Lost River Field Trip

for the
Indiana Water Resources Association

Richard L. Powell

INTRODUCTION

This guidebook primarily covers karst features and subterranean drainage within parts of the Mill Creek and Lost River watersheds located on the Mitchell Plateau and Crawford Upland physiographic units (Gray, 2000, p. 8–9, and Malott, 1922, p. 94–102 and 187–247) (fig. 1). The Mitchell Plateau encompasses about 1,200 square miles, underlain primarily with westward dipping, predominately carbonate strata of the Blue River and Sanders Groups. The Crawford Upland covers about 2,500 square miles consisting of clastic and carbonate strata of the Chester Series and lowermost Pennsylvanian Age units. The Mitchell Plateau and the eastern portion of the Crawford Upland are known for their karst features and caverns and are world renowned for the karst features of the Lost River area, owing primarily to the publications of Clyde A. Malott.

The "Mitchell plain" was originally named by J. W. Beede (1911, p. 95) for the excellent sinkhole topography in the vicinity of Mitchell, Indiana. Clyde A. Malott (1922, p. 94) formalized the name "Mitchell plain" in *The Physiography of Indiana*. A significant factor for the development of karst features on the Mississippian Age carbonates was the fact that the Mitchell plain was more accurately a plateau—the "Mitchell Plateau" as described by Richard L. Powell (1966, p. 119) and Henry H. Gray (2000, p. 8–9)—in recognition of deeply incised major surface drainage in places and development of cavernous subsurface passages somewhat at grade with the incised streams. The division between the Mitchell Plateau has been called the Chester escarpment (Malott, 1948, p. 239), befitting the eastward-facing cuesta developed on the upper part of the Blue River Group and the lower part of the West Baden Group, but was formally named the "Springfield Escarpment" by Gray (2000, p. 8).

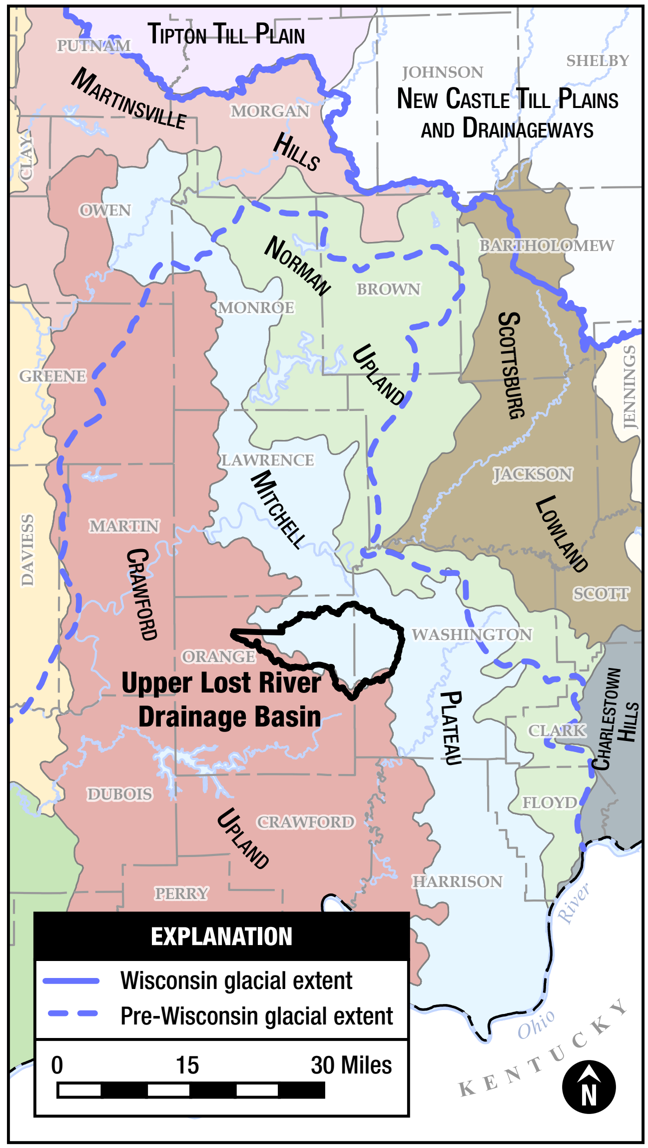


Figure 1. Map showing the location of the Upper Lost River drainage area within the Mitchell Plateau and the Crawford Upland (modified from Gray, 2000, plate 1).

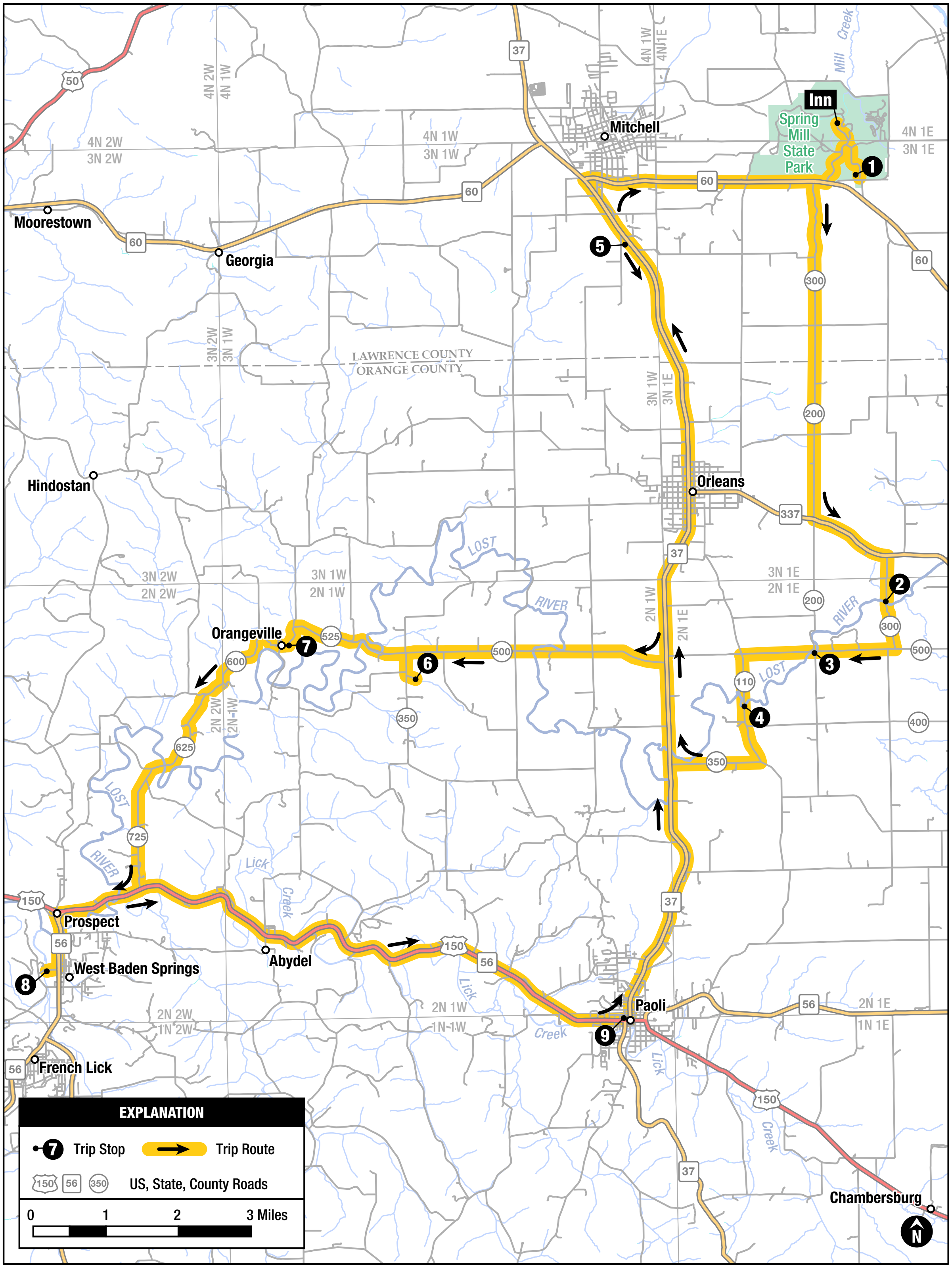


Figure 2. Route map for the Lost River Field trip.

Subsequent to the papers on Lost River by Malott (1922a, 1929, 1932, 1945?, 1949a, 1949b, and 1952), Malott and Shrock (1933), and Childs (1940), were several guidebooks for field trips by various authors, but which contained little new information. A few new caves were mapped, in particular, more than 20 miles of passages in the Lost River Cave system (Deebel, 2007, p. 27). But the major accomplishment since 1952 was the addition of a series of dye traces by Murdock and Powell (1968), Bassett (1976), Bolton (1980), W. W. Engineering & Science (1994), Bayless and others (1994), Earth Tech (1995), and Buehler and others (2002), that better defined the size of the Lost River drainage system.

