KNOWN AND PROBABLE KARST IN OHIO
Revised 2006

Drift-thickness and glacial boundary information are added to the map to depict the relationship between drift thickness and active karst processes, and the increasing density of karst features beyond the glacial margins.

STATE OF OHIO
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DEPARTMENT OF NATURAL RESOURCES
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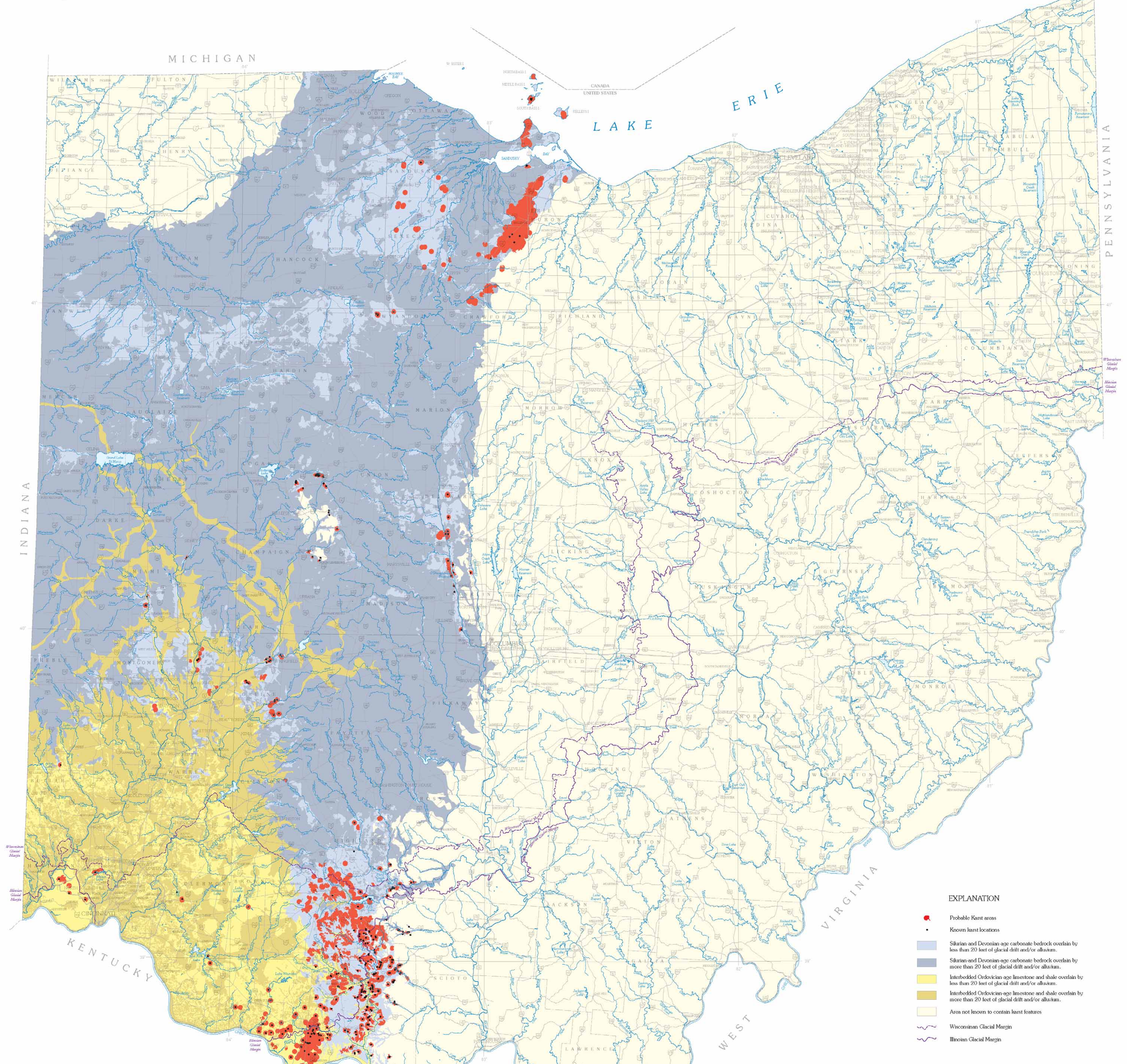
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

