



CECIL COUNTY, MARYLAND

GREEN INFRASTRUCTURE PLAN



CECIL COUNTY, MARYLAND

Green Infrastructure Plan



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CECIL COUNTY, MARYLAND

Green Infrastructure Plan

EXECUTIVE SUMMARY

Green infrastructure is our natural life support system – an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife. The Conservation Fund has completed a Green Infrastructure Plan for Cecil County, Maryland. Based on the approach outlined in *Green Infrastructure: Linking Landscapes and Communities* (Benedict and McMahon, 2006), the Fund undertook a series of tasks to help Cecil County identify and protect its critical green infrastructure. Using the Fund's green infrastructure approach to strategic conservation, the plan includes four key products:

Green Infrastructure Network Design —

The Fund updated the green infrastructure hub and corridor network developed originally by the Maryland Department of Natural Resources in its statewide Green Infrastructure Assessment (Weber, 2003; Weber et al., 2006). The updated network, which represents 37% of the county's land, includes 75% of the county's forest land and 94% of its wetlands. The updated network takes into account recent land use change and includes a hub ranking system and new corridor connections where development and fragmentation had removed other linkages. 39 of 46 hubs entirely or partially within Cecil County were affected by development between 1992 and 2002. 36 corridor or hub connections were broken by development, including almost all those north of Interstate 95. Only 23% of the updated network is some form of protected status,

leaving over 63,000 acres currently unprotected. More importantly, much of the green infrastructure is found in areas currently designated for growth. The green infrastructure network identifies and prioritizes the areas of greatest ecological importance within the county's natural ecosystems and provides a scientifically defensible framework for green infrastructure protection countywide.

Water Quality Maintenance and Enhancement Analysis —

The Fund examined the relationship between land cover, impervious surface and water quality and found that the green infrastructure network is a major source of clean water in the county. The analysis found that water quality was highest in watersheds with less than 7% impervious surface and greater than 50% forest and wetland land cover, areas primarily within the county's green infrastructure hubs. The Fund developed Land Conservation and Reforestation models that identify protection and restoration opportunities that would best enhance water quality. Conservation strategies were recommended for incorporation into future comprehensive plan objectives, performance zoning standards, and other land use planning tools. The Fund provided additional recommendations on nutrient reduction best management practices for Maryland tributary strategy efforts and guidance on managing total maximum daily load (TMDL) caps. Conservation and Reforestation Focus Watersheds were also identified that could serve as a method to target financial investments of the full array of conservation programs.

Ecosystem Services Assessment — The Fund has completed a comprehensive identification of ecosystem services provided by the county's green infrastructure network. The list of ecosystem services analyzed include:

- Clean air
- Clean water
- Carbon sequestration
- Water supply and hydrologic regulation
- Flood protection and stormwater management
- Erosion control and sediment retention
- Regulation of water temperature
- Wood products
- Fish and wildlife habitat
- Recreation
- Soil and peat formation
- Pest control
- Pollination
- Genetic information and biological diversity
- Savings in community services
- Increase in property values

The assessment found that 81% of the ecosystem service value of the county fell within the network (which covers 37% of the land area) and that the network provided an estimated \$1.7 billion in ecosystem services per year. Large contiguous blocks of forests and wetlands (i.e., green infrastructure hubs) are more likely to contain fully functioning ecosystems, and more likely to provide these corresponding values to humans. The assessment confirmed that protection of these areas is a vital investment.

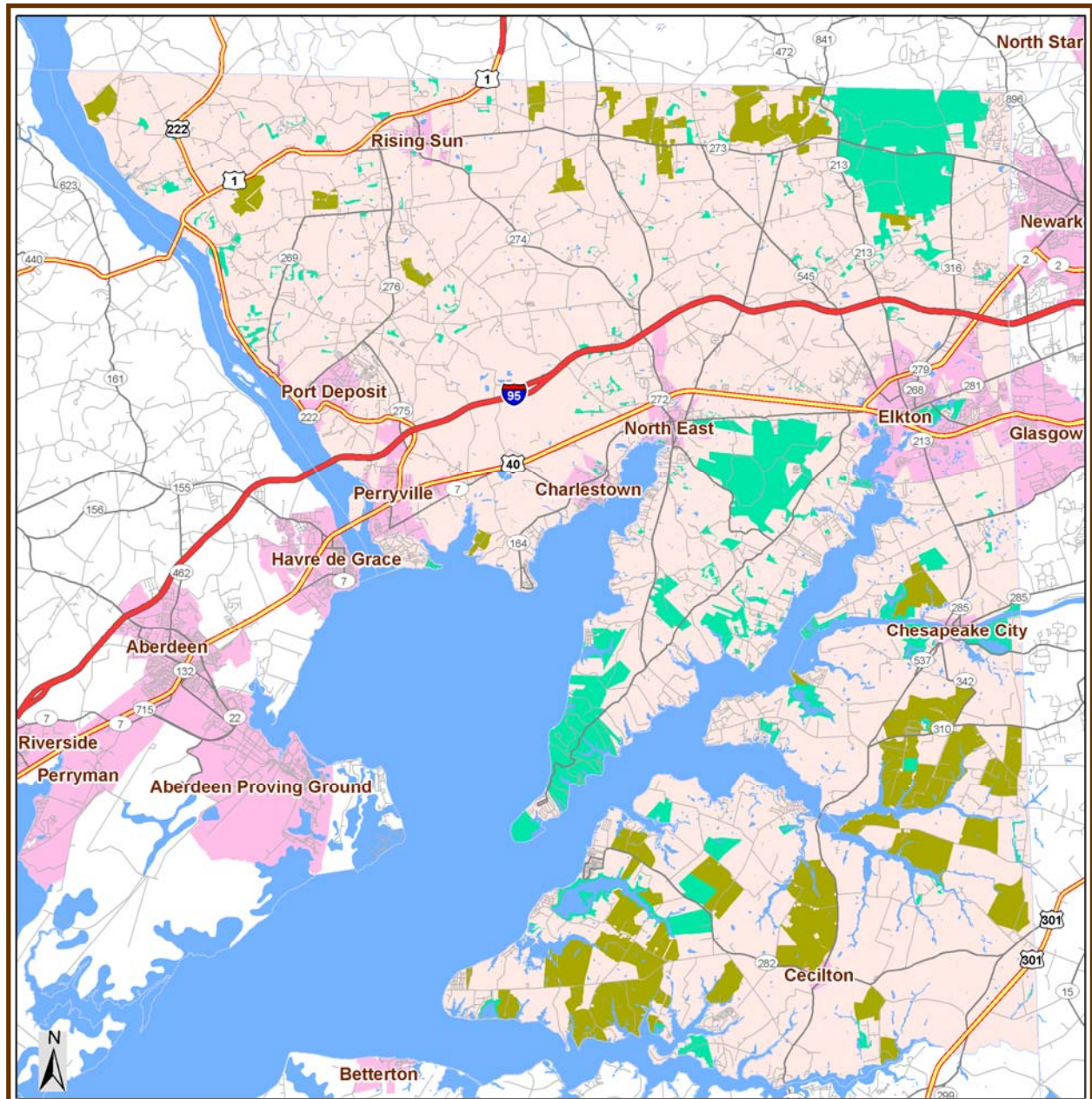
Implementation Quilt Analysis — Utilizing the results from the three products above, the Fund developed an innovative set of policy and funding strategies to advance the protection and

enhancement of the county's green infrastructure. These recommendations include:

- Leverage key state and federal conservation incentive programs.
- Incorporate green infrastructure analysis into landscape and site level land use decisions.
- Develop a green infrastructure tracking and reporting system.
- Initiate a new County department focused on protection of green infrastructure, water quality, and natural resources.
- Explore a potential nutrient trading system.
- Explore new mechanisms for obtaining conservation capital, including a new local transfer tax.
- Foster partnerships and educate the public about green infrastructure.
- Implement identified water quality strategies.

Taken together, this set of products outlines a comprehensive approach to green infrastructure protection in Cecil County. Given recent trends in land use change and the fact that only 23% of the county's green infrastructure network is in some form of protected status, the time is now to evaluate the recommendations in this plan and take tangible steps towards implementation. The Fund identified some opportunities for near-term action in key locations where green infrastructure investments can quickly achieve significant benefits. The illustration of these opportunities provides a useful framework to undertake a comprehensive green infrastructure protection program using the full array of tools available in the Implementation Quilt. Investing in these assets now will help ensure the protection of green infrastructure, water quality, ecosystem services, and the associated benefits of nature to humans for current and future generations. The maps of the following pages provide an introductory overview of Cecil County's green infrastructure.

Cecil County Maryland Green Infrastructure Plan



Cecil County Green Infrastructure Plan

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1:200,000
0 1 2 4 Miles

Cecil County

Towns

Major Roads

Limited Access

Highways

Secondary Roads

Local Roads

Conserved and Managed Lands

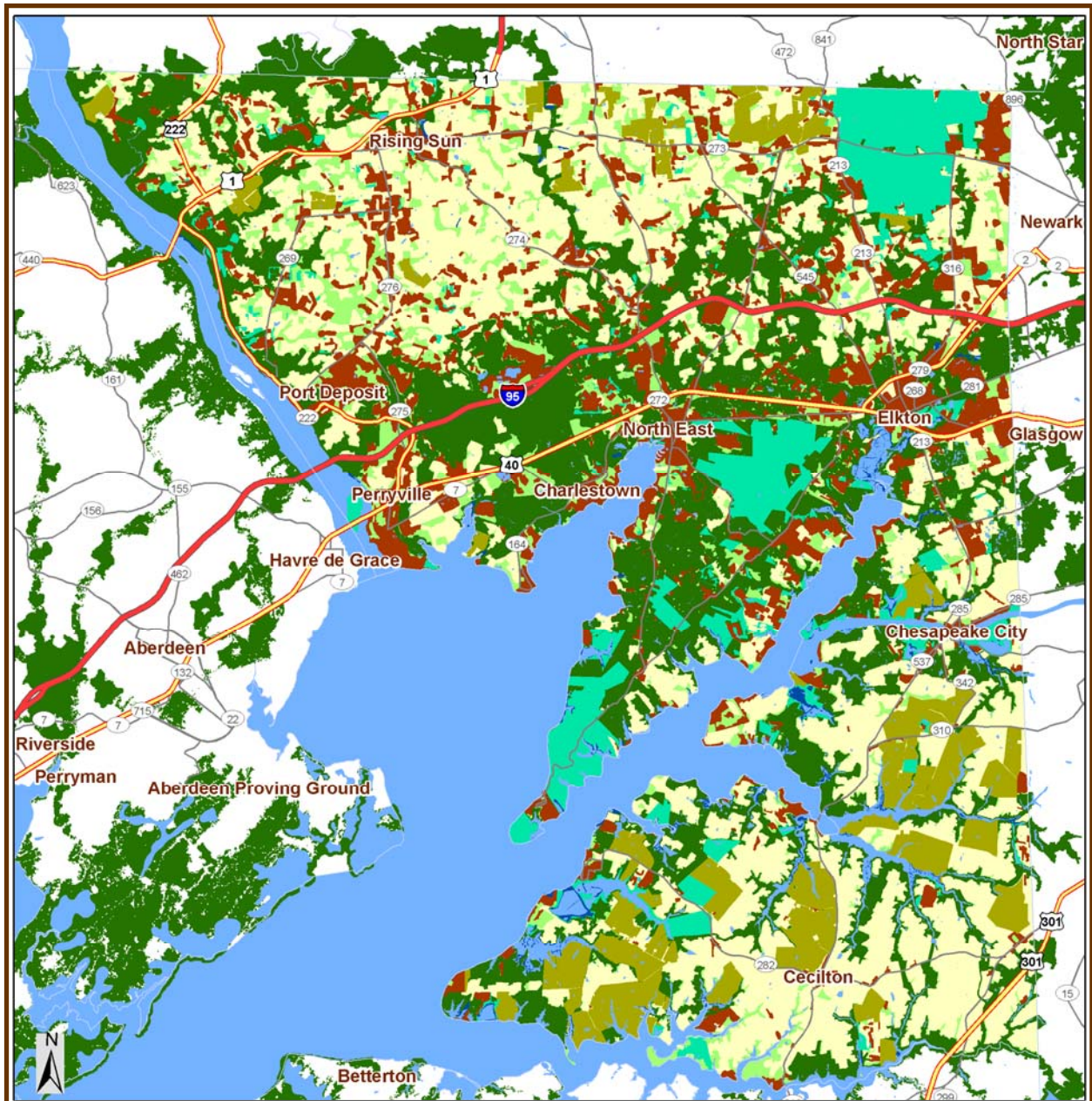
Fed, DNR, Forest Legacy, MET/Co Parks, ESLC, Subdivision OS

Agricultural Easements

MALPF, MET, PDR, Rural Legacy

Hydrography

Chesapeake Bay, Rivers, Creeks, Ponds, Wetlands



Cecil County Green Infrastructure Plan

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Green Infrastructure Network

- Hubs and Corridors
- Conserved and Managed Lands**
- Fed, DNR, Forest Legacy, MET/Co Parks, ESLC, Subdivision OS
- Agricultural Easements**
- MALPF, MET, PDR, Rural Legacy

Cecil Co 2002 Land Use

- Developed, Barren Land
- Forest outside GI Hubs and Corridors
- Agriculture
- Wetlands

GREEN INFRASTRUCTURE NETWORK DESIGN

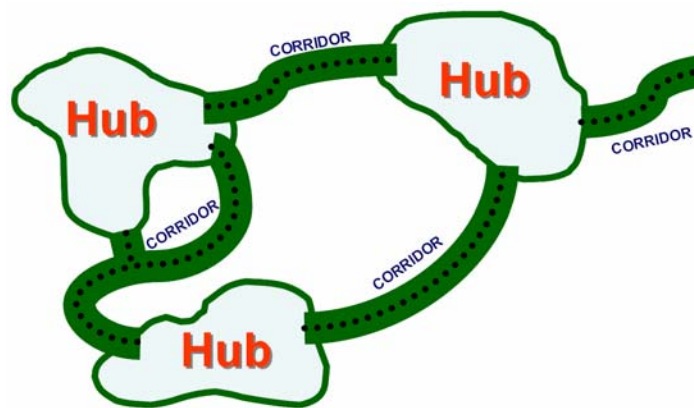
Defining the Network

Green infrastructure is our natural life support system – an interconnected network of natural areas and other open spaces that maintains fully functioning ecosystems, sustains clean air and water, and provides a wide array of benefits to people and wildlife (Benedict and McMahon, 2006). Green infrastructure is also a systematic and strategic approach to land conservation, encouraging land use planning and practices that are beneficial to nature and people. The planning and management of a green infrastructure network can guide the creation of an open space system that supports multiple objectives. Green infrastructure provides a framework that can be used to guide future land development and land conservation decisions to accommodate population growth and protect and preserve community assets and natural resources.

According to Webster's New World Dictionary, infrastructure is defined as "the substructure or underlying foundation, especially the basic installations and facilities on which the continuance and growth of a community or state depends". When we think of infrastructure, we typically think of built (or gray) infrastructure such as roads, electric power lines and water systems, as well as social infrastructure such as schools, hospitals and libraries. However, the concept of green infrastructure elevates air, land, and water to an equal footing with built infrastructure, and transforms open space from "nice to have" to "must have." Protecting and restoring our natural life-support system is a necessity, not an amenity. What gives the term green infrastructure its staying power is its ability to invoke images of planned networks of

green spaces that benefit wildlife and people, link urban settings to rural ones and, like other infrastructure, form an integral part of government programs and budgets.

The basic building blocks of the green infrastructure network are hubs and corridors. Hubs are large unfragmented areas hundreds or thousands of acres in size that contain forest, wetland, and stream systems vital to maintaining ecological health. Hubs include rare or sensitive species locations, unmodified wetlands, interior forest for many species of birds, excellent water quality, and other valuable natural features.



Corridors maintain connectivity in the landscape, and are often linear remnants of natural land such as wooded stream valleys. Corridors thereby allow animals, as well as animal-dispersed seeds and pollen, to move from one area to another. Preserving linkages between the remaining blocks of habitat will ensure the long-term survival and continued diversity of the county's wildlife and plants, which are less likely to persist when isolated by roads and development. Vegetation in streamside or floodplain corridors also stabilizes stream banks and protects water quality. A third element – sites – includes other important natural features that may not be incorporated into the hub and corridor network. Although these features may not be in a large enough block of natural land to constitute a hub, they may still provide valuable ecosystem services or habitat for imperiled

plants or animals. As shown in the Fund's ecosystem service analysis, all forested wetlands and non-forested riparian wetlands provide value and should be protected.