The Lost River portion of the field trip consists of Stops 1 through 7 (fig. 2). Stop 8 is at the West Baden Springs Hotel and Stop 9 is at a gasoline station in Paoli. The route to Stop 1, Twin Caves, the type locality of the karst window and the sinkhole terrain southeast of Mitchell, type locality of the Mitchell Plain of C.A. Malott (1922, p. 94), is shown on Figure 3.

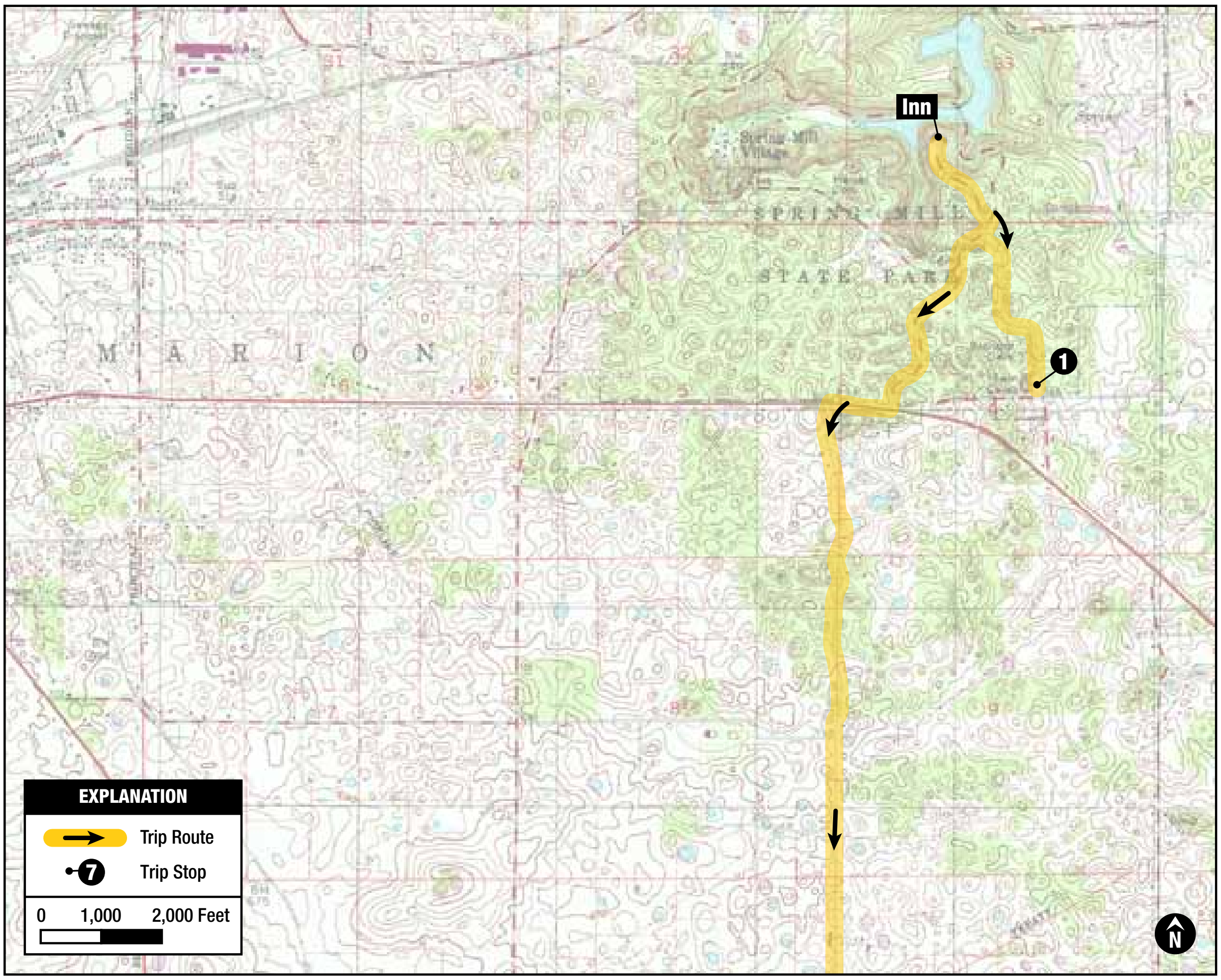


Figure 2. Map of a portion of the Mitchell Quadrangle showing the type area of the Mitchell Plain of Malott (1922, p. 94) and the route to Twin Caves, Stop 1.

STOP 1 – TWIN CAVES

Twin Caves (fig. 4) is a collapse sinkhole called a "karst window' by Malott (1932, p. 290), owing to the fact that the collapse provides a view or window into the cavern and cave stream that caused the collapse. Twin Caves was designated as the type locality by W. P. Von Osinski (1935). The collapse of the cave roof at Twin Caves progressed upward through about 50 feet of rock, the collapsed material dumping into the cave stream; this material was removed progressively by solution and erosion (fig. 5). The karst window at Twin Caves exposes about 200 feet of stream passage. The roof of the cave is generally within the St. Louis Limestone above the contact with the Salem Limestone. Bronson Caves, located about 500 feet north of Twin Caves, is a second example of a karst window. The cave stream exits its subterranean route at picturesque Donaldson Cave, located about 2,500 feet to the northwest.

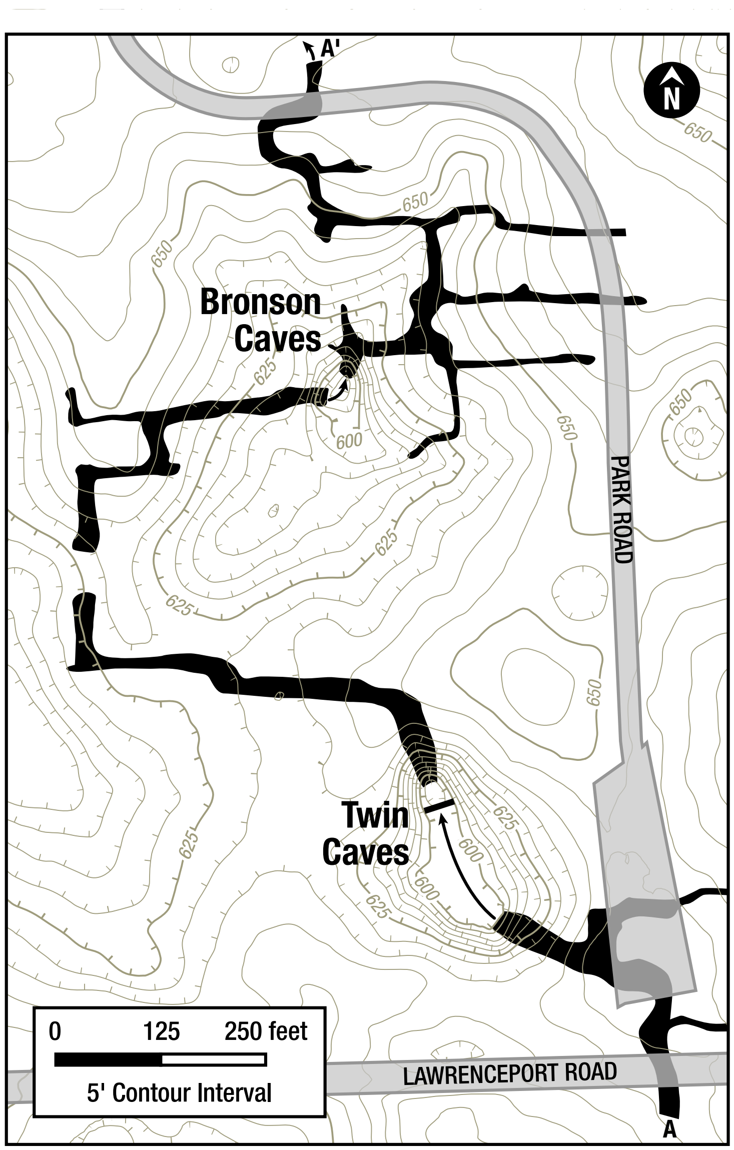


Figure 4. Map of the Twin Caves and Bronson Caves karst windows in Spring Mill State Park. Lidar base map and digital compilation by Matthew Johnson, Indiana Geological Survey.

