

Karst and Groundwater of the Northern Shenandoah Valley

(Source: Environmental Science Institute, University of Texas at Austin
www.esi.utexas.edu/outreach/caves)



Figure 1. Karst Topography

What is karst? *Karst* is a landscape formed from the dissolution of soluble rocks including limestone, dolomite, and gypsum. It is characterized by sinkholes, caves, and underground drainage systems (figure 1). Nearly all surface karst features are formed by internal drainage, subsidence, and collapse triggered by the development of underlying caves. Rainwater becomes acidic as it comes in contact with carbon dioxide in the atmosphere and the soil. As it drains into fractures in the rock, the water begins to dissolve away the rock creating a network of passages. Over time, water flowing through the network continues to erode and enlarge the passages; this allows the plumbing system to transport increasingly larger amounts of water. This process of dissolution leads to the development of the caves, sinkholes, springs, and sinking streams typical of a karst landscape (figures 2 and 3).

Why is karst important? Dissolution associated with karst development has created a complex underground water flow network that includes caves large enough for humans to access. Rainwater travels through the network until it reaches the water table. The karstified limestone acts as an aquifer where water can be stored and later extracted by humans.

What is an aquifer? An *aquifer* is a body of rock that can store and transmit significant quantities of water. Rocks vary in the way they store water according to their porosity and permeability. **Porosity** is the percentage of open space in a rock or surface material. **Permeability** is a measure of a material's ability to transmit fluids. If the pores are very small or if they are not connected to form a channel, the material will have a low primary permeability. If the material is fractured (broken) the permeability will be increased. A sandstone aquifer, for instance, acts like a sponge, and water slowly seeps between the grains

of sand at a rate of inches per day. A karst aquifer, on the other hand, stores water in fractures, conduits, and cavities and can transport water up to miles per day!

There are two main threats to the northern Shenandoah aquifer system: pollution and extraction. Urbanization concentrates pollution by collecting pollutants on impervious, or impenetrable, surfaces. Rain within the catchment and recharge zones washes pollutants into the aquifer. Second, with increased population comes a higher demand for water. If the amount of extraction exceeds the amount of recharge, the water level within the aquifer will fall. If this occurs over a long period of time, the water table in the aquifer could be lowered substantially making existing wells unproductive.

Karst aquifer water is especially important for the northern Shenandoah Valley as the area becomes more urbanized. With a higher density of people, we face higher demand on and increased pollution of this water resource. Just like rainwater, pollutants can easily pass through the karstified limestone. Another difficulty is that streams and surface runoff entering the aquifer via sinkholes and caves bypass the natural filtration produced by seeping through soil and bedrock. This direct recharge quickly replenishes the water supply; however, it also leaves the aquifer particularly vulnerable to contamination.

