Ground Water is one of our most important natural resources. Fifty-five percent of the population depends on ground water for drinking. More and more, we are learning that this resource is in danger. The expansion of population, industry, and agriculture places greater demands on the natural system. We must plan carefully if we are to enjoy growth and progress and still protect our ground-water resources for ourselves and future generations.

This publication will provide an understanding of ground water and its sources. Understanding will make our task of preserving this valuable resource much easier.

Ground Water - What Is it?

The ground beneath our feet is not completely solid. It is more like a sponge with pores of many shapes and sizes. When rain falls, it soaks into the ground and moves throughout this pore space. Pore space may account for up to 50 percent of the total volume of some soils.

Near the soil surface, in the unsaturated zone, the pores contain a combination of air and water. Further down is the saturated zone where all of the pore space is filled with water. This water is called ground water. The water table is the boundary between the saturated zone and the unsaturated zone. A well must reach down below the water table, into the saturated zone, to obtain ground water.
Aquifers and Confining Beds

The word aquifer comes from the Latin for “water bearing” and is used for any geologic formation that contains water in sufficient quantity and with sufficient mobility to be useful as a water source (for example, a layer of sand or gravel).

When water mobility is very limited (such as in a layer of clay or silt), the formation is called a confining bed or an aquitard.

Recharge and Discharge

Aquifer recharge is the movement of water from the surface down into an aquifer. In a recharge area, the net movement of water is downward. Recharge usually occurs in the upland areas between streams.

On the other hand, a discharge area is an area where the net movement of water is toward the surface. Ground water discharge usually occurs in low areas close to streams and through the banks and beds of streams.

Aquifer Systems of the Coastal Plain

The four major aquifers in North Carolina's coastal plain region are, in order of increasing age and depth:

- the surficial aquifer
- the Yorktown aquifer
- the Castle Hayne aquifer
- the Cretaceous aquifer

The single-hatched areas of Figures 1 through 4 show the range of each aquifer. The double-hatched areas in the figures indicate where each aquifer is an important source of water.

Surficial Aquifer

The surficial aquifer is the saturated portion of the upper layer of sediments. The thickness of this layer, from the surface down to the first major confining bed, is typically from 20 to 50 feet. The surficial aquifer is unconfined, meaning that its upper surface is the water table rather than a confining bed. (The surficial aquifer is sometimes called the water-table aquifer.) The composition of the surficial aquifer varies across the region, but it is generally 50 percent to 70 percent sand, allowing high infiltration rates.

Many shallow wells tap the surficial aquifer, especially near the coast and on the Outer Banks, where deeper waters are too salty. The surficial aquifer is also important in the Sandhills area.
Because the water in the surficial aquifer tends to be acidic, it is somewhat corrosive. The surficial aquifer is particularly vulnerable to contamination.

Yorktown Aquifer

The Yorktown aquifer lies below the surficial aquifer in the northern half of the coastal plain. The Yorktown is thin toward the west, sometimes less than 20 feet. It thickens eastward, to as much as 300 feet in Dare County. The Yorktown is mostly fine sand, silty and clayey sand, and clay with shells and beds of shells throughout.

The Yorktown aquifer is an important source of water in the northeastern part of the region, where deeper aquifers are too salty. It is not used as much in the western part, since more productive sources are available.

Castle Hayne Aquifer

The Castle Hayne aquifer, underlying the eastern half of the coastal plain, is the most productive aquifer in the state. It is primarily limestone and sand. The Castle Hayne is noted for its thickness (more than 300 feet in places) and the ease of water movement within it, both of which contribute to high well yields. It lies fairly close to the surface toward the south and west, deepening rapidly toward the east.

Chloride content exceeds 250 parts per million east of a line between Gates and Carteret counties. Water in the Castle Hayne aquifer ranges from hard to very hard because of its limestone composition. Iron concentrations tend to be high near recharge areas but decrease as the water moves further through the limestone.

Cretaceous Aquifer

The Cretaceous aquifer is a grouping of several of the oldest and deepest sedimentary deposits that lie directly over the basement rock. The Cretaceous is the primary source of water for the western half of the coastal plain with the exception of the Sandhills. To the east, the Cretaceous dips underneath the Castle Hayne. Toward the west, it rises near the surface, covered only by the surficial deposits, and in the northern part it rises to just below the Yorktown.

Water cannot move as easily in the Cretaceous as it does in the Castle Hayne, but the Cretaceous aquifer is very thick, allowing deep and productive wells. Water from the Cretaceous is generally soft and slightly alkaline, requiring no treatment for most uses. In a few areas, however, natural fluoride concentrations exceed the national drinking-water standard.

Table 1 indicates typical well depths and yields in the four aquifers described above. Yields obtained from private wells usually fall near the lower values. Larger well diameters and special construction methods may be required to obtain the higher yields.
Looking Forward

Not long ago, it was assumed that ground water was beyond the influence of human activity. Dumping and burial of wastes were widespread. Many of those wastes have moved down through the soil, appearing in the ground water years or decades later. Such contamination is practically impossible to clean up. We are only now learning the staggering price of yesterday's ignorance.

The coastal plain area of North Carolina has one of the most abundant supplies of ground water in the world. Yet, the U.S. Geological Survey reports slowly declining water levels in the coastal plain aquifers caused by increased pumping rates. It is not clear what effect this may have on the future quality of the ground water.

We can all help to maintain the highest possible quality through careful management of fertilizers, pesticides, and wastes. Proper construction, maintenance, and management of wells and wellhead areas are vital to prevent direct contamination of our ground water. As individuals and as a society, we must act wisely today so that future generations can share this precious resource.

For More Information

The following Extension publications are about ground water and ways to protect it:

- AG-439-1, Soils ant Water and Quality .25
- AG-439-2, Nitrogen Management and Water Quality .25
- AG439-8, Pollutants in Groutwater Risk Assessment .25
- AG-439-10, Goot Soil Management Helps Protect Groundwater .25
- AG-439-14, Pollutants in Groundwater Health Effects .25
- AG441-1, Liability Issues in Groundwater Quality Protection .50
- AG441-2, Key Policy Choices in Groundwater Quality Management .50
- AG441-3, Groundwater Quality: A Public Policy Perspective .50
- AG4414, Sources and Extent of Groundwater Contamination .50
- AG441-5, Federal Policies to Protect Groundwater Quality .50

These publications are available at your county Cooperative Extension Service office. Or, you may order them from Agricultural Publications, Campus Box 7603, North Carolina State University, Raleigh, NC 27695-7603 (prepayment is required).

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