In addition to hubs and corridors, an array of human-oriented land uses complement the green infrastructure network by providing a compatible use buffer between sensitive habitats and more developed landscapes. Such land uses as working farms and forests, recreational trails, scenic vistas, and historic/cultural sites also provide important benefits to human populations. Although even yard and street trees provide some benefits, like shading and air purification, the state's most important natural lands are those that are large and intact enough to provide a full suite of environmental functions.

Cecil County's Green Infrastructure Network

Methods

In order to obtain a more accurate picture of Cecil County's green infrastructure (GI), the Fund updated the hub and corridor network identified by the Maryland Department of Natural Resources in its statewide Green Infrastructure Assessment (Weber, 2003; Weber et al, 2006). The state assessment utilized source data primarily from the early 1990s and thus no longer accurately reflected conditions in the county. The Fund used more recent and higher-resolution data (i.e. 2002 land use and 2005 aerial photography) to identify changes in the landscape and more accurately map the county's hubs and corridors. The Fund also identified linkages to the Delaware Ecological Network (see Weber, 2007) on the eastern border, and to areas of forest in Pennsylvania, to ensure connectivity and long-term ecosystem integrity across county and state boundaries. The Fund also examined land use trends between 1973 and 2002.



Tidal marsh along Plum Creek.

Recent Changes

Based on 2002 land use statistics, forests and wetlands comprised 39% of the county's land, with agriculture comprising 44%, and urban and other developed comprising 16%. We found fast changing conditions and a significant loss of green infrastructure during the past three decades. Cecil County's green infrastructure is shrinking and becoming more fragmented.

Table 1 shows how land use has changed in Cecil County between 1973 and 2002.

Developed area has more than doubled, at the expense of forests, wetlands, and agriculture. Furthermore, the rate of development has been increasing, with more area being converted in recent years.

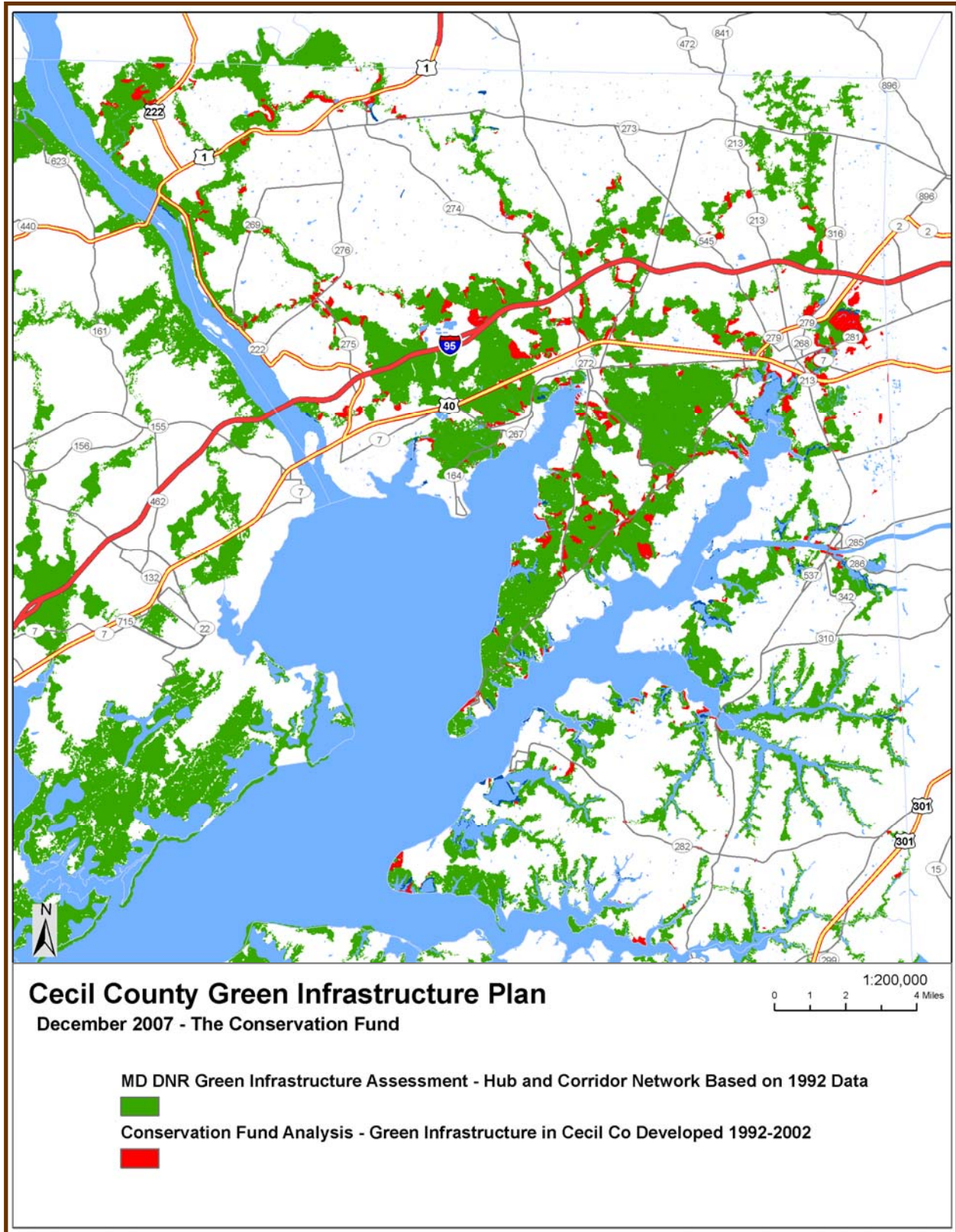
New development approvals continue to fragment the landscape and reduce the value of Cecil County's ecosystem services. Only 17% of new developed area (between 1997 and 2002) fell within town boundaries. About half (52%) of

new development fell within town or designated growth boundaries. Sewer service did not seem to be an issue; only 26% of new development had existing sewer service. The Fund also mapped recent development within the green infrastructure (See map on facing page.) and tabulated its impacts. 39 of 46 hubs entirely or partially within Cecil County (85%) were affected by development between the early 1990s and 2002. Eight of these hubs (17%) were significantly reduced or fragmented. 36 corridor or hub connections were broken by development, including almost all those north of I-95. In many cases, we identified alternate corridors where those identified earlier had been broken. We also found through field investigations, however, that some green infrastructure hubs and corridors had been fragmented since the aerial photography we used was taken in 2005.

TABLE 1: Land use changes in Cecil County, 1973—2002

Category	Acres			% change 1973-2002	% change 1997-2002
	1973	1997	2002		
Developed	15,845	31,077	35,962	127.0%	15.7%
Agriculture	112,729	102,489	98,655	-12.5%	-3.7%
Forest and wetlands	91,259	86,002	84,853	-7.0%	-1.3%

Category	Acres			Average acreage change per year	Average acreage change per year
	1973	1997	2002		
Developed	15,845	31,077	35,962	635	977
Agriculture	112,729	102,489	98,655	-427	-767
Forest and wetlands	91,259	86,002	84,853	-219	-230



Network Characteristics

In our updated analysis, we identified 59 hubs within the GI network totaling approximately 58,725 acres. Hubs in Cecil County range in size from 200 acres to over 11,000 acres, with the median hub size a little over 600 acres. These hubs provide critical habitat for native plants and animals, protect water quality, provide recreational opportunities for humans, and supply an array of ecosystem services. Corridors, totaling approximately 22,894 acres, connect the hubs and preserve linkages between these large unfragmented areas. Corridors vary in width but are generally at least 200 meters wide. In sum, the green infrastructure network encompasses 81,619 acres, or 37% of the county's land (222,969 acres). This 81,619-acre network, based on 2002 land use statistics, includes 75% of the county's forest and 94% of its wetlands.

The Fund also determined that only 23% of the network is currently protected, leaving 63,218 acres unprotected. This lack of protection makes it important to prioritize network elements for their relative value. The Fund examined each hub for qualities such as the area of interior forest, unmodified wetlands, and sensitive species habitat (See Table 2 for complete list). These parameters were then weighted and used to rank each hub according



Red fox in Elk Neck State Park.

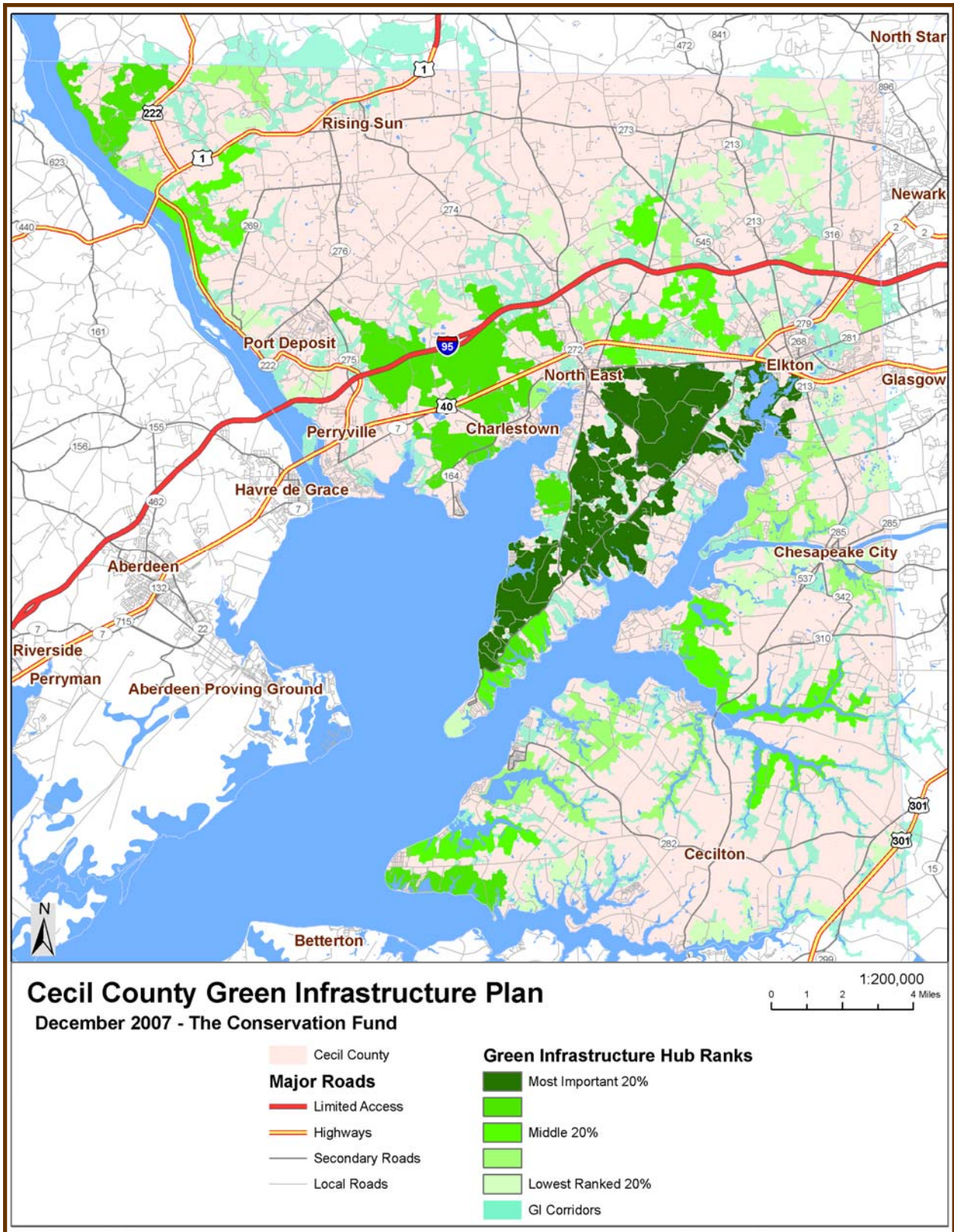
TABLE 2: Parameters used to assess hubs in Cecil County's green infrastructure

Area of sensitive species habitat or sentinel watersheds
Area of interior forest (>30m from edge)
Area of unmodified wetlands
Length of streams and rivers
Percentage in mature and natural vegetation communities
Number of natural vegetation alliances
Maximum modeled vertebrate richness
Mean modeled vertebrate richness
Mean water quality rank
Maximum distance to edge
Mean distance to edge
Area of other GI within 1 km (measurement of connectivity)

to its overall ecological importance relative to other hubs in the county. The map on the facing page shows the updated GI network with hub ecological rankings. Generally, hubs on the Elk Neck ranked the highest. A detailed overview of the hub ranking methods is available in an accompanying technical report (Weber, 2007c).

The Cecil County Comprehensive Plan of 1990 includes a land use plan that presents guidelines for development in the various districts created by the Comprehensive Plan. The plan defines seven land use districts and an overlay zone for the Chesapeake Bay Critical Area. Each district emphasizes a particular intensity of land use or resource and allows a specific mix of development consistent with the principal goal of the district. Unfortunately, the areas identified for growth and development overlap significantly with the location of a large proportion of the county's GI.

Cecil County Maryland Green Infrastructure Plan



WATER QUALITY MAINTENANCE and ENHANCEMENT ANALYSIS

Water Quality Issues in Cecil County

Water quality is a major issue throughout the Chesapeake Bay watershed. Cecil County, Maryland, borders the upper Chesapeake Bay, which is the nation's largest estuary and known for its enormous ecological, economic, and cultural significance. Not only do most of the streams in the county ultimately drain into the Chesapeake Bay (with the remainder draining to Delaware Bay), but they also provide 56% of public drinking water (2 million gallons per day). Big Elk Creek and North East Creek supply the towns of Elkton and North East, respectively. In addition to water supplies for household use and farming, the county's streams provide important habitat for fish and other aquatic organisms.

The Clean Water Act requires states to develop water quality standards for all surface waters, monitor these waters, and identify and list those waters not meeting water quality standards. A water quality standard is the combination of its designated use and the water quality criteria designed to protect that use. Designated uses include recreational activities (fishing and



Silt and algae choke Mill Creek's streambed.

swimming), drinking water supply, and support of fish and shellfish. An impairment is identified when water quality monitoring data suggest that a water body does not meet or is not expected to meet water quality standards. The 303(d) list reports a jurisdiction's impaired surface waters. All of Cecil County's watersheds are on this list for biological impairment, excess nutrient or sediment input, or metal or toxic contamination (Maryland Department of the Environment, 2004a).

Of greatest concern in Cecil County are excess nutrients, particularly nitrogen. Excess nutrient input (primarily nitrogen and phosphorus from sewage and urban and agricultural runoff) has impaired the Bay by fueling algae blooms, a process known as eutrophication. Decay of these algae lowers dissolved oxygen levels to the point that fish and shellfish die. Large algae blooms also prevent sunlight from reaching submerged vegetation, eliminating habitat for crabs, fish and other organisms. The State of Maryland and its Chesapeake Bay Program partners have set a 40% nitrogen reduction goal as part of the Chesapeake Bay Agreement. Meeting this goal will require an array of green infrastructure implementation strategies to reduce current nitrogen runoff levels.

The Chesapeake Bay Program Tidal Monitoring and Analysis Workgroup (2005) reported that as of 2002, the most significant contributor of nitrogen, phosphorus, and sediment to rivers in Maryland's Upper Eastern Shore (which includes most of Cecil County) was agricultural sources. Point sources and urban runoff also contributed to these stressors. Vegetation, especially in forests, can prevent excess nutrient and sediment flows into water bodies by absorbing nutrients from groundwater and slowing surface runoff.

Developed as a tool to address impaired surface waters, Total Maximum Daily Loads (TMDLs)

establish the maximum amount of an impairing substance or stressor that a waterbody can assimilate and still meet water quality standards, and allocate that load among pollution contributors. A TMDL is the sum of the allowed pollutant loads for point sources, non-point sources, projected growth and a margin of safety. Load allocations are determined from monitoring data and watershed modeling by the Chesapeake Bay Program (Maryland Department of the Environment, 2007).

