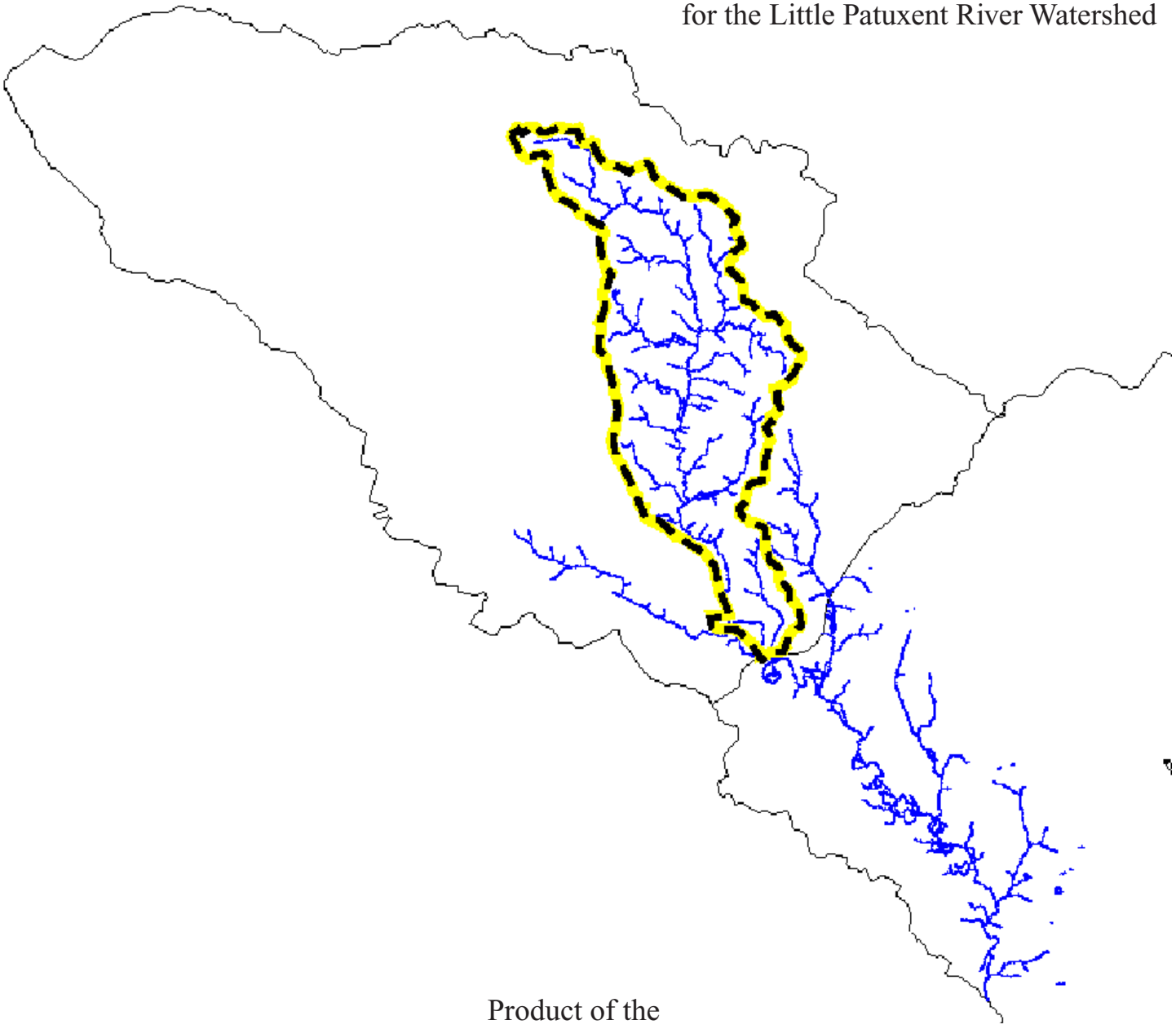
Little Patuxent River
Watershed Characterization

July 2001

In support of Howard County's
Watershed Restoration Action Strategy
for the Little Patuxent River Watershed



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In partnership with Howard County

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To inspire people to enjoy and live in harmony with their environment, and
to protect what makes Maryland unique – our treasured Chesapeake Bay,
our diverse landscapes, and our living and natural resources.

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Introduction

The Little Patuxent River watershed is located in the eastern portion of Howard County and is approximately 51 square miles, excluding the Hammond Branch and Dorsey Run tributary watersheds. The watershed is predominantly located within the County's Planned Water and Sewer Service Area, which is also the County's Priority Funding Area. The County has conducted numerous watershed protection and restoration projects over the past decade within this watershed.

Howard County is receiving Federal grant funding and State technical assistance to prepare a Watershed Restoration Action Strategy (WRAS) for the Little Patuxent River watershed for the following reasons:

– The 1998 *Maryland Clean Water Action Plan* identified the Little Patuxent River watershed as a Priority Watershed "in need of restoration."

– Howard County applied for grant funding and volunteered to develop a strategy in the watershed to improve water quality and habitat by identifying protection needs and implementing restoration projects.

The WRAS will include a watershed restoration plan and implementation strategy that will serve as a workplan for restoring and protecting water quality and aquatic and terrestrial habitats, and for addressing the need for community environmental education. The watershed restoration plan and implementation strategy will identify and prioritize future actions needed, including additional studies and implementation projects. This watershed characterization [be developed] describes current conditions, based on existing watershed information and includes information on the natural and built environment in addition to identifying information gaps. The Characterization focuses on the following categories.

Water Quality

The Little Patuxent River is a Use I-P water with designated uses of water contact recreation, protection of aquatic life and public water supply. Maryland's Water Quality Inventory for 1993-1995 (the 305(b) report) describes water quality in the Little Patuxent River as probably fair, with high levels of bacteria, nutrients and suspended sediments. The 1996 Maryland list of water quality limited segments (the 303(d) list) describes the Little Patuxent River as impaired for nutrients, suspended sediments and cadmium. Water quality problems associated with nutrients tend to be limited to impoundments within the Little Patuxent River watershed and to areas downstream of the watershed in estuarine areas of the Patuxent River. Suspended sediment problems appear both in impoundments where the sediments settle or in excessive sediment bed load in local streams. Cadmium is a localized concern in relatively limited areas of the watershed.

Land Use

The Little Patuxent River watershed encompasses over 66,200 acres in Howard and Anne Arundel Counties. The WRAS area in Howard County covers slightly over 28,000 acres and is in the Mid Atlantic Piedmont Physiographic Province. The watershed contains a variety of land uses, including residential, commercial, industrial, institutional, parks, open space and agriculture.

Based on Maryland Department of Planning data, about 60% of the Little Patuxent watershed in Howard County was in urban land use in 1997. Agriculture and forest lands covered about 15% and 25% respectively. Urban lands are projected to expand to 74% of the watershed by 2020 while agriculture and forest lands decline. This land use shift is likely to increase the existing pressures on water quality and living resources in the watershed.

Living Resources and Habitat

Available information indicates that aquatic species and habitat are under stress from a number of factors related to habitat degradation in many areas and water quality limitations in localized areas. For example, fish species found in local streams tend to be species tolerant of sediment covered stream bottom.

As part of this WRAS, Howard County will conduct biomonitoring and a forest assessment within the watershed. In addition, as part of the County's National Pollutant Discharge Elimination System stormwater permit, the County will conduct an assessment of water quality based on impervious area. This additional information will increase understanding of water quality and habitat conditions within the watershed and help prioritize subwatersheds for restoration activities.

Restoration Targeting Tools

A 1999 stream corridor assessment survey conducted by the Maryland Dept. of Natural Resources (DNR) field personnel found 1,098 problem riparian conditions including inadequate buffers, eroding stream banks, fish passage blockages, channelized stream sections, pipe outfalls, trash, exposed pipes and unusual conditions. These findings indicate numerous stream segments that could be enhanced by restoration projects such as riparian buffer planting, wetland creation and other restoration projects. Howard County is using these detailed findings in its geographic information system (GIS) to help target restoration projects.

Computerized mapping was used to demonstrate techniques and to suggest approaches for prioritizing restoration of stream buffers and wetlands. For example, scenarios based on remote sensing data identified areas where targeted stream buffer enhancement could maximize nutrient uptake by vegetation. Additionally, scenarios were created that identified potential opportunities for enhancing existing wetland areas by restoring adjacent stream buffers and/or restoring wetlands.

The WRAS will use information generated by these tools and other sources to establish priorities for types of restoration projects that meet local interests. It will also provide priorities for the detailed site investigations necessary to identify viable restoration project candidates based on information collected by the stream corridor assessment survey and identified using GIS.

INTRODUCTION

Watershed Selection

Maryland's 1998 *Clean Water Action Plan* identified water bodies that failed to meet water quality requirements. As part of the State's response, the Maryland Department of Natural Resources (DNR) is offering funding and technical assistance to counties willing to work cooperatively to devise and implement a Watershed Restoration Action Strategy (WRAS) for the impaired water bodies.

Howard County is one of five counties participating in the first round of the WRAS program. The portion of the Little Patuxent River watershed within Howard County was selected for restoration based on its geographic location and hydrology. This watershed is located within the Piedmont Plateau and in general this physiographic province has few limitations to land use except for some areas of poor drainage or steep slopes. The surface hydrology is dominated by nontidal streams that are typically free flowing except for man-made impoundments or beaver activity.

Location

The WRAS area is located in the headwaters of the Little Patuxent River watershed encompassing about 43% of the total watershed. Map 1 Regional Context and Map 2 WRAS Project Area show the geographic location of the WRAS watershed. Map 3 County Road Network and Map 4 Streams and Sub-Watersheds provide additional details. Focusing on this area for restoration will allow for tracking at the subwatershed level and for conveyance of benefits from restoration projects downstream in the Little Patuxent River.

Little Patuxent River Watershed

Area	Acreage
Howard Co. WRAS Area	28,055
Howard Co. Other Area	9,929
Anne Arundel Co. Area	28,230
Watershed Total	66,214

Purpose of the Characterization

One of the earliest steps toward devising a Watershed Restoration Action Strategy is to characterize the watershed using immediately available information. This Watershed Characterization is intended to meet several objectives:

– Briefly summarize the most important or relevant information and issues regarding water quality, land uses, and living resources and habitats
– Provide preliminary findings based on this information
– Identify sources for more information or analysis
– Suggest opportunities for additional characterization and restoration work.

Additional Characterization Recommended

The Watershed Characterization is intended to assist the County in developing its WRAS. It is part of a framework for a more thorough assessment involving an array of additional inputs:

– Self-investigation by the local entity
– Targeted technical assistance by partner agencies or contractors
– Input from local stakeholders
– Stream Corridor Assessment, i.e. physically walking the streams and cataloguing issues, which is part of the technical assistance offered by DNR
– Synoptic water quality survey, i.e. a program of water sample analysis, that can be used to focus on local issues such as nutrient hot spots, point source discharges or other selected issues, is also part of the technical assistance offered by DNR.
- Forest Assessment
- Biological water quality monitoring.

Identifying Gaps In Information

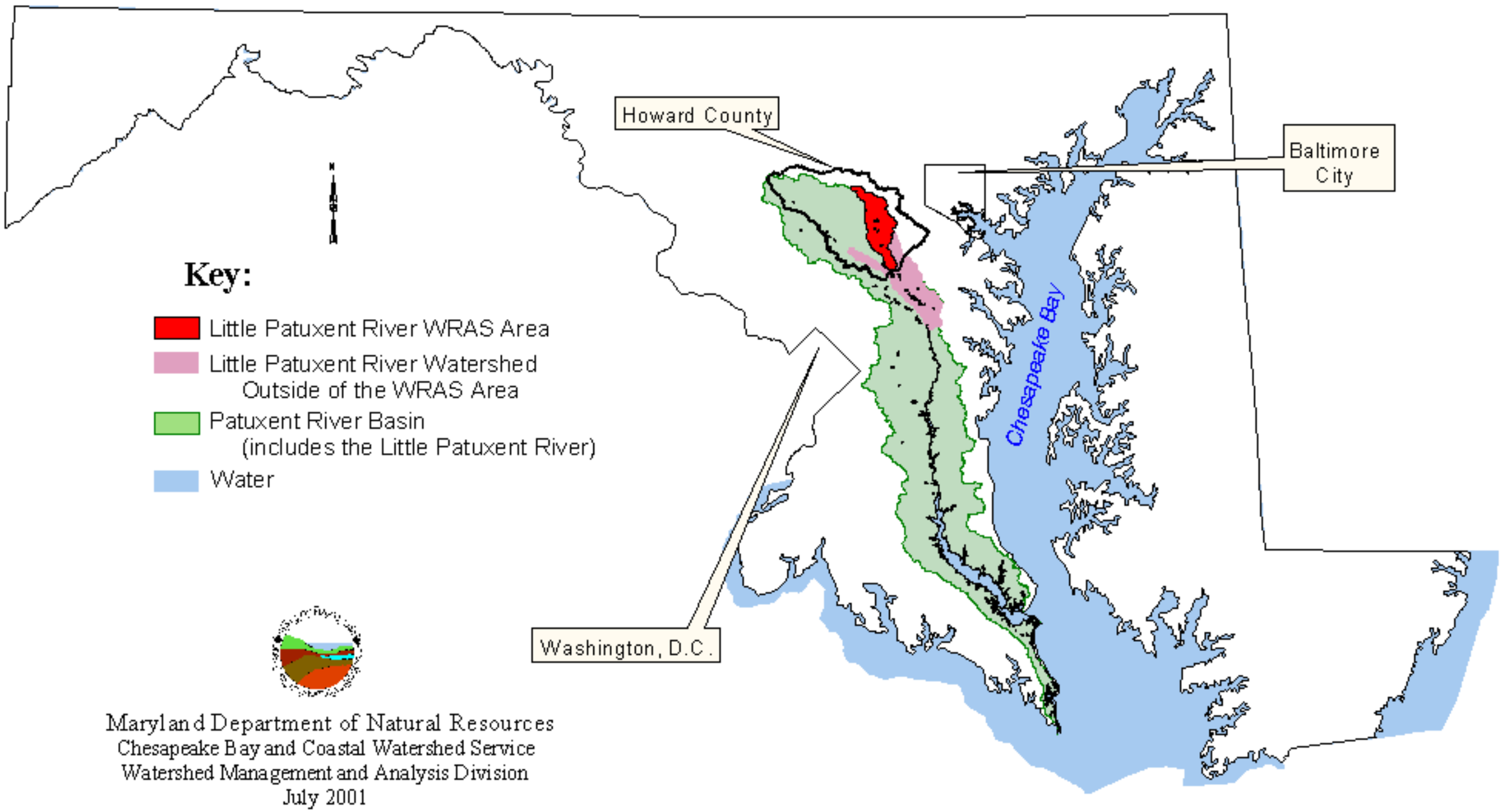
It is important to identify gaps in available watershed knowledge and gauge the importance of these gaps. One method is to review available information in the context of four physical / biological assessment categories that have been successfully applied in other watershed restoration efforts. The main categories that impact aquatic biota include:

– Habitat: physical structure for stream stability and biotic community (including riparian zone)
– Water Quantity: high water - storm flow & flooding; low water - baseflow problems from dams, water withdrawals, reduced infiltration
– Water Quality: water chemistry; toxics, nutrients, sediment, nuisance odors/scums, etc.
– Cumulative effects associated with habitat, water quantity and water quality.

Adaptive Management

The Watershed Characterization and the Watershed Restoration Action Strategy should be maintained as living documents within an active evolving restoration process. These documents will have to be updated periodically as new, more relevant information becomes available and as the watershed response is monitored and reassessed. This type of approach to watershed restoration and protection is often referred to as “adaptive management.”

Map 1 Regional Context
Little Patuxent River Watershed In Howard County
Watershed Restoration Action Strategy (WRAS) Area



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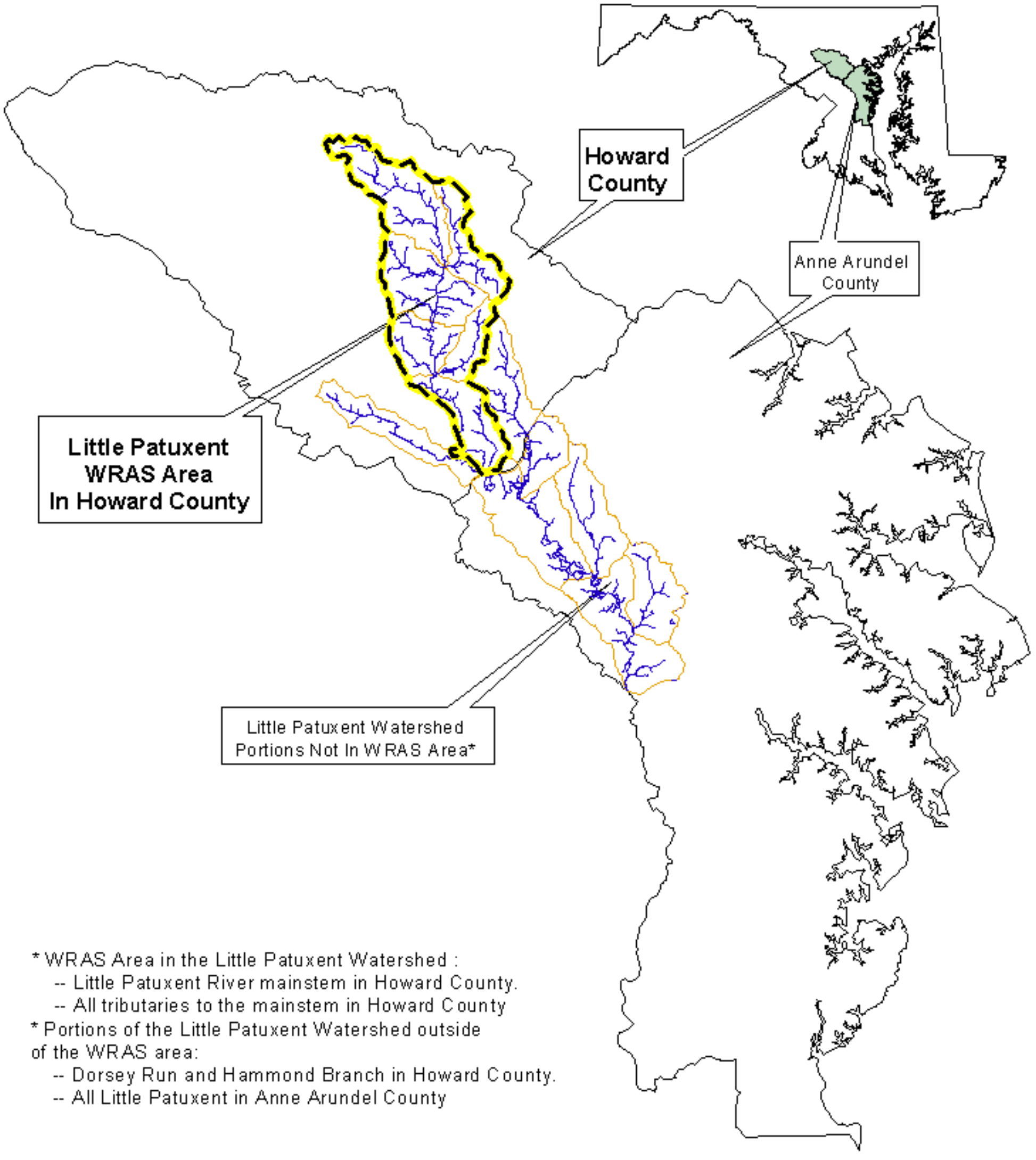
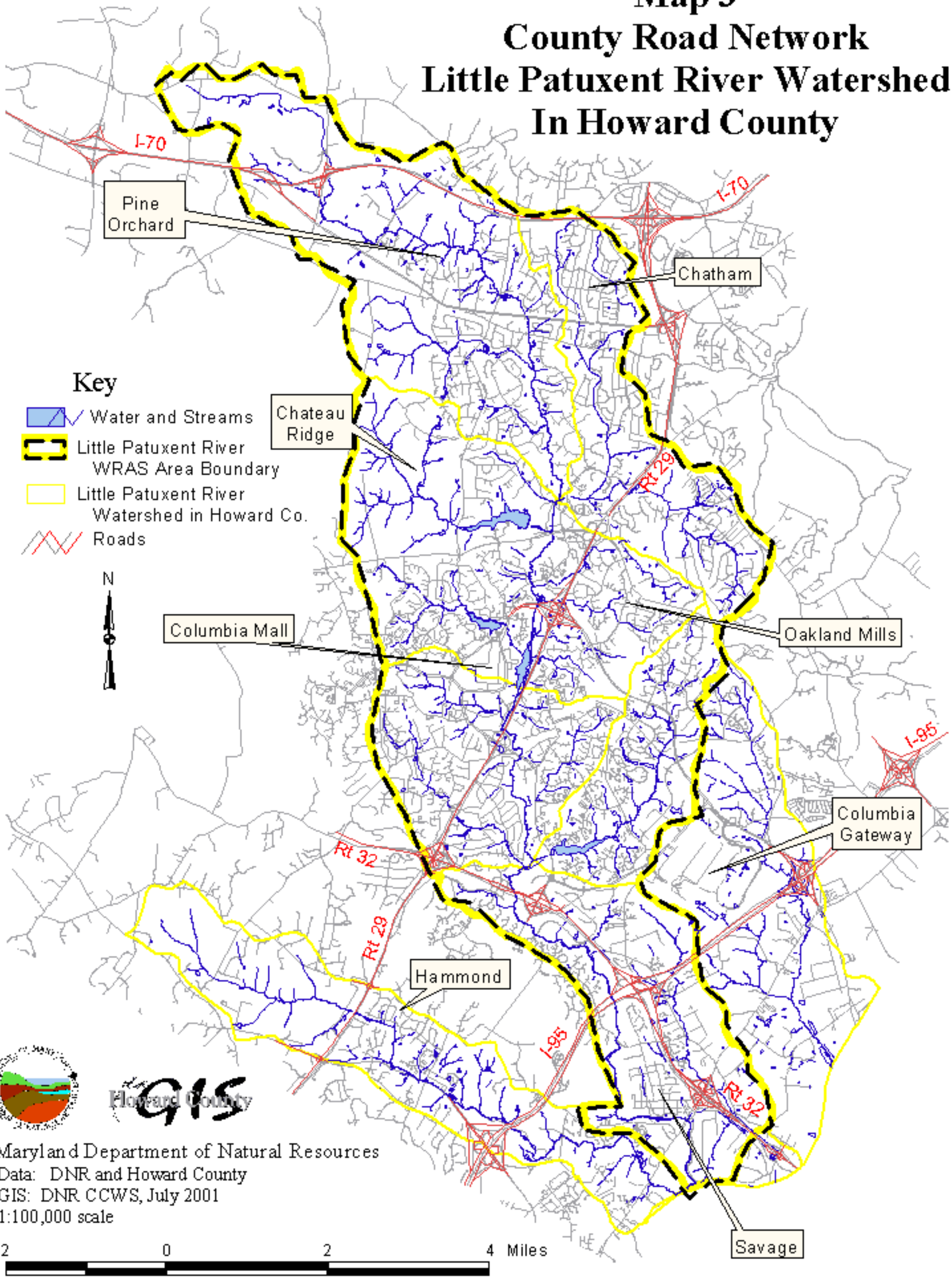
July 2001

