Western Branch
Watershed Characterization

December 2003

In support of Prince George's County and the City of Bowie's
Watershed Restoration Action Strategy for the Western Branch Watershed

Product of the Maryland Department of Natural Resources Watershed Services
In partnership with Prince George's County and the City of Bowie

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Project funding of this document were made possible through a grant from the US EPA Section 319(h) Nonpoint Source Program. Although this project is funded in part by the EPA, it does not necessarily reflect the opinion or position of the EPA.

Support for this project was provided by the Maryland Coastal Zone Management Program, Department of Natural Resources pursuant to a cooperative agreement from the National Oceanic and Atmospheric Administration. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies.

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Electronic Publication: Dec. 2003, at http://dnr.maryland.gov/watersheds/surf/proj/wras.html
Print Publication: May 2004

Printed on Recycled Paper

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For the Western Branch Watershed Characterization

Prince George's County and the City of Bowie, Maryland are receiving Federal grant funding to prepare a Watershed Restoration Action Strategy (WRAS) for the Western Branch Watershed. The WRAS project area encompasses about 71,420 acres (112 square miles).

As part of the WRAS project, the Maryland Department of Natural Resources (DNR) is providing technical assistance, including preparation of a watershed characterization – a compilation of available water quality and natural resources information and identification of issues – and two field studies of on-the-ground conditions. The County and City will use information generated in these efforts as it drafts their Watershed Restoration Action Strategy.

Water Quality

The Western Branch Watershed is identified in Maryland's list of impaired waters for nutrients, biological limitations (poor or very poor fish or benthic organism populations/conditions) and sediment.

The Western Branch mainstem at Upper Marlboro consistently meets the State dissolved oxygen (DO) standard of 5.0 mg/l. Based on long term monitoring, this area is rated as good for several parameters: total nitrogen and total phosphorus (both with a trend to improvement), algae abundance (no trend) and suspended solids (no trend).

However, during warm-weather months the lower tidal reaches of Western Branch occasionally fail to meet the DO standard. To remedy this problem, the June 2000 determination of a Total Maximum Daily Load (TMDL) for biological oxygen demand (BOD) in Western Branch indicates that BOD control is the most effective way to maintain adequate DO levels. The TMDL also notes that limiting nutrients could also have a positive impact, but a BOD limit alone should be sufficient to meet DO requirements.

Additionally, impoundments in the watershed are subject to the Statewide fish consumption advisory on methylmercury in several species.

The Western Branch Waste Water Treatment Plant is the only sewage effluent discharge in the watershed. Its discharge includes nutrient controls designed to meet Patuxent River mainstem needs as well as water quality needs in the local stream.

The Landscape

Land in Western Branch Watershed is mostly developed land (about 44%) and forest (about 39%), based on Maryland Department of Planning estimates. Prime agricultural soils characterize about 28% of the watershed, but agricultural land use only accounts for about 15% of watershed land use.

The Upper Southwest Branch and Bald Hill subwatersheds have the most impervious area, based on subwatershed averages generated from the University of Maryland's Regional Earth Science Applications Center (RESAC) data (25.4% and 22% respectively). The Lower Western Branch subwatershed has less than 1% impervious land cover.

Green Infrastructure in the Western Branch watershed tends to be concentrated along streams. Portions of green infrastructure hubs and corridors that lack protection from development are in Prince unincorporated areas in George's County, and in the City of Bowie and Upper Marlboro.

Protected land accounts for about 10 % of the land in the watershed – mostly in County ownership.

Living Resources and Habitat

Spawning by herring, white perch, and yellow perch extends up the Western Branch mainstem, lower Collington Branch, and lower Charles Branch. Several nontidal stream areas have been rated as good based on the Fish Index of Biological Integrity, including parts of Collington Branch / Black Branch, Folly Branch and Southwest Branch.

Two nontidal stream areas rated good based on the Benthic Index of Biological Integrity: Western Branch near Route 214 and Bald Hill Branch near Folly Branch. The majority of areas that were assessed by the Maryland Biological Stream Survey in the Western Branch watershed were rated as either poor or very poor.

Ecologically Significant Areas, which are used to help track sensitive species and for project review, extend along most of the Western Branch mainstem, lower Collington Branch, lower Charles Branch and much of Northeast Branch. Wetlands of Special State Concern, which include sensitive species habitat, are concentrated along the Western Branch near the Patuxent River and from Southwest Branch into Northeast Branch.

Restoration Targeting Tools

Scenarios for stream buffer restoration and wetland restoration were developed using GIS to help identify opportunities for further investigation, and potentially for restoration projects. Findings reported by the US Army Corps of Engineers on potential restoration projects were also incorporated in these scenarios. These findings and others from the watershed characterization will be integrated with findings from the 2003 stream corridor assessment and synoptic survey to help provide support for drafting goals and objectives for the Western Branch Watershed Restoration Action Strategy.

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INTRODUCTION

Background

In 1998, under provisions of the Federal Clean Water Action Plan, Maryland completed an assessment of all of the state's watersheds in order to identify high priorities for restoration action, based on impaired waters, and high priorities for conservation action, based on high or unique natural resource value. The assessment, called the *Unified Watershed Assessment*, was conducted by the Maryland Department of Natural Resources (DNR), with assistance from the Maryland Departments of Environment, Agriculture, and Planning, and the University of Maryland. It moved beyond focusing on chemical water quality in the streams in the state, which had been assessed regularly since the early 1970's, to a larger consideration of living resources in the streams and the landscape conditions which could impact both water quality and living resources.[1,2]

On the basis of the assessment, watersheds throughout the state were categorized as to whether they were deemed "in need of restoration" in order to meet water quality and living resources goals–Category 1–or needed preventive action to retain existing quality–Category 2. Some watersheds having pristine and/or highly valued natural resources were assigned to Category 3. Because of the size of the "eight-digit" watersheds used as the basis of the evaluation, it was possible for a watershed to be both Category 1 and Category 3–to have both impairments and highly valued resource areas.

In response to the findings of the *Unified Watershed Assessment*, DNR offers technical and financial assistance to local governments who are willing to develop and implement Watershed Restoration Action Strategies (WRAS) addressing needs for restoration and conservation in priority watersheds. One of these projects is in the Western Branch watershed in Prince George's County, where the County, the City of Bowie, DNR and other local cooperators, both public and private, are engaged in developing a watershed management strategy.

Location

Western Branch Watershed Acreage Summary MDP 2000 Land Use/Land Cover		
Land	Water	Total
71,114	306	71,420

The Western Branch Watershed is in the Patuxent River drainage basin as shown in Map 1 Location. It is entirely within Prince George's County shown in Map 2 Project Area. The watershed is drained by some 185 miles of mapped streams. The lower 5 miles or so of Western Branch, roughly the area below the Route 4 bridge, are tidal, partially influenced by conditions in the Patuxent River, while the majority of the streams in the watershed are non-tidal. Map 2 and the table Subwatersheds also show 15 smaller "12-digit" subwatersheds that DNR uses for analysis.

Purpose of the Characterization

One of the earliest steps in 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
- provide preliminary findings based on this information
- identify sources for more information or analysis
- suggest opportunities for additional characterization and restoration work
- provide a common base of knowledge about the Western Branch Watershed for local governments, citizens, businesses and other organizations.

Additional Characterization Work

The Watershed Characterization is intended to be a starting point that can be updated as needed. It is part of a framework for a more thorough assessment involving an array of additional inputs:

- self-investigation by Prince George's County and the City of Bowie
- targeted technical assistance and assessment by partner agencies or contractors
- input from local citizens
- completion of a Stream Corridor Assessment, in which DNR personnel walk streams cataloguing issues, and the synoptic survey, a program of water and biological sample analysis, can both be used to focus on local issues like nutrient hot spots, point source discharges or other issues. These surveys are provided by DNR.

Identifying Gaps in Information

It is important to identify gaps in available watershed knowledge and gauge the importance of these gaps. In assessing data gaps, we have found it helpful to review information in four categories:

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

The Watershed Characterization and the Watershed Restoration Action Strategy are intended to be maintained as living documents within an active, evolving watershed management process. These documents will need to be updated periodically as new, more relevant information becomes available and as the watershed response is monitored and reassessed.

Subwatershed Delineation

To facilitate watershed assessment, comparison of various tributary streams is frequently accomplished by analyzing their separate drainage areas. Maryland 12-digit subwatersheds shown in Map 2 Project Area and described in the table below provide one method for organizing analysis for this watershed characterization. Prince George's County has also delineated subwatersheds as shown in Map 21. When interpreting the information in this watershed characterization, it is important to recognize that some of the State and County subwatersheds are nearly identical while others differ. Map 22 shows that the two appraoches are generally parallel and also highlights where the differences are greatest.

Maryland 12-Digit Subwatersheds in the Western Branch Watershed

Suggested Name	Number (02131103----)	Acres	Description
Bald Hill Branch	0928	4,105	
Cabin Branch / Back Branch	0919	5,476	
Charles Branch - Southwest Br.	0911	2,830	
Charles Branch - Upper	0912	5,456	
Collington Branch - Lower	0920	5,140	
Collington Branch - Middle	0923	5,872	
Collington Branch - Upper	0927	3,839	
Folly Branch / Lottsford Branch	0929	6,134	
Kettering Area	0925	3,775	Western Br. mainstem
Northeast Branch	0926	5,549	
Southwest Branch - Lower	0922	3,276	
Southwest Branch - Upper	0924	6,837	
Turkey Branch	0921	3,449	incl. Western Br. mainstem
Upper Marlboro	0918	6,094	Western Br. mainstem
Western Branch - Lower	0913	3,588	incl. lower Charles Branch
TOTAL - Western Branch Watershed		71,420	

WATER QUALITY

Water quality is in many respects the driving condition in the health of Maryland's streams. Historically, efforts to protect water quality have focused on chemical water quality. More recently, additional factors are being considered, like measurements of selected biological conditions and the physical conditions that affect habitat quality in streams and estuaries. This developmental path is reflected in the ways in which streams have been monitored, the types of data gathered, and the regulatory approach taken.

Water Quality Indicators–Setting Priority for Restoration and Protection

As the basis for the prioritization of watersheds in the *Unified Watershed Assessment*, indicators of water quality, landscape condition, and living resources were developed for all watersheds in Maryland. Other approaches to assessing water quality have been in use for several years and are further described below. In general they do not look comparatively at watersheds as the *Unified Watershed Assessment* did, in an effort to set priorities. The range of living resource and landscape indicators developed for the Unified Assessment is described in later chapters.

The *Unified Watershed Assessment* looked at five water quality indicators to compare the State's 134 "8-digit" watersheds, although not all watersheds had sufficient information to allow generation of each indicator. Of four indicators applicable to Western Branch, only the watershed's placement on the State's list of impaired waters, discussed in the next section, qualified Western Branch for Category 1 designation.

1. Tidal Habitat Index

The tidal habitat index combines three measurements of water quality: algae populations as measured by surface chlorophyll *a*, water clarity as measured by secchi depth, and summer bottom dissolved oxygen (July-Sept.). To use this indicator for comparative purposes, the index scores for the 8-digit watersheds draining to the Chesapeake Bay were ranked highest to lowest and then divided into four groups, each containing 25% of the watersheds (quartiles). The watersheds with the worst conditions, which ranked in the lowest quartile of watersheds, were deemed in need of restoration according to this indicator.

In comparison to the other watersheds that drain to the Chesapeake Bay in Maryland and using 1994-1996 data, the Western Branch ranked among the better watersheds for the Tidal Habitat Index.

2. Tidal Eutrophication Index

The tidal eutrophication index combines three measurements of water quality (in surface mixed-layer water): total nitrogen, total phosphorus, and total suspended solids. As with the Habitat Index, watersheds in the worst quartile were deemed in need of restoration according to this indicator.

In comparison to the other watersheds that drain to the Chesapeake Bay in Maryland, using 1994-1996 data, the Western Branch watershed ranked among the better ones for the Tidal Eutrophication Index.

3. Modeled Loads for Phosphorus and Nitrogen

Two of the most important pollutants in the Chesapeake Bay system are the nutrients nitrogen and phosphorus, deemed this because of their contribution to excessive growth of algae, which speed the processes of eutrophication. To estimate how much total phosphorus (TP) and total nitrogen (TN) reach the streams and how much of each is available for transport to the Bay, computer models are used. For the computer modeling used to generate the yield estimates reported in the assessment, the following information was used for the models: 1) monitoring data of point source nutrient discharges; 2) estimated nonpoint sources loads, based on 1996 land use and estimates of selected land management practices, and 3) consideration of other factors like deposition from the air.

In comparison with the other watersheds that drain to the Chesapeake Bay in Maryland, the *Unified Watershed Assessment* estimated that the Western Branch watershed was not in the lowest-scoring quartile of watersheds for either nitrogen or phosphorus loadings–the cut-off point for Category 1 designation–although it was in the lower 50% of all watersheds.

2002 modeling conducted by DNR, using 2000 data, shows somewhat lower average yields for the Western Branch watershed–0.369 pounds per acre annually of total phosphorus and 6.38 pounds per acre annually of total nitrogen. These load estimates differ from the estimates used in the *Unified Watershed Assessment* for several reasons: modification of the models used, changes in point source discharges and land use, and differing consideration of best management practices and septic system loads. The synoptic survey conducted in conjunction with WRAS development in 2003 found no elevated nutrient yields in the subwatersheds that were surveyed.

Water Quality Standards and Designated Uses

Streams and other water bodies in Maryland are each assigned a "designated use" in the Code of Maryland Regulation (COMAR) 26.08.02.08, which is associated with a set of water quality criteria necessary to support that use. Together, the designated use and the criteria are commonly referred to as "Water Quality Standards;" they are established by the Maryland Department of the Environment (MDE) in regulation. All streams and impoundments in the Western Branch watershed are designated Use I, Water Contact Recreation and Protection of Aquatic Life.

Use Impairments and Restrictions[4]

Some streams or other water bodies in the Western Branch watershed cannot be used to the full extent envisioned by their designated use due to water quality or habitat problems. These areas, known as "impaired waters", are tracked by the State of Maryland under Section

303(d) requirements of the Federal Clean Water Act. Maryland's list of impaired waters reflects several types of problem for the Western Branch watershed:

- Nutrients (nitrogen and phosphorus)
- Biological Limitations (poor or very poor fish or benthic organism populations/conditions)
- Sediment

Each water body listed may require preparation by MDE of a Total Maximum Daily Load (TMDL) to address the water quality and/or habitat impairment. [4]

1. Nutrients

In Maryland, most water bodies naturally have low levels of the nutrients nitrogen and phosphorus. Without these essential nutrients, they could not support aquatic life. However, in tidal waters, including those in the Patuxent River system, nutrients can become too readily available. When high nutrient availability is combined with warm weather, sufficient light, etc., algae populations can grow to excessive levels. These algae can then crowd out other small organisms, clouding the water and limiting light penetration; they eventually die off, consuming the dissolved oxygen that other aquatic life needs in order to survive.

The tidal portion of Western Branch is listed as impaired in the 1996 303(d) list because occasional low dissolved oxygen concentrations were believed to be caused by excessive nutrient loads. According to computer model results presented in the December 1999 report *Total Maximum Daily Load of Biochemical Oxygen Demand (BOD) for the Western Branch of the Patuxent River*, nutrient loads are among several contributing factors. (Also see section on TMDL.)

Nutrient pollution or over-enrichment problems may arise from numerous sources, including all types of land use and the atmosphere. Residential land can be an important contributor of nutrients, depending on fertilizer use, extent of lawn, and the status of septic systems. Farmers apply nutrients using different approaches, so nutrients entering waterways from crop land vary greatly depending on management techniques. Typically, streams and other surface waters receive relatively small amounts of nutrients from forest land and relatively large amounts from land uses that involve soil disturbance and application of fertilizer. Most of the nutrients in Western Branch tidal waters are generated within the Western Branch watershed. However, the atmosphere can contribute various forms of nitrogen produced by the burning of fossil fuels in power plants, other industries, and automobiles, some at a considerable distance from Western Branch.

2. Sediment

Most unpolluted streams and tidal waters naturally have limited amounts of sediment moving "suspended" in the water. Excessive amounts of suspended sediment in waterways are considered pollution because they can inhibit light penetration, prevent plant growth, smother fish eggs, clog fish gills, etc. Sediment in streams tends to come from stream bed and bank erosion and from land in the watershed that is poorly vegetated or disturbed. Suspended sediment pollution may come from construction sites, crop land, bare ground, and exposed soil generally. The amount of sediment contributed varies greatly from site to site depending upon stream stability, hydrology, management controls, and other factors.

The tidal waters of Western Branch are listed for suspended sediment in Maryland's 2002 list of impaired waters.

3. Biological Impairment

A major reason for caring about water quality is its impact on the health and vitality of living resources–the fish and bugs that live in the water. In selected stream segments statewide, populations of fish and benthic macroinvertebrate animals, and their associated physical habitat, have been assessed by the Maryland Biological Stream Survey (MBSS) over a period of several years. For each stream segment that is assessed, a rating of "good", "fair", "poor" or "very poor" is determined, using criteria developed for the applicable physiographic/ecological zone. Ratings of poor and very poor were listed as biological impairment for the first time in Maryland in the 2002 draft list of impaired waters. In the Western Branch watershed, 11 stream segments appear in the list because of biological impairment. (See Biological Monitoring of Streams for additional details.)

4. Statewide Consumption Advisory On Fish From Impoundments

In January 2003, MDE issued revised fish consumption advisories. None of the advisories singled out water bodies in the Western Branch watershed. However, several statewide advisories affect impoundments within the watershed, and they are listed in the table below. For more information see www.mde.state.md.us/CitizensInfoCenter/FishandShellfish

Statewide - 2003 Advisory On Fish Consumption For Methyl-Mercury: Recommended Maximum Allowable Meals Per Month				
Species	**Area**	**General Population 8 oz. meal**	**Women 6 oz. meal**	**Children 3 oz. meal**
Smallmouth & Largemouth Bass, Pickerel, Northern Pike, Walleye	Lakes and Impoundments	4	4	4
	Rivers and Streams	no advisory	8	8
Bluegill	Lakes and Impoundments	8	8	8

Total Maximum Daily Loads

The Maryland Department of the Environment (MDE) uses the 303(d) list of impaired waters to determine the need for establishing Total Maximum Daily Loads (TMDLs). A TMDL is the amount of pollutant that a water body can assimilate and still meet its designated use. A water body may have multiple impairments and multiple TMDLs to address them. MDE is responsible for establishing TMDLs. In general, TMDLs have two key parts:

1- Maximum pollutant load that the water can accept while still allowing the water body to meet its intended use.
2- Allocation of the maximum pollutant load to specific pollutant sources.

As of October 2003, one approved TMDL directly affects the Western Branch watershed – it addresses Biological Oxygen Demand (BOD) in Western Branch.

1. BOD TMDL for Western Branch

The report *Total Maximum Daily Load of Biochemical Oxygen Demand (BOD) for the Western Branch of the Patuxent River* was completed by MDE in December 1999 and was approved by US EPA in June 2000.

Computer modeling for the TMDL addressed ways to prevent minor problems with low dissolved oxygen that occasionally occur during warm months in the tidal waters of Western Branch. The results of several computer model scenarios predict that reducing BOD loads to the tidal Western Branch will effectively prevent occurrences of low dissolved oxygen. Nutrients (nitrogen and phosphorus) are also potential indirect contributors to low dissolved oxygen, but the modeling results predict that nutrient controls would be less effective than BOD controls in preventing low dissolved oxygen in Western Branch tidal waters.

BOD TMDL for Western Branch Summary	
TMDL Component April 1 through October 15.	**Pounds Per Month**
Point Source (Waste Load Allocation)	75,080
Nonpoint Source (Load Allocation)	1,040
Future Allocation	4,680
Margin of Safety	4,040
TOTAL MAXIMUM DAILY LOAD	**84,840**

Water Quality Monitoring

1. Long Term Monitoring

The State of Maryland regularly monitors the Western Branch mainstem at two locations as shown on Map 3 Water Quality Monitoring and MDE Permits.

– Station TF1.2 is located in Upper Marlboro near Water Street. This site reflects inputs from most of the Western Branch watershed. Data from this station are summarized in the table Status and Trends for Western Branch at Upper Marlboro, Station TF1.2.

– Station WXT0001 is on Western Branch near its confluence with the Patuxent River. Data from this station reflect inputs from the entire Western Branch watershed, the Western Branch Waste Water Treatment Plant and influences from the Patuxent River.

Water quality data collected between January 1995 and December 2002 at these two monitoring stations are the basis for findings below. More details are available at DNR's Internet site: [1]

- Algae abundance as measured by Chloropyll *a* at Upper Marlboro is typically less than 5 Fg/l and always less than 17 Fg/l, which suggests good water quality conditions. At Station WXT0001, Chloropyll *a* concentrations between 20 and 50 Fg/l are common and sometimes reach 75 Fg/l, which suggests fair water quality conditions.
- Dissolved oxygen (DO) concentrations are consistently good at Upper Marlboro as the Dissolved Oxygen Graph shows. However, DO levels near the mouth of Western Branch during warm weather months sometimes falls below the 5.0 mg/l State standard.
- Salinity at Upper Marlboro is typically less than 0.4 parts per thousand (ppt) as the Salinity Graph shows. Salinity levels at Station WXT0001 are comparable.
- Total Phosphorus (TP) at Upper Marlboro averages less than 0.1 mg/l but has reached as high 0.3 mg/l. The TP average for WXT0001 is greater than 0.2 mg/l and reaches over 0.4 mg/l.
- Total Nitrogen (TN) at Upper Marlboro tends to be less than 1.0 mg/l but has reached as high as 1.7 mg/l. At Station WXT001, TN concentrations are typically between 1 and 2 mg/l in warm-weather months and two or three times greater in cold-weather months. This pattern may reflect seasonal differences in nutrient control at the Western Branch sewage treatment plant.
- Total Suspended Solids (TSS) concentrations in Upper Marlboro are commonly less than 10 mg/l but have been measured in the 100 to 200 mg/l range. At Station WXT0001, TSS concentrations are commonly 10 to 30 mg/l and have been measured in the 100 to 160 mg/l range.

Status and Trends for Western Branch at Upper Marlboro, Station TF1.2		
Parameter	**Status 1998 -2001 data**	**Trend 1985 through 2001**
Total Nitrogen	Good	Improving (22%)
Total Phosphorus	Good	Improving (26%)
Algae: Abundance	Good	No Trend
Suspended Solids: total	Good	No Trend

2. Continuous Monitoring

One continuous monitoring station is located in the tidal fresh area of Western Branch (Iron Pot Landing) and is anchored in the water column. Findings for 2003, April through September, are summarized below:

- Chlorophyll *a*, which is a measure of algae population, was generally less than 20 micrograms per liter (Fg/l). However, several instances were recorded when concentrations around 60 Fg/l were recorded, indicating that algae blooms were occurring. Chlorophyll *a* measurements at or near the surface may have been greater.
- Dissolved oxygen is generally good, but several instances of DO near or below the State standard of 5.0 mg/l were recorded in June, July and August.
- pH was consistently near neutral, varying between 7.5 and 6.5.
- Salinity varied between 0.23 parts per thousand (ppt) and about 0.07 ppt
- Turbidity is generally low but more than a dozen instances of turbidity over 200 NTU (Nephelometric Turbidity Units) were recorded between late May and early September.

Sources of Pollution

Since European settlement of North America there has been an explosive growth in human population, supported by more intensive agriculture and the growth of industry. The entire continent has been cris-crossed and made mutually interdependent by vast transportation systems. All of this contributes to the decline in quality of our water and other natural resources.

