarthy et al., 1988).
- *Cecil Bog*. This rare wetland type (boggy wet meadow and gravel seepage slope) has chrome soils and a lack of woody vegetation (due to the powerline right-of-way maintenance), similar to those found in historical fire-suppressed systems. This site contains three rare plant species. Additional rare species would likely be found with additional surveys (DNR, 1991). This site is unprotected. Main threats include alteration of hydrology, certain powerline maintenance practices, logging, and ATV use (which is already occurring adjacent to the site) (McCarthy et al., 1988). Property owners of two adjacent sites have agreed to protect the portion of their land that acts as a forested buffer (DNR, 1991).
- *Log Cabin Sedge Meadow (DNR calls the northern portion of this WSSC Rock Springs Barren)*. This rare wetland type has chrome soils and a lack of woody vegetation, similar to those found in historical fire-suppressed systems. This lack of woody vegetation is partially maintained by groundwater seepage, powerline right-of-way maintenance, and the shallow chrome-rich soils (DNR, 1991). This site contains three rare plant species. This site is unprotected. A portion of the site along the stream was recently (1988) sprayed with a non-selective herbicide, likely reducing the population of rare species. Additional threats include logging and invasion by non-native plant species (McCarthy et al., 1988).
- *Wildcat Ravine*. This steep narrow ravine contains pond, marsh, mature Hemlock/Tulip forest, and historically contained a State Endangered plant species (current presence of this species is unknown). This area is unprotected, but the main landowner has agreed to voluntarily protect their portion of the site (DNR, 1991). Main threats include logging/forest clearing (McCarthy et al., 1988).



- There is one potential WSSC at the very southern portion of this watershed, along the Susquehanna River (extending into Octoraro Creek and Lower Susquehanna watersheds). This site is unprotected.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the Susquehanna River and other waterways.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

Elk River (021306)

The 6-digit Elk River basin drains into the northeastern portion of the Chesapeake Bay from Cecil and Kent Counties. Portions of the basin drain from Pennsylvania and Delaware. The Elk River basin includes the 8-digit watersheds of the Elk, Sassafras, Northeast, and Bohemia Rivers. Land use in this 6-digit basin is primarily rural, however urbanization is occurring at a moderate rate. The basin drains an area of 440 square miles. The population is about 160 people per square mile, a number expected to increase by 22% in the next 20 years.

The logperch, highly rare in Maryland, is found in the Elk River basin. The basin has an outstanding diversity of wetlands, with 33 distinct plant community types recognized. Among these is the Maryland bur-marigold, a threatened species of global concern.

The Elk River 6-digit watershed has ten 8-digit watersheds in Cecil County. Information on the individual 8-digit watersheds is as follows:

Lower Elk River (02130601)

*Background*

Based on MDP 2002 GIS land use data, the Lower Elk River watershed has 6,996 acres of open water and 25,466 acres of land. The land acres are divided as follows: urban 1,964 acres (8%), agriculture 10,598 acres (42%), forest 11,597 acres (46%), wetlands 1,166 acres (5%) and barren land 140 acres (1%) (Figure 5). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

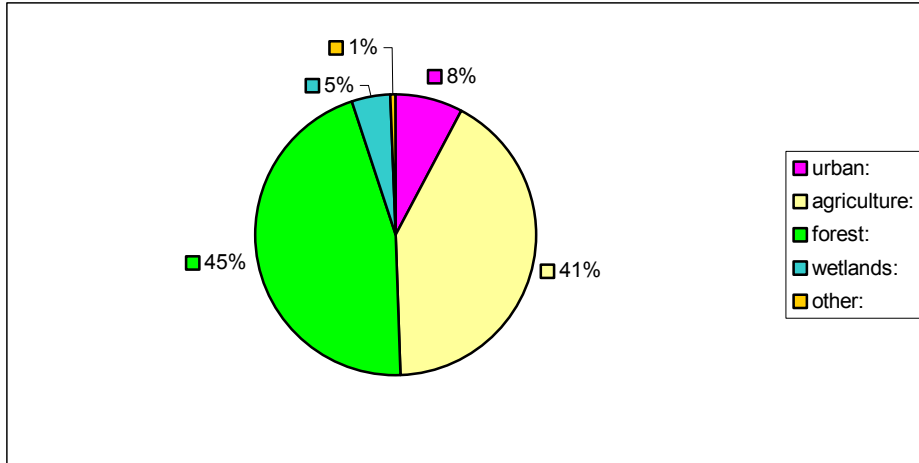


Figure 5. Land use in the Lower Elk River watershed.

There are extensive freshwater tidal marshes located along meandering portions or on alluvial deposits along the Elk River (Sipple, 1999).

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

- Emergent
  - Emergent: 400 acres
  - Scrub shrub: 4 acres
  - Unconsolidated shore: 81 acres
- Palustrine
  - Emergent: 247 acres
  - Scrub shrub: 244 acres
  - Forested: 210 acres
  - Unconsolidated bottom: 167 acres
- Total: 1,353 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)
02130601	-0.23	0.10	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 not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Elk River and tributaries (above Bull Minnow Point and Courthouse Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

### *Water Quality*

A sourcewater assessment for Harbor View, withdrawing from a confined aquifer, is not susceptible to contamination.

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 low SAV abundance and habitat index and poor tidal benthic index of biotic integrity (BIBI). Wetland loss was estimated to be 5,218 acres. Indicators for Category 3 include migratory fish spawning areas and high percent of headwater streams being in Interior Forest.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all uses due to PCBs, while data 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:

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Lower Elk River* (tidal); nutrients, sediments.

### *Restoration/Preservation*

There is a large portion of Green Infrastructure hub within this watershed, with a large hub around Elk Neck State Park. Smaller Green Infrastructure hubs are scattered on the south side of Elk River (DNR, 2000-2003). Protected areas include Stemmers Run Managed Hunting Area, Earleville WMA, Elk Neck State Park, Elk Neck State Forest, Courthouse Point Managed Hunting Area, and several METs. There are still many unprotected areas within the Green Infrastructure hubs.

According to the 2000 Maryland Greenways Commission document, an existing ecological and recreational greenway is the Elk Neck Peninsula Greenway. This planned greenway would offer a recreational connection between Elk Neck State Forest, smaller State-owned properties, Rodney Scott Boy Scout Camp, and Elk Neck State Park. This mostly forested greenway would connect 6,000 acres of publicly owned land.

The 2,188-acre Elk Neck State Park lies on the tip of the peninsula where the Elk and Bohemia Rivers meet the Susquehanna and Northeast Rivers to continue into the Chesapeake Bay (2000 Maryland Greenways Commission document).

The following information is summarized from the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. Within the Sassafras watershed lies a portion of the Marshyhope-Sassafras-Tuckahoe area, 36,100 acres in total. This Rural Legacy Area (RLA) combines three focus areas, the Marshyhope, Sassafras, and Tuckahoe areas, into one large Rural Legacy Area. In 1994 the corridor concept was developed to focus local, regional, and national efforts on one of the largest, contiguous blocks of highly productive farmland in the rapidly developing mid-Atlantic. Safeguarding the agricultural economy of the Eastern Shore is the goal of the three Agricultural Security Corridor focus areas. Located north and south of Federalsburg, the Marshyhope area is defined by an important river corridor, prime farms soils, a concentration of stable farm support businesses and an extensive public investment in farm preservation easements. The portion of the Agricultural Security Corridor within this watershed is the Sassafras Rural Legacy Area. The sponsors include Eastern Shore Rural Legacy Sponsor Board and Eastern Shore Land Conservancy, Inc. There are 5,210 acres of land in the Cecil County portion (based on GIS data), including 781 acres protected. The Sassafras area includes the Sassafras Natural Resource Management Area of Bloomfield Farm. The area is contiguous to thousands of acres of donated easements and existing agricultural easements and districts. It is rich in natural resources and historic farm structures dating from the 18th Century. The Tuckahoe area is located west and south of Denton. All three focus areas serve as an anchor for agricultural production and investment, buffering and enhancing the region's natural, cultural, and open space priorities. The goals include protecting agricultural land and natural resources, including protecting the water quality of the Sassafras River and other waters, and wildlife habitats. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not always adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are two State-designated Wetlands of Special State Concern (WSSC) in this watershed and one potential WSSC.

