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U.S. Department of the Interior

Mammoth Cave National Park
Kentucky

Mammoth Cave Historic District

Cultural Landscape Report

100% DRAFT — MARCH 2021

Cultural Resources, Partnerships and Science Division

Southeast Region

Mammoth Cave Historic District

Mammoth Cave National Park, Kentucky

Cultural Landscape Report

100% DRAFT – March 2021

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About the front cover: Mammoth Cave, Pass of El Ghor near the Black Hole of Calcutta, June 2017. (Source: Liz Sargent HLA)

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Mammoth Cave Historic District

Mammoth Cave National Park, Kentucky

Cultural Landscape Report

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Foreword

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Management Summary

Introduction

The purpose of Mammoth Cave National Park is to preserve, protect, interpret, and study the internationally recognized biological and geologic features and processes associated with the longest known cave system in the world, the park's diverse forested, karst landscape, the Green and Nolin Rivers, and extensive evidence of human history. Further, the park provides and promotes public enjoyment, recreation, and understanding of its natural and cultural resources.

Mammoth Cave National Park is located in south-central Kentucky midway between Louisville, Kentucky, and Nashville, Tennessee. Mammoth Cave was established as a national park on July 1, 1941, for the purpose of preserving the extensive system of underground passages and formations that had long been the object of exploration, scientific research, and tourism. Today, at a length of at least 412 miles, the system of passages documented within Mammoth Cave is considered to be the longest in the world. The importance of Mammoth Cave has been recognized through its designation as a UNESCO (United Nations Educational, Scientific, and Cultural Organization) World Heritage Site on October 27, 1981, and as part of an International Biosphere Reserve on September 26, 1990.[1] Much of the area that has been the focus of tourism and other historic period cultural use is listed in the National Register of Historic Places as the Mammoth Cave Historic District.[2]

More than two million people visit Mammoth Cave National Park each year, with approximately 500,000 of them participating in a tour of the cave (Figure 1). Most visitors enter the cave through a large natural opening known as the Historic Entrance that is located in proximity to the park visitor center, although tours are also routed through five additional human-made entrances within the park. Visitors experience the cave, and its constant, year-round temperature of 54 degrees Fahrenheit, as part of one of the various guided tour offerings. The length and difficulty of each tour is outlined in detail at the visitor center. The tours traverse carefully selected routes that illustrate the cave's range of passages, large chambers, small crawl spaces, deep pits, steep domes, intricate formations, and cultural artifacts. Visitors also learn about the numerous animal species that occupy the cave interior, such as the varieties of eyeless fish in the underground streams.[3]

Since the early nineteenth century, the individuals and organizations involved in accommodating visitors to the cave have created systems of trails, stairs, bridges, overlooks, and gathering spaces to facilitate access. The earliest visitors, led by enslaved guides, experienced the cave with only

1. The International Biosphere Reserve extends over 909,295 acres, including the land above Mammoth Cave. Land use and management practices are recommended for the Reserve as a way to adequately protect the sensitive natural resources associated with the region from development that would potentially lead to pollution of important aquifers.
2. Kelly A. Lally, *Mammoth Cave Historic District,* National Register of Historic Places Nomination (#91000503, listed May 8, 1991).
3. National Park Service, Statement of Work for Mammoth Cave Historic District Cultural Landscape Report Services (May 2016), 3.

the aid of grease- or oil-fueled lanterns. They followed relatively narrow trails littered with uncleared rocks and rubble in some places, and sometimes wet or muddy in others. Where the trail edged steep slopes or drop-offs, wooden handrails were sometimes provided, while wooden bridges and wood or stone stairs were used to span pits and chasms. Many of the early trails were improved upon during the 1930s by the Civilian Conservation Corps (CCC), work that entailed moving a tremendous amount of rock and soil to create a more stable systems of paths, stairs, walls, causeways, and handrails and guardrails through toured sections of Mammoth Cave. Additional improvements were made during the 1950s and 1960s as part of the federally funded Mission 66 program, including walls, stairs, an elevator, handrails and guardrails, seating, electrical system upgrades, restroom facilities, a dining area, and drinking fountains.

Since the 2000s, the National Park Service (NPS) has been evaluating the safety and condition of cave trails, bridges, guard rail systems, stairs, and other features, and their impact on natural resources. The park has already updated many of the access features associated with accommodating visitors within the Mammoth Cave Historic District and continues to plan for additional improvements. Alterations have included the replacement or addition of entry gates, handrails, and bridges, and the introduction of an electric lighting system into certain of the most heavily toured areas of the cave. All alterations have been made to enhance the enjoyment, accessibility, and safety of visitors to Mammoth Cave. Because these changes have their roots in the cave's historic utilization as a tourist attraction, these alterations are compatible with the historical motives that led to the development of the cave.[4] Despite these changes, the cave exhibits a good degree of overall integrity for the pre-World War II era of development currently recognized as significant and listed in the National Register of Historic Places.

To address the impact of additional proposed access upgrades and other management concerns associated with the Mammoth Cave Historic District, the NPS engaged a consultant team of preservation professionals to prepare this Cultural Landscape Report (CLR). The team was led by Panamerican Consultants, Inc., Buffalo, New York, and included Wiss, Janney, Elstner Associates (WJE), Northbrook, Illinois, and Liz Sargent Historic Landscape Architect (HLA) of Charlottesville, Virginia. The management guidance provided in this CLR is based on detailed documentation of historic and existing conditions, the identification of character-defining features, National Register significance evaluation and integrity assessment, and treatment guidelines and recommendations designed to address the specific needs and concerns of the NPS related to the Mammoth Cave Historic District.

FIGURE 1. Visitors experiencing the Rotunda area of Mammoth Cave Historic District, which includes surviving evidence of early nineteenth-century saltpetre extraction activities. (All photographs by the authors unless otherwise noted)

The CLR follows the guidance afforded in several NPS planning and compliance documents, such as the Mammoth Cave General Management Plan (1983) and Foundation Document (2014). Work conducted in support of the CLR has also reflected the concurrent preparation by the NPS of a Cave Management Plan, as well as a trail improvement project.

4. National Park Service, Statement of Work for Mammoth Cave Historic District Cultural Landscape Report Services (May 2016), 3.

Description of Study Area Boundaries

Mammoth Cave National Park is in the east-central portion of the Commonwealth of Kentucky. Most of the park falls within Edmonson County, although small portions extend into Hart and Barren Counties, Kentucky (Figure 2). The cave study area extends southeast from the Historic Entrance, which is in the Core Visitor Services Area near the visitor center (Figure 3). The Core Visitor Services Area is accessed from Mammoth Cave Parkway. Five additional entrances are located along internal park roads. These are known as Violet City, Carmichael, the Elevator, New Entrance, and Frozen Niagara (Figure 4).

The CLR study area encompasses the cave passages that have traditionally supported tourism. These are shown in red and purple on Figure 5. The current Wild Cave Tour, shown in green, also includes some passages that are addressed by the CLR.

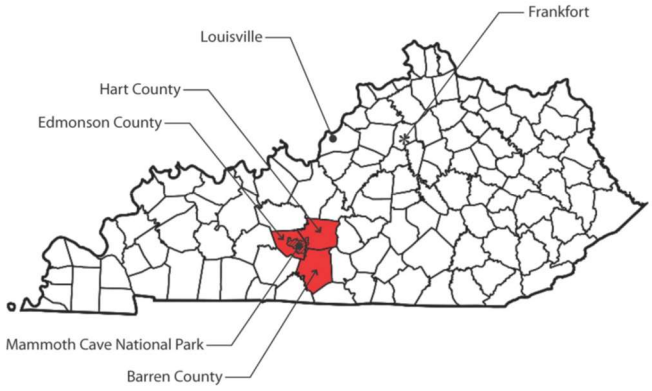

FIGURE 2. Mammoth Cave National Park Context Map (not to scale). (Source: Mammoth Cave National Park Core Visitor Services Area CLR)

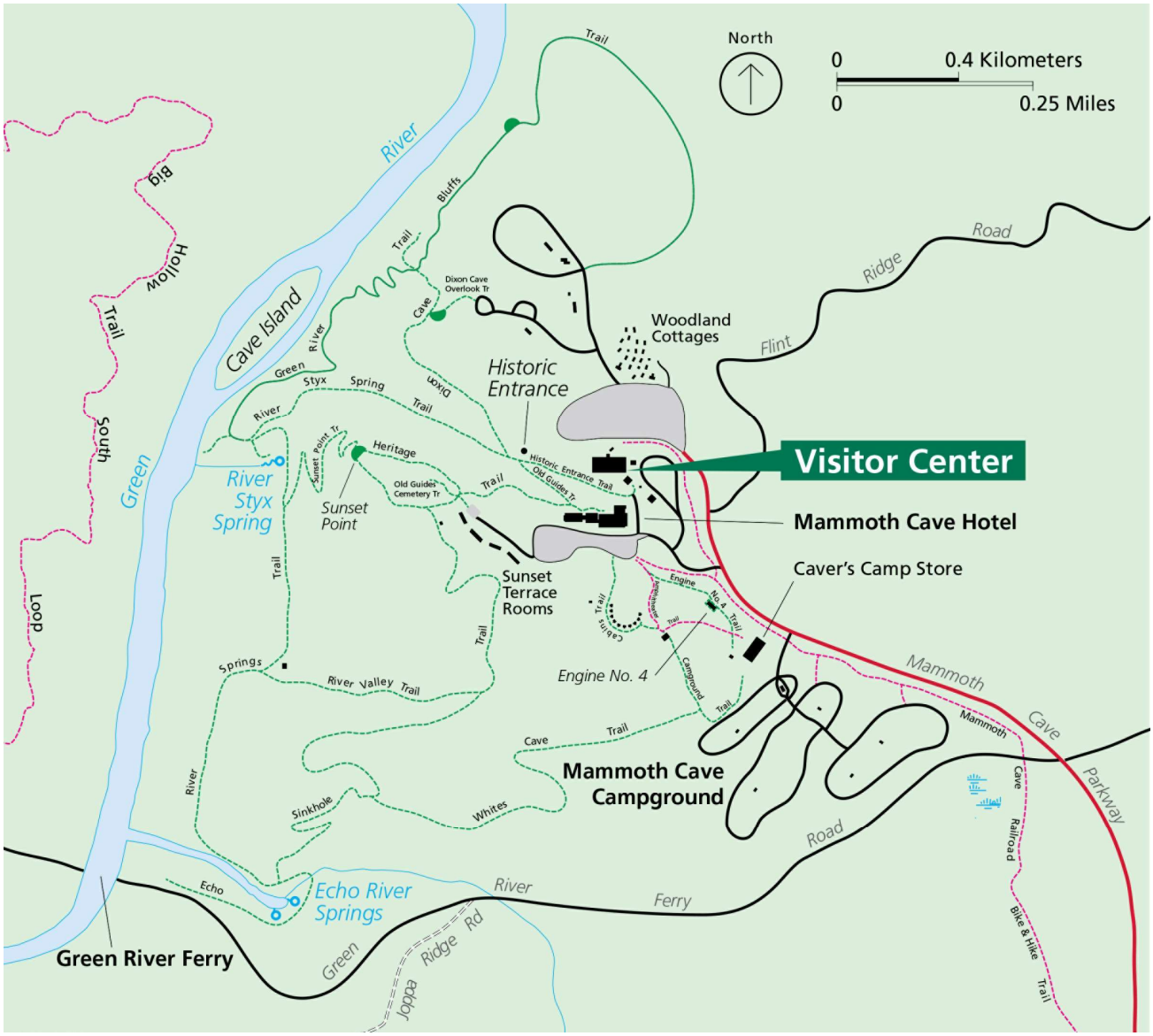

FIGURE 3. Detail map of the Mammoth Cave National Park Core Visitor Services Area. (Source: National Park Service)

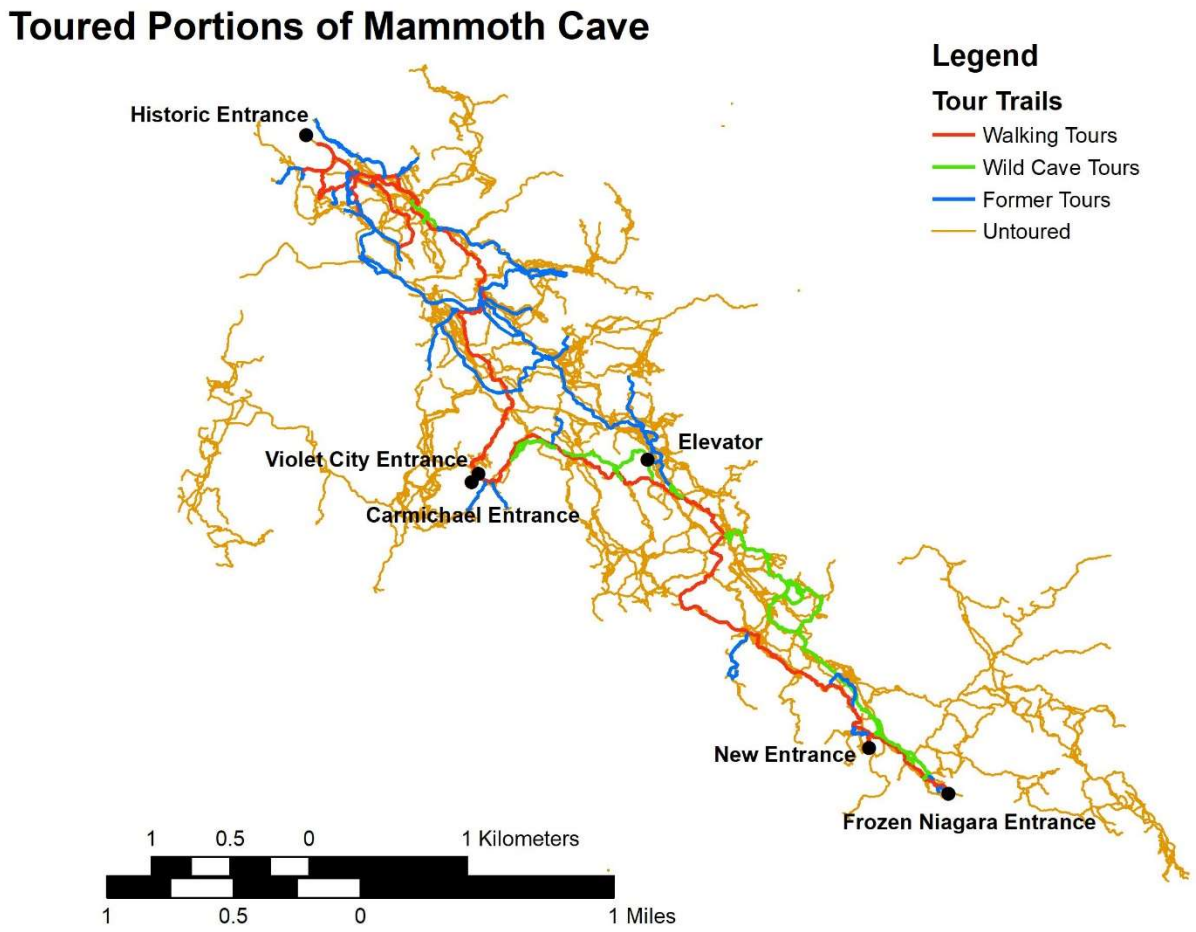

FIGURE 4. Toured portions of Mammoth Cave. (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver, eds., *Mammoth Cave: Human and Natural History*, Figure 1.5)

