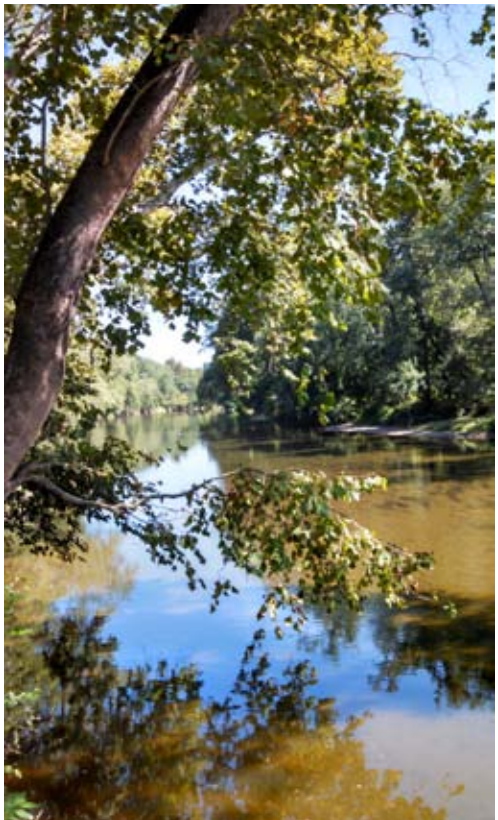
The care of rivers is not a question of rivers, but of the human heart.

Tanako Shozo



THE PHYSICAL ENVIRONMENT

Photo by Kai Hagen

Geography and Topography

The Monocacy River flows through central Maryland's Frederick and Carroll Counties. The river is located on the western edge of the Piedmont Physiographics Province, adjacent to the mountainous Blue Ridge Province. Beginning at the confluence of Marsh and Rock Creeks near the Pennsylvania and Maryland border, the Monocacy slowly meanders 58.2 miles in a southerly direction to the Potomac River. The watershed represents approximately 970 square miles of the 14,640 square mile Potomac River basin. Fifteen percent of the Monocacy River basin lies in the Blue Ridge Province; the remainder is in the Piedmont Province.

Topography is an expression of the relative positions and elevations of land regions. The Frederick Valley, through which the Monocacy flows, is nestled between the Catoctin Mountains to the west, and the lower Parrs Ridge to the east. A relatively flat plain extends west from the river to the Catoctin Mountains, where the basin reaches a height of up to 1,600 feet. The river valley's topography includes little steep terrain, but some steep gradients do exist adjacent to the river. These land elevations and the degree of slope have influenced land use in the watershed. The region's relatively flat topography has made it easily accessible for development and agriculture in some areas next to the river and tributaries.

Geological History

The topography and other physical characteristics of the Monocacy River basin were created through a variety of geomorphic actions including geological upheavals, and the combined erosive forces of wind, water, temperature fluctuations, and gravity. The Monocacy River watershed is located in the Piedmont and Blue Ridge Physiographic Provinces. The rock formations that influence the river basin's geological history are varied and include both intensely metamorphosed and sedimentary rock types.

The Piedmont Province within the Monocacy River Watershed is further divided into the following major sections, as shown on the accompanying map:

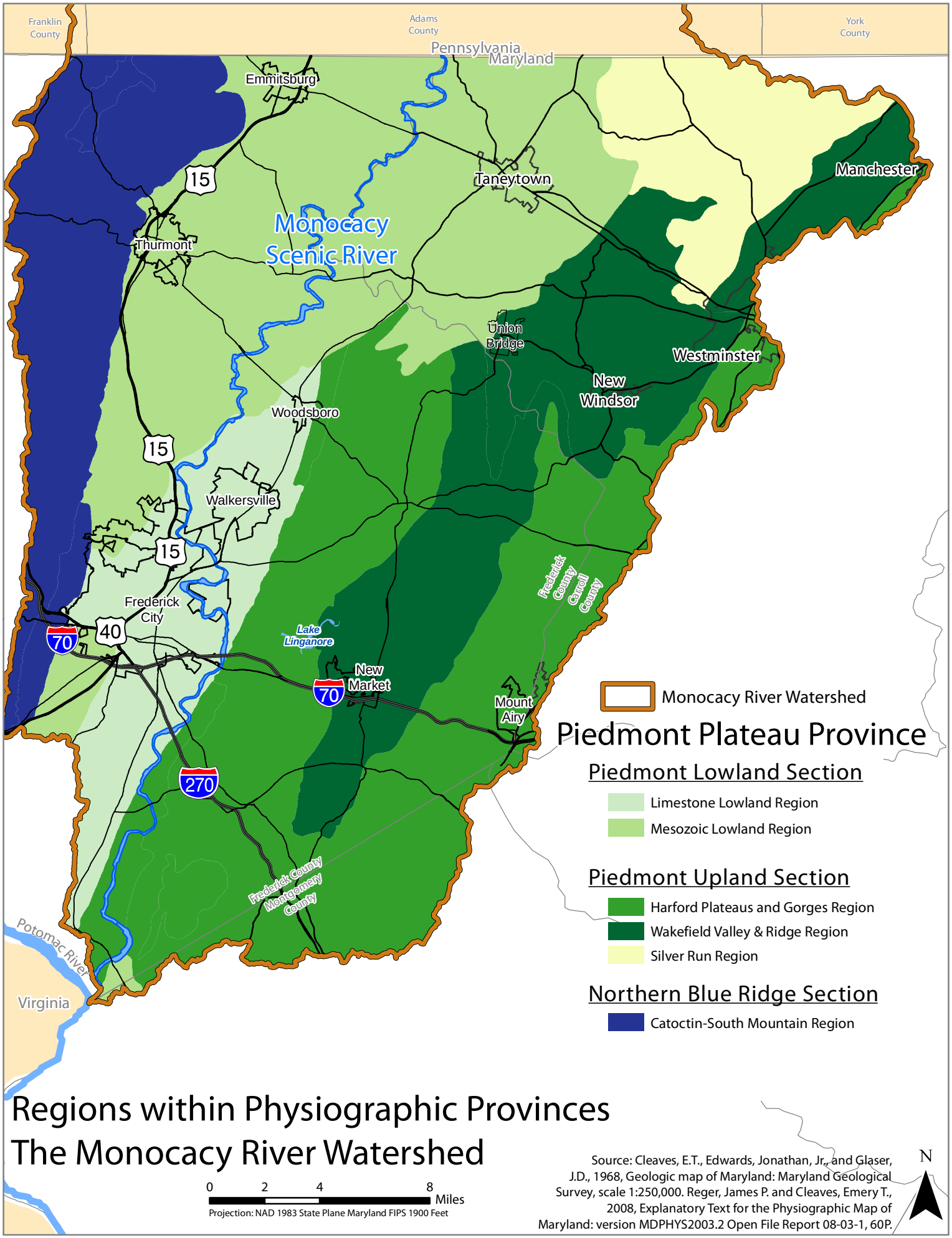
1) Piedmont Lowlands – Includes the Frederick Valley north to Woodsboro is a carbonate valley of low relief with gentle rolling topography, deep soils, and streams with shallow banks. The predominate underlying rock type here is Frederick and Grove limestones. The northern and western areas of the Piedmont Lowlands are called the Mesozoic Lowlands Region and extend from the Catoctin Mountains to east of Taneytown. This area is characterized by more rolling topography with shallower red soils and underlain by red shale, siltstone, and sandstone bordered with quartz conglomerate.

2) Piedmont Uplands – Present in the eastern half of the watershed is underlain by metamorphic, igneous, and sedimentary materials, related to volcanic activity that occurred in Precambrian time. The Piedmont Uplands within the watershed are further divided into three regions. The Harford Plateaus and Gorges Region, comprised of rolling upland with herringbone texture and underlain with siltstones and quartzites. The Wakefield Valley and Ridge Region, comprised of polydeformed metrahyolite, phyllite, metabasalt, quartzite, and narrow bands of marble. Finally, the far northeast corner of the watershed lies within the Silver Run Region, which is comprised of rolling upland underlain by quartzite and conglomerate beds in phyllitic rocks and limestone bands.

