ALBEMARLE-PAMLICO ADVOCATE
. . . the newsletter of the Albemarle-Pamlico Estuarine Study
June 1994 Vol. 6, No. 2

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Still, as the Study nears completion and implementation of recommendations resulting from it begins, it is clear that research conducted through APES will influence management decisions for years to come. Some of the reserch projects represent the first comprehensive studies of their subject ever conducted in North Carolina, others provided major breakthroughs in our understanding of the estuary's problems.

For example, one of the biggest concerns about the A-P estuary prior to APES was the dramatic increase in fish kills and disease epidemics in the Pamlico and Neuse rivers. APES funding helped Dr. JoAnn Burkholder of N.C. State University isolate a prime suspect in many of those kills -- a fascinating and powerfully toxic dinoflagellate algae that had never been identified before. Dr. Burkholder's research also pinpointed natural and human-caused changes in the estuary that appear to help the dinoflagellate gain a biological foothold, thus laying a foundation for effective management of it.

*(See **The Role of a Newly Discovered Toxic Dinoflagellate, APES Report #93-08.**)*

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GROUNDWATER: *Hidden but critical player in the A-P system*

Most of the attention of the Albemarle-Pamlico Estuarine Study, and most of the concern over water quality in general in eastern North Carolina, has been focused on surface water -- the rivers, creeks and streams that we can see. But a large role in the health and function of surface waters is played by a system of underground water bodies we can't see called **aquifers**.

Aquifers in the A-P Region

The uppermost aquifer in the A-P region, called the "surficial aquifer," extends from the earth's surface to a depth of some 30-50 feet. This system has a significant influence on the rivers and streams of the area.

Below the surficial aquifer is a series of thicker aquifers that start about 100 feet down and continue to over 9,000 feet below the surface. These aquifers -- the Yorktown, Pungo, Castle Hayne, Beaufort and Cretaceous in descending order -- tend to thicken and lie deeper beneath the surface as they move in a southeasterly direction under North Carolina's coastal plain and nearshore continental shelf.

Inside the Aquifers

The aquifer system is comprised of different layers of sand, gravel or limestone that are saturated with water. Each of these strata are interlaced with layers of clay that keep water confined in the deeper aquifers. In some areas, however, a change in geological characteristics allows the water to "discharge" upward into a higher aquifer or surface waters.

Because North Carolina's coastal plain has generally porous soils and flat terrain, rainfall is more prone to soak into the ground than to run off directly into surface waters. In fact, of the 50 or so inches that falls in the A-P region in an average year, about 12 inches (25%) enters the aquifer system, while only about 5 inches (8%) runs off the surface. (The remaining 33 inches -- 67 percent -- evaporates or is soaked up by plants.) Of the 12 inches of water entering the aquifers, 11 stay in the surficial aquifer.

For more information on aquifer systems in the A-P area, request APES Report #93-05: *Groundwater Discharge and a Review of Groundwater Quality Data.* Produced by Research Triangle Institute

Water flows downward, upward and laterally through the aquifer system at a very gradual rate. As the water percolates through, soils filter and purify it. The purity of the water allows many communities in the A-P region, especially those in the east where surface waters are salty, to use the aquifers for drinking water.

Recently, however, attention has been focused on the aquifer's interaction with surface water and the possible "side effects" of controlling nonpoint runoff.

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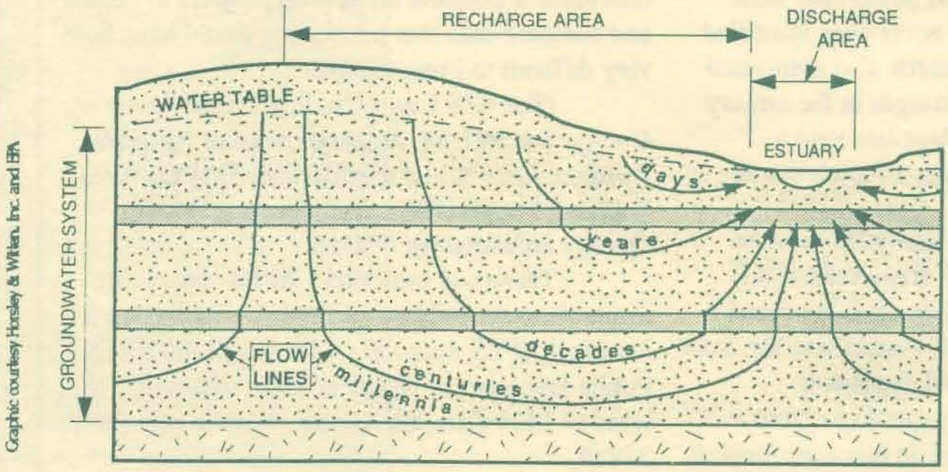