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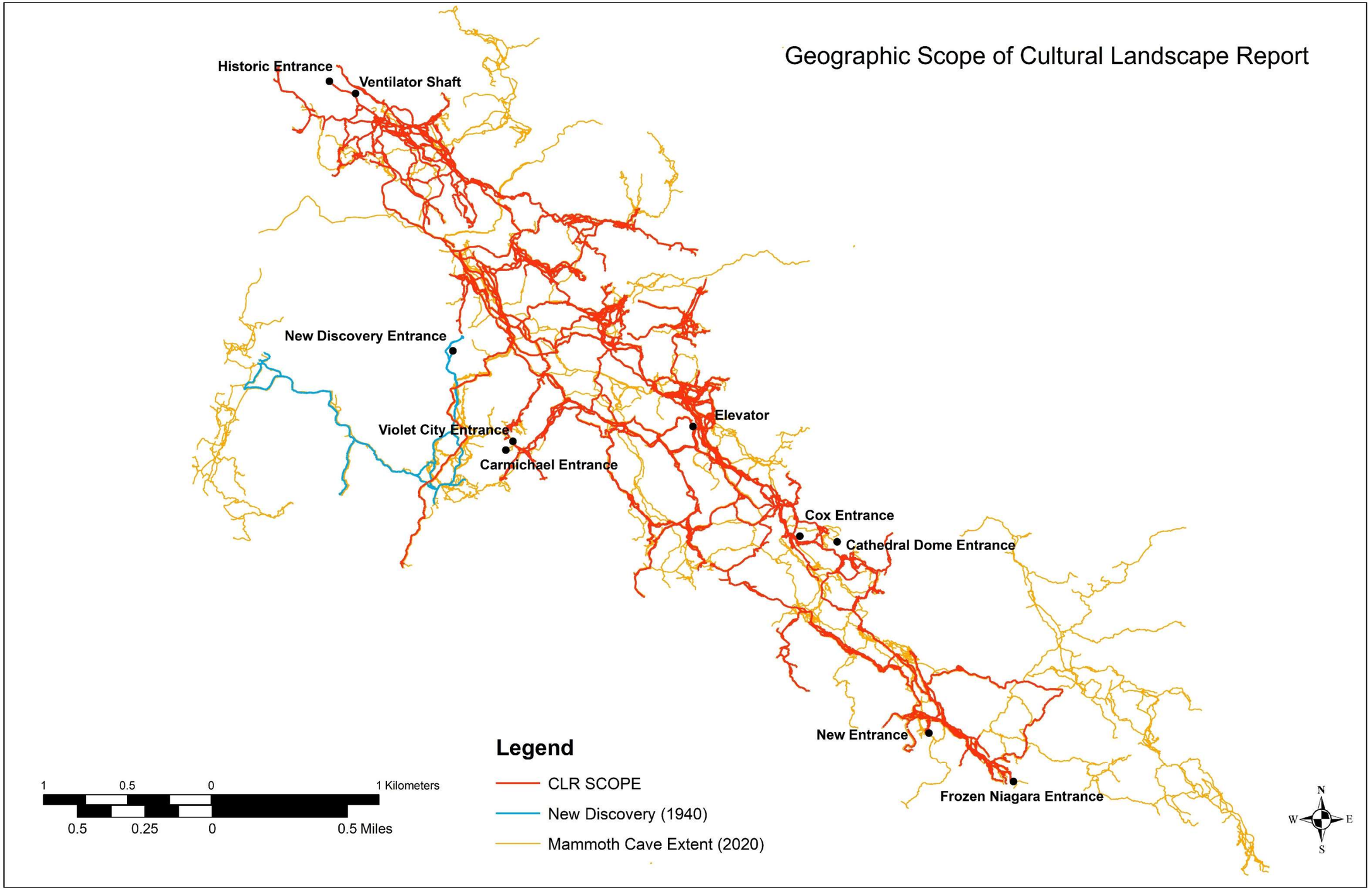

FIGURE 5. Study area boundary for the CLR. (Source: Rickard S. Toomey III, PhD)

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Historical Summary

Mammoth Cave has been explored, and its resources exploited, for thousands of years. The earliest pre-Contact period visits to Mammoth Cave for which there is archeological evidence occurred around 3,500 BCE (Before Common Era), when people began camping in the cave vestibule.[5] Nels C. Nelson, an early twentieth-century archeologist who was interested in, among other topics, stratigraphic dating methods and establishing the age of American Indian occupation of the Americas, conducted excavations in the vestibule on behalf of the American Museum of Natural History in 1916. He speculated that the remains of the camps indicated that they were of long duration, although they may also have accumulated during numerous short-term stays. Items he collected included charcoal, bone, stone, and shell tools; human bones; charred sunflower seeds; and bone and shell.[6] There is evidence that people began exploring the interior of the cave shortly after the earliest camp dates; George M. Crothers notes the earliest radiocarbon dates from the cave interior range from 2,570 to 2,910 BCE.[7]

From the years between circa 1,450 and 220 BCE (i.e., the latter portion of the Late Archaic through the Early Woodland periods), the frequency with which people visited interior portions of the cave increased significantly. and their activities became focused on mining three minerals that accumulated on the cave's walls: gypsum, epsomite, and mirabilite (Figure 6).[8] The activities of these people are evident in vast amounts of torch-related materials, including torch cane, weed, and wood fragments, some of which are in bundles tied with bark strips; pieces of partially-charred wood; charcoal; and torch marks (smudges of cave surfaces that were struck by torches to refresh their lit ends); less numerous implements related to mining (such as wood and shell mining tools and wood poles probably used for climbing); and visible direct effects of mining along the cave walls, comprising areas of bare limestone whose surfaces were pitted, battered, and scratched during the removal of the mined materials.[9] Breakdown—rock that falls from cave

5. George M. Crothers, "The Prehistoric Archeology of Mammoth Cave," in *Mammoth Cave: A Human and Natural History*, ed. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver (Cham, Switzerland: Springer, 2017), 31; Nels. C. Nelson, *Contributions to the Archaeology of Mammoth Cave and Vicinity, Kentucky. Anthropological Papers of the American Museum of Natural History*, Vol XXII, Part I (New York: The American Museum of Natural History, 1917), 45–69.
6. Nelson, 68; see also information about Nelson's general contributions to archeology in Gordon R. Willey and Jeremy A. Sabloff, *A History of American Archaeology*, second edition (San Francisco: W. H. Freeman and Company, 1980), 84–97; and Douglas R. Givens, "History of Archaeology from 1900 to 1950: Archaeology of the Americas," in *The Oxford Companion to Archaeology*, Brian M. Fagan, ed. (New York: Oxford University Press, 1996), 295–296; and others.
7. Crothers, 31.
8. George M. Crothers, "Early Woodland Ritual Use of Caves in Eastern North America," *American Antiquity* 77, no. 3 (2012); Mary C. Kennedy, "Radiocarbon Dates from Salts and Mammoth Caves," in *Of Caves and Shell Mounds*, ed. Kenneth C. Carstens and Patty Jo Watson (Tuscaloosa: University of Alabama Press, 1996), 48-81; Mary C. Kennedy and Patty Jo Watson, "The Chronology of Early Agriculture and Intensive Mineral Mining in the Salts Cave and Mammoth Cave Region, Mammoth Cave National Park, Kentucky," *Journal of Cave and Karst Studies* 59, no. 1 (1997), 5–9; Patty Jo Watson, "The Cave Research Foundation Archaeological Project: An Update," in *Proceedings of the Fifth Annual Mammoth Cave National Park Science Conference* (Mammoth Cave National Park, August 1–2, 1996), 171–174; Patty Jo Watson, "Of Caves and Shell Mounds in West-Central Kentucky," *Of Caves & Shell Mounds*, ed. Kenneth C. Carstens and Patty Jo Watson (Tuscaloosa: University of Alabama Press, 1996).
9. Crothers, "Prehistoric Archeology,"32–33; Douglas W. Schwartz, *Archaeological Survey of Mammoth Cave National Park*, Document D-28, manuscript on file at Mammoth Cave

walls and ceilings—overlies cane fragments in some places and was possibly used by miners for climbing.[10] The seasonality of the mining is currently not completely understood, but it is possible that mining occurred throughout the year.[11]

FIGURE 6. Gypsum deposit on cave wall along Cleaveland Avenue.

The purpose or purposes of pre-Contact period mining in Mammoth Cave are challenging to reconstruct. Possible explanations for mirabilite mining are that it was being used as a food preservative and/or a trade good.[12] As Crothers has noted, epsomite and mirabilite are mineral salts and possess some medicinal qualities, but gypsum—by far the most commonly-mined material—has no such characteristics and has been found in significant amounts at nearby contemporary archeological sites outside the cave.[13] He and Watson suggest that the mining may be related to cosmology and the gradually increasing importance of horticulture through the Late Archaic and Early Woodland. They underscore the fact that caves and underground watery areas are dangerous, but symbolically potent, settings in Native American belief systems throughout the Eastern Woodlands, and the locations probably played similarly prominent roles in the cosmologies of Mammoth Cave's pre-contact visitors. These ideas may even have been important motivating factors for their extensive uses of the cave. Crothers argues the mining was related to male initiation rites/rites of passage in which epsomite and mirabilite were used as purgatives, and gypsum was employed as paint for body decoration. The rites may have developed in congruence with societal changes that accompanied the development of agriculture during the Late Archaic and Early Woodland. [14]

Pre-Contact period human uses of the cave decreased markedly after about 200 BCE. While caves elsewhere in the Eastern Woodlands—including the nearby Salts Cave—continued to be visited by people and used for purposes that included ritual activities (such as the creation of rock art or mortuary-related practices), Mammoth Cave was apparently visited and used with far less frequency than during the heyday of its pre-Contact mining period. The decline may be related to changes in the roles of caves in belief systems, the possibility that the Green River area was more peripheral to regional trade networks than earlier, or a combination of these and other factors.[15]

During the historic period, the cave is known to have been discovered during the early years of European-American exploration of the region in the eighteenth century. According to folklore, the

National Park, (July 18, 1958), 5–6; Watson, "Cave Research Foundation."

10. Watson, "Cave Research Foundation."
11. James Schoenwetter, "Rethinking the Paleoethnobotany of Early Woodland Caving," *Midcontinental Journal of Archaeology* 23, no. 1 (1998), 23–44.
12. Kenneth B. Tankersly, "Prehistoric Mining in the Mammoth Cave System," in *Of Caves and Shell Mounds*, ed. Kenneth C. Carstens and Patty Jo Watson (Tuscaloosa: University of Alabama Press, 1996), 33–39.
13. Crothers, "Prehistoric Archeology."
14. Ibid.; Patty Jo Watson, "Rethinking the Prehistoric Archaeology of Salts Cave and Mammoth Cave," in *Proceedings of Mammoth Cave National Park's Eighth Science Conference* (Mammoth Cave National Park, October 5–6, 2000), 127-129.
15. Crothers, "Prehistoric Archeology"; "Early Woodland Ritual Use"; Guy Louis Prentice, *A Settlement Pattern Analysis of Prehistoric Sites in Mammoth Cave National Park, Kentucky* (unpublished PhD dissertation, University of Florida, 1994).

cave was discovered during the historic era by John Houchin, a hunter who shot a bear in the vicinity and followed it to the cave entrance. While the exact date of historic period cave discovery is not known, European-American settlers recorded the location of the historic entrance and their visits to the interior by 1798.

By circa 1806, potassium nitrate deposits containing saltpetre reserves were being extracted from the cave for use in producing gunpowder. These activities increased in response to the demand for gunpowder driven by the War of 1812. Following the War of 1812, exploration of the cave led to interest by the public in touring the interior. By the late 1810s and 1820s, tourists began to travel to the area to see several discoveries made inside the cave, including prehistoric human remains. Owners of land near the cave built hotels and restaurants to cater to visitors and offered tours for a fee.

To capitalize on the tourism trade, Franklin Gorin purchased property near the entrance to Mammoth Cave in 1838. Gorin moved to the property, bringing enslaved persons from his home in Glasgow, Kentucky. Among the enslaved persons was Stephen Bishop, who would become renowned as a guide for visitors to the cave (Figure 7).

In 1839, Dr. John Croghan also purchased land near the cave entrance. Croghan built an addition to an existing hotel near the cave entrance and several new roads to facilitate visitor travel to the area. In 1842, he arranged for thirteen individuals suffering from tuberculosis, along with members of their families, to live in Mammoth Cave as an experimental treatment. The patients lived in wooden structures scattered throughout the cave. Croghan also built two stone structures to house a kitchen and an office where he himself worked (Figure 8). Croghan's experiment lasted less than a year; by 1843, seven of the patients had died. Dr. Croghan himself died of tuberculosis in 1849.

FIGURE 7. A sketch and signature by Stephen Bishop.

FIGURE 8. Stone building constructed by Dr. Croghan in 1842 to support his work with patients with tuberculosis within the cave.

The popularity of Mammoth Cave as a tourist destination grew throughout the mid-nineteenth century, with many visitors traveling from Europe to experience the cave interior. Tourism and resource exploitation associated with Mammoth Cave transformed the region by introducing transportation systems such as roads, ferries, dams, bridges, and rail lines, as well as hotels, restaurants, recreational facilities, and plantings.

The number of visitors traveling to Mammoth Cave grew substantially after the end of the Civil War. The influx of travelers prompted the Louisville & Nashville Railroad to build a rail line that tourists could use to reach the site. The line ended at Bell's Tavern (present-day Park City, Kentucky), where travelers could board stagecoaches to Mammoth Cave.

As the number of tourists visiting the cave increased, the stagecoach line was replaced by a new rail line dubbed the Mammoth Cave Railroad. The first passengers of the Mammoth Cave Railroad arrived at the area now referred to as the Core Visitor Services Area on November 8, 1886. A hotel nearby served travelers. The idea of creating a park to conserve the magnificent cave dates to this period and was first suggested by representatives of the Louisville & Nashville Railroad, who thought that a national park would result in increased business for the company.

To capitalize on the growing number of tourists visiting Mammoth Cave, local residents began searching for other caves and cave entrances that they might develop to attract paying visitors. By the turn of the twentieth century, approximately ninety caves had been discovered near Mammoth Cave. One of the most extensive cave development efforts was conducted by nearby land owner George Morrison, who constructed an entrance to Mammoth Cave approximately 2-1/2 miles from the Historic Entrance in 1921. The efforts set off a period referred to as the "cave wars," as various owners competed for tourist dollars.

Members of the United States Congress began to show interest in creating a national park at Mammoth Cave as early as 1905, but the idea did not result in legislation. In 1924, the Mammoth Cave National Park Association was founded to promote national park designation. The Southern Appalachian National Park Commission visited Mammoth Cave in May 1925 and recommended establishing a national park at the site. As a result of the efforts of these groups in promoting the concept, the US Congress passed enabling legislation authorizing the establishment of Mammoth Cave National Park in 1926 (56 Statute 317). Park establishment was contingent on the Commonwealth of Kentucky acquiring approximately 25,000 acres of land in the vicinity of the cave; however, the park could only be opened to the public after 45,310 acres had been secured and transferred to the federal government.

In 1929, the Louisville & Nashville Railroad supported the project by donating more than 3,000 acres to the Mammoth Cave National Park Association. Using funds donated by the public, the Association was also able to purchase two-thirds ownership in the Mammoth Cave estate, the property that included the Historic Cave Entrance, and thus benefit from proceeds of tourism sales. In May 1934, Congress passed legislation that allowed the Secretary of Interior to accept monetary donations for land purchases; this led to additional land acquisitions for Mammoth Cave National Park. On May 22, 1936, the Secretary of the Interior formally accepted deeds to 27,561 acres of land, passing the threshold required to officially designate Mammoth Cave National Park.

The Association helped to secure funds used to purchase land within the area designated for Mammoth Cave National Park, while other tracts were acquired by the Commonwealth of Kentucky using the right of eminent domain. By the late 1930s, land acquisition began to proceed at a more rapid pace.

Although federal funds were not immediately available for the development of the park, facility construction began in the mid-1930s as a result of other sources of support. Funding was provided from the profits realized through the two-thirds interest acquired by the Association in the hotel operations and tour guide business, now overseen by the Mammoth Cave Joint Operating Committee, which provided over $400,000 for park development between1934 and 1940. The other primary source was the labor contributions of the CCC. During the 1930s, CCC enrollees razed buildings on land acquired by the government and constructed a park maintenance complex, six employee residences, a home for the Park Superintendent, a chlorinator house and sewer system, and ranger station facilities. They made extensive improvements to the cave trail system, including the trail surface, associated handrails, stairs, and bridges, as well as the cave entrances.