Soils

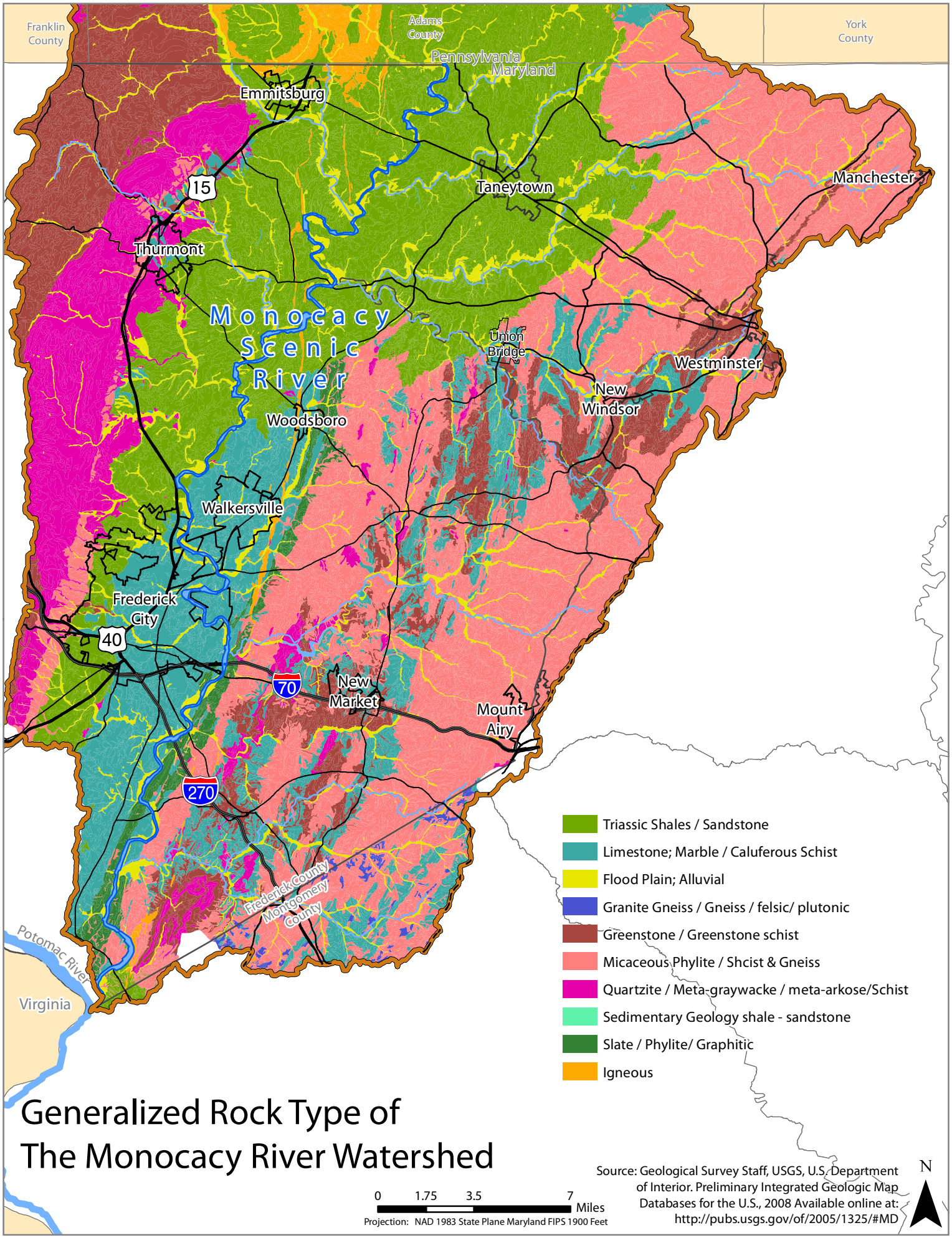
The diversity of physical and chemical soil properties found within the Monocacy watershed are derived from different rock formations (also called 'parent material') associated with the Northern Piedmont and Blue Ridge physiographic regions. Soil formation is the result of parent material, climate, plant and animal life, topography and interactions over time. The parent material is still the most important factor in soil classification; consequently soils are subdivided by geological parent material. Soil health and it's physical characteristics are critical to biomass production, rainfall infiltration, nutrient/pollutant filtration and ultimately stream/river water quality. The impact of erosion on soil health can be minimized by reducing the amount of time bare soil is left unvegetated during urban development projects and agriculture practices.