- *Camp Rodney Swamp*. This large wetland complex contains sphagnum hummocks, shrub swamp, emergent marsh, and swamp forest. Even within a wetland type there is great variation in hydrology, creating a very diverse plant system and the presence of two rare plant species (one State Endangered; DNR, 1991). There is great potential for environmental education within this site since it is located on Rodney Scout Reservation. Main threats include alteration of hydrology or forest clearing (McCarthy et al., 1988).
- *Elk Neck Coves*. This site is mostly protected by Elk Neck State Park, with the exception being the inlet next to Harry's Lane.
- There is an additional 2002 potential WSSC is located Elk Neck State Park, north of Elk Neck Coves.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the waterways and large hubs.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect land within the designated Rural Legacy Area.
- Protect wetlands and streams within the headwaters.

Bohemia River (02130602)

*Background*

The Bohemia River watershed is located in the southeastern part of Cecil County. Portions of this watershed are also located in Delaware, with some small tributaries of the headwaters located in New Castle County, Delaware. It drains to Big Elk River roughly four miles south of Town Point and then into the Chesapeake Bay. The largest city in the watershed is Cecilton. Based on MDP 2002 GIS land use data, the Cecil County portion of Bohemia River watershed has 3,162 acres of open water and 26,490 acres of land. The land acres are divided as follows: urban 1,018 acres (4%), agriculture 19,102 acres (72%), forest 5,980 acres (23%), and wetlands 389 acres (1%) (Figure 6). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

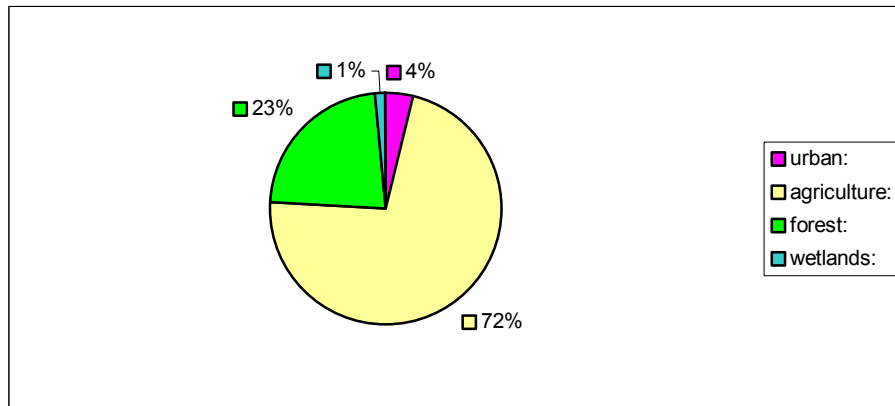


Figure 6. Land use in the Bohemia River watershed.

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

- Estuarine
  - Emergent: 350 acres
  - Unconsolidated shore: 76 acres
- Palustrine
  - Aquatic bed: 1 acre
  - Emergent: 161 acres
  - Scrub shrub: 156 acres

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- Forested: 285 acres
- Unconsolidated bottom: 195 acres
- Riverine unconsolidated bottom 42 acres
- Total 1,266 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 no regulated change in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130602	0	0	0	0	0

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Bohemia River and tributaries (above Rich Point and Battery Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

*Water Quality*

A sourcewater assessment for the town of Cecilton, withdrawing from a confined aquifer, is not susceptible to contaminants.

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, poor tidal fish index of biotic integrity (FIBI), poor non-tidal benthic IBI, and high soil erodibility (0.30). Wetland loss was estimated to be 11,799 acres. Indicators for Category 3 include high fish index of biotic integrity (FIBI), high imperiled aquatic species indicator, and the presence of five drinking water intakes.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all uses due to PCBs, nutrients, and high pH from natural sources, unknown sources and eutrophication. A portion of nontidal wadeable tributaries fail to support all uses (8 miles) due to poor biological communities and siltation from agricultural runoff. The remaining portion of the nontidal wadeable tributaries (6 miles) have inconclusive data.

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

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- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Bohemia River* (tidal); sediments, PCBs (in fish tissue). A TMDL has been completed for nutrients within this waterway.
- *Unnamed Stream* (021306020365 non-tidal); sediments.

The Bohemian River was on the State's 1996 list of WQLSs as being impaired by nutrients (nitrogen and phosphorus) due to signs of eutrophication, as seen by high chlorophyll *a* levels and suspended sediments. For this reason, TMDLs were made for the Bohemia River; one for nitrogen and one for phosphorus.

*Restoration/Preservation*

There are several linear Green Infrastructure hubs and corridors throughout the watershed, including along Great Bohemia Creek and Little Bohemia Creek (DNR, 2000-2003), the majority of which are unprotected. Protected land includes a U.S. Preservation, a MET, and a County-owned property.

The Earlville WMA, an 195-acre Wildlife Management Area is also located in this watershed. Beavers have built several large dams along a branch of Cabin John Creek, with the resulting ponds being excellent wood duck habitat. Wood edges and fields planted in warm season grasses to benefit wildlife have numerous Bobwhite quail, wild turkey, and rabbits. The variety of habitats attract a host of bird species, counted each year by the Maryland Ornithological Society during the annual Christmas bird counts.

There is one State-designated Wetland of Special State Concern in this watershed. Great and Little Bohemia WSSC is located along Great Bohemia Creek and Little Bohemia Creek and is unprotected.

Existing Recommendations for Restoration:

- Restore "gaps" in Green Infrastructure to natural vegetation.
- Restore wetlands designed to remove nutrients and sediments entering Bohemia River, especially in the headwater areas.

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the waterways.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect tidal wetlands used as reference site within DNR wetland community type study (located within Little Bohemia Creek).
- Protect wetlands and streams within the headwaters.

Upper Elk River (02130603)

*Background*

The Upper Elk River watershed is located in the eastern part of Cecil County. This watershed starts in Elkton and Delaware and runs to the confluence with Back Creek/Chesapeake & Delaware Canal before eventually entering the Chesapeake Bay. The main streams are the upper part of the Elk River and the last part of the Big Elk Creek. Based on MDP 2002 GIS land use data, the Cecil County portion of the Upper Elk River watershed has 2,337 acres of open water and 19,872 acres of land. The land acres are divided as follows: urban 5,690 acres (29%), agriculture 3,412 acres (17%), forest 10,223 acres (51%), wetlands 481 acres (2%) and barren land 66 acres (<1%) (Figure 7). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

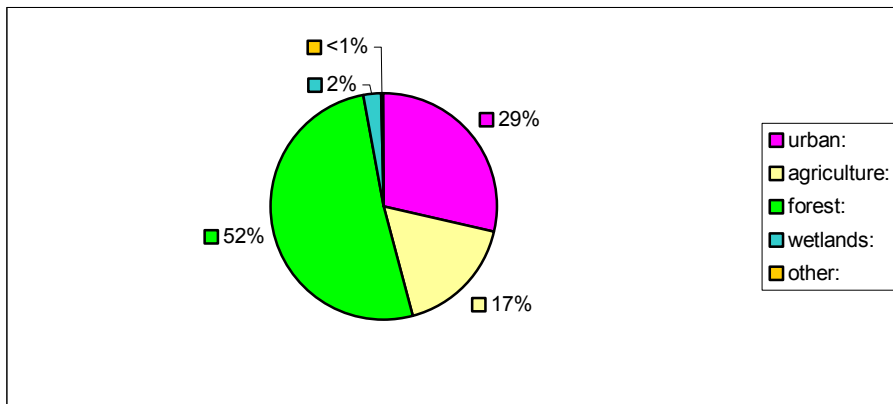


Figure 7. Land use in the Upper Elk River watershed.