In 1941, the NPS finally reached the necessary amount of park-owned land required by the 1926 legislation, and Mammoth Cave was fully established as a national park. The NPS assumed full responsibility for the administration,

protection, and development of Mammoth Cave National Park on July 1, 1941. Despite receiving full designation as a national park in 1941, official dedication of the park was postponed until 1946 due to the involvement of the United States in World War II.

During and following World War II, funds were limited, and park development slowed. Mammoth Cave received a much needed influx of funding as a result of the Mission 66 program approved by Congress for the period 1956–1966. The funds were used to build a new visitor center and hotel with adjacent parking lot, walkways, plazas, and a pedestrian bridge. In addition, a camp store and service station building and a campground were constructed. Improvements were made to the walkway and stairs leading to the Historic Entrance; electric lighting was extended into the cave; the Snowball Dining Room, restrooms, an elevator, and food service facilities were added inside the cave; and several trails within the cave were improved through the construction of walls, stairs, and edging systems. Areas where visitors could gather for ranger-led talks were also established.

Since the park was established in 1941, hundreds of miles of additional passages have been discovered in association with Mammoth Cave. In addition, the NPS has adjusted to ever increasing numbers of visitors by upgrading facilities and safety features. Since circa 2000, work to improve the cave tour and trail system has been taking place systematically, including replacement of uneven path surfaces, bridges, guard rails, lighting, electrical systems, and wayside exhibits. This work is ongoing. Examples of completed projects include installation of oil and grit separators to protect water quality entering the cave (2004), rehabilitation of the road to the Historic Entrance (2004), installation of a cave electrical system (2007), and completion of trail improvements (2017). These improvements were made to a second section of the cave in FY 2019. The final draft of the Cave and Karst Management Plan/Environmental Assessment was submitted for review in July 2019, and the Finding of No Significance Impact (FONSI) was signed on October 4, 2019.

Mammoth Cave continues to draw thousands of visitors each year, among them explorers, scientists, and others from the United States and around the world, who brave its shadowed chambers in search of wonder and new knowledge.

Scope of Work and Methodology

Project Scope

Cultural Landscape Reports (CLRs) serve as the principal treatment documents and primary tools for long-term management of cultural landscapes. Treatment and management decisions related to the physical features, biotic systems, and use of the cultural landscape are guided by the comprehensive documentation, analysis, evaluation, and establishment of preservation goals presented in a CLR.

The CLR for the Mammoth Cave Historic District is intended to provide park management with an assessment of the character-defining features of the cultural landscape and specific treatment recommendations designed to ensure the preservation of these significant resources. The treatment guidelines, recommendations for specific treatment projects, and implementation strategies provided in the CLR will identify and prioritize the actions needed to ensure resource preservation, while balancing the goals of historic preservation with contemporary park use and management. The completed CLR will facilitate better inventory and evaluation of park resources, assist in achieving improved resource conditions, and contribute to the satisfaction of key issues and needs identified in the park's Foundation Document (2014).

The statement of work provided to the project team by the NPS identifies the following tasks to be completed in support of the CLR:

- describe the historical development of the study area, including use as known prior to European-American contact
- document existing site conditions

- provide analysis of the landscape's potential National Register significance
- identify and assess integrity of character defining features
- determine appropriate treatment strategies
- develop treatment recommendations that facilitate preservation of these resources, address park management concerns, and inform ongoing and proposed facility development
- provide a prioritized list of possible NPS Project Management Information System (PMIS) statements for landscape rehabilitation projects
- consider recommendations for future study, including an approach to documenting and evaluating pre-Contact-period archeological resources

Project Methodology

The CLR for the Mammoth Cave Historic District has been prepared in accordance with the guidance offered in the most recent versions of various federal standards documents, such as:

- *A Guide to Cultural Landscape Reports: Contents, Process, and Techniques*
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*
- NPS Director's Order 10A: *Design and Construction Drawings*
- NPS Director's Order 28: *Cultural Resources Management*
- NPS Director's Order 77—Reference Manual 77: *Natural Resource Management*
- NPS-SER-82: *Biotic Cultural Resources: Management Considerations for Historic Districts in the National Park System, Southeast Region*
- The Uniform Federal Accessibility Standard (UFAS) and Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- *National Park Service Guiding Principles of Sustainable Design*
- National Register Bulletin: *How to Apply the National Register Criteria for Evaluation*
- National Register Bulletin: *How to Evaluate and Nominate Designed Historic Landscapes*
- National Register Bulletin: *Guidelines for Documenting and Evaluating Rural Historic Landscapes*
- National Register Bulletin: *Guidelines for Evaluating and Registering Cemeteries and Burial Places*
- National Register Bulletin: *Telling the Stories: Planning Effective Interpretive Programs for Properties Listed in the National Register of Historic Places*

The methodology used to prepare each component of this CLR is described below.

Background Research and Data Collection. Prior to the project kick-off meeting at the park in November 2016, CLR project team members began to collect documents and other materials pertaining to the project and site. These included various NPS reports, secondary sources addressing the history of the site and region, and information available from the NPS electronic Technical Information Center (eTIC) in Denver, Colorado. In preparation for field investigations, project personnel requested mapping files from the park and the NPS Southeast Regional Office for use in conducting field inventory. Project team members also assembled information that had been collected in support of three earlier projects at the park, including a CLR for the Core Visitor Services Area, additional documentation to guide updates to the National Register listings associated with the park, and a Historic Structure Report (HSR) for the Superintendent's Residence.

Start-up Meeting. On November 14, 2016, Panamerican Consultants, Inc., and WJE project team members met with park and regional NPS personnel at Mammoth Cave National Park to initiate work on the CLR. Those participating in the meeting included:

Southeast Regional Office of the National Park Service

- David Hasty, Historical Landscape Architect and Contracting Officer's Representative

Mammoth Cave National Park

- Sarah Craighead, Superintendent
- Bobby Carson, Chief, Science and Resource Management Division
- Ken Kern, Program Coordinator
- Michael Cline, Foreman, Facility Management Division
- Johnny Meredith, Park Ranger, Interpretation Division
- Kathy Proffitt, Supervisory Park Ranger, Interpretation Division
- Terry Langford, Curator, Science and Resources Management Division
- Lillian Scoggins, GIS Specialist, Science and Resources Management Division

Panamerican Consultants, Inc.

- Kelly Nolte, Historian/Project Manager
- Donald Smith, PhD, Archeologist

Wiss, Janney, Elstner Associates, Inc.

- Deborah Slaton, Project Manager/Historian
- Tim Penich, Project Architect/Historian

Research sources available to the project team were discussed during the meeting, including park planning documents, maps and drawings, aerial photographs, and natural resources. Park personnel also suggested persons associated with the park as an additional source of information, for possible follow up by the project team. For archeological information, the park recommended that the team contact Dr. George Crothers, state archeologist, who has inventoried many sections of the cave through a memorandum of agreement with the NPS. Another good resource for the team is the Cave Research Foundation, which has developed detailed mapping of the historic district.

The team reviewed the proposed study area boundary, associated historic structures, and the issue of how to address pre-Contact use areas and resources (refer to Figure 5). Also, discussed was the existing Mammoth Cave Historic District. As documented, the historic district encompasses twelve discontinuous miles of cave; however, the rationale for what is listed is not clear, and there are several additional miles of cave that potentially meet the criteria for listing. For example, CCC-built trails were not included in the nomination, although the park and the Kentucky State Historic Preservation Office (SHPO) have determined them eligible. The group considered how the CLR study area might be structured to address this discrepancy, and how to identify resources that contribute to the significance of the historic district. Other specific issues of interest conveyed to the project team by the NPS for consideration as part of the CLR included the evaluation of the significance of Mission 66-era features and features built by the Job Corps; the need to protect archeological resources; and interpreting the significance of cultural as well as natural resources associated with Mammoth Cave. Following the kick-off meeting, the NPS led the project team on a tour of the cave, and identified additional specific issues for consideration in the CLR.

Additional personnel joining the Mammoth Cave National Park team providing guidance regarding the CLR after the initial meeting include Tim Pinion, Chief, Science and Resources Management Division; Rickard Toomey III, PhD, Cave Management Specialist; and Edward Jakaitis, Cultural Resource Program Manager.

Initial Field Investigations. CLR project team members conducted preliminary field investigations on November 15–16, 2016, documenting resources associated with the Mammoth Cave Historic District using photographs and notes regarding the location, materials, and condition of landscape features.

Second Meeting and Additional Field Investigations. Historical landscape architect

Liz Sargent of Liz Sargent HLA and archeologist Dr. Don Smith of Panamerican Consultants, Inc., visited Mammoth Cave on June 28–30, 2017, to conduct field investigations. Cave Management Specialist Dr. Rick Toomey (Figure 9) and archeologist Dr. George Crothers of the University of Kentucky served as guides for the field investigations. The group visited extensive areas of the Mammoth Cave Historic District, including all of the currently accessible entrances, as well as other areas important for their association with American Indian use. During the site visit, the group discussed criteria for establishing an appropriate CLR study area based on a potential expanded historic district boundary, and how to address archeological resources in the report.

FIGURE 9. NPS Cave Management Specialist Rick Toomey leading CLR project team members on a tour of the cave, May 2018.

Liz Sargent and Jen Trompetter of Liz Sargent HLA later returned to Mammoth Cave for additional field investigations between May 29 and June 1, 2018, to visit the cave passages related to the proposed expanded historic district, covering approximately 13 miles of ground under the guidance of Dr. Toomey.

Historical Landscape Documentation and Site Physical History. Project team members also conducted research at the park archives during the November 2016 site visit, collecting archival documents and photographs related to the history of the region and the park. They were assisted in the research by park curator Terry Langford.

Following review of available research materials, historical landscape documentation was prepared. Documentation was organized chronologically into a series of historic periods, illustrated with historic photographs, maps, and diagrams showing cave exploration over time.

Supporting the historical landscape documentation is a series of historic period studies that show how exploration and knowledge of cave passages and entrance has evolved over time. The historic period studies include diagrams that show the expansion of cave touring over time. The historic period studies were prepared in lieu of historic period plans, typically part of most CLRs, due to the challenges posed by preparing maps of the extensive, complex underground landscape of Mammoth Cave.

Base Mapping. A historic district map prepared in Adobe Illustrator by the Cave Research Foundation served as the basis for fieldwork and base mapping for the CLR.

Existing Conditions Documentation. The project team prepared existing conditions documentation for the cave study area based on a compilation of base mapping, data collected during field investigation, and review of park planning documents, park files, and other relevant cultural and natural resource documents provided by NPS. The existing conditions documentation is conveyed in chapter three of the CLR as cross-referenced narrative, graphic, and photographic information organized in accordance with the framework established in the NPS *A Guide to Cultural Landscape Reports: Contents, Process, and Techniques*. A section describing the environmental and cultural context for the cave introduces the existing conditions documentation chapter. This is followed by resource descriptions arranged by the following landscape characteristics:

- Natural Systems and Features
- Responses to Natural Resources
- Land Uses and Activities
- Circulation

- Buildings and Structures
- Views and Vistas
- Small-scale Features
- Known and Potential Archeological Resources

For each landscape characteristic, the team prepared an inventory of feature typologies or individual features, depending on existing conditions in the cave. For each landscape feature or typology, the team assessed its condition according to the categories of Good, Fair, Poor, and Unknown. The condition ratings were annotated as possible to include specific condition-related observations made in the field that help to justify the ratings.

Evaluation of Significance. As noted above, a portion of the cave passage system has been listed in the National Register of Historic Places as the Mammoth Cave Historic District. The listing referenced a Multiple Property Documentation Form (MPDF) accepted by the Keeper of the National Register on May 8, 1991, which established the historic contexts related to Mammoth Cave National Park and the eligibility of various park resources for listing in the National Register of Historic Places. Contexts established by the MPDF include Exploration and Settlement in the Mammoth Cave Area, circa 1754–1927; Discovery and Early Uses of Mammoth Cave, 1798–1849; Commercial Cave Development and the Growth of Tourism in the Mammoth Cave Area, 1849–1926; and Establishment of Mammoth Cave National Park, 1924–1941.[16]

The nomination refers to the latter three historic contexts articulated in the Mammoth Cave National Park Historic Resource Study MPDF in arguing the significance of the historic district.[17] Specifically, the nomination indicates the historic district to be significant at the national level under Criterion A in the areas of Industry, Entertainment/Recreation, and Health/Medicine. Within an overarching period of significance of 1806 to 1941, the nomination indicates the historic district to be significant within the area of Industry between 1806 and 1814; in the area of Entertainment/Recreation between 1816 and 1941; and within the area of Health/Medicine between 1842 and 1843. The 1806 start date is based on the approximate beginning of saltpetre mining in Mammoth Cave, while the end date appears to be tied to fifty years before the date of the nomination.

The property encompassed by Mammoth Cave Historic District includes approximately 12 miles of underground passages known to have supported early mining, medical, exploratory, and commercial purposes.[18] The nomination listed a total of seventeen contributing resources—five sites, eleven structures, and one object—and one non-contributing site.[19] These resources include:

- Historic Entrance
- Mushroom Beds

16. Kelly A. Lally and Bruce Noble, *Mammoth Cave National Park Historic Resource Study*, National Register of Historic Places Multiple Property Documentation Form (#645007, listed May 8, 1991).
17. Lally, Mammoth Cave Historic District nomination, 8-1. The National Register nomination cites the latter three contexts established by the MPDF, but it uses a different title and dates for the last context, identifying it as "The Development of the Mammoth Cave Area into a National Park (1926–1942)." As the nomination and MPDF were in progress simultaneously, it is possible that the nomination referenced this context as defined in a draft rather than the final MPDF.
18. Lally, Mammoth Cave Historic District nomination, 7-1.
19. Based on a later amendment, nine non-contributing structures were added to the listing. Some of the listed features may require additional evaluation to confirm that they date to New Deal-era construction, such as some of the rock walls.

- Rock Stairs and Walls to Olive's Bower
- Saltpetre Mining Works
- Rock Monuments, Walls, and Signatures in Gothic Avenue
- Rock Wall at the Bridal Alter
- Rock Wall at Jenny Lind's Armchair
- Rock Wall at End of Gothic Avenue
- Rock Stairs at End of Gothic Avenue
- Tuberculin Huts
- Albert's Stairway
- Violet City Entrance
- Carmichael Entrance
- Cable at Aerobridge Canyon
- Landing at Crystal Lake
- Frozen Niagara Entrance

The non-contributing site is the New Entrance to Mammoth Cave. The non-contributing structures identified later in an amendment to the documentation include the gate at the Historic Entrance, the electrical system, modern metal handrails, the metal bridges, and the metal gates and fences.

This information, as provided in the MPDF, the Mammoth Cave Historic District nomination, and the additional documentation prepared by WJE and LSHLA served as the basis for the CLR significance evaluation. The evaluation was also prepared using the guidance provided in the National Register Bulletin, *How to Apply the National Register Criteria for Evaluation*.

Comparative Analysis of Historic and Existing Conditions. To better understand the relationship between the existing landscape and the character of the landscape during the period of significance identified in the CLR, the project team prepared a comparative analysis of historic and existing landscape conditions by landscape characteristic. The three primary goals of the comparative analysis were to:

- Understand which features survive from the period of significance;
- Establish the basis for an integrity assessment; and
- Provide an understanding of the similarities and differences between historic and existing conditions that would contribute to the development of a well-grounded treatment plan for the cultural landscape.

The analysis narrative is illustrated with photograph pairs that compare historic with existing conditions within the study area, and other graphics.