TMDLs were established in three of the county's rivers – the Northeast, Bohemia, and Sassafras – for nitrogen and/or phosphorus to reduce algal blooms and ensure adequate dissolved oxygen. The Maryland Department of the Environment (2006a) provides guidance on estimating non-point source pollution loads to the Chesapeake Bay and developing plans to meet TMDL requirements. According to data from the Maryland Department of Planning, Cecil County's population is projected to rise 64% between 2005 and 2030, from 97,250 to 159,950. The number of households is projected to rise 74% in the same period, from 35,250 to 61,175. If present development trends continue (85% of housing units being single-family homes, with an average lot size of 1.144 acres), this would consume an additional 25,209 acres of land. Development between 1997 and 2002 was 77% on farm land and 23% on forest land. If these trends continue, 19,411 acres of agriculture and 5,798 acres of forest will be converted between 2005 and 2030. However, 69% of new residential units were on private septic (1000 Friends of Maryland). If this trend continues, and given an average household size of 2.64 (the midpoint between 2005 and that projected for 2030), the 17,888 new households on septic will export an additional 180,000 pounds per year of nitrogen into the water.

Key Water Quality Factors

To address Cecil County's TMDL issues holistically, we identified water quality protection and enhancement opportunities to help meet nutrient reduction goals while also enhancing the county's green infrastructure network and ecosystem services. The Fund examined biological and chemical stream data collected statewide and countywide, and compared these to watershed and site conditions to search for possible relationships. Using previously published studies on water quality along with analyses of stream monitoring data, watershed characteristics, and land cover, the Fund identified key factors that contribute to water quality and recommended appropriate implementation strategies.

Forested Land Cover in a Watershed

According to The State of the Chesapeake Forests report (The Conservation Fund, 2006), forests are the best land cover for protecting water quality. Forests help control hydrology in a watershed by absorbing and recycling rainfall, with the potential to control runoff and flooding. Floodplains and wetlands can absorb and store stream and river overflows, and also reduce flow velocity through friction. Heavy vegetation can slow the runoff of precipitation into waterways, permitting some of the runoff to seep into groundwater aquifers and reducing peak flows.

Impervious Surface in a Watershed

There are numerous studies relating watershed imperviousness to hydrologic response, stream stability, and aquatic habitat. The increased impervious surface associated with development has major impacts on the biological health of streams. According to the Maryland DNR Monitoring and Non-tidal Assessment Division (1999), when watershed imperviousness exceeds 25%, only hardy, pollution tolerant



New development in the Principio Creek watershed.

organisms can thrive. Other species decline or become extinct. Above 15% impervious cover in a watershed, fish and benthic macro-invertebrate community condition, as measured by the indices of biotic integrity, is Fair to Poor. Even very low levels of imperviousness can have detrimental effects. When upstream impervious land cover is above 2%, pollution-sensitive brook trout are lost.

Riparian Forest in a Watershed

Stream health is strongly dependent on the surrounding terrestrial environment, which serves as both a buffer and a source of organic matter, especially for small streams. Natural vegetation in the riparian zone has been shown to stabilize stream hydrology; maintain the integrity of stream channels and shorelines; intercept nutrients, sediment, and chemicals; moderate water temperature; and supply food, cover and thermal protection to fish, amphibians, invertebrates, and other wildlife. Riparian forest buffers have proven to be effective at reducing nutrient loads in areas that have largely been deforested. Studies have demonstrated reductions of 30 to 98% for nitrogen, phosphorus, sediments,

pesticides, and other pollutants in surface and groundwater after passing through a riparian forest. Retaining buffers is one of the least expensive strategies for reducing nitrogen loads, costing approximately \$5 per pound of nitrogen removed (Moore, 2002). Stream buffers are most effective when they are continuous and sufficiently wide (Weber, 2003). Jones et al. (2001) found that the percentage of stream miles with riparian forest at the watershed scale was one of the most important predictors of nutrient levels in Chesapeake Bay tributaries. The percentage of forest buffers was by far the leading predictor of total nitrogen, dissolved phosphorus, total phosphorus, and suspended sediment concentrations (Jones et al., 2001). In Delaware, Weber (2007) found that streams were likely to be in better physical condition if their upstream catchment had greater than 45% forests or wetlands within 30 meters of the stream bank.

Riparian Forest at the Site Level

At the site level, at least two aquatic stressors in Cecil County are related to the absence of riparian forest: unstable stream banks and the lack of a riparian buffer. As mentioned above, buffers are most effective when they are continuous and sufficiently wide. Gaps in the



Forested tributary to Principio Creek.

buffer allow nutrients, sediments, and other pollutants, as well as elevated water discharges, to bypass the filtering effect of natural vegetation. A review of studies by North Carolina State University (1998) on specific buffer performance found that for sediment removal, necessary widths ranged from 10 to 60 meters; for nutrient and metals removal, widths ran from 4 to 85 meters; for species distribution and diversity protection, from 3 to 110 meters was required; and for water temperature moderation, requirements ranged from 15 to 28 meters. One study recommended minimum buffer widths around 30 meters under most circumstances to provide both basic physical and chemical buffering to maintain biological components of wetlands and streams. Researchers noted that fixed-width buffer approaches are easier to enforce, but that variable-width buffers are more likely to provide adequate protection on a specific-case basis.

Wetlands at the Site Level

Wetlands provide many ecosystem services to humans, including water quality improvement and flood mitigation. According to the Maryland Department of the Environment (2006b), there are three processes in wetlands that maintain or improve water quality of adjacent surface waters: (1) nutrient removal, transformation, and retention; (2) retention of toxic materials; and (3) storage of sediment transported by runoff or floods. Soil characteristics, landscape position, vegetation, and hydrology all contribute to the relative ability of a wetland to perform these tasks. In particular, wetlands along rivers, streams and coastal areas are important for removing sediment from surface and tidal waters. Lack of dense vegetation in some floodplains, and narrow width of floodplains, reduces the ability of wetlands to slow velocities of floodwaters and allow settling of transported sediments.



Wetland along a Principio Creek tributary.

Major Findings from Analysis

The Fund’s water quality analysis findings for Cecil County were consistent with previous studies that indicated that forest and wetland cover have a significant impact on water quality. As indicated by the aquatic biological communities, water quality in Cecil County was generally highest in watersheds with less than 7% impervious surface cover (based on National Land Cover Data – NLCD) and greater than 50% forest and wetland cover. Water quality tended to be moderately good in watersheds with 40-50% forest and wetland cover. Riparian forest was also strongly related to water quality, with high quality streams averaging 88% riparian cover in the upstream catchment, and impaired sites averaging 51%. Stream condition was most affected by the percentage of forests and wetlands, and percent impervious surface, in the watershed. At the site level in the county, both nitrate and phosphorus levels were higher in reaches without adequate riparian buffers. Phosphorus levels were also higher in channelized streams with high sediment loads. The fish community was most affected by in-stream habitat quality, with depth playing a major role.

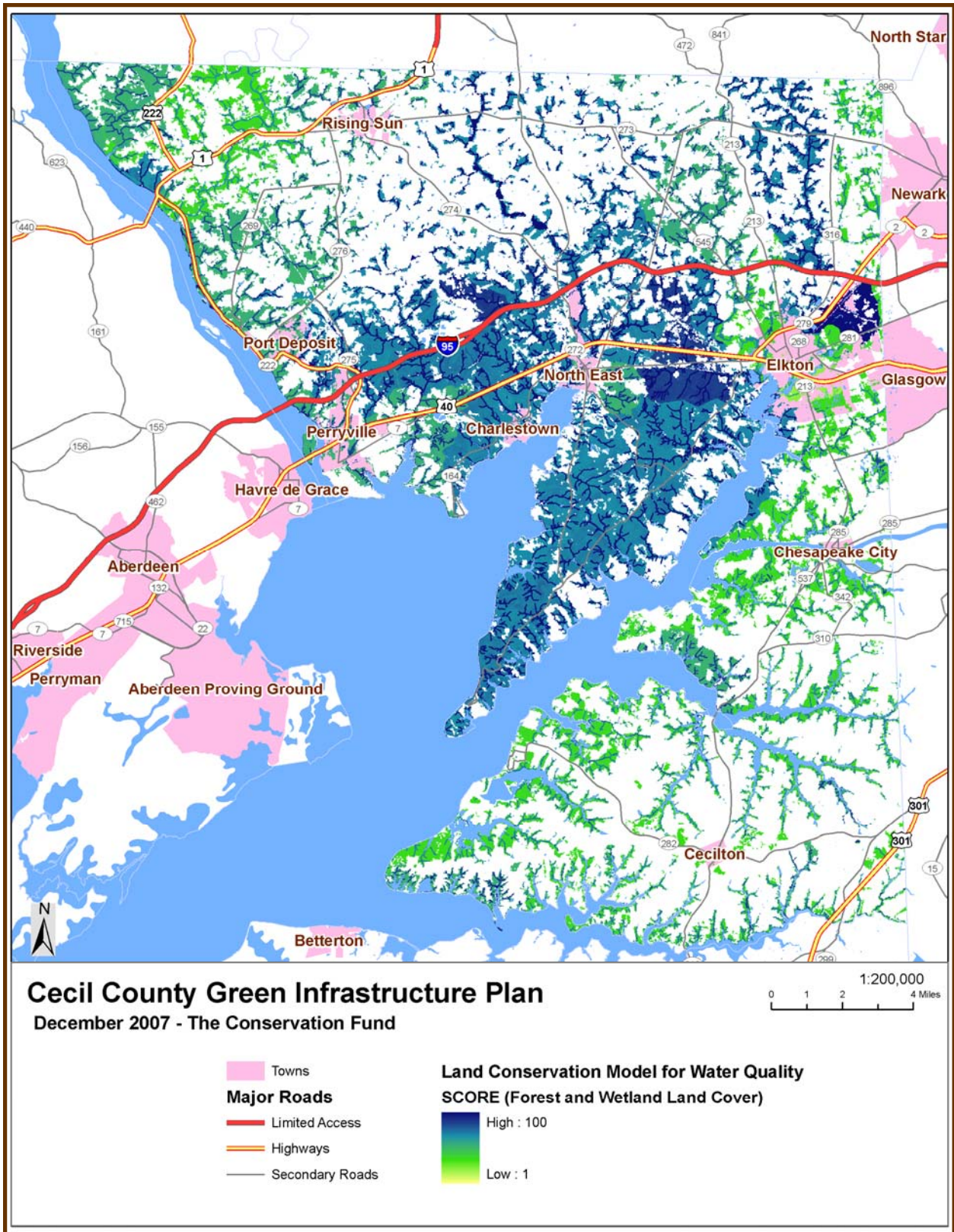
Water Quality Models

Based on these key analysis findings and water quality factors, the Fund developed a series of Geographic Information System (GIS) models to help identify locations where conservation and restoration strategies would benefit water quality. The models are described in Table 3, and maps for two of the models are included on the following pages. Since appropriate soil data for Cecil County was not available in time for this project, the wetland restoration model was not run. A detailed overview of each model is provided in an accompanying technical report prepared for this project (Weber, 2007b).

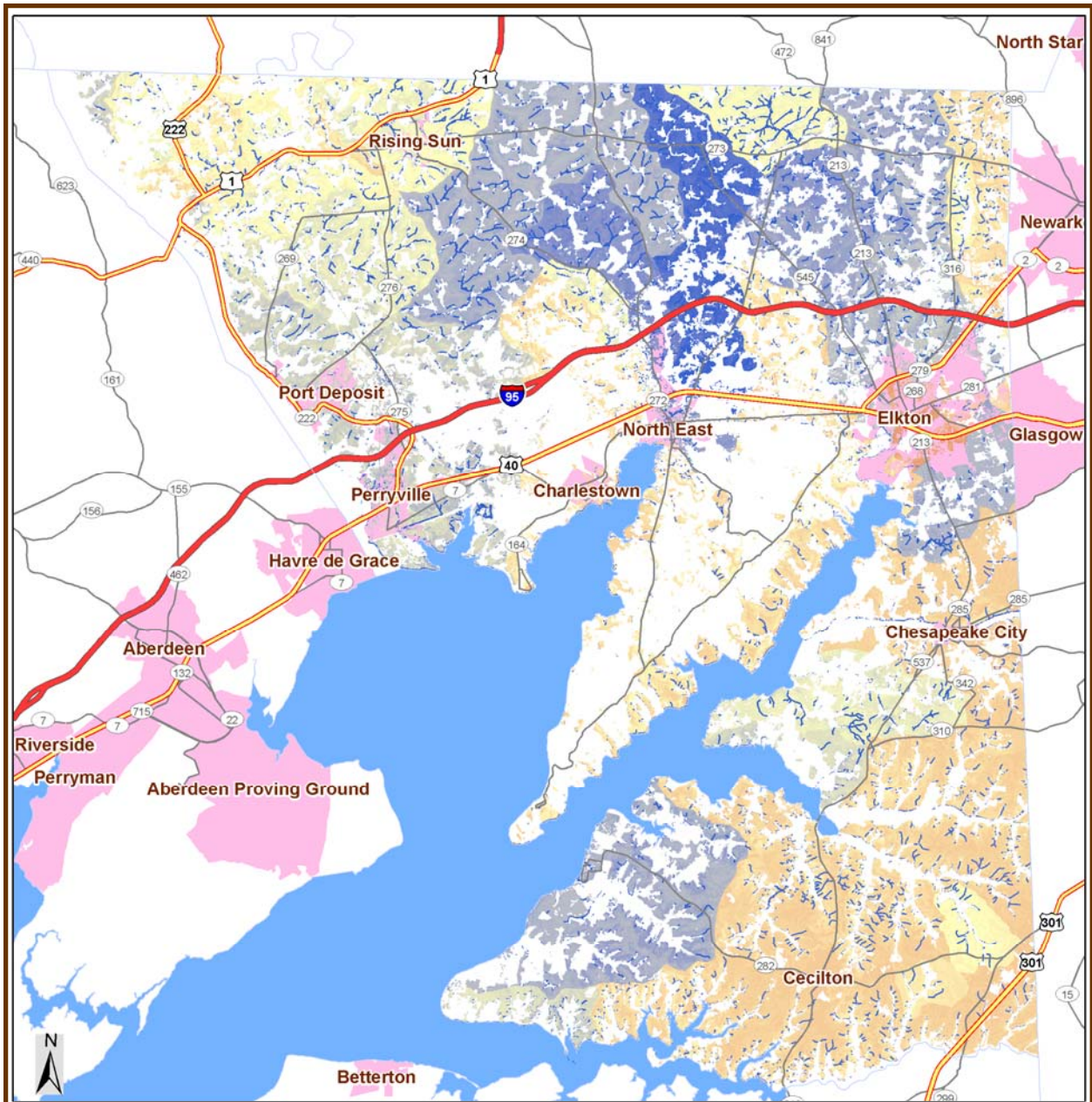
The GIS models for land conservation and reforestation had a spatial resolution of 10 meters. Values for a variety of model parameters or factors were based on data analyses and expert judgment. The factors for each 10 meter by 10 meter raster cell in the GIS surface were then summed to derive a composite model score between 0 and 100, with higher numbers corresponding to greater water quality benefits.

Model	Purpose	Primary Factors
Land Conservation	Evaluate forest and wetland cover as a contributor to water quality. Identify opportunities for land conservation that also achieve water quality goals by retaining optimal quantities and distributions of forests and wetlands in a watershed.	Watershed % forest/wetland cover, watershed % impervious surface, watersheds draining to drinking water supplies, wetland characteristics, soil permeability, soil erodibility, stream biological integrity, proximity to streams and shorelines
Reforestation	Identify opportunities for reforestation of agricultural land, lawns, or barren land to achieve water quality goals.	Watershed % forest/wetland cover, watershed % impervious surface, watersheds draining to drinking water supplies, soil erodibility, stream biological integrity, proximity to streams and shorelines
Wetland Restoration	Evaluate agricultural land, lawns, and barren land for potential wetland creation or restoration where water quality is most likely to be improved.	Watershed % forest/wetland cover, watershed % impervious surface, watersheds draining to drinking water supplies, soil drainage, farmed wetland classification, hydric soils adjacent to streams and shorelines

Cecil County Maryland Green Infrastructure Plan



Cecil County Maryland Green Infrastructure Plan

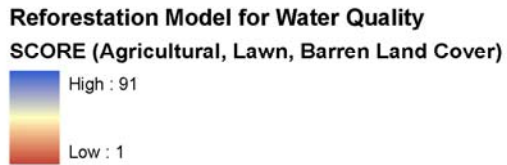


Cecil County Green Infrastructure Plan

December 2007 - The Conservation Fund



- Towns
- Major Roads**
- Limited Access
- Highways
- Secondary Roads



Water Quality Strategies

Based on the water quality analysis findings, we identified water quality strategies for Cecil County, which can be grouped into five primary categories: (1) Land Conservation, (2) Reforestation/Restoration, (3) Best Management Practices, (4) Development Site Design, (5) TMDL/Nutrient Reduction.