There are extensive freshwater tidal marshes located along meandering portions or on alluvial deposits along the Elk River (Sipple, 1999).

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

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

- Emergent
  - Emergent: 101 acres
  - Unconsolidated shore: 135 acres
- Palustrine
  - Emergent: 431 acres
  - Scrub shrub: 55 acres
  - Forested: 238 acres
  - Unconsolidated bottom: 89 acres
  - Unconsolidated shore: 2 acres
- Riverine
  - Emergent: 3 acres
  - Unconsolidated shore: 98 acres



- Total: 1,152 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)
02130603	-0.49	0	0	0	-0.49

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Use I-P: recreation contact, protection of aquatic life, and potable water supply; Big Elk Creek and tributaries (above U.S. Route 213).
- Use II: Shellfish harvesting; all estuarine portions of tributaries except Elk River and tributaries (above line from Bull Minnow Point to Courthouse Point).

*Water Quality*

A sourcewater assessment was conducted for Whispering Pines Mobile Home Park, withdrawing from an unconfined aquifer, had low susceptibility to VOCs, SOCs, inorganic compounds, radiological compounds, and microbiological contaminants.

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 nitrogen loading, poor SAV abundance and habitat index, poor non-tidal benthic index of biological integrity (BIBI), and high soil erodibility (0.32). Wetland loss was estimated to be 8,606 acres. Indicators for Category 3 include migratory fish spawning areas, high percent headwater streams in Interior Forest, high percent of watershed forested, and the presence of one drinking water intake.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all uses due to PCBs. Data for the nontidal wadeable tributaries was inconclusive.

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

- *Elk River* (021306 tidal); PCBs (in fish tissue).

- *Upper Elk River* (tidal); nutrients, sediments.

#### *Restoration/Preservation*

There is a fair amount of Green Infrastructure hub in this watershed, with a large one around Elk Neck State Forest (DNR, 2000-2003) which is protected. Unprotected Green Infrastructure hub is located around the mouth of Big Elk Creek and south of Elk Neck State Forest. Main park areas include: part of Welch Point Managed Hunting Area, Elk Neck State Forest (south of Route 7, west of the Old Neck Road), and areas such as: Hollinsworth Park, West Meadow Park, East Meadow Park, Hatchery Park, and Elkton Marine Park. According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- Elk Creek Greenway
- Elk Neck Peninsula Greenway.

There are two State-designated Nontidal Wetlands of Special State Concern (WSSC) in this watershed.

- *Plum Creek*. This site is partially protected by Elk Neck State Forest. The downstream portion of Plum Creek is a designated Natural Heritage Area. To receive this designation, an area must contain threatened or endangered species and be the best Statewide examples. This wetland contains a State-Threatened plant species and an uncommon plant species. Historically it contained four additional rare plant species, which were not observed in the more recent surveys (DNR, 1991).
- *Whitehall Road* (DNR name: *Whitehall Road Shoreline*). This area is an unprotected wetland southwest of Elkton.

Plum Creek Natural Heritage Area is unprotected and should be high priority for protection.

#### Existing Recommendations for Restoration:

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

#### Existing Recommendations for Preservation:

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

#### Back Creek (02130604)

#### *Background*

Back Creek watershed is located in eastern Cecil County, in the Coastal Plain Province, and includes Back Creek/Chesapeake & Delaware Canal and some area within Delaware. The biggest city in Maryland is Chesapeake City. Based on MDP 2002 GIS land use data, the Cecil County portion of the Back Creek watershed has 744 acres of open water and 8,705 acres of land. The land acres are divided as follows: urban 939 acres (11%), agriculture 4,111 acres (47%), forest 3,126 acres (36%), wetlands 293 acres (3%) and barren land 236 acres (3%) (Figure 8). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

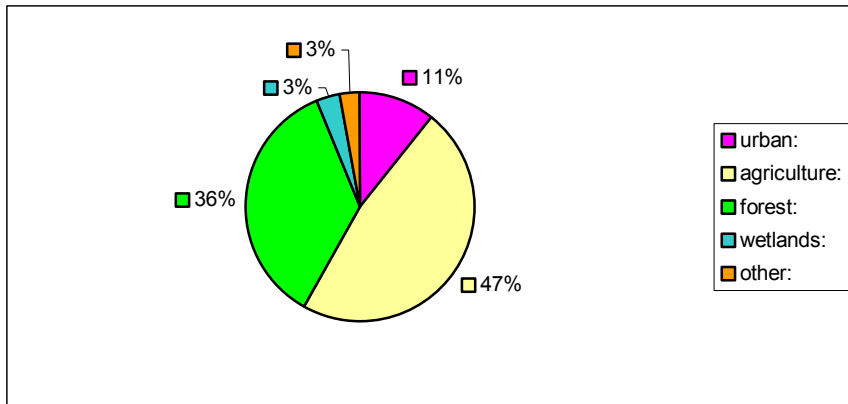


Figure 8. Land use in the Back Creek watershed.

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 have been no regulated impacts to wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130604	0	0	0	0	0

*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 this watershed, they are designated as Use I, recreation contact and protection of aquatic life.

- Use II: shellfish harvesting; All estuarine portions of tributaries.

*Water Quality*

A sourcewater assessment conducted for Chesapeake Estates Mobile Home Park, withdrawing from a confined aquifer, found a moderate susceptibility to microbiological contaminants and a low susceptibility to VOCs, SOCs, inorganic compounds, and radiological contaminants.

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, and high soil erodibility (0.29). Wetland loss was estimated to be 3,320 acres. Indicators for Category 3 include migratory fish spawning areas and a high amount of wetland-dependent species.

According to the 2002 305(b) report, the tidal mainstem, tributaries, and C&D Canal fully support all uses. Data for the nontidal wadeable tributaries was inconclusive.

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

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Back Creek* (tidal); arsenic, cadmium, silver, nutrients, sediments (from point and non-point sources, natural sources, and the C&D Canal).

The Draft 2005 MDE report entitled *Water Quality Analysis of Arsenic, Cadmium and Silver in Back Creek, Cecil County, Maryland*, found no impairment due to As, Cd, or Ag in Back Creek. Therefore, they recommend removal of the Back Creek from the 303(d) List for impairment by As, Cd, and Ag. However, this study did verify sediment toxicity to aquatic life.

*Restoration/Preservation*

There are several small Green Infrastructure hubs in this watershed (DNR, 2000-2003), some protected by federal land (Canal National Wildlife Refuge, Welch Point Managed Hunting Area, Bethal Managed Hunting Area, Elk Forest Managed Hunting Area, and small County-owned properties). An unprotected hub is located in the far northeastern portion of the watershed. Since some Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation.