Identification of Character-Defining Features. As part of the development of the comparative analysis of historic and existing landscape conditions, the CLR identified the character-defining qualities and characteristics of the cultural landscape. Character-defining qualities are the prominent or distinctive aspects or characteristics of a cultural landscape that contribute significantly to its physical character.

The comparative analysis also identifies individual features contributing to the significance of the historic landscape. Contributing features are those surviving from the period of significance with integrity that can be tied to the site's associated historic contexts. The CLR also identifies noncontributing features, which are those that originated outside the period of significance, have lost integrity, or are not associated with significant historic contexts for the historic landscape. Finally, the CLR discusses historic features of importance that are no longer extant.

Assessment of Integrity. In a CLR, the integrity of a historic landscape is evaluated to determine whether the characteristics and features that defined the landscape during the period of significance are present, retain their historic qualities, and convey their historic associations. The Mammoth Cave Historic District CLR assesses the overall integrity of the Mammoth Cave Historic District in accordance with the seven aspects—location, design, setting, materials, workmanship, feeling, and association—discussed in the National Register Bulletin, *How to Apply the National Register Criteria for Evaluation*.

Treatment Plan. The CLR culminates in a treatment plan that provides preservation

strategies and specific recommendations for the long-term management of the cultural landscape based on its significance, existing condition, and use. The CLR treatment plan also includes a discussion of the overall management objectives for the historic landscape as documented in planning studies or other management documents. The Mammoth Cave Historic District CLR treatment plan is supported by the identification of implementation projects that prioritize and coordinate treatment recommendations into a series of discrete tasks. The implementation projects are conveyed in a format similar to PMIS so that they can be easily transferred to FMSS work orders, where applicable.

The treatment plan specifically addresses the management issues and concerns identified by the park and region during the kick-off meeting, such as:

- Cave trail management associated with accommodating the 500,000 visitors who take tours of the cave each year
- Consideration of ways to expand the areas accessed by cave tours, the expansion of tour capacity, circulation dynamics, and enhancing the visitor experience
- Management of supporting infrastructure, such as electricity, lighting, telephone service, running water for restrooms, waste management
- Provision of a clear definition of the Mammoth Cave Historic District study area, associated period of significance, distinguishing characteristics, features, and boundaries
- Recommendations related to the documentation, evaluation, and protection of pre-Contact-period resources
- Recommendations for enhanced interpretive opportunities intended to increase visitor understanding and enjoyment of the area and cave history
- Recommendations for long-term preservation of the character-defining features of each cave entrance and vegetation management approaches to maintaining the integrity of the historic scene
- Consideration of the coordination of cultural landscape features and FMSS data
- Addressing the potential impacts of climate change

Summary of Findings

Based on the fact that nearly thirty years have elapsed since the Mammoth Cave Historic District was listed in the National Register of Historic Places, and further research and cave development have occurred that needs to be assessed, the CLR provides a significance evaluation that suggests potential expansion of the historic district in terms of the property boundary, and the criteria, areas, and period of significance. Additionally, the CLR suggests a more extensive list of both contributing and non-contributing resources. Specifically, the CLR addresses the role of New Deal-era programs in improving access to and within the cave, including the contribution of the CCC, as well as the National Park Service's Mission 66 program.

Based on the findings of this study, the historic district is nationally significant under Criterion A in the areas of Entertainment/Recreation, Exploration, Politics/Government, and Science; at the statewide level in the area of Industry; and at the local level in the area of Health/Medicine. The historic district is also significant under Criterion C at the local level in the area of Engineering; and under Criterion D in the area of Archeology (Historic, Non-Aboriginal). Further consideration is needed to identify the level of significance associated with Criterion D. For the associations of the historic district to the historic contexts indicated in the MPDF and those developed as part of additional documentation (New Deal era and Mission 66), as well as contexts related to Conservation and Science articulated by the park, the CLR recommends extending the period of significance to circa 1798–1969. The beginning date of 1798 encompasses the first known historic-period exploration of the cave that led to later industry and tourism. The CLR also recommends that the park consider developing a historic context for pre-Contact-era use of the cave, which

could support revising the start date of the period of significance to circa 500 BCE. The end date of 1969 reflects the completion of many Mission 66 programs and projects. During Mission 66, federal funding was used to improve cave trails, access, amenities, and interpretation, which broadened visitor access to and appreciation and understanding of the cave. (Although the Job Corps continued work above-ground at Mammoth Cave National Park following completion of Mission 66, it is not currently known whether Job Corps activities were conducted within the cave.)

FIGURE 10. The Snowball Dining Room, open by 1936, was updated during the Mission 66 period to include a comfort station and food preparation facilities. An elevator was also established during Mission 66 that facilitated access to the complex.

The CLR recommends that consideration be paid to expanding the boundary of the current Mammoth Cave Historic District to encompass all passages that have been the focus of visitor use and tours from the pre-Contact era through the 1940s, between the Historic Entrance and Frozen Niagara. (Note that areas toured did not change from the 1940s through the end date of the period of significance in 1969.) The expanded boundary includes a total area of approximately 22.5 miles of passages associated with tour routes, as well as 10.4 miles of passages associated with pre-Contact use (Figure 11). The two categories of passages overlap for a total of 7.0 miles, thus the expanded boundary would encompass 25.9 miles of passages overall.

The passages proposed for inclusion in the expanded historic district include:

- **Hovey Route 1—Echo River, Pits and Domes**. Modern Historic Tour Route. Corkscrew, Labyrinth, Pensacola Avenue, Echo River.
- **Hovey Route II—Star Chamber Gothic**. Historic Entrance to Star Chamber. Gothic and Gratz Avenues, Audubon Avenue—Rotunda to Olive's Bower.
- **Hovey Route III—Main Cave and New Discovery (Violet City).** Historic Entrance to Violet City.
- **Hovey Route IV—To the Maelstrom and to Hovey's Cathedral.** Historic Entrance to Echo River (via Corkscrew or Fat Man's Misery). Echo River to Silliman or Historic Entrance to Wooden Bowl. Ganter-Welcome to Silliman, Silliman-El Ghor to Snowball. Valley Way Sidecut, Snowball to Maelstrom (via Cleaveland Avenue), Franklin Avenue, Snowball to Cathedral Domes (via Boone, Martel, Hawkins Pass).
- **Morrison Long Route.** New Entrance, Grand Central, Kentucky Avenue, Aerobridge, Woodbury Pass or Grand Canyon, Mount McKinley, Morrison Avenue, Forks of the Cave, Jeanne's Avenue-Rose's Pass, Cathedral Domes via Martel—Hawkins Pass, Becky's Alley and Lida's Pass, Gerta's Grotto, Robertson-Nickerson, Big Break, Frozen Niagara
- **Other side toured areas.** Solitary Cave-Fairy Grotto, Cyclops Gateway, Wrights Rotunda-Black Chambers, Briggs Avenue-Charlotte's Dome, Sylvan-Wyatt's Domes, Blue Spring Branch, Blackall Avenue, Marion Avenue, Radio Room.

Based on consideration of the existing historic district, the CLR recommends that pre-Contact-period archeological resources be addressed in an amendment to the existing National Register nomination that would focus on historic contexts beyond the scope of the CLR.

The proposed boundary expansion is further discussed in the Analysis and Evaluation chapter of this report.

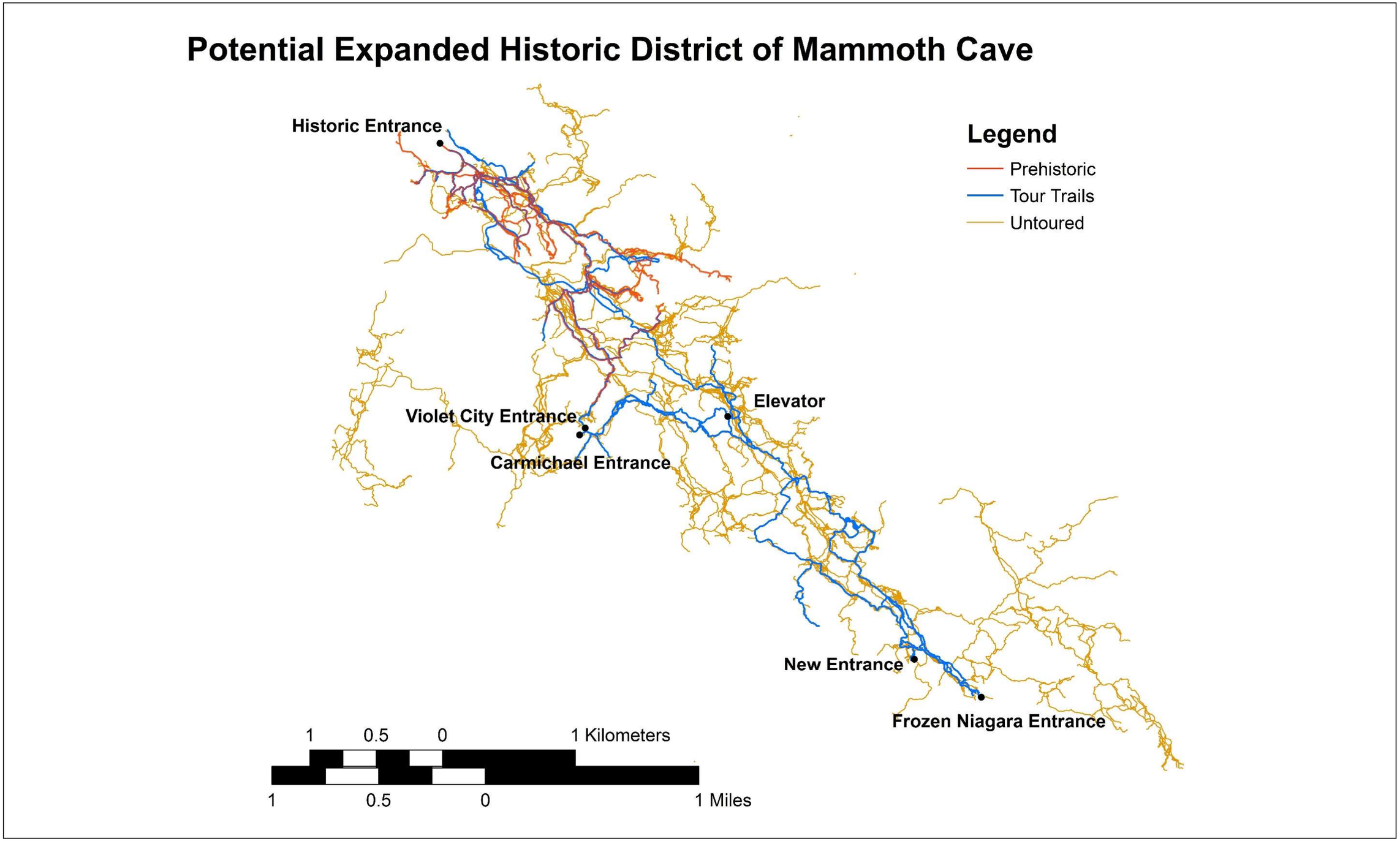

FIGURE 11. Diagram of existing and proposed boundaries of Mammoth Cave Historic District. (Source: Rickard S. Toomey III, PhD, and Edward Jakaitis, Mammoth Cave National Park)

Recommendations for Further Study

- In cooperation with the Cave Research Foundation, conduct a survey of accessible passages and areas of the cave that have not yet been documented. Survey features for which limited or not recorded documentation exists, as well as features for which additional documentation would benefit preservation planning and interpretation. Such features may include the Walker survey markers, surviving low walls constructed by the NPS following Mission 66-era work in the cave, and other resources.

- Research conducted for this study did not uncover any additional information regarding Job Corps activities within Mammoth Cave, and park staff have indicated that they are not aware of any Job Corps activity within the cave. Further research into this topic is recommended to understand whether Job Corps activities at the park included work within the cave (e.g., the 1968–1969 work at the entrance trail).

- Further research is recommended to identify the dates of origin of features for which that information is not currently known, based on available information. Refer to Appendix A for specific resources that would benefit from this additional research.

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Site History

Pre-Contact Occupation of the Mammoth Cave Area

Refer to Figure 12 for map showing the explored portions of Mammoth Cave in 500 BCE.

Mammoth Cave National Park is located in the Mississippian Plateaus/Limestone Plateau Physiographic Region of Kentucky, an area of hilly, strongly developed karst terrain with numerous caves, sinkholes, and springs. Drainage is both subterranean and above ground; when at the surface, it is along deeply incised rivers and streams.[20] Surface drainage near the cave is along small streams, such as Echo River, that flow into the Green River, which runs about 2,000 feet west of the cave's Historic Entrance. The Green River flows generally west-northwest to the Ohio River and into the Mississippi River. Mammoth Cave developed in Mississippian-period (circa 330–340 million years old) bedrock that comprises limestones of the Girkin formation and limestones and dolomites of the Ste. Genevieve and St. Louis formations. Chert deposits are also present in the Ste. Genevieve and St. Louis formations.[21]

Human occupation of southeastern North America began before 9,500 BCE, during the latter part of the Pleistocene geologic epoch, a time of lower global temperatures (the Younger Dryas period). At this time, glaciers covered significant portions of the northern part of the continent.[22] At their maximum extent, the glaciers remained north of Kentucky.[23] Early human inhabitants

20. Kristen J. Gremillion, "Environment," in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 14, *Southeast*, ed. Raymond D. Fogelson (Washington, DC: Smithsonian Institution, 2004), 55; David Pollack, "Introduction," in The *Archaeology of Kentucky* 1, ed. David Pollack, ed., *State Historic Preservation Plan Report No. 3* (Kentucky Heritage Council, 2008), 15.
21. M. C. Noger, "Geologic Map of Kentucky: Sesquicentennial edition of the Kentucky Geological Survey" (US Geological Survey and the Kentucky Geological Survey, 1998), accessed December 3, 2018, https://mrdata.usgs.gov/geology/state/state.php?state=KY; Arthur N. Palmer, "Geologic History of Mammoth Cave," in *Mammoth Cave: A Human and Natural History*, ed. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver (Cham, Switzerland: Springer, 2017).
22. David G. Anderson and Kenneth E. Sassaman, "Early and Middle Holocene Periods, 9500 to 3750 B.C.," in *Handbook of North American Indians*, William C. Sturtevant, gen. ed., vol. 14, *Southeast*, Raymond D. Fogelson, ed. (Washington, DC: Smithsonian Institution, 2004), 87; P. Gibbard and T. van Kolfschoten, "The Pleistocene and Holocene Epochs," in *A Geologic Time Scale 2004*, ed. F.M. Gradstein, James G. Ogg, and A. Gilbert Smith (Cambridge University Press, 2004), 441–452; Greg J. Maggard and Kary L. Stackelback, "Paleoindian Period," in *The Archaeology of Kentucky*, vol. 1, ed. David Pollack, State Historic Preservation Plan Report No. 3 (Kentucky Heritage Council, 2008), 113–114; Dennis Stanford, "Paleo-Indian: Introduction," in *Handbook of North American Indians*, William C. Sturtevant, gen. ed., vol. 3, *Environment, Origins, and Population*, ed. Douglas H. Ubelaker (Washington, DC: Smithsonian Institution, 2006), 16–22.
23. Christopher L. Hill, "Geological Framework and Glaciation of the Eastern Area," in *Handbook of North American Indians*, gen ed. William C. Sturtevant, vol. 3, *Environment, Origins, and Population*, ed. Douglas H.