During periods of rainfall, some shallow, erodible soils are washed into the Monocacy River and its tributaries, resulting in sedimentation and nutrient loading into the surface water. When erodible soils are disturbed for urban development or agriculture, the potential for erosion substantially increases. Proper land management allows biological activity to thrive, which can lead to an increase of organic matter in the soil profile. This increase in organic matter improves water infiltration/storage and nutrient absorption throughout the watershed and particularly along riparian areas, which are represented as floodplain/alluvial on the map associated with this section.



Regions within Physiographic Provinces
The Monocacy River Watershed

Source: Cleaves, E.T., Edwards, Jonathan, Jr., and Glaser, J.D., 1968, Geologic map of Maryland: Maryland Geological Survey, scale 1:250,000. Reger, James P. and Cleaves, Emery T., 2008, Explanatory Text for the Physiographic Map of Maryland: version MDPHYS2003.2 Open File Report 08-03-1, 60P.



Generalized Rock Type of The Monocacy River Watershed

Source: Geological Survey Staff, USGS, U.S. Department of Interior. Preliminary Integrated Geologic Map Databases for the U.S., 2008 Available online at: http://pubs.usgs.gov/of/2005/1325/#MD

NRCS Web Soil Survey Printable reports of your soils: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
NRCS SoilWeb General info of soil maps for your smart phone: http://casoilresource.lawr.ucdavis.edu/soilweb/

Hydrology- Ground and Surface

The hydrologic or water cycle describes the continuous movement of water above and below the surface of the earth. When rain or snow falls onto the surface one of three actions may occur. These actions include: Re-evaporation back into the atmosphere; Run-off to streams and rivers; Infiltration into soil where it may be taken up by plants or slowly moving to groundwater aquifers. Aquifers in the watershed partially contribute to the discharge (flow) and water quality of the Monocacy River. If a source of groundwater is contaminated by pollution, there is a possibility that the contaminants will eventually reach the stream. (4)

The surface water system of the Monocacy River basin is extensive. The Monocacy is well known as a flat, slow moving river, subject to periods of high turbidity and rapidly changing water levels during heavy rainfall. Over 75 percent of the watershed is in Maryland, while the remainder is in Pennsylvania. Approximately 1,700 miles of streams feed into the large tributaries of the Monocacy

Boyer's Mill Rock Shelter, a.k.a. the Indian Caves

River. The major Monocacy River tributaries include: Rock Creek, Marsh Creek, Piney Creek, Tom's Creek, Double Pipe Creek, Owens Creek, Hunting Creek, Fishing Creek, Tuscarora Creek, Carroll Creek, Israel Creek, Glade Creek, Linganore Creek, Bush Creek, Ballenger Creek and Bennett Creek.

We live in a Watershed

A watershed is simply an area of land that drains into a creek, river, or lake. Watersheds can be as small as your backyard or contain millions of square miles, depending on how one measures the water drainage paths or run-off flows of a particular land area. The Monocacy River Watershed is 970 square miles or approximately 620,800 acres, extending north to Gettysburg, Pennsylvania, east to Westminster, Maryland, west to the Catoctin Mountains, and south to the Potomac River. Many sub-watersheds within the larger Monocacy River Watershed are identified by the main tributary streams that flow into the Monocacy River. Finishing its journey, the Monocacy River meets the Potomac River at the C&O Canal National Park, and eventually flows into the Chesapeake Bay. Therefore, in the Monocacy River Watershed, we all are connected to the Chesapeake Bay.