According to the 2000 Maryland Greenways Commission document, a proposed recreational greenways is Chesapeake and Delaware Canal Greenway. The Chesapeake and Delaware Canal Greenway is a planned greenway linking Welch Point Managed Hunting Area, Elk Forest Wildlife Management Area, Canal National Wildlife Refuge, and Bethel Managed Hunting Area. The U.S. Army Corps of Engineers currently holds ownership to substantial tracts of land along the canal.

There is one proposed State-designated Wetland of Special State Concern west of Canal National Wildlife Refuge Area (south of Chesapeake City), that is unprotected.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

### Little Elk Creek (02130605)

#### *Background*

The Little Elk Creek watershed is located in the northeast portion of Cecil County and into Pennsylvania. A small part of Elkton City lies within the watershed. Based on MDP 2002 GIS land use data, the Cecil County portion of Little Elk Creek watershed has 37 acres of open water and 15,675 acres of land. The land acres are divided as follows: urban 3,661 acres (23%), agriculture 6,862 acres (44%), forest 5,082 acres (32%), and wetlands 70 acres (<1%) (Figure 9). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

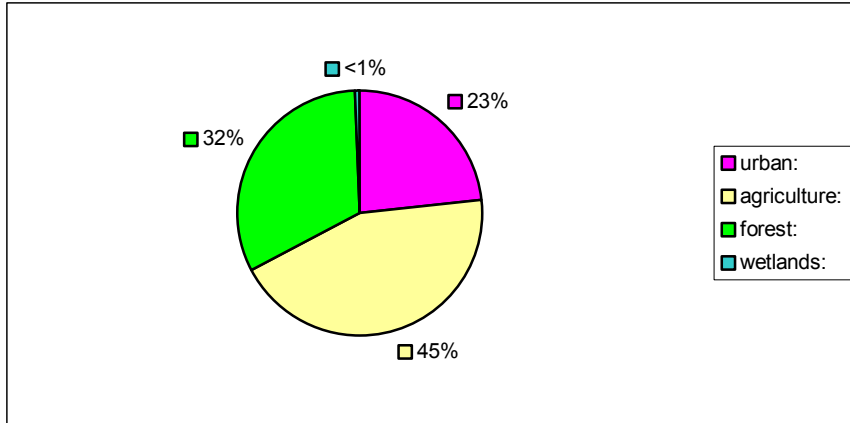


Figure 9. Land use in the Little Elk Creek watershed.

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

- Palustrine
  - Emergent: 70 acres
  - Scrub shrub: 18 acres
  - Forested: 103 acres
  - Unconsolidated bottom: 63 acres
- Riverine unconsolidated shore: 1 acre
- Total: 255 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)
02130605	-0.47	0.21	0	0	-0.25

*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 this watershed, they are designated as Use I, recreation contact and protection of aquatic life.

*Water Quality*

A sourcewater assessment for Forest Green Court Mobile Home Park, withdrawing from an unconfined aquifer, found a moderate susceptibility to radon-222 and a low susceptibility to VOCs, SOCs, inorganic compounds, other radionuclides, and microbiological contaminants.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Failing indicators include high nitrogen loading and high soil erodibility (0.34). Wetland loss was estimated to be 6,577 acres. Indicators for Category 3 include a high amount of wetland-dependent species.

According to the 2002 305(b) report, a portion of the wadeable creek and tributaries fail to support all designated uses due to poor biological community from channelization. The remaining portion of the wadeable creeks and tributaries fully support all uses (6 miles) or were inconclusive (2 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:

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Little Elk Creek* (021306050382 non-tidal); poor biological community.
- *West Branch Laurel Run* (021306050383 non-tidal); poor biological community.

#### *Restoration/Preservation*

There are two small Green Infrastructure hubs located west of Elkton and a few corridors running east/west (DNR, 2000-2003). These areas are unprotected, with the exception of a small County-owned property. Since some areas within the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these areas to natural vegetation. One park area is part of the Fair Hill Natural Resource Area.

The Tri-State Greenways is a potential wildlife corridor along the Mason-Dixon line that would connect three large parcels of publicly-owned land in three States: Maryland's Fair Hill Natural Resources Management Area (5,622 acres), Delaware's Walter Carpenter State Park (707 acres), and Pennsylvania's White Clay Creek Preserve (1,251 acres). Possible recreation corridors are also being considered. Future connections in Delaware to Middle Run Natural Area and the Delaware Greenways system along Delaware Bay offer high potential use. A westward connection down Rte. 273 in Cecil County, currently identified as a Maryland Scenic Route, could link this greenways to the Octoraro Creek and Susquehanna River Greenways (2000 Maryland Greenways Commission document).

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Fair Hill Rural Legacy Area includes approximately 16,045 acres. This area is currently largely undeveloped (78%), but is also the most heavily traveled and rapidly developing due to its proximity to the I-95/Rt. 40 corridor. This area was chosen in order to protect contiguous areas of productive agriculture, rural area, and wildlife habitat, and to improve water quality in the watersheds Big and Little Elk Creek, and buffering/expanding the State-owned Fair Hill Natural Resource Management Area. The goal is to protect 12,034 acres (75%).

Currently, 7,317 acres (46%) of this land is protected through various methods. The sponsor is Fair Hill. 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 State-designated Nontidal Wetlands of Special State Concern in this watershed.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the Little Elk Creek and tributaries.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect land designated Rural Legacy Area.
- Protect wetlands and streams within the headwaters.

### Big Elk Creek (02130606)

#### *Background*

Big Elk Creek watershed is located in the northeastern part of Cecil County, with portions in Pennsylvania. The largest city in the watershed is Elkton. Based on MDP 2002 GIS land use data, the Cecil County portion of the Big Elk Creek watershed has 10,933 acres of land. The land acres are divided as follows: urban 1,740 acres (16%), agriculture 4,796 acres (44%), forest 4,357 acres (40%), and wetlands 40 acres (<1%) (Figure 10). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.



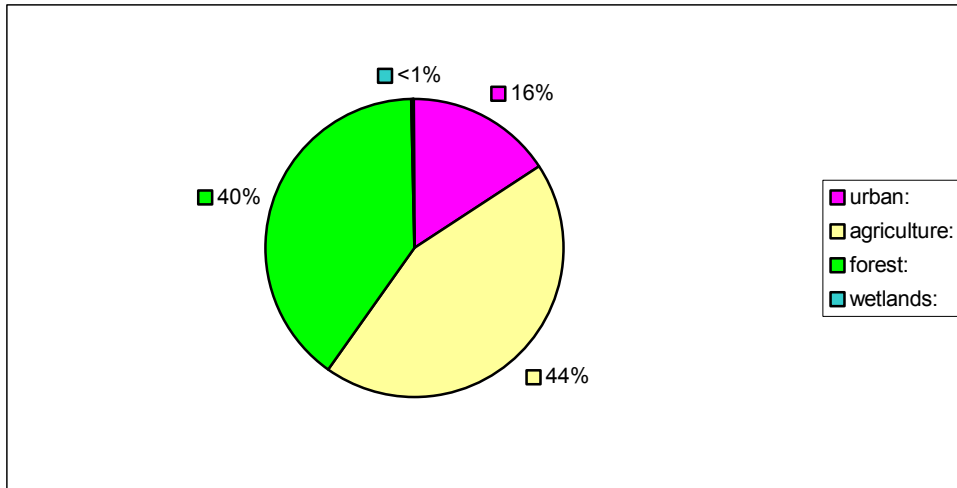


Figure 10. Land use in the Big Elk Creek watershed.