Land Conservation

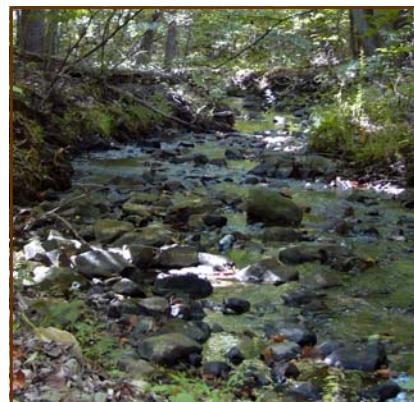
Water quality in Cecil County was best in watersheds with forest and wetland land cover of greater than 50% and impervious surface of less than 7%. Water quality was also moderately good in watersheds with 40-50% forest and wetland land cover. Therefore, the County might consider establishing Conservation Focus Watersheds where maintenance of forest and wetland land cover should remain above 40% (and ideally above 50%). These watershed designations could then be one key factor in targeting future financial investments of conservation programs (e.g., Maryland's Program Open Space). The Fund identified 16 Conservation Focus Watersheds, which are mapped on page 19. In addition, the County could consider the following general conservation strategies when developing comprehensive plan objectives, performance zoning standards, and other land use planning programs:

- Minimize conversion of forest and wetland land cover to development.
- Minimize impervious surface.
- Maintain forest cover in floodplains and on land with high erosion potential.
- Maintain existing riparian forest and wetlands.
- Identify and protect highly permeable soils, especially in the Coastal Plain, to ensure effective groundwater recharge and minimize pollution.

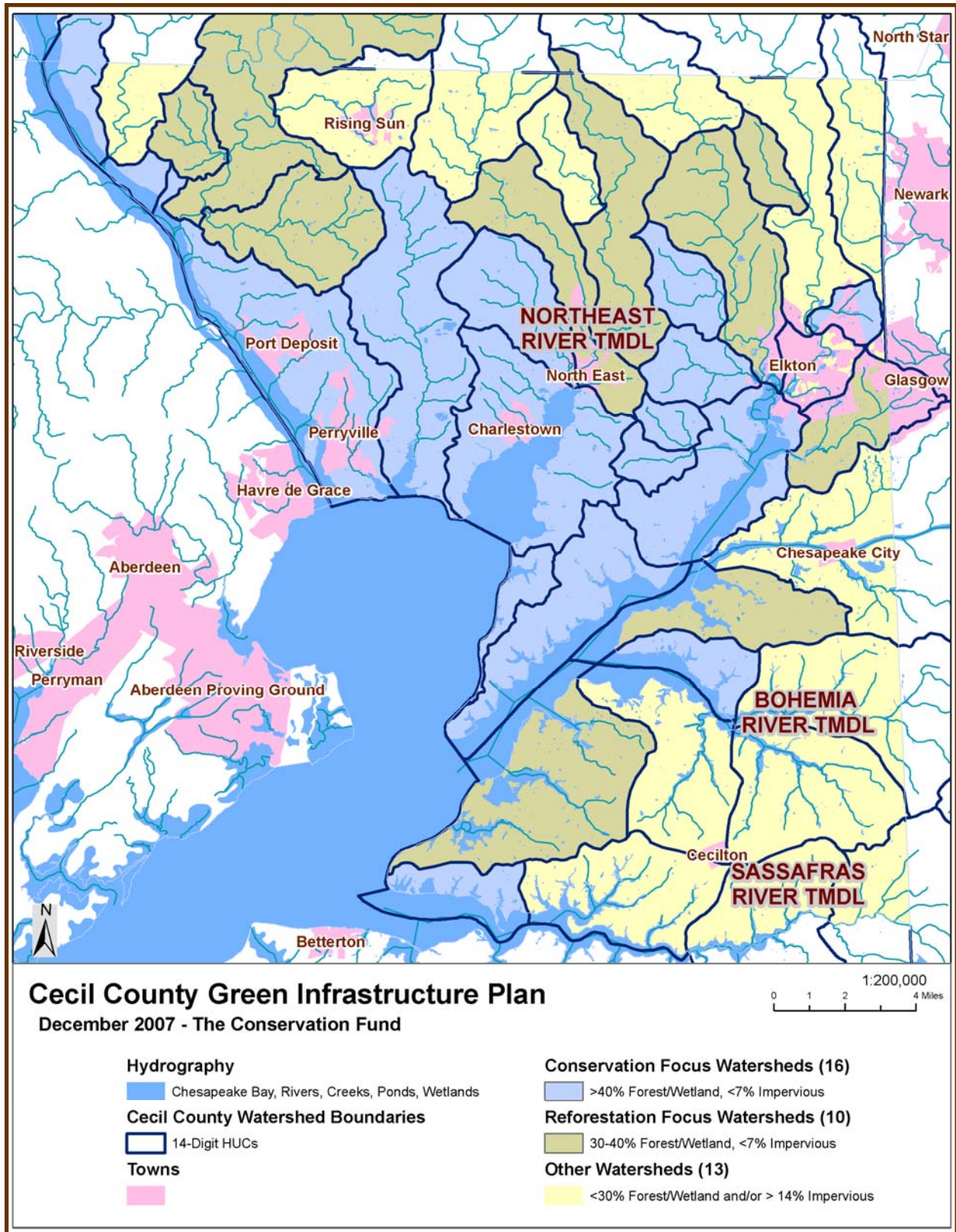
Reforestation/Restoration

Opportunities for water quality improvement are best in watersheds with forest and wetland cover between 30-40% and impervious surface of less than 7%. The County might therefore consider establishing Reforestation Focus Watersheds where water quality enhancement through reforestation and wetland restoration could be implemented to achieve at least 40% forest and wetland land cover. These watershed designations could then be one key factor in targeting future financial investments of reforestation and restoration programs (e.g., USDA cost share programs). The Fund identified 10 Reforestation Focus Watersheds, which are also mapped on page 19. In addition, the County could consider the following general restoration strategies when developing comprehensive plan objectives, performance zoning standards, and other land use planning programs:

- Restore forest buffers along streams feeding drinking water supplies to reduce non-point pollution.
- Restore forest cover on eroding stream banks and hill slopes.
- Restore wetlands in areas with poorly drained hydric soils, especially on floodplains and toe slopes.
- Remove invasive species from sensitive aquatic habitat.



Mill Creek.

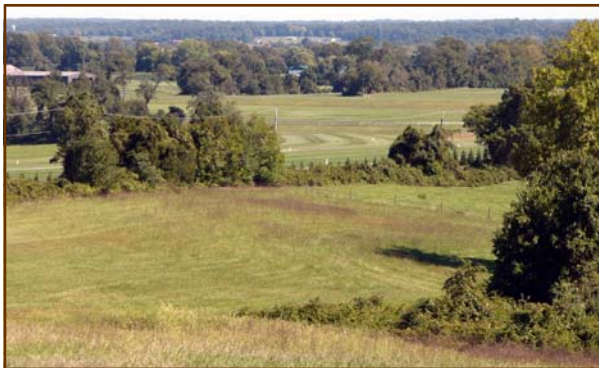


Agricultural Best Management Practices (BMPs)

Langland and Cronin (2003) reported that wetland restoration and tree planting were the most effective BMPs at reducing sediment runoff from agricultural fields (96% from high-till fields). As a result, the reforestation strategies outlined in the previous section also serve as BMPs. In addition to those, specific strategies related to agricultural operations include:

- Fence livestock out of streams.
- Implement effective animal waste and nutrient management strategies.
- Use conservation tillage and cover crops to reduce erosion and runoff.
- Treat and retire highly erodible land, especially areas that are marginally productive.
- Reduce phosphorus and protein in animal feed.
- Identify opportunities to reduce methane production — collect and burn for energy where feasible.

Best management practices can be employed in watersheds where agriculture will continue to be the primary land use. An appropriate goal for the County to consider would be to target cost share programs from USDA and the State of Maryland to promote conservation practices on working lands.



Farms on the Elk Creek peninsula.

Development Site Design

The best mechanism for improving development site design would be the development of a comprehensive zoning program using performance standards for site plan review. Specific performance thresholds for individual watersheds may differ based upon the watershed targeting strategies employed. The performance zoning code would reward projects that do not increase pre-development runoff from a site and maintain pre-development groundwater recharge. For example, low impact design (LID) techniques can reduce stormwater runoff and protect water quality by making the built environment function like the natural environment. On-site LID utilizes natural features (like native vegetation) and low-cost engineered controls (like rain gardens, 'green roofs', and rain barrels) to maintain pre-development hydrology.

TMDL/Nutrient Reduction

For Cecil County to meet the 40% nitrogen reduction goal set by the State of Maryland and its Chesapeake Bay Program partners, all of the above strategies need to be evaluated and employed to the extent practical. If current trends continue, 19,411 acres of agriculture and 5,798 acres of forest will be converted between 2005 and 2030, meaning 16,637 acres of forest would have to be planted just to offset the increase in non-point loads. To offset point sources, an additional 2,500 acres of forest would be required. Thus, a total of about 19,000 acres of reforestation would be required to keep nitrogen runoff at current levels, without considering meeting the 40% reduction goal. Since there are only 85,700 acres of farmland in the county, this is unrealistic. Thus, a major part of the County's strategy to meet water quality goals must be to minimize conversion of open space, especially forest (which has by far the lowest nutrient export rates).

In addition to land conversion, other TMDL strategies might include:

- Complete upgrades of the county's wastewater treatment plants, which would decrease nutrient output by 72,000 pounds per year from 2002 levels even with a doubling of service.
 - Provide incentives for the installation of denitrifying septic systems, which would reduce nutrient output by another 90,000 pounds per year.
 - Construct tertiary treatment wetlands. Landers (2006) compared 11 types of BMPs side-by-side, and found that constructed wetlands were the most effective at treating parking lot runoff. The wetland removed 100% of suspended solids, 99% of nitrate, 100% of zinc, and 100% of petroleum byproducts, and reduced peak flows by 85%. This greatly exceeded the performance of standard retention ponds, as well as expensive manufactured devices.
- Direct growth to areas with sewer service.
 - Plant 0.43 acres of riparian forest for each acre of agriculture developed, and 1.43 acres of riparian forest for each acre of forest developed. This would help offset the nutrient increases from new development. These offsets should either be planted in the same watershed as the development, or in one of the Restoration Focus Watersheds.

Reforestation to meet TMDL requirements should be targeted in the three county rivers (Northeast, Bohemia, and Sassafras) where TMDLs have been set for nitrogen and phosphorus loads.



Riparian forest in the Mill Creek watershed.

ECOSYSTEM SERVICES ASSESSMENT

The Importance of Ecosystem Services

Cecil County's undeveloped lands and waterways provide the bulk of the county's natural life support system. Ecosystem services, such as cleaning the air, filtering and cooling water, storing and cycling nutrients, conserving and generating soils, pollinating crops and other plants, regulating climate, sequestering carbon, protecting areas against storm and flood damage, and maintaining hydrologic regimes, are all provided by the existing expanses of forests, wetlands, and other natural lands (Costanza et al., 1997; The Conservation Fund, 2000). These ecologically valuable lands also provide marketable goods and services, like forest products, fish and wildlife, and recreation. They serve as vital habitat for wild species, maintain a vast genetic library, provide scenery, and contribute in many ways to human health and quality of life.

When wetlands and forest are utilized for development, there are costs incurred that are typically not accounted for in the marketplace. The losses in ecosystem services are hidden costs to society. These services, such as cleansing the air and filtering water, meet fundamental needs for humans and other species, but in the past, the resources providing them were so plentiful and resilient that they were largely taken for granted. In the face of a tremendous rise in both population and land consumption, we now realize that these natural or ecosystem services must be afforded greater consideration. The breakdown in ecosystem functions causes damages that are difficult and costly to repair, as well as taking a toll on the health of plant, animal, and human populations (Moore, 2002).

Large contiguous blocks of forest and wetland are more likely to contain fully functioning ecosystems (MacArthur and Wilson, 1967; Forman and Godron, 1986; Weber, 2007), and provide corresponding benefits to humans. Smaller, fragmented ecosystems are more likely to be impaired (Weber et al., 2004; Weber, 2007). Retaining connectivity, as appropriately sited and configured corridors can accomplish, can help to offset some of the functional losses caused by fragmentation (Anderson and Danielson, 1997; Beier and Noss, 1998; Bennett, 1998; Söndgerath and Schröder, 2002).

Similarly, not all forest and wetland types provide services equally. For example, more productive soils facilitate faster plant growth, and faster uptake of carbon. Some tree species are better at carbon uptake than others. Finally, using some services may impair other services. For example, timber extraction can hinder other forest functions like erosion control, soil formation, wildlife habitat, etc. Constructing trails for recreation can create vectors for invasive species. Proper management is therefore necessary to prevent long-term ecological degradation.

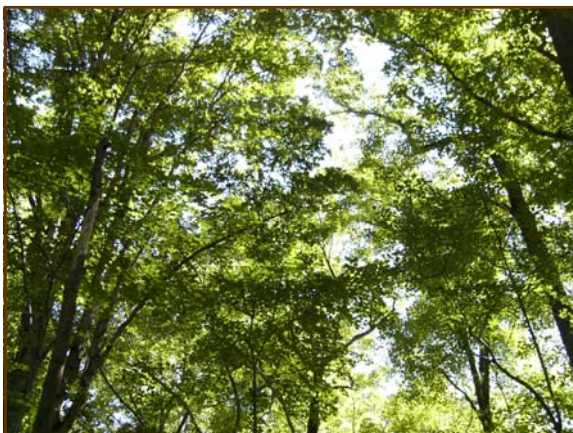


Oak-heath forest in Elk Neck State Forest.

Types of Ecosystem Services

Clean Air

Air quality affects the health of everyone, and is a major factor in illnesses ranging from cardiovascular disease to cancer and respiratory ailments (Moore, 2002). According to the State of the Air 2004 report issued by the American Lung Association (2004), all monitored Maryland counties, including Cecil County, received an air quality grade of “F” (Fail) for the number of days with high ground ozone levels. Maryland has one of the highest asthma rates in the country (Moore, 2002). Of a population around 90,000, Cecil County has an estimated 2,000 children and 5,419 adults with asthma, 2,929 people with chronic bronchitis, and 976 with emphysema (American Lung Association, 2004). Trees provide air quality benefits by absorbing sulfur dioxide and nitrogen oxide, two major components of acid rain (American Forests, 1999). In addition, trees can trap ozone, carbon monoxide, and particles in the air, all of which can be harmful to humans (American Forests, 1999).



Oak tree canopy in western Cecil County.

Clean Water

Forests and wetlands protect water bodies from pollutants and sedimentation by absorbing and filtering water. Compared to these natural ecosystems, urban landscapes add seven times as much nitrogen and ten times as much phosphorus to surface waters (Moore, 2002), and impervious surfaces like roads and parking lots carry pollutants such as oils, grease, heavy metals, and salts to streams. By slowing surface runoff and providing opportunities for settling and infiltration, forests help remove nutrients, sediments and other pollutants. Infiltration rates 10-15 times higher than grass turf and 40 times higher than a plowed field are common in forests (Chesapeake Bay Program, 2000; Casey, 2004). Many studies have shown a relationship between water quality and the amount of forest cover in the watershed. Riparian forest buffers have proven to be effective at reducing nutrient loads in areas that have largely been deforested. Retaining and restoring buffers is one of the least expensive strategies for reducing nitrogen loads, costing approximately \$5 per pound of nitrogen removed (Moore, 2002).

Carbon Sequestration

With its 4,360 miles of coastline, Maryland is the third most vulnerable state to climate change, after Florida and Louisiana. The U.S. Environmental Protection Agency (1998) projects that Maryland could experience up to one meter of sea level rise, causing erosion along the coast, major property damage, and loss of wetlands. Carbon dioxide (CO₂) is the leading “greenhouse gas”, trapping some of the sun’s energy, warming the Earth, and changing our climate systems (Solomon et al., 2007). Forests and wetlands remove large amounts of CO₂ from the air via photosynthesis and carbon sequestration in biomass and soil.