OHIO DIVISION OF GEOLOGICAL SURVEY
Map EG-1
revised 05/2006



KNOWN AND PROBABLE KARST IN OHIO

By
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Karst terrains exist in many Ohio counties where dissolution processes in carbonate rocks (limestone and dolomite) and gypsum (calcium sulfate) have produced networks of subsurface conduits. The rapid transmittal of pollutants in the environment through karst is a major concern. In Ohio, karst areas are the most vulnerable natural settings for ground-water contamination. Other karst-related problems include major delays and additional expenses in construction projects caused by the unanticipated occurrence of extensively solutioned bedrock. Although it has long been known that Ohio has cave and sinkhole areas, there had been no comprehensive mapping of the state's karst terrains before this investigation.

In 1995, in anticipation of the statewide search for a low-level radioactive-waste disposal site, the Ohio General Assembly enacted site-screening criteria. These criteria included Section 3747.12 of the Ohio Revised Code, which states, "The disposal site shall not be located in areas of known or probable karst. As used in Division (A)(13) of this Section, 'karst' means a terrain with an assemblage of landforms such as sinkholes and caves that are due to solution weathering of predominantly carbonate bedrock." To address this criterion, the Ohio Division of Geological Survey, through a grant from the Midwest Compact administered by the Ohio Low-Level Radioactive Waste Disposal Facility Development Authority, conducted an investigation in 1997 to document surficially expressed karst features in the state.

The investigation began with a review of cave inventories, theses, and scientific literature for field-documented karst locations. These locations were defined as known karst and were plotted on 7.5-minute bedrock-geology work maps. The primary source for known karst locations was the Ohio Cave Inventory provided by Dr. Horton H. Hobbs III of Wittenberg University. Next, the locations of additional karst features were identified through examination of geomorphic features on 7.5-minute topographic maps in carbonate-rock terrains, analysis of county soil-survey reports, and interpretation of aerial photography to define indicated karst. Thousands of individual sinkholes were plotted on the work maps, but for clarity are not shown on this map. Field inspection of many indicated karst features documented more known karst locations and verified the mapping methods.

Probable karst areas were defined as areas that: (1) lie within a half mile of a known or indicated karst location, and (2) are underlain by carbonate or gypsiferous bedrock with overburden generally of less than 20 feet of noncarbonate bedrock and/or unconsolidated material as shown by comparison of 7.5-minute bedrock-topography and bedrock-geology maps to surface topography. Known karst locations and probable karst areas on the work maps were digitized and are shown on this 1:500,000-scale map.

The May 2006 revision of this map is the first to portray information on the thickness of glacial drift and/or alluvium overlying bedrock. Drift-thickness information is provided to: 1) illustrate that karst terrain in Ohio is generally limited to areas of carbonate rock (limestone and dolomite) overlain by less than 20 feet of glacial drift and/or alluvium, and 2) indicate areas of the state where drift-thickness/bedrock-lithology conditions are most conducive to karst development, even though reconnaissance mapping may not have identified karst features in all such areas. It should be noted that some of the probable-karst areas depicted on this map occur where bedrock is indicated to be overlain by more than 20 feet of drift and/or lie outside the boundaries of bedrock lithologies most susceptible to karst development. Such apparent outliers from the basic model used to map karst terrain are the result of: 1) the availability of more reliable drift-thickness information than was available in 1997 when probable-karst areas were originally determined, and 2) that karst occasionally develops in areas where soluble bedrock underlies as much as 20 or more feet of relatively insoluble bedrock (e.g., noncalcareous shale).

Although Ohio has not been regarded as having a significant amount of karst, this investigation revealed many areas of the state that contain well-developed karst terrains, which occur mostly in four geographic regions of the state: (1) north-central Ohio, where a broad band of solution-collapse depressions extends from northeastern Seneca County to Lake Erie; (2) central Ohio, where thin-drift-covered carbonate uplands lie adjacent to the Scioto and Olentangy Rivers; (3) southern Ohio, in carbonate regions lying beyond the Wisconsinan glacial boundary; and (4) west-central Ohio, in the Bellefontaine upland of Logan and Champaign Counties.