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

- Palustrine
  - Emergent: 41 acres
  - Scrub shrub: 8 acres
  - Forested: 85 acres
  - Unconsolidated bottom: 13 acres
- Riverine unconsolidated shore: 4 acre
- Total: 151 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)
02130606	-1.71	3.66	0	0.45	2.40

*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 this watershed, they are designated as Use IP, recreation contact, protection of aquatic life, and potable water supply.

*Water Quality*

The 1998 Clean Water Action Plan classified this watershed as Category 3, a pristine or sensitive watershed in need of protection. Wetland loss was estimated to be 5,350 acres. Indicators for Category 3 include high non-tidal instream habitat index, high non-tidal fish index of biotic integrity (FIBI), and a high amount of wetland-dependent species.

According to the 2002 305(b) report, the wadeable creek and 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:

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Big Elk Creek* (021306060386 non-tidal); poor biological community.

#### *Restoration/Preservation*

There are two large Green Infrastructure hubs in this watershed, a northern hub around Fair Hill Natural Resource Management Area and a southern hub on the northern part of Elkton, and smaller corridors connecting the hubs (DNR, 2000-2003). The northern hub is mostly protected (Fair Hill NRMA) but the southern hub is unprotected. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation. According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Elk Creek Greenway*. The Elk Creek Greenways is a potential greenways between Fair Hill Natural Resource Management Area and the town of Elkton's John Stanley Meadow Park. While most of the land along the corridor is privately owned, routes other than alongside the Big Elk Creek offer strong potential.
- *Tri-state Greenway*. The Tri-State Greenways is a potential wildlife corridor along the Mason-Dixon line that would connect three large parcels of publicly owned land in three States: Maryland's Fair Hill Natural Resources Management Area (5,622 acres), Delaware's Walter Carpenter State Park (707 acres), and Pennsylvania's White Clay Creek Preserve (1,251 acres). Possible recreation corridors are also being considered.

Future connections in Delaware to Middle Run Natural Area and the Delaware Greenways system along Delaware Bay offer high potential use. A westward connection down Rte. 273 in Cecil County currently identified as a Maryland Scenic Route, could link this greenways to the Octoraro Creek and Susquehanna River Greenways (2000 Maryland Greenways Commission document).

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Fair Hill Rural Legacy Area includes approximately 16,045 acres. This area is currently largely undeveloped (78%), but is also the most heavily traveled and rapidly developing due to its proximity to the I-95/Rt. 40 corridor. This area was chosen in order to protect contiguous areas of productive agriculture, rural area, and wildlife habitat, and to improve water quality in the watersheds Big and Little Elk Creek, and buffering/expanding the State-owned Fair Hill Natural Resource Management Area. The goal is to protect 12,034 acres (75%). Currently, 7,317 acres (46%) of this land is protected through various methods. The sponsor is Fair Hill. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural

Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are several proposed State-designated Nontidal Wetlands of Special State Concern. While most are within Fair Hill Natural Resource Management Area, there are two just south, that are unprotected.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along Big Elk Creek, Gramies Run, and the large hub around Elkton.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect land designated as Rural Legacy Area.
- Protect wetlands and streams within the headwaters.

### Christina River (02130607)

#### *Background*

This watershed is located in the northeastern corner of Cecil County. It borders Delaware, in the east and Pennsylvania in the north. This is one of the few watersheds in the State that does not drain into the Chesapeake Bay, as it instead drains into the Delaware River. This watershed is within the Piedmont Plateau Province and the Coastal Plain Province. Based on MDP 2002 GIS land use data, the Cecil County portion of the Christina River watershed has 5,217 acres of land. The land acres are divided as follows: urban 1,532 acres (29%), agriculture 2,542 acres (49%), and forest 1,143 acres (22%) (Figure 11). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

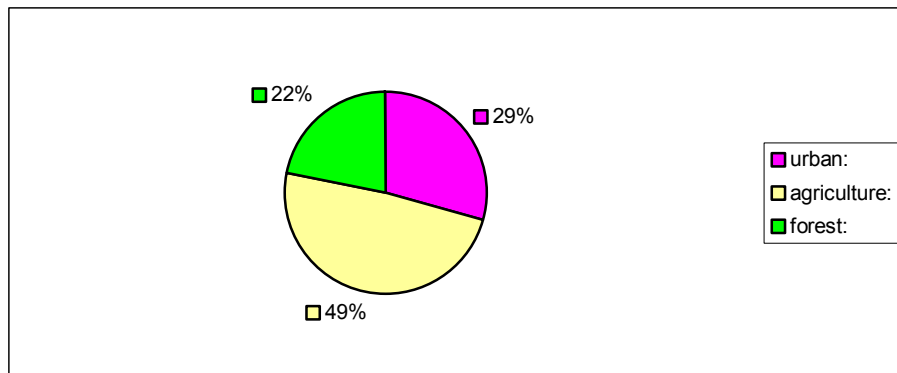


Figure 11. Land use in the Christina River watershed.

Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Maryland.  
 May 18, 2006 - Maryland Department of the Environment

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

- Palustrine
  - Emergent: 5 acres
  - Scrub shrub: 4 acres
  - Forested: 36 acres
  - Unconsolidated bottom: 32 acres
- Total: 77 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)
02130607	-1.16	0.87	0	0	-0.29

*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 this watershed, they are designated as Use I, recreation contact and protection of aquatic life.

*Water Quality*

The 1998 Clean Water Action Plan classified this watershed as Category 2, a watershed meeting clean water and other natural resource goals. It had high soil erodibility (0.35), estimated historic wetland loss of 1,928 acres, and presence of trout spawning areas.

According to the 2002 305(b) report, the wadeable river and 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:

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *West Branch* (021306070381 non-tidal); poor biological community.

EPA established the Christina River Basin low-flow TMDLs in 2001. After discovering errors in the original flow rates calculations for several facilities, a revised TMDL was completed in 2002.

*Restoration/Preservation*

There are portions of two large Green Infrastructure hubs in this watershed, one around Fair Hill Natural Resource Management Area (protected) and one on the northern part of

Elkton (unprotected) (DNR, 2000-2003). According to the 2000 Maryland Greenways Commission document, an existing greenway is called Tri-state Greenway.

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Fair Hill Rural Legacy Area includes approximately 16,045 acres. This area is currently largely undeveloped (78%). This area was chosen in order to protect contiguous areas of productive agriculture, rural area, and wildlife habitat, and to improve water quality in the watersheds Big and Little Elk Creek. The goal is to protect 12,034 acres (75%). Currently, 7,317 acres (46%) of this land is protected through various methods. The sponsor is Fair Hill. 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 State-designated Nontidal Wetlands of Special State Concern in this watershed.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected.
- Protect designated Rural Legacy Area.
- Protect wetlands and streams within the headwaters.