Water Supply & Hydrologic Regulation

Cecil County withdraws 3.66 million gallons of fresh water per day for public drinking water: 44% from groundwater, and 56% from surface water (City-data.com, 2007). Forests and wetlands slow surface runoff during rainfalls, and allow it to percolate into aquifers where it provides base flow to streams as well as a supply of groundwater.

Flood Protection & Stormwater Management

Conserving forests and wetlands can help local governments and other public agencies reduce costs from flooding and other natural hazards (McQueen, 2000). Nationwide, floods cause over \$4 billion in damages in an average year (Salzman et al., 2001). Floodplains and wetlands absorb and store stream and river overflows, and also reduce flow velocity through friction. Heavy vegetation can slow the runoff of precipitation into waterways, permitting some of the runoff to seep into groundwater aquifers and reducing peak flows. In contrast to natural land, developed land has little ability for absorption, and instead creates a large volume of fast moving (and more polluted) runoff.

Erosion Control & Sediment Retention

Standing vegetation stabilizes soils, especially along stream banks, on steep slopes, and where soils are highly erodible. Forests and forest buffers help protect streams by sheltering and anchoring their banks. Trees and vegetation also intercept driving rain and slow the flow of water over the ground, thereby reducing scouring and preventing soil from eroding into water bodies and roads. Increased sediment loads in streams and lakes can impact fish and invertebrate populations and habitats, alter stream channels, and reduce water quality. Erosion also leads to poor soil productivity

(Moore, 2002). Dreher and Price (1995) reported sediment delivery from developed land as 8 to 28 times greater than that from woodlands and wetlands.

Regulation of Water Temperature

Riparian vegetation shades adjacent streams, moderating water temperatures and protecting against rapid fluctuations that can harm many aquatic species. Elevated water temperatures and increased sunlight when riparian vegetation is lost can also accelerate algae growth and reduce dissolved oxygen. In a small stream, temperatures may rise 1.5 degrees in just 100 feet of exposure without trees (Casey, 2004).

Wood Products

Forestry and wood products are the fifth largest industry in Maryland (Moore, 2002). The long-term profitability of this industry is directly linked to a sustainable forest resource base. In 2001, according to the economic model IMPLAN, the forestry and wood products industries in Cecil County generated \$9 million in wood products and 180 jobs.



Sustainable forestry in Cecil County.

Fish & Wildlife Habitat

About 78% of the commercial fish and shellfish in the Chesapeake Bay are dependent on estuarine wetlands, including striped bass, menhaden, hard clam, and blue crab (Stedman and Hanson). In 2002, the cumulative impact of commercial fish and shellfish landings in Maryland added \$182 million to Maryland's economy (2006 dollars) (Ryan and Duberg).

Recreation

Natural areas provide an array of recreational opportunities that contribute to our quality of life. These include hunting, fishing, hiking, bird watching, camping, rock climbing, canoeing, and many others. A survey by the U.S. Fish and Wildlife Service (2003) revealed that in 2001, 1.9 million people 16 years old and older engaged in fishing, hunting, or wildlife-watching activities in Maryland, spending \$1.7 billion in the process (U.S. Fish and Wildlife Service, 2003). This amount was a 55% increase from 1996.

Soil & Peat Formation

Fertile soil is a necessity for most plants, and in turn, the animals and people who depend on them. NRCS (2007) estimated Maryland's annual soil loss to erosion at 3.6 tons per acre, almost entirely due to rainfall and runoff. This was one of the highest rates in the country (NRCS, 2007). Yet soil formation is a slow process, taking up to 1,000 years to form 25mm (1 inch) of soil (Pimentel, 1998).

Pest Control

Pimentel (1998) estimated that pests destroy \$100 billion per year in potential food and fiber in the United States. Bats and insectivorous birds living in suitable habitat can help control pests in nearby agricultural fields or residential areas.

Pollination

Studies have shown that plants near forest stands are much more effectively pollinated by native bee species than commercial bee hives (Ricketts et al., 2006). Furthermore, the high diversity of bees supported by these forested



Enjoying the view at Elk Neck State Park.

areas makes crop pollination reliable from year to year. Forests and other areas with high plant diversity have different flowers blooming throughout the spring and summer, and therefore can support pollinators year-round.

Genetic Information & Biological Diversity

One of the greatest values of biodiversity might be a capacity to adapt to change, such as global warming. Another value is the mostly untapped potential of species and genes to tailor crops, cure diseases, and provide other vital services. All of our food crops have their roots in wild species. Species and genotypes found in Maryland could contribute to future agricultural, pharmaceutical, and biotechnology advances.

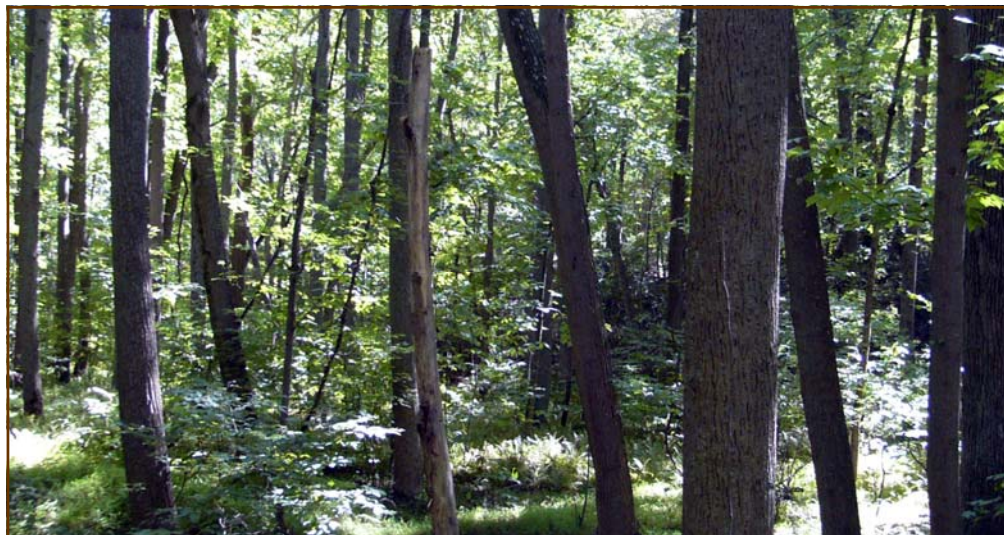
Savings in Community Services

Cost-benefit analyses of development versus land preservation tend to show a net loss over time for developed lands (Balmford et al., 2002; Moore, 2002). Sprawl development and the inefficient use of land and resources require communities to stretch services across a larger area and at a higher cost than the revenue generated by taxing these new residents, resulting in huge investments required for new

roads, sewers, schools and other public infrastructure (Benedict and McMahon, 2002). In Cecil County, residential development from July 2000 to June 2001 generated \$72,232,503 in revenues to cover expenditures of \$84,308,241, resulting in a deficit of \$12,075,738 (American Farmland Trust, 2002). For each acre of forest converted to housing, Cecil County loses around \$439 per year in net expenditures.

Increase in Property Values

Many studies have shown that parks and greenways increase nearby property values (e.g., Bockstael, 1996; McQueen, 2000; Crompton, 2001). A 2002 survey of home buyers found that nearby trails and parks were among the most important amenities, well ahead of ball fields and golf courses (National Association of Home Builders and National Association of Realtors, 2002). The quality of life of a community is an increasingly important factor in the location decisions of businesses. In one survey, corporate CEOs reported quality of life for employees as the third most important factor in locating a business, behind only access to domestic markets and availability of skilled labor.



Riparian oak-poplar forest on Elk Neck.

Valuing Cecil County's Ecosystem Services

Most ecosystem services do not have established markets, making estimates of their value difficult. We used studies and figures from Cecil County where possible, within Maryland as our second choice, and elsewhere in the U.S. as a third choice. In cases where there was a range of values for a given service, we usually chose the conservative route and picked the lowest number. Dollar figures were transformed to 2006 equivalents, using an on-line inflation calculator. Though we have published a specific estimated value, it should be evaluated in terms of a likely range of values around that estimate. A comprehensive review of our estimates for valuing Cecil County's ecosystem services can be found in a detailed technical report prepared as part of this project (Weber, 2007a).

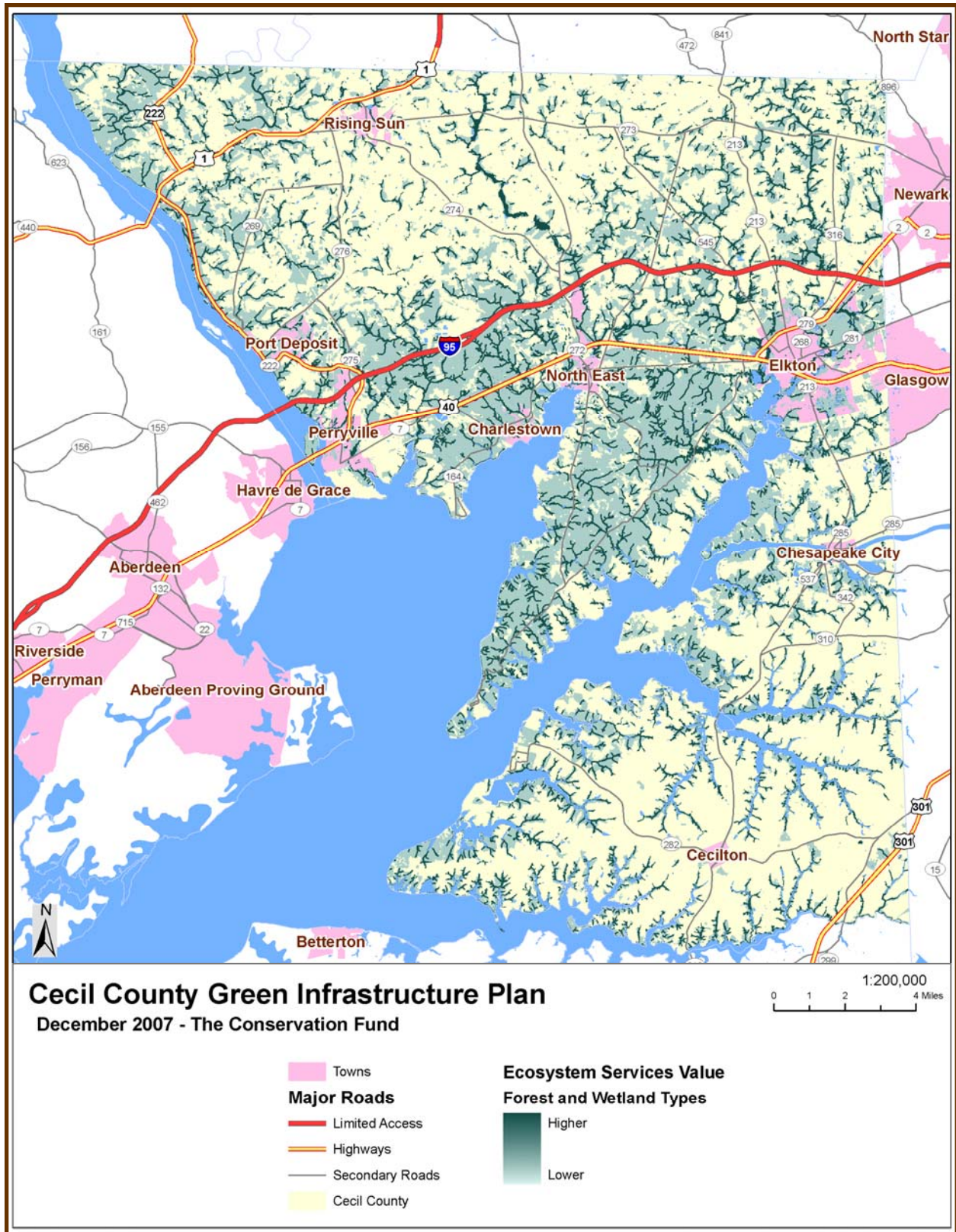
The Fund categorized ecosystems into four broad classes, based on documented differences in ecosystem services: upland forests, riparian forests and wetlands, non-riparian wetlands, and tidal marsh (see Table 4). We summed these values per acre for each class. The technical report provides a detailed account of our methodology and a series of caveats on utilizing the estimates (Weber, 2007a).

Wetlands had a much higher value per acre than upland forest, primarily because of their added hydrologic services. Ecosystem values were summed within green infrastructure hubs to estimate a dollar figure of hub value. As discussed earlier, large contiguous blocks of forest and wetland are more likely to contain fully functioning ecosystems, and more likely to provide corresponding values to humans. The map on the facing page provides an overview of relative ecosystem service value.

Forests and wetlands in Cecil County provide approximately \$2.1 billion in ecosystem services each year according to our estimates (Weber, 2007a). This amount is two-thirds that of the county's economic output (\$2.9 billion from all sectors in 2001, which is \$3.3 billion in 2006 dollars), and does not include ecosystem services from bodies of water, like the Chesapeake Bay. Although Cecil County's green infrastructure network only covers 37% of the land area, it encompasses 81% of the county's ecosystem services and includes 76-93% of key ecosystem types. Ecosystem service value by hub was highly correlated with hub area, interior forest, stream and shoreline length, and unmodified wetland area. Thus, hub area can be used to identify relative value in Cecil County's green infrastructure: the bigger the hub, the more valuable to humans.

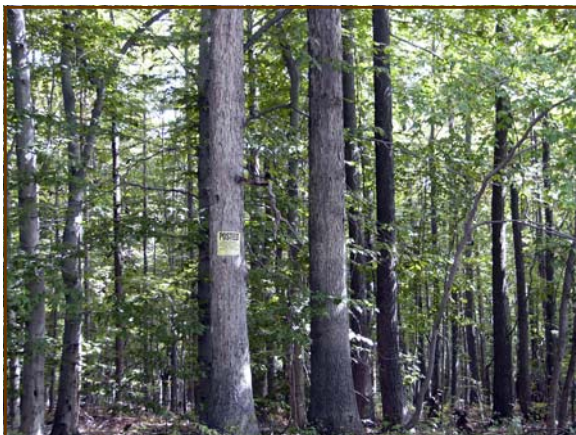
TABLE 4: Estimates of ecosystem service values from forests and wetlands in Cecil County

Area	Area (acres)				Estimated value (2006\$/yr)
	Upland forests	Riparian forests & wetlands	Non-riparian wetlands	Tidal marsh	
Cecil County	60,050	25,370	633	1,857	\$2.1 billion
Cecil Green Infrastructure	45,446	19,620	563	1,724	\$1.7 billion
% Services from GI Network	76%	77%	89%	93%	81%



IMPLEMENTATION QUILT ANALYSIS

As referenced in the book *Green Infrastructure: Linking Landscapes and Communities*, the Implementation Quilt is a framework for matching available resources – tools, programs, funding, and people – to the needs of the green infrastructure network. Every planning context, like every quilt, is unique. For Cecil County, the quilt described below is an implementation strategy that identifies what tools can be used, who can use them, and what resources are available to achieve protection of the green infrastructure network. The quilt also underscores the underlying principle of green infrastructure — that natural resource and working lands should be identified and protected prior to development. Implementation tools include such elements as land acquisition, conservation easements, purchase and transfer of development rights, zoning, and conservation development. The toolbox also includes refining land use planning policies and funding programs to allow users of these tools – federal, state, and local governments and non-governmental organizations (NGOs) – to more effectively protect Cecil County’s GI network.



Privately owned oak-beech forest in a GI hub.

Key State & Federal Conservation Incentive Programs

The programs and tools identified in this section provide a comprehensive array of resources available to private landowners, County officials and NGOs operating within the county or region. Most of these mechanisms are familiar to those who are actively engaged in conservation activities. Maryland has a noteworthy array of nationally renowned conservation programs available to landowners and local governments. Similarly, some federal cost-sharing programs have been pioneered in Maryland because of the state’s long-standing interest in conservation. The availability of such a comprehensive menu of state and federal incentive programs and funding sources is largely responsible for the successful conservation efforts evident at the local government level throughout Maryland. Remarkably, some of these programs such as the Rural Legacy Program; the Maryland Agricultural Land Preservation Foundation and the federal Forest Legacy Program seek to affect landscape level changes in how forest and farm lands are protected. Most of the federal incentive programs listed here are primarily aimed at individual landowners acting on their own volition and are limited, by definition, in the extent to which they can be targeted protect Cecil County’s green infrastructure network as a whole. Over time, the Fund anticipates more state, federal and local programs will be designed to protect large, contiguous networks of conservation lands which represent our “natural capital” and wealth of ecosystem goods and services - provided at no cost to current residents and future generations.

