Karst of the Western Delaware County, Ohio, Region

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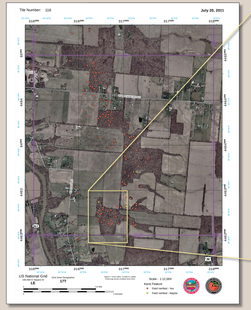
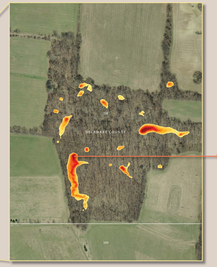
ABSTRACT

Karst terrain forms by dissolution of carbonate rocks (limestone or dolomite) and occasionally evaporites (gypsum or salt) and is characterized by features such as sinkholes (or sinks), disappearing streams, caves, and springs. The many passageways formed in karst terrain allow for high connectivity between the land surface and the water table and can bypass soil and rock layers that filter out contaminants. When materials such as fertilizer, pesticide, and waste enter sinkholes, they are rapidly transported to the water table and quickly pollute water wells, streams, and rivers. Karst also poses infrastructure complications: roads, utilities, houses, and other facilities built in karst areas are at risk of subsidence or collapse.

In order to test a process for determining areas at risk from karst in Ohio, an area encompassing Western Delaware and bordering counties was selected. Rapidly developing and known to contain karst, Delaware County is close to the Ohio Geological Survey's main office, so field verification could be easily accomplished while sink-locating methods were refined. To locate sinks, LiDAR was used to create an ArcGIS layer that identified low, enclosed areas. These low spots were cross referenced with known karst points, bedrock geology, aerial photography (multiple sources/ages), soil maps, drift thickness, and water well logs to locate potential sinks. Suspect locations then were visited in the field, evaluated, and photographed. Through this process we quickly learned that many of the LiDAR returns were not sinks; features such as building foundations, broken field tile, steep-walled streams, and road culverts often produced enclosed areas similar in shape to sinkholes. Many of these features were eliminated using 6-inches-per-pixel aerial photography and experience from field verification. The resulting map of sinkholes and collection of photographs can be used to monitor the growth of preexisting sinkholes and the development of new karst features. Furthermore, areas of land development should be carefully planned in regions of dense karst since they are highly susceptible to pollution and may subside.



An example tile from the map book that covers in detail the locations of each sinkhole. There are 255 total tiles of which 35 contain sinkholes.



Low areas were found using LiDAR (Light Detection And Ranging) and overlain on high resolution imagery to locate potential sinkholes.

Debris-filled sinkhole at the end of a stream; connects to a small cave passage for at least 15 ft that is blocked by flotsam.

This small cave (left) formed along jointing in the Delaware Limestone; the entrance has grown during the last four months, allowing access to the interior (below and below right).

Trash-filled sinkholes containing tires, 55-gallon drums, recliners, and a printer.

Sinking stream flowing over the Delaware Limestone and into the ground; the tree is about 0.5 m in diameter, and downstream (not shown) is completely dry.

Broken drain tiles in fields often cause misleading LiDAR responses.

Columbus Limestone showing fractures and vugs (top left).

Sinkhole located in a small fracture cave about 8 ft deep, 10 ft long, and 1.5 ft wide; fossils and a small water-filled sump inside.

A sinking stream near the new water treatment plant at the intersection of Moore Road and State Route 745 in Delaware County.

A pristine sinkhole.

Three sinkholes in a forested area surrounded by neighborhoods.

Pollution in this sinking stream can be rapidly transported to the water table.