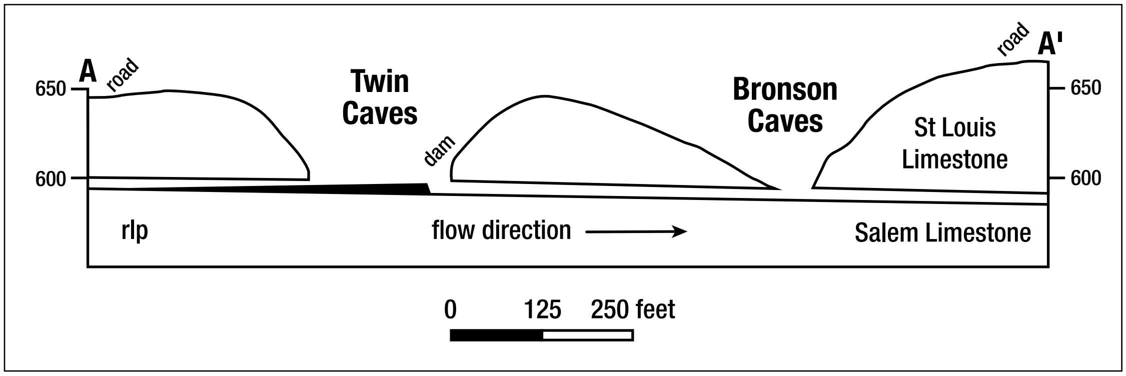


Figure 5. Generalized south-to-north cross section along cave passages of Twin and Bronson Caves.

STOP 2 – FLOW CONDITIONS

Do not exit the vehicle. This stop is to view the current flow condition of Lost River about a mile upstream of the "1st Sink" of Lost River (figs. 6 and 7). Lost River drains about 62 square miles above the First Sink from drainage in Orange and Washington Counties that is not characterized as typical of the sinkhole plain of the Mitchell Plateau. Although some sinkholes are present in places, much of the drainage area is typically surface drainage on relatively thick clay deposits. The flood plain of Lost River is about 1,500 feet wide at this point.

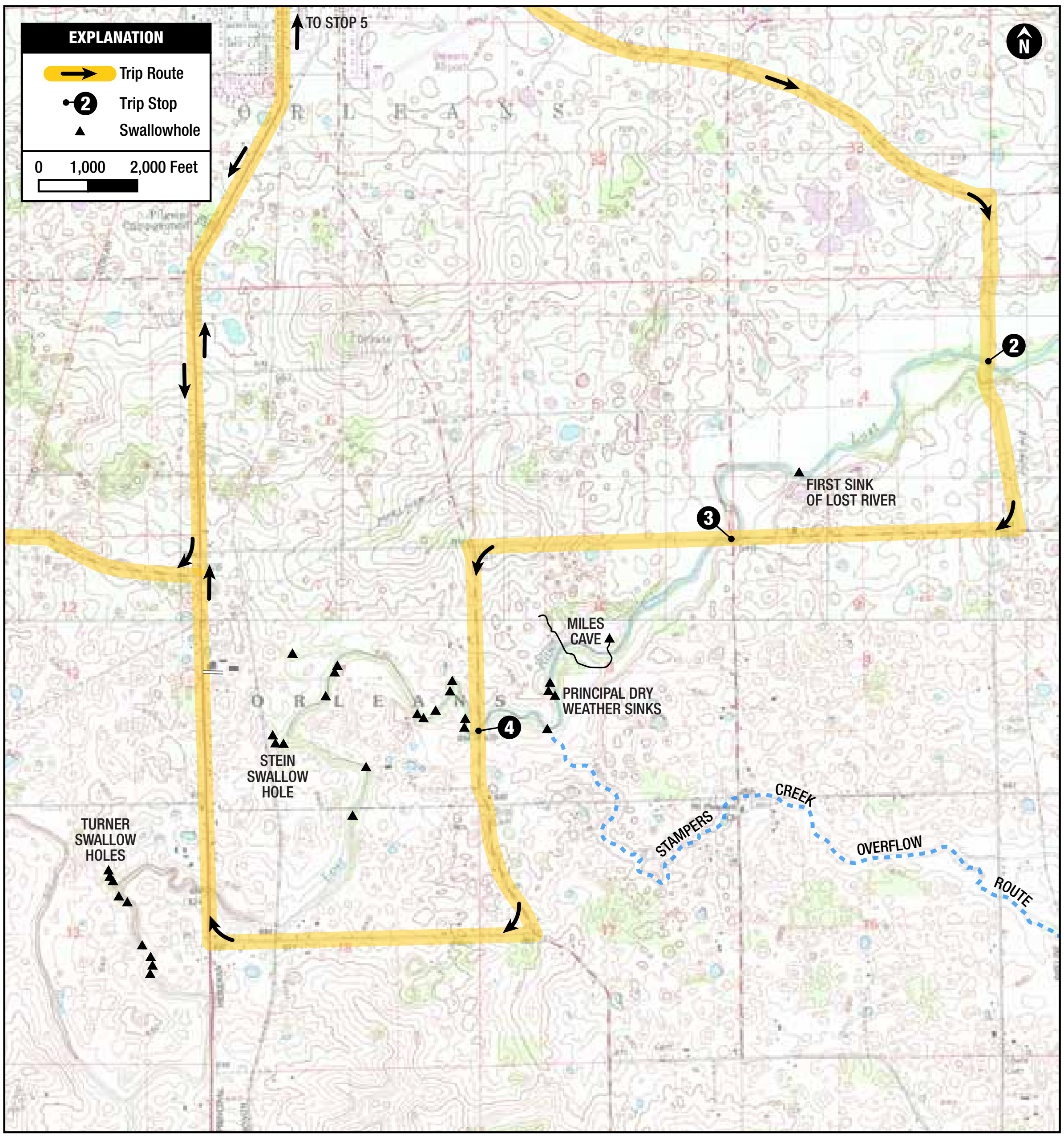


Figure 6. Topographic map showing the field trip route to Stops 2 through 5.

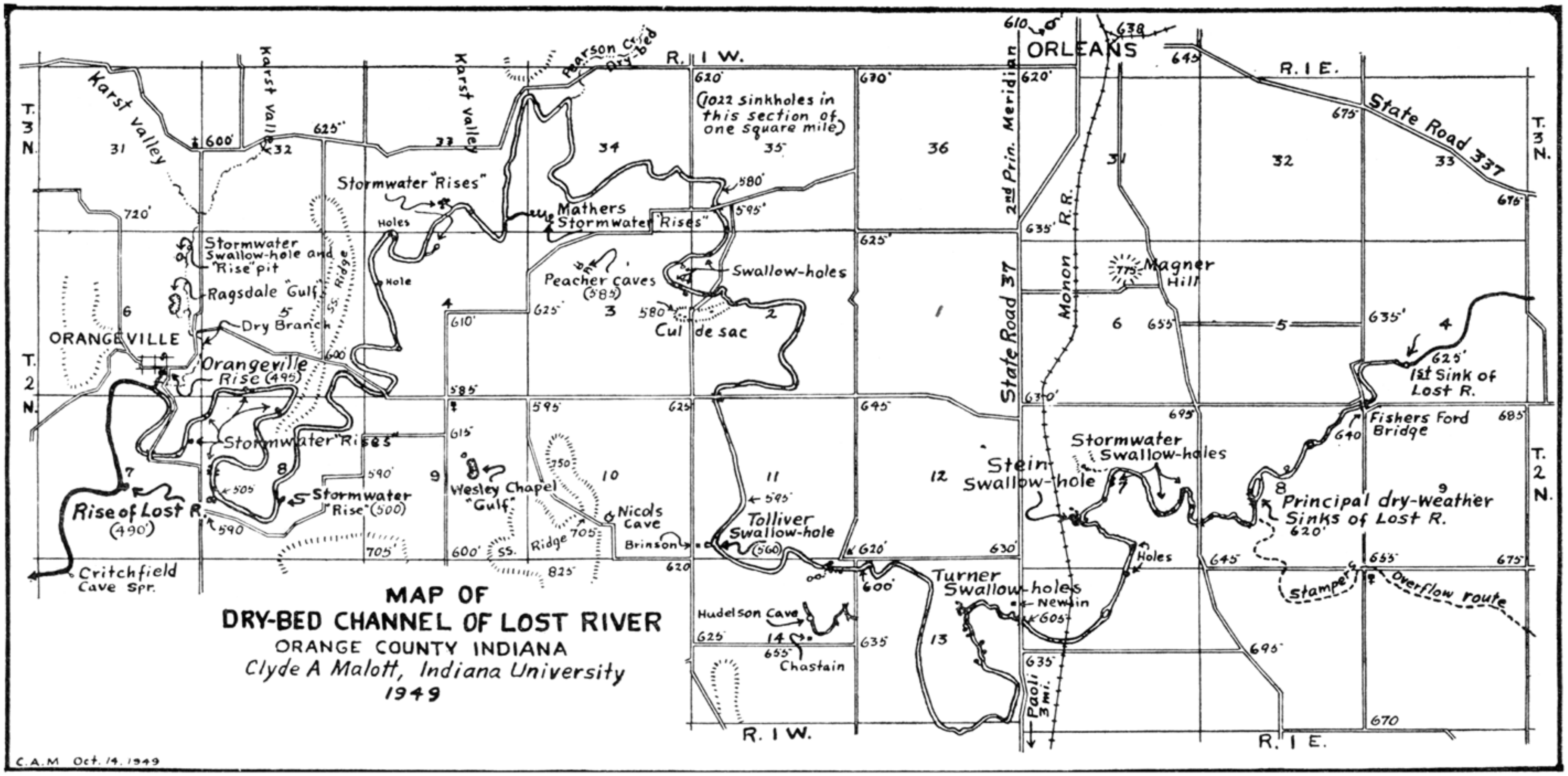


Figure 7. Map showing the major karst features of the Lost River subterranean drainage area (Malott, 1952, fig. 2).

