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USGS Chesapeake Bay Activities

National Water-Quality Assessment: Water Quality in the Potomac River Basin and Delmarva Peninsula Study Unit

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Statement of Problem: The Potomac River Basin and Delmarva Peninsula (PODL) study units have been combined for cycle II of the NAWQA Program. The PODL study unit covers 20,728 square miles in the Mid-Atlantic region and includes parts of Maryland, Delaware, Virginia, West Virginia, Peninsula, and the District of Columbia. The Potomac River Basin portion of the study unit covers 14,760 square miles and has an integrated drainage basin that covers 11,600 square miles from the Fall Line at Washington, DC., to the west, which is just over one-half of the unit (56%). The Coastal Plain portion of the study unit is drained by a series of predominantly tidal streams. The non-tidal watershed headwaters and tributaries to these streams cover, on the average, less than 25 square miles. The largest non-tidal tributary watershed is the Choptank River, which is on the Delmarva Peninsula and is 119 square miles at its long-term stream-gaging station. Most of the study unit drains into the Chesapeake Bay, with the exception of the eastern part of the Delmarva, which drains into the Delaware Bay and Atlantic Ocean.

The PODL includes portions of seven physiographic provinces or subprovinces: the Appalachian Plateau, Valley, and Ridge, Great Valley, Blue Ridge, Piedmont, Triassic Lowlands, and Coastal Plain. The Valley and Ridge is the largest province (41%) and includes the Great Valley subprovince (15%). The Great Valley subprovince was further divided into carbonate and noncarbonate subunits for water-quality investigations based on characteristics of the underlying rock (Blomquist and others, 1996). The Coastal Plain is the next largest province (38%). It has been subdivided into seven hydrogeologic subregions based on physiographic features and surficial geology as part of a framework developed for a NAWQA synthesis of water-quality in the Mid-Atlantic Coastal Plain (Ator and others, in review). The Piedmont is the next largest and includes the Triassic Lowlands subunit (14%). The Triassic Lowlands and Piedmont are treated as separate,

distinct entities because they are topographically and geologically distinct (Blomquist and others, 1996). The Blue Ridge, which separates the Great Valley and the Piedmont, is the next smallest province (5%). The Appalachian Plateau is the westernmost and smallest province (3%). Rock types include unconsolidated sand, gravel, silt, and clay in the Coastal Plain; siliciclastic sedimentary rocks, which dominate in the Valley and Ridge, Triassic Lowlands, and Appalachian Plateau; carbonate sedimentary rocks, which dominate in the Great Valley subprovince but are also present in the Valley and Ridge, and Piedmont; and the crystalline rock in the Blue Ridge and Piedmont, and some parts of the Triassic Lowlands.

Land use in the PODL is 51% forested, 37% agricultural, 6% wetlands, and 5% urban. Forested areas, which occur in each province, are concentrated on the steep slopes of the Appalachian Plateau, Valley and Ridge, and Blue Ridge provinces. Major agricultural areas are located in the Great Valley, Piedmont, Triassic Lowlands, and the Coastal Plain. The areas where agriculture is dominant include the most permeable rock types: including carbonates and unconsolidated sands and gravels. Wetlands are concentrated in tidal and non-tidal areas of the Coastal Plain and along major river valleys in other physiographic provinces. The Washington, D.C. metropolitan area is the major urban center. Wilmington, Delaware is the next largest. Both cities straddle the Fall Line. Urban areas associated with Washington, D.C. are located in the Potomac River Basin in both the Piedmont and the Coastal Plain. The urban area associated with Wilmington, Delaware is located in the Coastal Plain in the northern part of the Delmarva Peninsula. Both areas are experiencing rapid development and growth. The PODL includes several other smaller cities that are also undergoing urban growth and industrialization to varying degrees.

Drinking water is supplied from both surface water and ground water. The distribution of water use closely follows population. Surface water supplies about 76% of the total drinking water use. Most of the use is in urban areas around Washington, D.C. with most withdrawals from the Potomac River. Ground water supplies the remaining 24%, including 100% of the drinking water for individual domestic use from private wells. Ground water is the predominant source of supply in the Coastal Plain and the Great Valley Carbonate. Surface-water sources also supply drinking water to parts of the Coastal Plain adjacent to the Fall Line where distribution systems draw from reservoirs and rivers located in the Piedmont, and from the Shenandoah River in the Great Valley Carbonate.