Groundwater is essentially at the earth's surface in the area right around surface waters. This close spatial relationship results in a fairly rapid "discharge" of groundwater into the surface water system -- generally only in a matter of days.

Farther away from surface waters, however, the groundwater seeps downward at a very gradual rate, often moving only inches a year.

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Aquifers and Surface Water

In the rivers of the A-P watershed, aquifer discharge, coming primarily from the surficial aquifer, contributes anywhere from 60 to 90 percent of the water that flows in the rivers of the A-P basin. Overland runoff, on the other hand, contributes only around 10-35 percent.

This leads to concerns about whether controlling surface runoff is letting pollutants get into rivers through the "back door" of the surficial aquifer. Many runoff controls rely on systems designed to slow down overland runoff and let it -- and the pollutants it carries -- seep into the ground. If pollutants in the runoff wind up in the surficial aquifer, then they may get into rivers via aquifer discharge.

The most worrisome pollutant in this scenario is nitrate nitrogen, whose two primary sources are agricultural fertilizers and septic tanks. Some studies have shown significant nitrate transfer from agricultural lands to surface waters through underground flow.

However, extensive root systems and organically active soils along vegetated river shores seem to take up much of the nitrate before it enters surface waters. This gives further support to calls for programs that encourage the leaving of strips of natural vegetation (i.e., shrubs, trees and grasses) along shorelines, as they can help filter both surface runoff and aquifer discharge.

Of additional concern, though, is the impact of pollutants on aquifers used as drinking water supplies. While the deeper aquifers are thought to be safe, some of the upper units could be vulnerable. Nitrate and pesticide contamination has been found in numerous private wells in the A-P area; and in areas where surface waters are saline, saltwater intrusion can occur when too much water is taken from an aquifer too quickly.

Researchers agree that our understanding of the effects of land uses on the aquifer and of the interaction between the aquifer and surface waters is limited. They do believe, though, that the relationship between land uses, aquifers, and surface waters is a critical one, and that integrated management of all three will be important both to the environmental and economic health of the Albemarle-Pamlico estuarine region.

APES-Sea Grant study examines marsh-breakwater combo

The rapid growth of residential development along rivers and sounds in the A-P region has led to widespread bulkheading of shorelines to reduce erosion. While complete statistics are unavailable, one report found that 31 miles of shoreline were bulkheaded in North Carolina during 1986-87 alone.

For more information on marsh-breakwater systems, request APES Report #94-03, *Shoreline Erosion Control Demonstration.* Produced by S. Rogers, UNC Sea Grant.

Bulkheads effectively stabilize a shoreline, but they often destroy or isolate shallow, marshy habitats that serve as nursery areas for young fish. In order to prevent large-scale destruction of nursery areas as development of estuarine shorelines increases, "softer" methods of combating erosion need to be implemented.

A potential answer for some sites is a combination of offshore breakwater and planted marsh area. The system, which is being tested at 12 sites in the A-P area through an APES-funded project, works by placing a breakwater 20-30 feet offshore, then planting marsh grasses along the shoreline behind the breakwater. A small gap is left between the vertical slats of the breakwater to let water pass through but still cut down sharply on the force of incoming waves. The marsh grass provides a further damping effect on waves, and its roots help stabilize shoreline sediments.

The major benefits of the breakwater-marsh system are that it controls erosion and *creates* nursery habitat, instead of destroying it as bulkheading does. Plus, it is less expensive than bulkheading.

Drawbacks are: (1) the system does not work well in areas of high erosion; (2) its life span is not known since the 12 study sites are only recently established, though it is likely comparable to bulkheads; and.(3) the breakwater could affect public trust access. However, the system's ecological benefits have led the state to expedite permit procedures for it to encourage its use.

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