Map 2
Little Patuxent River Watershed and Watershed Restoration Action Strategy (WRAS) Project Area In Howard County



* WRAS Area in the Little Patuxent Watershed :
  -- Little Patuxent River mainstem in Howard County.
  -- All tributaries to the mainstem in Howard County
* Portions of the Little Patuxent Watershed outside of the WRAS area:
  -- Dorsey Run and Hammond Branch in Howard County.
  -- All Little Patuxent in Anne Arundel County

Map 3
County Road Network
Little Patuxent River Watershed
In Howard County



Map 4
Streams and Sub-Watersheds
Little Patuxent Watershed
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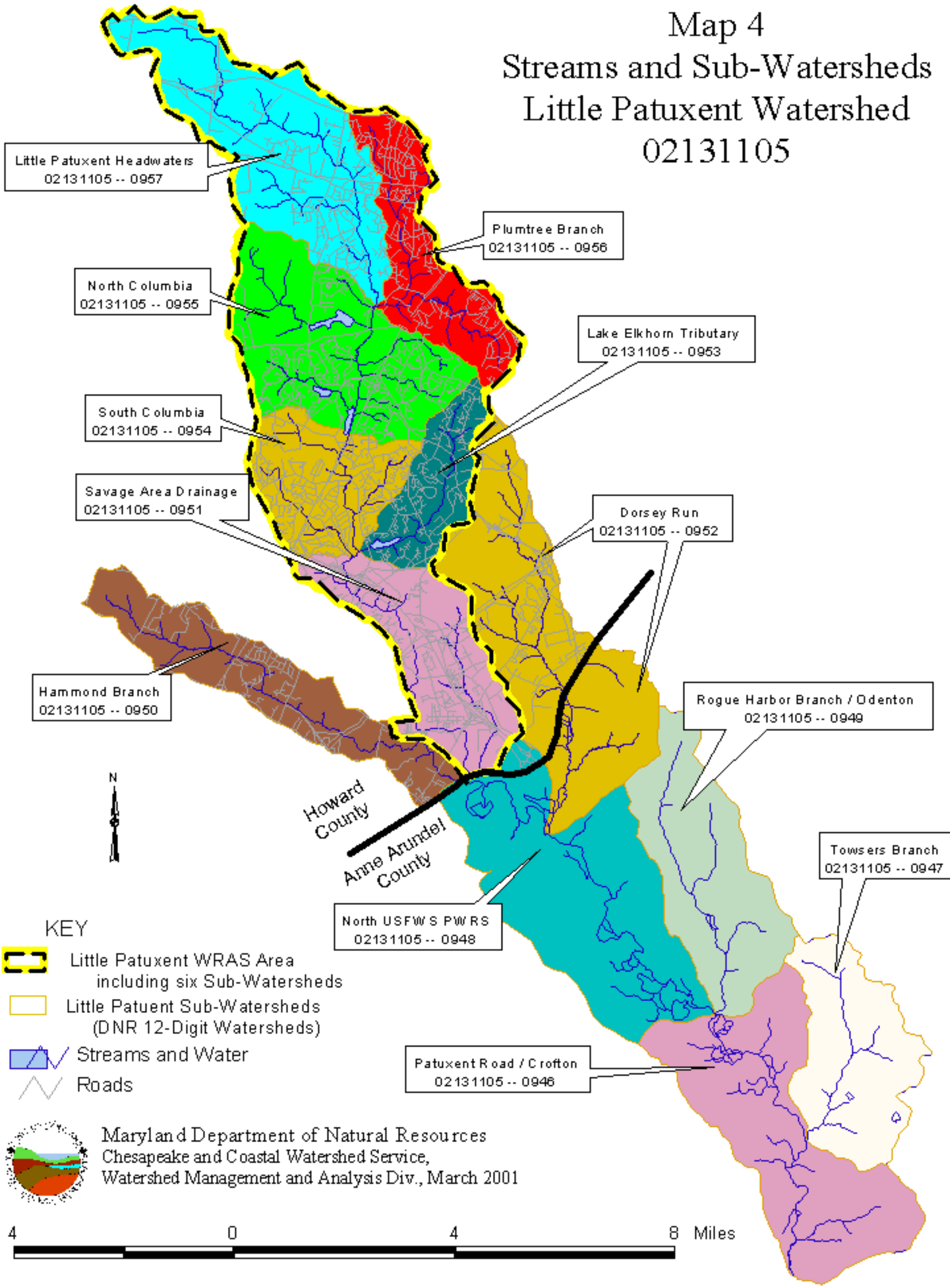

Maryland Department of Natural Resources
Chesapeake and Coastal Watershed Service,
Watershed Management and Analysis Div., March 2001

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WATER QUALITY
Little Patuxent River Watershed

River Basin Context of Local Water Quality Issues

The Little Patuxent River is part of the headwaters for the Patuxent River Basin as shown in Map 1 Region Context. As a result of this hydrologic location, water quality issues in Howard County's portion of the Little Patuxent River watershed have mostly local origins that can be addressed by local action. For example, nutrients in the Little Patuxent River system are mostly generated within the watershed and related issues like eutrophication of local lakes may be addressed by local action to control nutrient loads. (A minority of the total load is from atmospheric deposition.) Therefore, the primary focus of this Characterization is on the local watershed.

However, most nutrients in the Little Patuxent River are transported downstream to the Patuxent River estuary before the water flows slow down enough for water quality problems to arise. For example, excessive algae growth in the Patuxent estuary during warm months is caused by high nutrient loads that arise from upstream nutrient sources including the Little Patuxent River. While this Characterization does not focus on the larger Patuxent River Basin issues, it is important to realize that other State and Federal programs and requirements driven by downstream issues will affect Little Patuxent River watershed programs like the future development of a total maximum daily load (TMDL).

Designated Uses

All waters of the State are assigned a "Designated Use" in regulation, COMAR 26.08.02.08, which is associated with a set of water quality criteria necessary to support that use. In Howard County, the Little Patuxent River and all tributaries are designated as Use I-P, for water contact recreation, protection of aquatic life and public water supply. (The Maryland Department of the Environment should be contacted for official regulatory information about designated uses.) [5]

Not Supporting Designated Use – 303(d) Listings

Significant portions of the Little Patuxent River either do not support their designated use or partially do not support their designated use.[2] As required under Section 303(d) of the Federal Clean Water Act, Maryland tracks waterways that do not support their designated use in a prioritized list of "Water Quality Limited Basin Segments" (also called the "303(d) list").

The 303(d) list references to the Little Patuxent River watershed, which is part of the larger Patuxent River Basin, identifies nutrients and other pollutants as issues in several places:

- Nutrients. In the 1996 303(d) list, the Patuxent River (which includes the Little Patuxent River) is listed as Priority #8. Nutrients from point, nonpoint and natural sources are identified as the problem.
- Cadmium. In the 1996 303(d) list, the Patuxent River is also listed separately for nutrients from nonpoint and natural sources. The Little Patuxent River / Dorsey Run east of Route 1 is also listed as Priority #20 for cadmium from nonpoint and natural sources.
- Nutrients, Suspended Sediments and Cadmium. In the 1996 303(d) list, the Little Patuxent River is listed separately a second time for nutrients, suspended sediment and cadmium from nonpoint and natural sources.
- Nutrients and Sedimentation. In the 1998 Additions to the 303(d) list, Centennial Lake is listed as a low priority for targeting remediation (relative to other Statewide priorities). Nonpoint sources were listed as the origin of these problems.

The 303(d) priorities referenced above are established by the Maryland Department of the Environment. Information considered in setting these priorities include, but is not limited to, severity of the problem and the extent of understanding of problem causes and remedies. These priorities are used to help set State work schedules for various programs including total maximum daily loads (TMDLs).

Total Maximum Daily Loads

Maryland Department of the Environment (MDE) has responsibility under the Clean Water Act to determine appropriate total maximum daily loads (TMDLs) for water bodies in the State that do not meet water quality standards. A TMDL calculates the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. This maximum allowable loading must consider point and nonpoint sources while allowing for future growth and a margin of safety. As of July 2001, a schedule for beginning work on a TMDL for the Little Patuxent River watershed has not been established. However, it may be anticipated that the Little Patuxent River will be the subject of TMDL work for one or more parameters identified in the 303(d) listing. To find current information on scheduling of TMDL work, see the MDE Internet site at www.mde.state.md.us/tmdl/index.html (7/31/2001).

Water Quality Indicators

The 1998 *Maryland Clean Water Action Plan* listed the following water quality indicators for the Little Patuxent River including both Howard County and Anne Arundel County portions of the watershed.[3] The Little Patuxent River is also identified in the Plan as a Category 1 Priority Watershed "in need of restoration during the next two years."

Water Quality Indicator	Finding	Rank	Bench Mark
State 303(d) Impairment No.	3	Fail	3 = additional protection needed. This watershed is included in the 303d list.
Modeled TN Load	14.14 lbs/acre	Fail	In comparison to 138 watersheds in Maryland, this watershed is among the 25% with the highest loads.
Modeled TP Load	0.69 lbs/acre	Fail	In comparison to 138 watersheds in Maryland, this watershed is among the 25% with the highest loads.

See Interpreting Water Quality Indicators for more information (next page).
For more details on the *Clean Water Action Plan*, see www.dnr.state.md.us/cwap/ (7/31/2001)

Interpreting Water Quality Indicators

State 303(d) Impairment Number. This number is used to characterize watersheds relative to regulatory requirements of the Federal Clean Water Act. It is based on numerous water quality-related factors that are tracked by the State of Maryland under these federal requirements.

Modeled TN Load. TN refers to Total Nitrogen. Nitrogen Load is a measure of how much of this important nutrient is reaching streams and other surface waters. For each type of land use in the watershed, on average, stormwater tends to carry or transport a characteristic amount of nitrogen from the land to nearby streams. Based on these averages, computers can be used to estimate (model) how much nitrogen is likely to be reaching local streams. This method was applied Statewide to all the 138 watersheds in Maryland to allow comparison of "modeled total nitrogen load" among them. A rank of "fail" means that this watershed was among the 34 watersheds (25%) that had the highest estimated total nitrogen load. High nitrogen levels in tidal waters and lakes are often associated with poor water quality.

Modeled TP Load. TP refers to Total Phosphorus. It is a measure of how much of this important nutrient is reaching streams and other surface waters. The ranking for modeled TP Load was performed in parallel to the ranking for modeled TN Load above. (Note: details of the models differ.)

Howard County Font Hill Area Monitoring

As part of Howard County's National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit, the County has collected storm and dry weather flow data at three sampling stations on the Font Hill tributary since 1995. Land uses within the subwatershed include agriculture, forest, and residential land with and without stormwater management. Samples are analyzed for twelve chemical constituents as well as flow rate, temperature, and pH. Benthic macroinvertebrate community analysis, added in 1997, suggests that this stream segment is "moderately impaired." The Font Hill tributary has also been used to assess different land uses relevant to existing water quality. This assessment compares monitoring data from two single residential land use sites (one with and one without stormwater management) and an ambient water monitoring station located downstream. A detailed description of the methodology used and assessment results can be found in the report prepared for Howard County titled "Stream Monitoring and Rapid Bioassessment Analysis for Font Hill Tributary to Little Patuxent River."

Point Sources

Discharges from discrete conveyances such as pipes are called "point sources." Point sources may contribute pollution to surface water or to groundwater. For example, waste water treatment discharges may contribute nutrients or Biological Oxygen Demand (BOD) that reduce oxygen available for aquatic life. Stormwater discharges may contribute excessive flow of water and/or seasonally high temperatures. Industrial point sources may contribute other forms of pollution. Some understanding of point sources discharges in a watershed targeted for restoration is useful in helping to prioritize potential restoration projects.

According to the Maryland Department of the Environment (MDE) permit data base summarized in the following table Point Source Discharges Permitted by MDE, there are eight permitted surface water discharges and two permitted groundwater discharges in the Howard County portion of the Little Patuxent River watershed. Characteristics of the these permitted discharges (volume, temperature, pollutants, etc.) are tracked by MDE through the permit system. Most of this information is accessible to the public and can be obtained from MDE.

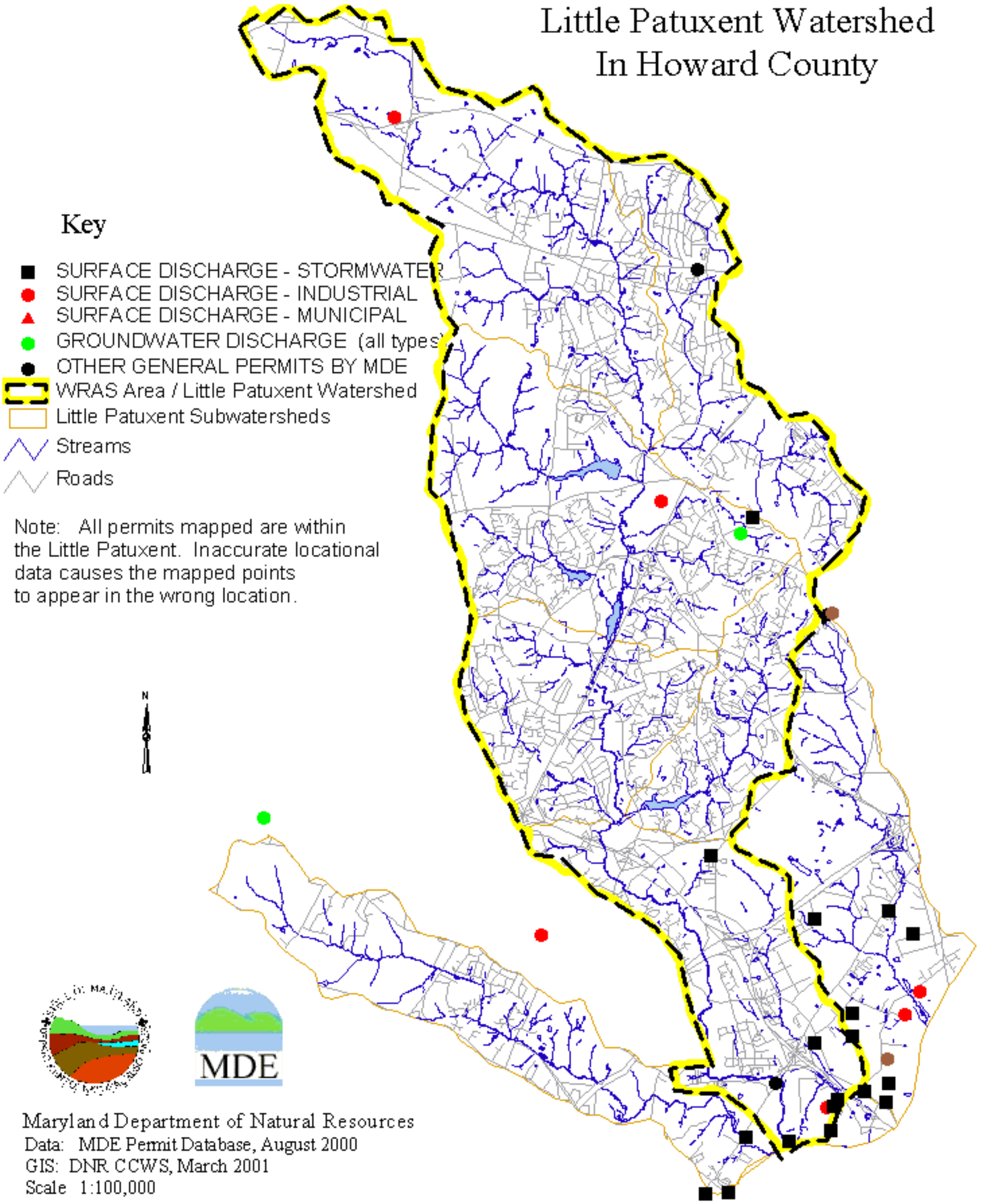
Map 5 MDE Permits shows the approximate locations of the permitted point sources discussed above.

Point Source Discharges Permitted By MDE in Howard County's Little Patuxent River Watershed			
Facility Name	**NPDES Permit / MD Code**	**Discharge Type / MDE Permit Category**	**Additional Information**
Alpha Ridge Landfill	MD0067865 97DP3224	Surface Water / Industrial	2350 Marriottsville Road
General Electric Co.	MD0067938 98DP3245	Surface Water / Industrial (groundwater remediation)	9001 Snowden River Parkway. Cooking equipment manufacture.
Honeywell / Bookham formerly Allied Chemical	MD0061760 96DP2289	Surface Water / Industrial	9140 Old Annapolis Road. Semiconductor manufacture. Permit likely to expire in June 2001.
Marriott Distribution Serv.	MD0060917 95DP2147	Surface Water / Industrial	8704 Bolman Place. Cooling towers for food distribution. Renewal pending.
MG Industries	MD0067792 93DP3065	Surface Water / Industrial	8025 Dorsey Run Road. Industrial gas manufacture and packaging. Renewal pending.
Owens Corning Jessup Roofing Plant	MD0052531 00DP1125	Surface Water / Industrial	8235 Patuxent Range Road. Cooling water blowdown discharge.
Md & Va Milk Producers	MD0000469 99DP0033	Surface Water / Industrial	8321 Leishear Road. Dairy food processing. Hammond Branch
Little Patuxent WWTP	MD0055174 94DP1421	Surface Water / (County operated)	8900 Greenwood Place. 18 MGD. Renewal pending.
IGENE Biotechnology, Inc.	94DP2129	Groundwater / Industrial	9110 Red Branch Road. Yeast production. 800 GPD for cooling water withdrawal / replacement.
Ashleigh Knolls WWTP	00DP3102	Groundwater / (County operated)	12100 Block Simpson Road. Shared community septic system. Hammond Branch

Nonpoint Sources

A quantitative estimate of nonpoint source loads is not immediately available for the Little Patuxent River watershed. However, listing of the river under Section 303(d) of the Clean Water Act, the nutrient summary in the *Water Quality Indicators* section of this report, and eutrophication issues reports for the Columbia Lakes suggest that nonpoint source nutrient loads are significant in the Little Patuxent River watershed. Under NPDES stormwater permit requirements, Howard County is estimating nonpoint source loads from specific land uses. When available, this information will augment the County's ability to prioritize areas within the Little Patuxent River watershed for restoration.