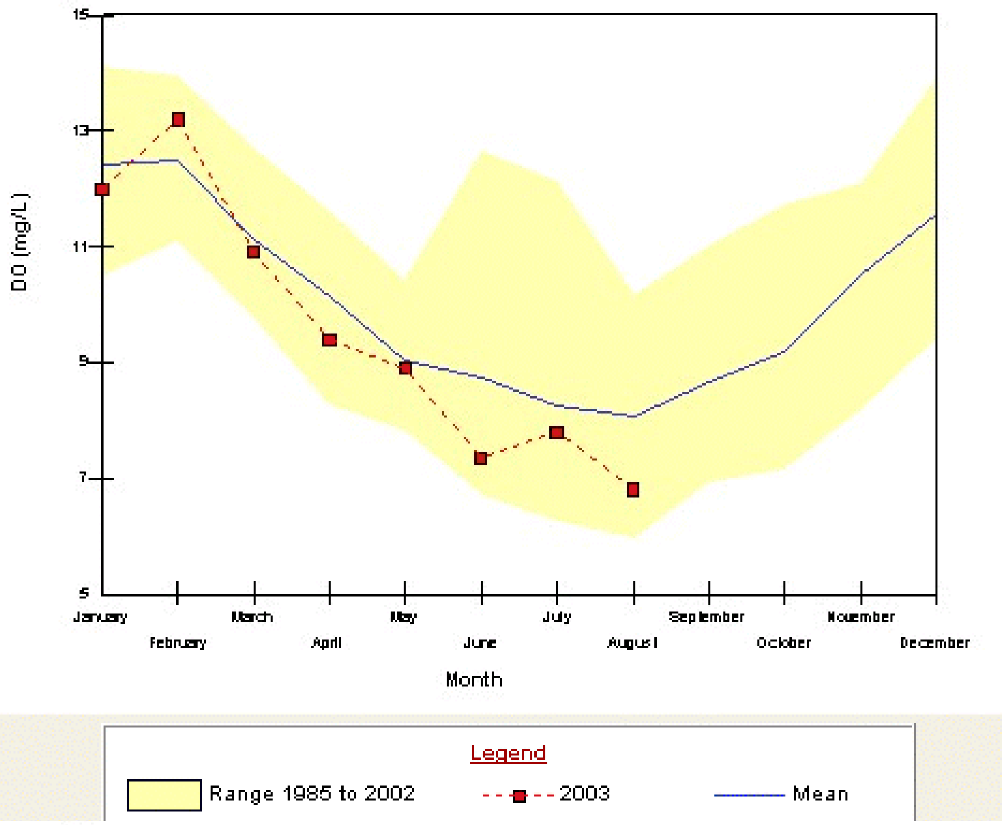
1. Point Sources

Discharges from pipes or other "discrete conveyances" are called "point sources." Point sources may contribute pollution to surface water or to groundwater. For example, wastewater treatment discharges may contribute nutrients or microbes that consume oxygen (measured as Biochemical Oxygen Demand (BOD)) reducing oxygen available for other aquatic life. Industrial point sources may contribute various forms of pollution. Some understanding of point

Dissolved Oxygen
Long Term Monitoring

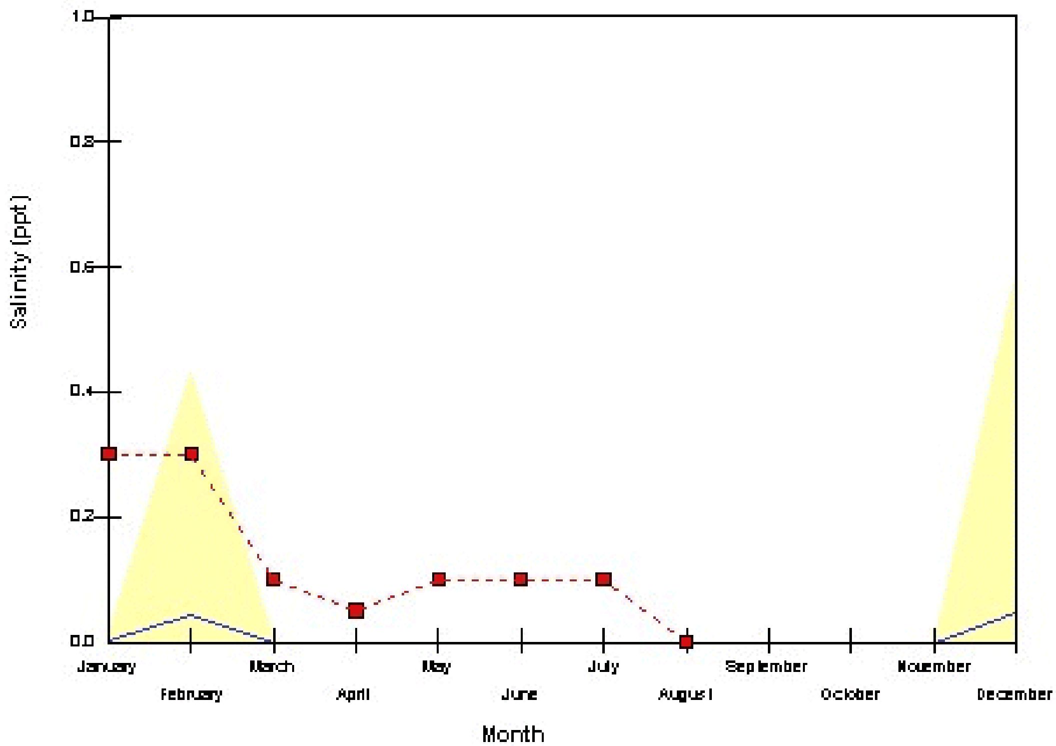
Western Branch at Water Street in Upper Marlboro

Station TF1.2



Salinity
Long Term Monitoring

Western Branch at Water Street in Upper Marlboro



source discharges in a watershed is necessary in helping to identify and prioritize potential restoration measures.

Overall findings are listed below for the 31 Western Branch watershed point source discharges, based on information from the Maryland Department of the Environment (MDE) permit data base. Summary information is presented in the table MDE Permits Western Branch Watershed Summary and on Map 3 Water Quality Monitoring and MDE Permits. 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.

– Point sources tend to be concentrated in the most highly developed areas of the Western Branch watershed including the Washington DC suburbs and Upper Marlboro.
– Western Branch Wastewater Treatment Plant (WWTP) is the only sewage treatment plant discharge in the entire Western Branch watershed. It serves 95% of the developed parcels in the watershed and provides a high degree of treatment, including phosphorus and nitrogen reduction. Its design capacity is 30 million gallons per day (MGD), and current flows average a good deal less than that.
– There are four industrial discharges in the watershed.
– Eleven general discharge permits in the watershed include six swimming pool operations.
– Fifteen permitted stormwater management facilities discharge in the watershed.

MDE Permits Western Branch Watershed Summary – Page 1 of 3 Sewage Effluent and Industrial Discharges (2/2003 data)				
Type / MDE Category		**Facility**	**MD Permit / NPDES Permit**	**Watershed Street Location / Description**
Surface Water Discharge	Sewage Effluent	Western Branch WWTP	00DP0632 MD0021741	WWSC Treatment Plant Drive, Upper Marlboro (Western Branch mainstem)
	Industrial	Arcal Chemicals, Inc.	99DP2543 MD0063410	West Hampton Ave., Capitol Heights chemicals blending/wholesale
		County Chrysler Plymouth Jeep, Inc.	99DP2934	Rt 3, Upper Marlboro car dealer, washing discharge
		Forestville Asphalt	96DP2771	D'Arcy Road, Forestville paving materials
		PG Co. Yard Waste Facility	95DP2792A MD0065111A	WSSC Treatment Plant Drive, Upper Marlboro

MDE Permits Western Branch Watershed Summary – Page 2 of 3 General Permits (2/2003 data)			
	Facility	**MD Permit / NPDES Permit**	**Watershed Street Location / Description**
Surface Water Discharge	Berkley Estates	01SI6386 MDG766386	Rochelle Ave, District Heights swimming pool discharge
	Carleton East Aptmts.	01SI6540 MDG766540	Good Luck Road, Seabrook swimming pool discharge
	Chaney Enterprises	00MM9873 MDG499873	Chrysler Drive, Upper Marlboro concrete product
	Chesapeake Petroleum	2003OGT4351 MDG344351	Fallard Drive, Upper Marlboro petroleum products
	Days Inn	01SI6449 MDG766449	Hampton Park Blvd, Capitol Heights swimming pool discharge
	Marlboro Texaco	2003OGR6845 MDG916845	Rt 3, Upper Marlboro refuse system permit
	Maryland Reclamation, LLC	00MM9705 MDG499705	Brown Station Rd, Upper Marlboro sand & gravel mine
	Riverdale Baptist Church	2003OGR4673 MDG914673	Largo Road, Upper Marlboro
	R. Bickford Natatorium	01SI6058 MDG766058	Largo Road, Largo swimming pool discharge
	Southlake at Lake Arbor	01SI6539 MDG766539	Southlake Drive, Mitchellville swimming pool discharge
	Whitfield Town Aptmts	01SI6372 MDG766372	Whitfield Chapel Road, Lanham swimming pool discharge

MDE Permits Western Branch Watershed Summary – Page 3 of 3 Stormwater Discharges (2/2003 data)			
	Facility	**MD Permit**	**Watershed Street Location**
Surface Water Discharge	ABF Freight	97SW0560	Rochelle Ave, Capitol Heights
	BFI	97SW1092	Ritchie Road, Capitol Heights
	Brown Station Rd Landfill	97SW0401	Brown Station Rd, Upper Marlboro
	Colonial Moving	97SW0982	Fallard Court, Upper Marlboro
	Foreign Car Parts, Inc.	97SW0844	Brown Station Rd, Upper Marlboro
	Murry's, Inc	02SW0649	Pennsylvania Ave., Upper Marlboro
	Oceaneering Technologies	97SW0238	Prince George's Ave., Upper Marlboro
	PG Co. Recycling	97SW1224	Ritchie Road, Capitol Heights
	PG Co. Composting	97SW0521	D'Arcy Road, Forestville
	PG Co. Vehicle Audit	97SW0312	Ritchie-Marlboro Rd, Upper Marlboro
	Ripple's Service	97SW1064	Largo Road, Upper Marlboro
	SHA Shop	97SW1325	SE Crain Hwy, Upper Marlboro
	US Post Office	97SW0937	Edgeworth Dr, Capitol Heights
	Western Branch WWTP	97SW0121	WWSC Treatment Plant Drive
	WMATA Metro	97SW1642	Largo Drive West, Largo

2. Diffuse or Nonpoint Sources

Nonpoint sources do not have an identifiable point of entry into a stream. They are commonly significant contributors of pollutants, particularly nutrients and sediment. These diffuse sources include rain water that runs off roofs, streets and parking lots (sometimes via storm drains) into nearby surface waters, as well as run-off from farm fields and, to a much lesser extent, forests. Also included in nonpoint source pollution are deposition from the atmosphere and contributions from ground water, where septic systems are a factor.

a. Nutrients

The role of nonpoint source nutrients relative to point source nutrients in Western Branch's 303(d) listing for nutrients has not been well documented. Problems with depressed dissolved oxygen concentrations in some areas, and some water quality data indicative of algae blooms, point to a nutrient problem without identifying its source. Additionally, nutrients originating in the Western Branch watershed contribute to the well-documented nutrient-related water quality problems in the Patuxent River.

The water quality indicator section of this chapter includes modeled nutrient loads used to estimate the Western Branch watershed's nonpoint source contributions to the Chesapeake Bay. Modeled load estimates for subwatersheds within the Western Branch watershed have not been generated. However, in the future nonpoint source nutrient loads may be assessed in greater detail: the 2003 synoptic water quality monitoring can be used to generate estimates of base flow nutrient loads in various Western Branch tributaries, and eventually MDE may model nutrients for a TMDL, partitioning nutrient load between nonpoint sources and point sources. From the absence of elevated nutrient levels in the synoptic survey and the very low number of parcels developed on septic systems, it would appear that any significant pulses of nutrients into the Western Branch system, and from there into the Patuxent River, would be associated with storm flows, which have also contributed in a major way to the most significant problem in the watershed, the degradation of habitat.

b. Sediment

Nonpoint source sediment loads have not been estimated for the Western Branch Watershed. However, current sources of information identify sediment as a problem:

– Erosion and sedimentation contribute to low ratings for some streams assessed by the Maryland Biological Stream Survey.
– Sediment contributes to occasionally high total suspended solids levels in Western Branch.

Ground Water and Water Supply

In most of the urbanized areas of the Western Branch watershed, public water is provided by the Washington Suburban Sanitary Commission (WSSC) through a system of Patuxent River reservoirs and Potomac River intakes that originate outside of the Western Branch watershed. After use, this "imported" water is either discharged through the Western Branch Wastewater Treatment Plant or sometimes, in the case of water used to irrigate lawns and gardens, through various stormwater outfalls.

The City of Bowie operates its community water supply system under MDE permits PG1961G208 and PG1961G108. The Town's wells are all in the immediate vicinity of the community that they serve, as shown in Map 3 Water Quality Monitoring and MDE Permits. In general, community water supply systems employ confined aquifers in order to avoid the potential of local near-surface pollution.

The Aquia aquifer outcrops in the Western Branch watershed. Since this aquifer is a major source of drinking water in Southern Maryland and parts of the Eastern Shore, some care in land use and waste management practices should be taken to protect the aquifer from potential sources of contamination.

LANDSCAPE

Water quality, particularly in streams and rivers, is affected by the land in the riparian zone and by soils, vegetative cover and land use 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 on a watershed scale that tend to support good water quality or that tend to degrade water quality.

Landscape Indicators

The 1998 *Unified Watershed Assessment* used a number of landscape indicators to compare the State's watersheds.[2] The landscape indicators figured into the determination of a watershed's status with respect to a need for restoration action–whether it was assigned to Category 1. The following sections identify findings for the Western Branch watershed. For the most part these are drawn from the 1998 assessment, with the exception of population density, which is based on more recent Year 2000 Census data, and riparian buffer, which is also based on newer information. A sixth indicator was developed subsequent to the *Unified Watershed Assessment* for other purposes but is being included here because it has bearing on watershed restoration.

1. Population Density

While population density may be beyond the scope of a WRAS, directing and accommodating growth is a potential WRAS component. As human population increases, the effects of human activity that degrades, displaces, or eliminates natural habitat also tend to increase. Watersheds with higher populations, assuming other factors are equal, tend to exhibit greater impacts on waterways and habitat. However, population growth can be accommodated in ways that reduce negative impacts.

Using data available at the time of the *Unified Watershed Assessment*, Western Branch was among the 25% most densely populated watersheds in the State, contributing to its Category 1 designation. Based on the Year 2000 Census, the population density in the Western Branch Watershed was 2.31 people per acre of land. A comparison with other watersheds in the state has not been completed using the 2000 census data.[2]

2. Historic Wetland Loss

This indicator was developed based on the assumption that the hydric soils in the watershed were all, at one time, wetlands. 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.

The Western Branch Watershed is estimated to have lost nearly 10,479 acres of wetlands over the years. This is a relatively large loss of wetlands compared with other Maryland watersheds, although it was not among the 25% highest-loss watersheds, the cut-off point for a Category 1 designation for this indicator.[2]

3. Unbuffered Streams

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 enhances stream habitat. (For this indicator, only "blue line streams" were included. Intermittent streams were not considered.)

To develop this indicator, a Geographic Information System (GIS) was used to define corridors 100 feet wide (50 feet either side) along streams; these corridors were combined with forest cover data from the National Land Cover Data set (NLCD), and lengths of stream without forest cover were calculated. At the time of the 1998 assessment, Western Branch compared fairly well with other Maryland watersheds – about 33% of streams in the watershed lacked a forested buffer.[2] Using more recent information, about 50 miles, or 26%, of the streams in Western Branch were unbuffered by forest.

4. Soil Erodibility

Watersheds with more highly erodible soils are naturally more susceptible to surface erosion, sedimentation, streambank erosion and other problems related to soil movement. These negative effects of soil erodibility on water quality can be minimized through careful management. The soil erodibility indicator accounts for natural soil conditions but not for management of the land. (Existing cropland management was not considered.) The naturally erodible soils in the watershed are addressed by techniques called Best Management Practices (BMPs) to prevent soil loss, practices that are typically in use on local farms. BMPs like no-till or reduced-till cropping, planting cover crops, field strips, or retiring erodible soils from production can significantly reduce erosion and sediment movement. These BMPs can be seen in use in many places in the watershed.

Soil erodibility for the Western Branch Watershed is represented by what is known as the K factor, in this case estimated to be 0.31.[2] The K factor normally varies from approximately zero to about 0.6. A K value of 0.17 has a very low erosion potential, a value of 0.32 has a moderate erosion potential, a value of 0.37 has a high erosion potential, and a value of 0.43 has a very high erosion potential. The Western Branch watershed's erodibility is borderline low/moderate to moderate, although its ranking among all watersheds in the state was fairly high and exceeded the threshold set for the *Unified Watershed Assessment*.

Because soils can vary significantly within very small areas, a generalized erodibility indicator must be used with caution and supplemented with site-specific evaluation prior to implementing any management action.

5. Streams with Headwaters in Interior Forest

This indicator was used in the 1998 Assessment to help identify landscape features contributing to pristine or highly valued conditions–Category 3 watersheds. Forested headwater areas represent pristine, sensitive communities with high value for conservation. They benefit terrestrial as well as aquatic ecosystems, providing water and food for terrestrial animals and microhabitat conditions for riparian vegetation, favoring some rare species. Forested headwater streams also provide the base of the aquatic food web: trees and other vegetation are a source of detritus, which is colonized by bacteria, fungi, and epiphytic algae communities, and consumed by aquatic invertebrates before being swept downstream, where it is further processed. Overhanging trees also provide shade to shelter fish and create snags when their twigs and branches fall into the stream.

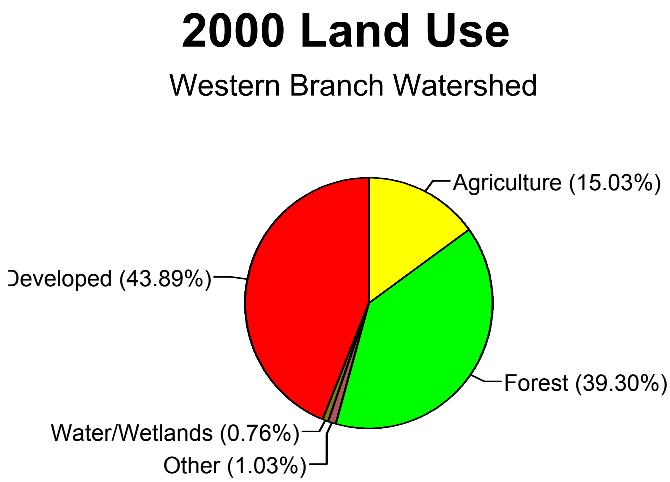
In heavily urbanized areas, like much of Prince George's County, headwater streams are often piped to make way for development, and their important habitat values are lost. This practice may be reflected in the *Unified Watershed Assessment's* finding that only 8% of Western Branch's headwater streams were located in interior forest, among the lowest percentages in the State.

6. Forested Wetlands

As part of its Strategic Forest Lands Assessment (SFLA) DNR has developed a number of additional watershed indicators since the *Unified Watershed Assessment* was completed. Some related to sensitive species will be cited in the Living Resources chapter, below. Forested wetlands are particularly important to water quality and to restoration work related to water quality because they filter nutrients (especially nitrogen and phosphorus), wastes, and sediments from water flowing within them. Thus the quality of water leaving a forested wetland is higher than that entering it. Forested wetlands also provide flood control by stabilizing soils with their extensive root systems and absorbing excessive water. Forested wetlands are important because they contain a number of diverse habitats and support high numbers of plant and animal species. Finally, forested uplands and wetlands sequester carbon dioxide and act as an important sink for carbon. According to the most recent National Wetlands Report by the US Fish and Wildlife Service, forested wetlands experienced the greatest decline of all wetland types.

With over 2000 acres of forested wetlands, the Western Branch watershed ranks among the better of the State's watersheds for this indicator.

Land Use / Land Cover



The following table and pie chart summarize 2000 land use / land cover for the Western Branch Watershed as categorized by the Maryland Department of Planning. Map 4 Land Use / Land Cover shows the distribution of these land use categories in the watershed.

Overall, nearly 44% of the Western Branch Watershed is developed. This development is distributed throughout the watershed, and all subwatersheds exhibit sufficient development to affect water quality and aquatic habitat. The upper watershed tends to be more densely developed than the lower watershed. For example, the Bald Hill Branch and Lower Western Branch subwatersheds are 77% and 12% developed, respectively.

Forest and brush cover over 39% of the Western Branch watershed. This cover type is significant in all subwatersheds.

Agriculture covers about 15% of the watershed. It is most concentrated in the lower Western Branch watershed except for the Upper Collington Branch subwatershed, which has 22% agricultural use. Some subwatersheds in the most developed areas have insignificant amounts of agricultural land use. All other types of land together amount to less than 2% of the watershed.

As potential nonpoint sources of nutrients, developed and agricultural lands contribute the greatest loads to local waterways. Forests and wetlands are most protective of water quality.

2000 Land Use / Land Cover Summary
Western Branch Watershed in Prince George's County and the City of Bowie

Category	Description	Acres
Agriculture	Field, Pasture, farm buildings	10,731
Forest	All woodlands and brush	28,071
Developed	All developed areas	31,343
Water/Wetlands	Open water, Tidal marsh, Emergent wetlands	541
Other	Extractive industry, bare ground (sand and gravel pits, etc.)	734
Watershed Total – including open water		**71,420**

Land Use / Land Cover In Western Branch Subwatersheds In Acres, MDP 2000 Data						
Subwatershed Name / Number	Ag	Forest	Developed	Wetland, Water	Other	Total
Charles Br., SW Branch 0911	461 16%	1367 49%	943 33%	0 --	59 2%	2830
Charles Branch, Upper 0912	1205 21%	2745 51%	1396 26%	7 --	103 2%	5456
Western Branch, Lower 0913	702 20%	2195 61%	448 12%	243 7%	0 --	3588
Upper Marlboro Area 0918	1031 17%	2884 47%	2097 35%	77 1%	5 --	6094
Cabin Br. / Back Br. 0919	1670 31%	2363 43%	1405 26%	7 --	31 --	5476
Collington Br., Lower 0920	676 13%	2798 55%	1524 30%	17 --	125 2%	5140
Turkey Branch Area 0921	523 15%	1354 40%	1412 41%	14 --	146 4%	3449
Southwest Br., Lower 0922	602 18%	1134 35%	1528 47%	3 --	9 --	3276
Collington Br., Middle 0923	874 15%	2813 48%	2118 36%	23 --	44 1%	5872
Southwest Br., Upper 0924	309 5%	1985 29%	4450 65%	11 --	82 1%	6837
Kettering Area 0925	271 7%	893 24%	2574 68%	37 1%	0	3775
Northeast Branch 0926	1060 19%	1739 31%	2672 48%	35 1%	43 1%	5549
Collington Br., Upper 0927	833 22%	1212 32%	1746 45%	13 --	35 1%	3839
Bald Hill Branch 0928	109 3%	803 20%	3169 77%	8 --	16 --	4105
Folly Br., Lottsford Br. 0929	406 7%	1783 29%	3863 63%	45 1%	37 --	6134

Impervious Surface

Roads, parking areas, roofs and other human constructions are collectively called impervious surface. Impervious surface blocks the natural seepage 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. Watersheds with small amounts of impervious surface tend to have better water quality, stream stability, and biological integrity in local streams than watersheds with greater amounts of impervious surface.

Urbanization and the increase in impervious surfaces that accompanies development can significantly impact stream health. Increases in the extent of upstream impervious surface are strongly associated with a decrease in stream quality. As impervious surfaces cover more of the landscape, less water infiltrates the soil and more water enters stream systems through runoff or stormwater discharge. This increased stormwater runoff from impervious surfaces contributes to stream quality degradation by introducing more non-point source pollution, higher temperatures, and habitat-damaging changes in hydrology.

The table below shows the relationship between upstream impervious land cover and in-stream quality. These thresholds are based on extensive biological monitoring conducted by the Maryland Biological Stream Survey.[9]

Upstream Impervious Cover Thresholds	
Percent	**Effects on Stream Quality**
Less Than 2	Imperviousness is relatively insignificant compared to other factors affecting habitat quality. In cold-water habitats, brook trout may be found.
Above 2	Negative impacts to stream health begin. Brook trout are never found in streams with watershed imperviousness above this threshold.
Above 15	Stream health is never rated good, based on a combined fish and benthic macroinvertebrate Index of Biotic Integrity.
Above 25	Only hardy, pollution-tolerant reptiles and amphibians can thrive, while more pollution-sensitive species are eliminated.

Map 5 Impervious Surface Western Branch Watershed and the table Average Subwatershed Imperviousness, reflect data developed by the University of Maryland's Regional Earth Sciences Application Center (RESAC).[10] The map and table are color coded to show the relative average amount of impervious cover for each subwatershed. The map also shows higher concentrations of local impervious cover as darker areas. Overall, average subwatershed imperviousness is highest closer to Washington DC. For example, Bald Hill Branch and Upper Southwest Branch have the highest average impervious cover. The only subwatershed with less than 2% average imperviousness, Lower Western Branch, is the furthest from Washington DC.

Map 6 Impervious Cover Bowie/Rt. 214 Vicinity shows the distribution of impervious surface at the south end of the City of Bowie, including protected land. At this scale, it is possible to see that suburban residential communities on the east side of the watershed exhibit some significant areas of impervious cover. Some of the least impervious area, like Belt Woods, is protected from development by public ownership or easement, but most of the land exhibiting low impervious cover has no similar protection.

The findings from these two maps present several implications for watershed management:

– The distribution of impervious cover across the Western Branch watershed may present watershed-wide effects on water quality.

– Considering the Western Branch watershed as a whole, the areas of greater impervious cover in headwater streams will likely affect potential opportunities for downstream-stream protection and restoration.

– Protecting existing habitat and restoring potential habitat in developed areas may require consideration of existing and future impervious area as one gauge to successful implementation.

Average Subwatershed Imperviousness	
Subwatershed	**Percent**
Bald Hill Branch	22
Cabin Branch / Back Branch	4.9
Charles Branch - Southwest Br.	4.1
Charles Branch - Upper	4.4
Collington Branch - Lower	5
Collington Branch - Middle	7
Collington Branch - Upper	8.5
Folly Branch / Lottsford Branch	11
Kettering Area	11.4
Northeast Branch	6.3
Southwest Branch - Lower	13.7
Southwest Branch - Upper	25.4
Turkey Branch	5.1
Upper Marlboro	7.3
Western Branch - Lower	0.7

Projected Land Use

As a part of the Washington, D.C., metropolitan area, Prince George's County, including most of the Western Branch watershed , will continue to experience growth and development in the coming decades. Modeling done in conjunction with DNR's Strategic Forest Lands Assessment suggests that no subwatersheds in Western Branch will retain rural character by 2020, based on the proportions of rural and urban uses projected for them by the Maryland Department of Planning.

Much of this projected development is anticipated in accordance with Prince George's County's land use planning. In Maryland, designated "Priority Funding Areas" identify areas in which State funding is more likely to be available to support local development projects. Designation of these areas provides one of several ways to anticipate where new development or redevelopment is likely to occur. About 63% of the Western Branch watershed has this designation. All municipalities in the watershed are within the Priority Funding Area, which is shown in Map 9, Protected Land.

Prince George's County has designated a Rural Legacy area covering some 3000 acres along the lower portions of Charles Branch and the Western Branch mainstem at the confluence with the Patuxent River. Such a designation signals the County's interest in retaining the rural character, although land shown in the designated area that is not currently under easement or County ownership is open to land use change consistent with local zoning and comprehensive plan requirements. Rural Legacy designation allows for Program Open Space funds to be targeted to help protect the land from development. Some of this land is already protected by easement and/or by County ownership.

Lands With Significant Natural Resource Value and Large Area

As noted above, forests and wetlands are the land cover types that are most protective of water quality and that have high wildlife habitat value. At the time of the *Unified Watershed Assessment*, the Western Branch Watershed was estimated to have just under 40% forest, placing it in the lower half of watersheds statewide but better than some other metropolitan watersheds Both the acreage and distribution of tree cover are important considerations in watershed protection.

1. Green Infrastructure

DNR has mapped a network of ecologically important lands, forming a pattern of hubs and linking corridors, using several of the GIS data layers. Hubs contain one or more of the following:

- Areas containing sensitive plant or animal species;
- Large blocks of contiguous interior forest (at least 250 contiguous acres, plus the 300 foot transition zone);
- Wetland complexes with at least 250 acres of unmodified wetlands;
- Streams or rivers with aquatic species of concern, rare coldwater or blackwater ecosystems, or streams important to anadromous fish, with their associated riparian forest and wetlands; and
- Conservation areas already protected by public (primarily DNR or the federal government) and private organizations like The Nature Conservancy or Maryland Ornithological Society.