### Northeast River (02130608)

#### *Background*

Northeast River watershed is located in the extreme reaches of the Maryland portion of the upper Chesapeake Bay watershed. Portions of this watershed are also located in Pennsylvania. The two main cities are Charleston and North East. Based on MDP 2002 GIS land use data, the Cecil County portion of the Northeast River watershed has 4,037 acres of open water and 40,367 acres of land. The land acres are divided as follows: urban 8,117 acres (20%), agriculture 14,780 acres (37%), forest 17,242 acres (43%), wetlands 51 acres (<1%) and barren land 178 acres (<1%) (Figure 12). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

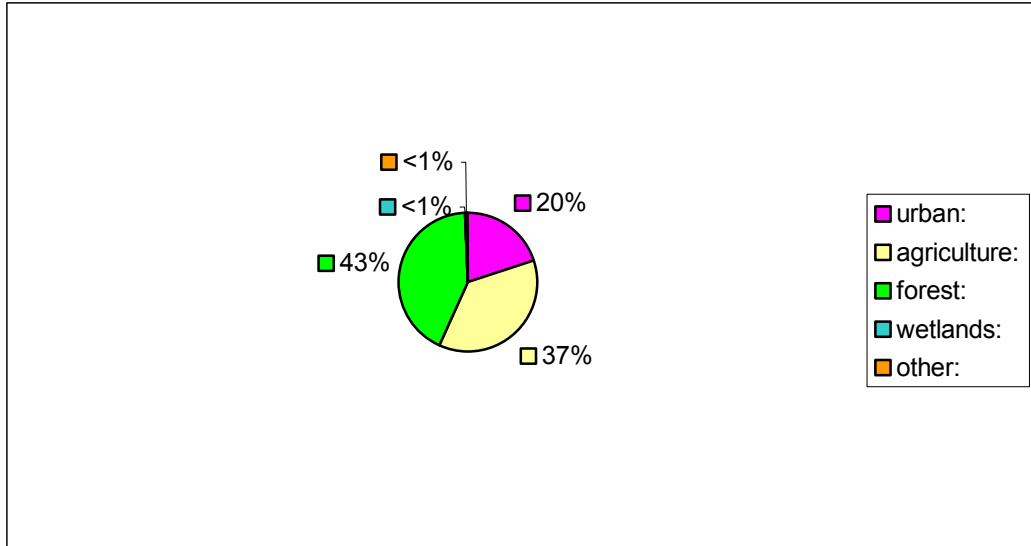


Figure 12. Land use in the Northeast River watershed.

The Northeast River is tidal (fresh) as far north as the Town of North East (about 5.9 miles) where the head of tide intersects the fall line at the confluence of two major streams, the Northeast Creek and the Little Northeast Creek. The fall line intersects most of the central watershed, transversing both the Northeast Creek to the west, and Little Northeast Creek to the east. The tidal segment of the Northeast River differs from a true estuary in that for the majority of the year there is little intrusion of salt from the lower Chesapeake. This atypical tidal exchange produces unusual salinity distributions within the Northeast River. The area has steep slopes. The waterway is depositional in nature in the tidal zone due to the steep topography, rocky streambed, and drop at the head of tide (at the confluence of Northeast Creek and Little Northeast Creek). The watershed consisting mainly of large farms for animal operations (dairy and beef), with fields for feed production. There are some rural residential areas and the cities of North East and Charlestown (MDE, 2003).

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

- Emergent
  - Emergent: 20 acres
  - Scrub shrub: 3 acres
  - Unconsolidated shore: 32 acres
- Palustrine
  - Emergent: 132 acres
  - Scrub shrub: 91 acres
  - Forested: 405 acres
  - Unconsolidated bottom: 208 acres
  - Unconsolidated shore: 23 acres
- Riverine unconsolidated shore: 9 acres
- Total: 921 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)
02130608	-4.12	1.84	0	0.21	-2.07

#### *Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Northeast Creek and tributaries (above confluence with Stoney Run): Use IP recreation contact, protection of aquatic life, and potable water supply.
- All estuarine portions except those listed below: Use II, shellfish harvesting.
- Northeast River above mouth: Use I recreation contact and protection of aquatic life.

#### *Water Quality*

Source water assessments were completed for several water supplies within this watershed. The water supply name and susceptibility are as follows:

- *Carpenter’s Point* (unconfined aquifer): none
- *Town of Charlestown* (semi-confined aquifer): VOCs
- *Bay County Estates Mobile Home Park* (unconfined aquifer): moderate susceptibility – VOCs; low susceptibility – SOCs, inorganic compounds, radionuclides, microbiological contamination.
- *Stoney Chase/Rock Creek Mobile Home Parks* (unconfined aquifer): moderate susceptibility – VOCs, radon-222, coliform bacteria; low susceptibility – SOCs, other radionuclides, inorganic compounds.
- *Town and Country Mobile Home Park* (unconfined aquifer): moderate susceptibility – VOCs, SOCs, radon-222; low susceptibility – inorganic compounds, other radionuclides, microbiological contaminants.
- *Chestnut Point Estates Mobile Home Park* (unconfined aquifer): low susceptibility – VOCs, SOCs, inorganic compounds, radionuclides, microbiological contaminants.
- *Cecil Woods Mobile Home Park* (unconsolidated aquifer): moderate susceptibility – VOC, radon-222; low susceptibility – inorganic compounds, SOC, other radionuclides, microbiological contaminants.

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 poor SAV abundance

and habitat index, poor non-tidal benthic index of biotic integrity (BIBI), and high soil erodibility (0.31). Wetland loss was estimated to be 16,056 acres. Indicators for Category 3 include high non-tidal instream habitat index, high non-tidal fish index of biotic integrity (FIBI), high imperiled aquatic species indicator, migratory fish spawning areas, and the presence of two drinking water intakes.

According to the 2002 305(b) report, the tidal embayment and tributaries fail to support all uses due to nutrients, high pH, and poor benthic community from natural sources and eutrophication. A portion of the nontidal wadeable tributaries (9 miles) fails to support all designated uses due to poor biological community. Of the remaining nontidal wadeable tributaries, a portion fully supports all uses (9 miles) while the other portion has inconclusive data (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:

*Elk River* (021306 tidal); PCBs (in fish tissue).

*Northeast River* (tidal); lead, zinc, nutrients, sediments.

A TMDL was completed for nitrogen and phosphorus in the Northeast River. This waterway had eutrophication and high chlorophyll a. Sources of total nitrogen are point source (13%), urban (31%), forest/herbaceous (6%), direct atmospheric deposition (<1%), and agriculture (49%). Sources of total phosphorus are point source (14%), urban (25%), forest/herbaceous (1%), direct atmospheric deposition (<1%), and agriculture (60%). Point sources are Northeast River WWTP and Morning Cheer WWTP, both discharging into the Northeast River. Although DO concentrations were above the required 5.0 mg/l in 1999 daylight samples, high concentrations of Chl<sub>a</sub> suggest the possibility of low DO concentrations from diurnal variations in oxygen due to algal respiration during non-daylight hours. These amounts do not satisfy the minimum water quality requirements of COMAR's designated use for this waterway. Water sampling found high chlorophyll a throughout the tidal portion. Low dissolved inorganic nitrogen and low dissolved inorganic phosphorus was present at all sampling stations, except at the mouth of the river and at the nontidal station (just upstream of the tidal portion). The suspended sediment, zinc, lead, and biological impairments will be addressed later.

A Draft WQA was completed for zinc in the Northeast River (MDE, 2005c). Since this analysis found that zinc did meet the water quality standards, they recommend the removal of zinc from the 303(d) List for the Northeast River.

#### *Restoration/Preservation*

There are portions of large Green Infrastructure hubs in the southern part of the watershed, around the Northeast River, and connecting corridors (DNR, 2000-2003). These are unprotected except areas of Elk Neck State Forest and a small County-owned property. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation. According to the 2000



Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Elk Neck Peninsula Greenway.*
- *Northeast Creek Greenway.* The Northeast Creek Greenways is a potential greenways along Northeast Creek. The town of North East is planning a trail system to link the community park to the downtown business district and continue north along the creek. Establishment of this greenways would protect water quality, wildlife, and fish spawning sites in Northeast Creek. The greenways would include the historic covered bridge at Gilpin's Falls and connect to an established trail at Cecil Community College. Plans for this trail will include acquisition and easements through targeted development areas.