Map 5 MDE Permits
Little Patuxent Watershed
In Howard County



LAND USE AND LAND COVER
Little Patuxent River Watershed

Landscape Indicators

Water quality, particularly in streams and rivers, is affected by the land in the riparian area and throughout the watershed. In an effort to gauge the affects of land use on water quality, and to allow comparison between watersheds, DNR has developed a series of Landscape Indicators. These indicators can be used to portray landscape conditions at a watershed scale that tend to support good water quality or that tend to degrade water quality.

The 1998 *Maryland Clean Water Action Plan* listed landscape indicators for the Little Patuxent River, including both Howard County and Anne Arundel County portions of the watershed, as summarized in the table below.[3] Most indicator ranking (pass / fail) is a relative measure that compares the Little Patuxent River watershed with the other 137 watersheds of similar size that cover the entire State of Maryland.

Landscape Indicator	Finding	Rank	Bench Mark
Impervious Surface	25.5 % of watershed is impervious	Fail	Of 138 watersheds in Maryland, the Little Patuxent is among the 34 watersheds (25%) having greater amounts of impervious surface.
Population Density	1.62 people per acre	Fail	Of 138 watersheds in Maryland, the Little Patuxent is among the 34 watersheds (25%) with the highest population density.
Historic Wetland Loss Density	10,022 acres	Pass	Of 138 watersheds in Maryland, this one is among the lower 75%
Unforested Stream Buffer	50 percent	Fail	Of 138 watersheds in Maryland, the Little Patuxent is among the 34 watersheds (25%) having the greatest extent of unforested stream buffer.
Soil Erodibility	0.29 value per acre	Fail	Of 138 watersheds in Maryland, the Little Patuxent is among the 34 watersheds (25%) having greater soil erodibility. Soil erodibility is a natural condition that can exist regardless of land use.

See Interpreting Landscape Indicators for more information.

Interpreting Landscape Indicators

Impervious Surface. Reduction of impervious area can be a valuable component of a successful Watershed Restoration Action Strategy (WRAS). Roads, parking areas, roofs and other human constructions are collectively called impervious surface. Impervious surface blocks the natural movement of rain into the ground. Unlike many natural surfaces, impervious surface typically concentrates stormwater runoff, accelerates flow rates and directs stormwater to the nearest stream. Side-effects of impervious surfaces become increasingly significant as the percentage of impervious area increases. Examples include reduction of groundwater infiltration, soil and stream bank erosion, sedimentation, destabilization or loss of aquatic habitat, and "flashy" stream flows (reduced flow between storms and excessive flows associated with storms.)

Population Density. While population density may be beyond the scope of a WRAS, directing growth is a potential WRAS component. Humans are usually very successful in competing for use of land and water. As human population increases, effects of human activity tend to degrade, displace or eliminate natural habitat. Watersheds with higher populations, assuming other factors are equal, tend to exhibit greater impacts on waterways and habitat. However, growth can be directed in ways to reduce negative impacts.

Historic Wetland Loss Density. About 26% of the Little Patuxent River watershed is hydric soil (about 10000 out of 38000 acres). The historic wetland loss estimate is based on the assumption that the hydric soils were all, at one time, wetlands. Thoughtful selective restoration of historic wetland areas can be an effective WRAS component. In most of Maryland's watersheds, extensive wetland areas have been converted to other uses by draining and filling. This conversion unavoidably reduces or eliminates the natural functions that wetlands provide. These functions include habitat and nursery areas for many aquatic organisms, buffering floods, uptake and redistribution of nutrients, etc. In general, watersheds exhibiting greater wetland loss tend to also exhibit greater loss of the beneficial functions that wetlands provide. Strategic replacement of wetlands can significantly improve natural function in local watershed areas.

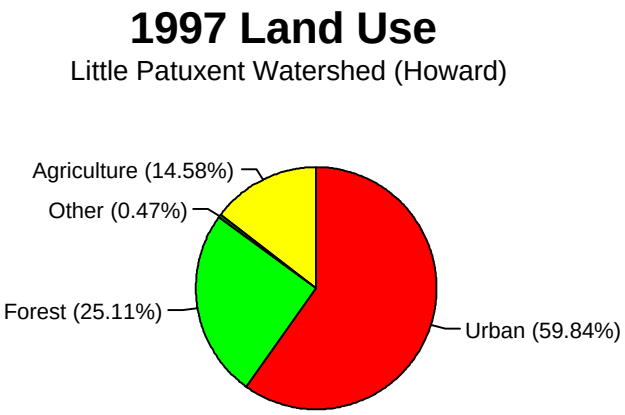
Unforested Stream Buffers. The finding listed in the table means that 50% of the "blue line" streams in the watershed do not have sufficient stream buffers to promote high quality stream habitat. DNR recommends that forested buffer 100 feet wide , i.e. natural vegetation 50 feet wide on either side of the stream, is typically necessary to promote high quality aquatic habitat and diverse aquatic populations. Restoration of natural vegetation adjacent to streams can be a valuable and relatively inexpensive WRAS element. In most of Maryland, trees are key to healthy natural streams. They provide numerous essential habitat functions: shade to keep water temperatures down in warm months, leaf litter "food" for aquatic organisms, roots to stabilize stream banks, vegetative cover for wildlife, etc. In general, reduction or loss of riparian trees / stream buffers degrades stream habitat while replacement of trees / natural buffers enhance stream habitat.

Soil Erodibility. A finding of 0.29 means that the Little Patuxent River watershed has "high" soil erodibility considering soils types, steep slopes and extent of cropland within 1000 feet of waterways. Watersheds with more easily erodible soils are naturally more susceptible to surface erosion, sedimentation, streambank erosion and other problems related to soil movement. These negative effects of soil erosion on water quality can be minimized through careful management. A WRAS can reasonably promote a reduction in disturbance of erodible soils and/or effective soil conservation practices planting like stream buffers.

1997 Land Use and Land Cover

The following table and chart summarize several major categories of land use integrated with land cover (vegetation) for the Howard County portion of the Little Patuxent River Watershed.[8] This combination of land use and vegetative cover was developed by the Maryland Department of Planning for use in Statewide tracking of both the status and changes in land conditions over time.

Viewing these categories of land use and land cover as potential nonpoint sources of nutrients, urban land lands may tend to be the dominate nutrient source even though agricultural lands tend to contribute more nutrients on a per acre basis. Map 6 1997 Generalized Land Use /Land Cover Map shows land use distribution in the watershed.



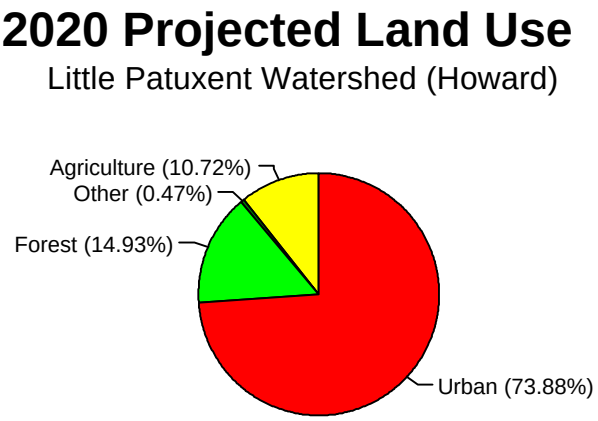
1997 Major Categories of Land Use / Land Cover Little Patuxent Watershed in Howard County		
Category	**Description**	**1997 Acres**
Agriculture	Field, Pasture, Agricultural buildings	5,540
Forest	All woodlands and brush	9,540
Urban	All developed areas	22,740
Other	Water and bare ground	180
Watershed Total (Howard Co. only)		**38,000**

Note: Minor differences in watershed acreage reported in different sections of this document are generally associated with rounding errors. Additionally, repeated manipulation of the data tends to introduce additional minor differences in acreage reported.

2020 Land Use and Land Cover Projection

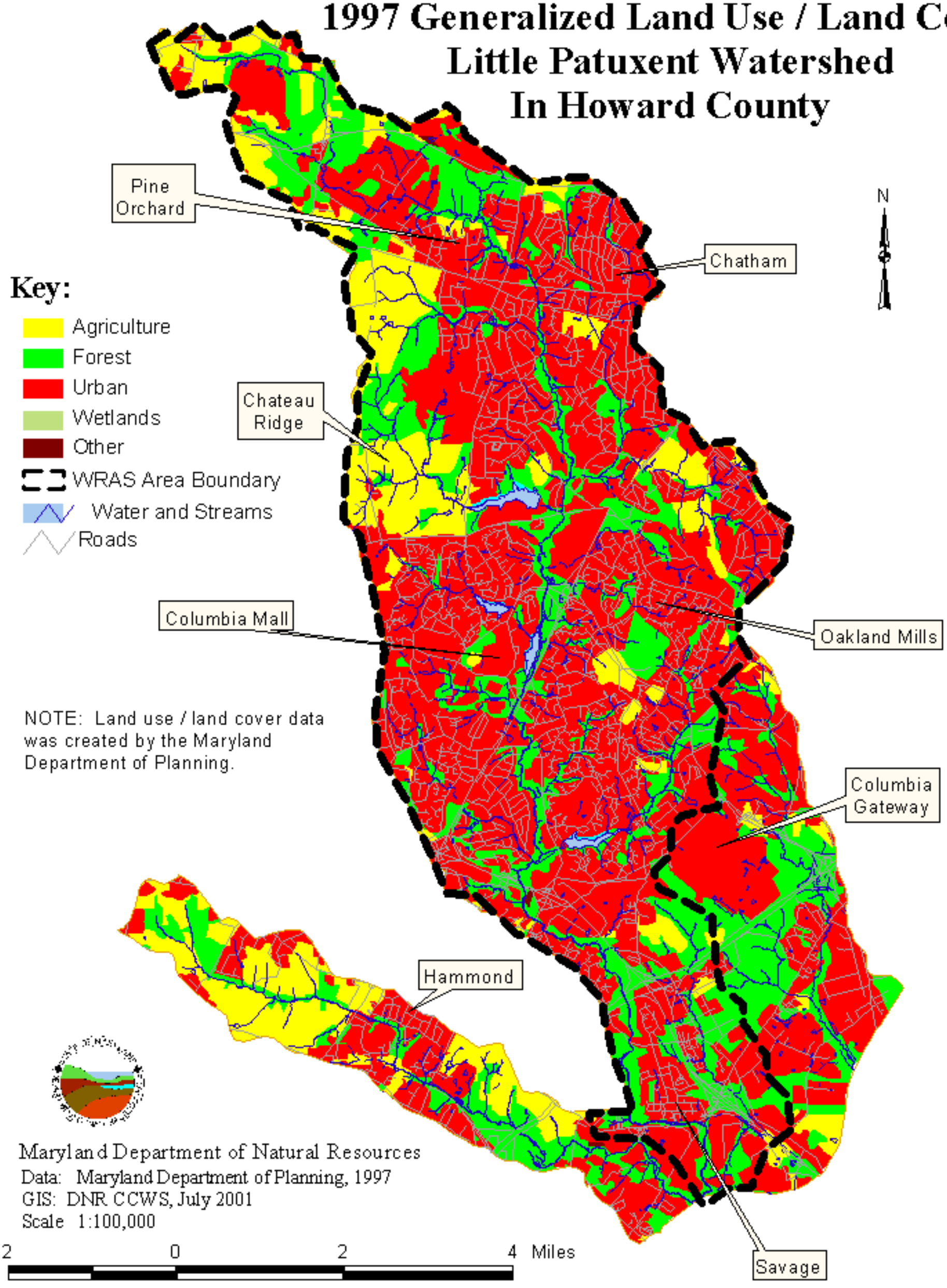
The Maryland Department of Planning's (MDP) projections for the year 2020 are based on the same integrated categories of land use and land cover presented for 1997. The changes that MDP projects are summarized in the table below and the adjacent pie chart based on work completed in November 2000.[8]

For the Little Patuxent watershed in Howard County, urban lands are projected to increase from about 60% to about 74% of the watershed. This projected shift to urbanized land use and land cover from agriculture and forest lands is anticipated to increase impervious land cover (roof tops, roads, parking lots, etc.) from about 26% in 1997 to about 31% in 2020. These projected changes will tend to increase stress on aquatic life and habitat.



1997 Major Categories of Land Use / Land Cover Little Patuxent Watershed in Howard County			
Category	**Description**	**1997 to 2020 Projected Change**	
		Acres	Percent
Agriculture	Field, Pasture, Agricultural buildings	-1,467	-26
Forest	All woodlands and brush	-3,868	-40
Urban	All developed areas	5,335	23
Other	Water, bare ground	no change	

Map 6
1997 Generalized Land Use / Land Cover
Little Patuxent Watershed
In Howard County



Maryland Department of Natural Resources
Data: Maryland Department of Planning, 1997
GIS: DNR CCWS, July 2001
Scale 1:100,000

Green Infrastructure

An additional way to interpret land use / land cover information is to identify "Green Infrastructure." In the GIS application developed by Maryland DNR and its partners, Green Infrastructure refers to areas of natural vegetation and habitat that have statewide or regional importance as defined by criteria developed by DNR. The criteria for identifying lands as Green Infrastructure is limited to considering natural resource attributes currently found on those lands. One example of the criteria is that interior forest and wetlands complexes at least 250 acres in size are considered as part of Green Infrastructure. As a second example, sensitive species habitat that is located within areas of natural vegetation at least 100 acres in size is also counted as Green Infrastructure. Other potential attributes of Green Infrastructure lands, such as ownership or if the current natural conditions are protected in some way, are not criteria for Green Infrastructure but they may be considered independently.

Within the Green Infrastructure network, large blocks of natural areas are called hubs, and the existing or potential connections between them, called links or corridors. Together the hubs and corridors form the Green Infrastructure network which can be considered the backbone of the region's natural environment.[2]

Protection of Green Infrastructure lands may be addressed through various programs including Rural Legacy, Program Open Space, conservation easements and others. Beginning in 2001, the "Green Print" program was initiated to target selected State funds for protection of Green Infrastructure areas.

The Green Infrastructure in the Little Patuxent River watershed exhibits several significant characteristics as shown in the Map 7 Green Infrastructure:

– Within the WRAS area, Green Infrastructure is generally associated with riparian areas.
– Green Infrastructure hubs are located around David W. Force Park and Centennial Park.
– Links or corridors connecting Green Infrastructure hubs, both inside and outside the WRAS area, primarily follow the Little Patuxent River mainstem's riparian area. As shown in the map, some edge areas of the corridor are already developed, which potentially limits protection and expansion opportunities.
– The majority of the Little Patuxent WRAS watershed does not appear on the map as Green Infrastructure. Apparently, the majority of the natural areas in this watershed do not meet the 100-acre size threshold used to identify areas of State or regional significance. However, from a local perspective, there may be very important areas that are smaller than 100 acres.

These Green Infrastructure areas can be incorporated into a Watershed Restoration Action Strategy as areas to protect, enhance or expand. Howard County has already designated the Little Patuxent River as a County greenway. The County Department of Recreation and Parks is developing a pathway system along the corridor.

Map 7
Green Infrastructure
Little Patuxent River
In Howard County

Key

- Natural Vegetation in a Green Infrastructure Hub
- Natural Vegetation in potential Green Infrastructure Corridor
- Developed Land Gap in a Hub or a Corridor
- Agriculture or Grassland Gap in a Hub or Corridor
- Barren Land Gap in a Hub or a Corridor
- Little Patuxent River WRAS Area in Howard Co.
- Little Patuxent River Other Areas in Howard Co.
- Water and Streams
- Roads

N

Maryland Department of Natural Resources
GIS: DNR CCWS, January 2001
Scale 1:100,000

2 0 2 4 Miles

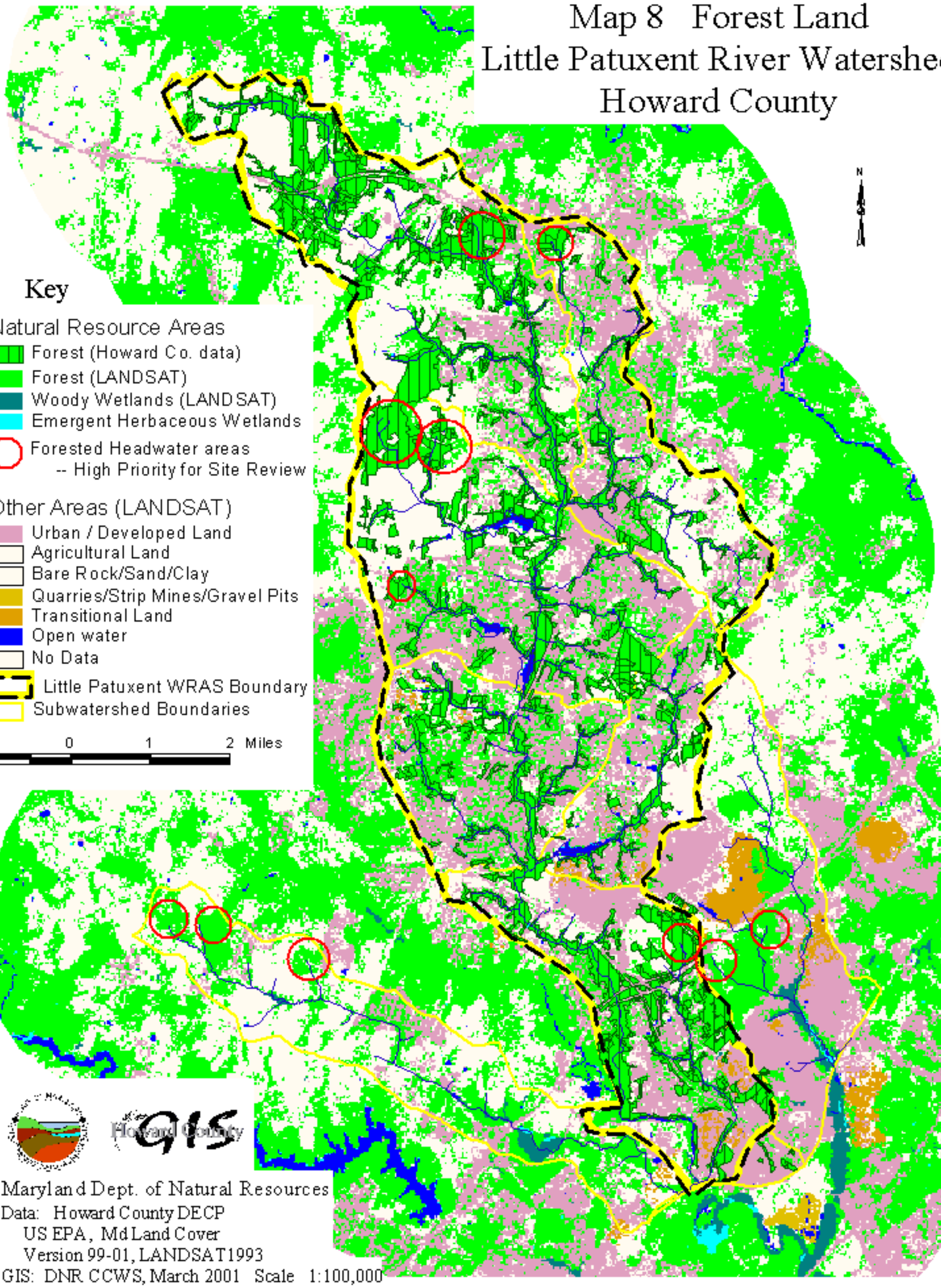
Forested Natural Resource Areas at the Stream Segment Scale

Compared to other major land use types in the Little Patuxent watershed, forest lands tend to be the most protective of water quality and the most conducive to high quality stream habitat. Forest land covers about one quarter of the Little Patuxent River watershed in Howard County overall. However, forest land is generally not present in large blocks that meet the size threshold used for Green Infrastructure. As shown in Map 8 Forest Land, smaller blocks of forest are located along the Little Patuxent tributary network. These conditions suggest several potential concerns and opportunities:

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

As part of developing the WRAS, Howard County is conducting a detailed forest assessment for the WRAS watershed. This information will enhance the County's ability to prioritize areas within the watershed for restoration and protection.