This "green infrastructure" provides the bulk of the state's natural support system: ecosystem services such as cleaning the air, filtering and cooling water, storing and cycling nutrients, conserving and generating soils, pollinating crops and other plants, regulating climate, protecting areas against storm and flood damage, and maintaining hydrologic function. For more information on the Green Infrastructure Assessment project in Maryland, see http://www.dnr.state.md.us/greenways/gi/gi.html

Protection of green infrastructure lands may be addressed through various existing programs, including Rural Legacy, Program Open Space, conservation easements and others. Within Program Open Space, the GreenPrint program has helped to target funds to protect green infrastructure areas.

Map 7 Green Infrastructure shows that, even from the statewide perspective that guided the analysis, there is a significant amount of green infrastructure in the Western Branch Watershed:

– Green infrastructure in the Western Branch watershed tends to concentrated along streams
– The natural resource values of most green infrastructure hubs in the watershed are not protected. The larger green infrastructure hubs are found mostly near Charles Branch, Folly Branch, Southwest Branch and the Western Branch mainstem.
– The City of Bowie includes part of a green infrastructure hub.
– Upper Marlboro includes part of a green infrastructure corridor.

2. Large Forest Blocks

Large blocks of forest provide habitat for species that need forested conditions with relatively little influence from open areas or humans. For example, some birds require forest interior habitat for their survival, and they cannot tolerate much human presence. Map 8 Forest Interior shows blocks of contiguous forest that are at least 50 acres in size with at least 10 acres of forest interior (forest edge is at least 300 feet away) that may be important locally within the Western Branch watershed. This size threshold was chosen to help ensure that the forest interior is large enough to likely provide locally significant habitat for sensitive forest interior dwelling species. The assessment shown in Map 8 differs from the *Green Infrastructure Assessment*, which considered only large blocks of forest land cover at least 250 acres in size that are likely to have state or regional importance.

The map illustrates several points about interior forest in the Western Branch watershed:

– In the Prince George's County portion of the watershed, there are numerous forest interior areas on both riparian areas and uplands.
– The portion of Bowie in the Western Branch watershed includes at least four forest interior areas.
– The parts of Glenarden in the Western Branch watershed are interior forest.

Interior forest habitats are relatively rare and easily lost. Interior forest provides one measure for identifying important habitat areas for specific species dependant upon interior conditions. As such, it can help in the identification of forest habitat conservation opportunities on a regional scale. It also suggests to local decision-makers that special care be taken in the land development process to avoid breaking up interior forest areas, particularly of FIDS are known to be present.

Not surprisingly, considering its heavily urban nature, the Western Branch watershed was assessed as being in the next-to-lowest quartile of watersheds statewide in DNR's Strategic

Forest Lands Assessment, with less than 15% of the watershed containing interior forest. It ranked similarly low for high quality FIDS habitat or potential FIDS habitat, when additional qualifications were added to interior forest to identify ecologically important watersheds.

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 low impact recreational intent, private ownership where a third party acquired the 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. Therefore, for some protected land, it may be necessary to explore the details of land protection parcel by parcel through the local land records office to determine the true extent of protection.

For purposes of watershed restoration, a knowledge of existing protected lands, as well as likely areas for new development, can provide a starting point in prioritizing potential restoration activities. Protected lands may provide opportunities for restoration projects because owners of these lands are likely to value natural resource protection or support enhancement goals.

Map 9 Protected Land shows the distribution of protected lands, Priority Funding Areas, and the designated Rural Legacy Area. The adjacent table shows that various types of land that are protected from development account for about 10% of the land in the Western Branch watershed. No agricultural easements or Forest Legacy areas are found in the watershed.

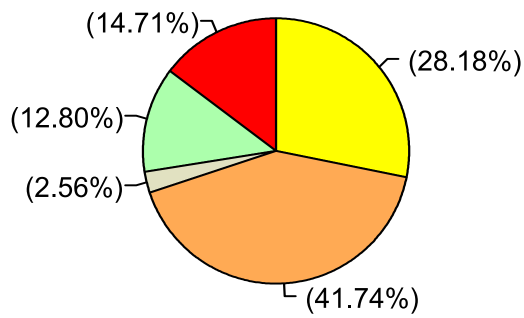
Protected Land In The Western Branch Watershed

	Acres	%
MET and Private Conservation Easements	292	--
DNR Land	1,658	2
County Parks, Open Space	4,701	7
Federal Land	674	1
Protected Land Total	**7,325**	**10**

Soils

1. Interpreting Local Conditions with Natural Soil Groups

Soil type and moisture conditions greatly affect how land may be used and the potential for vegetation and habitat on the land. Soil conditions are one determining factor for water quality in streams and rivers. Local soil conditions vary greatly from site to site, as published information in the Soil Survey for Prince George's County and the City of Bowie shows. This information has been summarized into Natural Soil Groups to help identify useful generalizations about groups of soils.



Map 10 Soils shows the distribution of natural soils groups in the Western Branch watershed. The table Natural Soil Group Summary provided details helpful in interpreting the map. The pie chart creates even broader categories from the natural soils groups (clockwise from 12 o'clock):

– Prime farmland soils cover over 28% of the watershed. Most prime agricultural land is not in municipalities, however, significant areas of the City of Bowie in the Western Branch watershed, west of Collington Branch and north of Route 50, are on prime agricultural land.
– Well drained soils similar to prime farmland but with slopes between 8 and 15% cover nearly 42% of the watershed
– Sandy, excessively well drained soils cover about two and half percent of the watershed
– Soils with wetness limitations (hydric soils: F1, F2, F3, G2, G3) cover nearly 15%
– Soils with various other limitations account for almost 13%.

2. Soils and Watershed Planning

Local soil conditions can be a useful element in watershed planning and for targeting restoration projects. Soils with limitations like wetness or slope naturally inhibit active use for farming or development and may then be available as restoration project sites. By comparing Map 10 Soils with the maps listed below, it may be possible to discern how patterns of active or passive land use relate to soil conditions:

– Map 4 Land Use / Land Cover
– Map 7 Green Infrastructure

Natural Soils Groups and other soils assessments can be used to help identify potential areas for restoration projects or habitat protection. Hydric soils, for example, are more easily restored as wetlands than soils that were never saturated with water. Once areas of interest are targeted and landowner interest is verified, additional detailed soil assessment is an essential step in identifying viable restoration project sites.

Natural Soil Group Summary in the Western Branch Watershed			
	Soil Group Description	Area in Acres	
Prime Agricultural Soils	B1a - Well drained, moderate erodibility.	18,972	20,064
	E1 - Moderately well drained, low erodibillity.	1,092	
Soils With Various Limitations	B1b - Similar to B1a but greater than 8% slope	29,720	40,662
	A1a, A1c - Sandy, excessively well drained	1,826	
	B2a, B2b - Well drained with slowly permeable sublayers. Strongly to very strongly acid.	2,625	
	B3, B3a - Well drained clay, slow permeability, strongly acid	3,216	
	E2a - Seasonally wet or dry, perched watertable, strong acidity	2,569	
	BP - Borrow pit (sand and gravel mine, etc.)	261	
	Ma - Made Land or H1a - Stoney Land	445	
Hydric Soils	F2 - Poorly or very poorly drained, strongly to extremely acid, low erodibility.	255	10,473
	F3 - Poorly drained to various extents – clayey, sticky and plastic when wet. Very high erodibility.	455	
	G2 - Poorly and very poorly drained floodplains subject to flooding, seasonally wet.	8,952	
	G3 - Marsh and swamp	625	
	Wa - water	186	

Wetlands

In the context of the Watershed Restoration Action Strategy (WRAS), wetlands serve valuable water quality and habitat functions that may not be provided by other land uses. Therefore, protection and enhancement of existing wetlands, and restoration of what were at one time wetland areas, can be valuable elements in the WRAS. (Also see Wetland Restoration.)

1. Wetland Categories

The Coastal Plain Province likely has the highest diversity of emergent estuarine and palustrine (fresh water) wetland communities compared to other Maryland physiographic regions, because both tidal and nontidal freshwater marshes occur here. Wetlands are most abundant in the Coastal Plain due to the low topographic relief and high ground water table characteristic of the region.

Estuarine Wetlands. Estuarine wetlands are abundant throughout the Coastal Plain. These systems consist of salt and brackish tidal waters and contiguous wetlands where ocean water is at least occasionally diluted by freshwater runoff from the land. These wetlands may extend far upstream in tidal rivers to freshwater areas. Differences in salinity and tidal flooding within estuaries have a significant effect on the distribution of these wetland systems. Salt marshes occur on the intertidal shores of tidal waters in areas of high salinity. Brackish marshes are the predominant estuarine wetland type in Maryland. They are found along the shores of Chesapeake Bay, mostly on the Eastern Shore, and for considerable distance upstream in coastal rivers. Estuarine shrub swamps are common along the Maryland coastal zone. Aquatic beds, comprised mostly of submerged aquatic vegetation (SAV), were historically abundant in shallow water zones of Maryland's estuaries, especially Chesapeake Bay and its tributaries.

Lacustrine wetlands. These wetlands are associated with lakes and are relatively uncommon in Maryland.

Palustrine wetlands. These are freshwater wetlands that are not associated with streams or lakes. In general, palustrine wetlands are associated with freshwater, high water tables, or intermittent ponding on land. Forested wetlands are the most abundant and widely distributed palustrine wetland type on the Coastal Plain. 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. Tidal freshwater swamps occur along coastal rivers in areas subject to tidal influence. Emergent wetlands on the Coastal Plain are characterized by a wide range of vegetation, depending on water regime.

Riverine wetlands. These wetlands are associated with streams or rivers
(Adapted from *Wetlands of Maryland*, Tiner and Burke, 1995.)

2. Wetland Distribution

The Wetland Acreage Summary Table summarizes distribution and categories of wetlands in the Western Branch watershed. Map 11 Wetlands: Upper Marlboro Vicinity focuses on an area of the watershed that exhibits most of the wetland types found in Western Branch:

– Palustrine wetlands altogether are 93% of all the wetlands in the watershed. Palustrine forested wetlands account for about 65% of all the wetlands in the watershed.
– Estuarine wetlands account for about 6% of watershed wetlands.
– Lacustrine and Riverine wetlands together are about 1%.

Wetland Acreage Summary Table Western Branch Watershed		
Wetland Class		Acres
Estuarine	emergent	198
Lacustrine	unconsolidated bottom	35
Palustrine	aquatic bed	38
	emergent	245
	forested	2,087
	scrub shrub	293
	unconsolidated bottom	301
	unconsolidated shore	2
Riverine	unconsolidated bottom	4
Total Wetlands (DNR mapped wetlands)		3,203

Wetlands of Special State Concern (WSSC)
868 acres of the wetlands in the table are subject to WSSC regulations. See the Sensitive Species Section.

In comparing the wetlands map to Map 4 Land Use / Land Cover, it can be seen that many of the nontidal wetland areas are depicted as forest on the land use map. And most of the estuarine wetlands are not identified on the land use map These differences are 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. Similarly, most of the estuarine wetlands shown on the wetlands map are considered open water on the land use map.

In the Western Branch Watershed, differing perspectives on counting wetlands are significant for watershed management. From a land use perspective, 180 acres of wetlands are identified by the Maryland Department of Planning. From a habitat / regulatory perspective, there are at least 6,220 acres of wetlands in the watershed.

3. Tracking Wetlands

Oversight of activities affecting wetlands involves several regulatory jurisdictions. The Maryland Department of the Environment (MDE) is the lead agency for the State and cooperates with DNR, the 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 table Tracking Nontidal Wetland Change shows, the State regulatory program has measured a small net increase of wetland acreage in the Western Branch watershed over the past 11 years. This slowing of wetland loss in the watershed contrasts significantly with the estimated 10,479 acre historic wetland loss in the watershed as described in the Landscape Indicators section.

Tracking Nontidal Wetland Change For The Western Branch Watershed In Acres 1/1/1991 through 12/31/2002 [11]				
Permanent Impacts	**Permittee Mitigation**	**Programmatic Gains**	**Other Gains**	**Net**
-19.10	20.47	0	4.16	5.53

Notes For Table: Tracking Nontidal Wetland Change

1) Regulatory tracking for authorized nontidal wetland losses began in 1991. Comprehensive tracking of voluntary wetland gains began in 1998. Only nontidal wetland changes are shown; tidal wetland changes are excluded. Acreage presented covers the entire watershed.

2) "Permanent Impacts" refers to acres altered (e.g., filled, drained) under permit issued from MDE.

3) "Permittee Mitigation" refers to acres restored by a permit holder as required by terms of the permit from MDE.

4) "Programmatic Gains" refers to acres restored by MDE using fees paid into a compensation fund by a permit holder in lieu of undertaking mitigation himself.

5) "Other Gains" refers to acres of wetlands restored when not required as mitigation for permitted losses.

Floodplains

Flooding was identified as a local issue early in the WRAS project. Flooding of public roads crossing streams is a particular concern. Map 12 Floodplain shows that the 100-year floodplain extends far up Western Branch and its tributaries toward their headwaters. Both the City of Bowie and Upper Marlboro have significant areas of 100-year floodplain within their jurisdictions.

LIVING RESOURCES AND HABITAT

Living resources, including all the animals, plants and other organisms that call the land and waters of the Western Branch watershed home, are being affected by human activity. The information summarized here suggests that some of the significant stresses on living resources in the watershed are alteration and destruction 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 readily available 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 as it becomes available.

Our focus here will be primarily on aquatic living resources and a few sensitive species or habitats not considered in the landscape chapter. Aquatic organisms are sensitive, in varying degrees, to changes in water quality and aquatic habitat. They are also sensitive to landscape changes. This association 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, the status of selected species can be used to assess local conditions for water quality, habitat, etc. This second perspective is the basis for using living resources as "indicators."

Fish

1. Anadromous Fish

Three species of anadromous fish are known to spawn in the Western Branch watershed. Anadromous fish are defined as species that lay eggs in fresh water and live much of their adult lives in salt water. Spawning habitat for these fish in fresh water streams is critical to the survival of these species. Map 13 Fish Index, Spawning & Blockage To Movement shows the general areas where spawning of these species has been documented:

– Herring are known to spawn in the mainstem of Western Branch up to the Upper Marlboro vicinity and in Charles Branch at least as far upstream as Route 301.
– White Perch spawn in the lower reaches of Collington Branch, the Western Branch mainstem upstream to at least Bach Branch, and in Charles Branch.
– Yellow Perch spawn in Charles Branch and Western Branch mainstem below Upper Marlboro.
– Shad spawning is documented just outside of the Western Branch watershed in the Patuxent River.

2. Tidal Freshwater Fish

The Fisheries Service of DNR surveys the tidal reaches in lower Western Branch, focusing primarily on game species. In support of sport fishing, the Service has stocked thousands of largemouth bass fry and fingerlings in the river; one of its more popular stocking sites has been at the boat ramp on property of the Washington Suburban Sanitary Commission (WSSC). Because of the rip rap at the site, the sewage treatment plant effluent, and a fair amount of structure, the fish congregate and do well there. Game fish that are frequently found in and around that area are listed in the table below.

Game Fish Frequently Found In The Western Branch Watershed	
Striped Bass	White Perch
Largemouth Bass	Yellow Perch
Smallmouth Bass	Bluegill Sunfish
Chain Pickerel	

Largemouth bass, perch and striped bass are the most abundant between the effluent outfall and the confluence of Western Branch with the main stem Patuxent.

3. Freshwater Fish

Information on fish populations in nontidal streams has been gathered as part of the Maryland Biological Stream Survey (MBSS). Sampling was conducted in the Western Branch watershed in 1994, 1997 and 2001. Map 13 Fish Index, Spawning & Blockage To Movement shows the locations assessed by MBSS. Some stream segments are well characterized, based on multiple assessments, while others have not been assessed.

Four fish species that require good water quality and habitat conditions have been identified in the Western Branch watershed–American Brook Lamprey, Glassy Darter, Least Brook Lamprey, and Roseyside Dace. The Glassy Darter is on Maryland's endangered species list. (Also see Sensitive Species). These four fish species are considered "intolerant" of poor water quality or habitat conditions. The presence of these fish suggests that some areas in the watershed offer a combination of good quality natural resources and natural fish populations that rely on those conditions. Areas where these species have been found are listed below. Additional details are presented in Appendix B:

– Lower Lottsford Branch has supported all four intolerant species. Based on fish population information, the good quality area extends between Route 50 and Bald Hill Branch.
– Black Branch, a tributary to Collington Branch, has supported all four intolerant species. Using fish population information as a guide, the good quality area extends into the Collington Branch mainstem both upstream and downstream of Black Branch.
– Lower Northeast Branch and Western Branch mainstem in that vicinity have supported three to four of the intolerant species.
– Southwest Branch near Route 301 has supported two of the four intolerant species.

Biological Monitoring of Streams

1. Rapid Bio-Assessment

The earliest biological monitoring by DNR of streams in the Western Branch watershed was conducted in the early to middle 1990s. As reported in the table, four stations on nontidal steams were assessed using the rapid bio-assessment technique. Sampling site locations are shown on Map 14 MBSS Benthic Index and Rapid Bio-Assessments. This technique was widely used in Maryland at the time and involves assessment of benthic macroinvertebrates. The value of this approach to assessment is explained in the text box Why Look at Benthic Macroinvertebrates in Streams?

DNR Rapid Bio-Assessment Summary - Western Branch Watershed [12]						
Map Key	**Location/ Station ID#**	**Sample Year**	**Benthic**	**Habitat**	**Water Quality**	**Comments**
1	Charles Branch at Croom Station Rd. CHL0028	1990, 1992, 1994,96	poor/ fair	good	poor/ fair	Stormwater affects, Andrews Airbase upstream
2	Collington Br. at Leeland Rd, CLN0037	1992, 1994, 1996	fair	poor/ fair	fair	Significant erosion from storm water
3	Southwest Br. near Western Br, SWB0002	1992, 1994, 1996	poor/ fair	poor/ fair	fair	Heavy stormwater damage
4	Western Branch near Southwest Br. WXT0121	1992, 1994, 1996	poor	poor	poor	Heavy sediment load, stormwater damage

2. Maryland Biological Stream Survey

In a separate sampling program, the Maryland Biological Stream Survey (MBSS) randomly selected stream sampling sites in the watershed in 1994,1997 and 2001. Additional work was conducted in 1998-99 for the Army Corps of Engineers at selected sites associated with existing stream channelization.[13] Some of the information collected by MBSS was used to generate three indices of stream conditions that are designed to allow comparison of one Maryland stream to another. Sampling locations and index information for each sampling site are found in three maps: Fish Index in Map 13; Benthic macroinvertebrates Index in Map 14, and; Physical Habitat *ndex* in Map 15. An overall summary table for all three indices is presented in Appendix C

3. Findings

Conditions in a stream or subwatershed may be interpreted by considering fish, benthos and physical habitat independently or in combination. Several observations on areas of good conditions that may be worthy of protection and/or enhancement are offered below.

– The Western Branch mainstem south of Route 214 exhibited good conditions considering fish, benthos and physical habitat.
– Near the confluence of Lottsford Branch and Bald Hill Branch fish and benthic populations appeared to be in good condition.
– Southwest Branch in the vicinity of Route 214 exhibited good fish and physical conditions.
– Black Branch, tributary to Collington Branch, had good fish conditions and lesser benthic and physical habitat conditions.

MBSS assessed several areas around channelized stream segments in Southwest Branch and Bald Hill Branch and recommended priorities for stream restoration based on potential for expanding aquatic habitat and maximizing diverse fish populations.[13] The MBSS recommendations for priorities are (in Map 13 and Map 14): #1 - SW17; #2 - SW9; #3 - BH2, and 4# SW10.

Why Look at Benthic Macroinvertebrates in Streams?

Benthic macroinvertebrates (benthic = bottom dwellers, macro = greater than .5 mm, invertebrate = without backbones) are sometimes called "stream bugs," although that name oversimplifies the diverse membership of this stream community. Unimpaired natural streams may support many dozens of species in their pools, riffles and runs, ranging from worms and clams to stoneflies and crayfish.

Benthic macroinvertebrates have been recognized worldwide by the scientific community as valuable indicators of a stream's health because of their generally sedentary nature, the diversity of habitats they utilize, and their varying sensitivity to water and habitat quality degradation. The presence or absence, and abundance, of species in this biological community give important clues to water and habitat quality and integrity within a stream system.

Benthic macroinvertebrates are critical links in the aquatic ecosystem food web. Like earthworms in the garden, some macroinvertebrates process and convert organic matter, such as algae, leaves, and sticks, into "compost" that is food for another part of the food web. The absence or significant reduction of organic matter in a stream, due to no trees along the banks for example, will reduce or remove these "processors" to the detriment of stream biological integrity. The macroinvertebrates are not only important for what they do, but what they are. They are a major food source for the fish communities of a stream. The flies that a trout fisherman ties are imitations of some of these fish food macroinvertebrates. As with the absence of organic matter impacting the macroinvertebrate community, the absence of macroinvertebrates negatively impacts the fish community, and so on up the food web.

Aquatic Living Resource Indicators

The *Unified Watershed Assessment,* published in 1998, included a number of living resource indicators which could contribute to a watershed's being assigned to Category 1 - in need of restoration.[2] In 1994, 1997 and 2001, the Maryland Biological Stream Survey (MBSS) randomly selected stream sampling sites in the watershed. In addition to contributing to the fisheries information summarized above, some of the information collected by MBSS was used to generate the first three of the following indicators of stream habitat conditions and biological communities. These indicators are designed to allow comparison of one Maryland stream to another. Sampling locations and index information for each sampling site are found in the maps and the appendix. The final two indicators were also used in the *Unified Watershed Assessment*, developed from data maintained by the Tidewater Ecosystem Assessment division of DNR.

Several of these indicators rely on extrapolations from a limited number of sampling sites, which were then generalized to represent entire watersheds. Some are indices comprising several conditions. Considering this limitation on field data, it is necessary to conduct additional assessments to provide a more complete understanding of local conditions.

1. Nontidal Fish Index of Biotic Integrity

The nontidal fish IBI Measures several characteristics of the fish community in small (first- to third-order) streams–numbers of native species, of benthic species and of tolerant individuals; the percent of pollution-tolerant species, of dominant species, and of generalists, omnivores and insectivores; the number of individuals per square meter, and more. The characteristics are scored in comparison with reference streams and the scores summed. Watershed scores are means of the sample points within them. Scores range from 1 (most degraded) to 10 (best condition).

An index of 6.0 or less means that restoration was recommended and an index of 8.0 or higher means that protection was recommended. With an IBI score of 7.9, the Western Branch Watershed would not have been placed in Category 1 for this indicator, had this score been an average of four or more samples. Because of an insufficient number of samples statewide, this indicator had very limited utility in the *Unified Watershed Assessment,* but it may be a useful way to measure change in Western Branch over time.

2. Nontidal Benthic Index of Biotic Integrity

This IBI considers insects and other invertebrates, like crayfish, living on the bottoms of streams; it includes the overall community composition, the number and diversity of species and the presence of sensitive species. To calculate the nontidal benthic IBI for the *Unified Watershed Assessment*, reference conditions were established for minimally-impacted streams and IBI scores for all streams were established relative to these minimally-impacted streams. Each watershed's score is an average of stream scores within the watershed. These watershed scores were ranked 1 (most degraded) through 10 (best condition). A score of 6 or greater meets the benchmark set for this index.

With score of 4.2, the Western Branch watershed did not meet the benchmark set for the Nontidal Benthic Index of Biotic Integrity (IBI).

3. Nontidal Habitat Index

This physical habitat indicator was developed for small (first- to third-order) non-tidal streams. It is based on several measures of in-stream habitat quality that are scored for each site based on observations of habitat condition in streams during sampling visits. The habitat measures rate the quantity and quality of physical habitat available in the stream for fish and benthic macroinvertebrate colonization and rate the degree to which the stream channel has been altered due to changes in watershed landscape. Physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing area of impervious land cover. Other major influences are channelization, encroachment by livestock, and blockages to upstream/downstream movements of fish.

The physical habitat characteristics are measured, scored, weighted, and summed to calculate the indicator for each sampled stream. A low score, or a decline in score over time, reflects both natural disturbances and human-induced alterations of the stream habitat relative to minimally-disturbed reference sites. The mean habitat score for watersheds is reported on a scale of 1 (most degraded) to 10 (best condition). The ranked scores were divided into four groups each containing 25% of the watersheds (quartiles). The watersheds with the worst conditions ranked in the lowest quartile, including Western Branch, and were assigned to Category 1 in the *Unified Watershed Assessment*, in need of restoration.

4. SAV Abundance

Submerged aquatic vegetation–SAV–are plants that are both ecologically very important and highly indicative of water quality. They provide food and cover for many fish and shellfish species during at least part of their life cycle. They cannot grow in the absence of appropriate nutrients and sunlight and are thus vulnerable both to algae blooms brought on by excessive levels of nutrients and to sediment loads that also block sunlight.

To generate the score for this indicator, two measurements of SAV area were used: 1) area covered by SAV in the year 1996 was measured using aerial survey data, and 2) the potential SAV area was measured based on water depth (up to two meters deep), physical characteristics and historic occurrence of SAV. This indicator is designed to allow comparison of watersheds based on actual SAV acreage versus potential SAV acreage.

The benchmark used in the *Unified Watershed Assessment* for the SAV Abundance indicator was 10%. If less than 10% of the potential SAV area in a watershed was covered by SAV in 1996, then the watershed was listed in the category “needs restoration”. (The maximum observed coverage in the State was 20%.) If more than 10% of the potential SAV area in a watershed was covered by SAV in 1996, then the watershed was listed in the category “needs preventative action” to protect or enhance SAV abundance. For tidal areas of the Western Branch Watershed, the abundance of SAV scored "1.0," which means that SAV covered 10% or less of the potential SAV habitat.

5. SAV Habitat Index

The SAV habitat index is designed to allow comparison of watersheds based on several measurements of habitat conditions: water clarity as measured by secchi depth, dissolved inorganic nitrogen where applicable, dissolved inorganic phosphorus, abundance of algae as measured by Chlorophyll *a*, and total suspended solids.

The range of scores for this indicator was from 1 (most degraded) to 10, representing the best condition. The benchmark used in the *Unified Watershed Assessment* for the SAV Habitat Index was 7. A score lower than 7 means that the watershed's habitat conditions were not favorable for SAV and the watershed was considered to be in need of restoration (Category 1). A score of 7 or higher means that 1994 through 1996 data showed that habitat conditions for SAV in a watershed were sufficiently good as to justify preventive measures rather than restoration. For tidal areas of the Western Branch watershed, the habitat for SAV scored 3.3, which means that SAV habitat requirements were not met based on 1994-1996 data. This score placed the Western Branch watershed among the lower scoring half of watersheds statewide.