The following information is based on the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. The Fair Hill Rural Legacy Area includes approximately 16,045 acres. This area is currently largely undeveloped (78%). This area was chosen in order to protect contiguous areas of productive agriculture, rural area, and wildlife habitat, and to improve water quality in the watersheds Big and Little Elk Creek. The goal is to protect 12,034 acres (75%). Currently, 7,317 acres (46%) of this land is protected through various methods. The sponsor is Fair Hill. 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 Wetlands of Special State Concern in this watershed and one potential WSSC.

- *Cameron Beach.* This site is on the border of Sandy Cove Camp and is unprotected.
- *Charlestown West Seeps.* This site is a complex of seepage wetland, pond, and stream system containing a diverse vegetative community and a State Endangered plant species (listed as Threatened in the U.S. Endangered Species Act) (DNR, 1991). This area is unprotected. The main threat is from mining, development, forest clearing, alteration of hydrology, and direct human removal (through plant collections) (McCarthy et al., 1988).
- *Whitaker Swamp.* This high water-quality seepage wetland contains mature forest, good water quality, and two State Endangered plant species (one listed as Threatened under the U.S. Endangered Species Act and the other a candidate for listing) and one uncommon plant species (DNR, 1991). This area is unprotected. The main threats include from mining (there is a nearby surface mining operation), logging, alteration of hydrology, trash, and beaver activity (McCarthy et al., 1988).
- There is several potential WSSCs, located in the northern half of this watershed, all unprotected. These are located east of Whitaker Swamp, along Wheatley Road, around the intersection of Rte. 272 and Rte. 273, and northeast of Cecil Community Center Park.

Existing Recommendations for Restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore/create wetlands designed to remove nitrogen and phosphorus from the Northeast River.
- Restore wetlands and streams within the headwaters.

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the waterways and large hubs.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect Rural Legacy Areas.
- Protect wetlands that function to remove nitrogen and phosphorus from the Northeast River.
- Protect wetlands and streams within the headwaters.

Furnace Bay (02130609)

*Background*

The Furnace Bay watershed is located in western Cecil County. The largest cities are the eastern portions of Perryville and Port Deposit. We are basing our watershed calculations on the most recent DNR 8-digit watershed delineation, having different borders for this watershed than the previous version. Based on MDP 2002 GIS land use data the Furnace Bay watershed has 478 acres of open water and 13,622 acres of land. The land acres are divided as follows: urban 2,182 acres (16%), agriculture 5,520 acres (41%), forest 5,840 acres (43%), wetlands 42 acres (<1%) and barren land 37 acres (<1%) (Figure 13). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

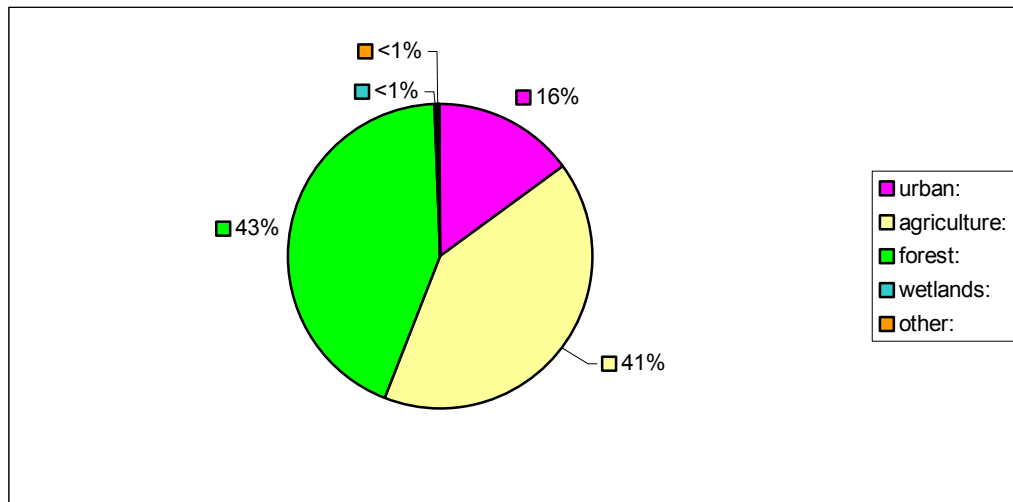


Figure 13. Land use in the Furnace Bay watershed.

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

- Emergent
  - Emergent: 26 acres
  - Scrub shrub: 2 acres
  - Unconsolidated shore: 93 acres
- Palustrine
  - Emergent: 26 acres
  - Scrub shrub: 19 acres
  - Forested: 50 acres
  - Unconsolidated bottom: 122 acres
  - Unconsolidated shore: 13 acres
- Riverine unconsolidated shore: < 1 acre
- Total: 353 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)
02130609	-1.54	1.79	0	0	0.25

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Principio Creek and tributaries: Use III natural trout waters.
- All estuarine portions: Use II, shellfish harvesting.

*Water Quality*

Source water assessments were completed for several water supplies within this watershed. The water supply name and susceptibility are as follows:

- *Woodlawn Mobile Home Park* (unconfined aquifer): high susceptibility - radon-222; moderate susceptibility – VOCs, coliform bacteria; low susceptibility – SOCs, other radionuclides, inorganic compounds.
- *Misty Meadows II Mobile Home Park* (unconfined aquifer): moderate susceptibility – VOCs; low susceptibility – SOCs, inorganic compounds, microbiological contaminants, radionuclides.

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. Wetland loss was estimated to be 2,260 acres. Indicators for Category 3 include migratory fish spawning areas and a high percent of headwater streams in Interior Forest.

According to the 2002 305(b) report, the tidal embayment and tributaries fully support all uses. The nontidal wadeable tributaries fail to support all designated uses due to poor biological community.

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

- *Elk River* (021306 tidal); PCBs (in fish tissue).
- *Furnace Bay* (non-tidal); nutrients, sediments.
- *Principio Creek* (021306090380); poor biological community.

#### *Restoration/Preservation*

There are some Green Infrastructure hubs in the southern portion of the watershed, and small Green Infrastructure corridors (DNR, 2000-2003), unprotected except for a few METs. Main park areas are around Farmington Airport and the Whitaker Wildlife Management Area.

According to the 2000 Maryland Greenways Commission document, two proposed greenways include:

- The Lower Susquehanna Heritage Greenway.
- Principio Creek Greenway. The Principio Creek Greenway is a potential wildlife corridor and passive greenway along Principio Creek. Portions of the creek have been identified as a Class III trout stream. Continued protection of a minimum 300-foot wooded buffer would maintain wildlife habitat and water quality. Acquisition during development may be feasible as a large portion of the basin is under single, private ownership. An agreement will be necessary to protect this area prior to development. This corridor could connect to the Lower Susquehanna Heritage Greenways.