Program Open Space (POS)

Initiated in 1969, POS funds were designed to offset development trends by conserving open space and building recreational infrastructure. Funded through a 0.5% real estate transfer tax, POS revenues now support additional conservation programs including the protection of threatened and endangered species habitat (through the Heritage Conservation Fund); agricultural land preservation (through the Maryland Agricultural and Land Preservation Foundation – MALPF); historic preservation (through the Maryland Heritage Areas Authority); and protection (acquisition) of large blocks of land with significant farm, forest, historic and natural resources (through the Rural Legacy Program). POS provides up to 100% of a project's cost for the acquisition of open space areas throughout the state and up to 90% for development of local outdoor recreation areas. POS receives approximately 75% of the total revenues collected from the real estate transfer tax. Of this amount, half is allocated for State acquisitions and half is allocated to local governments for acquisition and development of land for recreation and open space purposes. Each county must use at least half of its allocation for land acquisitions. A county may use the remaining half of its allocation for land acquisition or development projects, and 20% of the funds may be used for capital renewal but not routine maintenance. Cecil County's share of POS funds in 2007 was \$1.9 million or 1.4% of the total allocated to local governments.

The Maryland Department of Natural Resources is moving toward a more rigorous land screening and prioritization process designed to identify potential acquisitions using stateside POS funds. The Department's new conservation prioritization methodology will place more emphasis on acquisitions of the state's green infrastructure and will use, in part, GIS decision support tools based on a science-driven approach to targeting

and protecting areas with significant ecological, water quality and habitat values. Similar to the former GreenPrint program (now defunct), the prioritization methodology focuses, in part, on protection of large, contiguous blocks of forests, wetlands and other natural lands and maintaining connectivity between those lands through a system of natural corridors. With the completion of the Cecil County Green Infrastructure Plan, the County should be well positioned to leverage stateside POS funding for areas ranked highly under this plan.

Rural Legacy Program (RLP)

Created in 1997, RLP protects contiguous rural landscapes with natural, agricultural, cultural and forestry resources. Under the RLP, local governments and land trusts work in cooperation with landowners to identify Rural Legacy areas where conservation is needed and then compete for annual grant funding to purchase fee simple title or perpetual easements to protect priority areas. The Fair Hill Rural Legacy Area is Cecil County's most productive and economically important agricultural region. Nearly half of the Area is already under various forms of protection, but 31% is in need of protection due to increased development and its proximity to the I-95/Rt. 40 corridor. The Fair Hill RLA helps maintain water quality in the Big and Little Elk Creek watersheds and buffers and expands the state-owned Fair Hill Natural Resource Management Area. There is a waiting list of interested landowners committed to protection of the Area and willing to sell easements. During the 2007 funding cycle, \$3 million was awarded to FHRLA, and the sponsoring organization, Cecil County Land Trust is hopeful that future funding levels will remain adequate to meet demand and higher land values. Located along the Sassafras River is the northern portion of the Rural Legacy Area called Agricultural Security Corridor – Sassafras Focus

Area. The Sassafras Area includes the Sassafras Natural Resource Management Area of Bloomfield Farm and is contiguous to thousands of acres of donated easements and existing agricultural easements and districts. The RLP will continue to be a significant, on-going source of implementation funding for Cecil County.

Maryland Agricultural Land Preservation Foundation (MALPF)

Created in 1977 by the Maryland General Assembly, the Foundation purchases perpetual easements to protect prime farmland and woodlands in an effort to ensure continued production of food and fiber for Maryland citizens. Landowners may create Agricultural Preservation Districts out of at least 50 contiguous acres (some rare exceptions granted) if they agree not to subdivide it and keep it in production for at least 5 years. After the minimum eligibility standards are attained, a landowner can compete to sell their development rights to the State for permanent easement protection. Cecil County has enjoyed a highly successful agricultural preservation program with 12,677 acres preserved for agricultural purposes and 19,163 acres participating in the program. Agricultural districts totaling 947 acres received favorable recommendations in 2006. A total of 334 acres of MALPF easements were sold in 2006.

Maryland Environmental Trust (MET)

Set up in 1967 to “conserve, improve, stimulate, and perpetuate the aesthetic, natural, health and welfare, scenic, and cultural qualities of the environment, including but not limited to land, water, air, wildlife, scenic qualities, open spaces, buildings or any interests therein...”, MET accomplishes its mission principally through the solicitation and management of private landowner donated conservation easements. Various state and federal tax mechanisms

provide incentives for the donation of easements. Generally, these include income tax deductions, estate tax reductions, estate tax exclusions, and property tax reductions. Under Maryland law, donors of an easement to the Maryland Environmental Trust are eligible for a 100% property tax credit on the unimproved portion of their land. Thereafter, land subject to a permanent conservation easement is entitled to a lower real estate tax assessment to reflect the restrictions of the easement. In December of 2006, MET approved a 53 acre easement for the Woodlawn Wildlife Area. MET easements protect approximately 100,000 acres in Maryland, and the program provides on-going technical assistance and information for interested landowners.

Maryland Historical Trust (MHT)

MHT operates a network of programs that work together to acquire, rehabilitate or restore historic properties and structures. Eligibility requirements vary according to established programmatic criteria. In general, owners of properties listed on or eligible for the National Register of Historic Places, or located within a locally certified or Register-listed historic district, may be eligible to obtain assistance in the form of grants, tax credits, loans and technical assistance.

Conservation Reserve Program (CRP) & Conservation Reserve Enhancement Program (CREP)

The U.S. Department of Agriculture’s (USDA) Natural Resource Conservation Service (NRCS) provides technical and financial assistance to eligible landowners to address soil, water, and related natural-resource concerns on their lands in an environmentally beneficial and cost-effective manner. NRCS may pay up to 90% of the participant’s eligible costs to convert highly erodible cropland or other environmentally

sensitive acreage to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the 10 to 15-year contract based on the agriculture rental value of the land. CRP is administered by the Farm Service Agency, with NRCS providing technical land-eligibility determinations, conservation planning and practice implementation. CRP reduces soil erosion, protects the nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources.

In 1997 through a Memorandum of Agreement with USDA, Maryland became the first state to create a partnership to augment USDA's existing CRP by jointly committing resources to establish buffers, restore wetlands and retire highly erodible agricultural lands adjacent to water bodies that drain into the Chesapeake Bay. This program is called the Conservation Reserve Enhancement Program (CREP). CREP seeks to establish and enhance 93,000 acres of riparian buffers, 5,000 acres of wetland habitat and 2,000 acres of habitat for declining, threatened or endangered species including the bald eagle, Eastern bog turtle, dwarf wedge mussel, glassy darter, and harparella, a nearly extinct aquatic plant that grows only where suitable water quality conditions are present. USDA committed to CREP contracts on 100,000 acres of land in Maryland, and the State agreed to preserve 25,000 acres by permanent easement. Eligible landowners in CREP can receive assistance for removing land from agricultural production, installing conservation practices and executing perpetual easements through Rural Legacy, MALPF, or MET. The USDA share for Maryland CREP is estimated to be \$170 million for rental payments to be made over the next 15 years, and about \$21 million for cost-share payments

during the same period, for a total of \$191 million. Farmers have also received additional bonus payments through private sources and USDA incentive payments. Maryland has spent more than \$13 million in cost-share and other incentive payments through 2004 and expects to spend an estimated \$2.2 million in cost-share payments for the remaining life of the program.

Wetlands Reserve Program (WRP)

WRP, administered by the USDA's NRCS, is a voluntary program offering eligible landowners the opportunity to protect their lands through permanent easements, 30-year easements, or restoration cost-share agreements. The program requires that the NRCS and the landowner create a plan for the restoration of the area under the easement. The program is aimed at protecting farmed or converted wetlands that were drained for agricultural use prior to December 23, 1985, along with other lands the NRCS might deem appropriate. Acreage protected under the program is limited nationally to 2,275,000 acres and 25% of the total cropland in any county. Payment rates for easements are established by the state conservationist based on the agricultural value of the land. NRCS may pay from 75 to 100% of the cost to restore a wetland on land under a permanent easement, but only 50 to 75% of the cost of restoration on lands under non-permanent easements or cost-share agreements.

Wildlife Habitat Incentives Program (WHIP)

WHIP is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP, USDA's NRCS provides both technical assistance and up to 75% cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant

generally last from 5 to 10 years from the date the agreement is signed. WHIP was established by the 1996 Farm Bill for the purpose of making technical and financial assistance available to landowners to develop, enhance, and restore upland wildlife, wetland wildlife, threatened and endangered species, fish and other types of wildlife habitat. Maryland's identified wildlife habitat priorities and conservation practices eligible for WHIP funding in Maryland include: restoration of grassland habitat in field borders and entire fields; restoration of riparian buffers with trees, shrubs, or herbaceous plants; stabilization of stream banks with trees, shrubs, or herbaceous plants; restoration of wetlands; and establishment of shallow water areas for wildlife. To qualify for WHIP, the application must consist of at least one acre of eligible wildlife habitat improvement practices, or at least \$300 of WHIP cost-share assistance. Lands already enrolled in other USDA programs, such as the CRP, CREP, and WRP, are not eligible for WHIP. There is a significant backlog of projects, and only \$362,000 is available for Maryland in 2007.

Farm and Ranch Lands Protection Program (FRPP)

Under FRPP, USDA's NRCS may enter into an agreement with an eligible entity to pay up to 50% of the appraised fair market value for a conservation easement on private land. Eligible entities include tribal, state, local and appropriate NGOs. Eligible land includes prime, unique, or other productive farm or ranch land, or land containing historical or archaeological resources where a pending offer for purchase of development rights from an eligible entity exists. To be eligible, a landowner must certify that its adjusted gross income for the previous three tax years does not exceed \$2,500,000 unless at least 75% of its income comes from agriculture. The program is focused on topsoil conservation

through limitation of non-agricultural uses. The NRCS works with the entity and the landowner to develop a conservation plan on any highly erodible lands, which is enforced by the entity to limit nonagricultural uses of the land and protect any highly erodible land.

Environmental Quality Incentives Program (EQIP)

EQIP is a voluntary conservation program that promotes agricultural production and environmental quality as compatible national goals. Through EQIP, farmers may receive financial and technical help with structural and management conservation practices on eligible agricultural land. EQIP was reauthorized in the 2002 Farm Bill and is administered by USDA's NRCS. EQIP offers contracts that provide incentive payments and cost-sharing up to 75% (90% for new farmers and limited resource producers) to implement certain conservation practices. EQIP contracts have a minimum contract length of one year after the last scheduled practice is completed. The maximum contract length is 10 years. A number of application pools for farms in Maryland exist. They include: livestock-related agriculture; biodiversity and forest management; erosion control and crop management; irrigation water management; comprehensive nutrient management plans (CNMP); prescribed grazing plans, and forest management (stewardship) plans. A cover crop early planting bonus pool also exists. Over \$6 million was available in Maryland in 2006.

Forest Legacy Program (FLP)

This is a national program of USDA Forest Service that is administered in Maryland by the Department of Natural Resources (DNR). The program is designed to identify and protect environmentally important forest lands through the use of perpetual conservation easements

from willing sellers. Properties greater than 100 acres that have been identified by their vulnerability to development and existing threats to endangered species are eligible. The program is available only in areas identified in Maryland's Forest Legacy Assessment of Need. These areas are located in Anne Arundel, Calvert, Cecil, Charles, Harford, Queen Anne's and Worcester counties. Funding is limited and highly competitive.

Coastal and Estuarine Land Conservation Program (CELCP)

Operated through the National Oceanic and Atmospheric Administration (Department of Commerce), CELCP was established in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical or aesthetic values. The program provides state and local governments with matching funds to purchase significant coastal and estuarine lands, or conservation easements on such lands, from willing sellers. Lands or conservation easements acquired with CELCP funds are protected in perpetuity so that they may be enjoyed by future generations. A state must have an approved CELCP plan in order to compete for funding, and Maryland officials have yet to complete their plan. Eligible state and local governments may receive funds and hold title to land under the CELCP. A project must be located within a state's designated coastal zone, which includes Cecil County. Unfortunately, Maryland did not make the list of competitive projects eligible for funding in 2008, but future funding cycles may bring additional opportunities for state and local projects. The proposed Maryland CELCP plan generally favors projects located within the boundaries of the State's Green Infrastructure Assessment maps identified in the plan. Over the last 5 years CELCP national funding levels have varied from \$15 to \$50 million. Maryland

has a substantial amount of unspent funds from previous earmarks in fiscal years '04 - '06.

Pension Protection Act of 2006

Congress passed the Pension Protection Act of 2006 that, among other provisions, includes substantial new tax incentives for land conservation easement donations. The changes, currently effective only until December 31, 2007, represent a rare and significant opportunity for landowners who may be considering making a donation for conservation purposes. The legislation raises the deduction landowners can take for donating a conservation easement from 30% of their adjusted gross income in any year to 50%; allows qualifying farmers, ranchers and forest landowners to deduct up to 100% of their taxable income (e.g., pay no federal income tax); and extends the carry-forward period for a donor to take tax deductions for a conservation easement from 5 to 15 years. Efforts are now under way to make these changes a permanent part of the tax code.



Mosses in old growth forest of Elk Neck State Park.

Recent Cecil County Conservation Programs

Purchase of Development Rights (PDR) Program

The County operates a new freestanding PDR program to encourage continuation of agricultural production and maintain equity value of agricultural land. The County's recordation tax increase (\$8.20 per \$1,000) and optional payments made in lieu of common open space dedication requirements in the NAR and SAR zoning districts fund the program. Perpetual agricultural land preservation easements can be purchased on properties: with 50 acres or more (or less if they are contiguous with an existing eased property or existing district); and at least 50% of the soils are USDA Class I, II, III or for wooded lands at least 50% Woodland Group 1 or 2 soils; (other details apply regarding mixed classes and wetlands); and are located outside of existing or planned water or sewer service areas; and that are free and clear of liens. Easements can be bought back by landowners after 25 years.

The Maryland General Assembly authorized Cecil County to enter into "installment purchase agreements" for an aggregate purchase price of up to \$4 million plus interest to acquire the development rights for agricultural land. Under such an agreement, Cecil County would acquire development rights from landowners of agricultural land as part of the County's PDR program. In doing so, the County will be required to pay the purchase price for that land either in installments or at the maturity of the agreement, and interest on the unpaid balance.

Transfer of Development Rights (TDR) Program

The County's incentive based TDR program calls for properties zoned NAR and SAR to act as sending areas provided they meet certain minimum criteria, and that properties zoned SR and DR act as receiving areas provided they meet certain minimum criteria. Water and sewer availability must be adequate to service the base densities allowed plus the additional density transferred from the sending areas. Inter-jurisdictional cooperation will be critical to insuring adequate public facilities in receiving areas. The County should evaluate the effectiveness of this program to date to determine if adjustments are needed.

Land Use Planning Actions

While there is no better substitute for directly protecting land through outright acquisition or easements, it is not feasible that the 81,619-acre green infrastructure network in Cecil County can be conserved through these means alone. Unfortunately, County leaders are in a race with time to protect farms and forests before the land is rapidly converted to other uses or is degraded from indirect impacts. New techniques and approaches achieved through land use planning tools can be put in place now to achieve an "umbrella" of protection for the network, while direct acquisition efforts and conservation incentive programs identified in this document continue to be implemented.

While it is beyond the scope of this plan to provide detailed recommendations for a comprehensive county rezoning to protect green infrastructure, the Fund is proposing: (1) the design of a Green Infrastructure Network Overlay with performance standards, and (2) the enhancement of the cluster development option.

Green Infrastructure Network Overlay with Performance Standards

The Green Infrastructure Network Overlay is a tool to delineate the county's green infrastructure hub and corridor network across all zoning districts and direct how subdivision and development proposals will be addressed. The goals of the Overlay are to:

- Address the cumulative effects of development and non-point source pollution.
- Reduce fragmentation of forest habitat, wetlands, and aquatic systems.
- Maintain functional natural systems and retain ecosystem service values.
- Strategically locate and size lots for maximum environmental value and landowner enjoyment.
- Provide opportunities for conservation solutions on environmentally sensitive lands and stream corridors.