Sensitive Species

Sensitive species are generally recognized as being the plants or animals that are most at risk in regards to their ability to maintain healthy population levels. The most widely known are perhaps the State and Federally-listed Endangered or Threatened animals such as the bald eagle and Delmarva fox squirrel. In addition to charismatic animals such as these, however, both the United States Fish and Wildlife Service and the Maryland DNR work through their respective Federal and State programs to protect a wide variety of declining non-game animals, rare plants, and the unique natural communities that support them.

For the purposes of watershed restoration, it is valuable to account for the known locations and areas of potential habitat for sensitive species in the watershed. They are often indicators, and sometimes important constituents, of the network of natural areas which form the foundation for many essential natural watershed processes. In fact, in addition to conserving biodiversity in general, protecting these species and/or promoting expansion of their habitats can be an effective component for a watershed restoration program.

1. Sensitive Species Conservation Areas

DNR's Wildlife and Heritage Service identifies important areas for sensitive species conservation in different ways. The geographic delineations most commonly used are described in the text box Maryland's Sensitive Species Conservation Areas. As shown in Map 16 Sensitive Species, three specific sensitive species overlays used by the State of Maryland are found in the Western Branch Watershed. The purpose of utilizing these delineations is to help protect sensitive species by identifying the areas in which they are known to occur. Doing so allows DNR to evaluate potential impacts of proposed actions that may affect them. Specifically, working within an established procedural framework with county, state, and federal agencies, the Wildlife and Heritage Service reviews projects and provides recommendations for activities falling within these overlays. DNR also sorks proactively to pursue protection of sensitive species habitat with land trusts and non-profit land preservation groups.

The geographic areas covered by the overlays are coarsely mapped. To allow for uncertainty in interpretation, the mapped polygons to depict these locations have been buffered.

Accurate on-the-ground information regarding species locations, habitat delineations, and vital buffers for a specific area can be obtained from DNR's Natural Heritage Program. It is also important to note that outside of the Chesapeake Bay Critical Area, DNR generally only places requirements on projects requiring a permit/approval or those utilizing State funds. However, there are more broadly applied State and Federal laws and regulations that address "takings" of listed species. In addition, many counties have incorporated safeguards for areas associated with sensitive species into their project and permit review processes as well as adopting specific ordinances to protect them. In all instances, property owners are encouraged to seek advice on protecting the sensitive species / habitat within their ownership.

2. Rare, Threatened and Endangered Species

The Western Branch watershed provides an important opportunity to conserve Coville's phacelia (*Phacelia covillei*), a state endangered wildflower that is rare throughout its very limited range. This plant is known from a total of 11 counties in Maryland, Virginia, North Carolina and the District of Columbia, and it is ranked as rare in each jurisdiction. Several subpopulations of Coville's phacelia have been discovered in the floodplain of Western Branch. Seeds of this annual plant are dispersed during flooding, and the flowers may appear in different sites on the floodplain from year to year. Conservation of contiguous suitable habitat and buffer will be essential to maintain the population in this watershed. Alterations in stream flow patterns caused by rapid runoff from impervious surfaces may be particularly detrimental to this floodplain annual. Restoration of stream flow patterns and water quality will contribute to sustaining Coville's phacelia in Western Branch. Control of non-native, weedy species in the floodplain may also be necessary to sustain this rare wildflower.

An unusual number of rare fish have been documented in Western Branch. Two state threatened and one state endangered fish species currently inhabit this tributary to the Patuxent. These species are vulnerable to sedimentation, which smothers eggs and larvae, and to changes in water flow patterns. Efforts to maintain and restore water quality and natural stream flow patterns will be important to sustaining these rare fish in the watershed.

Exceptional concentrations of forest interior dwelling birds (fids), particularly given the suburban nature of the area, have been identified in various forest stands within the Western Branch watershed. Forest interior dwelling birds require large tracts of forest to successfully breed, and these species are declining in the mid-Atlantic region. Conservation of fids requires not only maintaining the large blocks of forest in which they breed, but maintaining forested corridors connecting these blocks for dispersal and migration. These birds are identified for protection within the Chesapeake Bay Critical Area due to their marked decline (further details regarding their decline and regulatory protection within the Critical Area is provided in *A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area*, June 2000, available at www.dnr.state.md.us/criticalarea). However, fids receive no regulatory protection throughout most of the Western Branch watershed because most of the watershed lies outside the Critical Area. Watershed restoration efforts that promote conservation and expansion of forested buffers along stream corridors that constitute large blocks of forest or that connect large blocks of forest will contribute to conserving habitat for fids.

The table below lists the rare, threatened and endangered species found in the Western

Branch Watershed. In general, these species are located within the area on Map 16 Sensitive Species labeled as Ecologically Sensitive Area (ESA).

In addition to the species listed below, the ESAs also include colonial waterbird nesting areas and old growth forest that are identified in the watershed. These areas are also tracked by Maryland's Natural Heritage Program.

Rare, Threatened and Endangered Species of the Western Branch Watershed			
	Common Name	**Scientific Name**	**Status***
Animals	Bald eagle	*Haliaeetus leucocephalus*	T
	Glassy darter	*Etheostoma vitreum*	E
	American brook lamprey	*Lampetra appendix*	T
	Stripeback darter	*Percina notogramma*	E
Plants	Giant cane	*Arundinaria gigantea*	O
	Field sedge	*Carex conoidea*	E
	Wister's coralroot	*Corallorhiza wisteriana*	E
	Glade fern	*Diplazium pycnocarpon*	T
	Large-seeded forget-me-not	*Myosotis macrosperma*	O
	Coville's phacelia	*Phacelia covillei*	E
	Pale green orchid	*Plantanthera flava*	O
* Key for Maryland Status. E-endangered, T-threatened, O-Other			

Sensitive Species Conservation Areas
In the Western Branch Watershed

Ecologically Sensitive Area (ESA)

The ESA is an envelope identified for review purposes to help ensure that applications for permit or other approval in or near sensitive areas receive adequate attention and that safeguards are provided for the sensitive species / habitat they contain. Each ESA contains one or more sensitive species habitats. However, the entire ESA is not considered sensitive habitat. Expanses of ESA are identified in the Western Branch Watershed as shown in Map 16 Sensitive Species. Most ESAs in the watershed are outside of municipalities, but both the City of Bowie and Upper Marlboro include portions of ESAs.

Natural Heritage Area (NHA)

NHAs are rare ecological communities that encompass sensitive species habitat and are among the best statewide examples of their kind. 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. To help ensure that proposed projects that may affect an NHA are adequately reviewed, an ESA is always designated to encompass each NHA and the area surrounding it. One NHA, known as the Upper Patuxent Marshes, is located near the confluence of Western Branch and the Patuxent River. About 354 acres of this NHA are in the Western Branch watershed. It is part of a nearly 2,600-acre habitat complex that extends up and down the Patuxent River as shown in Map 16 Sensitive Species.

Wetlands of Special State Concern (WSSC)

Numerous WSSCs are designated in the Western Branch Watershed, as shown on Map 16 Sensitive Species. 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. To help ensure that proposed projects that may affect a WSSC are adequately reviewed, an ESA is always designated to encompass each WSSC and the area surrounding it. For a listing of designated sites see COMAR 26.23.06.01 at www.dsd.state.md.us

RESTORATION AND CONSERVATION TARGETING

There are a number of programs and tools available to assist in implementing goals for protection of valued watershed resources and for targeting restoration of those that have become degraded or otherwise function less than optimally.

2003 Stream Assessments Conducted By DNR

During 2003 in partnership with Prince George's County and the City of Bowie, DNR conducted two types of assessment of selected streams in the Western Branch watershed. The reports are available at www.dnr.maryland.gov/watersheds/surf/proj/wras.html.

A Stream Corridor Assessment focused on several subwatersheds selected by the County and City. DNR uses trained teams who walk about 100 miles of streams to document potential problems and restoration opportunities. The kinds of issues identified include: channel alteration, erosion sites, exposed pipes, fish barriers, inadequate buffers, livestock in the stream, near-stream construction, pipe outfalls, unusual conditions, and reference conditions which are cataloged at regular intervals as a way to define typical stream conditions.

In the Synoptic Survey and Aquatic Community Assessment, DNR staff collected water quality samples and assessed fish and benthic macroinvertebrates in selected nontidal streams. The water quality findings in the report can help identify problem areas and relative conditions among local streams based on measurements of dissolved oxygen, pH, nutrients (phosphorus and nitrogen), conductivity and flow. The nutrient yields estimated at each sampling site allow ranking the subwatersheds based on the nutrient load estimates. For some of these nontidal stream sampling sites, DNR staff has also assessed fish and benthic organism populations. These assessments provide additional perspectives to gauge local water quality and habitat conditions.

Agricultural Programs

Many farmers in Prince George's County willingly implement management systems that address nutrient runoff and infiltration, erosion and sediment control, and animal waste utilization. Some of the conservation practices identified in Soil Conservation and Water Quality Plans for farms include grassed waterways, herbaceous and forested riparian buffers, winter cover crops, shallow water wildlife areas, and grade stabilization structures. The Maryland Agricultural Cost-Share program (MACS), the Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP), and the Environmental Quality Incentive Program (EQIP) are some of the state and federal programs promoted and administered by the Prince George's Soil Conservation District (SCD) and Natural Resource Conservation Service (NRCS). [28]

As part of the WRAS project, farmers in the watershed who are already using good management practices that benefit water quality could provide examples to promote adoption of similar practices by other farmers.

Fish Blockage Removal

Many fish species need to move from one stream segment to the next in order to maintain healthy, resilient populations. This is particularly true for anadromous fish species, because they spawn and hatch from eggs in free-flowing streams but live most of their lives in estuarine or ocean waters. Blockages in streams, such as dams, pipe crossings, and some road culverts, can inhibit or prevent many fish species from moving upstream to otherwise viable habitat.

To help prioritize stream blockages for mitigation or removal, the DNR Fish Passage Program maintains a database of significant blockages to fish movement. Map 13 Fish Index, Spawning and Blockage to Movement shows about 30 blockages to fish movement that were identified prior to 2003. Additionally, as noted above, the 2003 Stream Corridor Assessment found about 140 blockages to fish movement in the subwatershed where the assessment was conducted. Most of these are minor.

Considering the number of opportunities to enhance movement of fish in the watershed, it would be worthwhile to identify local priorities for further investigation and, potentially, restoration projects. Based on the map several blockages appear to be in locations that may significantly affect local fisheries:

– On the Western Branch mainstem, the database lists several blockages between Upper Marlboro and the confluence with the Patuxent River. This area appears to be important for spawning by several anadromous fish species.
– On the Western Branch mainstem near Route 214, the database lists one blockage. The area immediately downstream of this reported blockage appears to be a good quality area for fish.
– Most blockages identified in the data base are outside of municipalities, but both the City of Bowie and Upper Marlboro also have blockages to fish movement.

Stream Buffer Restoration

1. Benefits and General Recommendations

Natural vegetation in stream riparian zones, particularly forest, provides numerous valuable environmental benefits:

– Reducing surface runoff
– Preventing erosion and excessive 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 that supports diverse populations of aquatic life.

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.

The DNR Watershed Services unit and programs like the Conservation Reserve Enhancement Program (CREP), managed by the DNR Forest Service, are available to assist land owners who volunteer to explore these opportunities.

2. Progress In the Western Branch Watershed [15]

As shown on Map 17 Stream Buffer Scenario Lower Western Branch Watershed, at least two stream buffer plantings have occurred near Upper Marlboro between 1996 and the end of 2001, according to the DNR Forest Service database. Both the mapped information and the summary table below are drawn from a database maintained by the DNR Forest Service. The database only includes projects where DNR was a participant.

Riparian Forest Buffer Creation - Forest Service Database
Western Branch Watershed 1996 - 2001

Map Key	Stream	Buffer Length (ft.)	Average Width (ft.)	Area (acres)
1	Federal Spring Branch	2,112	50	2.4
2	Unnamed Trib to Western Branch	435	150	1.5
NA	Unnamed Trib. to Northeast Branch	1,122	50	1.3
Total	--	3,669	--	5.2

3. Headwater Stream Buffers

Headwater streams are also called first order streams. For many watersheds, first order streams drain the majority of the land within the entire watershed. Therefore, stream buffers restored along headwater streams (First Order) 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.

Restoring headwater stream buffers can also provide habitat benefits that can extend downstream of the project area. Forested headwater streams provide important organic material, like 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 aquatic habitat.

4. 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 adjacent tableshows. By restoring naturally vegetated stream buffers adjacent to lands producing the highest pollutant loads, nutrient and sediment loads can be reduced most efficiently. The GIS scenarios shown in Map 17 Stream Enhancement and in Map 18 Stream Buffer Scenario Bowie focus on the open land within 50 feet of a stream and identify stream segments that lack naturally vegetated stream buffers.

Annual Nonpoint Source Pollution Load Rates By Land Use Chesapeake Bay Watershed Model (2000)			
Land Use	Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Sediment (tons/ac)
Crop land	17.11	1.21	0.74
Urban	7.5	0.7	0.09
Pasture	8.40	1.15	0.30

5. 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 ground water, with a significant percentage of nitrogen entering streams in ground water. Stream buffers can be used to capture nitrogen moving in groundwater if buffer restoration projects have several key attributes:
– Plants with roots deep enough to intercept groundwater as it moves toward the stream
– Plants with high nitrogen uptake capability, and
– Plantings sited 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 offers greater potential for habitat.

The stream buffer scenarios shown in Map 17 Stream Enhancement Scenario and in Map 18 Stream Buffer Scenario - Bowie identify open lands adjacent to streams that are on hydric soil and also lack naturally vegetated stream buffers. Restoration of stream buffers in these areas would be most likely to intercept nitrogen, control sediment and phosphorus movement, and improve stream water quality and habitat in general. 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 serve to decrease potential benefits.

6. Optimizing Water Quality Benefits by Combining Priorities

Strategic targeting of stream buffer restoration projects may provide many different benefits. To maximize multiple benefits, site selection and project design need to incorporate numerous factors. 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 to 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

Additionally, selecting restoration projects that are likely to produce measurable success is an important consideration in prioritizing projects for implementation. In general, targeting restoration projects in selected tributaries or small watersheds will tend to offer the greatest probability of producing measurable water quality improvement in the short term. By selecting small areas like a small first order stream for restoration, there is greater likelihood that local water quality will improve with relatively limited investment. In addition, local water quality improvements will likely contribute to downstream improvements.

Wetland Restoration

Wetlands serve important environmental functions such as providing habitat and nursery areas for many organisms, facilitating nutrient uptake and recycling, and providing erosion control. However, most watersheds in Maryland have significantly fewer wetland acres today than in the past. This loss due to draining, filling, etc., has led to habitat loss and negative water quality impacts in streams and in the Chesapeake Bay watershed. 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 GIS to manipulate soils information with other data like land use. The GIS products can then assist in initiating the candidate site search process, targeting site investigations and helping to identify land owners.

One approach to identifying places to investigate for wetland restoration potential involves mapping open land on hydric soil as shown on Map 19 Wetland Restortation Scenario – Lower Western Branch and Map 20 Wetland Restoration Scenario – Bowie. This is one of many potential scenarios for finding opportunities for wetland restoration. The steps and priorities used to generate the map are listed below:

– Data used: Hydric soils (Maryland Dept. of Planning Natural Soil Groups), existing wetlands (DNR Wetlands), land use / land cover (Prince George's County, 2002).
– Identify candidate hydric soil areas based on land use. Open land (crop fields, pasture, large lawns / "urban herbaceous", etc.) on hydric soil is selected using GIS. Hydric soil areas underlying natural vegetation, and lands categorized as developed, are not considered.
– Explore hydric soils based on land use/cover and proximity to existing wetlands or streams.

The potential wetland restoration sites suggested in the scenario can be filtered further by using more accurate wetlands and soil information, considering land ownership, etc. For example, the soils data used in this scenario are generally indicative of areas where hydric soils are likely to exist. However, field verification of actual conditions is essential to determine physical potential of various sites for wetland restoration or enhancement.

Additional steps would be beneficial in applying this information, such as considering additional criteria–like habitat enhancement opportunities, restoring gaps in the green infrastructure network, protecting sensitive species , targeting specific streams or subwatersheds for intensive restoration–and using Conservation Reserve Enhancement Program (CREP) information.

PROJECTS RELATED TO THE WRAS PROCESS

There are numerous projects and programs that have the potential to contribute to successful development and implementation of a Watershed Restoration Action Strategy (WRAS). The listing included here suggests opportunities for cooperation and coordination that can improve the likelihood of success for the WRAS. This listing is not all-inclusive. It is recommended that this list be augmented as new information becomes available and that follow-up should continue to promote the WRAS process with these and other projects and programs.

Western Branch Patuxent River Ecosystem Restoration Study

The US Army Corps of Engineers Planning Division in Baltimore City completed a reconnaissance study of the Patuxent River basin in 1996 which recommended further investigation in eleven watersheds, including the Western Branch. They completed a feasibility study for Western Branch in May 2001.[14] The feasibility study addressed four selected subwatersheds covering 42 square miles:

– Bald Hill Branch

– Cabin Branch

– Southwest Branch

– Western Branch Mainstem

Within these subwatersheds, the feasibility study identified many sites for potential mitigation or restoration, encompassing many types of problems: channelized streams, blockages to fish movements, stream degradation associated with stormwater, lost wetlands and riparian corridors lacking vegetation. Restoration opportunities identified for these problems included removing fish blockages, restoring in-stream physical habitat, stormwater management projects to address both water quantity and water quality, and wetland restoration/creation. Potential restoration projects were assessed in a cost-effectiveness analysis and in coordination with the public and Federal/State agencies.

Nine projects were proposed for construction by the Army Corps. These proposed projects are listed below in categories based on subwatershed area and project type:[14]

– Southwest Branch watershed. See Map 17 Stream Enhancement Scenario.
- Near the Beltway: modification of three concrete channels to improve aquatic habitat. These are sites SW9, SW10 and SW17 on Map 13.
- Willow Hills area: retrofitting a stormwater management pond.
- In the small watershed containing Thomas Claggett Elementary School: installation of about 75 small stormwater retrofits using techniques associated with low impact development.

– Western Branch mainstem.
- Floodplain near Upper Marlboro: restoring wetlands on about 5.4 acres in three sites and restoring woodlands on about 6 acres in two sites. See Map 19 Wetland Restoration Scenario – Lower Western Branch.

City of Bowie Sustainable Development Demonstration Project

In the last ten years, the City of Bowie has grown rapidly in population and land area. As the City continues to grow, natural and wildlife habitat areas within the City will continue to show a noticeable reduction. The City of Bowie has come to acknowledge that critical decisions concerning land use, some of them outside the purview of the municipal government, must begin to consider the environmental disturbances inherent in development. In response, the City adopted policies that mandate that all capital projects incorporate "Green Building" techniques, renewable energy, Low Impact Development (LID), and conservation landscaping when feasible.

The *City of Bowie Sustainable Development Demonstration Project* will reuse the present Bowie Parks and Grounds site to construct the City's first environmentally sensitive green building, and will attempt to achieve a Leadership in Energy Efficient Design (LEED)™ Silver certification. The proposed facility will be 12, 000 square feet, and will incorporate environmentally sensitive design, recycled materials, resource conserving appliances, Low Impact Development, and BayScaping. The intent of the project, supported by all the agencies that are involved in changing codes in Prince George's County, is to help remove the impediments to sustainable development practices often posed by present codes and ordinances.

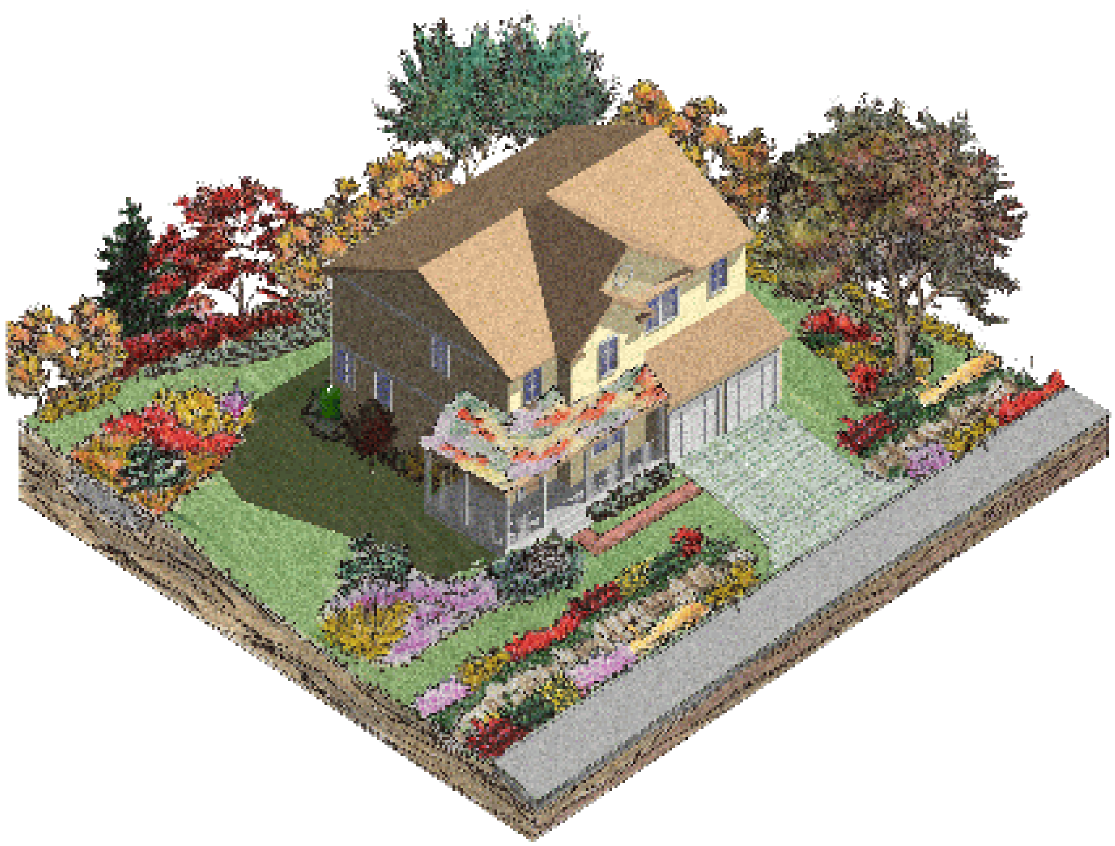
Through the WRAS partnership, other possible LID/Green Building projects within the Western Branch watershed are being identified. Parking lot retrofits, wetland restoration, drainage issues on ball fields, and other capital projects such as the replacement of the Allen Pond Amphitheater will be assessed as potential project sites. Project promotion and public information will occur through the City's Green Page, and through the GREEN Initiatives Public Information Presentations.

Low Impact Development (LID) Techniques

LID techniques emphasize proper site design techniques that protect the environment and water resources when land is developed, by minimizing the negative effects of impervious surfaces and enhancing the positive benefits of pervious surfaces. These techniques apply to new development projects and can also be used to retrofit existing developed areas.

Prince George's County has pioneered these techniques in many of its new development areas and for urban "retrofits." LID development uses every part of the landscape to maintain the natural runoff conditions. LID techniques can be incorporated into every part of the lot design: the roofs, pavement, road design, soils, and landscaping elements all are modified from what has been standard practice to store, detain, infiltrate or filter runoff.

Both commercial/industrial and high density residential areas will be evaluated for LID retrofits. The more intensely developed commercial and industrial areas will be among the first areas identified for urban retrofits through LID techniques. The information presented in Map 5: Percent Impervious Surface, in combination with data gathered from land use maps, chemical/biological surveys and the stream corridor assessment, can be used to assist in the identification of other investigation areas. Opportunities to address urban LID retrofit include redesigning hydrologic controls on roofs, buildings, downspouts, sidewalks, parking lots, and open space and landscaped areas.



REFERENCES

1. DNR. Internet Site accessed September 2003: http://www.dnr.state.md.us including
   - Surf Your Watershed http://www.dnr.state.md.us/watersheds/surf/index.html ;
   - Chesapeake Bay Tributary Strategies; (Search for the Patuxent Tributary Team); http://www.dnr.state.md.us/bay/tribstrat/index.html
   - Information Resource Center / Publications / Data http://www.dnr.state.md.us/irc/
   - Water Quality Data http://www.chesapeakebay.net/data/index.htm

2. Clean Water Action Plan Technical Workgroup. *Maryland Clean Water Action Plan.* December 1998. www.dnr.state.md.us/cwap/ Accessed October 2003.

3. Department of State Documents Internet Site accessed October 2003: www.dsd.state.md.us

4. MDE. Maryland's 303(D) lists: *1996 303(d) List of Water Quality Limited Basin Segements*, or *1998 Additions to Maryland's 303(d) List*, or *Draft Maryland's 2000 303(d) List.* For Internet access, go to www.mde.state.md.us, search for "impairment" and go to either 2002 303 or 303(d) List. Internet site accessed October 2003.

5. MDE. www.mde.state.md.us/tmdl/ Accessed October 2003.

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

7. Maryland Shore Erosion Task Force. *Final Report, State of Maryland Shore Erosion Task Force.* January 2000. 64 pages.

8. Johnson, Zoë Pfahl. *A Sea Level Rise Response Strategy For The State Of Maryland.* Document was prepared for Maryland DNR Coastal Zone Management Division. October 2000. 49 pages.

9. Boward, D.M., P.F. Kazyak, S.A. Stranko, M.K. Hurd, and T.P. Prochaska. 1999. From the Mountains to the Sea: The State of Maryland's Freshwater Streams. EPA 903-R-99-023. Maryland Department of Natural Resources, Monitoring and Nontidal Assessment Division, Annapolis, Maryland. http://www.dnr.state.md.us/streams/pubs/md-streams.pdf. Accessed October 2003.

10. Mid-Atlantic RESAC, Department of Geography, University of Maryland. Impervious surface mapping using multi-resolution imagery. Accessed October 2003 http://www.geog.umd.edu/resac/impervious.htm

11. MDE. *Nontidal Wetland Impact Data By Watershed Segment (In Acres) 01/01/1991 - 12/31/2002.* Received via fax from Kelly Neff, Maryland Dept. of the Environment June 26, 2003. Five pages.

12. Primrose, Niles. DNR Watershed Services, Watershed Evaluations. Personal communication June 2003.

13. Stranko, S. and S. Page. *Final Data Report: Habitat Quality and Biological Integrity Assessment Western Branch Patuxent River Feasibility Study.* Md DNR Monitoring and Nontidal Assessment Division. Unknown date, approximately 1999. 44 pages.

