Best Management Practices for Livestock Production and Operations in Karst Areas

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Sinkholes are found across much of East and Middle Tennessee in areas where the underlying rock (limestone and dolomite) is carved or dissolved by water to form caves and caverns through which much of the groundwater flows. These geologic features are referred to as karst geology or karst terrain, in which the ground surface is characterized by closed topographic depression features, or in the case of when the soil collapses into the underlying voids, sinkholes. Sinkholes and karst features are common in Tennessee, and details about the geologic conditions leading to karst and other information about Tennessee caves and sinkholes can be found in the series of publications, W 453-A: Guide to Caves and Sinkholes in Tennessee.pdf.

Unlike those found in urban or commercial areas where they may have been covered or remediated, sinkholes and karsts encountered in agricultural lands typically are minimally disturbed yet remain as conduits of surface water to the subsurface. The sinkholes and closed surface depression features may have been present and stable for many years and are often used for livestock watering (Figure 1) or pasture/forage production (Figure 2). However, sinkholes can also form or collapse unexpectedly, damaging structures and endangering livestock.

Because the karst features serve as a surface water recharge point to the underground hydraulic system, livestock operations may be affected. This document makes several recommendations regarding livestock operations in karst terrain and general methods should it become necessary to repair or remediate a sinkhole.
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Many Middle and East Tennessee farm pastures contain karst features and pose a potential hazard to livestock as well as people (Figure 3). It is also very important to protect against the potential hazards posed to the groundwater resources. Because karst features are usually connected hydraulically to the caves and caverns below, contaminated surface water may flow directly into the groundwater through unprotected karst features. Thus, wells that are used by homeowners and springs and streams that are used to feed livestock can be negatively impacted by contaminated runoff into karst features (Figure 4).

Proper management of surface water is the best way to keep contaminated surface water from entering the groundwater system through sinkholes. Vegetated buffer strips around sinkholes in areas with row crop production or no-till cultivation practices are best. Where tillage is necessary, careful contour tillage with buffer strips can slow runoff into sinkholes. Areas that have been cleared of vegetation should be re-seeded as soon as possible. The following are some best management practices to help protect groundwater resources:

- Grass or vegetative buffer strips surrounding the feature reduce the quantity and flow rate of surface water runoff, maintain sheet flow, and filter excess nutrients and/or contaminants. The appropriate width of the buffer strip depends on the actual site characteristics, but buffer strips of at least 25 feet are recommended, and strips 35 feet wide have been found to be very effective at capturing nutrients (Walker 2009).

- When applying manure, herbicides and pesticides, maintain adequate setbacks to avoid spray drift into the sinkhole. See: Weed Management in Pastures and Hay Crops

- In some cases, fencing should be provided to protect animals from injury and prevent animal waste from entering the subsurface (Figure 5).
• If a sinkhole holds water continuously, the nutrient inflow to underground may be minimized by fine-grained sediments in the bottom. However, long-term stability of the depression as a pond cannot be assured.
• Ditch lines should be inspected periodically for breakthroughs or dropouts. Use paved or membrane-lined ditches, particularly in cut areas, to collect and transport surface water.
• Maintain guttering and runoff from structures to avoid water collection adjacent to structures.
• When possible, divert surface runoff from structures to rain gardens or constructed wetland features. See: Rain Gardens for Tennessee: A Builder’s Guide
• Verify that subsurface piping is carefully constructed and pressure tested prior to being placed in service.
• Scarify and recompact the upper 9 inches of soil exposed in cut sections, thereby creating a blanket of less permeable material.
• Standard septic systems should not be located near sinkholes, caves or areas of thin soil cover. In karst areas with shallow soil cover (less than perhaps 3 feet), low pressure distribution or drip distribution systems may be appropriate. More information can be found in: Wastewater Basics, Decentralized Water Resources Collaborative, Decentralized Wastewater Glossary
• Septic system maintenance is important to assure proper performance.

Practices to Avoid

Because sinkholes are connected to the groundwater hydraulically, never put anything into a sinkhole that you would not want your family or livestock to drink.
• Do not dispose of waste materials, construction debris, dead animals or appliances in sinkholes (Figures 6 and 7).
• Excavation and extensive grading can reduce the amount of soil cover over the underground voids, leading to collapse. Thick soil cover over the cavernous bedrock provides stability (Drumm et al. 2009) and should be protected if possible. Care should be taken to route surface water away from excavations.
• Do not try to fill the sinkhole with soil since it will continue to travel downward into the subsurface, causing the sinkhole to reappear and add soil, sediment and potential pollutants to the groundwater. Soil can also clog the drainage pathways and cause surface flooding.
• Do not try to pour fresh or hardened concrete into the sinkhole in an attempt to stabilize. Specialized techniques (discussed below) are required to successfully remediate most sinkholes.

Sinkhole Stabilization and Repair

Sinkholes are difficult to stabilize without special treatment; simple filling of the depression is not likely to be successful. If the sinkhole threatens structures or is otherwise located where repair is economically justified, specialized construction techniques may be used to stabilize a sinkhole. However, these methods often require engineering designs and the services of specialty contractors. Special concrete grouting techniques can be used in the repair of some sinkholes to help stabilize the ground. A combination of grouting and placement of inverted filters may be required for repair of sinkholes.
involving structures and roads. These repair methods can be costly and may not be covered by standard insurance policies. The best repairs will stabilize the ground surface while allowing infiltration of surface water through the repair, such as the “inverted rock drain” approach (Figures 8 and 9).

References and Additional Reading


http://www.werf.org/c/Progress/Assets/2011winter/Try_This_on_for_Size.aspx