Several relationships between geologic units and the distribution and geometry of karst features were observed. These include: (1) karst in Ordovician-age interbedded limestone-and-shale units is most developed south of the Illinoian glacial margin; (2) the number of observed karst features increases south of the Wisconsinan glacial margin; (3) karst development is most prominent in the Columbus Limestone (Middle Devonian) and Peebles Dolomite (Lower Silurian); and (4) sinkholes developed in susceptible carbonate units have surface expression through as much as 20 feet of overlying noncarbonate materials such as shale or glacial drift.

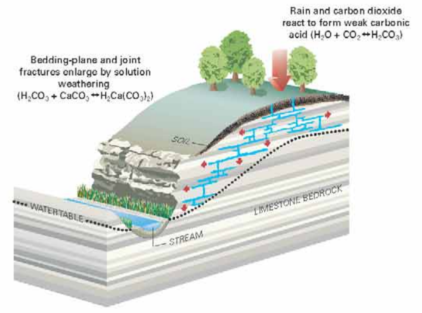

FIGURE 1. Rainwater falling through the air reacts with atmospheric carbon dioxide to form carbonic acid ($H_2O + CO_2 \leftrightarrow H_2CO_3$). Upon entering the soil, rainwater reacts with carbon dioxide released from decaying vegetation to form additional carbonic acid. As part of the ground-water environment, carbonic-acid-charged water continues to move downward under the force of gravity into underlying limestone bedrock. The water moves laterally along horizontal fractures (bedding planes) and downward along vertical fractures (joints) until it reaches a depth where all fractures and pore spaces within the rock are filled with water (the water table). As the water moves along fractures, both above and below the water table, small amounts of limestone are dissolved by the carbonic acid ($H_2CO_3 + CaCO_3 \leftrightarrow H_2Ca(CO_3)_2$). Additional limestone is mechanically abraded and removed by the movement of the water. Graphic from the Columbus Dispatch, used with permission.

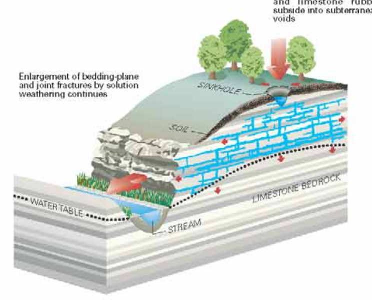

FIGURE 2. With the passing of time, bedrock fractures become greatly enlarged by the dissolution and abrasion process. Sinkholes (dolines) begin to form on the surface where enlarged vertical fractures allow soil and rock debris to collapse into the earth. Surface drainage is diverted directly into the ground-water environment where sinkholes intersect drainageways, thereby accelerating the rate of fracture enlargement through mechanical abrasion. The water table is lowered as ground water escapes to the surface through springs. The terrain created by the presence of numerous sinkholes and other solution features is called karst. Graphic from the Columbus Dispatch, used with permission.

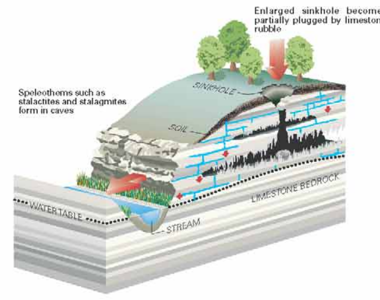

FIGURE 3. Over the course of many centuries, sinkholes continue to enlarge and coalesce with other sinkholes as underground voids collapse and ongoing abrasion and/or dissolution continue to remove bedrock. Horizontal and vertical fractures become enlarged to the extent that they can be classified as a cave (an underground passage large enough for a person to enter). The water table continues to drop in elevation as internal drainage networks within the cave system become more integrated and efficient in collecting and discharging ground water. Ground water saturated with calcium carbonate (calcite) and dripping from cave ceilings and walls or flowing along the cave floor evaporates, causing calcite to be deposited as cave formations (speleothems) such as stalactites, stalagmites, flowstone, and travertine. Graphic from the Columbus Dispatch, used with permission, modified slightly.