14. US Army Corps of Engineers. Western Branch, Patuxent River, Draft Integrated Detailed Project Report and Environmental Assessment. Baltimore District. May 2001. 239 pages.

15. Hairston-Strang, A., B. Harding, K. Powers. *Maryland Coastal Bays Forestry Strategy.* Maryland DNR Forest Service. April 2002. 43 pages.

GLOSSARY

303(d)	A section of the federal Clean Water Act requiring the states to report which waters of the state are considered impaired for the uses for which they have been designated, and the reasons for the impairment. Waters included in the "303(d) list" are candidates for having TMDLs developed for them.
319	A section of the federal Clean Water Act dealing with non-point sources of pollution. The number is often used alone as either a noun or an adjective to refer to some aspect of that section of the law, such as grants.
8-digit watershed	Maryland has divided the state into 138 watersheds, each comprising an average of about 75 square miles, that are known as 8-digit watersheds because there are 8 numbers in the identification number each has been given. These nest into the 21 larger 6-digit watersheds in Maryland which are also called Tributary Basins or River Basins. Within the Chesapeake Bay drainage, 8-digit watersheds also nest into 10 Tributary Team Basins.
Anadromous fish	Fish that live most of their lives in salt water but migrate upstream into fresh water to spawn.
Benthic	Living on the bottom of a body of water.
CBIG	Chesapeake Bay Implementation Grant Program, a DNR-administered program that awards grants from the Chesapeake Bay Program to reduce and prevent pollution and to improve the living resources in the Chesapeake Bay.

CBNERR	The Chesapeake Bay National Estuarine Research Reserve in a federal, state and local partnership to protect valuable estuarine habitats for research, monitoring and education. The Maryland Reserve has three components: Jug Bay on the Patuxent River in Anne Arundel and Prince Georges' Counties, Otter Point Creek in Harford County and Monie Bay in Somerset County.
COMAR	Code Of Maryland Regulations (Maryland State regulations)
CREP	Conservation Reserve Enhancement Program, a program of MDA. CREP is a federal/state and private partnership which reimburses farmers at above normal rental rates for establishing riparian forest or grass buffers, planting permanent cover on sensitive agricultural lands and restoring wetlands for the health of the Chesapeake Bay.
CRP	Conservation Reserve Program, a program of Farm Service Agency in cooperation with local Soil Conservation Districts. CRP encourages farmers to take highly erodible and other environmentally-sensitive farm land out of production for ten to fifteen years.
CWAP	Clean Water Action Plan, promulgated by EPA in 1998. It mandates a statewide assessment of watershed conditions and provides for development of Watershed Restoration Action Strategies (WRASs) for priority watersheds deemed in need of restoration
CWiC	Chesapeake 2000 Agreement watershed commitments. CWiC is a shorthand phrase used in the Chesapeake Bay Program.
CZARA	The Coastal Zone Reauthorization Amendments of 1990 address coastal non-point source pollution. Section 6217 of CZARA established that each state with an approved Coastal Zone Management program must develop and submit a Coastal Non-Point Source program for joint EPA/NOAA approval in order to "develop and implement management measures for NPS pollution to restore and protect coastal waters".
CZMA	Coastal Zone Management Act of 1972, establishing a program for states and territories to voluntarily develop comprehensive programs to protect and manage coastal resources (including the Great Lakes). Federal funding is available to states with approved programs.
Conservation Easement	A legal document recorded in the local land records office that specifies conditions and/or restrictions on the use of and title to a parcel of land. Conservation easements run with the title of the land and typically restrict development and protect natural attributes of the parcel. Easements may

stay in effect for a specified period of time, or they may run into perpetuity.

DNR	Department of Natural Resources (Maryland State)
EPA	Environmental Protection Agency (United States)
ESA	Ecologically Significant Area, an imprecisely defined area in which DNR has identified the occurrence of rare, threatened and/or endangered species of plants or animals, or of other important natural resources such as rookeries and waterfowl staging areas.
Fish blockage	An impediment, usually man-made, to the migration of fish in a stream, such as a dam or weir, or a culvert or other structure in the stream
GIS	Geographic Information System, a computerized method of capturing, storing, analyzing, manipulating and presenting geographical data.
MBSS	Maryland Biological Stream Survey, a program in DNR that samples small streams throughout the state to assess the condition of their living resources.
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MET	Maryland Environmental Trust, an organization that holds conservation easements on private lands and assists local land trusts to do similar land protection work.
MGS	Maryland Geological Survey, a division in DNR.
NHA	Natural Heritage Area, a particular type of DNR land holding, designated in COMAR.
NOAA	National Oceanic and Atmospheric Administration, an agency of the US Department of Commerce that, among other things, supports the Coastal Zone Management program, a source of funding for some local environmental activities, including restoration work.
NPS	Non-Point Source, pollution that originates in the landscape that is not collected and discharged through an identifiable outlet.

NRCS	Natural Resources Conservation Service, formerly the Soil Conservation Service, an agency of the US Department of Agriculture that, through local Soil Conservation Districts, provides technical assistance to help farmers develop conservation systems suited to their land. NRCS participates as a partner in other community-based resource protection and restoration efforts.
PDA	Public Drainage Association
Palustrine Wetlands	Fresh water wetlands, including bogs, marshes and shallow ponds.
RAS	Resource Assessment Service, a unit of DNR that carries out a range of monitoring and assessment activities affecting the aquatic environment.
Riparian Area	1. Land adjacent to a stream. 2. Riparian areas are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands, including portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (i.e. a zone of influence). Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes, and estuarine-marine shorelines. (National Research Council, *Riparian Areas: Functions and Strategies for Management*. Exec Summary p3. 2002)
SAV	Submerged Aquatic Vegetation, important shallow-water sea grasses that serve as a source of food and shelter for many species of fin- and shell-fish.
SCA[M]	Stream Corridor Assessment is an activity carried out by DNR Watershed Services in support of WRAS development and other management needs, in which trained personnel walk up stream channels noting important physical features and possible sources of problems.
SCD	Soil Conservation District is a county-based, self-governing body whose purpose is to provide technical assistance and advice to farmers and landowners on the installation of soil conservation practices and the management of farmland to prevent erosion.
Synoptic survey	A short term sampling of water quality and analysis of those samples to measure selected water quality parameters. A synoptic survey as performed by DNR in support of watershed planning may be expanded to include additional types of assessment like benthic macroinvertebrate sampling or physical habitat assessment.

TMDL — Total Maximum Daily Load, a determination by MDE of the upper limit of one or more pollutants that can be added to a particular body of water beyond which water quality would be deemed impaired.

Tributary Teams — Geographically-focused groups, appointed by the Governor, oriented to each of the 10 major Chesapeake Bay tributary basins found in Maryland. The teams focus on policy, legislation, hands-on implementation of projects, and public education. Each basin has a plan, or Tributary Strategy.

USFWS — United States Fish and Wildlife Service, an agency of the Department of Interior.

USGS — United States Geological Survey

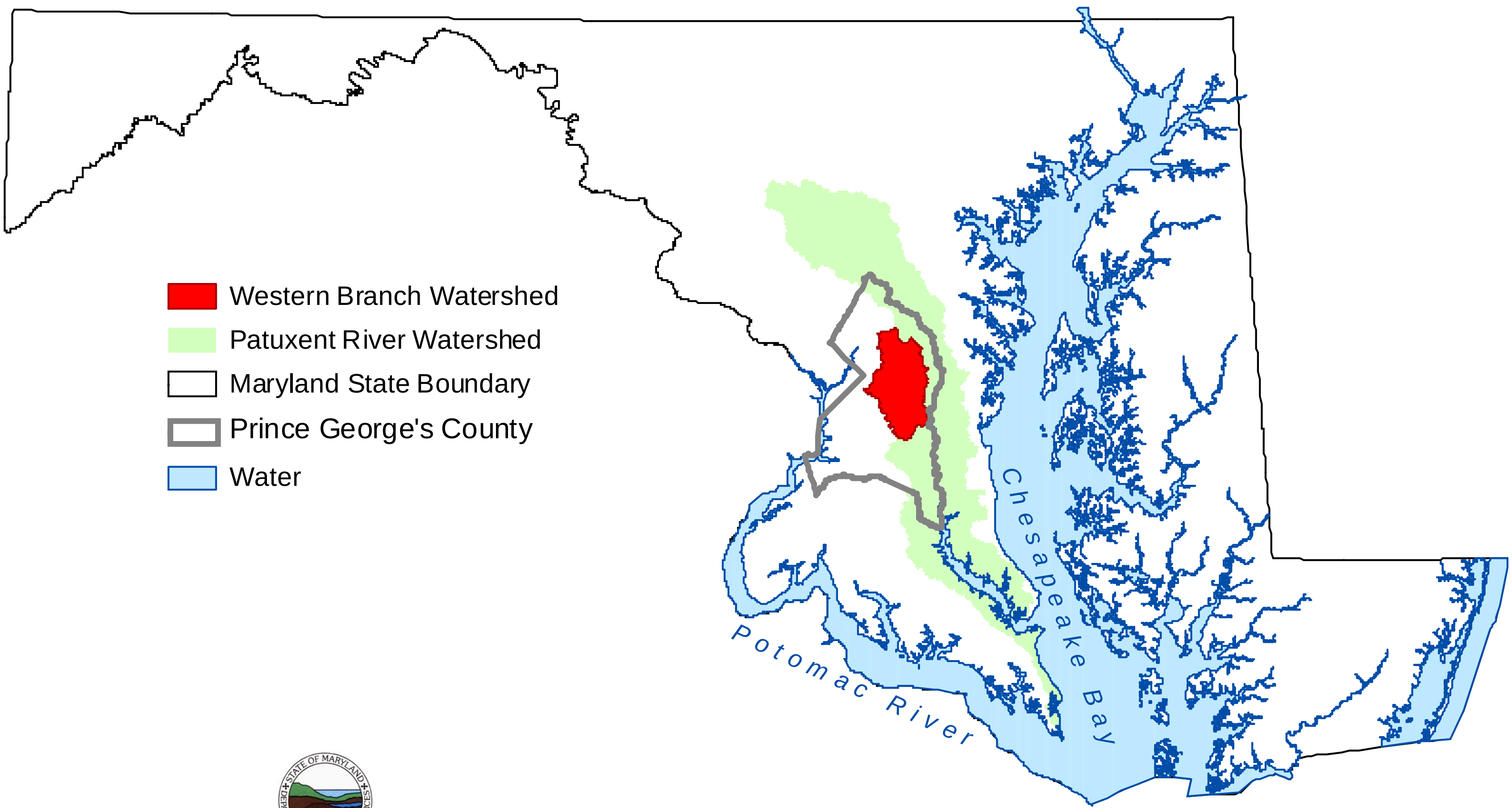
Water Quality Standard — Surface water quality standards consist of two parts: (a) designated uses of each water body; and (b) water quality criteria necessary to support the designated uses. Designated uses of for all surface waters in Maryland (like shell fish harvesting or public water supply) are defined in regulation. Water quality criteria may be qualitative (like "no objectionable odors") or quantitative (toxic limitations or dissolved oxygen requirements).

Watershed — All the land that drains to an identified body of water or point on a stream.

WRAS — Watershed Restoration Action Strategy, a document outlining the condition of a designated watershed, identifying problems and commiting to solutions of prioritized problems.

WSSC — Wetland of Special State Concern, a designation by MDE in COMAR.

Map 1 Location
Western Branch WRAS Project Area



Maryland Dept. of Natural Resources
Watershed Services
Landscape and Watershed Analysis Division
September 2003

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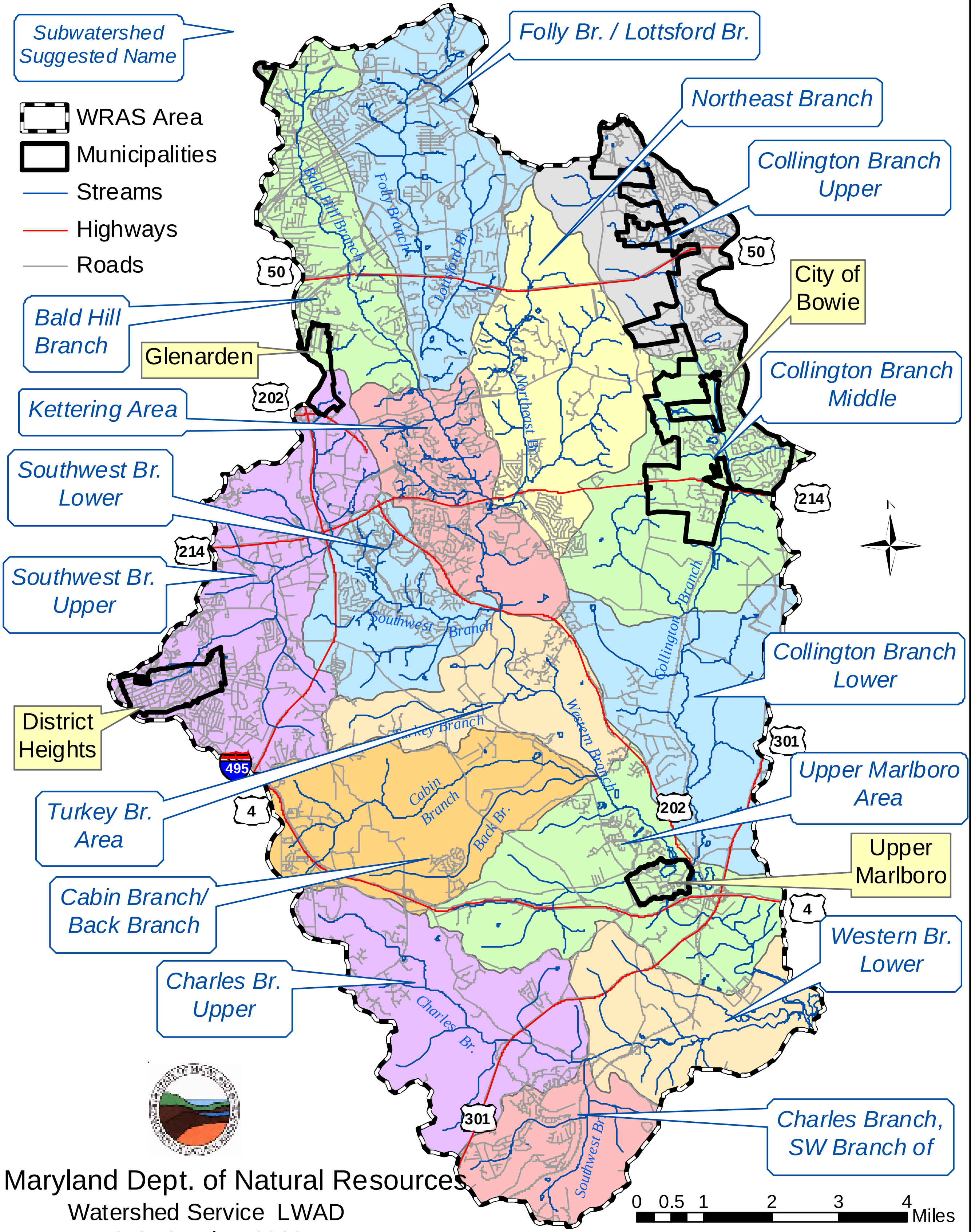
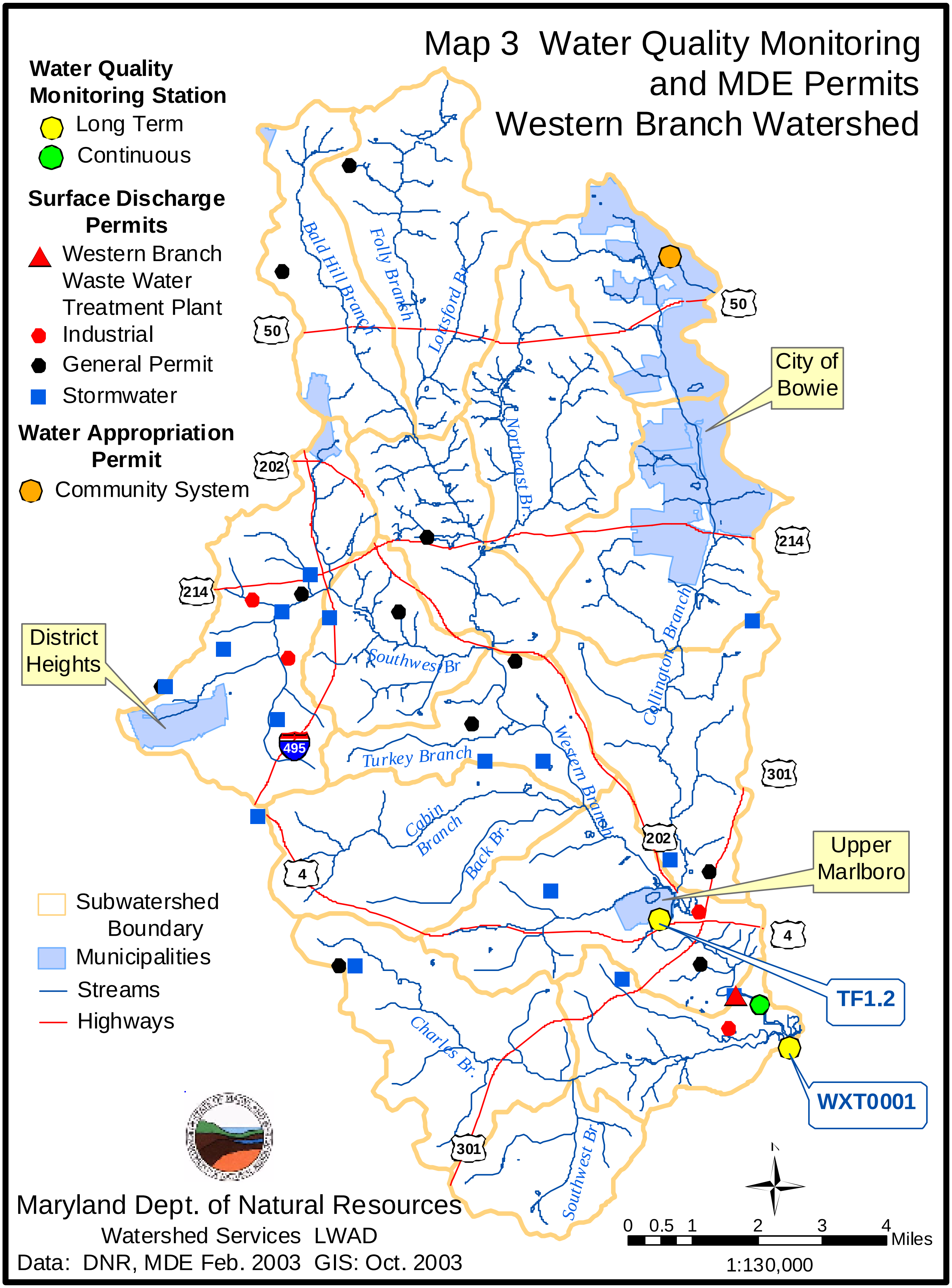
Map 2 Project Area, Western Branch Watershed



Maryland Dept. of Natural Resources
Watershed Service LWAD
GIS: October 2003


Map 3 Water Quality Monitoring and MDE Permits
Western Branch Watershed
Water Quality Monitoring Station
Long Term
Continuous
Surface Discharge Permits
Western Branch Waste Water Treatment Plant
Industrial
General Permit
Stormwater
Water Appropriation Permit
Community System
Subwatershed Boundary
Municipalities
Streams
Highways
City of Bowie
District Heights
Upper Marlboro
TF1.2
WXT0001
Bald Hill Branch
Folly Branch
Lottsford Br
Northeast Br.
Collington Branch
Southwest Br
Turkey Branch
Western Branch
Cabin Branch
Back Br.
Charles Br.
Southwest Br
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214
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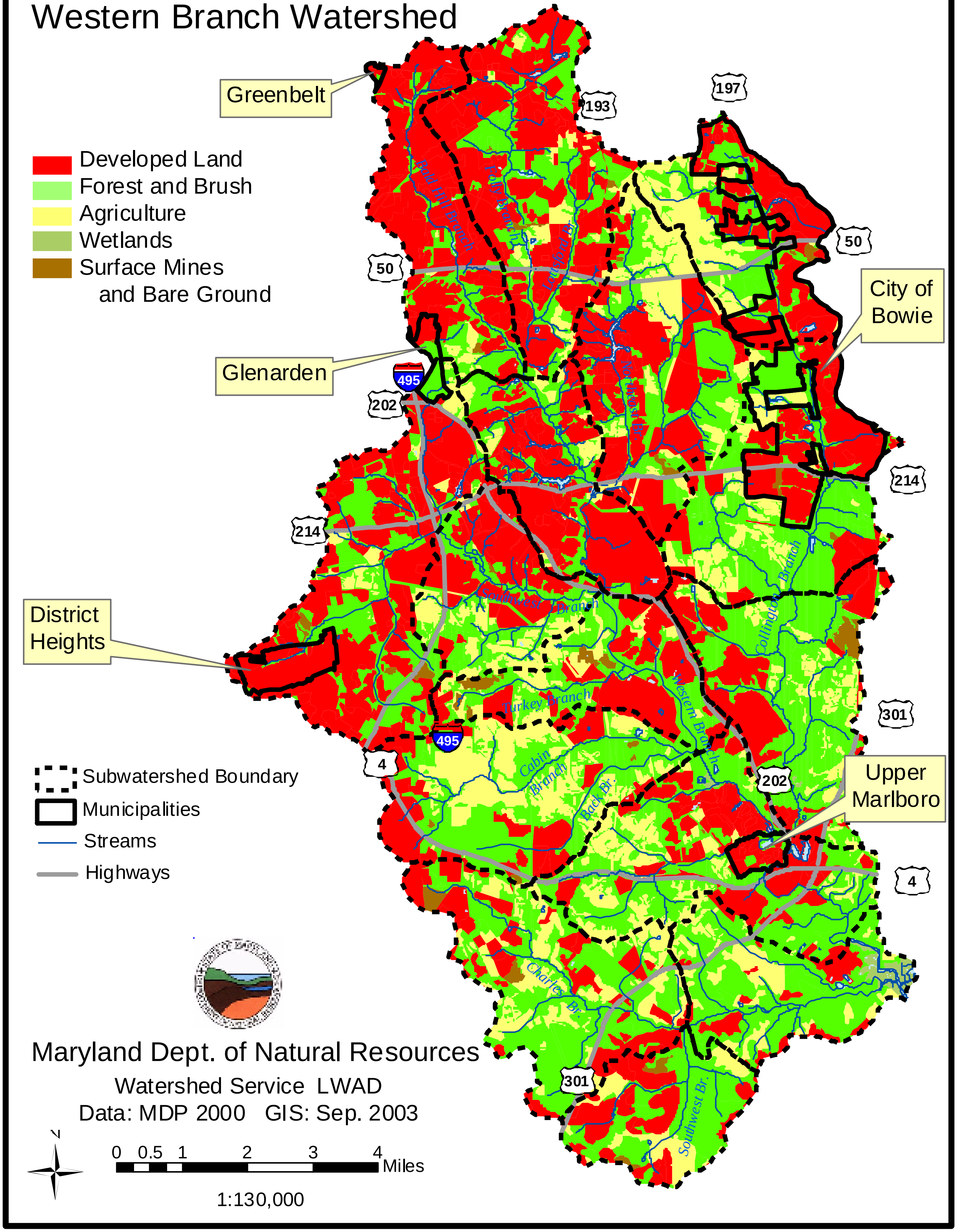
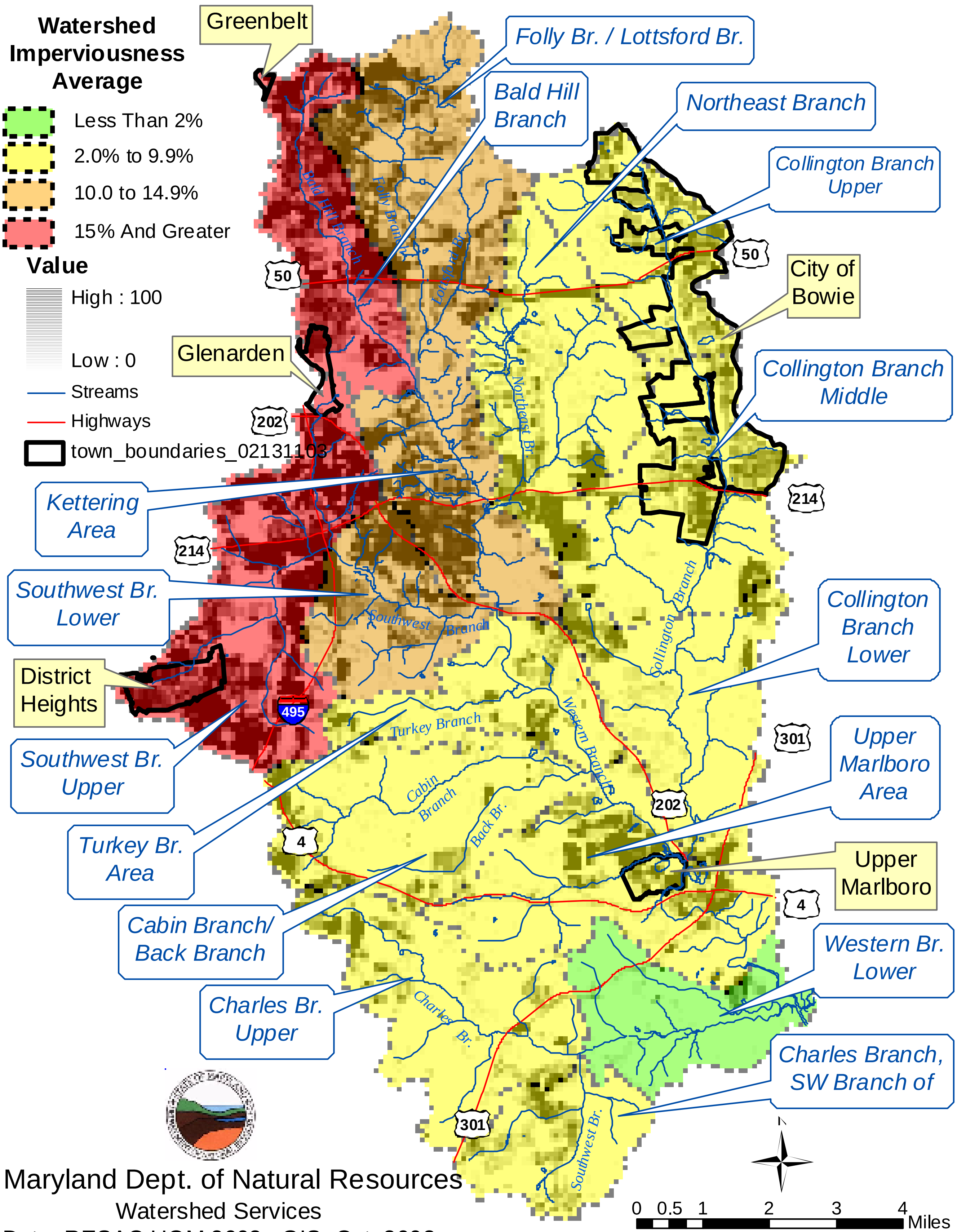
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: DNR, MDE Feb. 2003 GIS: Oct. 2003