(Paleoindians) in the Mammoth Cave area occupied a landscape that was drier than today and covered with spruce and jack pine.[24] Their earliest stone tools (from before circa 9,000 BCE), including knives, scrapers, gravers, and characteristic "fluted" projectile points and blade tools, were made of high quality and frequently exotic materials.[25] Their toolkits likely included numerous other types of non-lithic implements that have not survived in the archeological record. Paleoindians most likely lived in small groups and practiced highly mobile ways of life, probably following herds of large mammals including caribou, mastodon, and mammoth, the latter two of which became extinct in North America around 8,000 BCE. Paleoindian diets likely also included white-tailed deer, turkey, nuts, berries, seeds, and fish, all of which would have been found in late Pleistocene forests of the Southeast.[26] Several Paleoindian-period sites and finds have been identified in the region around Mammoth Cave, including a fluted projectile point found on the ground surface near the cave's Historic Entrance.[27]

The Southeast witnessed a warming trend following the end of the Pleistocene, defined geologically as the Early Holocene (9,500 to 6,950 BCE), a period that overlaps with the archeological Early Archaic in Kentucky (circa 8,000 to 6,000 BCE).[28] On average, temperatures approached modern levels during those times, but had greater extremes during summer and winter.[29] People living in the region during this time were likely the descendants of Paleoindian groups.[30] They inhabited a hardwood forest landscape of oak and hickory similar to that experienced by their forebears, but they possibly practiced less mobile systems of settlement in which rivers assumed increasing levels of importance—a trend that would continue in the Southeast until the arrival of Europeans in the 1500s CE. However, groups were still relatively mobile, and some stone tools were made from non-local materials.[31] Rather than migrating across large areas, people probably moved about annually within more confined zones, dispersing during summer months and congregating along rivers in larger camps. This strategy may be reflected in technology; instead of stone tools being made of high quality exotic materials, Early Archaic tools were increasingly manufactured from local stone types, suggesting their makers had less access to more-exotic and preferable raw materials.[32] Projectile point forms were also distinct from Paleoindian tools, and might reflect a change from reliance on large mammals to smaller animals, such as deer.[33] Although overall population increased throughout the early Holocene, social groups likely remained small and fairly egalitarian.[34] Several Early Archaic sites are known in Mammoth Cave National Park; small numbers of these sites are known from both upland and riverine contexts, but the majority are at rockshelters or in caves.[35]

The Middle Holocene in the Southeast (6,950 to 3,750 BCE) corresponds with the Hypsithermal

Ubelaker (Washington, DC: Smithsonian Institution, 2006), 83.

24. Gremillion, 66; Bradley T. Lepper and Robert E. Funk, "Paleo-Indian: East," in *Handbook of North American Indians*, gen ed. William C. Sturtevant, vol. 3, *Environment, Origins, and Population*, ed. Douglas H. Ubelaker (Washington, DC: Smithsonian Institution, 2006), 171; Herbert E. Wright, Jr., "Climate and Biota of Eastern North America," in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 3, *Environment, Origins, and Population*, ed. Douglas H. Ubelaker (Washington, DC: Smithsonian Institution, 2006), 108.
25. Lepper and Funk, 2006, 172; Maggard and Stackelback, 2008, 115–129.
26. Lepper and Funk, 2006, 171-172.
27. Maggard and Stackelback, 143; Prentice, 131–134.
28. Richard W. Jefferies, "The Archaic Period," in *The Archaeology of Kentucky*, vol. 1, ed. David Pollack, State Historic Preservation Plan Report No. 3 (Kentucky Heritage Council, 2008), 202–203.
29. Anderson and Sassaman.
30. Lepper and Funk, 173.
31. Anderson and Sassaman, 88–90; Jefferies, 203.
32. Anderson and Sassaman, 87–100.
33. Prentice, 131–132.
34. Anderson and Sassaman.
35. Prentice, 139, 142.

interval, a global-scale climatic phenomenon that was related to cooler winters, warmer summers, and drier inland conditions in southeastern North America, relative to earlier and later times.[36] It also roughly corresponds with the archeological Middle Archaic period (6,000 to 3,000 BCE).[37] Populations in the Southeast continued to rise during the Middle Holocene and social groups may have been larger than during the early part of the periods, with some numbering up to approximately fifty individuals. Drier conditions and larger groups would have made productive river settings, such as along the Green River, even more attractive for settlement. There were some technological changes related to projectile-point forms that may have been related to changes in subsistence practices or how the tools were used. Subsistence was almost entirely based on hunting and gathering of resources including small mammals, deer, fish, freshwater shellfish, nuts, and goosefoot. There is some evidence that people were starting to encourage the growth of some wild plants, such as gourds and squashes, which were likely used as containers. In addition to flaked stone tools, people were making use of spear-throwing devices (atlatls), baskets, plummets, bolas, nutting stones, netsinkers, and axes, as well as various bone, wood, and antler implements. The presence of small amounts of exotic materials at archeological sites, such as copper and stone used to make spear-thrower parts, indicates that people continued to conduct some long-distance trade.[38] Moderate numbers of Middle Archaic sites have been found in Mammoth Cave National Park, primarily in upland settings and at rockshelters and in caves.[39]

The Late Archaic period in the Southeast roughly corresponds with the part of the Late Holocene from the end of the Hypsithermal to the time at which people throughout the region adopted pottery technology, circa 3,750 to circa 1,000 BCE.[40] Climate recovered to approximately modern conditions during the early part of the period. Overall, populations increased, settlement system diversified, and some habitation sites concentrated in fertile zones such as along the Green River, with the area around the river a center for Late Archaic settlement in Kentucky. Jefferies notes that of 1,641 Late Archaic sites known in Kentucky as of 2008, 455 (27.7 percent) are in the Green River area; however, most of these are along the river west of Mammoth Cave.[41] Some of the loci on the river include large shell middens that attest to the importance of freshwater shellfish in the diets of the inhabitants.[42] There are also early indications of the manipulation of plant characteristics likely aimed at maximizing their availability—a trend

36. Anderson and Sassaman, 94.
37. Jefferies, 208.
38. Anderson and Sassaman, 87–100.
39. Prentice, 142.
40. Jefferies, 202; Kenneth E. Sassaman and David G. Anderson, "Late Holocene Period, 2750 to 650 B.C., in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 14, *Southeast*, ed. Raymond D. Fogelson (Washington, DC: Smithsonian Institution, 2004), 101. Archeological taxa such as the Archaic and subsequent Woodland periods were developed in the first half of the twentieth century to aid in describing archeological finds and for constructing regional chronologies before the invention of radiometric dating techniques. Following this innovation, researchers became increasingly aware of the complexities of pre-Contact-period social phenomena such as the adoption of pottery (the defining characteristic that separates the Archaic from the Woodland) and many are beginning to advocate their usage be abandoned or reevaluated. However, they are still commonly employed as a form of shorthand in scholarly literature and are included here for that reason. Applegate provides a summary of changing ideas about archeological taxa and how they have related to the study of Kentucky's pre-Contact-period past: Darlene Applegate, "Woodland Period," in *The Archaeology of Kentucky*, vol. 1, ed. David Pollack, State Historic Preservation Plan Report No. 3 (Kentucky Heritage Council, 2008), 416–418.
41. Jefferies, 214.
42. Christine K. Hensley, "Prehistoric Shell Mound Dwellers and Cavers of the Green River Valley," in *Proceedings of Mammoth Cave National Park's Third Science Conference* (Mammoth Cave National Park, July 5–6, 1994), 13–27; Sassaman and Anderson, 103.

that would later lead to the domestication of some species and full-time horticulture.

Items and materials likely associated with spirituality or the supernatural—such as intentionally broken pottery left as grave goods, bone, cylindrical pipes, marine shell cups, medicine bags, and red ochre—become more frequent through the Late Archaic.[43] One aspect apparently related to symbolically charged items relates to their exoticness; some Late Archaic inhabitants of the Southeast participated in long-distance exchange of objects and materials such as soapstone (most frequently used for stone vessels), exotic cherts, greenstone, and hematite.[44] Copper and marine shell have been found at sites on the Green River.[45] This long-distance trade was embodied at the Poverty Point site in northeast Louisiana, which, in addition to numerous artifacts of exotic origin, has a complex of earthen mounds, rings, and effigies covering a total of about 3 square kilometers. The sites' earthen features probably had cosmological significance and represent an early symbolically charged alteration of the landscape, a trend that would continue throughout the Southeast for much of the time between the Late Archaic and the arrival of Europeans. Shell mounds, such as those along the Green River, might also have played prominent symbolic roles in how people perceived their landscape.[46] There are moderate numbers of Late Archaic sites across the Mammoth Cave National Park, primarily located in upland settings and at rockshelters and in caves.[47]

The end of the Archaic and the beginning of the subsequent Woodland period are defined by the wide-scale adoption of pottery technology, which occurred incrementally throughout the North American Eastern Woodlands from approximately 1300 to 650 BCE. During the Early Woodland in Kentucky (650 to 250 BCE) people gradually intensified their uses and cultivation of plant species that included maygrass, sumpweed, sunflower, goosefoot, gourds, and squashes (knowledge of which has been significantly derived from work in Mammoth and Salts Caves).[48] Meanwhile, nuts, deer, fish, mussels, turtles, and small mammals continued to form significant portions of diets.[49] The developing importance of horticulture likely served to bind people to specific areas of land and may have contributed to new (possibly less mobile) systems of settlement.[50] Habitation sites are primarily distributed in uplands, ridgetops, and along river floodplains.[51] The Green River area is situated near the southwest periphery of an area in which Early Woodland people participated in a network of exchange of information and raw materials that extended across parts of the Midwest and

43. Prentice, 136–137.
44. Sassaman and Anderson, 101–114.
45. Jefferies, 210.
46. Sassaman and Anderson, 103.
47. Prentice, 142.
48. Prentice, 149; Applegate, 416–418; Crothers, "Prehistoric Archeology"; Renee M. Bonzani, George M. Crothers, Patrick Trader, Robert H. Ward, and Ronald R. Switzer, "Early Sunflower Head Remains from Mammoth Cave, Kentucky, U.S.A.," *Journal of Ethnobiology* 27, no. 1 (2007), 73–87; Stephen A. Chomko and Gary W. Crawford, "Plant Husbandry in Prehistoric Eastern North America: New Evidence for its Development," *American Antiquity* 43, no.3 (1978), 405–408; Kennedy and Watson, 5–9; William H. Marquardt, "A Statistical Analysis of Constituents in Human Paleofecal Specimens from Mammoth Cave," in *Archaeology of the Mammoth Cave Area*, ed. Patty Jo Watson (New York: Academic Press, 1974), 193–202; James Schoenwetter, 23–44; Richard A. Yarnell, "Intestinal Contents of the Salts Cave Mummy and Analysis of the Initial Salts Cave Flotation Series," in *Archaeology of the Mammoth Cave Area*, ed. Patty Jo Watson (New York: Academic Press, 1974), 109–112; Richard A. Yarnell, "Plant Food and the Cultivation of the Salts Cavers," in *Archaeology of the Mammoth Cave Area*, ed. Patty Jo Watson (New York: Academic Press, 1974), 113–122.
49. Applegate, 344; Richard W. Jefferies, "Regional Cultures, 700 B.C.–A.D. 1000," in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 14, *Southeast*, ed. Raymond D. Fogelson (Washington, DC: Smithsonian Institution, 2004), 117.
50. Crothers, "Early Woodland Ritual Use," 536–538.
51. Applegate.

Northeast collectively known as Adena.[52] Manifestations of the Adena phenomenon include burials in earthen mounds that are accompanied by elaborate and/or exotic grave goods and that are separated from habitation sites.[53]

There are over forty Early Woodland sites in Mammoth Cave National Park and, as of 2008, sixty-two were known in the upper Green River area.[54] The majority of the sites in the park are at rockshelters or in caves. Mammoth Cave's most intensive period of use, which included activities related to extensive mining of gypsum, mirabilite, and epsomite, came during the Early Woodland, a fact that Crothers suggests is related to changes in lifeways brought about by the adoption of agriculture.[55]

The Middle Woodland period (250 BCE to 500 CE) corresponds with the participation of many Eastern Woodlands populations in a regional network of exchange and shared burial practices (and possibly related cosmological concepts) collectively known as the Hopewell Interaction Sphere, a phenomenon that extended across much of the Eastern Woodlands of North America. Groups participating in Hopewell interred some deceased individuals in tombs beneath earthen and shell mounds with items sometimes made from exotic materials such as mica mirrors, copper pipes and plates, and shell beads.[56] The adoption of horticulture continued to intensify throughout the region, and people added maize to their diets as far north as New York State by around the beginning of the Middle Woodland.[57] The area around Mammoth Cave, however, was peripheral to (if not absent from) these regional developments. There are no mound sites near the park. This change may be related to adjustments in regional trade axes away from the Green River area or shifts in cosmological ideas related to caves.[58] Although in lesser frequency than during the Early Woodland, people were still visiting the area around the park during the Middle Woodland. Prentice notes thirty-one sites near the cave, of which twenty-six are at rockshelters or in caves, four are in uplands, and one is on bottomland.[59]

The Late Woodland period (500 to 1000 CE) spans the time between the end of Hopewell and the beginnings of the suite of settlement, subsistence, social, and religious practices together known as "Mississippian" cultures. The adoption of bow-and-arrow technology, evidenced by small triangular stone projectile points, is a definitive characteristic for the Late Woodland in Kentucky.[60] In general, populations continued to increase in the region and some groups adopted increasingly sedentary settlement patterns in the latter part of the period.[61] Known Late Woodland sites near Mammoth Cave, however, are typically small and tend to occur at rockshelters; of the thirteen sites Prentice catalogues for the Mammoth Cave National Park, two are in uplands and the remainder are at rockshelters.[62]

52. Don W. Dragoo, *Mounds for the Dead: An Analysis of the Adena Culture*, Annals of Carnegie Museum, 37 (Pittsburgh, 1963), 235; Bruce G. Trigger, "Cultural Unity and Diversity," in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 15, *Northeast*, ed. Bruce G. Trigger (Washington, DC: Smithsonian Institution, 1978), 799–801.
53. Applegate, 345.
54. Prentice, 159; Applegate, 387.
55. Crothers, "Early Woodland Ritual Use," 524–541; Patty Jo Watson, "Preface," in *Archaeology of the Mammoth Cave Area*, ed. Patty Jo Watson (New York: Academic Press, 1974), xv–xviii.
56. Jefferies, "Regional Cultures," 115–127.
57. John P. Hart, "Evolving the Three Sisters: The Changing Histories of Maize, Bean, and Squash in New York and the Greater Northeast," in *Current Northeast Paleoethnobotany II*, ed. John P. Hart (Albany: The University of the State of New York, the State Education Department, 2008), 89-90.
58. Prentice, 153–154.
59. Ibid., 155.
60. Applegate, 348.
61. Jefferies, "Regional Cultures."
62. Prentice, 159–161.