STOP 3 – FISHER'S FORD BRIDGE

Quickly exit vehicles, using *caution*. The First Sinks of Lost River are located about 1,700 feet northeast of the bridge. These sinks consist of some surface drainage filtering into gravel during most of the year. The flood plain is about 1,300 feet wide at this point.

The upland area to the northwest and southeast of this location are along the eastern margin of the sinkhole plain of the Mitchell Plateau. Lost River is here in the area where it is partly incised into the flood plain and the flood plain is narrowing and deepening to become the "dry-bed" of Lost River.

STOP 4 – JOHNSON BRIDGE

Quickly exit vehicles, using *caution*. The Principal Dry-Weather Sinks of Lost River are located about 1,500 feet northeast of the bridge. The flood plain of Lost River is generally about 500 feet wide and consists mainly of the dry-bed. Miles Cave, located about 1,400 feet upstream of the Principal Dry-Weather Sinks, consists of 2,800 feet of passages that are about 10 feet high and 20 feet wide (R. E. Bates, 1932, unpublished map and notes). The map shows three side passages entering the cave, drainage from swallow holes or sinkholes. There is at least one swallow hole a few hundred feet west of the bridge, possibly now decorated with corn stalks, that is the site of the vortex in a swallow hole during a flood event photographed by C. A. Malott (1952, p. 200).

The direct distance from the Principal Dry-Weather Sinks of Lost River to the Rise at Orangeville is about 6.5 miles along a nearly east to west line, but the sinuous course of the dry-bed is 23 miles, more than 3 times the direct distance, along a meandering incised course that ranges from 2 miles south and 2 miles north of the direct route (fig. 7). The dry-bed is 12 to 16 feet in depth and has a gradient of about 4 feet per mile in the upper 12.5 miles of its course primarily across the Mitchell Plateau. The dry-bed increases to 20 to 50 feet deep and a gradient about 11 feet per mile for the next 6.5 miles generally where it is crossing into the Crawford Upland. The last 4 miles of the dry-bed to the Orangeville Rise has a gradient less than 4 feet per mile.

Generally, the Principal Dry-Weather Sinks mark the end of surface drainage of Lost River during most of the summer and during dry periods, leaving no water in the dry-bed all of the way to the Orangeville Rise. Light rain will cause this sink to overflow and channel water downstream to a progression of small and large swallow holes. Heavy continuous rainfall will be carried the full length of the dry-bed to the Orangeville Rise.

About 19 square miles of drainage sinks at the Sinks of Stamper's Creek, located about three miles to the southeast, but during exceptional storms some of the overflow water from Stamper's Creek flows overland to Lost River in the vicinity of the Principal Dry-Weather Sinks.

STOP 5 – EXCAVATED SINKHOLE

A sinkhole was excavated to a depth of about 55 feet where a stream with crawfish and other critters was encountered (fig. 8). Bedrock was found within the bottom few feet. The stream was dye traced to Hamer Cave in Spring Mill State Park.

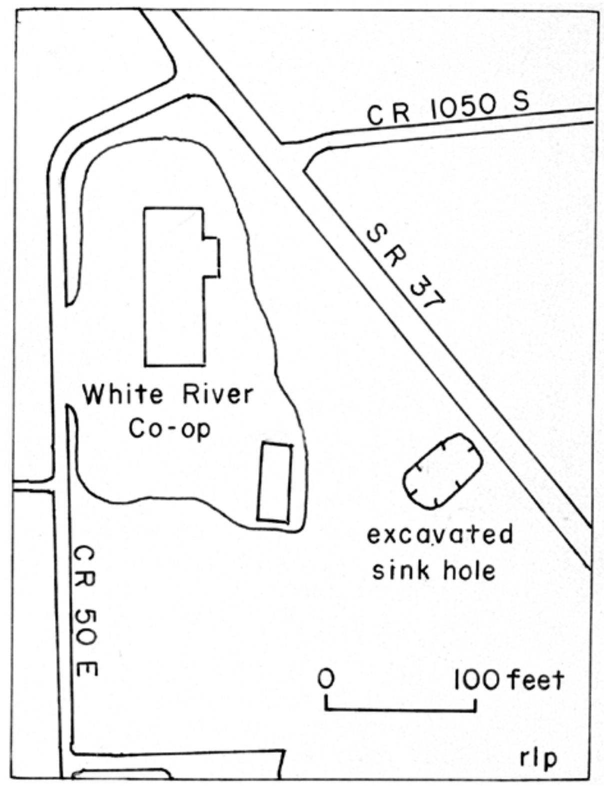


Figure 8. Sketch map showing location of excavated sinkhole.

STOP 6 – WESLEY CHAPEL GULF

Quickly exit vehicles and follow south along mowed path to and down into Wesley Chapel Gulf, which is owned by the U.S. Forest Service (fig. 9). Wesley Chapel Gulf was named by Elrod and McIntire (1876, p. 215), but has also been called the "Shirley gulf," and is labeled the "Elrod Gulf" by the U.S. Geological Survey on its 1:24,000-scale topographic map.

The steep perimeter of the collapse sinkhole at Wesley Chapel Gulf encloses about 8.3 acres and contains an alluvial floor of 6.1 acres, is 1,070 feet long and 325 to 350 feet wide, making the gulf one of the more impressive karst features in the Lost River area (fig. 10).

The steep perimeter of the rim of the gulf is from about 25 to 95 feet high. Nearly the entire floor of the gulf is an alluvial flood plain created by deposition of sediment from storm waters discharged from the Gulf Rise of Lost River located in the southeast end of the gulf. A submerged cave passage with a diameter of about 3 feet descends about 160 feet to a large passage about 10 feet high and 30 feet wide for a distance of at least 200 feet (S. D. Maegerlein, 1983, personal commun.). This passage is about 45 feet below normal pool level and extends northeastward at an altitude of about 510 feet (fig. 11). During periods of stormwater discharge the initial flow follows a 20-foot-deep channel along the southern rim of the gulf to a series of swallow holes and terminating at a major swallow hole near the entrance to underground passages of Lost River. During some floods the water has flowed northwestward in channels 5 feet deep along the western edge of the gulf. Extreme storms can cause water to flow out of the rise pit, fill all of the channels, and overflow the entire floor of the gulf to a depth of 3 to 5 feet. During the time that the gulf was mapped in 1931, Malott (1932, p. 294) counted 100 swallow holes in the floor of the gulf.