Map 4 Land Use / Land Cover
Western Branch Watershed

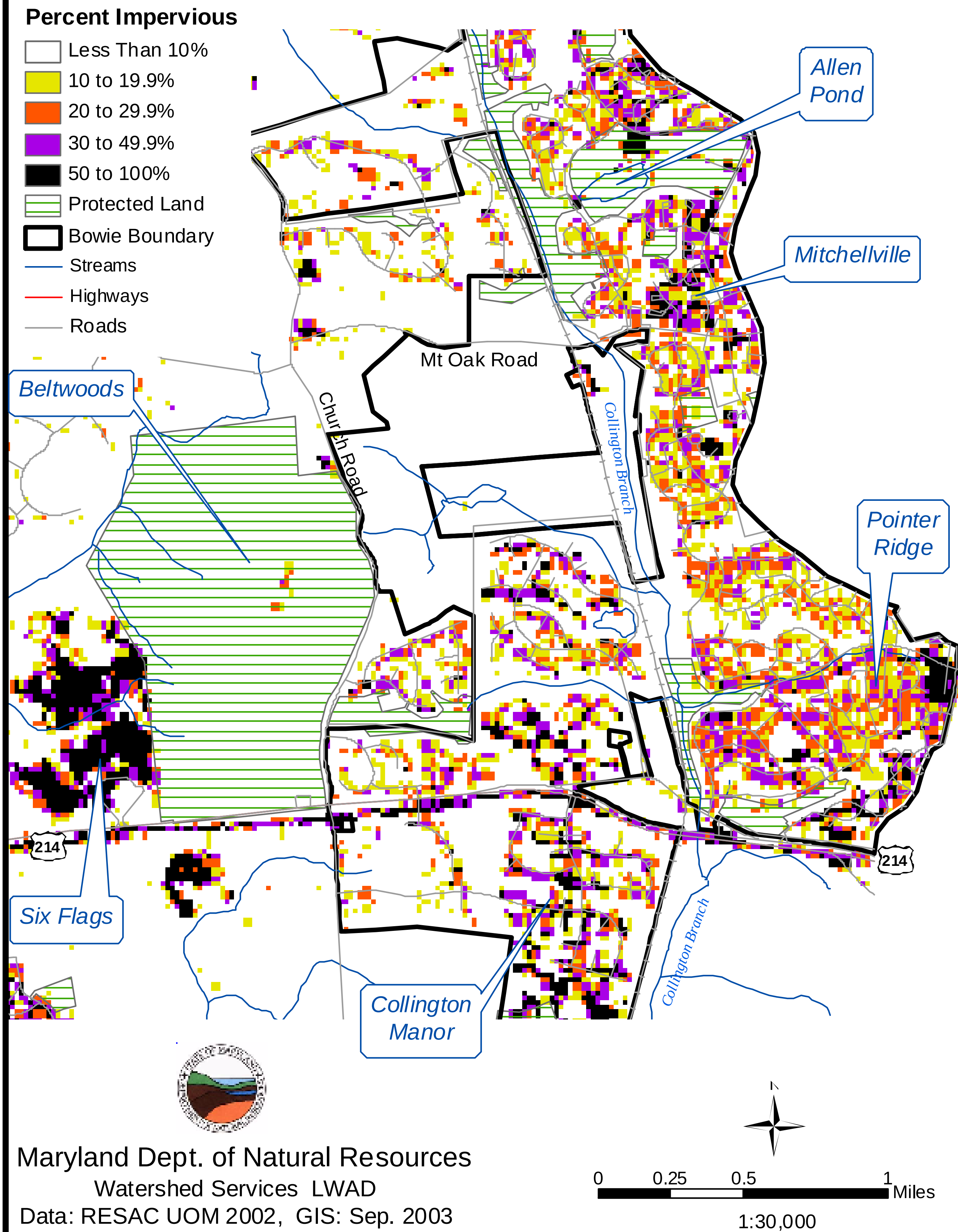


Map 5 Impervious Surface, Western Branch Watershed



Maryland Dept. of Natural Resources
Watershed Services
Data: RESAC UOM 2002, GIS: Oct. 2003

Map 6 Impervious Surface, Bowie / Rt. 214 Vicinity

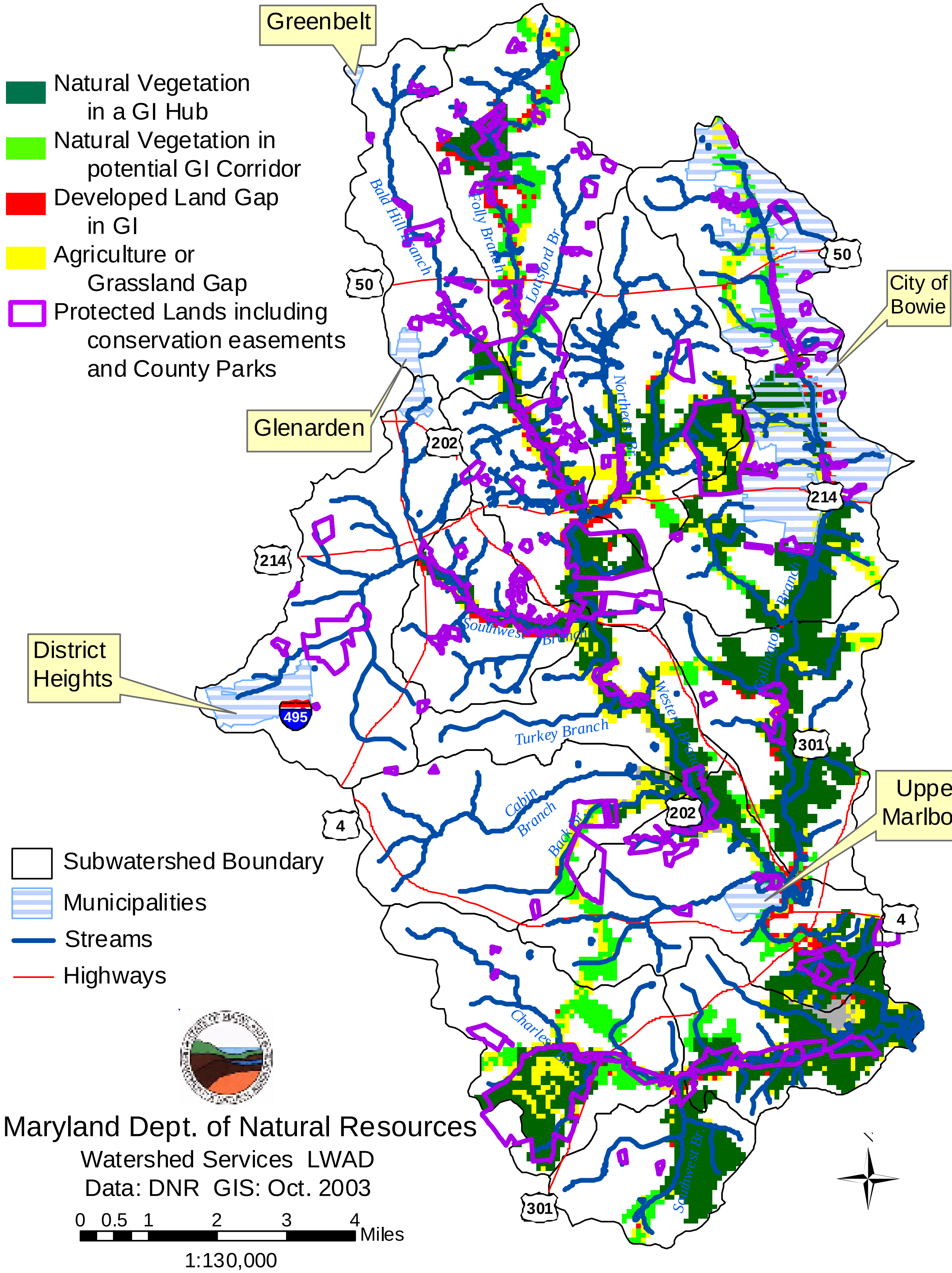


Maryland Dept. of Natural Resources

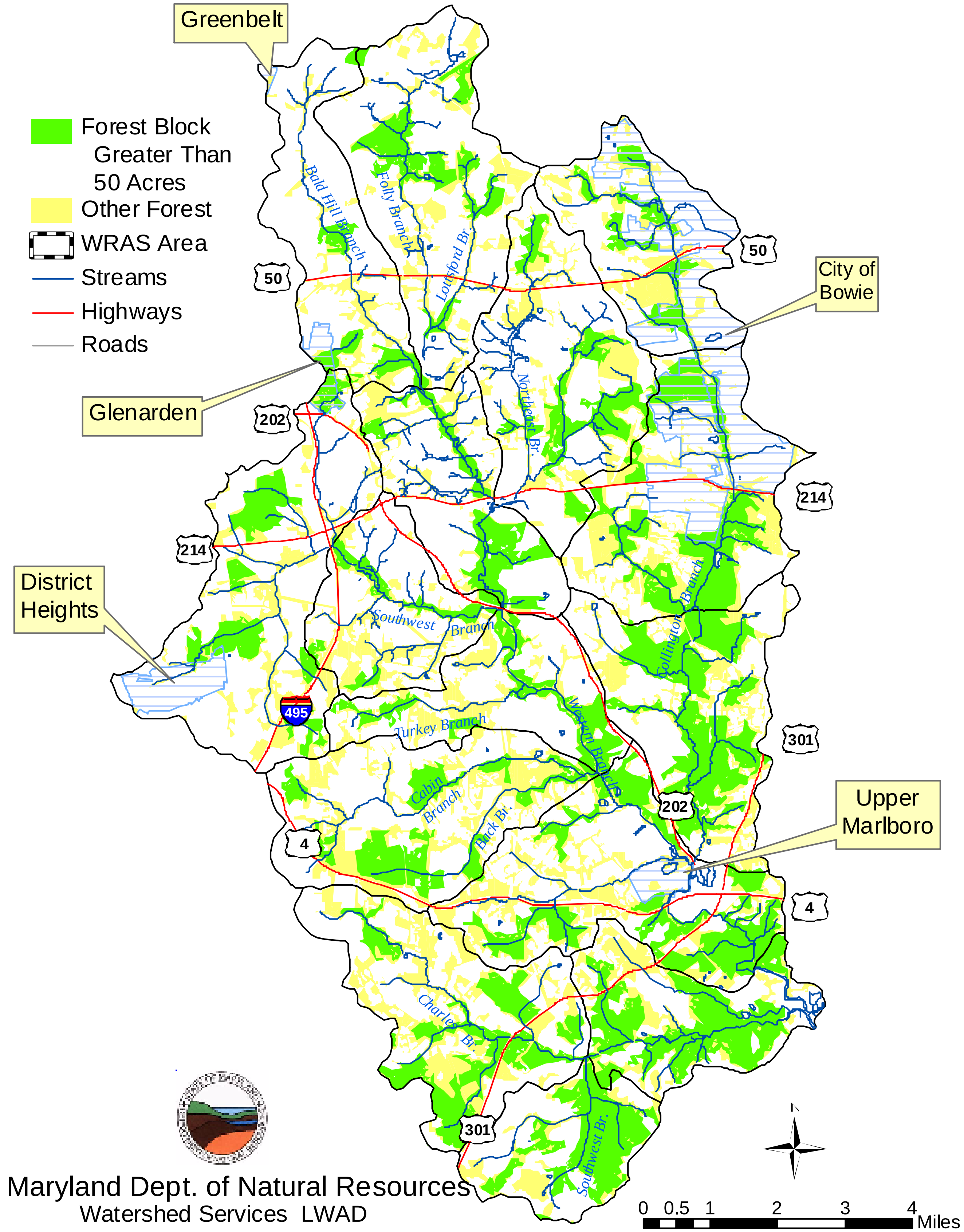
Watershed Services LWAD

Data: RESAC UOM 2002, GIS: Sep. 2003

Map 7 Green Infrastructure, Western Branch Watershed

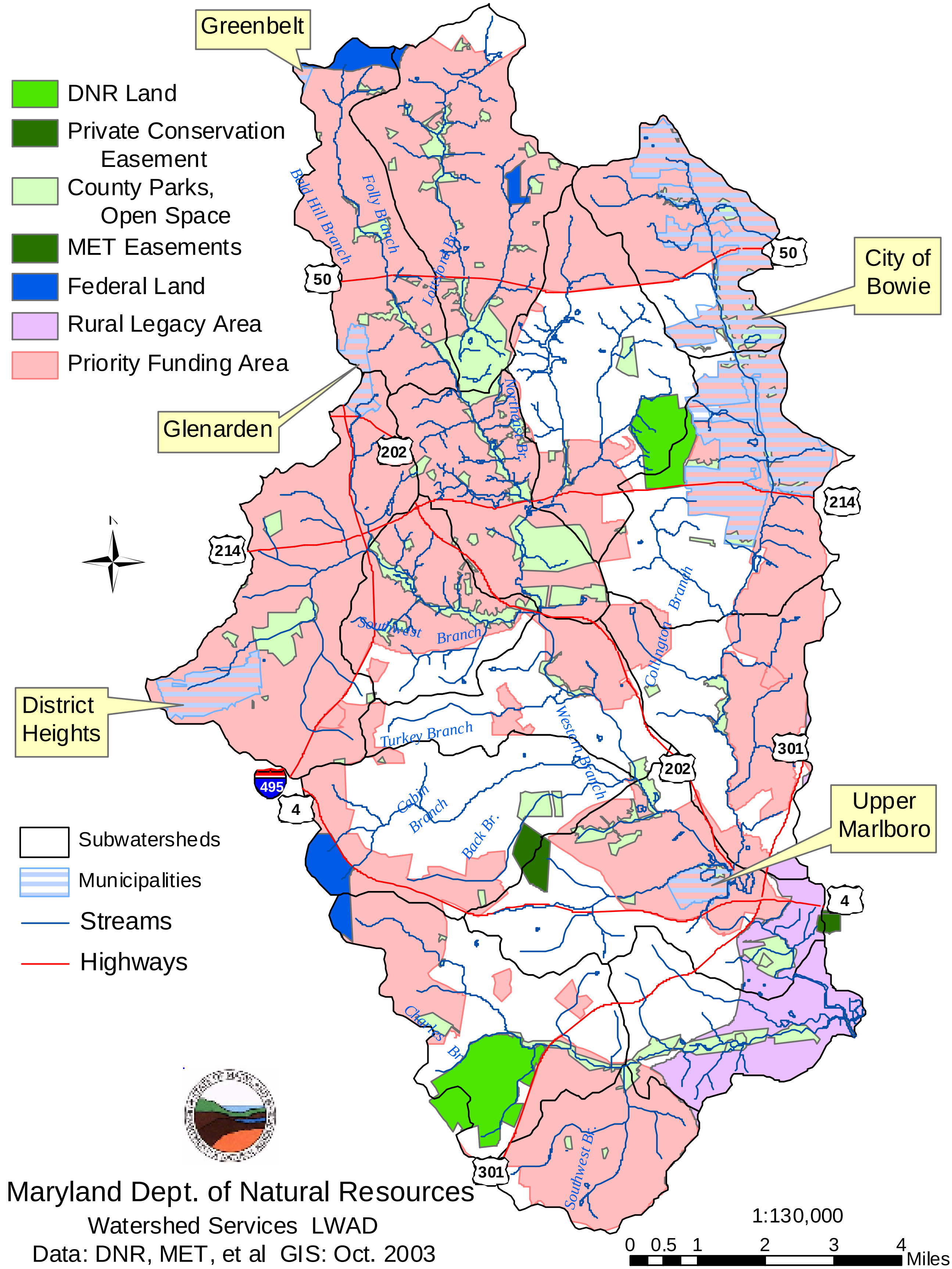


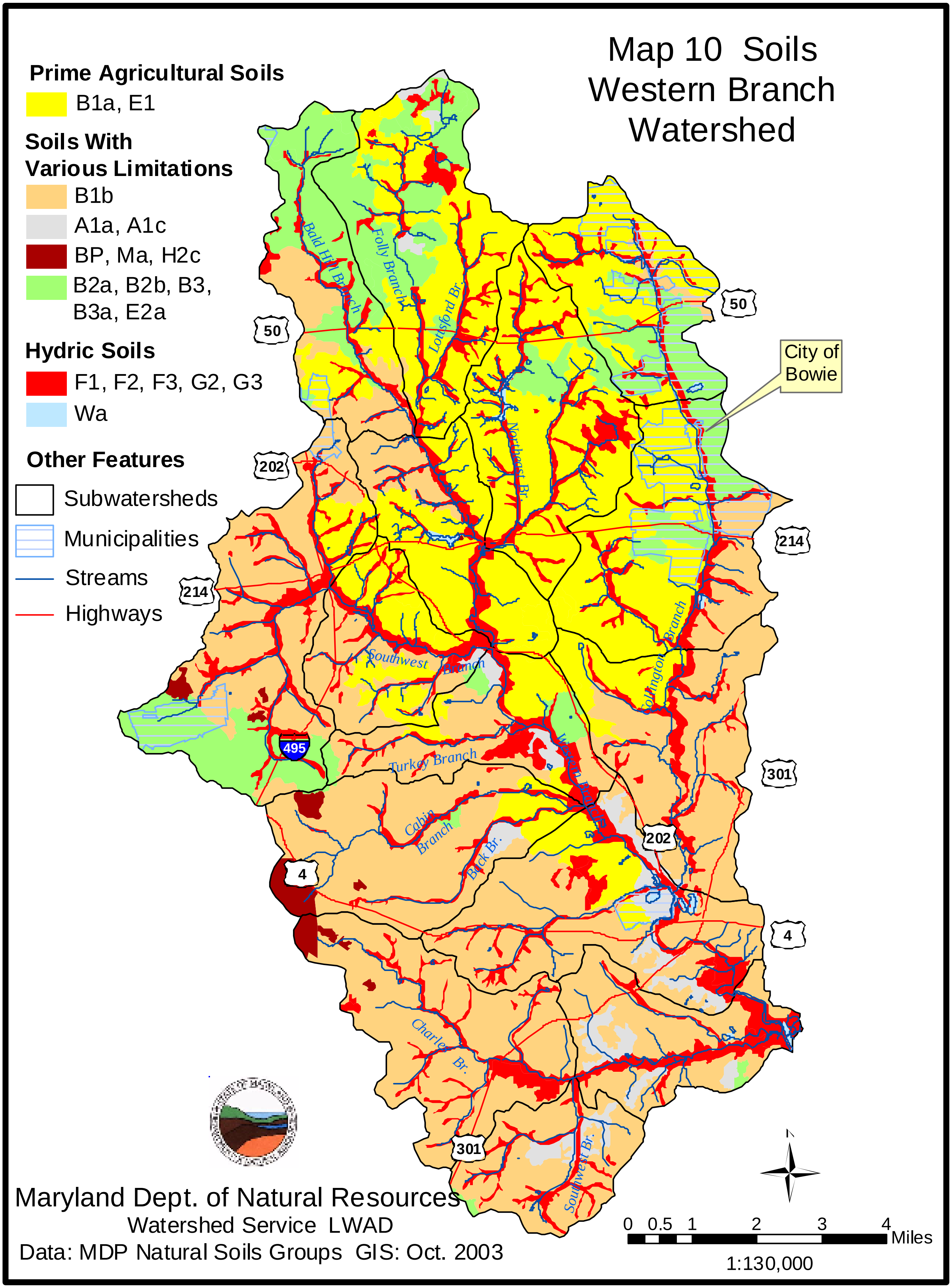
Map 8 Forest Interior, Western Branch Watershed



Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: MDP GIS: Oct. 2003

Map 9 Protected Land, Western Branch Watershed




Map 10 Soils
Western Branch
Watershed
Prime Agricultural Soils
B1a, E1
Soils With
Various Limitations
B1b
A1a, A1c
BP, Ma, H2c
B2a, B2b, B3,
B3a, E2a
Hydric Soils
F1, F2, F3, G2, G3
Wa
Other Features
Subwatersheds
Municipalities
Streams
Highways
City of
Bowie
Bald Hill Branch
Folly Branch
Lottsford Br.
Northeast Br.
Southwest Branch
Collington Branch
Turkey Branch
Western Branch
Cabin Branch
Back Br.
Charles Br.
Southwest Br.
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Maryland Dept. of Natural Resources
Watershed Service LWAD
Data: MDP Natural Soils Groups GIS: Oct. 2003
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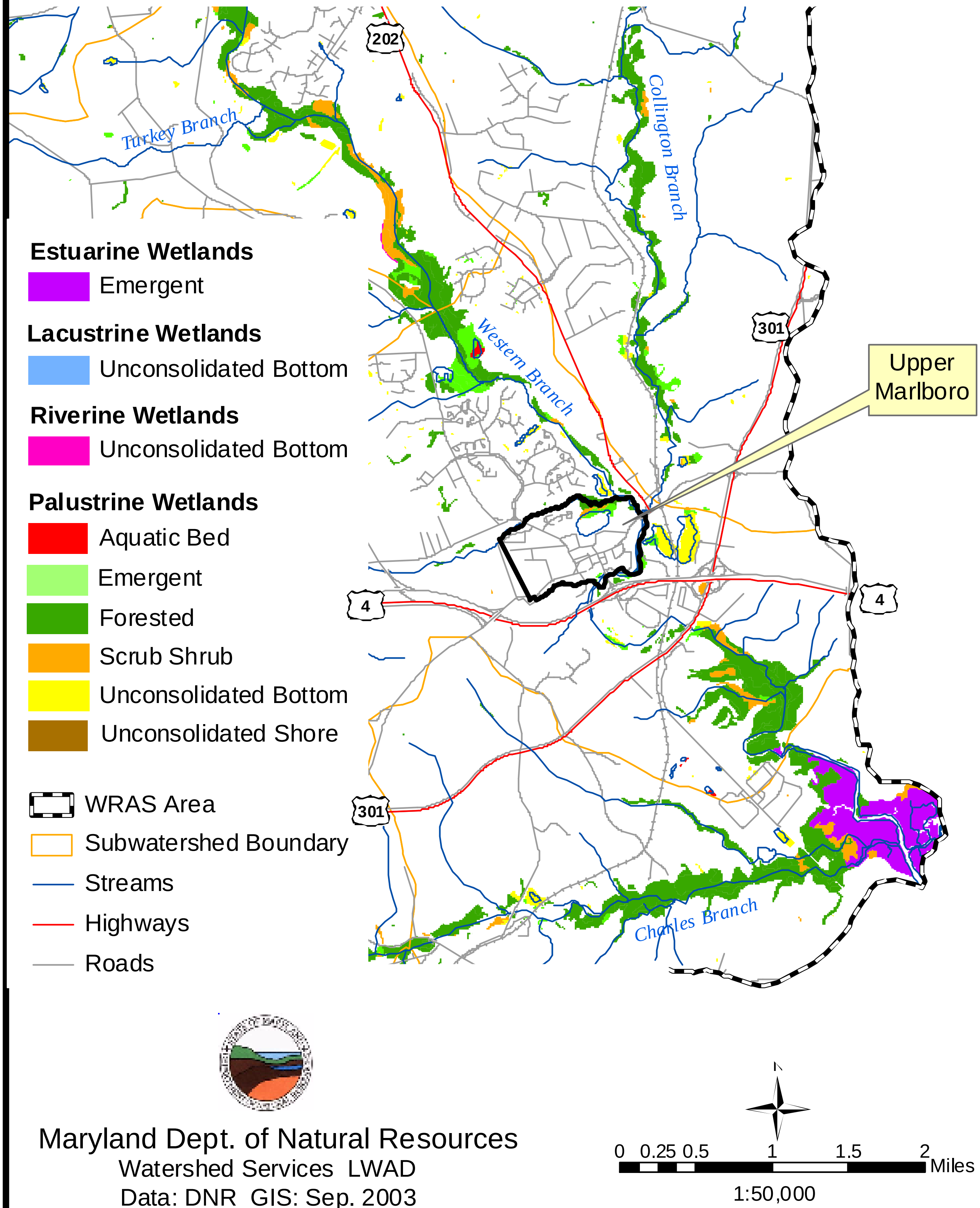
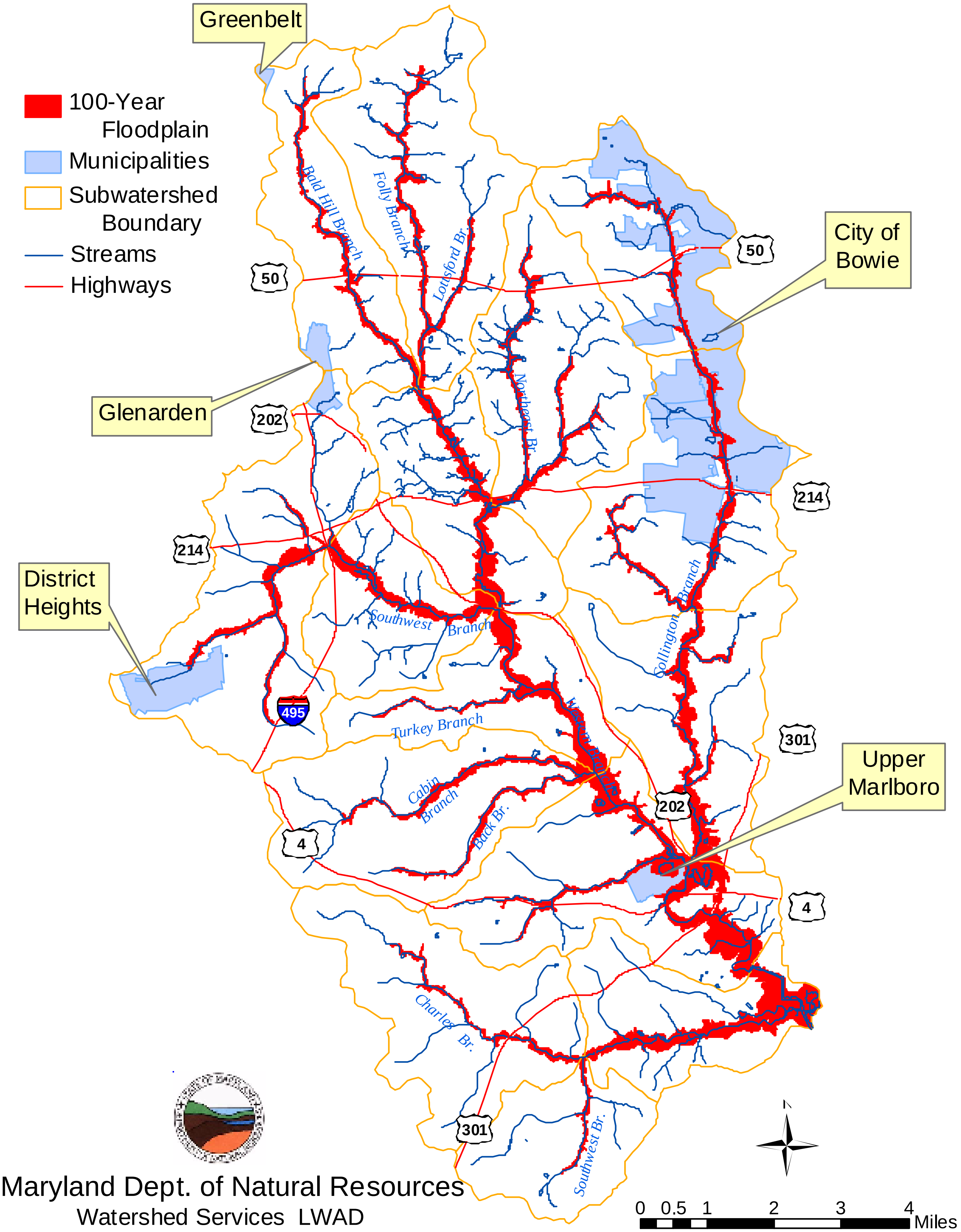
Miles
1:130,000