Objectives: Cycle II of the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA) will be the second decade of NAWQA in which 42 study units are revisited in three groups of 14 on a rotational schedule. Similar to Cycle I, each group will be intensively studied for three years, followed by six years of low-intensity assessment. The primary emphasis of Cycle II (2001-2011) of the Potomac - Delmarva study unit is to assess long-term trends in water quality and to improve the understanding of the factors and processes that govern water quality. The third priority is to fill critical remaining gaps in the status assessment, which was the main focus of Cycle I (1991-2001). This balance of priorities follows the recommendation of the NAWQA Planning Team, which concluded:

"The primary goals of NAWQA during its first decade continue to be appropriate as the program begins Cycle II. These goals are:

1. Provide a nationally consistent description of current water-quality conditions for a large part of the nation's water resources. (status)
2. Define long-term trends (or lack of trends) in water quality. (trends)
3. Identify, describe, and explain, as possible, the major factors that affect observed water-quality conditions and trends. (understanding)

To be successful, NAWQA must continue to focus on all of these goals. However, there should be a shift in the relative emphasis and resources given to the three goals as the program moves into its second decade. Relative to the first Cycle, the first goal, occurrence and distribution, should receive less emphasis in Cycle II. The third goal, explanation, should receive greater emphasis. The relative emphasis given to trends should increase in Cycle II because low-intensity phase (LIP) sampling, a key component for trends analysis, was not fully implemented during Cycle I."

Approach: Proposed Status and Trends Components

Surface Water Fixed Sites

Fixed sites were selected based on their current status as national trends sites and their potential use as components of integrated study of water quality and ecology associated with agricultural and urban land uses. These sites include several locations where paired watershed studies could be used for comparisons between urban and agricultural land uses in the same setting. The understanding of processes that affect water quality that can be derived from NAWQA stations, where a large suite of chemicals are monitored often in conjunction with other study components, can be extended to interpreting trends at sites in similar areas with only nutrient analysis.

Results of nutrient monitoring from all fixed sites monitored in the Potomac River Basin are important to, and will be used in, HSPF model development, along with several additional sites that have been selected specifically for that study. All of the proposed fixed sites for the PODL drain into the Chesapeake Bay watershed. NAWQA study at the fixed-site network will be coordinated with other ongoing studies.

Ground-Water Networks

Proposed ground-water study components for status and trends work include several options. Shallow ground-water resources susceptible to contamination are widely used as drinking-water sources in large parts of the study area. Contamination of shallow ground water is also important to other areas because of the relatively large contribution of ground water to surface-water resources.

Topical Studies

Agricultural Chemical Transport—The USGS is studying five watersheds across the Nation to better understand how natural factors and agricultural management practices (AMPs) affect the transport of water and chemicals. Natural factors include climate and landscape (soil type, topography, geology), and AMPs include practices related to tillage, irrigation, and chemical application. The study approach is similar in each watershed so that we can compare and contrast the results and more accurately predict conditions in other agricultural settings. Morgan Creek on the Delmarva Peninsula is one of the five study sites.

Effects of Nutrient Enrichment on Stream Ecosystems—In 2001, the NAWQA Program began an intensive study of nutrient enrichment—elevated concentrations of nitrogen and phosphorus—in streams in five agricultural basins across the Nation. This study is providing nationally consistent and comparable data and analyses of nutrient conditions, including how these conditions vary as a result of natural and human-related factors, and how nutrient conditions affect algae and other biological communities. This information will benefit stakeholders, including the U.S. Environmental Protection Agency (USEPA) and its partners, who are developing nutrient criteria to protect the aquatic health of streams in different geographic regions.

Selected Reports and Other Products:

Denver, J.M., Ator, S.W., Debrewer, L.M., Ferrari, M.J., Barbaro, J.R., Hancock, T.C., Brayton, M.J., and Nardi, M.R., 2004, Water quality in the Delmarva Peninsula, Delaware, Maryland, and Virginia, 1999-2001: U.S. Geological Survey Circular 1228, 36 p. http://water.usgs.gov/pubs/circ/2004/1228/pdf/circular1228.pdf

Ator, S.W., Blomquist, J.D., Brakebill, J.W., Denis, J.M., Ferrari, M.J., Miller, C.V., and Zappia, Humbert, 1998, Water quality in the Potomac River Basin, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia, 1992-96: U.S. Geological Survey Circular 1166, 38 p. http://water.usgs.gov/pubs/circ/circ1166/

Relevance and Benefits: Since 1991, USGS scientists with the NAWQA program have been collecting and analyzing data and information in more than 50 major river basins and aquifers across the Nation. The goal is to develop long-term consistent and comparable information on streams, ground water, and aquatic ecosystems to support sound management and policy decisions.

For more information on the Potomac-Delmarva NAWQA study unit visit http://md.water.usgs.gov/nawqa/podl/gwnetworks.htm