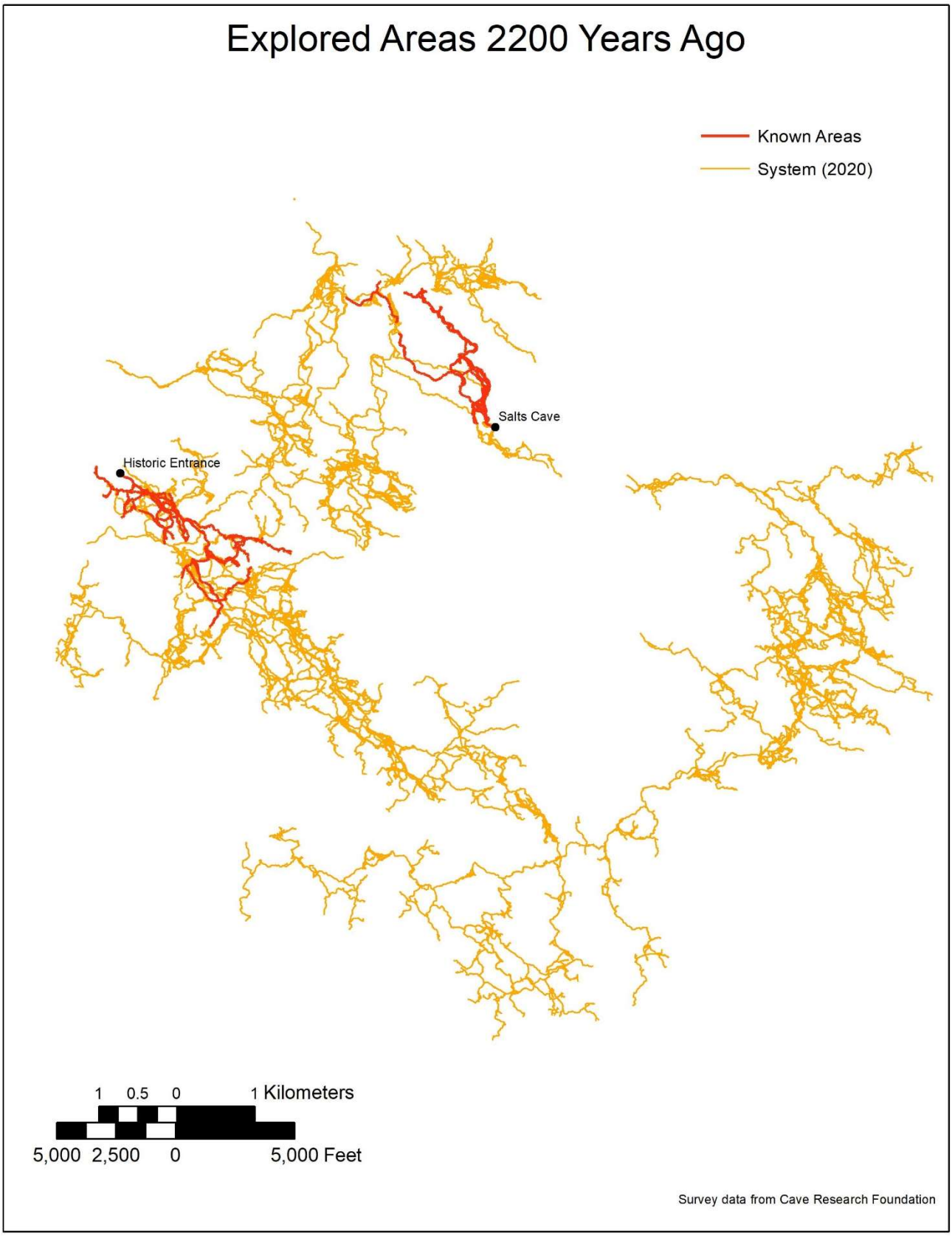

FIGURE 12. A diagram showing the explored portions of Mammoth Cave in 500BCE (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.7)

During the time between the Late Woodland and the arrival of Europeans in the sixteenth and seventeenth centuries, people in the Southeast were increasingly influenced by a set of sociopolitical, subsistence-settlement, and religious systems originating to the north and west and collectively termed "Mississippian"—many aspects of which were adopted throughout the region. Mississippian groups "practiced cleared-field agriculture with maize as the dominant crop . . . had hierarchical political organizations with evidence of ascriptive status differentiation [i.e., not egalitarian or 'tribal'], and . . . shared a set of religious cult institutions and iconographic complexes".[63] They are perhaps best known from archeological ruins of pyramidal/platform "temple" mounds at population centers and elaborate suites of symbolic/ritual artifacts that sometimes accompanied burials of individuals of social importance, including stone effigy sculptures, eccentric ceramic vessels and lithic items, elaborate smoking pipes, carved shell, copper ornaments, and large discoidal stones.[64] The spread of Mississippian ideas significantly altered the lifeways of the groups adopting them. Most notable of the changes were those related to full-time maize agriculture, which required field clearing and sedentary settlement strategies. This, coupled with large ceremonial centers surrounding mound sites, brought significant changes to the landscape relative to earlier times. Also, unlike in earlier times, the spread of Mississippian ideas was likely sometimes accompanied by influxes of populations.[65]

As during the Middle and Late Woodland, the area near Mammoth Cave was not a center of population during Mississippian times. There are no mounds in the park and the nearest site with a mound complex is the Annis Village site on the Green River approximately 37 miles to the west, where the river's floodplain is wide and capable of supporting extensive agriculture.[66] Prentice lists twenty-two known Mississippian sites in the Mammoth Cave National Park, of which three are scatters of materials in uplands, two are from bottomland settings, and seventeen are at rockshelters or caves.[67] Prentice suggests a settlement system in which the sites near Mammoth Cave:

> . . . consisted mainly of scattered, single family residences located on natural levees on the narrow Green River floodplain or on the level ridge tops overlooking the Green River. On the floodplain, [people] planted their gardens of maize and other domesticated plants; in the uplands they gathered nuts and hunted deer, turkey, raccoon, and other small animals. Periodically, particularly during the fall and winter, small groups would occupy rockshelters for short periods where they could exploit the nearby upland nut and animal resources.[68]

The area around Mammoth Cave was sparsely inhabited when European explorers visited Kentucky in the seventeenth and eighteenth

63. John F. Scarry, "The Nature of Mississippian Societies," in *Political Structure and Change in the Prehistoric Southeastern United States*, ed. John F. Scarry (Gainesville: University Press of Florida, 1996), 13; Trigger, 801.
64. Gordon R. Willey, *An Introduction to American Archaeology*, vol. 1, *North and Middle America* (Englewood Cliffs, New Jersey, 1966), 298–308.
65. John H. Blitz and Karl G. Lorenz, "The Early Mississippian Frontier in the Lower Chattahoochee-Apalachicola River Valley," *Southeastern Archaeology* 21, no. 2 (2002), 117–135.
66. David Pollack, "Mississippi Period," in *The Archaeology of Kentucky*, vol. 2, ed. David Pollack, State Historic Preservation Plan Report No. 3 (Kentucky Heritage Council, 2008), 740; Prentice, 165; James B. Griffin, "Late Prehistory of the Ohio Valley," in *Handbook of North American Indians*, gen. ed. William C. Sturtevant, vol. 15, *Northeast*, ed. Bruce G. Trigger (Washington, DC: Smithsonian Institution, 1978), 547–559.
67. Scarry; Prentice, 161–162. Sites are largely dated on the basis of the presence of shell-tempered pottery, which was first seen during the Late Woodland period and expanded during the Mississippian period.
68. Prentice, 165.

centuries. The decline in population was likely related to a combination of factors that included European diseases and warfare among American Indian groups that were ultimately related to and fueled by conflicts between European powers.[69]

Early Exploration and Settlement of the Mammoth Cave Area

European exploration began in Kentucky during the early 1700s. The region was then a part of Virginia with few permanent residents. Most of Kentucky's occupants consisted of Shawnee and Cherokee who hunted the land. The onset of the French and Indian War (1754–1763) brought the first Europeans to the immediate area of Mammoth Cave. Thomas Hutchins, a British soldier, was likely the first European to reach the Mammoth Cave area.[70] Hutchins was sent to the area during the war to conduct a survey along the Green River (then referred to as the Buffaloe River).[71]

Following the defeat of the French in the war, the British gained control of all land east of the Mississippi River. Shortly after the end of the war, King George III issued the Land Proclamation of 1763, establishing the land west of the Appalachians and south of the Ohio River—including all of present-day Kentucky—as an Indian reservation. British hunters and traders soon began exploring the Mammoth Cave region and noted its abundance of natural resources.[72]

In the years following the conclusion of the French and Indian War, settlers and land speculators largely ignored the Land Proclamation of 1763 and British military officials who sought to stop the settlement of the land west of the Appalachians, though the British were unwilling to remove settlers from the land. Settlement of the areas west of the Appalachians accelerated as the American Revolution drew near.[73]

Initial settlement of the Mammoth Cave area began in the early 1780s. In September 1783, a group of nineteen merchants from Philadelphia established a speculative land company and purchased several thousand acres of lands north of the Green River and Mammoth Cave. The land south of the Green River was set aside by the state of Virginia in 1784 for settlement by veterans of the American Revolution; however, this area remained largely unsettled for more than a decade.

Early Historic Period Exploration, Settlement, and Industry, circa 1797–1816

In 1797, John, Charles, and Francis Houchin settled south of the Green River.[74] According to folklore, Mammoth Cave was rediscovered by John Houchin, who allegedly shot a bear and followed the wounded animal to the cave entrance. While the exact date of the rediscovery of the cave is unknown, the cave was known to pioneer settlers by 1798.[75] In that year, the cave was mentioned as part of a land certificate in a

69. Kim A. McBride, "Historic Period," in *The Archaeology of Kentucky*, vol. 2, ed. David Pollack, State Historic Preservation Plan Report No. 3 (Kentucky Heritage Council, 2008), 906–908; Prentice 167–168.
70. Prentice, 24, citing Thomas Hutchins, *A Topographical Description of Virginia, Pennsylvania, Maryland, and North Carolina* (Cleveland, Ohio: The Burrows Brothers Company, 1904, reprint of 1778 edition), 97–98.
71. Ibid.
72. Lally, *Mammoth Cave National Park Historic Resource Study*, National Register of Historic Places Multiple Property Documentation Form Section III, A-1.
73. "Proclamation Line of 1763, Quebec Act of 1774 and Westward Expansion." Office of the Historian, United States Department of State. https://www.history.state.gov/milestones/1750-1775/proclamation-line-1763. Accessed August 2020.
74. Lally, Multiple Property Documentation Form, Section III, A-2, citing Charles E. Whittle, *Edmonson County Flashlights in Folklore* (Bowling Green, Kentucky: Whittle Places, 1932), 52–54. See also Prentice, 26.
75. Prentice, 26.

record of lands from the *Warren County Survey Book, 1796–1815*. The survey book states:

> Valentine Simmons [or Simons] [entered] 200 acres of second rate land in Warren County by virtue of the Commissioner's Certificate No. 2428 lying on Green River beginning on a sycamore tree on the bank of said River thence running southward including two peter caves, thence angling down said river for quantity to include the improvement.[76]

One of the two "peter" (saltpetre) caves referred to was Mammoth Cave. As a result of this entry in the survey book, Simons is believed to be the first legal owner of the cave. This title is the earliest known written record of Mammoth Cave.[77]

Saltpetre Production and the War of 1812

In 1797, American Revolution veteran Gilbert Imlay suggested the Mammoth Cave area as a possible domestic source of nitrates from which saltpetre could be extracted. While not specifically mentioning Mammoth Cave, Imlay noted that the largest known supply of saltpetre in colonial North America was found along the Green River.[78]

Saltpetre (potassium nitrate), properly combined with sulfur and charcoal, was used to produce black gunpowder—which was especially important at the time for use in the war effort. The nitrates to produce saltpetre were found to be present in the form of nitrocalcite in the earth of caves. These nitrates absorbed moisture from the air, making the cave earth unusable in its natural form to make gunpowder. To overcome this difficulty, the nitrates were processed with wood ashes to form potassium nitrate, which does not absorb moisture and, therefore, could then be used to make gunpowder.[79] As described by John H. Farnham in 1811:

> The earth is dug up and deposited in square pits, called hods. When one of these pits is filled, water is poured in until the strength of the earth is exhausted. The water drained off is called beer. This is conveyed through ducts or pipes from the hod as near as possible to the entrance of the cave, whence it is taken by buckets to some convenient place above ground and put into boilers, where by an infusion of potash, the limestone, which the beer contains, is separated from the salt, and the sediment, after boiling, is saltpetre.[80]

The manufacture of gunpowder was an important industry in the years following the American declaration of independence from Great Britain. During the American Revolution, when trade with Britain was not possible, large amounts of saltpetre needed to be found. After the war, as trade reopened with Great Britain, the United States was able to receive large amounts of saltpetre from India.[81] Despite importing ample saltpetre from abroad, domestic saltpetre production continued through the early nineteenth century.

As the relationship between the United States and Great Britain again worsened in the early nineteenth century, E. I. DuPont, the founder of the gunpowder manufacturer E. I. du Pont de Nemours and Company (DuPont), warned that an impending war with Great Britain could severely limit the ability of the United States to continue to import saltpetre from India. As a result, the government purchased a large reserve supply of

76. Margaret M. Bridwell, *The Story of Mammoth Cave National Park Kentucky: A Brief History* (Mammoth Cave, Kentucky: 1952, rev. ed., 1959).
77. Prentice, 26.
78. Lally, Multiple Property Documentation Form, Section III, Section III, B-1–B-2, citing Duane DePaepe, *Gunpowder from Mammoth Cave: The Saga of Saltpetre Mining Before and During the War of 1812* (Hays, Kansas: Cave Pearl Press, 1985), 9.
79. Marsha A. Mullins, "Mammoth Cave Saltpetre Works," Historic American Engineering Record No. KY-18 (Washington, DC: National Park Service, 1986), 6.
80. Extract of a letter from John H. Farnham, Esq., A Member of the American Antiquarian Society, describing Mammoth Cave in Kentucky" (1811), quoted in Thor Borresen, Report on saltpetre works of Mammoth Cave (National Park Service, 1942).
81. Lally, Multiple Property Documentation Form, Section III, B-3.

saltpetre from India, while also identifying domestic saltpetre supplies.[82]

The onset of the War of 1812 and the resulting increase in demand for saltpetre sparked the interest of investors in Mammoth Cave. In 1811, the first known map of Mammoth Cave was drawn. Created from memory, not survey, the "Eye-Draught Map of Mammoth Cave" helped acquaint merchants with the location of saltpetre in the cave. This map was the first to refer to the cave as "Mammoth Cave." The name may have been chosen to emphasize both the size and profit potential of the cave.[83]

The sudden interest in saltpetre mining at Mammoth Cave led to a spike in the value of the property. The first owner of Mammoth Cave, Valentine Simons, sold the cave and adjacent lands to John Flatt for $116.47 sometime after 1799. Flatt, who is believed to have operated a small saltpetre mining business at the cave, sold the property to the McClean brothers for $400 around 1808. The McClean brothers, who expanded the mining operation at the cave, sold the property to Charles Wilkins and Fleming Gatewood in 1810 for $3,000.[84] Wilkins, a saltpetre merchant from Lexington, had knowledge of the industry; he designed pumping systems and laid out cart routes within the cave, allowing the saltpetre mining operations to expand significantly. In 1812, Hyman Gratz, a Philadelphia merchant, bought out Fleming Gatewood's interest in the cave for $10,000. With Gratz's financial backing, Wilkins was able to fully implement his saltpetre extraction system.[85] Despite the general increase in demand caused by the onset of the War of 1812, saltpetre production at Mammoth Cave had begun to decrease by 1812. One reason for this decrease was a series of four earthquakes centered in New Madrid, Missouri, which occurred between December 1811 and February 1812. The earthquakes caused damage to the equipment used in the mining process and made workers fearful of returning to the cave.

During the late eighteenth and early nineteenth centuries, when saltpetre was being mined inside Mammoth Cave, as many as seventy enslaved persons were leased by the mine operators to work there. The process of extracting saltpetre from the cave involved collecting dirt from cave passages, loading it onto ox carts, and hauling it to leaching vats located at the Rotunda, near the Historic Entrance, and at Booth's Amphitheater. Much of the dirt processed for nitre was mined in locations near the Rotunda and Booth's Amphitheatre. Once the vats were filled with dirt, they were flooded with water brought into the cave through wooden pipes. The water, which absorbed the calcium nitrate from the soil, was drained into troughs beneath the vats. The calcium nitrate-containing water was then siphoned into a tank and pumped by hand through a wooden pipeline toward the entrance and out of the cave. Outside the cave, the solution was leached through wood ashes and then boiled in iron kettles until saltpetre crystals formed. Two chimneys or furnaces located outside the cave were used in this process. Following the manufacturing process, the saltpetre crystals were then shipped to gunpowder manufacturers in the eastern United States.[86]

The enslaved persons who extracted the saltpetre lived in one-room log cabins outside the cave. The log rooms would later be modified to form a portion of the first Mammoth Cave Hotel, which opened in the 1820s.[87]

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82. Mullins, 11–12.
83. Lally, Multiple Property Documentation Form, Section III, B-2, citing DePaepe, *Gunpowder*, 9–10.
84. Ibid., citing Harold Meloy and William R. Halliday, "A New Concept of the Initial History of Mammoth Cave, 1798–1812," *Journal of Spelean History* 1, no. 4 (1968), 110. Confusingly, all of these deeds were recorded the same day, January 31, 1812. However, historians Meloy and Halliday interpret this information as a formal legal recording of transactions that had actually taken place years earlier.
85. Ibid., citing DePaepe, *Gunpowder*, 10.
86. Ibid., B-3–B-4.
87. Joy Medley Lyons, *Making their Mark: The Signature of Slavery at Mammoth Cave* (Fort Washington, Pennsylvania: Eastern National, 2006), 10–11.