Map 11 Wetlands, Upper Marlboro Vicinity

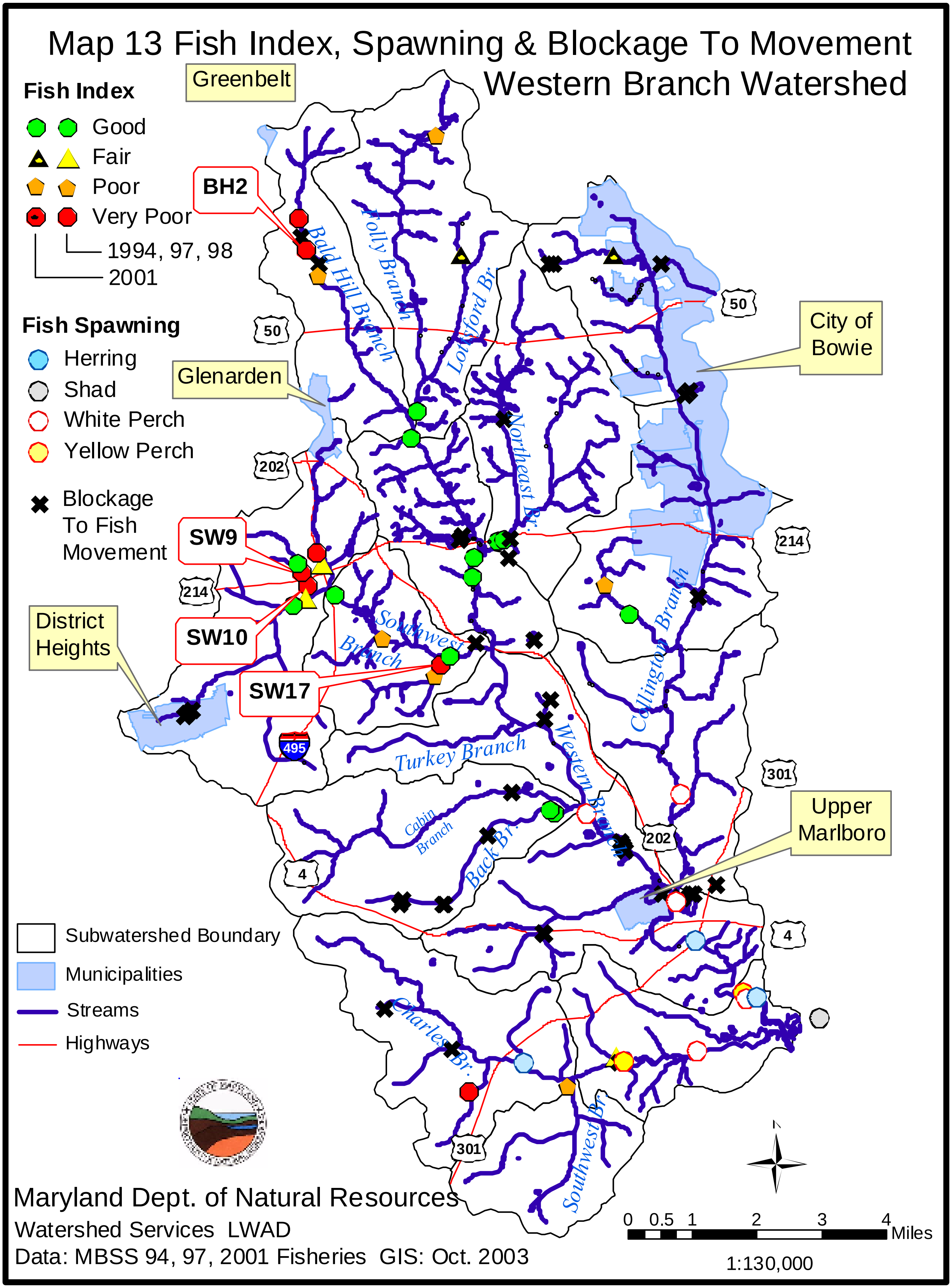


Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: DNR GIS: Sep. 2003

Map 12 Floodplains, Western Branch Watershed



Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: FEMA GIS: Oct. 2003


Map 13 Fish Index, Spawning & Blockage To Movement
Western Branch Watershed
Fish Index
Good
Fair
Poor
Very Poor
1994, 97, 98
2001
Fish Spawning
Herring
Shad
White Perch
Yellow Perch
Blockage To Fish Movement
Greenbelt
BH2
Glenarden
City of Bowie
SW9
SW10
SW17
District Heights
Upper Marlboro
Bald Hill Branch
Folly Branch
Lottsford Br.
Northeast Br.
Southwest Branch
Collington Branch
Turkey Branch
Western Branch
Cabin Branch
Back Br.
Charles Br.
Southwest Br.
50
202
214
495
301
4
Subwatershed Boundary
Municipalities
Streams
Highways
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: MBSS 94, 97, 2001 Fisheries GIS: Oct. 2003
0 0.5 1 2 3 4 Miles
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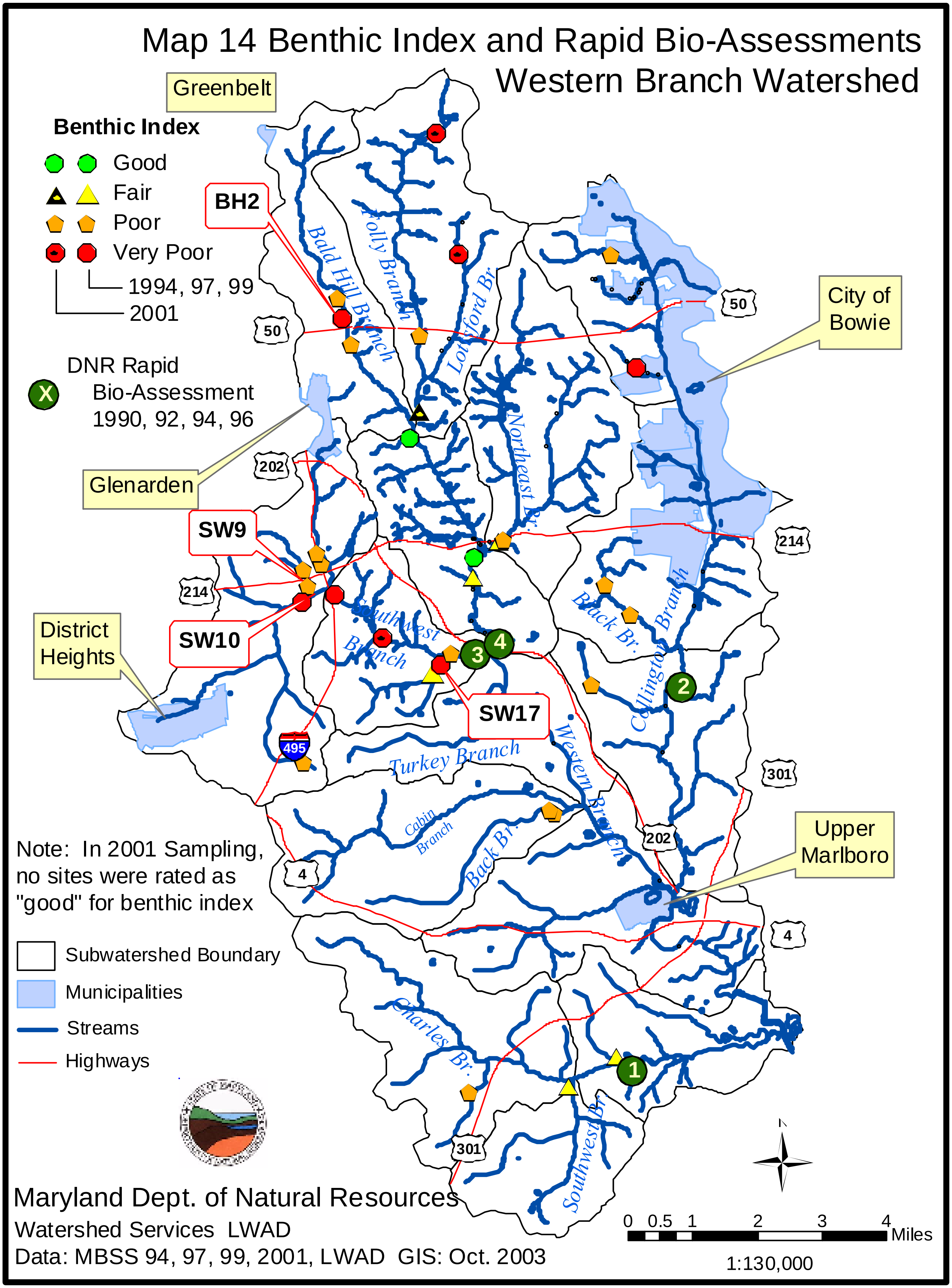
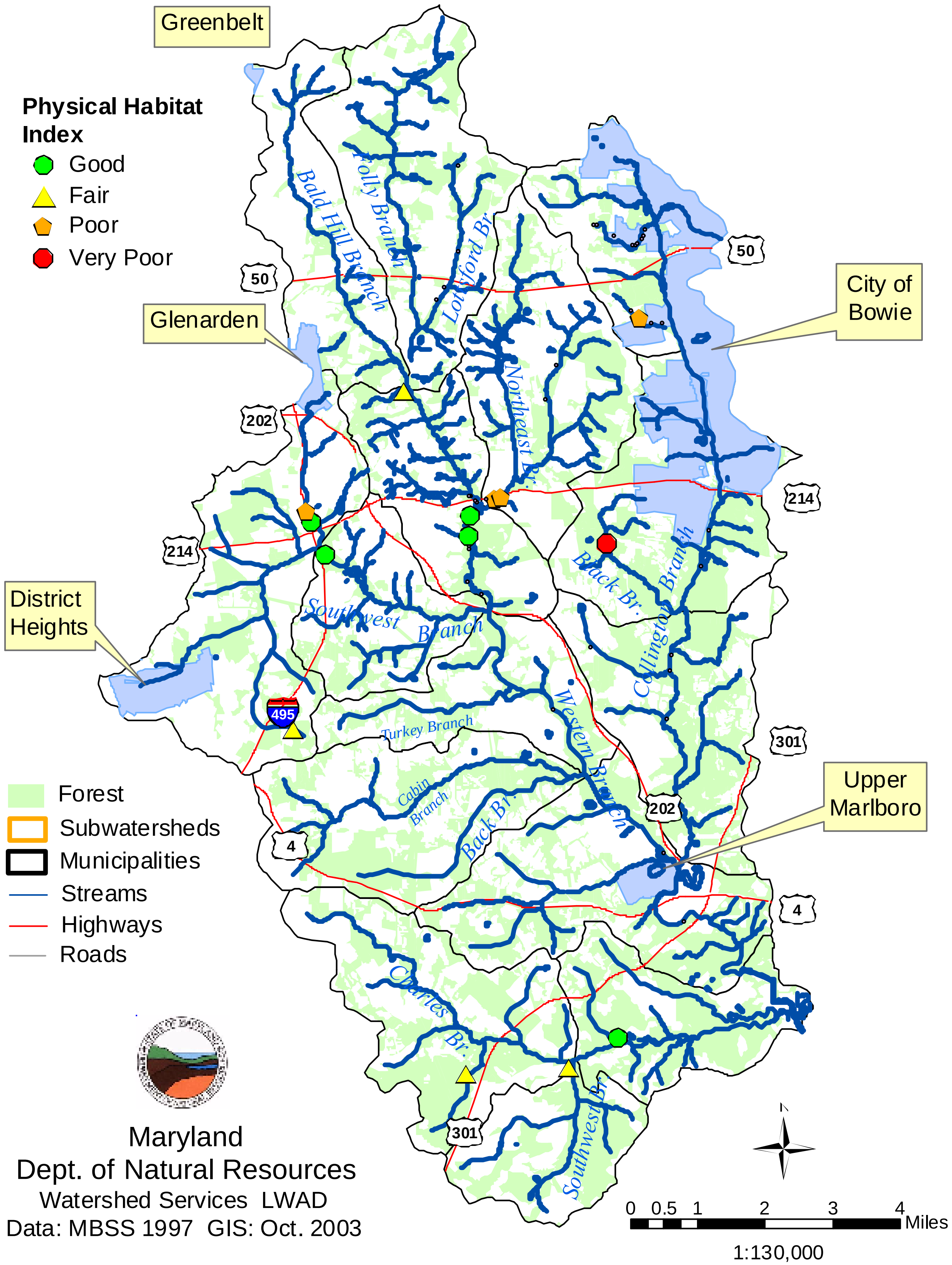
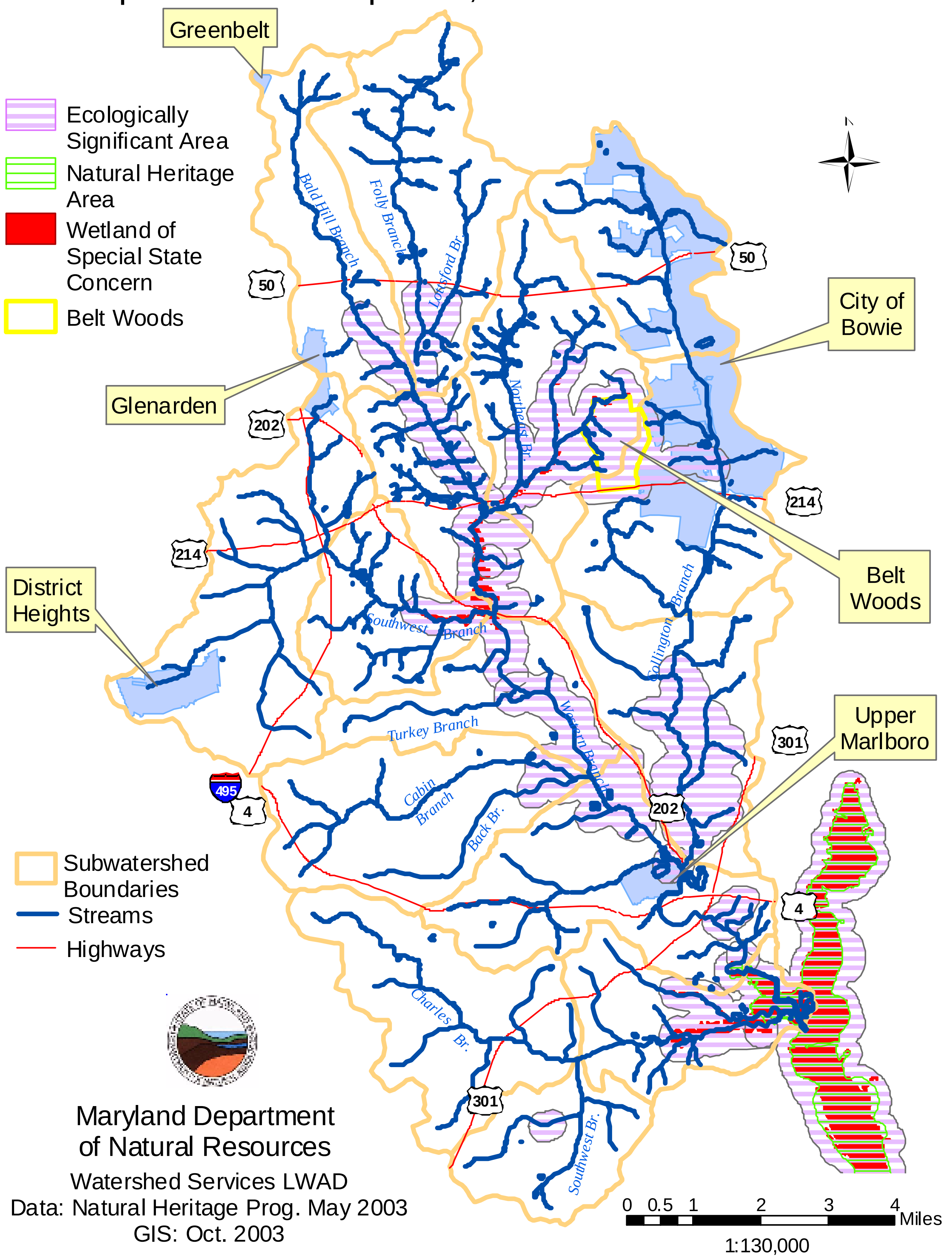

Map 14 Benthic Index and Rapid Bio-Assessments
Western Branch Watershed
Greenbelt
Benthic Index
Good
Fair
Poor
Very Poor
1994, 97, 99
2001
DNR Rapid
Bio-Assessment
1990, 92, 94, 96
X
BH2
Glenarden
SW9
SW10
SW17
District Heights
City of Bowie
Upper Marlboro
Bald Hill Branch
Folly Branch
Lottsford Br.
Northeast Br.
Southwest Branch
Black Br.
Collington Branch
Turkey Branch
Western Branch
Cabin Branch
Back Br.
Charles Br.
Southwest Br.
50
202
214
495
301
4
1
2
3
4
Note: In 2001 Sampling, no sites were rated as "good" for benthic index
Subwatershed Boundary
Municipalities
Streams
Highways
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: MBSS 94, 97, 99, 2001, LWAD GIS: Oct. 2003
0 0.5 1 2 3 4
Miles
1:130,000

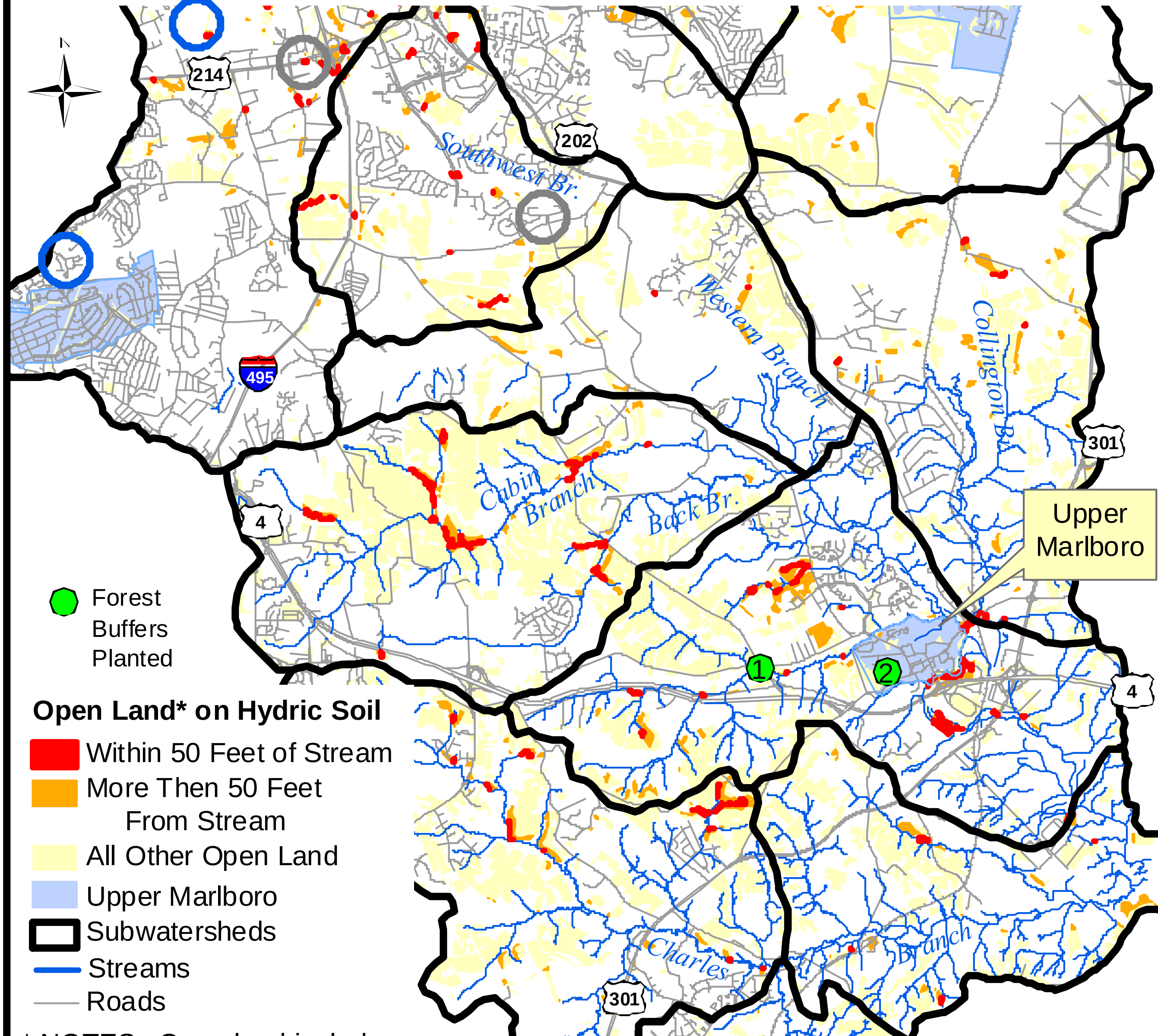
Map 15 Physical Habitat Western Branch Watershed



Map 16 Sensitive Species, Western Branch WRAS



Map 17 Stream Buffer Enhancement Scenario
Lower Western Branch Watershed



* NOTES: Open land includes crop land, pasture and large areas of lawn. Open land on hydric soil is shown larger than scale to improve map legibility.