There are no designated Nontidal Wetlands of Special State Concern (WSSC). However, there are five potential WSSC in this watershed, all unprotected. These are located along the CSX Railroad, north of the Chesapeake House Service Area, south of the town of Principio, and on the eastern side of Port Deposit.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways and large hubs.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

### Sassafras River (02130610)

#### *Background*

This watershed is in the southern part of Cecil County, within the Coastal Plain province. Portions of this watershed are also located in Kent County, Maryland and in Delaware. Based on MDP 2002 GIS land use data, the Cecil County portion of the Sassafras River watershed has 3,619 acres of open water and 17,216 acres of land. The land acres are divided as follows: urban 682 acres (4%), agriculture 11,629 acres (68%), forest 4,702 acres (27%), and wetlands 203 acres (1%) (Figure 14). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

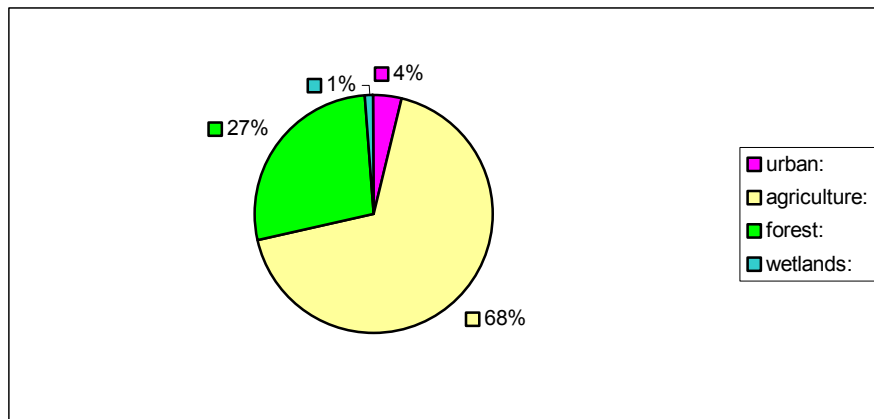


Figure 14. Land use in the Sassafras River watershed.

There are extensive freshwater tidal marshes located along meandering portions or on alluvial deposits along the Sassafras River (Sipple, 1999).

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

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

- Estuarine
  - Emergent: 451 acres
  - Scrub shrub: 49 acres
  - Unconsolidated shore: 397 acres
- Palustrine

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- Aquatic bed: 3 acres
- Emergent: 253 acres
- Scrub shrub: 244 acres
- Forested: 1,047 acres
- Unconsolidated bottom: 419 acres
- Farmed: <1 acre
- Total: 2,864 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)
02130610	-0.33	0	0	0.36	0.03

*Code of Maryland Regulations*

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Sassafra River and tributaries (above Ordinary Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

*Water Quality*

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resources goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. Failing indicators include a high monitored nutrient concentrations, high modeled phosphorus loading, poor SAV abundance, poor SAV habitat index, high soil erodibility (0.28), and being on the 303(d) List for water quality impairment. Indications for Category 3 include six migratory fish spawning areas.

According to the 2002 305(b) report, the tidal mainstem and tributaries fail to support all uses due to dieldrin, PCBs, nutrients, and high pH from natural sources, eutrophication, and unknown sources. Nontidal wadeable tributaries had inconclusive data.

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

- *Elk River* (021306 tidal); PCBs (in fish tissue).

- *Sassafras River* (tidal) sediments, PCBs (in fish tissue). A TMDL has been completed for nutrients in this waterway.
- *Woodland Creek Unnamed Tributary* (021306100355 non-tidal in Kent County); poor biological community.
- *Swantown Creek* (021306100357 non-tidal in Kent County); poor biological community.
- *Duffy Creek* (021306100357 non-tidal in Cecil County); poor biological community.

In 2002, a Total Maximum Daily Load (TMDL) was completed for phosphorus in the Sassafras River. The Sassafras River drains to the Chesapeake Bay and is part of the Upper Eastern Shore Tributary Strategy Basin. The Sassafras River was identified on the State's 1996 list of Water Quality Limited Segments (WQLSs) as being impaired by nutrients and suspended sediments. The suspended sediment impairment will be addressed at a later date. Limits are established for phosphorus because phosphorus is the nutrient that limits algal growth. The water quality goal of the TMDL is to reduce high chlorophyll *a* concentrations (a surrogate for algal blooms) and to maintain the dissolved oxygen criterion at a level where the designated uses for the Sassafras River will be met (MDE, 2002b).

#### *Restoration/Preservation*

There are a number of Green Infrastructure hubs throughout the watershed, with the largest along the mouth of the Sassafras River (DNR, 2000-2003). This hub is partially protected by Groves Neck Wildlife Sanctuary and several large METs. There is still a fair amount of unprotected Green Infrastructure hub land. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation.

The following information is summarized from the document entitled *Rural Legacy FY 2003: Applications and State Agency Review*. Within the Sassafras watershed lies a portion of the Marshyhope-Sassafras-Tuckahoe area, 36,100 acres in total. This Rural Legacy Area (RLA) combines three focus areas, the Marshyhope, Sassafras, and Tuckahoe areas, into one large Rural Legacy Area. In 1994 the corridor concept was developed to focus local, regional, and national efforts on one of the largest, contiguous blocks of highly productive farmland in the rapidly developing mid-Atlantic. Safeguarding the agricultural economy of the Eastern Shore is the goal of the three Agricultural Security Corridor focus areas. Located north and south of Federalsburg, the Marshyhope area is defined by an important river corridor, prime farms soils, a concentration of stable farm support businesses and an extensive public investment in farm preservation easements. The portion of the Agricultural Security Corridor within this watershed is the Sassafras Rural Legacy Area. The sponsors include Eastern Shore Rural Legacy Sponsor Board and Eastern Shore Land Conservancy, Inc. There are 5,210 acres of land in the Cecil County portion (based on GIS data), including 781 acres protected. The Sassafras area includes the Sassafras Natural Resource Management Area of Bloomfield Farm. The area is contiguous to thousands of acres of donated easements

and existing agricultural easements and districts. It is rich in natural resources and historic farm structures dating from the 18th Century. The Tuckahoe area is located west and south of Denton. All three focus areas serve as an anchor for agricultural production and investment, buffering and enhancing the region's natural, cultural, and open space priorities. The goals include protecting agricultural land and natural resources, including protecting the water quality of the Sassafras River and other waters, and wildlife habitats. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Since the Rural Legacy Program funds are not always adequate enough to support all of these requests, other programs should consider preservation of these sites.

There is one State-designated Wetland of Special State Concern, called Grove Neck Natural Heritage Area. This site is located along the Sassafras River, between Grove Point and Ordinary Point. Only a small portion of this area is protected by METs. Since it was also designated as a Natural Heritage Area, it must contain threatened or endangered species and be the best Statewide examples. This area should be high priority for protection.

Existing Recommendations for Restoration:

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

Existing Recommendations for Preservation:

- Protect portions of Green Infrastructure that are not currently protected, especially along the Sassafras River and waterways.
- Protect WSSC and their buffers.
- Protect additional wetland areas within State-designated Ecologically Significant Areas.
- Protect Rural Legacy Area.
- Protect wetlands that function to remove phosphorus and sediment from the Sassafras River.
- Protect wetlands and streams within the headwaters.

Upper Chesapeake Bay (02139996)

Based on MDP 2002 GIS land use data the Cecil County portion of the Upper Chesapeake Bay watershed has 22,277 acres of open water and 23 acres of land. The land acres are divided as follows: urban 12 acres (53%), forest 8 acres (36%), and wetlands 2 acres (10%). Since MDP estimates of wetland acreage are often underestimated, DNR wetland data estimates, as described later in this document, are preferred.

According to the 2002 305(b) report, the upper mainstem bay fully supports all uses.



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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:

- *Upper Chesapeake Bay* (tidal); nutrients.