Map 8 Forest Land
Little Patuxent River Watershed
Howard County



Maryland Dept. of Natural Resources

Data: Howard County DECP
US EPA, Md Land Cover
Version 99-01, LANDSAT1993

GIS: DNR CCWS, March 2001 Scale 1:100,000

Protected Lands

As used in the context of watershed restoration, "protected land" includes any land with some form of long term limitation on conversion to urban / developed land use. This protection may be in various forms: public ownership for natural resource or recreational intent, private ownership where a third party acquired development rights or otherwise acquired the right to limit use through the purchase of an easement, etc. The extent of "protection" varies greatly from one circumstance to the next and it may be necessary to explore the details of land protection parcel by parcel through the local land records office.

For purposes of watershed restoration, a knowledge of existing protected lands can provide a starting point in prioritizing potential restoration activities. In some cases, protected lands may provide opportunities for restoration projects because owners of these lands may value natural resource protection or enhancement goals.

The following table and Map 9 Protected Land and Smart Growth summarize the status of protected lands in the Little Patuxent River watershed using data from both DNR and Howard County:

– Most land in the watershed is not protected.
– Significant areas in Local / County parks are in the Little Patuxent WRAS watershed. These lands are often geared to local recreational interests in urbanized areas or intended to protect riparian areas along local streams.
– Land protected with the intent of continued agricultural use is concentrated in one large block in the watershed.
– Numerous areas in the watershed are protected under the ownership of the Columbia Association and numerous home owner associations.
– No DNR land or easements for conservation have been identified in the watershed.

Howard County Department of Recreation and Parks is developing a map to track open space acquisitions, forest mitigation and enforcement of open space regulations. This information will provide additional local perspective for the WRAS.

Smart Growth

Within Maryland's Smart Growth program, there are two targeting programs that should be considered as potential watershed restoration projects. In Rural Legacy Areas, protection of land from future development through purchase of easements (or fee simple purchase) is promoted. In Priority Funding Areas, State funding for infrastructure may be available to support development and redevelopment. Howard County's Priority Funding Area within the Little Patuxent River watershed is shown on Map 9 Protected Land and Smart Growth.

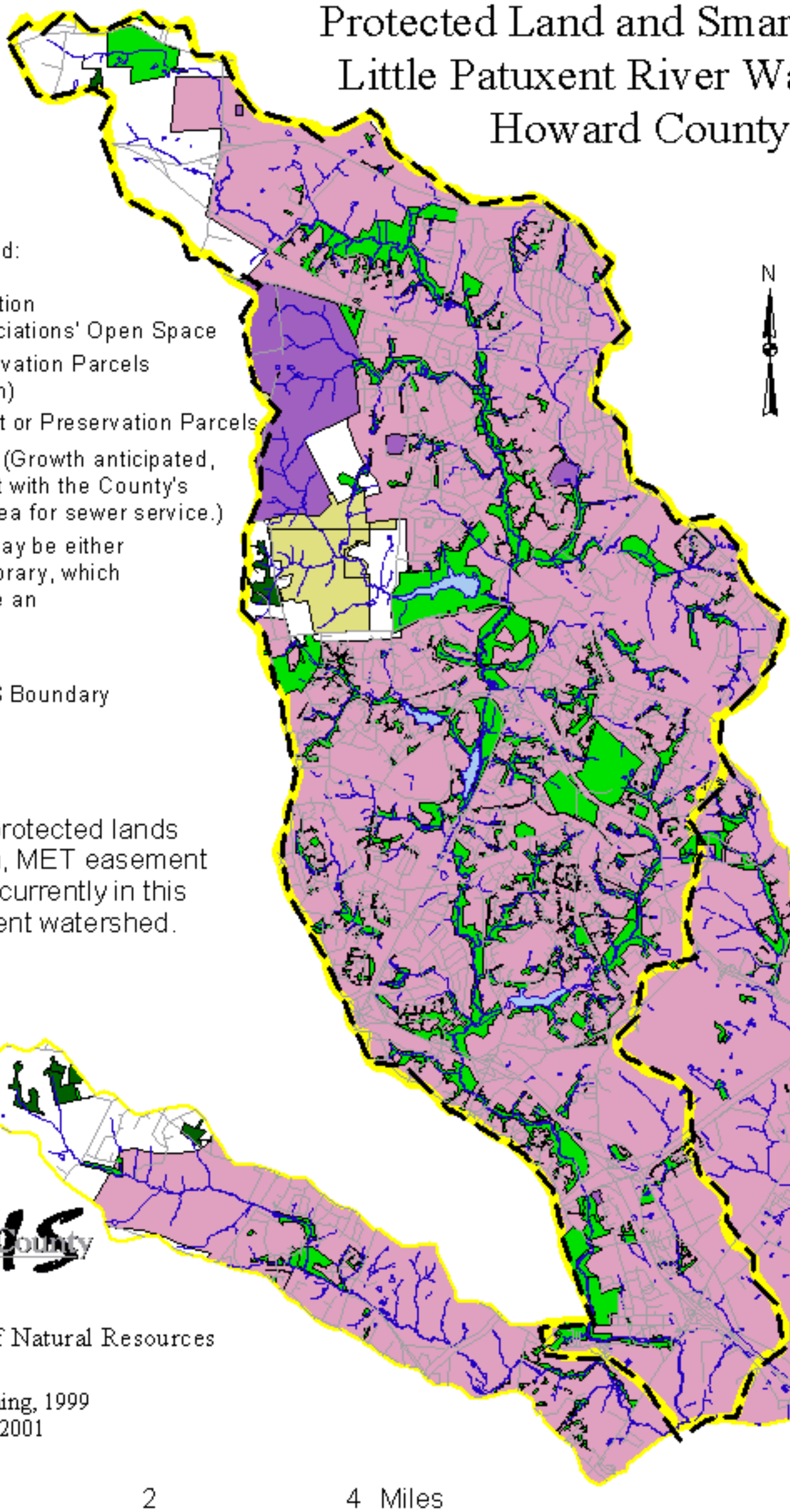
1. Rural Legacy Areas

The Little Patuxent River watershed in Howard County does not include a Rural Legacy Area. Howard County's Rural Legacy Area, the Upper Patuxent Headwaters watershed, is located in the Patuxent reservoirs watershed at the western edge of the County. It is highly unlikely that the Little Patuxent River watershed would meet the Rural Legacy criteria.

2. Priority Funding Areas

The majority of the Little Patuxent River watershed in Howard County is designated as a Priority Funding Area. The Priority Funding Area corresponds to the County's Planned Service Area for public water and sewerage service. In Priority Funding Areas, new development and redevelopment may be anticipated. Planning for watershed restoration projects in Priority Funding Areas, or downstream of them, needs to account for potential changing conditions during the life of the project. For example, increasing impervious area may alter stormwater conditions that a watershed restoration project will have to adequately address.

Map 9
Protected Land and Smart Growth
Little Patuxent River Watershed
Howard County



Key

- Locally Protected Land:
  - County Parks
  - Columbia Association
  - Homeowner Associations' Open Space
- Environmental Preservation Parcels (County Designation)
- Agricultural Easement or Preservation Parcels
- Priority Funding Area (Growth anticipated, generally consistent with the County's Planned Service Area for sewer service.)
- Historic Easement (may be either permanent or temporary, which possibly would have an expiration date.)
- Water and Streams
- Little Patuxent WRAS Boundary
- Roads

Note: Other types of protected lands like Rural Legacy Area, MET easement and DNR land are not currently in this part of the Little Patuxent watershed.

Howard County GIS

Maryland Department of Natural Resources

Data: Howard County
DNR Resource Planning, 1999
GIS: DNR CCWS, March 2001
Scale: 1:100,000

2 0 2 4 Miles

Wetlands

Wetlands serve valuable water quality and habitat functions that may not be served by other land uses. Therefore, protection and enhancement of existing wetlands, and restoration of past wetland areas, can be a valuable element in the WRAS. (Also see Wetland Restoration in the Restoration Targeting Tools chapter.)

1. Introduction to Wetland Categories [10]

The Little Patuxent River watershed is predominantly in the Piedmont Province. Overall, wetlands in the Piedmont Province are limited in type and extent due to constraints arising from topographic relief, regional geology, depth to groundwater table and absence of significant open waters or tidal influence. Isolated palustrine and riverine wetlands are most common in this area. In general, these wetlands are found on floodplains along the freshwater tidal and nontidal portions of rivers and streams, in upland depressions, and in broad flat areas between otherwise distinct watersheds. Forested wetlands within the Piedmont are typically found on floodplains in stream valleys and are characterized by the frequency and duration of flooding (seasonally flooded and temporarily flooded forested wetlands). Scrub shrub wetlands are found in wide river floodplains, valleys and meadows. Emergent wetlands can occur in areas of former forested wetlands that were cleared for agriculture, meadows and valleys and are also characterized by the frequency and duration of flooding (seasonally flooded marshes and meadows, and temporarily flooded wet meadows) (from Wetlands of Maryland, Tiner and Burke, 1995).

2. Tracking Wetlands [10]

Oversight of activities affecting wetlands involves several regulatory jurisdictions. The Maryland Department of the Environment (MDE) is the lead agency for the State. MDE cooperates with DNR, the US Army Corps of Engineers and other Federal and local agencies. As part of its responsibility, MDE tracks State permitting and the net gain or loss of wetlands over time. As the Tracking Wetland Change table shows, changes tracked in the State regulatory program have resulted in a net gain of wetland acreage in Howard County's portion of the Little Patuxent River watershed.

Tracking Nontidal Wetland Change
Little Patuxent River Watershed
Permits Authorized = 30
Letters of Authorization Issued = 117

Wetland Class	**Acres**
Permanent Impacts	-11.31
Mitigation by Permittee	26.25
Other Gains (Regulatory)	0.71
Programmatic Gains	2.75
Net Gain/Loss	18.40

Note: Regulatory tracking for authorized nontidal wetland losses began in 1991. Comprehensive tracking of voluntary wetland gains began in 1998.

3. Interpreting Wetland Distribution

Wetlands in the Little Patuxent River watershed are found in areas throughout the watershed as shown in Map 10 Wetlands. In comparing this map to Map 6 1997 Generalized Land Use, it can be seen that the majority of the wetlands in the watershed are found in association with forested areas and stream valley corridors.

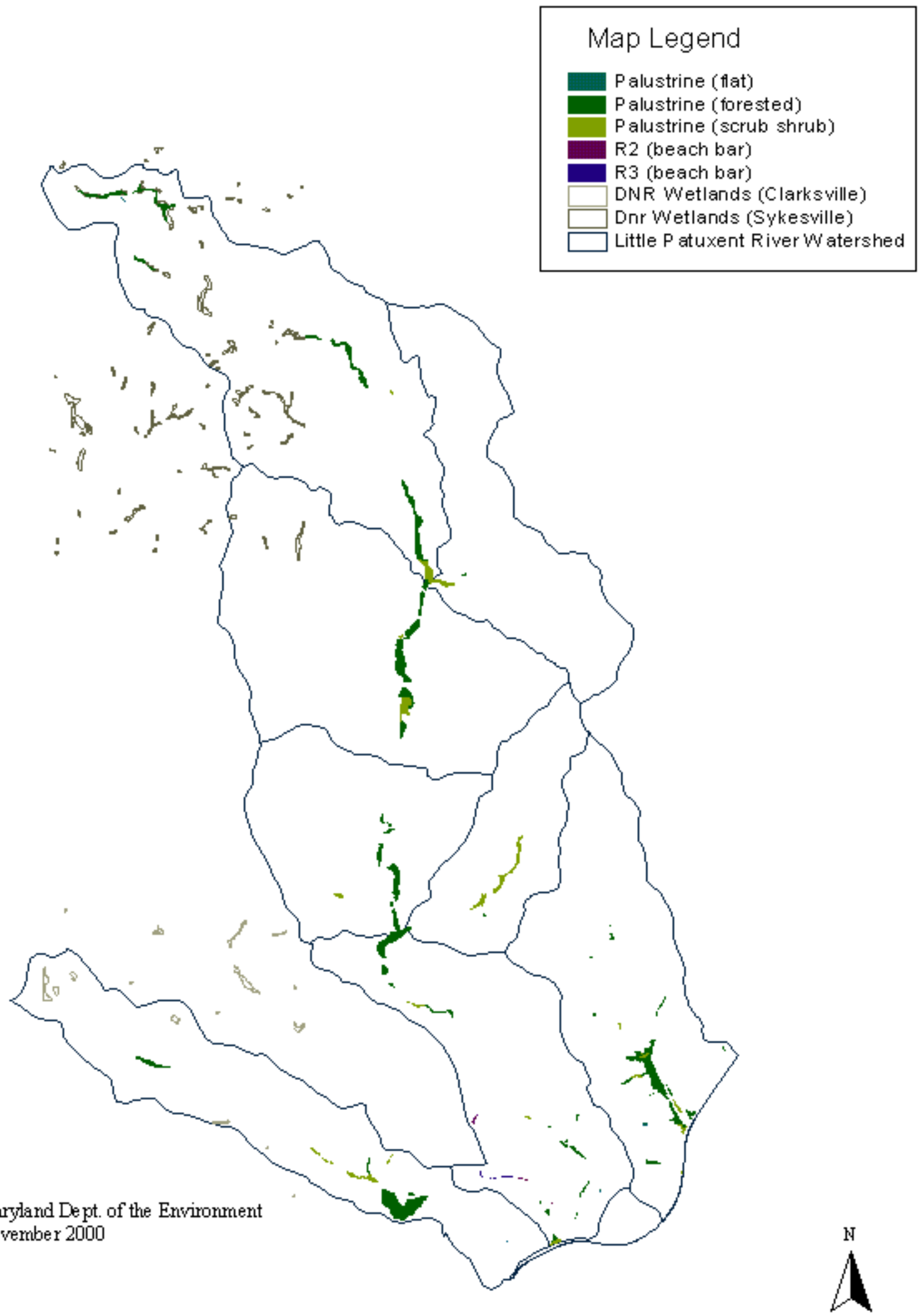
A comparison the two maps shows that most of the nontidal wetland areas shown on the wetlands map are depicted as forest on the land use map. This difference is simply the result of two differing views of the landscape. For example, wooded nontidal wetlands can be viewed as "wetlands" from a habitat / regulatory perspective and they can be viewed as "forest" from a land use perspective.

In the Little Patuxent River watershed, differing perspectives on counting wetlands are significant for watershed management. From a land use perspective, the Little Patuxent River watershed's wetlands were not identified by the Maryland Department of Planning. From a habitat / regulatory perspective, there are approximately 4,378 acres of wetlands in the Howard County portion of the Little Patuxent watershed. Also see Wetland Restoration in the Restoration Targeting Tools chapter.

Wetland Acreage Summary
Little Patuxent River Watershed[10]

Wetland Class		Acres
Estuarine, Intertidal (E2)	aquatic bed	0
	beach bar	0
	emergent	0
	forested	0
	scrub shrub	0
Palustrine (P)	aquatic bed	0
	emergent	0
	flat	35
	forested	4,261
	scrub shrub	0
Riverine, Lower Perennial (R2)	beach bar	45
Riverine, Upper Perrenial (R3)	beach bar	37
Total Wetlands (National Wetlands Inventory)		4,378

Map 10 Wetlands
Little Patuxent River Watershed
Howard County



LIVING RESOURCES AND HABITAT

Overview

Living resources, including animals, plants and other organisms that call the land and waters of the Little Patuxent River watershed home, are being affected by human activity. The information summarized in the Watershed Characterization suggests that some of the significant stresses on living resources in the watershed are manipulation of habitat, excessive movement of sediment and excessive availability of nutrients.

The living resource information summarized here should be considered a partial representation because numerous areas of potential interest or concern could not be included due to lack of information, time, etc. For example, information on many forms of aquatic life, woodland communities, terrestrial habitats, etc. should be considered as watershed restoration decisions are being made. Therefore, it is recommended that stakeholders in the watershed identify important living resource issues or priorities so that additional effort can be focused where it is most needed. New information should be added or referenced as it becomes available.

Living Resource Indicators

Aquatic organisms are sensitive, in varying degrees, to changes in water quality and habitat. This sensitivity offers two perspectives that are important for watershed restoration. First, improvements for living resources offer potential goals, objectives and opportunities to gauge progress in watershed restoration. Second, selected living resources can be used to gauge local conditions for water quality, habitat, etc. This second perspective is the basis for using living resources as an "indicator."

The 1998 *Maryland Clean Water Action Plan* listed the following living resource indicators for the Little Patuxent River, including both Howard County and Anne Arundel County portions of the watershed.[3] Compared to other watersheds in Maryland, the Little Patuxent watershed exhibits problems for populations of fish and benthic organisms and for the habitat that would support those populations.

Living Resource Indicator	**Score**	**Rank**	**Bench Mark** (percent based on 138 watersheds)
Nontidal Benthic Index of Biotic Integrity	4.6	Fail	Scale of 1 (worst) to 10 (best) Score less than 6 yields a rank of "fail"
Nontidal Fish Index of Biotic Integrity	5.6	Fail	Scale of 1 (worst) to 10 (best) Score less than 6 yields a rank of "fail"
Nontidal In-stream Habitat Index	4.9	Fail	Scale of 1 (worst) to 10 (best) Of 138 watersheds in Maryland, the 34 (25%) with the lowest nontidal in-stream habitat index received a rank of "fail" and were designated as Category 1 watersheds in need of restoration. The top 34 (25%) were designated as Category 3 watersheds in need of protection.

See Interpreting Living Resource Indicators for more information.

Interpreting Living Resource Indicators

General. Several of these indices rely on index rankings generated from a limited number of sampling sites which were then generalized to represent entire watersheds. Considering this limitation on field data, it may be beneficial to conduct additional assessments to provide a more complete understanding of local conditions as part of the WRAS.

Nontidal Benthic Index of Biotic Integrity. An index less than 6 indicates that benthic organisms are significantly stressed by local conditions. This index allows comparison of streams based on the populations of bottom-dwelling "bugs" (benthic macroinvertebrate organisms) found in the stream. For coastal plain streams, this index employs seven measurements of these populations which is translated into a rank for each sampling site.

Nontidal Fish Index of Biotic Integrity. An index less than 6 indicates that improvements would be beneficial to fish populations. This index allows comparison of selected streams (first through third order nontidal streams) based on fish community health. In each sampling site where fish are surveyed, the makeup of the overall fish population is measured in nine distinct ways such as the number of native species, number of benthic fish species, percent of individuals that are "tolerant" species, etc. These nine scores are then integrated to generate an index ranking for the survey site.

Nontidal In-Stream Habitat Index. This index allows comparison of streams based on fish and benthic habitat as measured by in-stream and riparian conditions. For each stream site that was assessed, visual field observations are used to score the site for substrate type, habitat features, bank conditions, riparian vegetation width, remoteness, aesthetic value, etc. These scores are then integrated to generate a single rank for each stream sampling site.

Fisheries [6]

DNR Fisheries Service has conducted some limited fish sampling at a few locations in the Little Patuxent River watershed. While this information is mostly in the form of field data sheets, the accompanying species summary table suggests the type of fish populations found in the watershed. Approximately three sites have been sampled in the past 9 years. Site 1 is a headwater stream segment, Site 2 is probably representative of most of the low gradient middle portion of the river, and Site 3 was in a rocky stream segment below the fall-line. Overall, the species and their relative abundance are reflective of the habitat in each section. Fish in general were scarce due, most likely, to poor habitat for most species. The species that were common or abundant tend to adapt well to sandy, low gradient streams. Northern hogsuckers and longnose dace are both adapted to rocky riffle habitat. Both species are found in low abundance because there are few sections like that in the 3 sites sampled. Longnose dace and hogsuckers could be more common in the fall-line section at Savage where the habitat is suitable for them.

Based on observations by DNR Fisheries Service personnel, the main problems affecting fisheries in this watershed are related to urbanization and all its associated impacts. Uncontrolled runoff from old developments and excessive runoff from those that need retrofitting are two problems that generate erosion, destabilize streambanks, and thermally pollute the river.