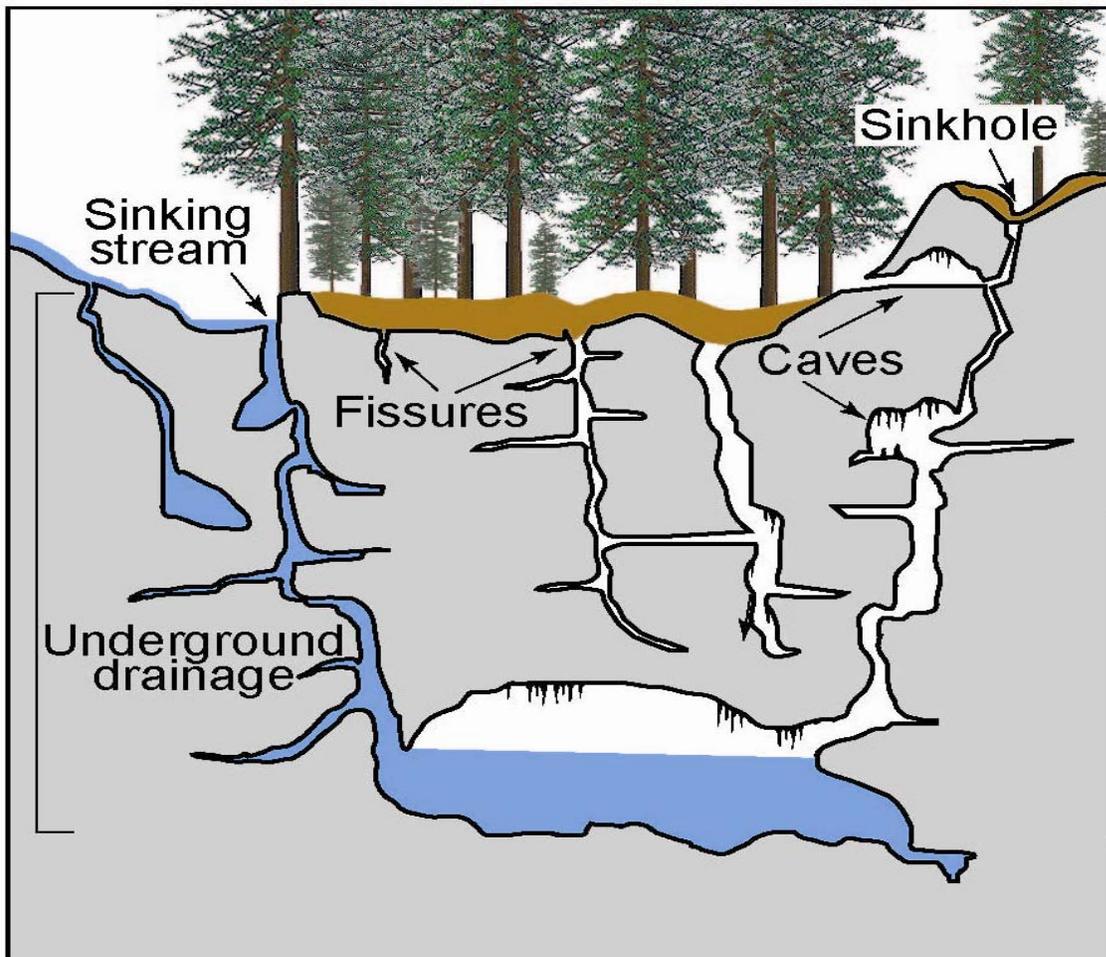
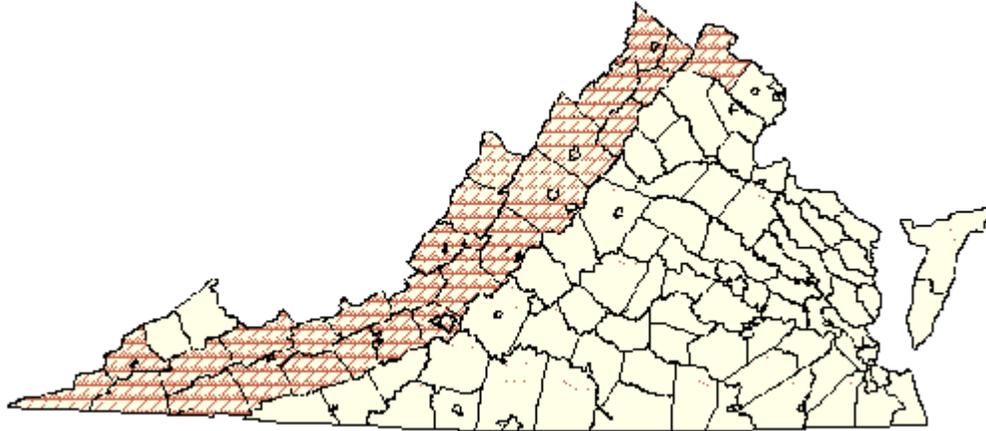


Figure 2. Diagram of a karst groundwater system

Karst Information Sheet
(Source: Virginia Department of Conservation & Recreation,
http://www.dcr.virginia.gov/natural_heritage/karsthme.html)

VA Counties Containing Karst Topography



- Karst is a landscape to a significant degree resulting from the dissolution of bedrock.
- Karst landscapes are most commonly underlain by limestone and dolostone bedrock.
- Karst landscape features include sinkholes, sinking and losing streams, caves, and large flow springs.
- Karst landscapes are characterized by underground drainage networks that commonly bypass surface drainage divides.
- Karst landscapes provide and support habitat for rare animal and plant species, including bats, cave-adapted invertebrates, plants that grow on the surface and at springs and seeps, and fish and mussels living in streams and rivers fed by karst springs.
- Karst landscapes supply water for many Virginians. Land use activities place these water supplies at risk.



Figure 3. An example of a sinking spring, Virginia

Karst and Groundwater Questions and Answers for the General Public

What is a watershed?

- ◆ A watershed is an area over which surface water (and the materials it carries) flows to a single collection place.
- ◆ Our watershed is the Chesapeake Bay watershed.
- ◆ Water resources in Virginia include ponds, lakes, rivers, groundwater, bays, and the Atlantic Ocean.

What is groundwater?

Groundwater is water that collects under the ground.

Where does groundwater come from?

- ◆ The original source of water in the ground is precipitation (rain, snow, sleet, hail).
- ◆ The source of water for many people who live in the northern Shenandoah Valley is ground water that is pumped out of the ground through wells.

What is a sinkhole?

A sinkhole is a hollow in the ground caused by the dissolving by rainwater of certain types of rock, especially limestone. These holes are commonly connected to the under the ground water, or groundwater, system.

What is a cave?

A cave is a large hole under the ground that forms in a type of rock called limestone. Limestone dissolves as water flows through it leaving these holes (caves).

What is karst?

Karst is a type of landscape that has sinkholes, springs, and caves because there is a lot of limestone rock. A common feature of karst is underground drainage systems.

Why should we be especially careful in our above ground use of the land in a karst area such as the northern Shenandoah Valley?

Groundwater flows into karst areas almost directly from the surface of the soil into the caves and caverns underground. Because the flow of water is so direct, it is easy to pollute the groundwater with materials such as gasoline, oil, fertilizers, pesticides, chemicals from factories, and leaking septic tanks. We need to be especially careful in protecting our drinking water that comes from the ground.