KARST SINKHOLES OF THE COWPASTURE RIVER WATERSHED

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Editor's note: The following essay is the fifth in a five-year series on water resources stewardship in the Cowpasture River Watershed, sponsored by the Cowpasture River Preservation Association and published by The Recorder. The goal of the series is to create awareness among students, citizens and officials of the critical need to protect our surface and ground-water resources, and to stimulate interest in progressive stewardship.

Sinkholes are natural depressions on the surface of the land which are shaped like a bowl or cone. Rain that falls in a sinkhole drains internally. They are also known as sinks, dolines, and closed depressions. Sinkholes together with sinking streams, springs, caves, and blind valleys form karst or karst terrain.

How Sinkholes Form – Sinkholes, in the Cowpasture River watershed, form in two ways. In the first process mildly acidic water dissolves limestone, dolomite, or a sandstone which is held together by a carbonate cement. The acidic water is produced when rain dissolves carbon dioxide, which is produced by bacteria in the humus layer of the soil. This downward migration of acidic water enlarges cracks in the bedrock by dissolving limestone to form larger conduits. Surface debris is also carried downward by the water creating the bowl or cone. In the second process ground water, moving laterally, dissolves an underground chamber whose roof collapses. Most of these conduits lead to well-developed drainage systems.

Types of Sinkholes – There are five types of sinkholes. In the above paragraph I have described a **solution sinkhole** in the first process and a **cave collapse sinkhole** in the second. It should be noted that cave collapse sinkholes are very rare and comprise a very small percentage of the cave openings in the Cowpasture River watershed. A sinkhole with a hole in its bottom is said to have an “open throat”.

In addition there are **cover-collapse sinkholes** where a solution sinkhole is partially filled and plugged. The soil in the sinkhole is carried away by water from the bottom up. This eventually causes a rapid collapse forming a bowl or cone shape. A **cover-subsidence sinkhole** forms when a solution sinkhole is partially or completely covered. Water slowly carries soil into the conduit below and the surface of the sinkhole deforms and takes on the classic bowl or cone shape. The process of a cover-collapse sinkhole opening and closing can be repeated many times. If the sinkhole is completely covered it is called a **buried sinkhole**.

Sinkholes, in the Cowpasture River watershed, can be a couple of feet in diameter to thousands of feet across. They can be less than a foot deep to hundreds of feet deep. The largest sinkhole in the Cowpasture River watershed is near the community of Flood, north of

Burnsville in both Bath and Highland counties. This sinkhole or blind valley is a mile long and almost a half-mile wide.

A Karst Sinkhole with an Open Throat – Karst buffer areas surrounding sinkholes are arguably the most important conservation measure for protecting ground water quality. Photographic attribution hereby given to Rick Lambert.

Movement of Underground Water – In the Cowpasture River watershed the limestones, dolomites and sandstones which make up the karst terrain generally run from the southwest to the northeast. The limestones and dolomites are sandwiched between sandstones. These sandstones generally confine the water which enters the sinkholes and channel it to the northeast or southwest where it escapes at springs or seeps sometimes many miles away. When these confined bands of limestones are on the mountains of the watershed the springs and seeps can be hundreds of feet higher than the Cowpasture River.

Management of Sinkholes – Since sinkholes, in karst terrain, are the most common input point for water to enter the groundwater system they must be understood and managed carefully. All sinkholes should have a barrier of vegetation and/or fencing around them. While a 100-foot wide grass filter strip is ideal, filter strips as narrow as 13 feet can trap enough sediment to be effective. When clearing land or harvesting timber around a sinkhole a wide natural buffer of trees and understory vegetation should be left.

Like water, hydrocarbons, heavy metals, PCB's, herbicides, pesticides, other chemicals, storm water, sewage, and bacteria from dead animals can quickly enter the ground water system and turn up many miles away. These karst drainage systems do not normally filter the water but rapidly move it from inlet to outlet. Cleaning up underground pollution can be very difficult, if not impossible. The process can take years, if not generations, and be very costly. In most cases of groundwater pollution it is not something you clean up, but something you live with.

Buried sinkholes, cover-collapse sinkholes, and cover-subsidence sinkholes can all present problems in construction. Because the sinkhole is covered or partially filled its true extent and danger can't be fully assessed. If sinkholes were filled in during the construction process in an attempt to "level the ground" this alteration can lead in the future to a gradual caving in (or subsidence) or a rapid collapse. Farm ponds, roads and structures are at risk for damage if they have not been adequately designed or sited. Construction should stay away from active karst features such as sinking streams, sinkholes, and land over top of caves.

Filling in sinkholes can alter the flow of groundwater by blocking the input. The water, which normally would have entered the groundwater system, runs off increasing creek flow. This in turn reduces the amount of groundwater available locally. Filling in sinkholes can also result in the fill being washed into the conduit changing the chemistry of the groundwater at a spring or seep. Disturbed areas during construction should be reseeded as soon as possible. Vegetated strips should be maintained down slope to reduce and disperse runoff from the site.

Agricultural practices in karst areas should include the use of contour tillage, vegetative barriers, restriction of livestock access to streams and sinkholes, and limiting overgrazing. The proper application of fertilizers and animal waste is essential to prevent runoff which would impact water quality. Keep pesticide and herbicide use to a minimum. Use least toxic alternatives. Evaluate field limitations based on environmental hazards such as sinkholes, highly erodible soils, shallow aquifers, shallow depth to bedrock, and nearby surface waters.

The U.S. Environmental Protection Agency has identified failing septic systems as a major source of groundwater pollution in karst areas. Conventional septic systems should not be located near sinkholes, sinking streams, caves, or springs. Your septic tank should be inspected annually and pumped out every three to five years.

A Shared Responsibility – All of us live on a watershed and have an impact on the quality of our groundwater whether we think about it or not. As a result we have a shared responsibility to make the protection of our groundwater a life style in both small and big ways. It is not something we do once but many things we do or don't do every day. Like air and food we can't live without groundwater.

Internet Research URLs:

Publication 44 Selected Karst Features of the Northern Valley and Ridge Province, Virginia

http://www.dmme.virginia.gov/commercedocs/PUB_44.pdf

Publication 83 Selected Karst Features of the Central Valley and Ridge Province, Virginia

http://www.dmme.virginia.gov/commercedocs/PUB_83.pdf

Living on Karst by Cave Conservancy of the Virginias

http://www.dcr.virginia.gov/natural_heritage/livingonkarst.shtml

Sinkholes and Karst by Department of Mines, Minerals and Energy

http://www.dmme.virginia.gov/dgmr/sinkholes.shtml

Living With Sinkholes by Virginia Cave Board

http://www.dcr.virginia.gov/natural_heritage/vcbsinkholes.shtml

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