From a recreational perspective, DNR Fisheries Service concentrates on the highly popular recreational trout stocking at Savage Mill Park. (See Map 13 Fish Blockages and Trout Stocking.) This program could not have been developed without the excellent cooperation and encouragement from the Howard County Department of Recreation and Parks, Land Management Division. DNR stocks catchable size trout into the river several times each Spring and once in the Fall. Anglers are allowed to fish with any legal bait, lure, or fly and the limit is two trout/day. A daily limit of two trout allows for a longer season to fish and spreads the resource among more anglers. The rail trail along the south bank of the river provides excellent access for stocking and fishermen. This area provides good trout fishing access for urban/suburban anglers in a scenic setting.

Little Patuxent River Fish Species
Md. DNR Freshwater Fisheries Service Electrofishing Surveys
Qualitative Rank: Rare (R), Scarce (S), Common (C), or Abundant (A)

Common Name	Site 1	Site 2	Site 3
White Sucker	S	S	R
Northern Hogsuckel	–	–	S
Cutlips Minnow	--	S	S
Blacknose Dace	C	S	--
Longnose Dace	--	R	--
Rosyside Dace	C	C	--
Creek Chub	--	R	--
River Chub	--	--	S
Common Shiner	--	C	S
Swallowtail Shiner	--	R	--
Satinfin Shiner	--	R	S
Fallfish	--	A	S
Tessellated Darter	--	C	S
Shield Darter	--	--	R
Smallmouth Bass	--	--	S
Redbreast Sunfish	--	S	S
Bluegill	--	--	R
Sunfish hybrid	--	--	R
Green Sunfish	--	R	--
Pumpkinseed Sunfish	--	S	R
Margined Madtom	–	–	S
American Eel	S	R	S

Little Patuxent River Site Location / Date Key:

Site 1: Howard County Landfill entrance road at Marriottsville Road, December 9, 1991.
Site 2: 9673 Gwynn Park Drive, June 2, 1999
Site 3: Water Reclamation facility downstream of Route 1 near Savage, May 22, 1995.

Biological Monitoring [7]

1. Maryland Biological Stream Survey

The DNR program, Maryland Biological Stream Survey, assesses in-stream aquatic communities and stream habitat conditions in the State. The work often includes fish community and/or assessments of benthic macroinvertebrates ("stream bugs"). Sites in the Little Patuxent River have been assessed in recent years as summarized below. Also see Map 11 Monitoring Sites for sampling site location and the text box, Why Look At Benthos In Streams?, for additional information.

– The first round of the Maryland Biological Stream Survey, conducted 1995 through 1997, included six sites in the WRAS area and 13 in the Little Patuxent River watershed.
– Statewide randomly selected sampling sites in the year 2000 also included six sites in the WRAS area with a total of 13 sites in the Little Patuxent River watershed. A report on these results is anticipated in 2001.
– Additional sampling in the watershed is likely but is has not yet been scheduled.

As summarized in the 1997 MBSS Findings Table, scores for both benthic populations and fish populations for the sites surveyed indicated that the populations were either poor or fair. Physical habitat conditions were more varied ranging from very poor to fair. As part of this work, MBSS also identified "reference sites" in its statewide sampling that serve as examples of relatively good conditions. One of these sites was identified in the Anne Arundel County portion of the Little Patuxent River watershed. This Little Patuxent site exhibits the best overall conditions surveyed by MBSS in the watershed during this period. This site is also listed in the Findings Table for comparison.

2. Howard County Biomonitoring Program

In July 2000, Tetra Tech, Inc. was hired to develop the design of a biomonitoring program in Howard County. The design called for the development of: watershed stratification/list frame; data quality objectives and sampling strategy; site selection; and a quality assurance plan. The goals and objectives of the design are to develop a County-wide, long-term biomonitoring program that will provide an assessment of the ecological health of the County's stream systems, which can be used to help establish priorities for watershed management planning.

Howard County also established a biomonitoring Technical Advisory Committee (TAC), which is the work group responsible for overseeing the development of a biomonitoring program. The workgroup consists of Tetra Tech, representatives from Tetra Tech, DNR, Howard County's Departments of Public Works, Planning and Zoning, and Recreation and Parks, along with the Howard Soil Conservation District.

The program involves sampling a different set of watersheds every year. Sampling for 2001 will be conducted at the Little Patuxent, Brighton Dam, and Cattail Creek watersheds. Sampling for 2002 will be conducted in the Middle Patuxent River. Sampling for 2003 will be

conducted in the South Branch of the Patapsco River tributaries and the lower Patuxent tributaries. In 2004, the Patapsco River lower branch will be sampled and in 2005, the Hammond Branch and Dorsey Run will be sampled.

In March 2001, Tetra Tech, Inc. and the Maryland Department of Natural Resources (DNR) conducted biomonitoring within the Little Patuxent WRAS watershed. DNR and Tetra Tech Inc., will conduct the benthic biomonitoring sampling from March through April 2001, while DNR will provide additional biomonitoring by collecting fish samples in June 2001. A final report incorporating all the sampling results and analysis is expected by August 2001.

Property owner notification prior to the sampling is an important component of the biomonitoring program and offers a unique opportunity to educate property owners. The biomonitoring program results will be available to the public through the County's Storm Water Management web page. In addition, the Howard County Department of Recreation and Park (DRP) has a volunteer, public outreach and education biomonitoring program that involves citizens and increases awareness of stream health in the County. Citizens involved in the program sample macro invertebrates in their neighboring streams and report the results to the Department of Recreation and Parks.

1997 MBSS Findings * Little Patuxent River Watershed In Howard County							
Station # HO-...-97	Stream Location	Fish		Benthos		Physical Habitat	
		Score	Condition	Score	Condition	Score	Condition
P-195-130	Plumtree Branch	---		2.56	Poor	3.41	Very Poor
P-208-120	Plumtree Branch	2.33	Poor	2.11	Poor	22.18	Poor
P-002-321	Mainstem above Plumtree Branch	3.67	Fair	2.78	Poor	28.34	Poor
P-098-224	Unnamed trib south of Columbia Mall	2.11	Poor	2.78	Poor	44.94	Fair
N-039-114	Unnamed trib at Gilford	3.67	Fair	3.29	Fair	33.73	Poor
N-038-204	Dorsey Run at Patux. Prkway	2.11	Poor	2.14	Poor	63.10	Fair
AA-N-063 -232-97	Dorsey Run in A. Arundel Co.	4.25	Good	2.14	Poor	76.41	Good

Index Used In 1997 MBSS	Description
Fish Index of Biotic Integrity	Ranges from 1.0 (worst) to 5.0 (best)
Benthic Index Biotic Integrity	Ranges from 1.0 (worst) to 5.0 (best)
Physical Habitat Index	Range from 0 (worst) to 100 (best)

* Additional details are available at www.dnr.state.md.us. (7/31/2001)
At the DNR home page:
– Click on “Bays and Streams”
– Click on “Streams” (upper left corner of page)
– Click on “Small Streams (MBSS)” (upper left corner of page)
– Click on “Results” (near top center of page)
– Scroll toward bottom of page and click on “Searchable data from first round MBSS”

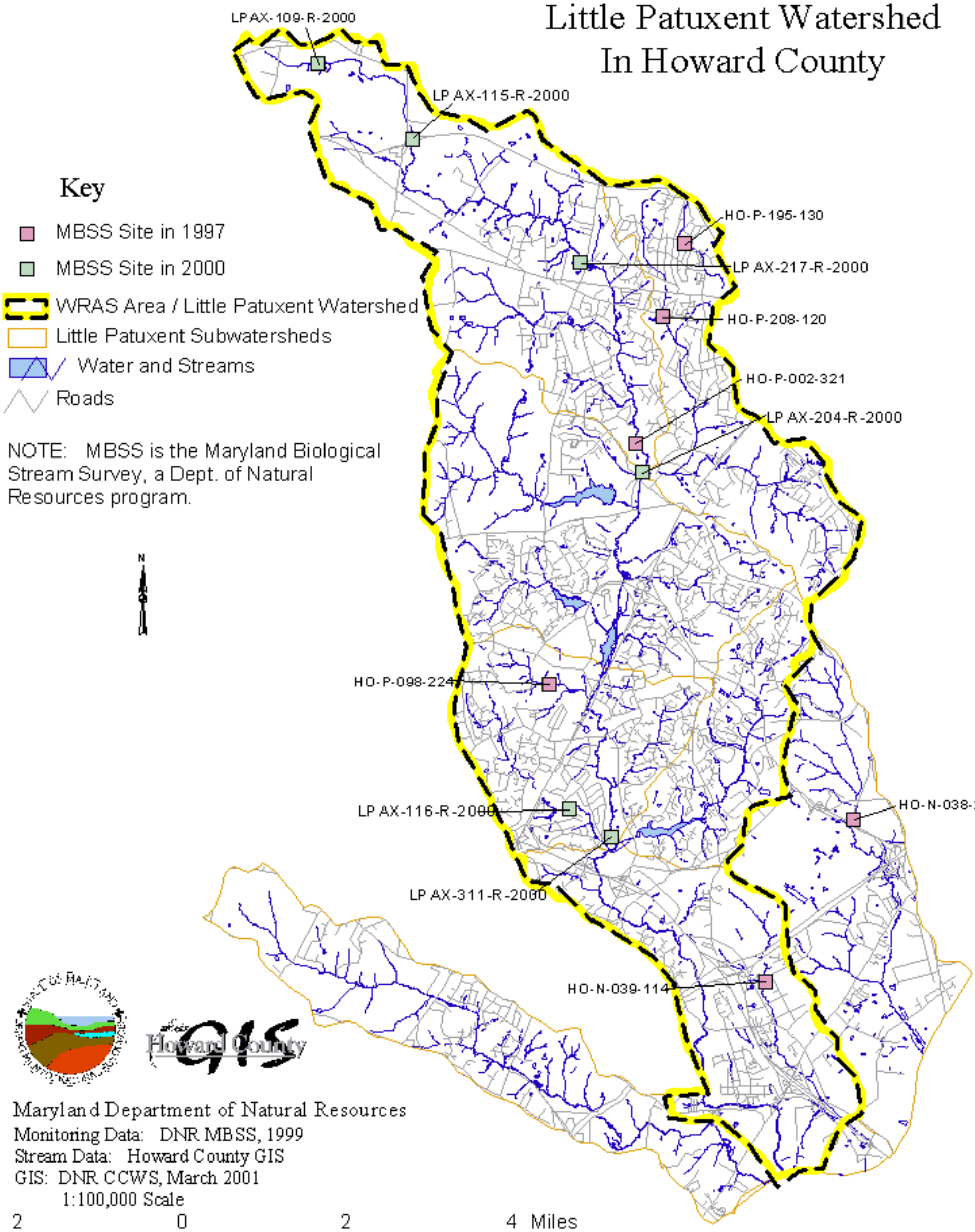
Why Look At Benthos In Streams?

Benthos are sometimes called "stream bugs" though that name overly simplifies the diverse membership of this group. Unimpaired natural streams may support a great diversity of species ranging from bacteria and algae to invertebrates like crayfish and insects to fish, reptiles and mammals. Benthic macro-invertebrates, also called benthos, are an important component of a stream's ecosystem. This group includes mayflies, caddisflies, crayfish and others that inhabit the stream bottom, its sediments, organic debris and live on plant life (macrophytes) within the stream.

The food web in streams relies significantly on benthos. Benthos are often the most abundant source of food for fish and other small animals. Many benthic macroinvertebrates live on decomposing leaves and other organic materials in the stream. By this activity, these organisms are significant processors of organic materials in the stream. Benthos often provide the primary means that nutrients from organic debris are transformed to other biologically usable forms. These nutrients become available again and are transported downstream where other organisms use them.

Benthos are a valuable tool for stream evaluation. This group of species has been extensively evaluated for use in water quality assessment, in evaluating biological conditions of streams and in gauging influences on streams by surrounding lands. Benthos serve as good indicators of water resource integrity because they are fairly sedentary in nature and their diversity offers numerous ways to interpret conditions. (They have different sensitivities to changing conditions, they have a wide range of functions in the stream and they use different life cycle strategies for survival.)

Map 11 Monitoring Sites Little Patuxent Watershed In Howard County



Maryland Department of Natural Resources
Monitoring Data: DNR MBSS, 1999
Stream Data: Howard County GIS
GIS: DNR CCWS, March 2001
1:100,000 Scale

2 0 2 4 Miles

Sensitive Species

Sensitive species are most widely known in the form of Federally listed endangered or threatened animals such as the bald eagle. In addition to these charismatic rare animals, both US EPA and Maryland DNR work through their respective Federal and State programs to protect numerous endangered, threatened, or rare species of plants or animals, and ecological communities of those species.

For the purposes of watershed restoration, it is valuable to account for known locations of habitat for these species. These places are often indicators and sometimes are important constituents of the network of natural areas or "green infrastructure" that are the foundation for many essential natural watershed processes. Protecting these species and/or promoting expansion of their habitats can be an effective foundation for a watershed restoration program.

1. Habitat Protection Categories

One way to characterize a watershed for sensitive species is to identify known habitat locations using several broad categories employed by DNR's Wildlife and Heritage Division. The following table and Map 12 Sensitive Species summarize this information. Based on this general information, more detailed information and guidance can be requested from Division staff.

Two of the three categories used to help protect sensitive species during review of applications for a State permit or approval or involve State funds are found in the Little Patuxent River Watershed. These categories are Sensitive Species Project Review Areas and Wetlands of Special State Concern. For projects potentially affecting these areas, the State permit or approval will include recommendations and/or requirements to protect sensitive species and their habitat. In addition, many counties have incorporated safeguards for these areas into their permit review process.

These categories do not place requirements on any activities that do not require a State permit, a State approval or involve State funds. However, property owners are encouraged to seek advice on protecting the sensitive species / habitat within their ownership.

Maryland's Sensitive Species Protection Categories

Sensitive Species Project Review Area (SSPRA)	Natural Heritage Area (NHA)	Wetlands of Special State Concern (WSSC)
At least two SSPRAs are in Howard County's WRAS area and at least four additional SSPRAs are in other portions of Howard County's Little Patuxent River watershed. Each SSPRA contains one or more sensitive species habitats. However, the entire SSPRA is not considered sensitive habitat. The SSPRA is an envelope identified for review purposes to help ensure that applications for permit or approval in or near sensitive areas receive adequate attention and safeguards for the sensitive species / habitat they contain. At least one SSPRA encompasses each Natural Heritage Area and Waterland of Special State Concern.	No NHAs are located in Howard County's Little Patuxent River watershed. NHAs are rare ecological communities that encompass sensitive species habitat. They are designated in State regulation COMAR 08.03.08.10. For any proposed project that requires a State permit or approval that may affect an NHA, recommendations and/or requirements are placed in the permit or approval that are specifically aimed at protecting the NHA.	One WSSC is designated in Howard County's Little Patuxent watershed. It is labeled in Map 12 Sensitive Species as the Route 32 wetlands. These wetlands are associated with one or more sensitive species habitats that are in or near the wetland. For any proposed project that requires a wetland permit, these selected wetlands have additional regulatory requirements beyond the permitting requirements that apply to wetlands generally. For a listing of designated sites, see COMAR 26.23.06.01

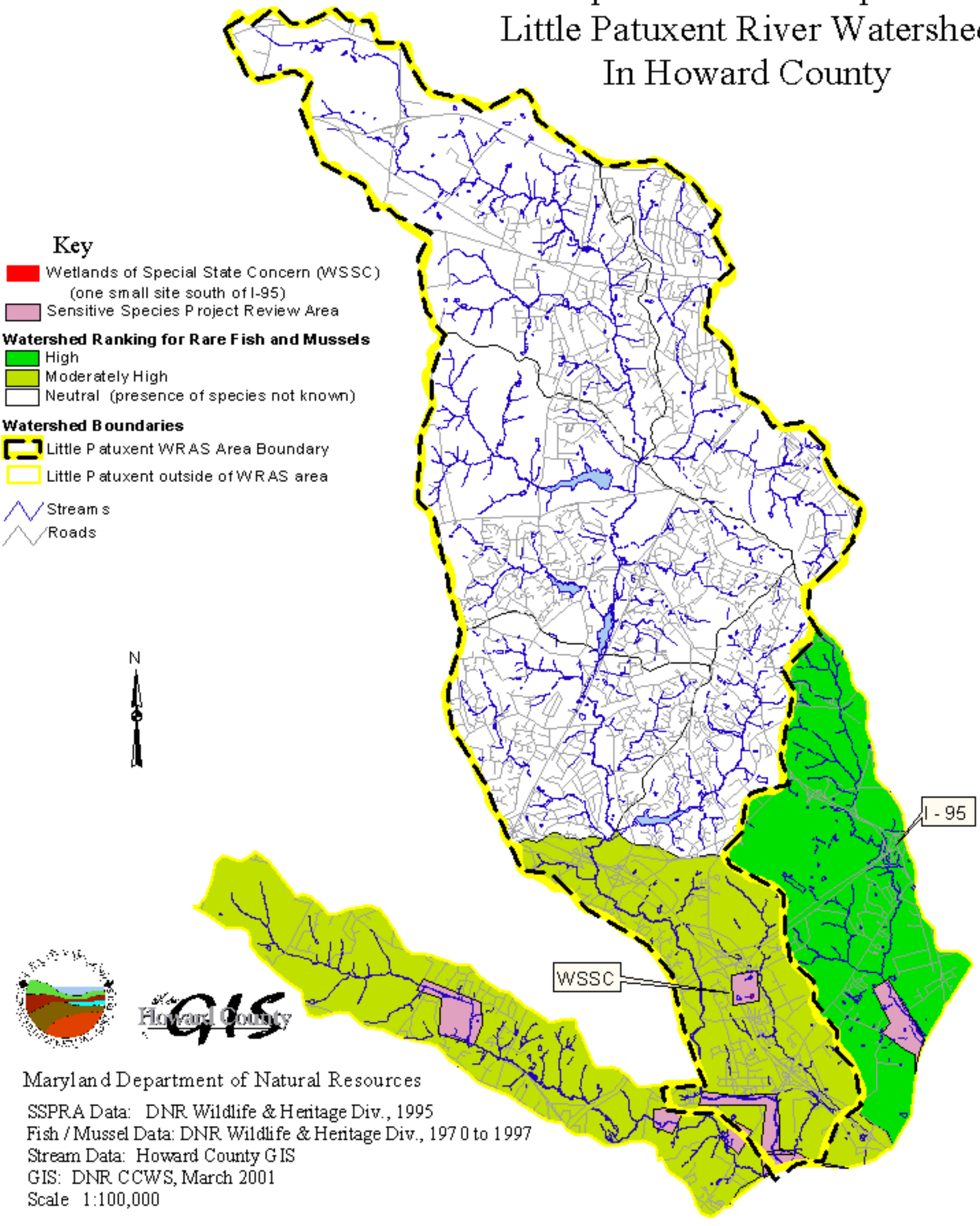
2. Rare Fish and Mussels

DNR recently initiated a project to rank watersheds across Maryland to aid in targeting conservation and restoration efforts to benefit known populations of rare fish and mussels. This ranking considers information from 1970 to 1997 only for rare species of fish or mussels being tracked in Maryland. Four possible ranks were used for this project: Very High, High, Moderately High and Neutral. Each rare species being tracked contributed to this ranking based on two types of criteria: 1) presence or absence, and 2) if present, a "weighted relative rarity" based on worldwide and Statewide scales.

In comparison to the more than 1,000 small (12-digit) watersheds identified by DNR in Maryland, several of the 12-digit subwatersheds in Howard County's Little Patuxent watershed ranked either "High" or "Moderately High" and the remainder ranked "Neutral." Map 12 Sensitive Species shows the watershed rankings.

In general, higher ranking suggests that restoration or conservation projects in these areas may have greater potential to protect aquatic species diversity. Projects could be used to protect, enhance or expand existing aquatic habitat. A ranking of neutral indicates that information is insufficient (not absence of these species or low priority.) Neutral areas upstream of higher ranked areas are potentially important because they affect rare fish and mussel populations located downstream. In neutral ranked areas, it is reasonable to rely on other available criteria for targeting watershed conservation and restoration projects.