C. A. Malott (1932, fig. 3 and p. 308) and R. R. Shrock mapped 5,175 feet of passages in the

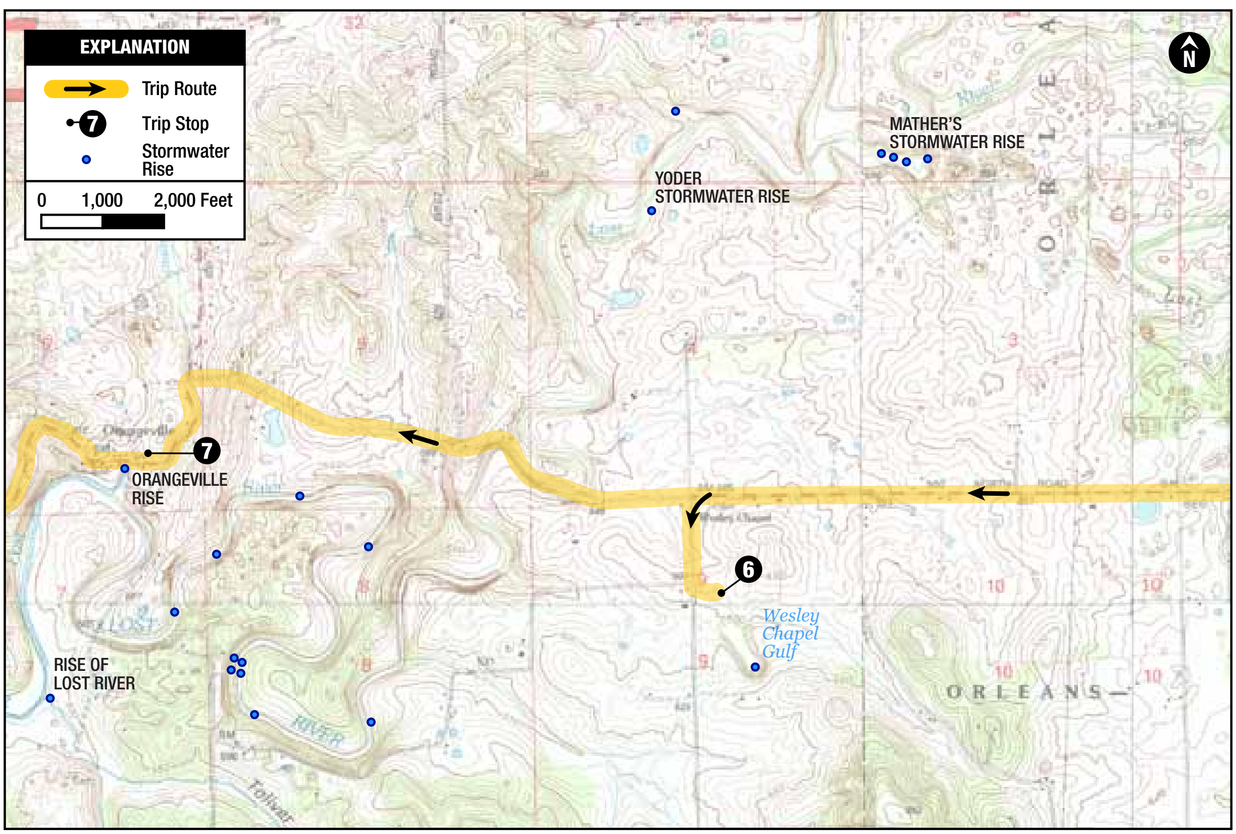


Figure 9. Topographic map showing the field trip route to Wesley Chapel Gulf, Stop 6, and the Orangeville Rise, Stop 7.

Lost River subterranean system. The map published in 1952 (Malott, 1952, p. 214) retained a reduced version of the map published in 1932, (dated 1931) but with the addition of about 200 feet of additional mapped passages, which made the mapped length more than 1 mile. The labyrinth or network character of some of the underground extent of the cave is evident from the map and the descriptions provided by Malott, including the broad extent of the passage in Elrod Cave where circular area 90 feet in diameter of the ceiling had collapsed.

The mapped passages of the underground Lost River Cave System were extended to 20.55 miles as of January 2007 (Deebel, 2007, p. 37) (fig. 12). The initial survey work was in Boiling Spring and Elrod Caves in 1996, but started in Lost River Cave in Wesley Chapel Gulf in January 1997 as a project by members of the St. Joseph Valley Grotto of the National Speleological Society. Ninety-two people were involved with the survey and 18 of them mapped more than a mile of passages. More than 250 leads remain to be mapped in the system.

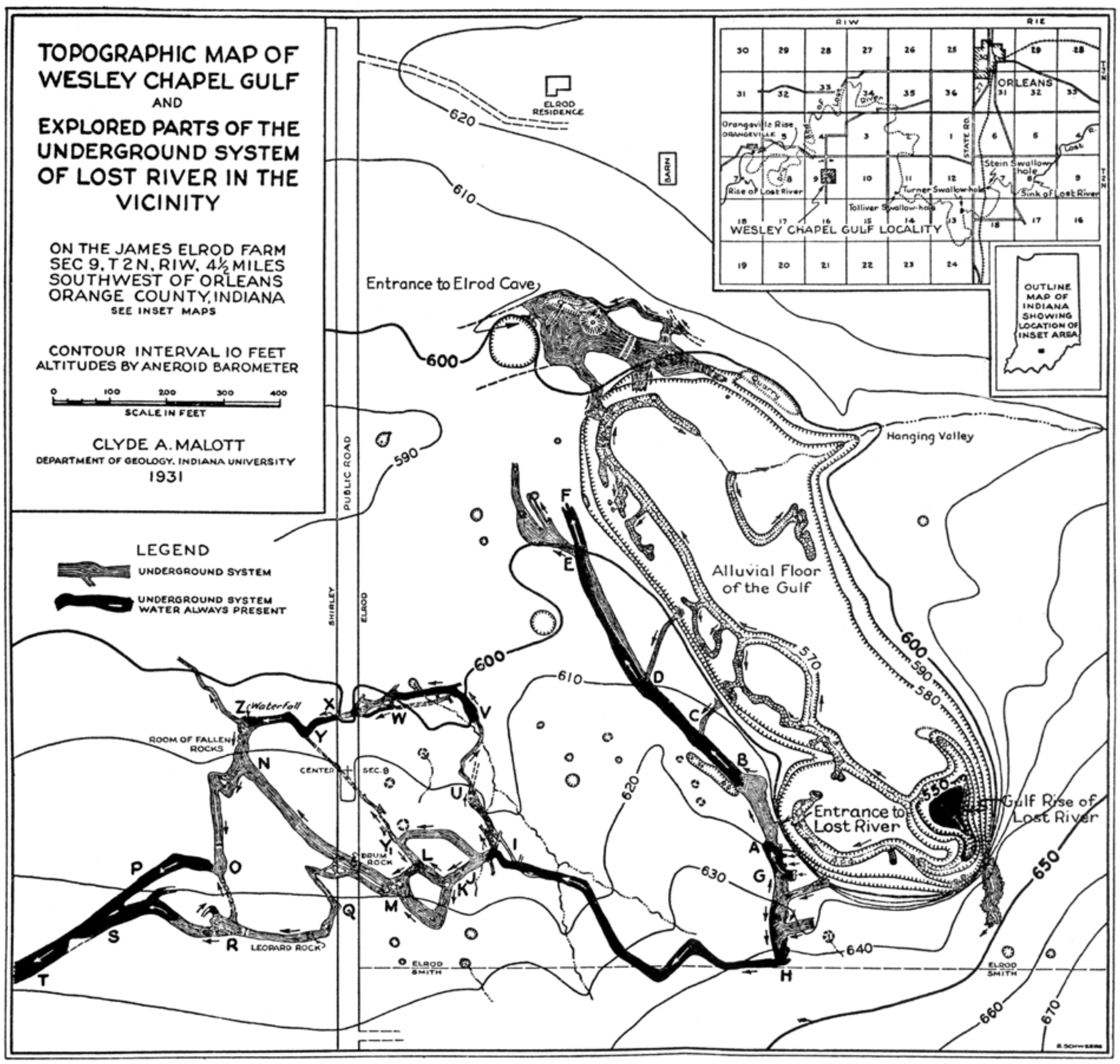
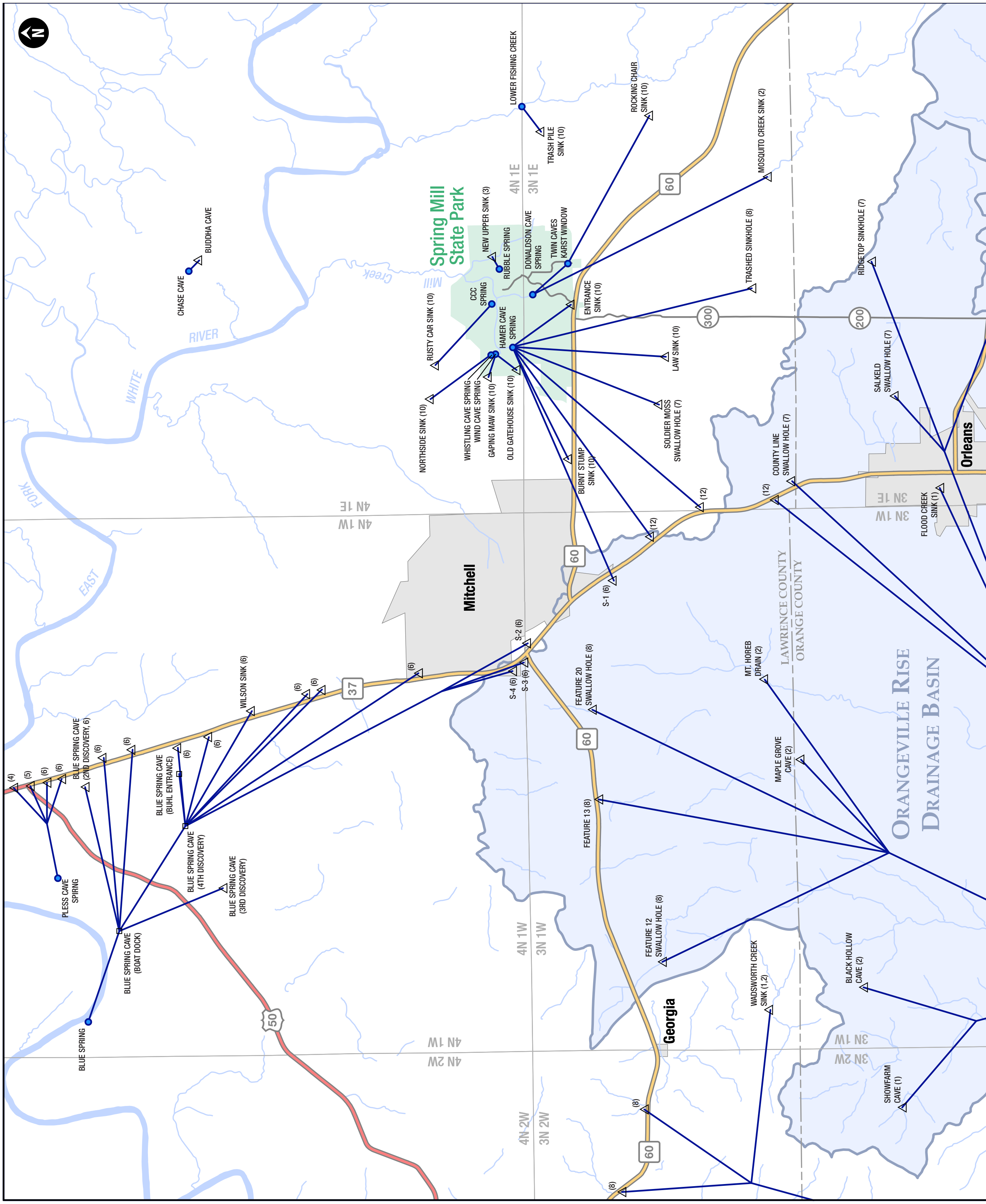