While much of the saltpetre works remain intact, portions have been dismantled or damaged over the years. Early tour guides allegedly removed pieces of wood from the mining structures for use as torches, while timbers from the mining structures were also used to construct railings. The pump tower in Booth's Amphitheater was dismantled in 1900. In 1903, a lighted torch used by a guide started a fire that resulted in the destruction of the pump tower in the Rotunda.[88]

With the end of the War of 1812, the demand for saltpetre fell sharply. At the same time, however, word spread of the wonders of the cave. Soon, visitors began to travel to the area simply to see Mammoth Cave.

Character Study of the Early Historic Period Exploration, Settlement, and Industry Period, circa 1797–1816

As noted above, the first map of record of Mammoth Cave is the 1811 "Eye-Draught Map of Mammoth Cave" (Figure 13). Three copies exist, one of which was later included in the 1853 edition of Thomas Jefferson's *Notes on the State of Virginia*. The map may have been designed to illustrate to saltpetre merchants the extent of available cave sediment deposits that could be mined to produce gunpowder by such organizations as the DuPont Company in Philadelphia. The map shows the historic cave entrance, Houchins Narrows, Main Cave passage, and the beginnings of several branches leading off of these routes. The map also shows the locations of some mining and equipment. Although the map illustrated passages approximately 3 miles in length, mining was generally unproductive beyond Star Chamber due to the challenges associated with hauling the material over the breakdown floor. Oxen carts were used on the so-called turnpike road, which was more evenly surfaced.[89] Other maps known to exist from this period include the Bogert map and two Draper maps.

Efforts conducted to mine cave soil reportedly led to modifications of the Historic Entrance to improve access, as well as construction of a door and stacked stone walls up to 4 feet in height along the sides of Houchins Narrows to secure the entrance. Other modifications included the construction of wooden staging equipment within the passage and a wooden plank bridge at Booth's Amphitheater. Piles of tailings produced by the operation were left behind in passage near the Historic Entrance. A trough of water in the room beyond Wandering Willie's Spring was reportedly used to water oxen.

Surviving today are the vats and vessels used in the saltpetre operations (Figure 14). Historic American Engineering Record documentation provides measured drawings of the surviving features associated with this industrial enterprise (Figure 15).

88. Lally, Multiple Property Documentation Form, Section III, B-4–B-5.
89. Allison Cohen Diehl and Phillip DiBlasi, DRAFT *Historic Chronology of Mammoth Cave* (Louisville: University of Louisville, July 1998), 24.

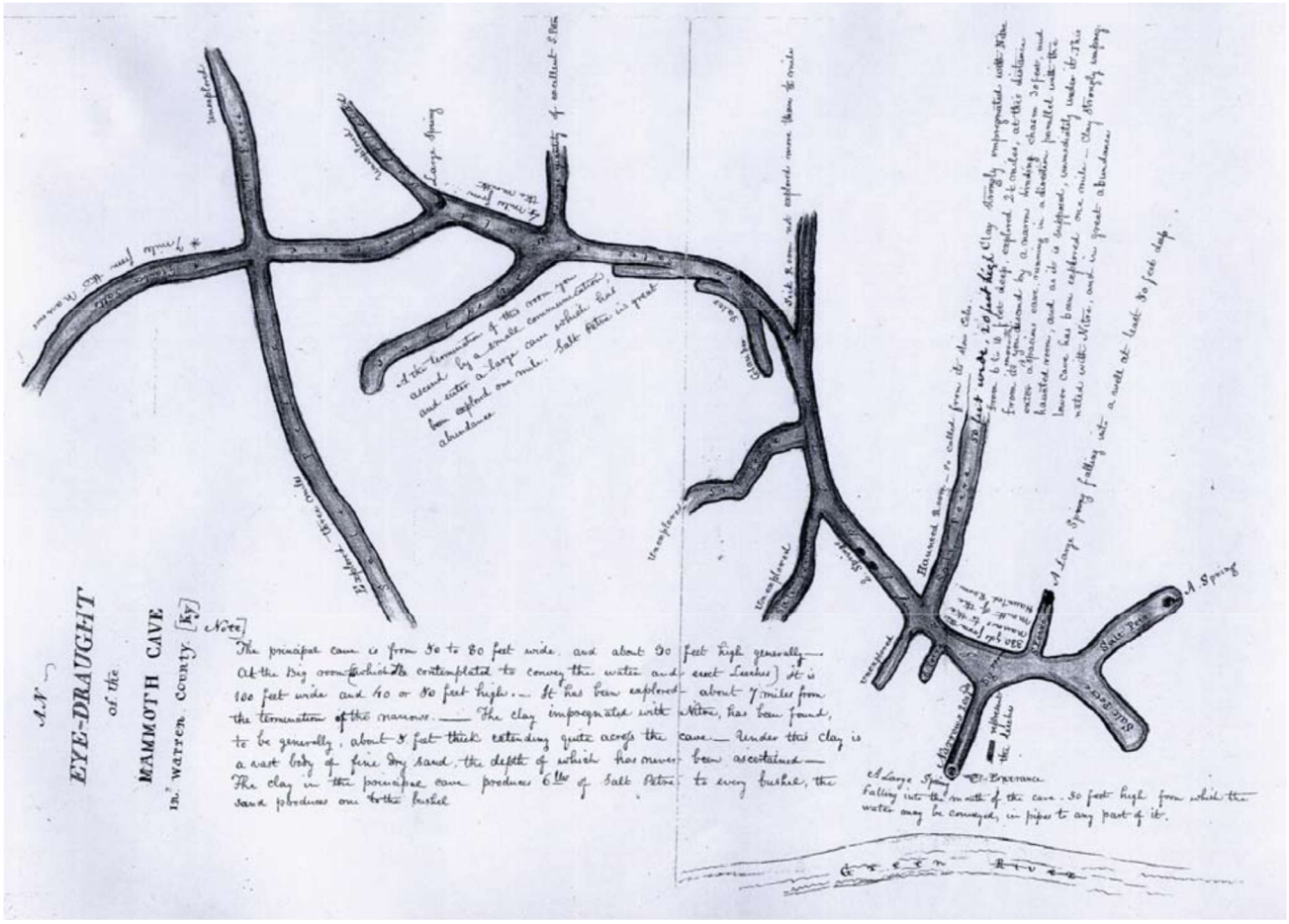

FIGURE 13. The Eye-Draught Map of Mammoth Cave, 1811. (Source: Mammoth Cave National Park)

FIGURE 14. Views of the saltpetre mining operations from 1892 (left) and 2018 (right). (Source: Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 3.2 [left])

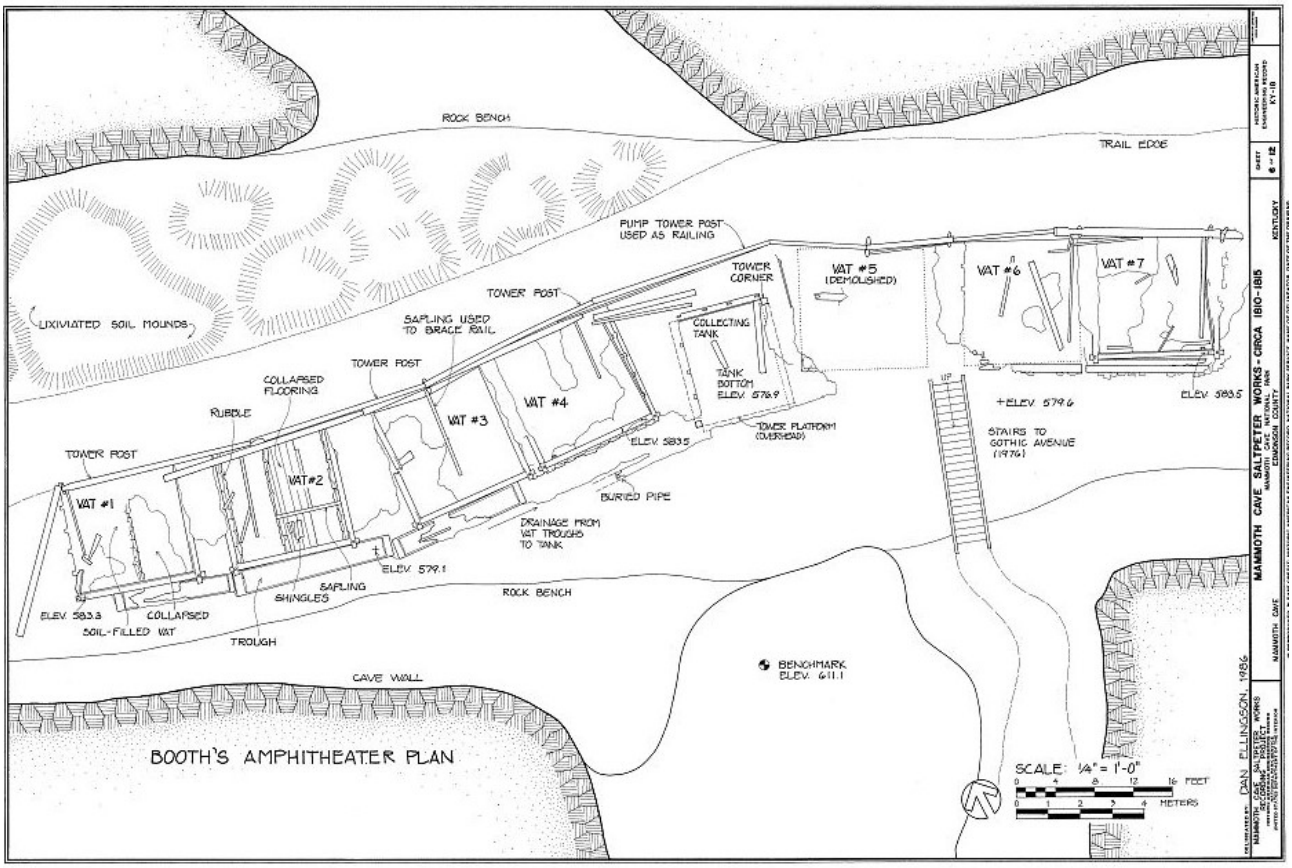

FIGURE 15. HAER drawing of saltpetre features near Booth's Amphitheater, 1986. (Source: Historic American Engineering Record, HAER No. KY-18, 1986)

Early Nineteenth Century Tourism, 1816–1850

In 1815, following the end of the War of 1812, Wilkins and Gratz suspended saltpetre mining operations. In October of that year, Nahum Ward, a Massachusetts native and land speculator from Marietta, Ohio, visited Mammoth Cave, where during an extended (eighteen-hour) tour he saw a mummy of an adult woman previously discovered by saltpetre miners. Ward took the mummy, known as Fawn Hoof, with him and wrote an account of his visit to the cave. This article was published throughout the country and appeared in England in 1817.[90] The popularity of the narrative contributed to increasing numbers of visitors to Mammoth Cave.

Fawn Hoof was displayed at the American Antiquarian Society and elsewhere until 1914, when the Smithsonian Institute took possession of the mummy.[91]

In the early 1820s, Archibald Miller Sr. showed visitors the cave as an agent for Wilkins and Gratz. By the 1820s, guests from as far away as Europe were visiting the cave.[92] Initially, visitors were only

90. References to archeological artifacts found within the cave were documented as early as the circa 1813 Bogart map, which noted the locations of "the Indian Mummy, the Mockason Room, and the Basket Room." In 1916, after a century of visitation, excavations were conducted in the cave by Nels C. Nelson on behalf of the American Museum of Natural History. See Prentice, 584–594.
91. Hobbs, 41.
92. Harold Meloy, "Introduction to the Reprint Edition," in Alexander Clark Bullitt, *Rambles in the Mammoth Cave during the Year 1844, By a Visiter* [*sic*] (Louisville, Kentucky: Morton &

taken to areas of the cave with which guides were familiar; however, as time went on, new areas were explored. Often, early visitors used open flame lanterns to lead themselves through the cave. As time went on, guides would ignite oiled paper to light large rooms, while oil-soaked rags were thrown in dark chasms to the light the way.[93]

Visitors to the cave in the early nineteenth century made a habit of "smoking" their names onto the white ceilings of the cave, a practice that involved writing with candle smoke. In addition, during the mid- to late 1800s, a caving costume was available to guests for a fee. The costumes, which were individually unique, were designed to protect the clothing of visitors to the cave. The 1860 *Guide Manua*l noted:

> The proper costume for a gentleman consists of a jacket, heavy boots, a cloth cap and woollen [sic] pants . . . the Bloomer or Turkish dress is the proper costume for a lady.[94]

In 1827, Archibald Miller Sr. moved from a house near the cave to another one nearby, and Fleming Gatewood, a former owner of the cave, served as the new agent to manage visits to the cave. Also in 1827, Charles Wilkins died; Gratz later bought out Wilkins' share of the cave property.

In 1828, Hyman Gratz, by that time the sole owner of the cave, began to operate a small log inn near the cave to house visitors.[95] The original inn as it existed in 1828 was a two-story log building with two rooms on the ground floor, each 18 feet square, with a 10-foot open space between.[96] Many visitors preferred to stay at Bell's Tavern (located near what would become known as Glasgow Junction and now Park City, Kentucky). It appears that the building that served as the original inn was the former home of Archibald Miller Sr. and his family, built circa 1811 when he worked as manager for the saltpetre works.[97] The house was later the home of Fleming Gatewood and his family.[98]

In the 1830s, a chamber of the cave was used for religious services. Known as the "cathedral" and later the "Methodist Church," the chamber contained seats for worshipers and a pulpit, and it was lighted with a large number of lanterns. Religious services in the chamber are thought to have continued through the late nineteenth century.[99]

In winter 1834–1835, Edmund F. Lee, a civil engineer, spent several months measuring every known passage and branch in the cave. Lee found the cave to be approximately 2-1/4 miles in length, with the known branches measuring a combined 8 miles. In conjunction with his survey work, Lee published a guidebook entitled *Notes on the Mammoth Cave*, which included a scale map of the cave. The map and guidebook would soon be obsolete, as a number of new passages were found in 1838 following the crossing of Bottomless Pit, a large active domepit and canyon about 110 feet deep, by guide Stephen Bishop, who placed a ladder across the hole.[100] A permanent structure to span the opening was added in 1843.

In 1836, Joseph C. Shackelford and Archibald Miller Jr. (son of Archibald Miller Sr.) leased the cave and began to work as cave guides, charging

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Griswald, 1845, Reprinted, Dayton, Ohio: Cave Books, 1973), vi–vii. According to Mammoth Cave National Park personnel, tours of the cave began in 1816.