Map 12 Sensitive Species
Little Patuxent River Watershed
In Howard County



Maryland Department of Natural Resources

SSPRA Data: DNR Wildlife & Heritage Div., 1995
Fish / Mussel Data: DNR Wildlife & Heritage Div., 1970 to 1997
Stream Data: Howard County GIS
GIS: DNR CCWS, March 2001
Scale 1:100,000

2 0 2 4 Miles

RESTORATION TARGETING TOOLS

Stream Corridor Assessment

At the request of Howard County, a Stream Corridor Assessment was conducted in 1999 by the DNR Watershed Restoration Division in the WRAS area. This effort employed trained teams selected from the Maryland Conservation Corps. These teams walked along streams identifying and recording potential problems. Immediate products generated by this effort includes maps and photographs. A report for the overall findings of the effort is anticipated in 2001. The findings from the assessment can help establish a factual basis for targeting numerous restoration projects in the watershed.

The range of potential problems identified during the assessment is summarized in the table Little Patuxent Stream Corridor Assessment - Findings Matrix. In the table under severity frequency, columns 1 through 5 are a severity ranking with 1 being the most severe occurrences and 5 being the least severe. For the potential problems listed, the numbers shown in the columns under severity frequency are a count of occurrences within that problem category ranked by severity. Also see two maps for details:
Map 14 Stream Corridor Assessment: Inadequate Stream Buffer and
Map 15 Stream Corridor Assessment: Buffer and Erosion Problem Areas

Little Patuxent Stream Corridor Assessment – Findings Matrix							
Potential Problems Identified	**Count**	**Length Est. feet / miles**	**Severity Frequency**				
			1	**2**	**3**	**4**	**5**
Pipe Outfalls	531	--	--	2	16	290	223
Tree Blockages	148	--	--	--	--	--	--
Inadequate Buffers	117	187,720 / 35.5	1	23	42	41	10
Erosion	103	51,405 / 9.7	2	5	40	38	18
Fish Blockages	66	--	2	10	17	21	16
Channel Alternation	49	15,662 / 3.0	--	5	20	16	8
Exposed Pipe	48	455 / 0.08	2	1	8	22	15
Unusual Conditions	28	--	1	--	15	11	1
Trash Dumping	7	--	--	1	--	4	2
In or Near Stream Construction	1	--	--	--	1	--	--
TOTAL	1,098	--	8	47	159	443	293

Fish Blockages

The DNR Fish Passage program maintains a database of blockages to fish movement. The purpose of the database is to assist in efforts to remove significant blockages across the State. A summary of known blockages in the WRAS area in the Howard County portion of the Little Patuxent River watershed appears in the following table and in Map 13 Fish Blockages and Trout Stocking. Three blockages have been corrected. Note: The 1999 Stream Corridor Assessment identified 66 blockages, most of which are not listed here.

Fish Blockages Little Patuxent River Watershed in Howard County			
Station	Blockage Corrected	Stream	Name / Location
LPX02		Dorsey	CSX RR Culvert
LPX03	yes	Dorsey	Dorsey Run Dam above B&O RR
LPX04	yes	Hammond	at power line below Stephens Rd
LPX06		L Patuxent	at Route 32
LPX07		L Patuxent	Lake Kittamaqundi Dam
LPX08		L Patuxent	above Lake Kittamaqundi
LPX15		tributary	Rt 29 above Columbia Dam
LPX16		tributary	above I-95
LPX17	yes	mainstem	sewer line above Gorman Road

1. Current Fish Blockage Removal Projects

One mitigation project is currently underway in the Little Patuxent River watershed in Howard County at blockage LPX02. It is outside of the WRAS area on Dorsey Run a few hundred feet upstream of the Howard / Anne Arundel County boundary. This cooperative project between DNR Watershed Restoration Division and the Howard Soil Conservation District will incorporate fish passage around an impoundment dam and wetland restoration. As of March 2001, design for the project was underway.

Map 13
Fish Blockages and Trout Stocking
Little Patuxent Watershed
In Howard County

Key

- XXX — Existing Blockage to Fish Movement
- XXX — Past Fish Blockage That Has Been Corrected
- Little Patuxent WRAS Project Area in Howard County
- Little Patuxent Watershed Areas in Howard County outside the WRAS Area. Anne Arundel County portions of the watershed not shown.
- Put & Take Trout Stocking Area
- Streams
- Major Roads

N

LPX08
LPX07
LPX15
LPX16
LPX06
LPX03
LPX02
LPX17
LPX04

Note: The 1999 Stream Corridor Assessment identified 66 blockages to fish movement in the WRAS Area. This new information will be reported and added to the DNR fish blockage database.

Howard County GIS

Maryland Department of Natural Resources
Fisheries Data: DNR Fisheries Service
Stream Data: Howard County GIS
GIS: DNR CCWS, July 2001
Scale 1:100,000

2 0 2 4 Miles

Stream Buffer Restoration

In preliminary discussions between Howard County and DNR representatives, restoring riparian forest buffers was identified as a County priority. Using information gathered by the 1999 stream corridor assessment, the County has already completed at least one buffer planting and is working to prioritize additional work.

Natural vegetation in stream riparian zones act as stream buffers that can provide numerous environmental benefits:

– Reducing surface runoff
– Preventing erosion and sediment movement
– Using nutrients for vegetative growth and moderating nutrient entry into the stream
– Moderating temperature, particularly reducing warm season water temperature
– Providing organic material (decomposing leaves) that are the foundation of natural food webs in stream systems
– Providing overhead and in-stream cover and habitat
– Promoting high quality aquatic habitat and diverse populations of aquatic species.

To realize these environmental benefits, DNR generally recommends that forested stream buffers be at least 100 feet wide , i.e. natural vegetation 50 feet wide on either side of the stream. Therefore, DNR is promoting this type of stream buffer for local jurisdictions and land owners who are willing to go beyond the minimum buffer standards. The DNR Watershed Restoration Division and other programs like the Conservation Reserve Enhancement Program (CREP) are available to assist land owners who volunteer to explore these opportunities.

Based on the findings of the 1999 Stream Corridor Assessment, County staff have mapped buffer restoration opportunities using the County's GIS and have begun prioritizing areas for detailed assessment and restoration. Map 14 Stream Corridor Assessment: Inadequate Stream Buffer shows observations reported by the stream assessment crew. Some additional perspective on potential restoration areas are shown in Map 15 Stream Corridor Assessment: Buffer and Erosion Problem Areas, which also shows stream channel erosion sites.

In addition to the stream corridor assessment information, other factors can be considered that help to prioritize areas for stream buffer restoration. For example, stream buffer restoration opportunities can be considered in the context of land use, wetlands, hydric soils, green infrastructure, land ownership, etc. to assist in prioritizing potential projects to achieve multiple benefits. Multiple benefits within a project area could include but are not limited to habitat improvement, nutrient transport reduction, green infrastructure enhancement, recreational enhancement and buffering sensitive species habitat.

DNR Watershed Management and Analysis Division has developed GIS-based tools using remote sensing data to assist in the buffer restoration targeting process. Several scenario maps are presented to demonstrate methods that can be used to locate sites having a high probability of optimizing certain ecological benefits. Unlike the stream corridor assessment information, the resolution of the data used to generate these maps is not sufficient for an accurate site assessment, but they can be used to identify potential candidate sites for detailed investigation. The streams presented in the maps are "blue line streams" as generally shown on US Geological Survey

Quadrangle Maps. Intermittent streams were not considered in the stream buffer scenario maps.

1. Headwater Stream Buffers

Headwater streams are also called first order streams. These streams, unlike other streams, intercept all of the surface runoff within the watersheds that they drain. In addition, for many watersheds, first order streams drain the majority of the land within the entire watershed. Therefore, stream buffers restored along headwater streams tend to have greater potential to intercept nutrients and sediments than stream buffers placed elsewhere. In targeting stream buffer restoration projects, giving higher priority to headwater streams is one approach to optimizing nutrient and sediment retention.

Map 8 Forest Land, which shows "blue line streams" and forested areas, can be used to identify headwater areas with existing or potential forest. Restoring headwater stream buffers in these areas can also provide habitat benefits that can extend downstream of the project area. Forested headwater streams provide important organic material, such as decomposing leaves, that "feed" the stream's food web. They also introduce woody debris which enhances in-stream physical habitat. The potential for riparian forest buffers to significantly influence stream temperature is greatest in headwater regions. These factors, in addition to positive water quality effects, are key to improving habitat for aquatic resources.

2. Land Use and Stream Buffers

One factor that affects the ability of stream buffers to intercept nonpoint source pollutants is adjacent land use. Nutrient and sediment loads from different land uses can vary significantly. As the following table indicates, crop land typically contributes the greatest nutrient and sediment loads. However, under some conditions urban land can contribute higher phosphorus loads.

Nonpoint Source Pollution Load Rates By Land Use
Chesapeake Bay Watershed Model, in kg/ha-yr

Land Use		Nitrogen	Phosphorus	Sediment
Crop land		17.11	1.21	0.74
Urban	Impervious / Pervious	8.43 / 10.79	0.58 / 1.56	0.00 / 0.20
Pasture		8.40	1.15	0.30
Forest		1.42	0.00	0.03

By identifying land uses in riparian areas with inadequate stream buffers, such as crop land adjacent to streams, the potential to reduce nutrient and sediment loads can be improved. To assist in finding areas with crop land adjacent to streams, the same land use data shown in Map 6 1997 Generalized Land Use can be filtered using GIS. The new scenario shown in Map 16 Land Use Scenario for Stream Buffer Restoration focuses on the land use within 150 feet of a stream. This view, supplemented with the land use pollution loading rates, suggests potential buffer restoration opportunities that could maximize nutrient and sediment loads.

3. Nutrient Uptake from Hydric Soils in Stream Buffers

In general, the nutrient nitrogen moves from the land into streams in surface water runoff and in groundwater. In some soils, a significant percentage of nitrogen enters streams in groundwater. Stream buffer restoration can be used to capture nitrogen moving in groundwater if buffer restoration projects have several attributes:

– Plants with roots deep enough to intercept groundwater as it moves toward the stream,
– Plants with high nitrogen uptake capability, and
– Targeting buffer restoration projects to maximize groundwater interception by buffer plants.

Hydric soils in stream riparian areas can be used as one factor to help select stream buffer restoration sites. Siting buffer restoration on hydric soils would offer several benefits:

– Plant roots are more likely to be in contact with groundwater for longer periods of time
– Hydric soils tend to be marginal for many agricultural and urban land uses
– Natural vegetation in wet areas often offer greater potential for habitat.

Map 17 Nutrient Retention Using Hydric Soils Scenario identifies lands adjacent to streams that are on hydric soil in the Little Patuxent River watershed. An important next step in using this information is verification of field conditions. Care must be taken during field validation to evaluate any hydrologic modification of these soils, such as ditching or draining activities, which would likely decrease potential benefits.

One of several ways to refine the scenario in Map 17 is shown in Map 18 Nutrient Retention Using Hydric Soils Associated with Cropland. In the second map, cropland is singled out for consideration because of its nutrient export potential and its greater likelihood that opportunities to restore and enhance stream buffers may exist.

4. Wetland Associations

Wetlands and adjacent natural uplands form complex habitats that offer a range of habitat opportunities for many species. These "habitat complexes" tend to offer greater species diversity and other ecological values that are greater than the values that the wetland or uplands could offer independently. Therefore, restoring stream buffers adjacent to or near to existing wetlands tends to offer greater habitat benefits than the restoration project could otherwise produce. Map 19 Wetland Proximity Scenario for Stream Buffer Restoration identifies unforested buffer zones that are in close proximity (within 300 feet) to wetlands (National Wetlands Inventory). Restoration projects in these areas may offer opportunities to enhance and expand wetland habitat in addition to the other desirable buffer functions.

5. Optimizing Benefits by Combining Scenarios

Strategic targeting of stream buffer restoration projects can take into account many different potential benefits. Several of these scenarios are presented independently in this section. However, site selection and project design generally incorporate numerous factors to optimize benefits from the project. For example, finding a site with a mix of attributes like those in the following list could result in the greatest control of nonpoint source pollution and enhancement for living resources:

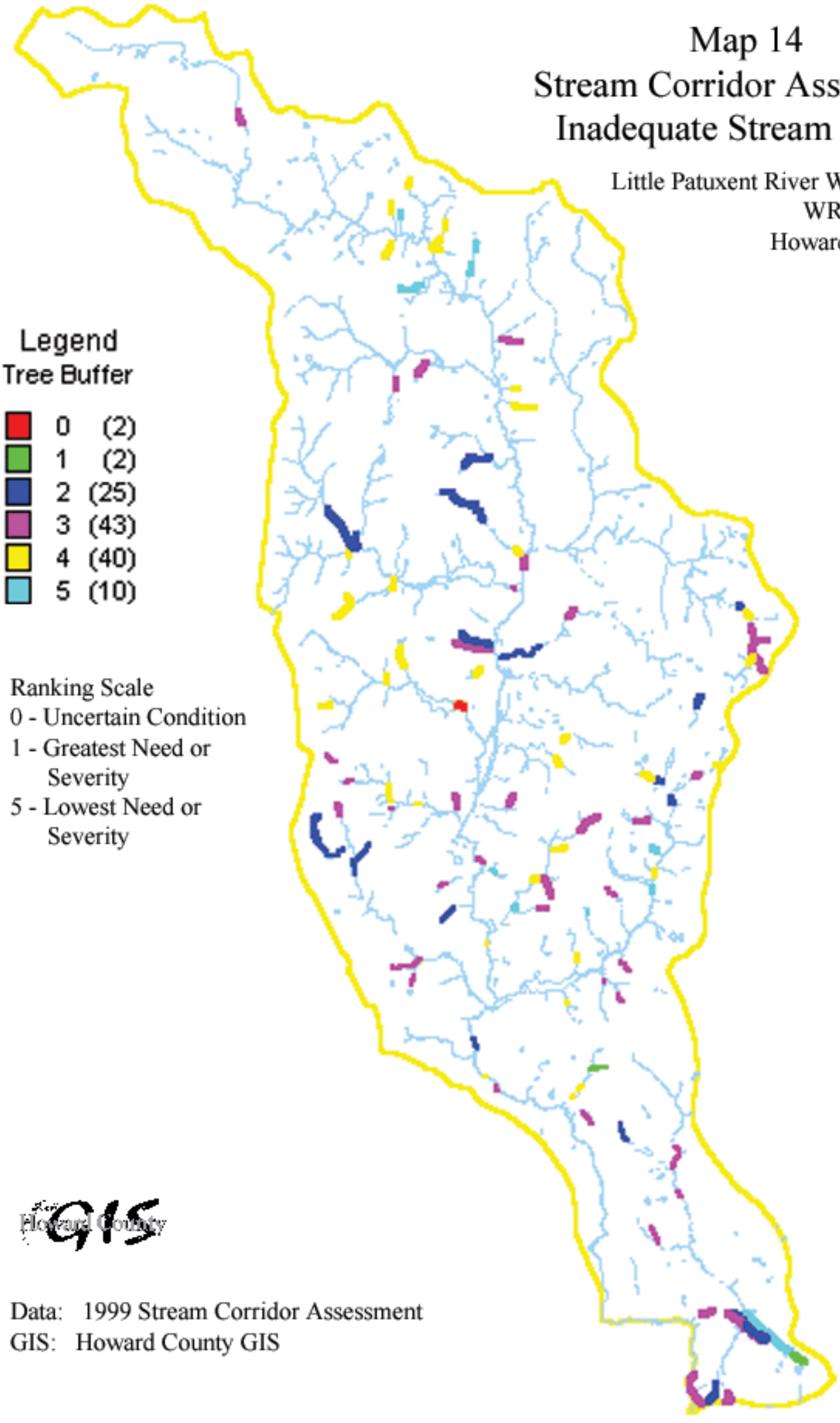
– Land owner willingness / incentives
– Marginal land use in the riparian zone
– Headwater stream
– Hydric soils
– Selecting appropriate woody/grass species
– Adjacent to existing wetlands / habitat

Two of the many ways to integrate targeting criteria to help identify candidate sites for additional investigation are shown here. One example is shown in Map 18 Nutrient Retention Using Hydric Soils Associated With Cropland Scenario. This map suggests potential stream buffer restoration areas that are likely to offer the greatest opportunity to reduce both nutrients and sediment entering the stream. By also considering land ownership it is reasonable to target sites for on-site investigation.

Another example shown in Map 20 Stream Prioritization Scenario prioritizes stream segments based on lack of adequate naturally vegetated buffers, land use adjacent to the stream and headwater stream status.

Map 14
Stream Corridor Assessment
Inadequate Stream Buffer

Little Patuxent River Watershed
WRAS Area
Howard County



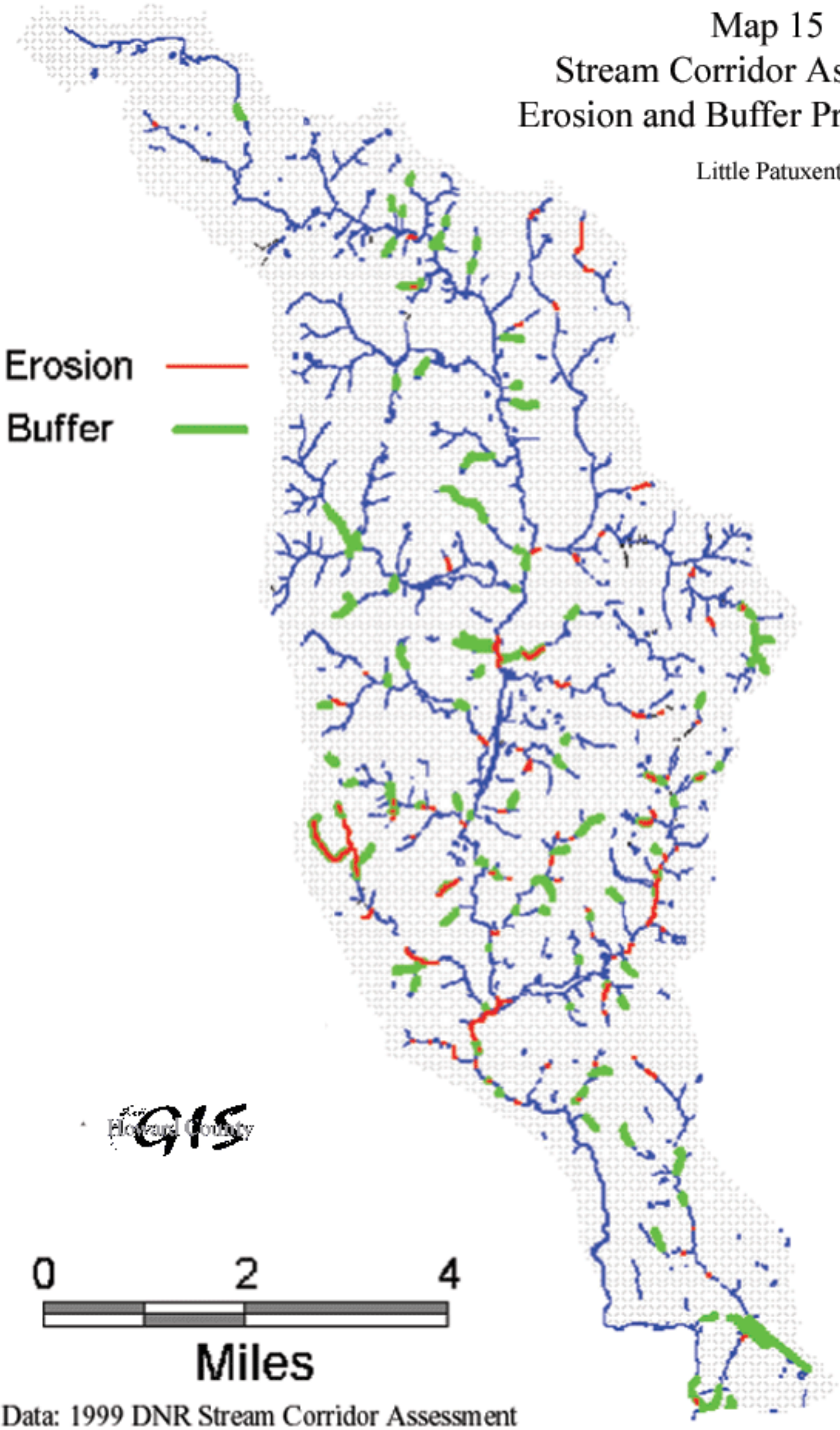
Ranking Scale
0 - Uncertain Condition
1 - Greatest Need or Severity
5 - Lowest Need or Severity