According to the Fund's analysis, many of the ecosystem service benefits provided by the GI network are operative only at scales of hundreds and even thousands of acres across and within the various watersheds of the county. For example, data indicate that when watersheds drop below 40% forest, water quality suffers, and restoration is needed. The Fund believes the most effective and direct means to avoid costly restoration efforts and maintain functioning natural systems is to undertake a comprehensive planning process that establishes performance-based zoning to protect the Green Infrastructure network.

To implement the Green Infrastructure Network Overlay and incorporate other tools outlined in the Green Infrastructure Network section, a series of performance standards should be instituted to better direct future development and public infrastructure such as utility corridors

and roadways. Performance standards would be aimed at maintaining or enhancing water quality and protecting or restoring GI elements such as: corridor connectivity; large highly ranked hubs; priority wildlife and plant habitat; and high quality streams and aquatic habitats. The exact approach and performance standards used to achieve protection of the network require further study, which should be the subject of a separate re-zoning exercise initiated in conjunction with the county-wide comprehensive planning update. Overlay performance standards either supplement or replace existing elements of the county zoning regulations. The scientific literature and publications, such as the Environmental Law Institute's *Conservation Thresholds for Land Use Planners* (2003), contain adequate guidance for setting thresholds to protect stream water quality, biodiversity and ecological integrity.

Cluster Development Option

In conjunction with the Overlay, the Fund recommends that the County enhance the Cluster Development option to increase density in suitable areas; achieve a compact environmental footprint that requires substantially less land for residential development; and guide design in locations outside of preferred growth areas. The fundamental goal of this option is to shift to cluster lot development in areas that can best support higher densities within carefully chosen envelopes that minimize or avoid further losses of the most productive agricultural lands; the most ecologically valuable green infrastructure; and the healthiest watersheds. The Cluster Development option would directly control subdivision and lot design; building envelopes; setbacks and buffer zones; and the scale and location of public infrastructure including roads, water, wastewater and utilities. Limiting grading and impervious surface area through

downscaled road design criteria; low impact development techniques; explicit impervious surface thresholds and building envelope square foot limits will be critical to maintaining stream health and controlling cumulative impacts at the watershed scale.

Water Quality Strategies

Based on the Fund's Water Quality Maintenance and Enhancement Analysis, water quality strategies were identified for land conservation, reforestation/restoration, best management practices, development site design, and TMDL/nutrient reduction. Major strategies identified in the analysis included:

- Target water quality maintenance and enhancement activities around 16 Conservation Focus Watersheds and 10 Reforestation Focus Watersheds. Several activities were recommended in these watersheds to achieve overall percentage goals for maintaining forest cover and limiting impervious surfaces.
- Target cost share programs from USDA and the State of Maryland to promote conservation practices on working lands. Specific BMPs with particular value for protecting water quality were identified such as conservation tillage, cover crops, and treatment/retirement of highly erodible land.
- Address nutrient reduction and TMDL requirements by: completing wastewater treatment plant upgrades; providing incentives for the installation of denitrifying septic systems; directing growth to areas with wastewater treatment service; and implementing a reforestation planting formula when conversions of forest and agricultural land occurs.
- Control watershed impacts through performance based zoning that emphasizes the use of low impact development techniques.

New Tracking and Reporting System

A new tracking and reporting system is recommended to monitor direct and indirect impacts to Cecil County's green infrastructure. The purpose of the system is to create the capacity to characterize, evaluate and recommend future actions to protect the GI by tracking quantitative and qualitative changes to the network. Examples of quantitative changes that could be tracked include: overall acreage and spatial distribution of network conversions to non GI uses; type, acreage and specific location of each conversion; number and location of corridor connections retained, broken or restored; number of intact hubs and fragmented hubs; trends in average forest patch size; and trends in stream miles buffered by forests or wetlands. Examples of qualitative changes to hubs or corridors that could be tracked include: results of on-site surveys of forest stand conditions; invasive species presence and extent; number and location of informal pathways and recreational vehicle trails in high ranked hubs; changes in hydrological conditions, sediment and stormwater pathways detrimental to the network; and the degree of envelopment and type of land uses adjacent to high ranking hubs. A reporting system could summarize statistics of quantitative and qualitative changes on an annual basis from subdivision and permitting activity reviews, and through remote sensing land use change detection techniques performed periodically (ideally every 2 years) when aerial photography or satellite imagery is available to allow a system wide assessment of direct conversions of the GI network.

Administrative Actions

Initiate a New Department to Protect Green Infrastructure, Water Quality & Natural Resources

Without a substantial investment in protecting Cecil County's existing forest and natural resource lands, it is unlikely the County will focus on or achieve the strategic retention and enhancement of its green infrastructure. If present trends continue, nearly 5,800 acres of forestland will be lost to development by 2030. This plan has demonstrated that vital ecosystem services are very costly to replace, and are critical to maintaining local air and water quality, water supplies, soil conservation, crop pollination, carbon sequestration, reducing storm and flood damage, storing and cycling of nutrients, wildlife habitat, hunting and fishing, and other values. In particular, the analysis completed by the Fund indicates reforestation will become a key issue for the county. More than a traditional community forestry program, the new department would work closely with landowners, communities and other County Departments to actively promote and provide technical assistance services aimed at a broad range of natural resource based watershed protection actions; and forest, wetland, plant and wildlife habitat; and stream protection and restoration. Depending upon the level of initial and long term staffing, the department could:

- Administer the County's Forest Conservation Act regulations and recommending appropriate amendments to enhance protection for the Green Infrastructure.
- Develop and administer a new tracking and reporting system to monitor changes in green infrastructure; stream water quality and habitat conditions; and record best management practices and other Tributary Strategies implementation actions for county watersheds.
- Develop an inventory of priority restoration opportunities and completed restoration projects.
- Manage a Green Infrastructure Fund, created through a portion of potential new development impact fees, excise taxes or other funding sources, aimed at maintaining and enhancing the county's green infrastructure.
- Manage a small tree nursery operation and in-house crew to plant, monitor and maintain reforestation projects.
- Promote private landowner forest banking and Forest Conservation Management Agreements in cooperation with the Maryland DNR.
- Establish county reforestation sites for nutrient offsets needed for TMDL and Tributary Strategy nutrient reduction goals using FCA fee-in-lieu funds or other sources such as borrowed money from the State revolving loan fund, government grant programs, or private foundation grants.
- Promote opportunities for restoration of GI through landowner outreach and technical assistance.
- Promote conservation developments with habitat and water quality enhancement and reforestation of open space features.

The Conservation Fund is familiar with and recommends an examination of Baltimore County's forestry programs, which are leading the nation in innovation and effectiveness. Baltimore County operates a Community Reforestation Program that, in part, uses Forest Conservation Act fee-in-lieu funds from the development community to reforest open lands being committed by agencies for this purpose, including State and County lands. All costs of equipment, reforestation materials and labor are paid for by the developers' mitigation fund.

Carroll County has achieved an 82% forest retention rate, compared to the state's average

of 65%, and leads the state in forest banking. More than 70 private landowner banks have been sold out with replacement forestland selling for about \$10,000 to \$12,000 an acre. Similar efforts to promote private landowner forest banking should prove fruitful in Cecil County.

Initiate Investigation of Pending Nutrient Trading System Rules & Possible Pilot County Program

Although the timing and scope for implementation of future nutrient trading systems are uncertain, it is in Cecil County's best interest to closely follow these developments to determine how nutrient trading and offsets would affect future development and reforestation efforts. A pilot program may be the first step to more actively manage nutrient pollution levels that will ultimately affect growth and development and the quality of life in the county. A serious dialogue with municipal and State officials would be a requisite step in assessing the pros and cons of a pilot program. The problem of nutrient reduction is primarily technological and is tied to: 1) achieving wastewater treatment plant nutrient removal upgrades that meet concentrations of 3.0 milligrams per liter or less total nitrogen and 0.3 milligrams per liter or less total phosphorous (ENR technology); and 2) maintaining nutrient loading caps specified by the Maryland Department of Environment. Beyond technology-based improvements, investment in a Green Infrastructure program emphasizing broad scale reforestation efforts could help address current and future nutrient cap issues.

The situation is complex and uncertain, yet critically importance to Cecil County. The county is affected by nutrient caps for nitrogen and phosphorous through the Upper Eastern Shore and Upper Western Shore Tributary Strategies which have set forth comprehensive nutrient

reduction policies and goals. Also, two rivers, the Northeast and Bohemia, have TMDL allocations for nitrogen and phosphorus, and the Sassafras River has a TMDL allocation for phosphorus. The Tributary Strategy caps are voluntary for the time being, but if the caps are not met, a formal TMDL for the Chesapeake Bay may be adopted in 2010. Maryland's 2006 draft policy on water quality trading does allow interstate trading. The State has not officially released its water quality trading policy, but this policy initially only addresses point to point source trading. Trading systems operate at the watershed level. The Octoraro watershed lies within several jurisdictional boundaries spanning Cecil and Harford Counties in Maryland, and Lancaster and Chester Counties in Pennsylvania. Pennsylvania's water quality trading policy does not explicitly specify if interstate trading is allowed, but the State has not ruled it out. Finally, although work is underway to resolve watershed boundary delineations used by Maryland and Pennsylvania, sub-watersheds are mapped differently in each state and do not line up across the borders.



Reforestation opportunity at Fair Hill Natural Resource Management Area.

New Fees & Taxes

Under the Commissioner form of government, Cecil County must obtain Maryland General Assembly authorization to enact new taxes, license or franchise fees, tax credits, impact fees and excise taxes. The latter two mechanisms – impact fees and excise taxes – were the subject of a January, 2007 report to the County by Sage Policy Group, Inc., reviewed by the Fund.

Impact Fees

The Conservation Fund supports the finding of the Sage report that impact fees are a reasonable means to provide needed water and wastewater systems capital improvements and can be used to guide growth and limit land consumption. The Fund supports the recommendation that a differential fee structure – higher in rural preservation zones and lower in the growth corridor – will support the County's stated goals of the comprehensive plan. Four of eight Commissioner-form local governments have impact fees. Levying impact fees must be done with caution and meet certain legal tests. Generally, fees must benefit primarily the new development and bear some rational relationship to the cost imposed on the community by the developments upon which the fees are charged. The Fund encourages the County to consult with its legal representatives to determine if a portion of any new impact fees can reasonably be earmarked for protection and restoration of local green infrastructure where deterioration of ecosystem services (mentioned in this report) are likely or direct resource losses are incurred.

Excise Taxes

Excise taxes are special taxes on specific goods or activities such as gasoline, tobacco, or real estate transactions ("transfer tax"). Cecil County has no local real estate transfer tax, while the

State of Maryland collects a 0.5% Program Open Space transfer tax. Three other Commissioner-form local governments collect transfer taxes ranging from 0.5 to 1%. Transfer taxes could be a significant revenue source for local land protection and restoration in Cecil County. If no other new revenue sources are considered for protection of green infrastructure lands or the operation of administrative programs recommended in the Implementation Quilt section of this report, the Fund recommends serious consideration of new local transfer taxes. Revenues from local transfer taxes should be set aside in a dedicated Community Conservation Fund that can only be used for land acquisition and administration of green infrastructure related activities.

Balancing Smart Growth Incentives & Disincentives

The rate of rural land consumption in Cecil County is rapidly diminishing natural and agricultural resources. Providing incentives to the development community to locate in designated growth areas is an obvious need. Requiring large lots in rural areas is often thought of as a conservation and open space solution, achieved through increases in minimum lot sizes and decreased density. However, large lots have the potential to raise land consumption rates, increased fragmentation, and further adverse impacts on natural systems. To avoid unintended consequences and ensure the protection of natural systems, a balanced approach of incentives and disincentives is needed that adheres to a few basic principles:

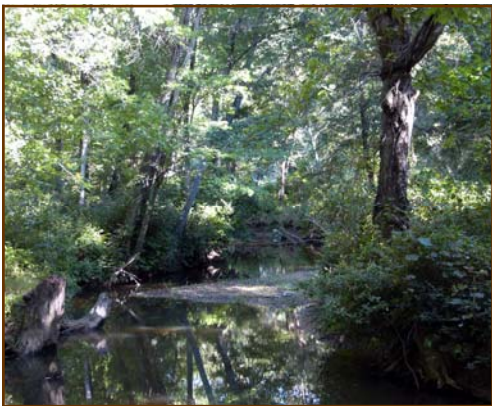
- Suitable locations for development, such as those near existing water and sewer infrastructure, should accommodate higher density development where existing gray infrastructure can support it.

- In suitable locations, minimum lot sizes should be reduced to facilitate economically viable cluster development and to avoid fragmentation of natural systems.
- Within sensitive areas, landowners should have viable options in addition to development in suitable locations on their property, including the ability to sell their development rights within a Transfer of Development Rights (TDR) program that transfers density to suitable development locations with existing built infrastructure and the ability to have development rights purchased as part of a Purchase of Development Rights (PDR) program.

Similarly, County officials can work closely with their municipal counterparts to determine if mutually advantageous incentive and disincentive mechanisms can be identified.

Some mechanisms might include:

- Establish steep “water quality” impact fees to discourage new developments in rural areas that are served by septic systems and requiring that all new septic systems be state-of-the-art nitrogen removing systems.
- Encourage local government jurisdictions to subsidize front end costs associated with sewer and water hookups – recouping fees from the developer once the units are sold.
- Encourage local government subsidy of sewer and water hook-ups only in Priority Funding Areas.



Plum Creek near head of tide.

Bond Funding

One potential mechanism the County can use to accelerate its land conservation efforts is bond financing. The advantage of bonds is their ability to facilitate immediate land or easement purchases and to distribute costs over a long-term, fixed time period (Maryland law sets a 15-year limit). The two main options are revenue bonds and general obligation (GO) bonds. GO bonds allow the government to borrow secure funds with a commitment to timely payments of principal and interest over a fixed time period. Bonding authority must specifically be authorized by the Maryland General Assembly. Although no statutory limitations exist, Cecil County has established a self-imposed debt affordability limitation and works closely with the Capital Improvements Program committee to establish local priorities. The recent Sage Group report indicates that by fiscal year 2009, general fund debt service, net debt per capita and net debt to income, will all exceed comfortable ranges. Due to the County's critical funding priorities for water and sewer improvements and other infrastructure needs it does not seem feasible, at this time, to create additional bond funding from general obligation bonds.

Alternatively, revenue bonds are paid by the proceeds from an existing specialized tax or fee (e.g., real estate transfer tax). These types of bonds are more expensive to repay than GO bonds, and they usurp future revenues to make interest payments that would otherwise be available for potential land conservation opportunities. According to a 1991 Maryland DNR report, two criteria determine the feasibility of using long-term debt to increase POS funding availability: 1) land appreciation rates are greater than tax-exempt interest rates; and 2) the land parcels in question face intense development and are unlikely to remain available (Maryland DNR, 1991). In the recent past,

condition #1 has occurred and condition #2 will likely be the case for the next several years. If the County elects to add a local transfer tax funding source for green infrastructure lands, then this revenue could be bonded to multiply the amount available upfront for priority acquisitions.

Partnerships

Forging partnerships and alliances is critical when pursuing ambitious conservation objectives. Collaboration allows for a greater likelihood of success in winning support and funding for land protection initiatives. Partnerships should be sought with municipalities within the county and other local governments outside the county. Ecosystem benefits derived from protection of green infrastructure networks extend beyond jurisdictional boundaries. Water quality maintenance and enhancement benefits, in particular, are leveraged by protection of green infrastructure networks across an entire watershed, often benefiting several jurisdictions.

Other excellent partners include the local land trusts serving Cecil County: the Cecil Land Trust, the Eastern Shore Land Conservancy, and the Maryland Environmental Trust (MET). MET uses State money to provide training, funds and other support to local land trusts. Shared visions and multi-organizational goals can be developed to target conservation of specific components of the county's green infrastructure network. Developing written, long term agreements which spell out the goals and organizational contributions involved in implementing a common vision can be a powerful arrangement. Facilitating sharing of scarce local financial and human resources, and enhancing competitive efforts to secure federal, state and private (e.g., corporate or foundation) funds is also important.



Old growth oak-beech forest in Elk Neck State Park.

Education Outreach

The Green Infrastructure Plan developed for Cecil County has not been vetted through an advisory group or public involvement process. The Fund recommends that additional public involvement and evaluation of the proposed plan and recommendations is undertaken. This may take the form of a citizen advisory group, focus groups, public forums hosted by the county or other local organizations or even an informal or formal opinion poll designed to gauge public acceptance of the proposed Green Infrastructure Plan and recommendations. Garnering public support will also require a discussion and evaluation of the costs and the near- and long-term benefits of pursuing a green infrastructure program versus a continuation of the status quo. The plan contains economic estimates of the values derived from an aggressive conservation program; however, the public must be assured that the program is a sound financial investment. An effective education campaign could present a convincing case for GI program benefits for present and future generations balanced against its investment costs.