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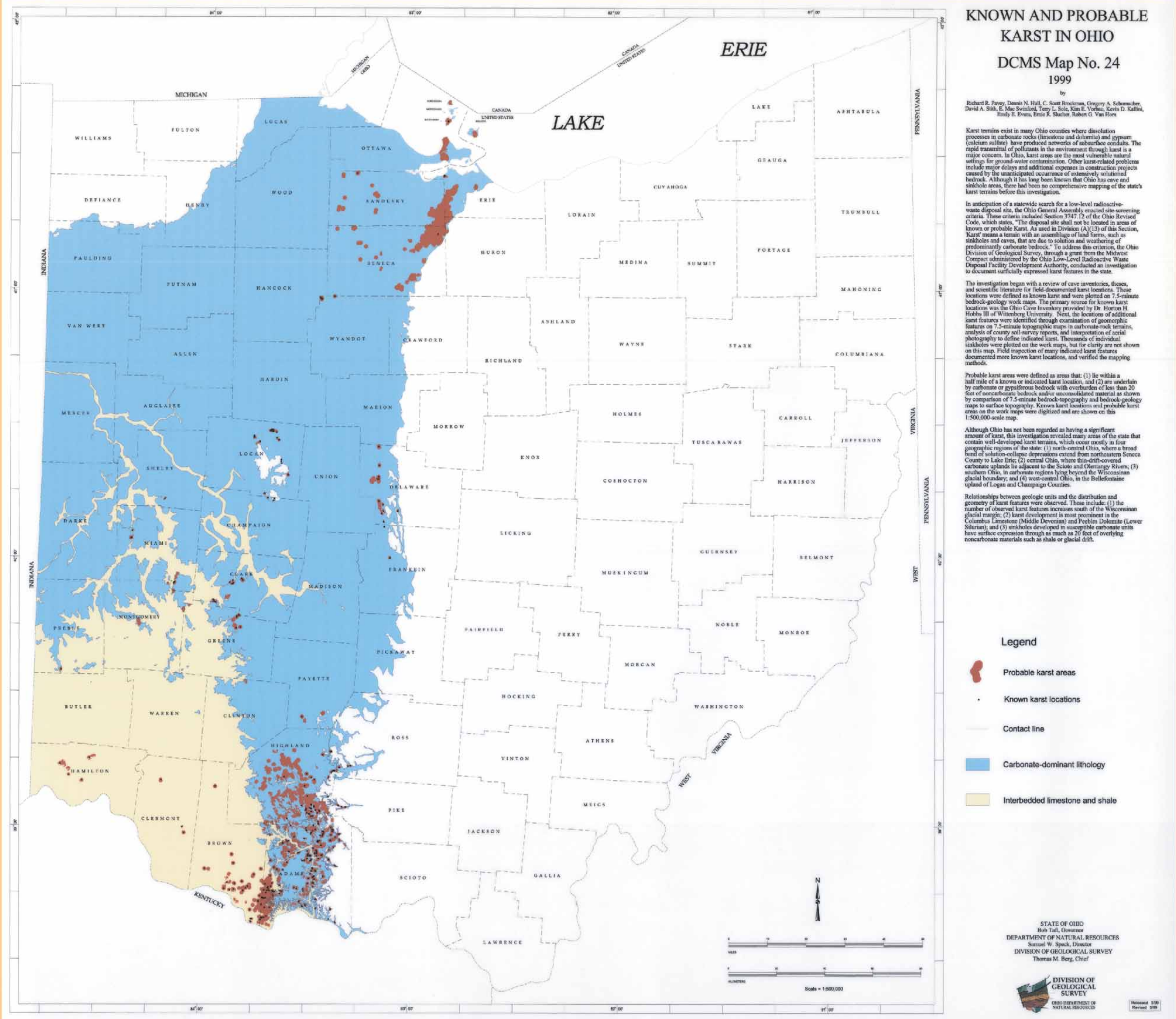
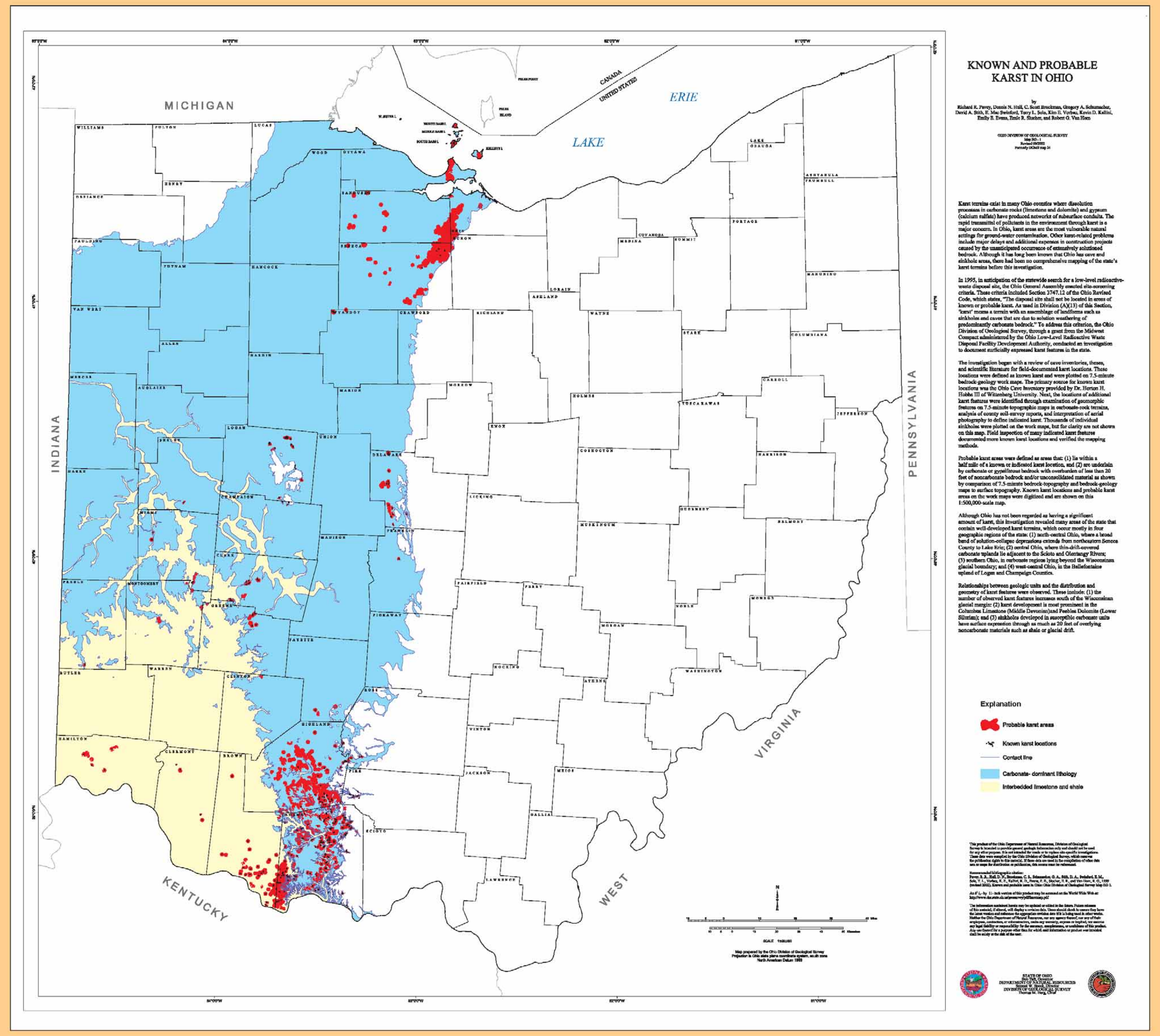
Scale 1:500 000

Base map derived from Ohio Department of Transportation data sets.
Projection of data is Ohio coordinate system, south zone, North American Datum 1983.

KNOWN AND PROBABLE KARST IN OHIO
DCMS 24
1999

Digital cartographic files of the locations of known and probable karst are merged with digital bedrock-geology maps to produce a non-GIS open-file map, DCMS 24, *Known and probable karst in Ohio*.



KNOWN AND PROBABLE KARST IN OHIO
2002

DCMS 24 is updated to true GIS format and renumbered EG-1