Howard County GIS

Data: 1999 Stream Corridor Assessment
GIS: Howard County GIS

Map 15
Stream Corridor Assessment
Erosion and Buffer Problem Sites

Little Patuxent River Watershed
WRAS Area
Howard County

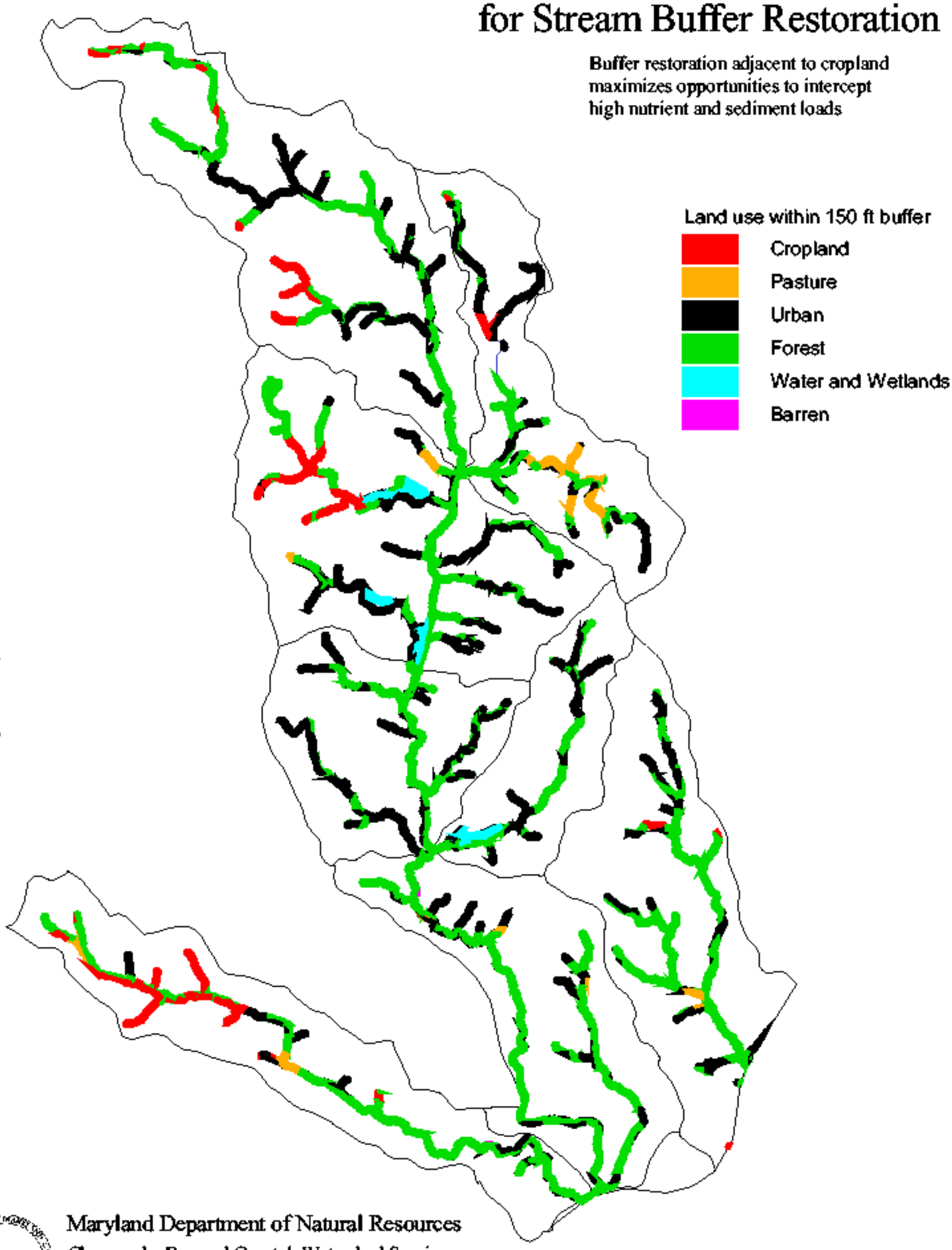


Data: 1999 DNR Stream Corridor Assessment
GIS: Howard County

Map 16

Land Use Scenario for Stream Buffer Restoration

Buffer restoration adjacent to cropland maximizes opportunities to intercept high nutrient and sediment loads



Maryland Department of Natural Resources
Chesapeake Bay and Coastal Watershed Service
Watershed Management and Analysis Division
December 5, 2000

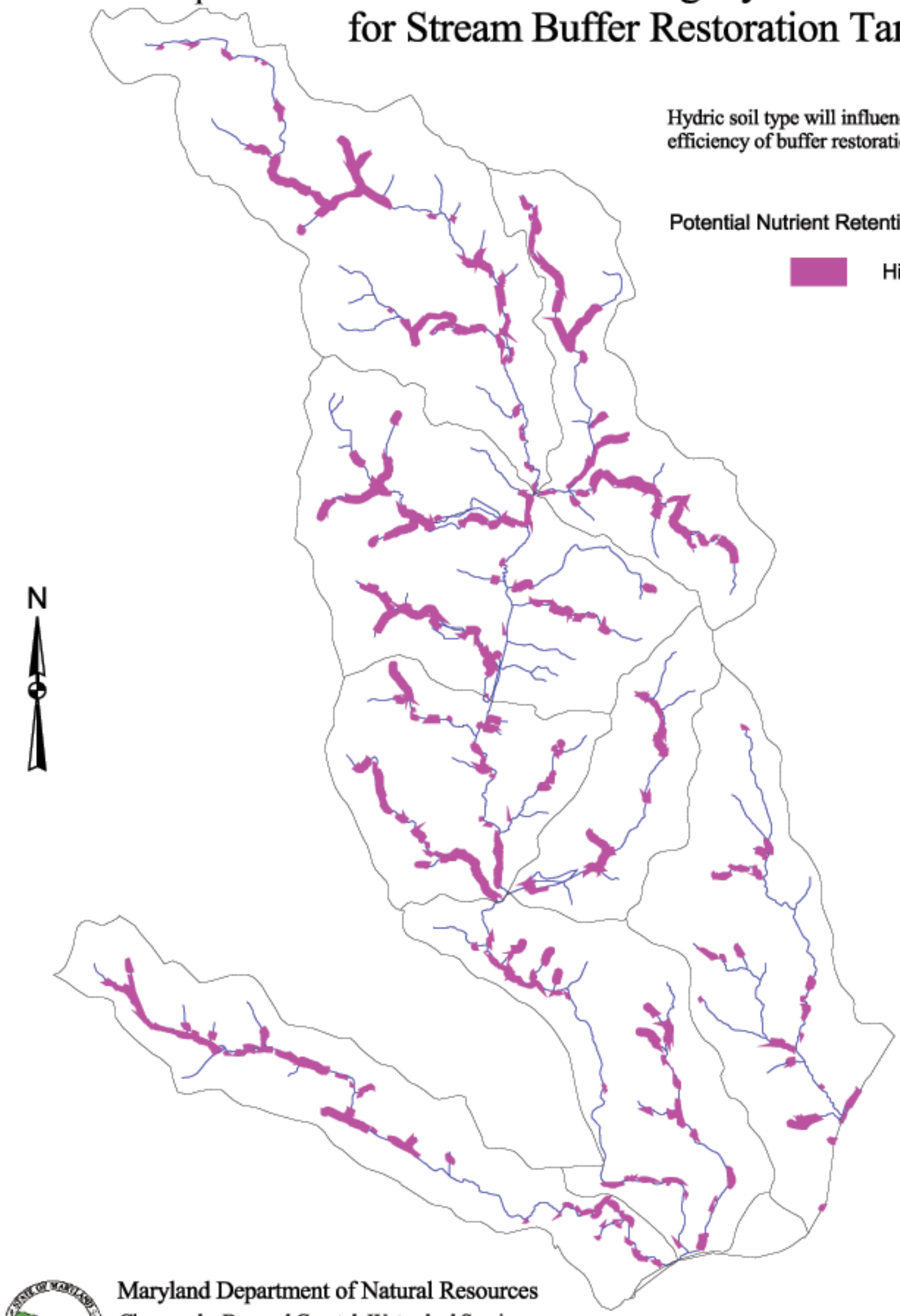
Map 17 Nutrient Retention Using Hydric Soils Scenario for Stream Buffer Restoration Targeting

Hydric soil type will influence nutrient retention efficiency of buffer restoration

Potential Nutrient Retention Efficiency

High

N

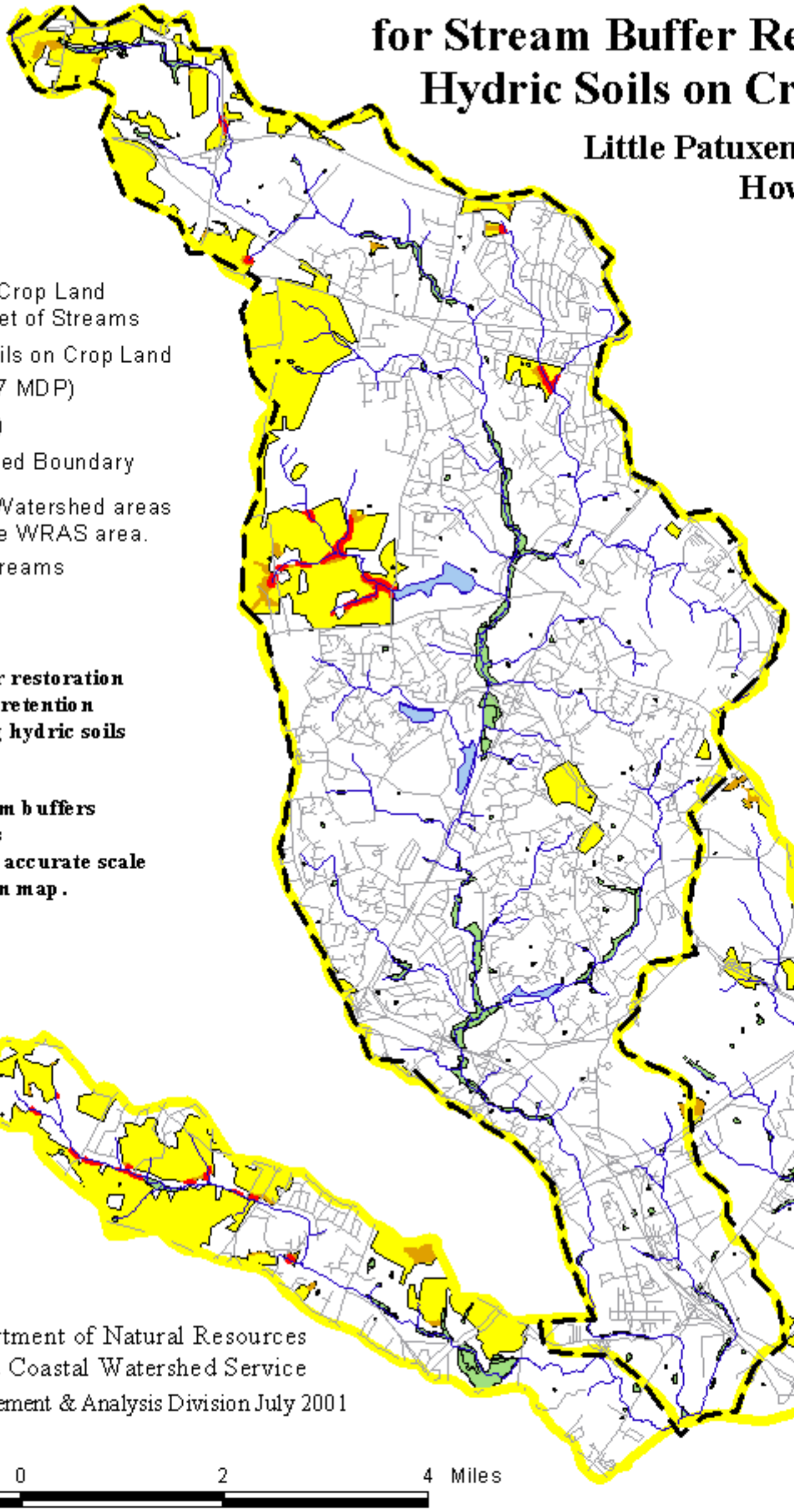


Maryland Department of Natural Resources
Chesapeake Bay and Coastal Watershed Service
Watershed Management and Analysis Division
December 5, 2000

0 2 Miles

Map 18
Nutrient Retention Scenario for Stream Buffer Restoration Hydric Soils on Cropland

Little Patuxent Watershed
Howard County



Key:

- Hydric Soils on Crop Land within 150 feet of Streams
- Other Hydric Soils on Crop Land
- Crop Land (1997 MDP)
- Wetlands (NWI)
- WRAS Watershed Boundary
- Little Patuxent Watershed areas outside of the WRAS area.
- Water and Streams
- Roads

Note 1: Stream buffer restoration can optimize nutrient retention efficiency by targeting hydric soils on cropland

Note 2: 150 foot stream buffers containing hydric soils are shown larger than accurate scale to improve legibility on map.

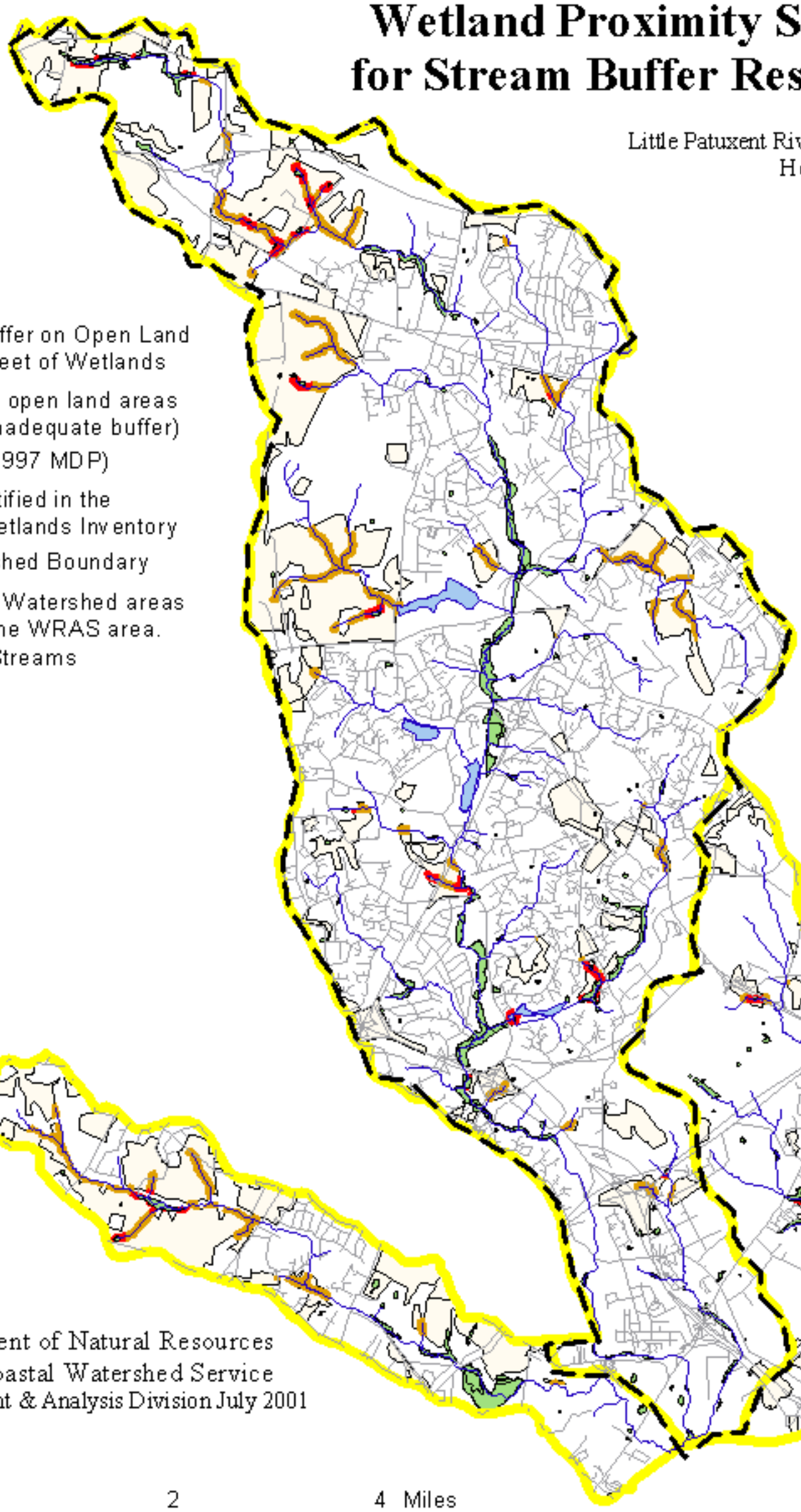
N

Maryland Department of Natural Resources
Chesapeake and Coastal Watershed Service
Watershed Management & Analysis Division July 2001
Scale 1:100,000

2 0 2 4 Miles

Map 19
Wetland Proximity Scenario for Stream Buffer Restoration

Little Patuxent River Watershed
Howard County



Key:

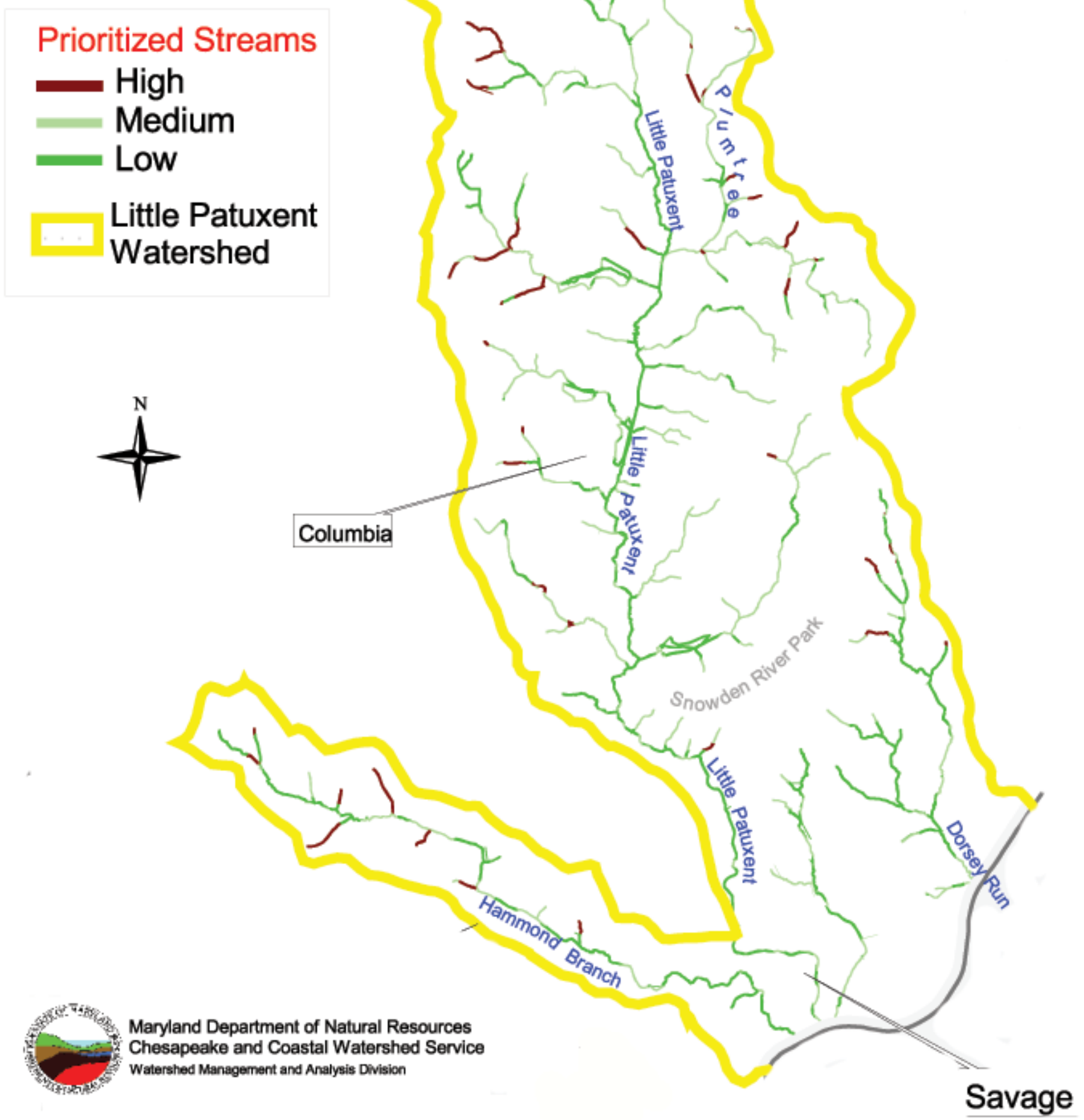
- Inadequate Buffer on Open Land within 300 feet of Wetlands
- Streams within open land areas (potentially inadequate buffer)
- Open Land (1997 MDP)
- Wetlands identified in the National Wetlands Inventory
- WRAS Watershed Boundary
- Little Patuxent Watershed areas outside of the WRAS area.
- Water and Streams
- Roads

N

Maryland Department of Natural Resources
Chesapeake and Coastal Watershed Service
Watershed Management & Analysis Division July 2001
Scale 1:100,000

2 0 2 4 Miles

Map 20
Stream Prioritization Scenario
Little Patuxent River Watershed
Howard County



Maryland Department of Natural Resources
Chesapeake and Coastal Watershed Service
Watershed Management and Analysis Division

Wetland Restoration

Wetlands serve important environmental functions such as providing habitat and nursery areas for many organisms, nutrient uptake and recycling, erosion control, etc. However, most watersheds in Maryland have significantly fewer wetland acres today than in the past. This loss is due to draining, filling, etc. and has led to habitat loss and water quality impacts in streams and in the Chesapeake Bay. Reversing this historic trend is an important goal of wetland restoration. One approach to identifying candidate wetland restoration sites involves identifying "historic" wetland areas based on the presence of hydric soils. This process can be accelerated by using a GIS to manipulate soils information with other data such as land use. The GIS products can then assist in initiating the candidate site search process, targeting site investigations and helping to identify land owners. To promote wetland restoration, DNR Watershed Management and Analysis Division has developed GIS capability for these purposes.