The Monocacy River's water comes from all the tributary streams present throughout its watershed that eventually flow into the mainstem of the River. Some of the Monocacy's tributaries are large, fifth order (or higher) streams that have miles of smaller streams that flow, converge, and grow into larger streams that eventually empty into the Monocacy River. Some tributaries that flow directly into the Monocacy River are relatively small, first or second order streams draining just a few hundred acres or less.

Wetlands – Springs and Seepage Areas

Hydric soils, vegetation and hydrology are some of the resources analyzed to classify wetlands. Wetlands have several major functions. They serve as habitat and breeding grounds for wildlife, and the dense and complex vegetation absorb and filter nonpoint pollution runoff. Wetlands also reduce flooding and recharge groundwater supply.(5)

Riverine, lacustrine and palustrine are the most common wetland types in the Monocacy watershed. The riverine includes the Monocacy River and its tributaries. Lake Linganore, a reservoir located east of the City of Frederick, is a good example of a lacustrine system. The lacustrine system consists of large open bodies of water such as lakes, ponds and reservoirs that are usually the result of a dammed river channel. Palustrine forested wetlands refer to wooded flood plain, swamps and associated emergent vegetation. Most of the Monocacy's stream valley corridors include this major type of wetland. (5)

One interesting aspect of the watershed is its abundance of springs and seepage areas which often are classified as a wetland type. With the exception of Fountain Rock Spring which produces over a thousand gallons of water per minute, springs and seepage areas are usually small, but differ primarily in their degree of permanence and nature of flow. Springs flow throughout the year, while seepage areas are typically dry during the summer and fall and always exhibit a seeping flow with no defined single point of discharge. However, springs and seepage areas do have the same important, cooling effect on the streams that they enter. (6)

Springs and seepage areas are often highly restrictive to the special species that dwell within them. These resurgences of cool groundwater impart many streams with year-round cool water conditions that make possible the survival of such stenothermic species as Brook Trout and Pearl Dace—fish that can only survive in a narrow range of temperature conditions.

River and Riparian Ecology

Rivers, sometimes called inland water systems, are part of the larger terrestrial landscape and are distinctly linked to their upstream catchments, or watersheds. Thousands of miles of streams within the Monocacy River Watershed flow and receive inputs—nutrients, sediment, pollutants, trash—from all the land within the watershed that eventually drains into the Monocacy River, as streams and rivers generally lie at the lowest points on the landscape. Therefore, for rivers, water is generated 'outside' the river system itself and enters primarily via tributary streams flowing across and through the surrounding watershed and, secondarily, through subsurface pathways. Streams and rivers 'collect' everything we do and deposit on the land. Numerous tributaries join the Monocacy River as it winds through our region. These tributaries begin as headwaters at the top of the watershed, merging with other streams until they finally reach the Monocacy River

A river system—its water, channel, banks, and adjacent land (called 'riparian' areas) is a rich and diverse ecosystem, defined by the International Union for the Conservation of Nature as a "dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." Riparian areas are places where the terrestrial meets the aquatic and include a variety of habitats, unique soil types, vegetation, animal communities, water regimes, and biogeochemical processes (e.g., nutrient cycling, chemical transformations, decomposition). A river system is rich in biodiversity—the variability among organisms, species, habitats or ecosystems.

A river's structure, function and overall ecology is driven by hydrological processes—water/flow regimes--- the magnitude, frequency, timing, and duration of water inputs and flows. A river system needs space to adjust to varying flow rates and storm events in order to efficiently transport and store water, sediment, and woody debris without excessively scouring the river bed and river banks. Thus, managing a river corridor to accommodate channel, riparian and floodplain adjustment processes will serve to reduce damages to existing structures and property, avoid new damages, protect public safety, and achieve the general health of the river system. (7)