Figure 10. Topographic map of Wesley Chapel Gulf by C. A. Malott (1932, fig. 3).


Spring Mill State Park
Mitchell
Orleans
Georgia
Orangeville Rise Drainage Basin
Lawrence County
Orange County
White River
East Fork
Mill Creek
4N 1E
3N 1E
4N 1W
3N 1W
4N 2W
3N 2W
Lower Fishing Creek
Trash Pile Sink (10)
Rocking Chair Sink (10)
Mosquito Creek Sink (2)
Trashed Sinkhole (8)
Ridgetop Sinkhole (7)
New Upper Sink (3)
Rubble Spring
Donaldson Cave Spring
Twin Caves Karst Window
Entrance Sink (10)
CCC Spring
Hamer Cave Spring
Rusty Car Sink (10)
Northside Sink (10)
Whistling Cave Spring
Wind Cave Spring
Gaping Maw Sink (10)
Old Gatehouse Sink (10)
Burnt Stump Sink (10)
Law Sink (10)
Soldier Moss Swallow Hole (7)
County Line Swallow Hole (7)
Salkeld Swallow Hole (7)
Flood Creek Sink (1)
S-1 (6)
S-2 (6)
S-3 (6)
S-4 (6)
Feature 20 Swallow Hole (8)
Feature 13 (8)
Feature 12 Swallow Hole (8)
Mt. Horeb Drain (2)
Maple Grove Cave (2)
Black Hollow Cave (2)
Wadsworth Creek Sink (1,2)
Showfarm Cave (1)
Chase Cave
Buddha Cave
Wilson Sink (6)
Blue Spring Cave (2nd Discovery, 6)
Blue Spring Cave (Buhl Entrance)
Blue Spring Cave (4th Discovery)
Blue Spring Cave (3rd Discovery)
Blue Spring Cave (Boat Dock)
Pless Cave Spring
Blue Spring
37
50
60
200
300

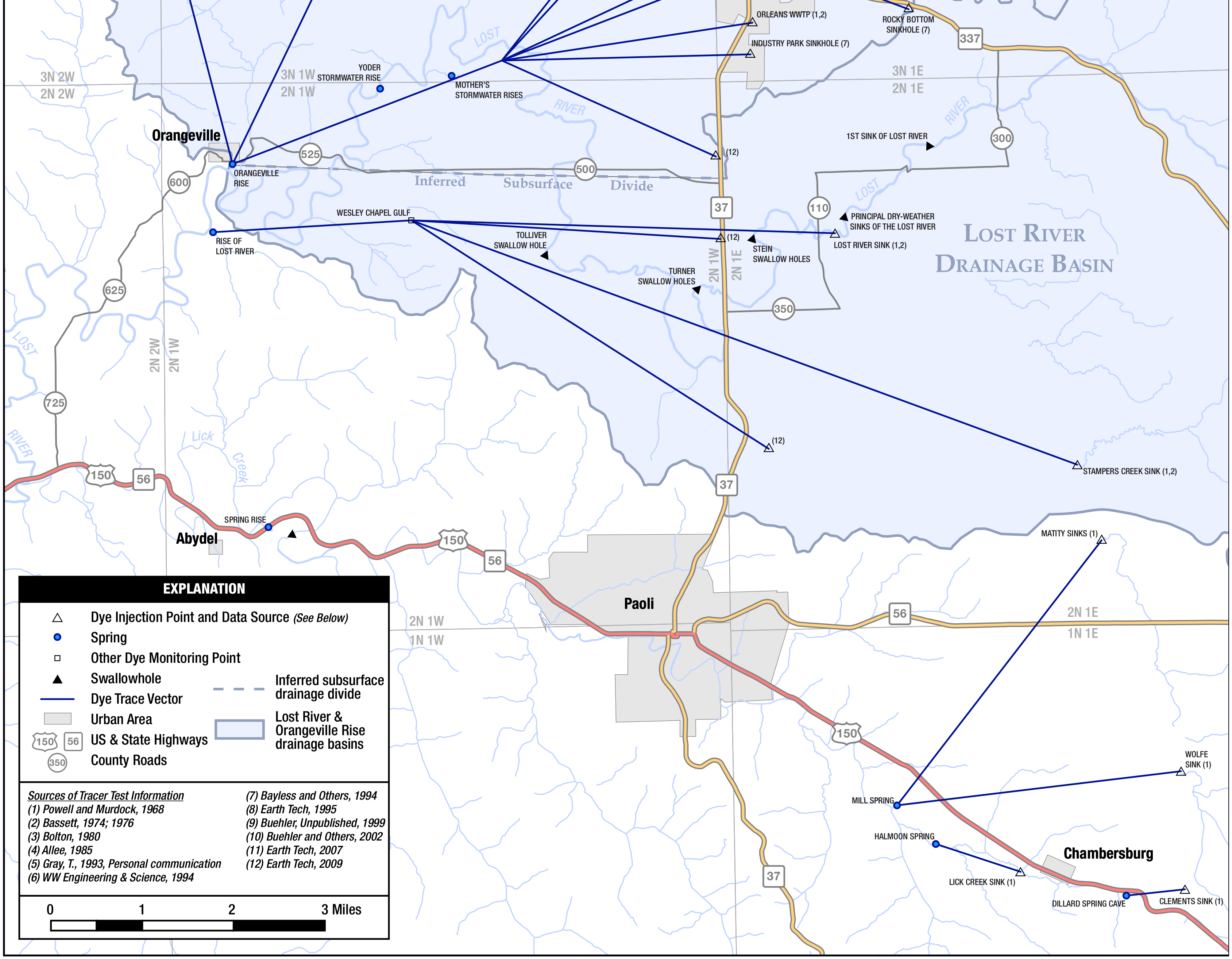


Plate 1. Map showing completed dye trace vectors in the area of Blue Spring Cavern, Mill Creek, Orangeville Rise, Lost River and Lick Creek drainage basins (modified from map compiled by John Bassett, 2009, for Earth Tech AECOM).

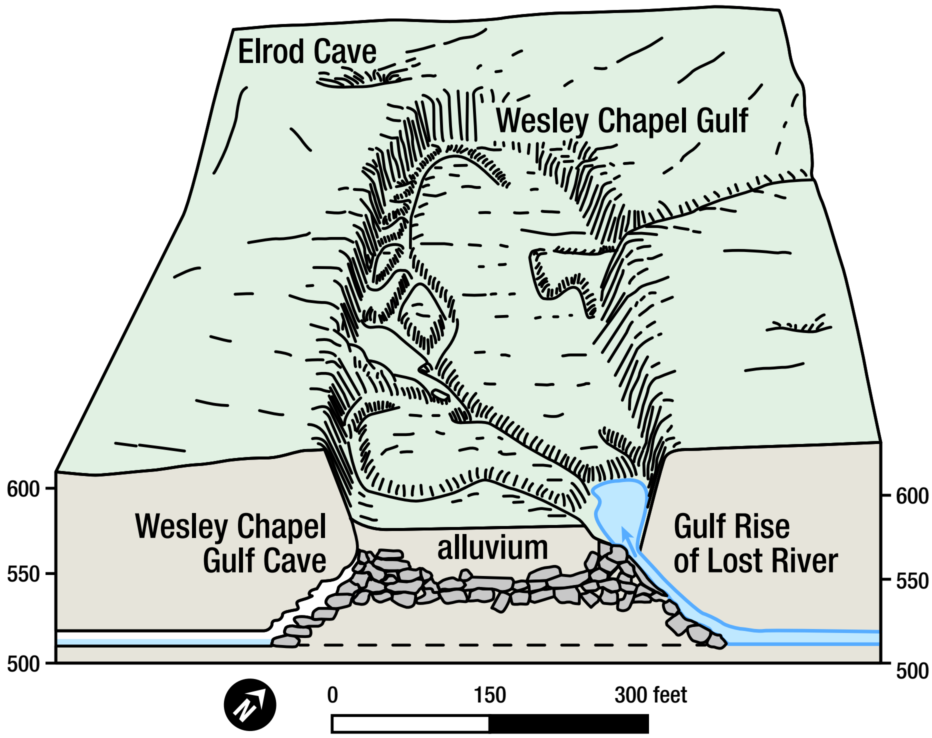


Figure 11. Idealized block diagram showing subterranean drainage at Wesley Chapel Gulf.