For the Little Patuxent River watershed, GIS was used to map and prioritize areas of hydric soil for potential wetland restoration. The steps and priorities used to generate the map are listed below:

– Data used: Hydric soils (Natural Soil Groups), existing wetlands (National Wetlands Inventory), land use (MDP 1997). The soils and wetlands data used are greatly generalized. Use of more detailed and/or higher accuracy information would increase confidence in identifying wetland restoration opportunities.

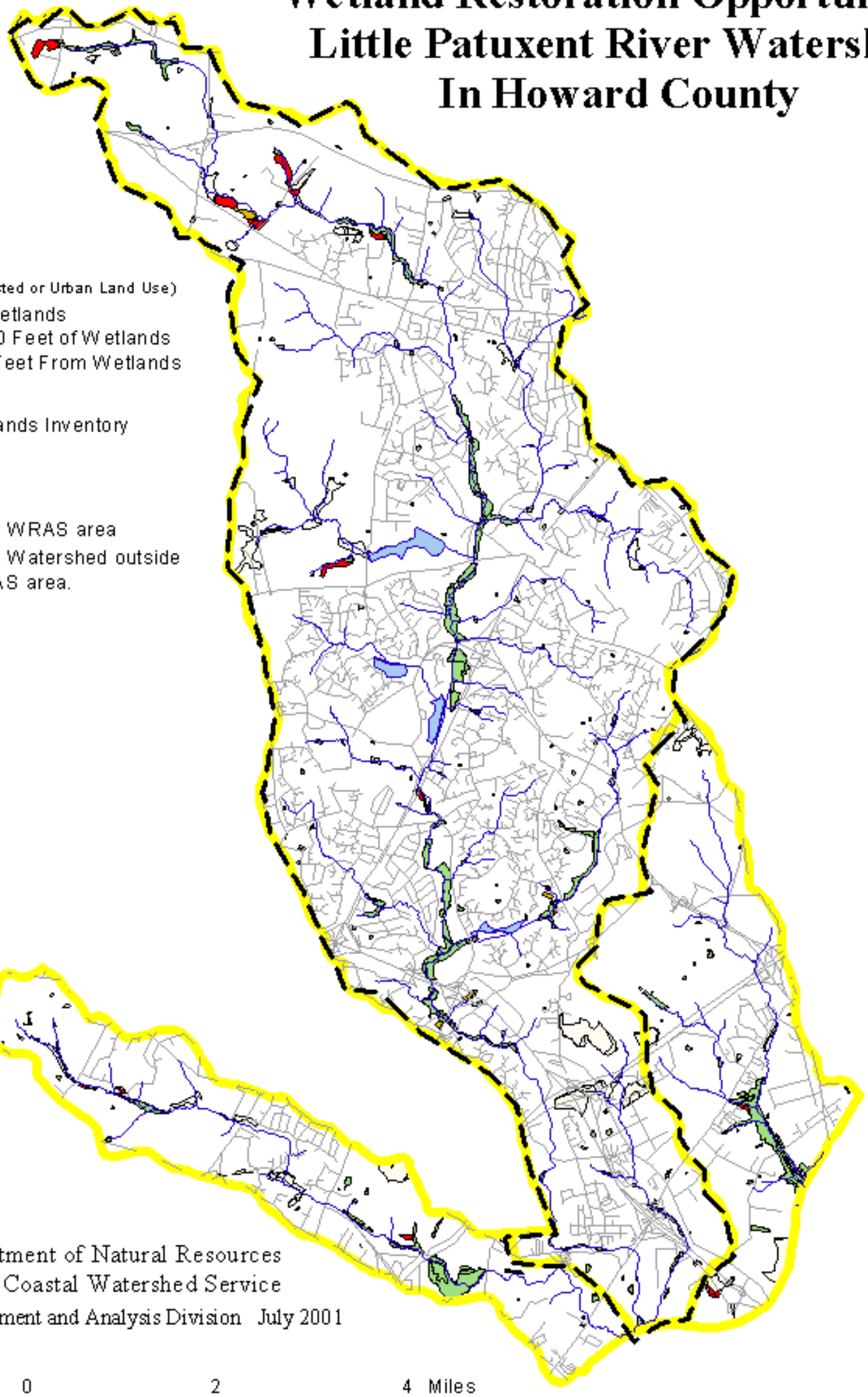
– Identify candidate hydric soil areas based on land use. Hydric soils on open land (agricultural fields, bare ground, etc.) are retained while those underlying forested or urban land use are excluded.

– Explore hydric soils near existing wetlands or streams. In the Little Patuxent River watershed, there are a small number of hydric soils on open land adjacent to wetlands or streams.

Map 21 Wetland Restoration Opportunities highlights the hydric soil areas discussed above. The number of potential opportunities is small enough that additional assessment of land ownership and, potentially, on-site investigation can be reasonably attempted. If assessments of land ownership are desirable, identifying land owners (via GIS) and willing cooperators (via direct contact), may be appropriate.

Based on the analysis above, prioritization of areas for on-site assessment and restoration projects can target areas closest to wetlands that have inadequate stream buffers.

Map 21
Wetland Restoration Opportunities
Little Patuxent River Watershed
In Howard County



Key

Hydric Soils (Not Forested or Urban Land Use)

- Adjacent to Wetlands
- Less Than 100 Feet of Wetlands
- At Least 100 Feet From Wetlands

Existing Wetlands

- National Wetlands Inventory

- Streams
- Roads
- Little Patuxent WRAS area
- Little Patuxent Watershed outside of the WRAS area.

N

Maryland Department of Natural Resources
Chesapeake and Coastal Watershed Service
Watershed Management and Analysis Division July 2001
Scale 1:100,000

2 0 2 4 Miles

RELATED PROJECTS

There are numerous projects and programs that have the potential to contribute to successful development and implementation of a Watershed Restoration Action Strategy. The listing included here suggests opportunities for cooperation and coordination that can improve the likelihood of success for the WRAS. While this listing is not all-inclusive, additions should be made to include important related projects and follow-up should continue to be undertaken to promote the WRAS process with these and other projects and programs.

Monitoring

1. County Volunteer Biomonitoring Program

The Department of Recreation and Parks (DRP) leads the County-wide volunteer "Stream Teams" Program, a citizen volunteer stream monitoring program started in the fall of 1989. The program is funded partially through a grant from the Chesapeake Bay Trust. To date, the program has trained over 806 volunteers. Currently there are 128 active volunteers contributing over 1,000 hours yearly, monitoring in both the Patapsco and Patuxent River watersheds. Currently there are 64 test sites being monitored monthly from April through October. Test results are sent to the DRP monthly.

Watershed Assessments

1. Stream Restoration and Stormwater Management Retrofits

A retrofit assessment for publicly owned stormwater management facilities has been completed in the Little Patuxent River watershed. As a result of this assessment, the County is currently evaluating two stormwater ponds for redesign to enhance water quality benefits. In addition, retrofit projects that the County has completed or is currently working on include the Burleigh Manor stormwater management pond modification, the Sewell's Orchard repair of existing farm ponds and wetland creation, and stream restoration along the tributaries to Wilde Lake. The County and Columbia Association have been advised that they will receive funding from MDE to reconstruct a storm water management pond in the Oakland Mills Village of Columbia. The Department of Public Works is working with the Department of Recreation and Parks on the early planning phase of the Blandair Property to provide water quality enhancements and education. The County is also working on several projects at the request of the DRP. These projects involve stream slope stabilization and restoration.

2. Centennial Lake Study

Phase II of the Centennial Lake Study was completed in January 1997. To improve water quality in Centennial Lake, the study recommended modifications to the chemical treatment program to allow additional plant growth in key areas, a public education program, goose control and continued monitoring. The County is currently preparing a design and beginning the permitting process for the dredging of Centennial Lake.

3. Other Recent Watershed Studies

These studies can provide additional data for the inventory and assessment:

-- 1994 NPDES retrofit assessment of County-owned stormwater management facilities
-- 1995 Wilde Lake Stream Evaluation and Sediment Study, prepared for Howard County by Peggy Johnson and T. Heil of the University of Maryland
-- 1995 MDNR/MGS Water Resources of Howard County, Maryland, Bulletin
-- 1994 Patuxent Watershed Demonstration Study for the Upper Little Patuxent Watershed
-- 1996 Patuxent Watershed Demonstration Study for the Font Hill Branch Watershed
-- 1980s Clean Lakes Studies for Wilde Lake and Lakes Elkhorn and Kittamaqundi and1990s study for Centennial Lake.

Watershed Restoration

1. Stream Clean-ups

The County's stream clean-up program has been in existence for many years and participation is on the rise. In 1999, 247 volunteers spent 309 hours removing trash and other debris from County waterways and ponds. This brings the cumulative totals since 1996 to 523 volunteers spending 950 hours on stream clean-ups.

2. Font Hill Wetlands Park

Construction of this wetlands mitigation project was completed and dedication was held on November 1, 1995. The 23-acre site has been well received by the community and the public at large. DRP personnel have begun educational programming of the site with the public schools as well as the general public. Aggressive control measures have been initiated for invasive exotic species.

3. Forest Mitigation / Reforestation Program

In 1989, the Department of Recreation and Parks initiated a County-wide buffer planting program for County-owned land. The County's first priority is planting and enhancing riparian and wetland buffers. Since 1989, the County has planted more than 68,000 trees and shrubs. In 1995, DRP began receiving Forest Conservation Act fee-in-lieu funds for planting riparian buffers on County-owned land. Since 1989, Howard County DRP has planted approximately 70 acres.

The 1999 Stream Corridor Assessment survey in the Little Patuxent River watershed showed that a stream in the County's Atholton Park was in need of a riparian buffer. A tree planting was held on October 14, 2000 in the park to establish the buffer. Employees of Howard County Recreation & Parks, Public Works, the Howard County Forestry Board, the Maryland Department of Natural Resources, area residents, and girl scouts planted 200 native trees and shrubs. The Forest Mitigation Program planted an additional 835 trees making the entire planting total three acres.

4. Trout Stocking

During 1999, several thousand brown and rainbow trout were stocked in the Little, Middle and Patuxent Rivers in the vicinity of Savage Park. State Fisheries officials determined

that the water quality in these rivers is sufficient to support a recreational, three (3) season fishery, although water conditions in the summer might not be suitable to support a perennial, cold water fish population that requires high levels of oxygen. To date, over 4,500 and 2,500 fish have been stocked in the Little Patuxent River and Centennial Lake, respectively.

5. Wildlife Habitat Incentives Program

The Natural Resources Conservation Service continues to run the Wildlife Habitat Incentives Program (WHIP) which provides cost-share assistance to landowners for installation of conservation practices that will restore upland grassland habitat and riparian habitat.

Best Management Practices

1. Patuxent Watershed Demonstration Project

Patuxent Watershed Demonstration Project, included two local demonstration projects in Font Hill and Sand Hill. The Maryland Department of Planning completed and distributed a final document that included modeling for growth management, project descriptions and monitoring summaries.

Font Hill. The 1995 Font Hill Demonstration Project included a stream corridor assessment survey and a public outreach and education component on best management practices for watershed residents. The project also included water quality sampling from two residential land uses, one with and one without stormwater management, and one ambient in-stream site. (These monitoring stations have since become the County's NPDES monitoring stations.)

Sand Hill. The Sand Hill Demonstration Project is designed to exclude cows from the Little Patuxent River through the use of fencing, a stream crossing and an alternate water source powered by a solar pump. The project also included stream buffer enhancements and water quality monitoring, both before and after project completion, to document the effectiveness of the project.

2. Deicing of Roads

The County carefully and thoroughly monitors storm conditions to determine the best time to apply deicers to minimize the amount of chemical used. The County is also using a GIS program for roadway snow removal that should help to manage the efficiency of plowing and reduce the amount of deicing material applied.

3. Herbicide and Pesticide Application

County agencies continue to reduce the amount of pesticides and herbicides used.

4. Illicit Discharge Program

Howard County's illicit discharge program incorporates four programs to meet the objectives: prevention, detection, removal and compliance, and management and reporting. Every year, the County is required to monitor 100 storm drains for illicit discharges.

5. Deer Management

During 1998 and 1999, deer populations in the David W. Force and Savage Park areas were assessed using Forward Looking Infra-Red technology. All tree plantings within the County have been treated with at least one of three types of deer repellent - bitrex tablets, garlic sticks and synthetic predator urine. Future plantings will also receive such treatments.

6. Alpha Ridge Landfill

At the Alpha Ridge Landfill, system closure and capping, and installation of the groundwater remediation system is continuing and is now approximately 95% complete. Public education and outreach continues to occur in conjunction with the landfill design and construction projects.

7. Agricultural Land Preservation Program

As of July 1999, the County's Agricultural Land Preservation Program and other County and State preservation programs have preserved about 18,000 acres of farm land through preservation easements. In addition, there have been approximately 350 conservation practices implemented over a 10-year period on more than 2,000 acres. Examples of the type of work that has been done include: 1,380 linear feet of stream bank protection, 43 acres of riparian forested buffer for an additional 1.5 miles of streams, 1,470 acres of conservation tillage and no-till, and one agricultural waste system.

Public Outreach and Education

1. *Eco-Review* Newsletter

The *Eco-Review* newsletter, published monthly by the Department of Public Works, appears in several local newspapers. It provides monthly and seasonal recycling ideas, a schedule of upcoming events related to recycling, and storm water management articles and tips.

2. General Recycling and Solid Waste Public Outreach

These programs include:

-- An Internet Home Page (http://www.co.md.us.review.html);
-- Cable TV public service announcements, features, daily news reminders and bulletin board messages;
-- Pre-recorded phone tips and seasonal information (voice mail);
-- A recycling pocket guide that is inserted in water and sewer bills, distributed to apartment and condominium management and residents, and included with the Eco-Review; and brochures on trash management, household hazardous waste and tree mulching.

3. Stormwater Management

The Storm Water Management Division has developed a web page, http://www.co.ho.md.us/swmindex.htm (7/31/2001) that serves as a public outreach tool, which informs the public about the activities conducted by the County as they relate to stormwater facilities. In addition, the Division has developed a manual titled "Maintaining Your Stormwater Management Structure," which is distributed to owners of stormwater management facilities and provides them with information with respect to the maintenance of stormwater management ponds.

POTENTIAL BENCHMARKS FOR WRAS GOAL SETTING

Several State and County programs designed to manage water quality and/or living resources have existing or proposed goals that are relevant to setting goals for the Little Patuxent River Watershed Restoration Action Strategy. The goals from these programs tend to overlap and run parallel to potential interests for developing WRAS goals. Therefore, to assist in WRAS development, selected goals from other programs are included here as points of reference.

Goals from the 1998 *Clean Water Action Plan* [3]:

- – Clean Water Goals - Maryland watersheds should meet water quality standards, including numerical criteria as well as narrative standards and designated uses.
- – Other Natural Resource Goals - Watersheds should achieve healthy conditions as indicated by natural resource indicators related to the condition of the water itself (e.g. water chemistry), aquatic living resources and physical habitat, as well as landscape factors (e.g. buffered streams and wetland restoration).

Water Quality Improvement Act of 1998

- – The most significant feature is requiring nutrient management plans for virtually all Maryland farms. The requirement is being phased in over a several year period:
  - Nitrogen-based plan implementation will be required in 2002
  - Phosphorus-based plan implementation will be required in 2005
- – Assistance with costs of manure transportation has the potential to move nutrients to sites where they are needed.

Additional goals and objectives from other programs will be added as appropriate.

ADDITIONAL INFORMATION

Sources Used for the Characterization

1. DNR. *Internet Site: www.dnr.state.md.us* (7/31/2001) Source areas from the site: *Surf Your Watershed; Chesapeake Bay Tributary Strategies; Information Resource Center / Publications / Data.* June 2000.

2. DNR. *Maryland Water Quality Inventory, 1993-1995.* December 1996.

3. Clean Water Action Plan Technical Workgroup. *Maryland Clean Water Action Plan.* December 1998. (Available in electronic form, see 1.)

4. Maryland Greenways Commission. *The Maryland Atlas of Greenways, Water Trails and Green Infrastructure 2000 Edition.* August 2000.

5. Department of State Documents *Internet Site*

6. M. Staley. Summary text prepared specifically for this document. DNR Fisheries Service. August 2000.

7. Klauda, Ron. Personal communication with Katharine Dowell. Monitoring and Nontidal Assessment Program, DNR Resource Assessment Service. July through Sept. 2000.

8. Weller, Deborah M.G. Personal communication with Maryland Dept. of Planning staff, Watershed Modeling and Resource Planning Section. November 2000.

9. National Academy of Sciences. *Clean Coastal Waters: Understanding and Reducing The Effects of Nutrient Pollution.* National Academy Press. 2000.

10. LaBranche, Julie. Maryland Department of the Environment. November 2000.

Abbreviation Key

CCWS - Chesapeake and Coastal Watershed Service (Part of DNR)
COMAR - Code Of Maryland Regulations (Maryland State regulations)
CREP - Conservation Reserve Enhancement Program (program of MDA)
CRP - Conservation Reserve Program (program of MDA)
CWAP - Clean Water Action Plan (Adopted by Maryland December 1998)
DNR - Department of Natural Resources (Maryland State)
DPW - Department of Public Works (Howard County)
DPZ - Department of Planning and Zoning (Howard County)
DRP - Department of Recreation and Parks (Howard County)
DTCS - Department of Technology and Communication Services (Howard County)
EPA - Environmental Protection Agency (United States)
MBSS - Maryland Biological Stream Survey (program in DNR RAS)
MDA - Maryland Department of Agriculture
MDE - Maryland Department of the Environment
MDP - Maryland Department of Planning
MET - Maryland Environmental Trust
MGS - Maryland Geological Survey
NHA - Natural Heritage Area (designation by DNR in COMAR)
NOAA - National Oceanagraphic and Atmospheric Agency
NRCS - Natural Resources Conservation Service
PDA - Public Drainage Association
RAS - Resource Assessment Service (part of DNR)
SAV - Submerged Aquatic Vegetation
SSPRA - Sensitive Species Protection Review Area (designation by DNR)
TMDL - Total Maximum Daily Loads
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
WRAS - Watershed Restoration Action Strategy (funding/assistance project by DNR)
WSSC - Wetland of Special State Concern (designation by MDE in COMAR)

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WRAS Internet Links

www.dnr.state.md.us/bay/czm/wras/

www.dnr.state.md.us/bay/czm/wras/grant.html

www.co.ho.md.us/swmindex.htm