US Army Corps Project Proposals For Stream Enhancement

Stormwater Retrofit

Channelization Removal / Stream Restoration

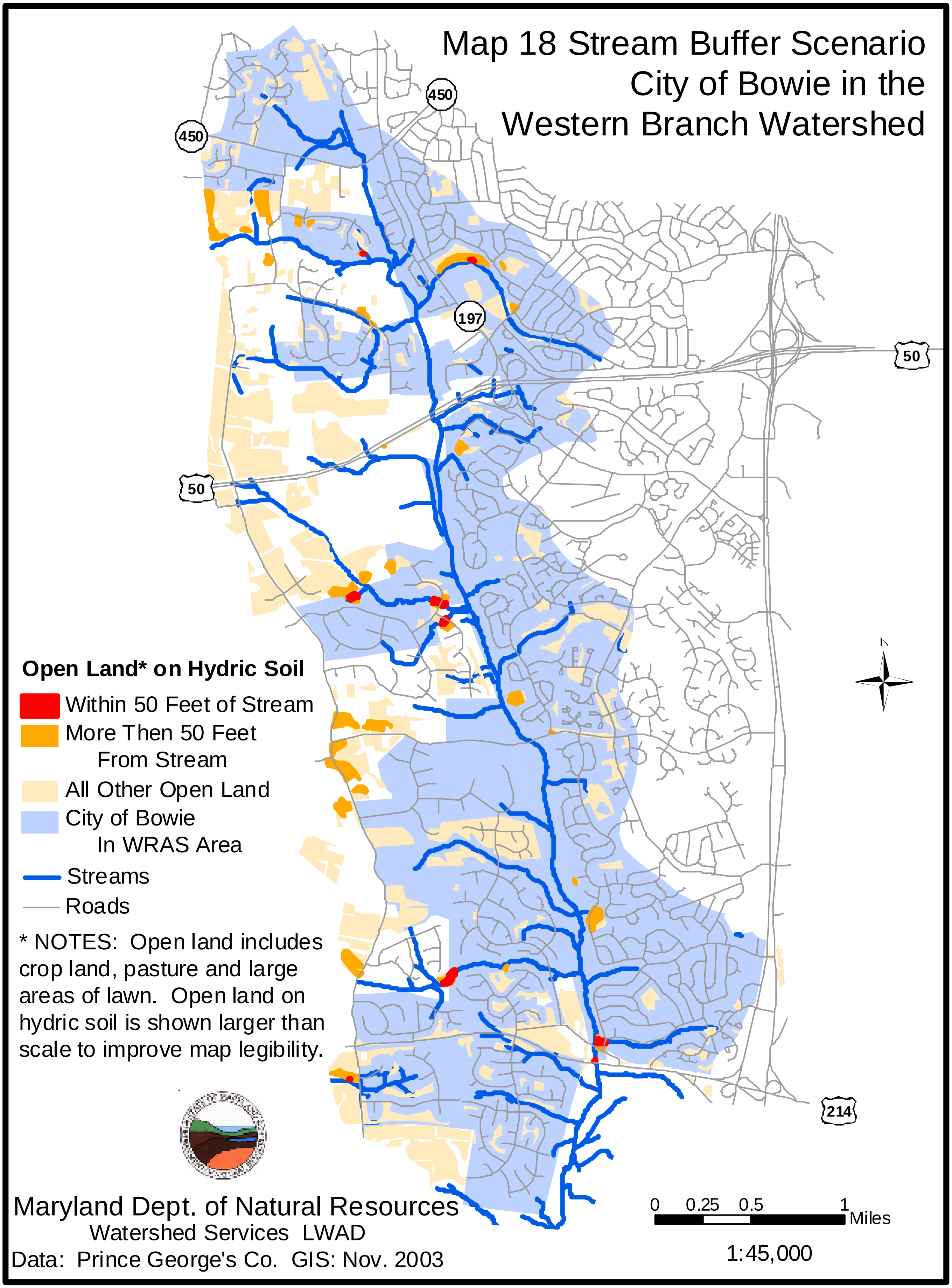
Maryland Dept. of Natural Resources

Watershed Services LWAD

Data: Prince George's Co., US Army Corps GIS: Nov. 2003

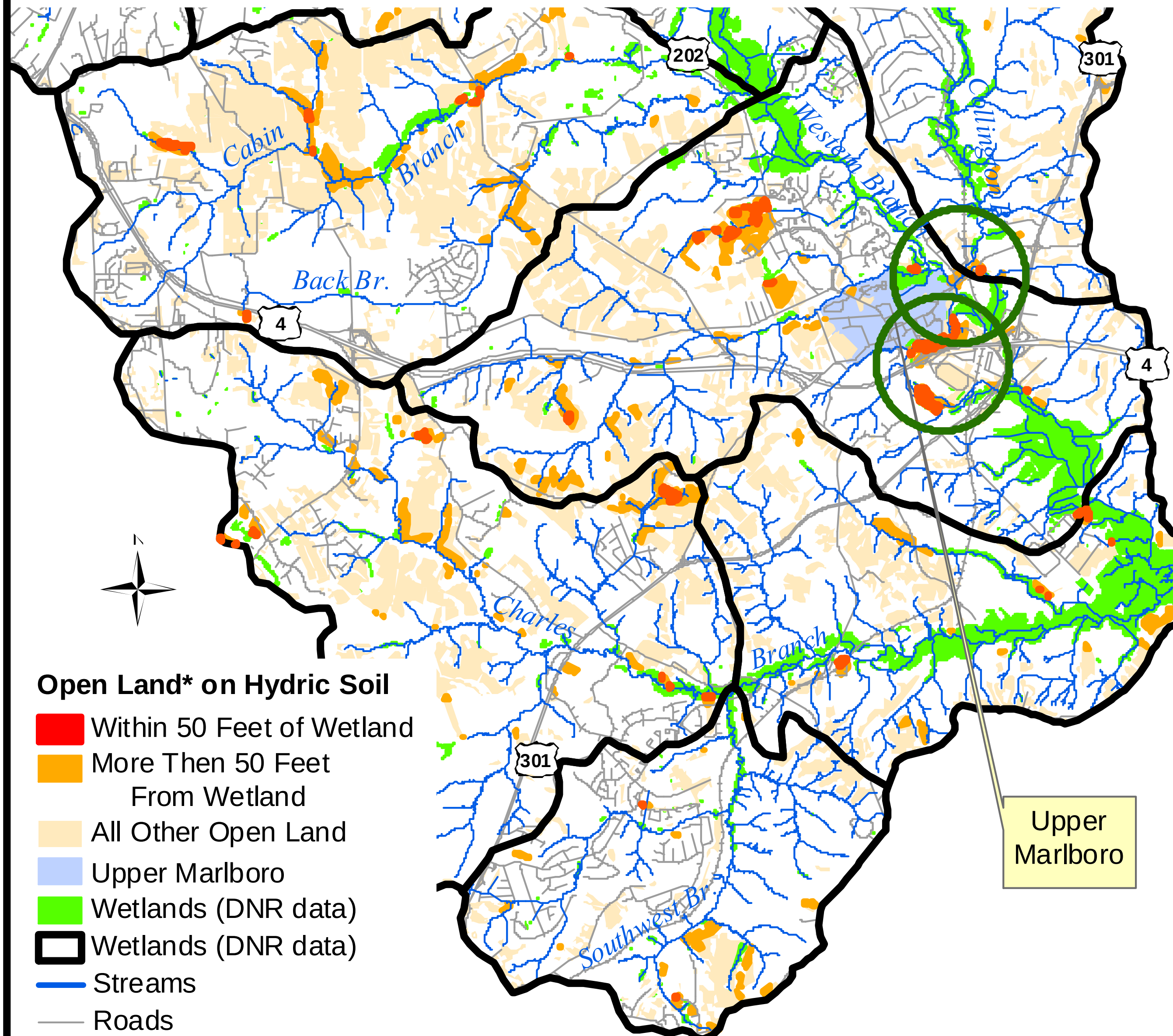
0 0.5 1 2 Miles

1:90,000



Map 18 Stream Buffer Scenario
City of Bowie in the
Western Branch Watershed
450
450
197
50
50
214
Open Land* on Hydric Soil
Within 50 Feet of Stream
More Then 50 Feet
From Stream
All Other Open Land
City of Bowie
In WRAS Area
Streams
Roads
* NOTES: Open land includes crop land, pasture and large areas of lawn. Open land on hydric soil is shown larger than scale to improve map legibility.
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: Prince George's Co. GIS: Nov. 2003
0 0.25 0.5 1
Miles
1:45,000

Map 19 Wetland Restoration Scenario
Lower Western Branch Watershed



Open Land* on Hydric Soil

- Within 50 Feet of Wetland
- More Then 50 Feet From Wetland
- All Other Open Land
- Upper Marlboro
- Wetlands (DNR data)
- Wetlands (DNR data)
- Streams
- Roads

* NOTES: Open land includes crop land, pasture and large areas of lawn. Open land on hydric soil is shown larger than scale to improve map legibility.

US Army Corps Project Proposals For Wetland Enhancement

- Creation / Restoration Areas

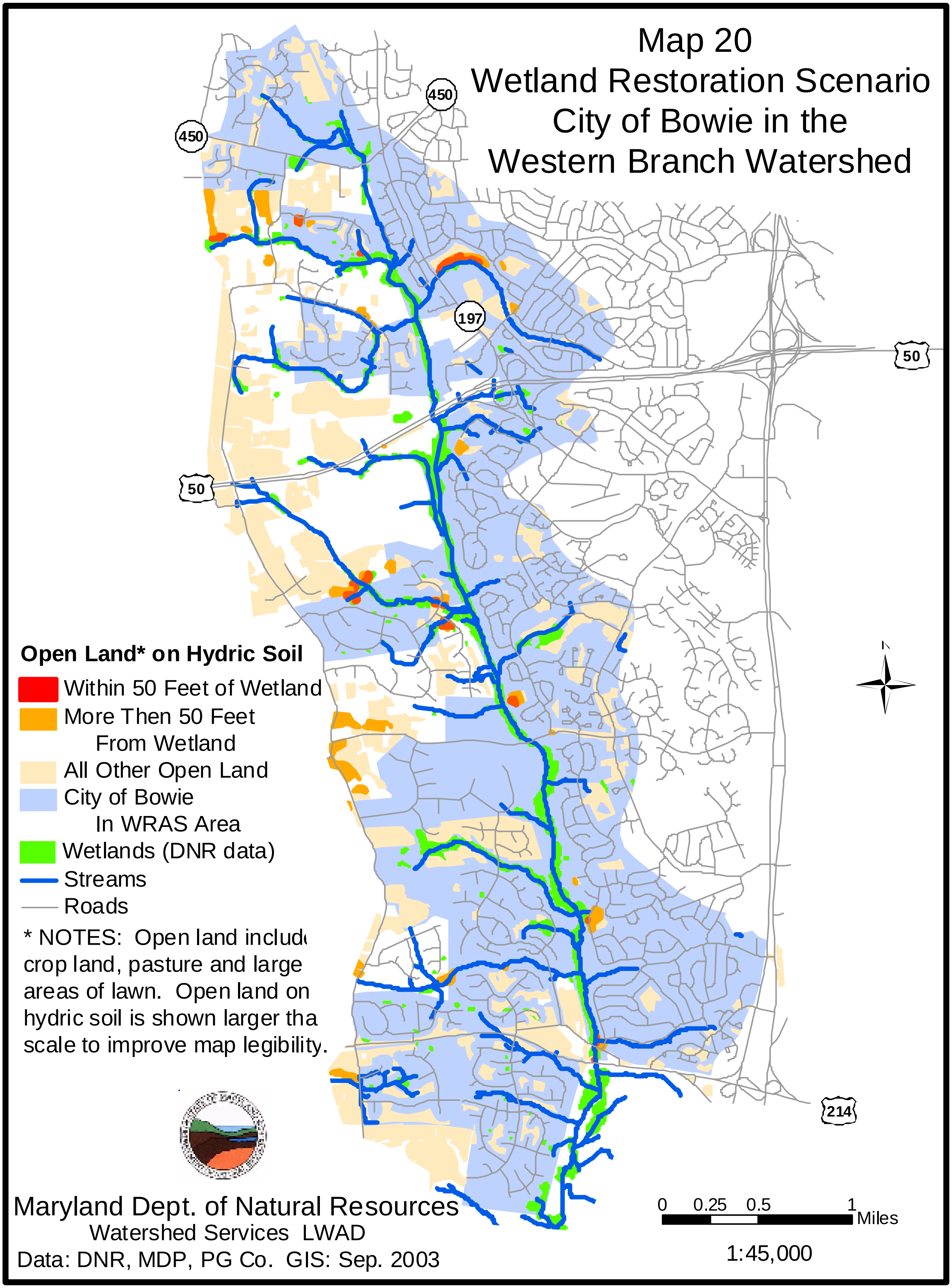
0 0.5 1 2 Miles

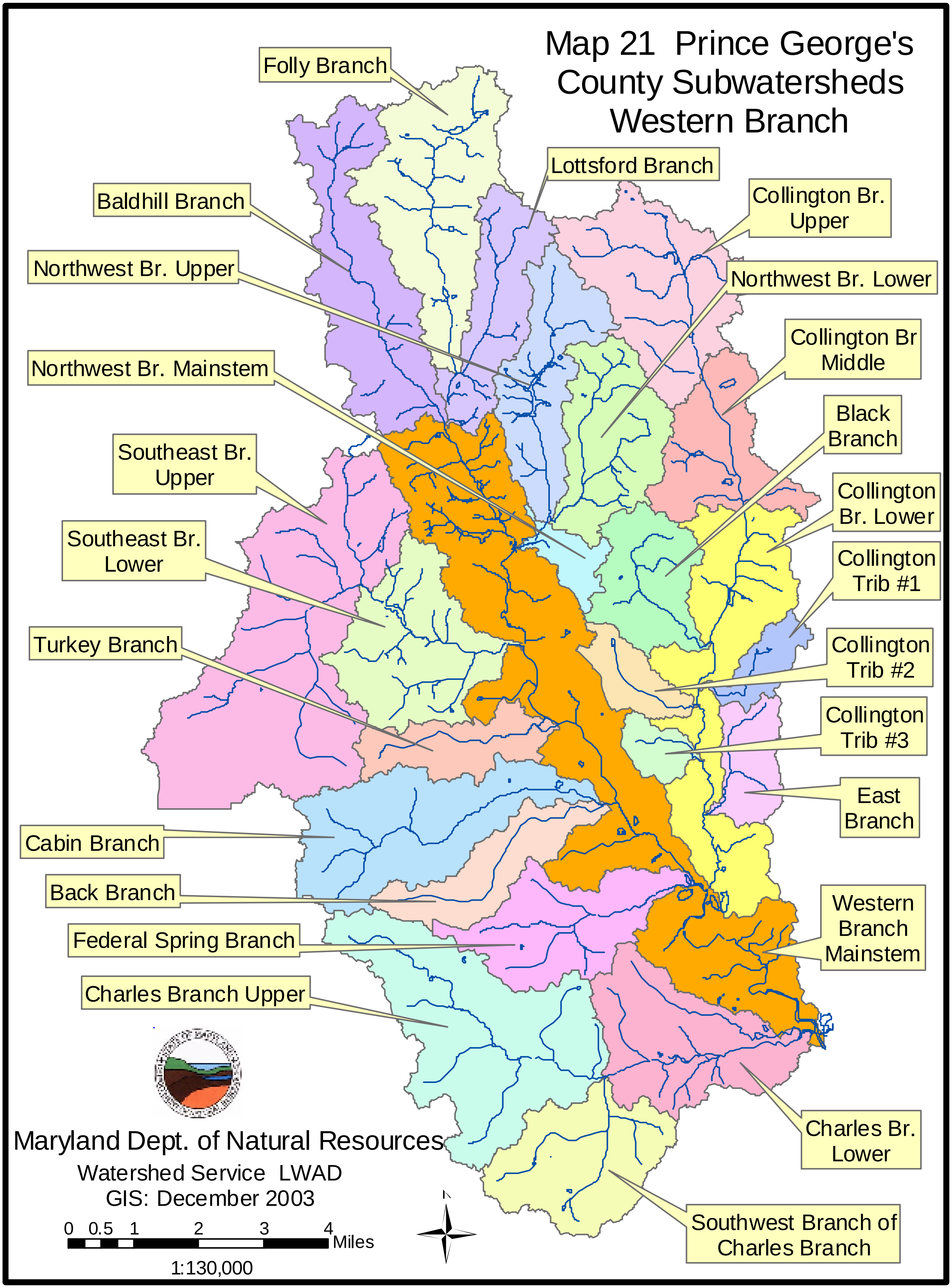
1:75,000

Maryland Dept. of Natural Resources

Watershed Services LWAD

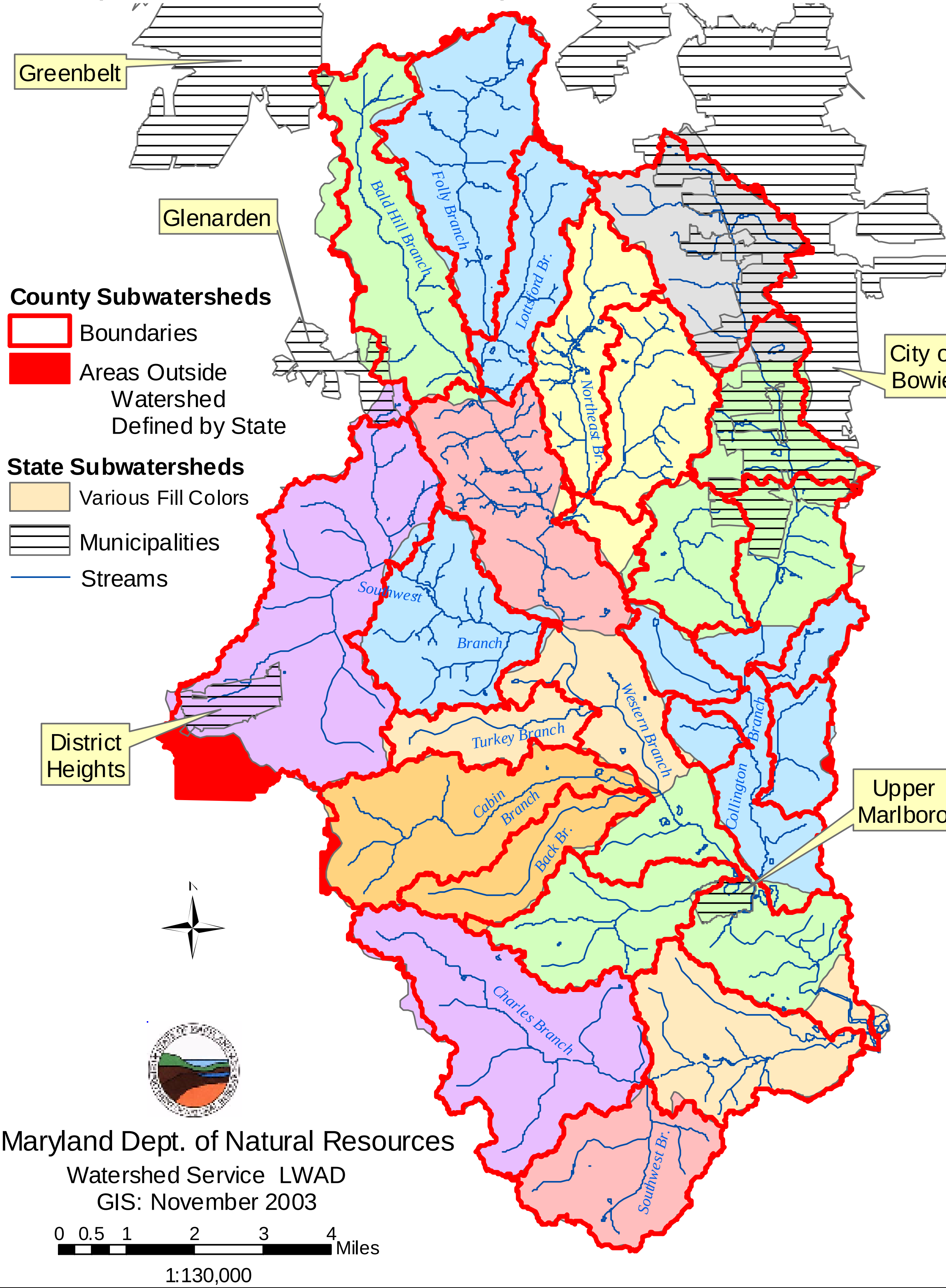
Data: Prince George's Co., US Army Corps GIS: Oct. 2003


Map 20
Wetland Restoration Scenario
City of Bowie in the
Western Branch Watershed
450
450
197
50
50
214
Open Land* on Hydric Soil
Within 50 Feet of Wetland
More Then 50 Feet
From Wetland
All Other Open Land
City of Bowie
In WRAS Area
Wetlands (DNR data)
Streams
Roads
* NOTES: Open land includ
crop land, pasture and large
areas of lawn. Open land on
hydric soil is shown larger tha
scale to improve map legibility.
0 0.25 0.5 1
Miles
1:45,000
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: DNR, MDP, PG Co. GIS: Sep. 2003



Map 21 Prince George's
County Subwatersheds
Western Branch
Folly Branch
Lottsford Branch
Baldhill Branch
Collington Br. Upper
Northwest Br. Upper
Northwest Br. Lower
Collington Br Middle
Northwest Br. Mainstem
Black Branch
Southeast Br. Upper
Collington Br. Lower
Southeast Br. Lower
Collington Trib #1
Turkey Branch
Collington Trib #2
Collington Trib #3
East Branch
Cabin Branch
Back Branch
Western Branch Mainstem
Federal Spring Branch
Charles Branch Upper
Charles Br. Lower
Southwest Branch of Charles Branch
Maryland Dept. of Natural Resources
Watershed Service LWAD
GIS: December 2003
0 0.5 1 2 3 4 Miles
1:130,000

Map 22 Subwatershed Comparison -- Western Branch



Maryland Dept. of Natural Resources
Watershed Service LWAD
GIS: November 2003

APPENDIX A   Presence of Fish Species -- MBSS Findings

Key for Labels In Data Table	**Stream / Description of Survey Area**
Back_Br	Back Branch
Bald Hill Branch	Bald Hill Branch near confluence with Folley Branch
Black_Br	Black Branch
Collington1	Collington Branch and tributaries - Bowie Area
Collington2	Collington Branch and tributaries - downstream of Route 214
Folley	Folley Branch and Lottsford Branch
Northeast	Northeast Branch of Western Branch
Southwest	Southwest Branch
Western	Western Branch mainstem

Key For Color/Font Code* for fish species in the data table (white: no data)	**Tolerant** Fish that tend to survive greater pollution and poorer habitat conditions	*Moderate Tolerance Fish with mid-range ability to co-exist with pollution and varied habitat conditions*	**Intolerant** Fish that require good water quality and good habitat conditions

MBSS Findings Fish Species Western Branch Watershed P = Species is Present	Back_Br	Bald Hill	Collington1	Collington2	Folley	Northeast	Southwest	Western
American Brook Lamprey	P	P	P	P	P	P		P
American Eel	P	P		P	P	P	P	P
Banded Sunfish				P				
Black Crappie								P
Blacknose Dace	P			P	P		P	
Bluegill		P	P	P	P	P	P	P
Bluespotted Sunfish		P		P	P	P		P
Brown Bullhead				P				
Chain Pickerel		P			P			
Common Shiner		P						
Creek Chub	P			P			P	
Creek Chubsucker	P		P	P	P	P	P	P
Cutlips Minnow				P			P	P
Eastern Mudminnow	P	P	P	P	P	P	P	P
Fallfish	P	P		P	P	P	P	P
Gizzard Shad						P		
Glassy Darter		P		P	P			P
Golden Shiner		P	P	P	P	P	P	P
Lamprey Sp.				P	P			P
Largemouth Bass						P		P
Least Brook Lamprey	P	P		P	P	P		P
Margined Madtom		P			P			P
Pirate Perch			P			P		P

MBSS Findings Fish Species Western Branch Watershed P = Species is Present	Back_Br	Bald Hill	Collington1	Collington2	Folley	Northeast	Southwest	Western
Pumpkinseed	P		P	P	P	P	P	P
Redbreast Sunfish					P	P	P	P
Redfin Pickerel	P		P		P	P		P
Roseyside Dace	P			P	P	P	P	P
Satinfin Shiner		P			P	P	P	P
Sea Lamprey	P				P			
Spotfin Shiner								P
Stripeback Darter		P		P	P			P
Swallowtail Shiner		P		P	P	P	P	P
Tadpole Madtom					P	P		
Tessellated Darter	P	P		P	P	P	P	P
White Sucker	P	P		P	P	P	P	P
Yellow Bullhead		P	P	P	P	P	P	P
Yellow Perch								P

* Rating of nontidal fish by tolerance level is adapted from the following document: *Maryland Biological Stream Survey, Ecological Status of Nontidal Streams in Six Basins Sampled in 1995.* Maryland Dept. of Natural Resources, Chesapeake Bay and Watershed Programs, Monitoring and Nontidal Assessment. CBWP-MANTA-EA-97-2. May 1997.

APPENDIX B   MBSS Indices

Key for MBSS Data Table					
Index of Biotic Integrity	Ranges for Index	Very Poor	Poor	Fair	Good
Fish	1.0 (worst) to 5.0 (best)	1.0 - 1.9	2.0 - 2.9	3.0 - 3.9	4.0 - 5.0
Benthic	1.0 (worst) to 5.0 (best)	1.0 - 1.9	2.0 - 2.9	3.0 - 3.9	4.0 - 5.0
Physical Habitat	0 (worst) to 100 (best)	0 - 11.9	12 - 41.9	42 - 71.9	72 - 100

* Additional details are available at http://www.dnr.state.md.us/streams/mbss/index.html
– Click "Search Online Data", "Western Branch" in "8 Digit watershed name" box, click on search.

1994, 1997 and 2001 MBSS Findings
For the Western Branch Watershed

Watershed	Stream Name / General Location	Station #	Score		
			Fish	Benthos	Physical
Bald Hill Branch	near Western Branch	PG-N-027-213-97	4.5	4	50
	upstream of Rt. 564	BH2 - Upstream	1.75	2.43	--
	between Rt 564 & Rt 450	BH2 - Channel	1.50	1.86	--
	downstream of Rt. 450	BH2 - Downstream	2.75	2.43	--
Cabin Br./ Back Branch	Back Branch	WEBR-111-R-2001	4.5	2.43	--
	Back Branch	WEBR-105-R-2001	4.75	2.71	--
Charles Branch (all sub-watersheds)	Rosaryville State Park	PG-N-190-103-97	1.75	2	59
	near Croom Station Rd.	PG-N-135-231-97	3.75	3	76
	SW Br. of Charles Br.	PG-N-152-124-97	2.75	3	54
Collington Branch	near Westview Forest Dr.	WEBR-107-R-2001	3.25	2.43	--

1994, 1997 and 2001 MBSS Findings For the Western Branch Watershed					
Watershed	Stream Name / General Location	Station #	Score		
			Fish	Benthos	Physical
	Black Branch	WEBR-110-R-2001	4.75	2.71	--
	near Brock Hall Manor	WEBR-113-R-2001	--	2.71	--
	near Dunwood Valley Rd	PG-N-087-115-97	--	1	14
	Black Branch	PG-N-213-113-97	2	2	10
Folly Br./ Lottsford Branch	Folly Branch, Glenn Dale	WEBR-106-R-2001	2.25	1.86	--
	Folly Branch near Rt. 50	WEBR-104-R-2001	--	2.71	--
	Lottsford Br. above Rt. 450	WEBR-116-R-2001	3.5	1.86	--
	Lottsford Br., Enterprise GC	WEBR-201-R-2001	4.5	3	--
Northeast Branch	near Western Branch	PG-N-141-215-97	4.75	3	41
	near Western Branch	PG-N-141-223-97	4.75	2	34
Southwest Branch	mainstem near H Truman Dr.	WEBR-212-R-2001	2.75	1.86	--
	Ritchie Branch near I-495	PG-N-253-122-97	--	2	49
	trib. NE of I-495 / Rt. 214	PG-N-216-135-97	1	2	26
	trib. NE of I-495 / Rt. 214	PG-N-071-212-97	3.25	2	72
	mainstem at I-495 / Rt. 214	PG-N-041-305-97	4	1	76
	Trib NW of Beltway Exit 15	SW9 - Upstream	4.0	2.71	--

1994, 1997 and 2001 MBSS Findings For the Western Branch Watershed					
Watershed	Stream Name / General Location	Station #	Score		
			Fish	Benthos	Physical
	Trib SW of Beltway Exit 15	SW9 -Channel	1.0	2.14	--
	SE of Beltway Exit 15	SW9&10 - Dnstream	4.0	1.30	--
	SW of Beltway Exit 15	SW10 - Upstream	4.0	1.86	--
	SW of Beltway Exit 15	SW10 - Channel	3.75	--	--
	Trib in Largo Woods	SW17 - Upstream	2.25	3.29	--
	Trib in Largo Woods	SW17 - Channel	1.0	1.86	--
	East of Largo Woods	SW17 - Downstream	4.25	2.14	--
Western Branch Mainstem	South of Rt. 214	PG-N-219-306-97	4.5	4	73
	South of Rt. 214	PG-N-219-324-97	4.75	3	89