CONCLUSION

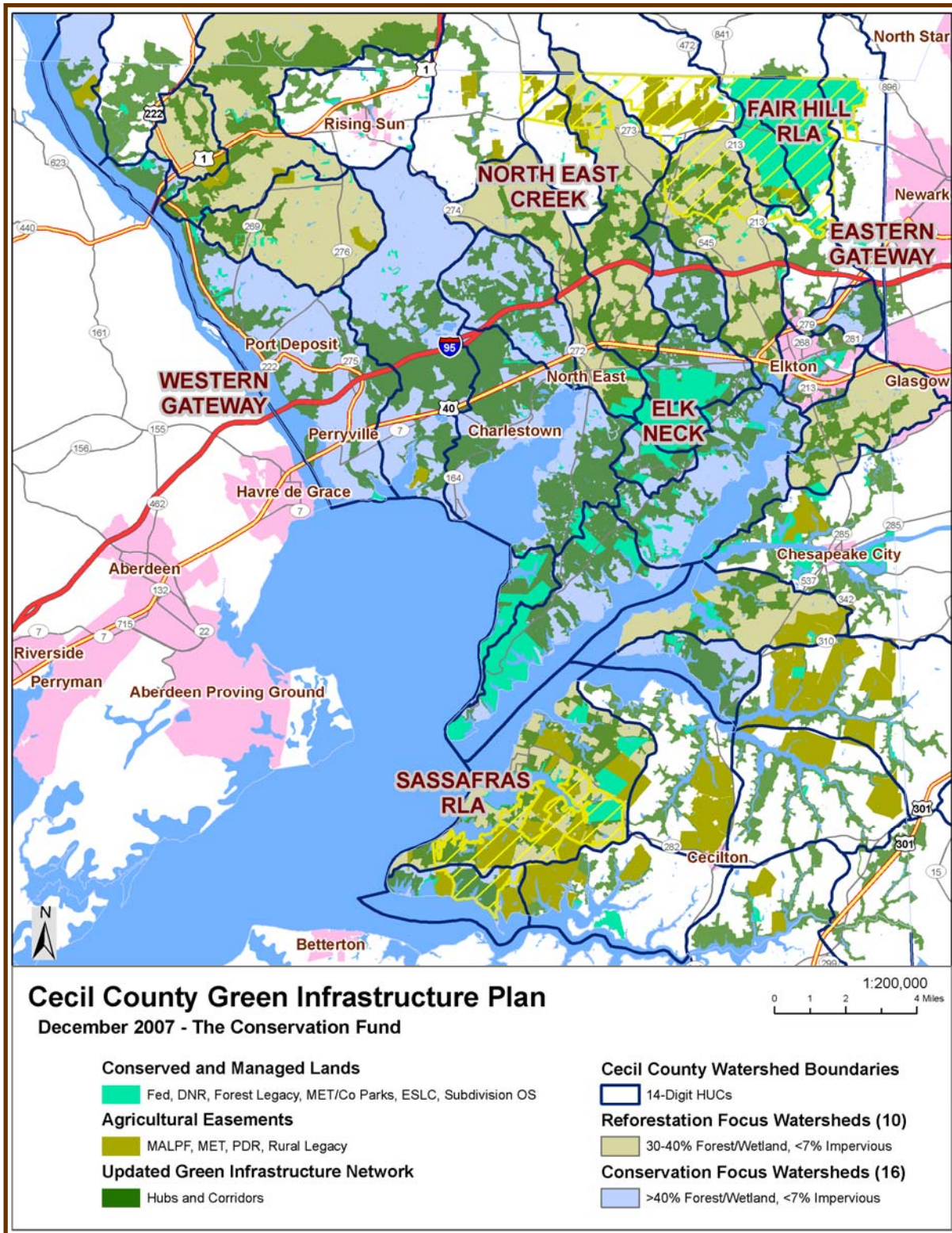
Cecil County, Maryland, is at a crossroads. Given recent trends in land use change and that only 23% of the county's green infrastructure network is in some form of protected status, the time is now to evaluate the recommendations in this plan and take tangible steps towards implementation in an effective and efficient manner. The County faces a significant challenge to the goal of protecting its green infrastructure given the present configuration of designated development districts. Future adjustments should be made through the comprehensive planning process and new land use planning strategies to address this fundamental conflict. Using green infrastructure as the organizing framework for resource protection in Cecil County will provide an array of benefits to residents, including a legacy of clean water, habitat protection, lands for human enjoyment, and protection of ecosystem services. Given the array of recommendations provided in this plan, an easy first step might be to identify opportunities for near-term action built around key locations where green infrastructure investments could achieve significant benefits within a shorter time horizon. The map on the facing page highlights key green infrastructure protection opportunities that best protect Cecil County's green infrastructure network, water quality, and other ecosystem services. Opportunities include:

- **Western Gateway** — This is a key entry point to Cecil County from the west on I-95 and includes a scenic vista of the bluffs along the Susquehanna River. The area also includes scenic roads and a state "sentinel" watershed, which contains one of the best remaining streams in the state, an unnamed tributary to Principio Creek (Prochaska, 2005). There also is an opportunity for a "greenbelt" between Perryville and Port Deposit that links to the broader green
- **Eastern Gateway** — This is a key entry point to Cecil County from the east on I-95 and is in close proximity to Big Elk Creek, Elkton's water supply. The area also is a key linkage to Delaware's Ecological Network.
- **Elk Neck** — This area has the highest ranked green infrastructure hubs in the county and opportunities remain to retain connections between large hubs in the north and south ends of Elk Neck.
- **North East Creek** — This is the most important riparian corridor in the northern part of the county, one of the only green infrastructure corridors not severed by development north of I-95 between 1992 and 2002. It is one of the only corridors remaining that links Cecil County to the green infrastructure network in Pennsylvania.
- **Rural Legacy Areas** — Cecil County contains two key Rural Legacy Areas (RLAs): Fair Hill and the Sassafras Agricultural Security Corridor. These are opportunities to target agricultural easement programs, USDA cost share programs, and other conservation techniques that preserve the county's rural heritage.
- **Conservation Focus Watersheds** — 16 watersheds with the best water quality were identified. Implementation efforts should focus on land conservation and targeted restoration to achieve or maintain at least 50% forest and wetland land cover.
- **Reforestation Focus Watersheds** — 10 watersheds were identified where water quality enhancement through reforestation would provide significant benefits. Implementation efforts should focus on achieving at least 40% forest and wetland land cover (currently between 30-40%).

With the opportunities mentioned here as a potential starting point, Cecil County can develop a comprehensive green infrastructure protection

program utilizing tools from the Implementation Quilt. Investing in these assets now will help ensure the protection of green infrastructure,

water quality, ecosystem services, and the associated benefits of nature to humans for current and future generations.



REFERENCES

- American Farmland Trust. 2002. Cecil County, Maryland: Cost of community services study. American Farmland Trust, Washington, DC.
- American Forests. 1999. Regional ecosystem analysis: Chesapeake Bay region and the Baltimore-Washington corridor. American Forests, Washington, DC.
- American Lung Association. 2001. American Lung Association fact sheet: asthma in adults. Online at <http://www.lungusa.org/asthma/aduasthmfac99.htm>.
- American Lung Association. 2004. State of the Air: 2004. <http://lungaction.org/reports/stateoftheair2004.html>.
- Anderson, G. S., and B. J. Danielson. 1997. The effects of landscape composition and physiognomy on metapopulation size: the role of corridors. *Landscape ecology* 12:261-271.
- Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R. E. Green, M. Jenkins, P. Jefferiss, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and K. Turner. 2002. Economic reasons for conserving wild nature. *Science* 297:950- 953.
- Beier, P., and R. F. Noss. 1998. Do habitat corridors provide connectivity? *Conservation Biology* 12 (6):1241-1252.
- Benedict, M., and E. McMahon. 2002. *Green infrastructure: smart conservation for the 21st century*. The Conservation Fund, Arlington, VA, and *Sprawl Watch Clearinghouse*, Washington, DC.
- Benedict and McMahon, 2006. *Green Infrastructure: Linking Landscapes and Communities*. Island Press. Washington, DC.
- Bennett, A. F. 1998. Linkages in the landscape: the role of corridors and sensitivity in wildlife conservation. IUCN, Gland, Switzerland and Cambridge, UK.
- Bockstael, N.E. 1996 Modeling economic and ecology: the importance of spatial perspective. *Amer. J. Agr. Econ.* 78: 1168-1180.
- Casey, J. F. 2004. The value of riparian forest buffers in the Chesapeake Bay watershed: an economic framework for policy-making. National Oceanic and Atmospheric Administration.
- Chesapeake Bay Program. 2000. Riparian Forest Buffers. Online at <http://www.chesapeakebay.net/info/forestbuff.cfm>.
- Chesapeake Bay Program Tidal Monitoring and Analysis Workgroup. 2005. Maryland Tributary Strategy Upper Eastern Shore Basin Summary Report for 1985-2003 Data. Maryland Dept. Nat. Res., Annapolis, MD.
- City-data.com. 2007. Cecil County, Maryland. Online at http://www.city-data.com/county/Cecil_County-MD.html.
- Conservation Fund, The. 2000. Welcome to the GreenInfrastructure.Net Website: Providing a Strategic Framework for Smart Conservation. Online at <http://greeninfrastructure.net/>.
- Conservation Fund, The. 2006. The state of the Chesapeake forests. The Conservation Fund, Arlington, VA.
- Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O'Neill, J. Paruelo, R. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:252- 259.
- Crompton, J. L. 2001. The impact of parks and open space on property values and the property tax base. National Recreation and Park Association, Ashburn, VA.
- Dreher, D. and T. Price. 1995. Application of urban targeting and prioritization methodology to Butterfield Creek, Cook and Will Counties, Illinois. National Conference on Urban Runoff Management. EPA/625/R-95/003. pp. 119-134.
- Environmental Law Institute. 2003. *Conservation Thresholds for Land Use Planners*. Washington, DC.
- Forman, R. T. T., and M. Godron. 1986. *Landscape Ecology*. John Wiley and Sons, New York, NY.
- Jones, K. B., A. C. Neale, M. S. Nash, R. D. van Remortel, J. D. Wickham, K. H. Riitters, AND R. V. O'Neill. 2001. Predicting nutrient and sediment loadings to streams from landscape metrics: a multiple watershed study from the United States Mid-Atlantic region. *Landscape Ecology* 16(4):301-312.
- Landers, J. 2006. Test results permit side-by-side comparisons of BMPs. *Civil Engineering*, April 2006, pp. 34-35.
- Langland, M., and T. Cronin (eds.) 2003. A summary report of sediment processes in Chesapeake Bay and watershed. Water-Resources Investigations Report 03-4123. U.S. Geological Survey, New Cumberland, PA.
- MacArthur, R. H. and E. O. Wilson. 1967. *The theory of island biogeography*. Princeton University Press, Princeton, NJ.

- Maryland Department of the Environment. 2006a. Maryland's Interim TMDL Implementation Guidance for Local Governments. Maryland Dept. Env., Baltimore, MD.
- Maryland Department of the Environment. 2006b. Prioritizing sites for wetland restoration, mitigation, and preservation in Maryland. Draft version: April 27, 2006. Maryland Department of the Environment Wetlands and Waterways Program, Baltimore, MD.
- Maryland Department of the Environment. 2004a. 303 (d) list searchable database. Online at http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/303d_search/303d_map.asp. Accessed on June 1, 2007.
- Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. 1999. From the mountains to the sea; the state of Maryland's freshwater streams. Environmental Protection Agency 903-R-99-023.
- Maryland Department of Natural Resources, Office of Planning, Department of Budget and Fiscal Planning. 1991. Program Open Space Bond Financing, Annapolis, MD.
- McQueen, M. 2000. Land and water conservation: an assessment of its past, present and future. The Conservation Fund, Arlington, VA.
- Moore, T. (ed.) 2002. Protecting Maryland's Green Infrastructure. The case for aggressive public policies. Online at http://www.magicalliance.org/GreenPrint/protecting_maryland.htm. Maryland Dept. of Natural Resources, Annapolis, MD.
- National Association of Home Builders and National Association of Realtors. 2002. Consumers survey. Online at <http://www.realtor.org/publicaffairsweb.nsf/Pages/SmartGrowthSurvey02?OpenDocument>.
- NRCS (Natural Resources Conservation Service). 2007. National Resources Inventory 2003 Annual NRI. Online at <http://www.nrcs.usda.gov/>.
- North Carolina State University. 1998. Information on Wetlands. Online at <http://h2osparc.wq.ncsu.edu/info/wetlands/>
- Pimentel, D. 1998. Economic and environmental benefits of biological diversity in the state of Maryland. pp. 63-75 in Therres, G. D. (ed.) Conservation of biological diversity: a key to the restoration of the Chesapeake Bay ecosystem and beyond. Maryland Dept. Nat. Res., Annapolis, MD.
- Prochaska, A. P. 2005. Maryland Biological Stream Survey 2000-2004, Volume XI: Sentinel Site Network. Maryland Dept. of Natural Resources, Annapolis, MD. PUB # DNR-12-0305-0104.
- Ricketts, T. H., N. M. Williams, and M. M. Mayfield. 2006. Connectivity and ecosystem services: crop pollination in agricultural landscapes. pp. 255-289 in Crooks, K. R., and M. Sanjayan (eds.) Connectivity conservation. Cambridge University Press, New York.
- Ryan, W., and J. Duberg. Date unknown. Assessing the Economic Importance of Commercial Fisheries in the Mid-Atlantic Region: A User's Guide to the Mid-Atlantic Input/Output Model. Northeast Fisheries Science Center, Woods Hole, MA.
- Salzman, J., Thompson, B. H. Jr., Daily, G. C. 2001. Protecting ecosystem services: science, economics, and law. Stan. Envtl. L. J. 309
- Solomon, S., D. Qin, and M. Manning (eds). 2007. Climate Change 2007: The Physical Science Basis. Intergovernmental Panel on Climate Change. Geneva, Switzerland.
- Söndgerath, D., and B. Schröder. 2002. Population dynamics and habitat connectivity affecting the spatial spread of populations - a simulation study. Landscape ecology 17:57-70.
- Stedman, S. and J. Hanson. Date unknown. Habitat Connections: Wetlands, Fisheries and Economics, Part Five: Wetlands, Fisheries, & Economics in the Mid-Atlantic. Online at <http://www.nmfs.noaa.gov/habitat/habitatconservation/publications/habitatconnections/num5.htm>.
- U.S. Environmental Protection Agency. 1998. Climate change and Maryland. EPA Publication 236-F-98-0071.
- U.S. Fish and Wildlife Service. 2003. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Maryland. FHW/01-MD-Rev.
- Weber, T. 2003. Maryland's green infrastructure assessment: a comprehensive strategy for land conservation and restoration. Maryland Dept. Nat. Res., Annapolis, MD.
- Weber, T. 2007. Development and application of a statewide conservation network in Delaware, U.S.A. Journal of Conservation Planning 3:17-46.
- Weber, T. 2007a. Ecosystem Services in Cecil County's Green Infrastructure. Unpublished report prepared for the Cecil County Green Infrastructure Plan.

Cecil County Maryland Green Infrastructure Plan

Weber, T. 2007b. Land Conservation, Restoration, and Management for Water Quality Benefits in Cecil County, Maryland. Unpublished report prepared for the Cecil County Green Infrastructure Plan.


Weber, T. 2007c. An Assessment of Cecil County's Green Infrastructure. Unpublished report prepared for the Cecil County Green Infrastructure Plan.

Weber, T., J. Wolf, P. Blank, R. Aviram, and J. Lister. 2004. Restoration targeting in Maryland's Green Infrastructure. Maryland Dept. Nat. Res., Annapolis, MD.

Weber, T., J. Wolf, and A. Sloan. 2006. Maryland's green infrastructure assessment: development of a comprehensive approach to land conservation. *Landscape and Urban Planning* 77:94-110.

1000 Friends of Maryland. Date unknown. Smart Growth: How is Your County Doing? Upper Eastern Shore. 1000 Friends of Maryland, Baltimore, MD.

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