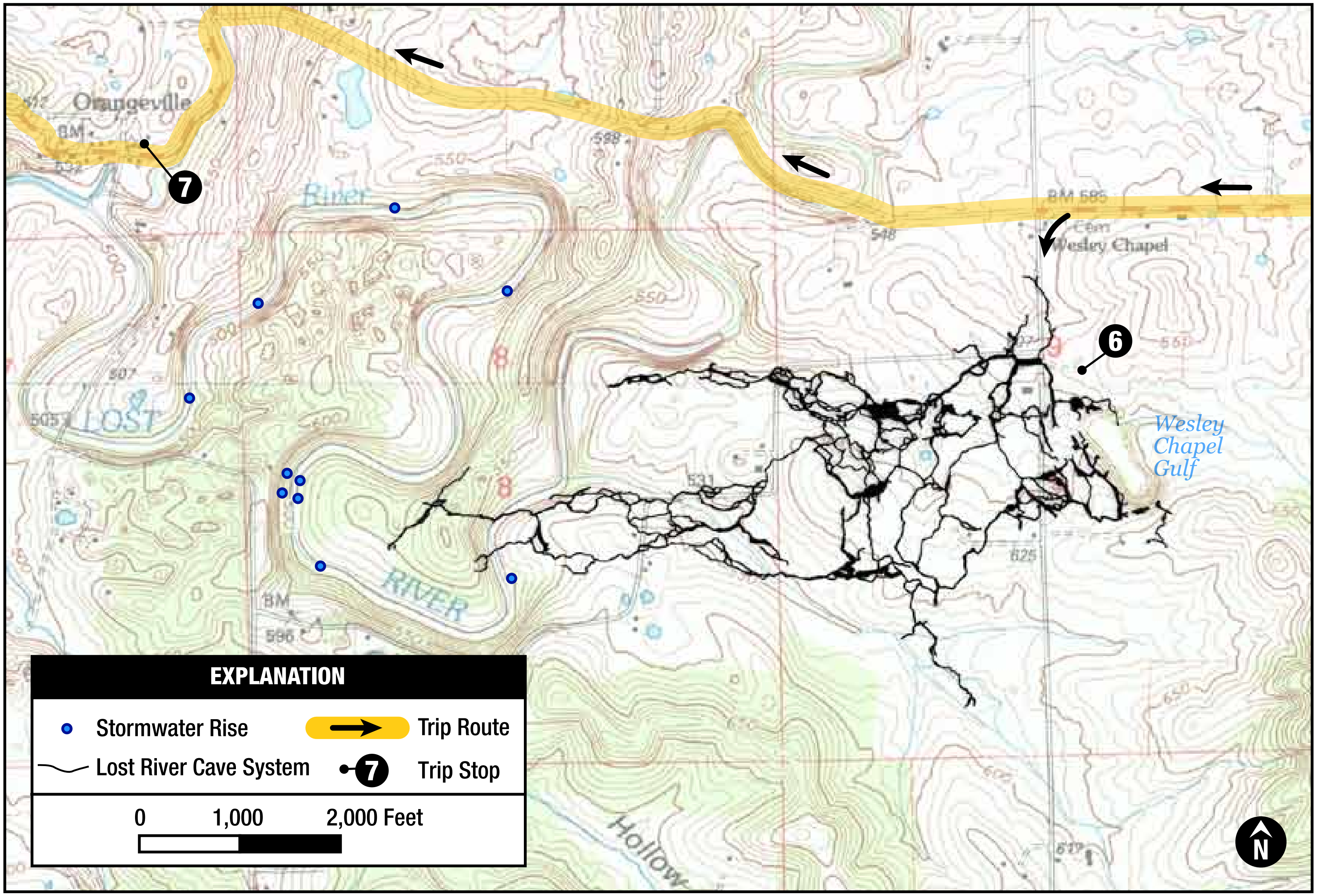


Figure 12. Topographic map showing the subterranean routes of more than 20 miles of passages of the Lost River Cave System (modified from Deebel, 2007, p. 164).

STOP 7 – ORANGEVILLE RISE AND LUNCH STOP

The Orangeville Rise is the resurgence of subterranean drainage from the area adjacent to the north of the drainage basin of Lost River. The Rise of Lost River is not currently accessible to visitation, nor is the Rise of Lost River as scenic as the Orangeville Rise. The Orangeville Rise consists of two or more openings just in front of the limestone ledge at a depth of about 20 feet during periods of normal flow (fig. 13) (Quinlan and others, 1983, p. 76). Divers have entered flooded passages for several feet at a depth about 10 feet below the bottom of the basin.

The Orangeville Rise is the second largest spring in Indiana, the Rise of Lost River is the third largest spring, although there is little difference between the two. Harrison Spring in Harrison County, Indiana, is the largest, based on low flow estimates. The minimum measured discharge at the Orangeville Rise is 8.9 cfs and the maximum discharge has a limit at about 180 cfs (Bassett, 1974, p. 30 and fig. 12) (fig. 14). The limit on discharge at the Orangeville Rise is caused by discharges of floodwaters at the Mather's Stormwater Rises, located about 2.5 miles northeast of Orangeville, into the dry-bed about 8 miles upstream of the Rise at Orangeville. The limit indicates the subsurface flow has attained a full pipe-flow condition. The amount of sulfate ions, as well as sodium, chloride, and magnesium, was reduced greatly with increased flow of floodwater through the system, indicating that a finite amount of sulfate was derived from underlying gypsum beds but was diluted with increased stormwater flow (fig. 15) (Bassett, 1974, p. 47).

The true Rise of Lost River is located about 0.8 miles south-southeast of Orangeville. The Rise of Lost River is a nearly vertical solution enlarged pit about 160 feet deep (fig. 16) (Quinlan and others, 1983, p. 77). A large, as yet unexplored passage, may be approximately in the stratigraphic position of the gypsum beds in the St. Louis Limestone.

A specific continuous hydrograph record for the Rise of Lost River is lacking. Heavy storms cause flow from a half-dozen or more stormwater rises in the dry-bed 2 to 5 miles above the Rise of Lost River; the fact that such storms cause overland flow and flooding within the dry-bed suggests there is likely a similar maximum subterranean flow limit on the Rise of Lost River as at the Orangeville Rise.

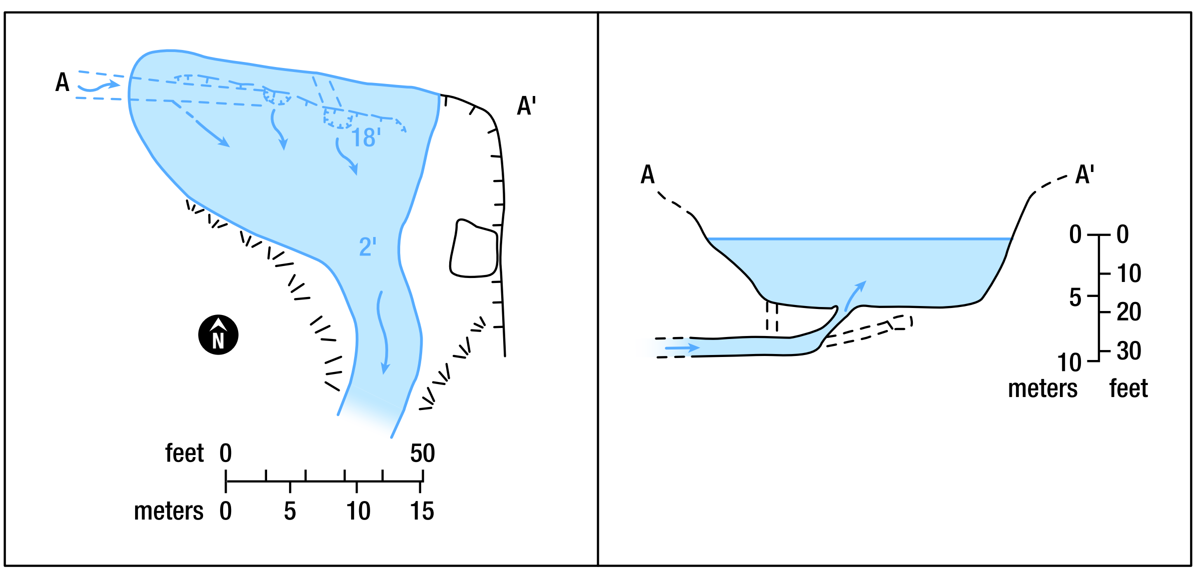


Figure 13. Sketch map and cross section of the Orangeville Rise by Steven Maegerlein (Quinlan and others, 1983, p. 76).

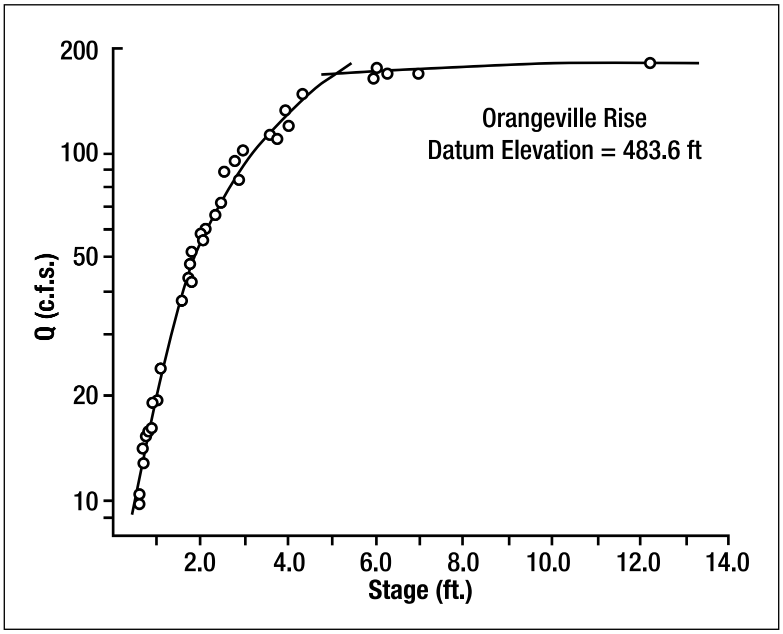


Figure 14. Graph showing the recorded flow regime of the Orangeville Rise (modified from Bassett, 1974, p.30, fig. 12).

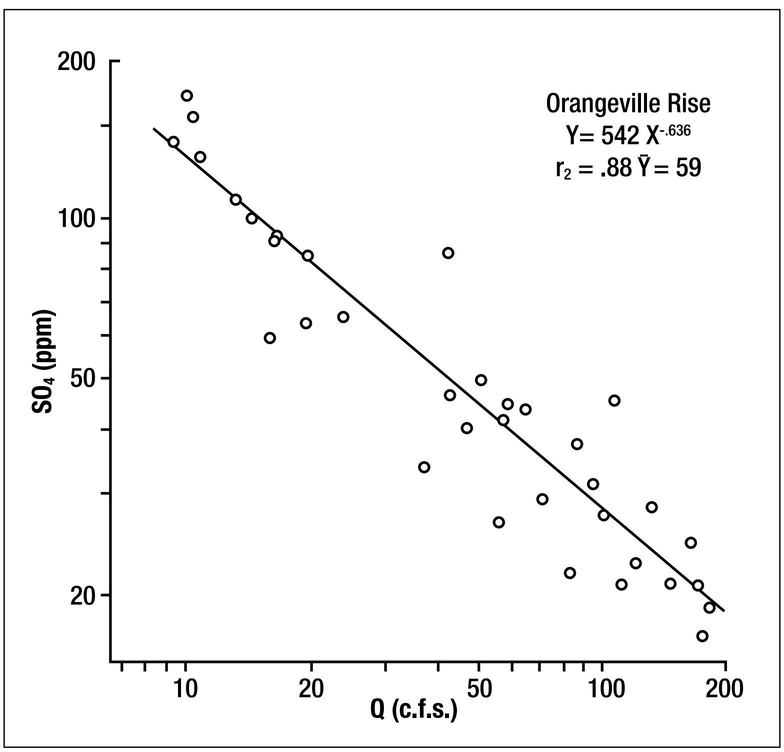


Figure 15. Graph showing the decrease of sulfate with increase of flood waters (modified from Bassett, 1974, p. 47).

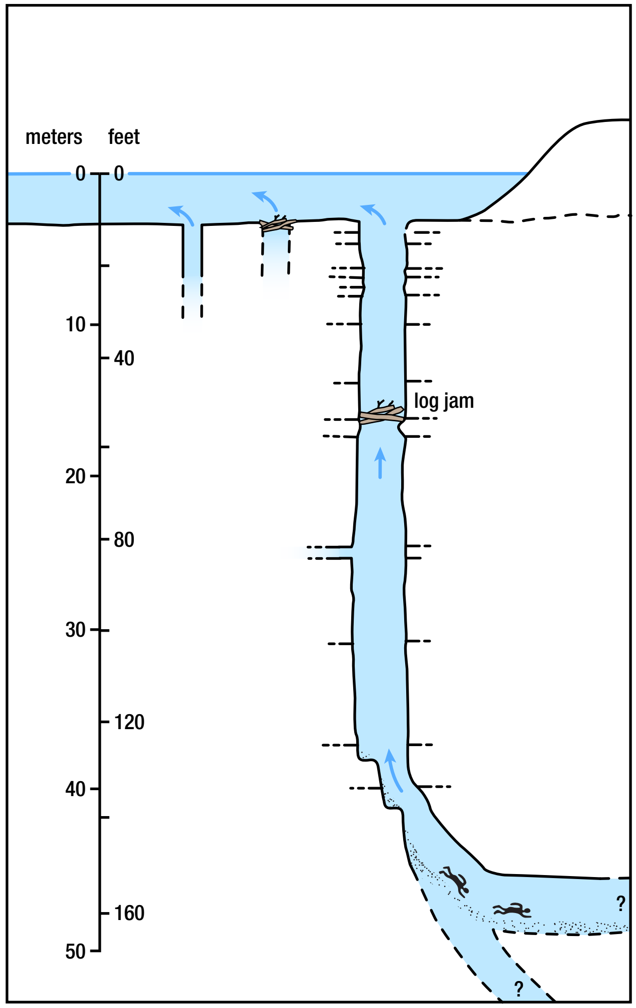


Figure 16. Sketch cross section showing the Rise of Lost River by Steven Maegerlein (Quinlan and others, 1983, p. 77).

STOP 8 – WEST BADEN SPRINGS HOTEL

This will be a quick stop to observe the restoration of this historic hotel (fig. 17) by Bill and Gayle Cook.

Figure 17. Photograph of the West Baden Springs Hotel in French Lick, Indiana.

STOP 9 – CIRCLE A 104 GASOLINE STATION

This site is an active gasoline sales station on Main Street, Paoli, Indiana, that has been active since the 1930s. A petroleum release at this site was reported to the Indiana Department of Environmental Management on March 5, 2008. We will focus on the site characterization activities, including evaluation of petroleum distillate in bedrock voids, the development of the corrective action plan to remove the petroleum residuals from groundwater, the implementation of the corrective action plan, and the operation and maintenance of the petroleum remediation system. There are a couple of closed stations along Main Street, U.S. Hwy. 150, west of this site.

ACKNOWLEDGMENTS

This field trip would not have been possible without the contribution of many people. First, I must acknowledge the abundant publications of Clyde A. Malott, whose detailed knowledge of the Lost River area is likely unequaled by anyone. Secondly, I must thank the staff of the Indiana Water Resources Association who made this trip happen: Mark S. Hopkins and Jeffrey D. Martin with the U.S. Geological Survey, Indianapolis; and Rosemarie N. Hansel with the Marion County Health Department, who arranged and rearranged the transportation. I have great appreciation for Ginger Korinek, Lost River Watershed Coordinator, U.S. Department of Agriculture, Paoli, for helping on the initial route selection and for arrangements related to dye tracing from the vicinity of Orleans.

A great thank you to the staff of the Indiana Geological Survey: Todd Thomspon, who requested staff support for this project; Barbara Hill and John Day, who scanned illustrations; Matthew Johnson and Laura Montgrain, who generated all the digital maps and illustrations, and to Deborah DeChurch, who edited and formatted the guidebook.

I must especially thank John Bassett for supplying information on dye tracing that he conducted and absorbed from other writers. Samuel Frushour, David Everton, and Keith Dunlap contributed information related to cave maps.

Special thanks to a few landowners who allowed us to visit their property, particularly to the White River Co-op south of Orleans and to the management of the West Baden Springs Hotel for access to their facility. Last, but not least, to Thelma Talbert, with the Orangeville Community Center, who allowed us to use their facilities for a lunch and rest stop.

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