93. Lyons, *The Story behind the Scenery*, 38.
94. "Who Would Pay to See a Hole in the Ground?" Mammoth Cave National Park, U.S. Department of the Interior, May 23, 2018, citing *Guide Manual,* 1860, https://www.nps.gov/maca/learn/historyculture/whowouldpay.htm. Accessed September 2020.
95. Lally, Multiple Property Documentation Form, Section III, B-5, no source cited.
96. Meloy, x.
97. Typed manuscript in park collection, recollections of O. P. Shackelford (son of Joseph C. Shackelford).
98. Correspondence with Joy Medley Lyons, Mammoth Cave National Park, as part of work relating to the Mammoth Cave Core Visitor Services Area Cultural Landscape Report.
99. Lally, Multiple Property Documentation Form, Section III, Section III, B-5–B-6.
100. Meloy, vii–viii.

visitors one dollar for a tour.[101] Shackelford's sons J. C. and Oliver also worked as guides.[102]

Franklin Gorin and Stephen Bishop at Mammoth Cave, 1838. Gratz continued to own the Mammoth Cave property until April 1838, when Franklin Gorin purchased the land for $5,000. Gorin, an attorney whose family had helped settle the city of Glasgow in Barren County, expanded visitor accommodations near the cave. After this work, the main hotel building included sufficient accommodations for thirty to forty persons.[103] Gorin also connected the former cabins of saltpetre miners and constructed a long promenade that ran the full length of the structure.[104]

Under Gorin's ownership, cave exploration was ongoing, leading to the discovery of new passageways that were eventually opened to the public. Enslaved laborers performed the majority of the work in the cave, some of whom also acted as tour guides.[105]

After he purchased the Mammoth Cave property in 1838, Franklin Gorin transported the enslaved laborers from his home in nearby Glasgow, Kentucky, to make improvements and lead tours at the cave. One of the enslaved laborers, Stephen Bishop, initially explored the cave to identify new passages and make improvements to existing ones. As he became more familiar with the cave, Bishop began to lead visitors on tours. He developed a good knowledge of the cave and was responsible for exploring several of the known cave passages. Bishop was often mentioned in glowing terms by visitors in accounts of their travels to Mammoth Cave. Years later, Gorin wrote the following about Bishop:

> I placed a guide in the cave—the celebrated and great Stephen—and he aided in making the discoveries. He was the first person who ever crossed the Bottomless Pit. . . . We discovered all that part of the cave now known beyond that point. Stephen was a self-educated man; he had a fine genius, a great fund of wit and humor, and some little knowledge of Latin and Greek, and much knowledge of geology; but his great talent was a perfect knowledge of man. . . . Stephen was certainly a very extraordinary boy and man.[106]

Other early enslaved guides at Mammoth Cave included Matt Bransford and Nicholas (Nick) Bransford, both of whom were brought to the cave by Franklin Gorin at about the same time that Stephen Bishop arrived at the cave.[107]

Other than those who worked as tour guides in the cave, the enslaved persons at Mammoth Cave largely worked in and around the nearby hotel. Very few of the enslaved laborers at Mammoth Cave worked there year round; many were leased from other nearby slave owners in order to properly staff the hotel during the peak tourist months, May through September.[108]

Dr. John Croghan at Mammoth Cave, 1839–1849. In October 1839, about 1-1/2 years after purchasing the Mammoth Cave property, Franklin Gorin sold Mammoth Cave and 1,600 acres of land to Dr. John Croghan, a Louisville physician and long-time business acquaintance, for $10,000. Stephen Bishop was included as part of the sale. Croghan continued the improvements begun by Gorin at the cave, with the expansion and remodeling of the hotel a high priority, and sought to make Mammoth Cave a greater commercial

101. Typed manuscript in park collection, recollections of O.P. Shackelford (son of Joseph C. Shackelford).
102. Oliver Shackelford, "An Account of the History of Mammoth Cave during the Middle Nineteenth Century" (typed manuscript in park collection, n.d., [circa 1920]), 3.
103. Meloy, "Introduction," in Bullitt, (1845, reprint 1973), xi.
104. Lyons, *Making their Mark*, 14.
105. Ibid., 16–18.
106. Ibid., 21, citing Harold Meloy, "The Legend of Stephen Bishop," *Journal of Spelean History* 10, no. 1 (1977).
107. Matt and Nicholas were slaves owned by a man named Bransford of Glasgow, Kentucky.
108. Lyons, 50–51. (Information about where the laborers were housed was not discovered in materials reviewed for this study.)

success.[109] Croghan hired Archibald Miller Jr. as manager of the property.[110]

As part of the hotel expansion, Croghan hired J. C. Shackelford to build two, two-story log buildings. Each building had a 12-foot-long hall and contained four rooms. Shackelford was also given the responsibility for cutting and hewing logs for a row of sixteen cottages. A post and rail fence was built around the hotel, and a stable was added for visitors' horses. In 1848, a larger two-story addition, 30 feet by 90 feet in plan, was constructed at the main building. The first floor of this building was the dining room, and the second floor was a ballroom.[111]

Croghan also had several new roads constructed to better facilitate travel to Mammoth Cave. One new road was opened from Cave City to the Mammoth Cave Hotel, continuing across the Green River to connect with an existing road to Grayson Springs. A second new road led from Rowletts Station on the Louisville & Nashville Turnpike, passed directly in front of the hotel, and continued southwest toward Dripping Spring. This new road bypassed Bell's Tavern, encouraging visitors to stay at the expanded Mammoth Cave Hotel. Stagecoaches were routed along this new road, further increasing business at the hotel.[112]

In addition to stagecoaches, early visitors arrived by steamboats, which traveled down the Ohio River and up the Green River, bringing visitors from Evansville, Louisville, or Cincinnati. (A series of dams and locks made the Green River navigable.)[113]

Advertisement of Mammoth Cave was also enhanced by the travel accounts and guidebooks Croghan published. One of these guidebooks, *Rambles in the Mammoth Cave* by Alexander Clark Bullitt (1844), included a lengthy account of the sights in the cave as well as a description of the accommodations available. Bullitt, a friend of Croghan's from Louisville, would go on to become editor of the *New Orleans Picayune*. Bullitt described the hotel as it existed in 1844: "The hotel is a large edifice, two hundred feet long by forty-five wide, with piazzas, sixteen feet wide, extending the whole length of the building, both above and below. . . ."[114]

Bullitt continued with a description of entering the cave for the first time:

> Proceeding onward about one-hundred feet, we reached a door, set in a rough stone wall, stretched across and completely blocking up the Cave; which was no sooner opened, than our lamps were extinguished by the violence of the wind rushing outwards . . . Our lamps being relighted, we soon reached a narrow passage faced on the left side by a wall, built by the miners to confine the loose stone thrown up in the course of their operations, when gradually descending a short distance, we entered the great vestibule or ante-chamber of the Cave. " What do we now see? Midnight?—the blackness of darkness?—Nothing! Where is the wall we were lately elbowing out of the way? It has vanished!—It is lost! We are walled in by darkness, and darkness canopies us above. Look again;—Swing your torches aloft! Aye, now you can see it ; far up, a hundred feet above your head, a grey ceiling rolling dimly away like a cloud, and heavy buttresses, bending under the weight, curling and toppling over their base, begin to project their enormous masses from the shadowy wall. How vast! How solemn! How awful! The little bells of the brain are ringing in your ears ; you hear nothing else—not even a sigh of air—not even

109. Richard Hobart and Bob Thompson, *The Mammoth Cave Estate: In Historical Photographs* (2013), 66.
110. Typed manuscript in park collection, recollections of O. P. Shackelford (son of Joseph C. Shackelford).
111. Meloy, "Introduction," in Bullitt, (1845, reprint 1973), xvi; Shackelford, "An Account," 5.
112. Ibid., xvii.
113. "Valley Residents Believe Being Able to Ship Coal By Water Will Bolster Economy," *The Courier-Journal* (November 18, 1951).
114. Bullitt (1845, reprint 1973), 11.

> the echo of a drop of water falling from the roof.[115]

During Croghan's ownership of the cave, a variety of tours were offered to visitors, led by Stephen Bishop, Matt Bransford, and Nicholas Bransford, among others. The tours typically travelled along Broadway and Gothic Avenue before making their way to pits and domes as well as to rivers. Broadway Avenue, an upper-level canyon that extends southeast from the Rotunda, connects with Gothic Avenue, a major upper-level trunk canyon that extends southeast from Broadway. Guides often travelled with open grease lanterns fueled with lard oil. During this time, tourists built monuments using stacked cave rock to commemorate their visits. Many of the monuments remain, particularly in Gothic Avenue.[116]

In 1842, Dr. Croghan also brought thirteen individuals suffering from tuberculosis and members of their families to Mammoth Cave to live. Croghan, like many others in the medical field at the time, believed that being in an environment with a constant temperature and humidity would be beneficial to those suffering from tuberculosis. To house his patients and their families, Croghan had wood and stone huts erected in the main avenue of the cave. Croghan's experiment lasted only until spring 1843, by which time seven of his patients had died and the health of others had worsened.[117] Three patients were buried at the Old Guide's Cemetery.[118]

Croghan died in 1849 of tuberculosis, at which time the Mammoth Cave properties were placed in a trust for his nine nieces and nephews. His will further stipulated that the properties be sold when the last of his nieces or nephews died.[119]

Character Study of the Early Nineteenth Century Tourism Period, 1816–1850

Refer to Figure 23 and Figure 24 for maps showing the explored portions of Mammoth Cave in 1835 and 1845, respectively.

Initial visitors came to see the natural wonders of Mammoth Cave during the early 1800s. Roads were rough, and there were no accommodations available to these visitors. The tales of these visits, mostly conducted by scientists and doctors, and the ancient relics and mummies observed in the cave were later published in journals and newspapers, and they encouraged others to travel to the remote area. A hotel was opened near the cave entrance in 1828 to take advantage of this influx of travelers. Produced during this period was the Lee map of 1835 (Figure 16). Drawn by civil engineer Edmund F. Lee, the map illustrates approximately 8 miles of passages, the farthest point represented being Symmes Pit Branch, now known as Blackall Avenue. Some of the present-day place names were established by early visitors, and the first religious ceremonies were conducted within the cave in 1834. While visits occurred more frequently, they remained very limited through 1835, and few improvements were made in the cave to accommodate tourists, with remnants of the saltpetre mining remaining. Bullitt describes the floor of the cave as:

115. Ibid, 13–14.
116. Lally, Multiple Property Documentation Form, Section III, B-6.
117. "Mammoth Cave Invalids," *The Illinois Free Trader* (May 26, 1843); "The Mammoth Cave," *Vermont Phoenix* (May 12, 1843).
118. Lally, Multiple Property Documentation Form, Section III, B-6, citing Samuel W. Thomas et al., "A History of Mammoth Cave, Emphasizing Tourist Development and Medical Experimentation Under Dr. John Croghan," *Register of the Kentucky State Historical Society* 68 (1970): 26.
119. Ibid.; Scott E. Sallee, "Mammoth Cave Guide," (1998), typed manuscript in park files, identifies the patients buried in the Old Guide Cemetery as Oliver H.P. Blair of Pittsburgh (May 14, 1814–March 2, 1843), John Wesley Harper of South Carolina (died January 18, 1843) and Charles Marshall of Oswego County, New York (died February 1, 1843).

> Very irregularly broken, consisting of vast heaps of the nitrous earth, and of the ruins of the hoppers or vats, composed of heavy planking, in which the miners were accustomed to leach it.[120]

In 1836, Franklin Gorin purchased much of the land around the cave entrance, expanded the hotel, and began to offer guided tours led by trained guides. Gorin also established one of the enslaved persons, Stephen Bishop, as a guide (Figure 17).[121] Bishop expanded the knowledge of the passages, with his first major discovery being Gorin's Dome. He also was the first explorer known to have crossed Bottomless Pit; he did this using a ladder, and the site was later made accessible through construction of a cedar bridge circa 1839 (Figure 18). Once Bottomless Pit had been crossed, guides were able to discover the rivers beyond it, which added to the caché of the cave. Boat tours would follow (Figure 19). By 1838, wood stairs had been added to provide access to Gothic Avenue. In the same year, Gorin sold the property to Dr. John Croghan, who successfully increased tourism during the late 1830s, leading to the hiring of additional guides. Along with Niagara Falls, Mammoth Cave became one of the most popular attractions for European travelers within the United States.

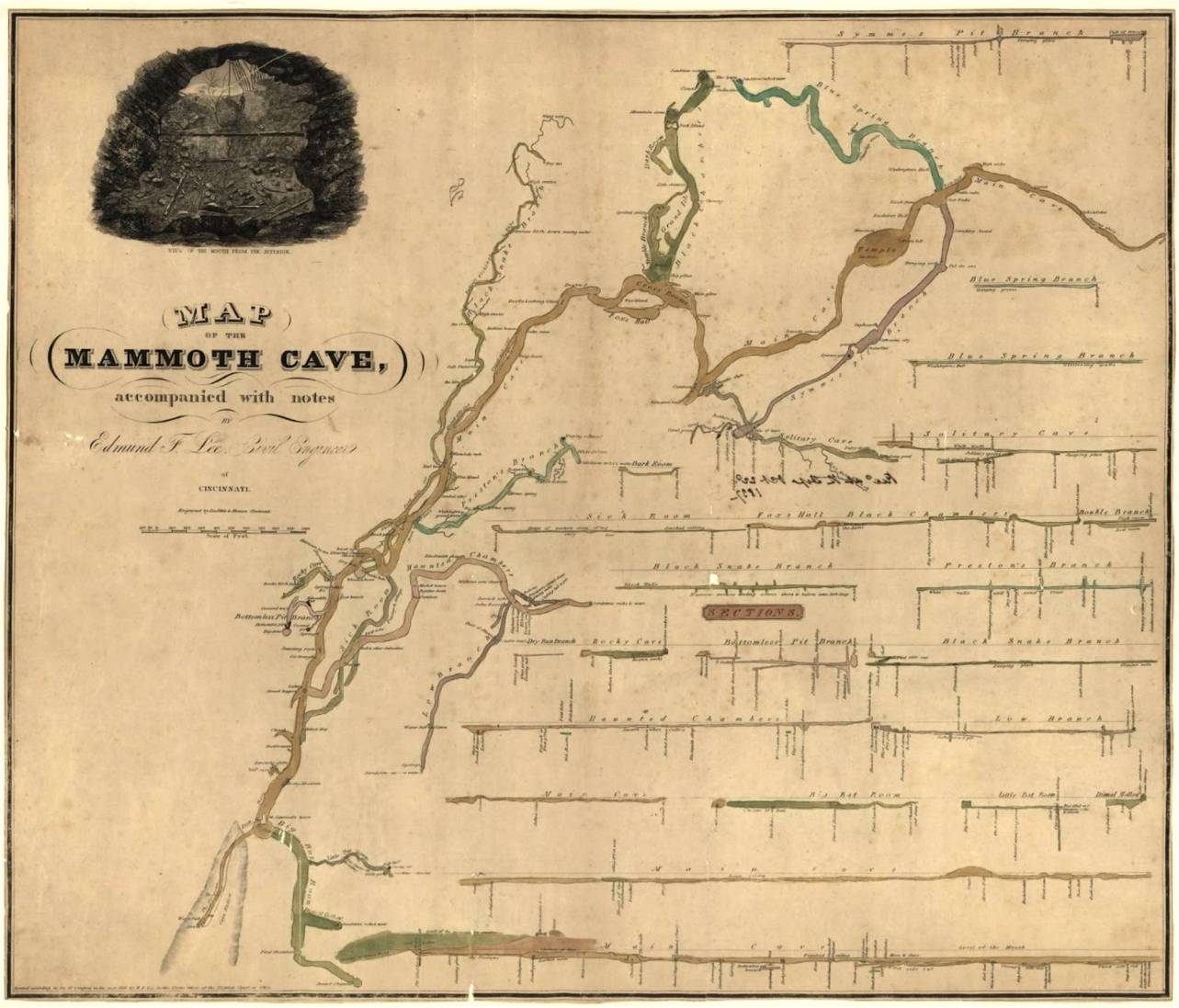

FIGURE 16. Lee Map of Mammoth Cave, 1835. (Source: Mammoth Cave National Park)

120. Bullitt (1845, reprint 1973), 16.

121. Lyons, *Making their Mark*, 16–18.

FIGURE 17. One of the most famous guides of Mammoth Cave, Stephen Bishop. (Source: H.C. Hovey, *One Hundred Miles in Mammoth Cave.* Reprint [Silverthorne, Colorado: VistaBooks, 2000])

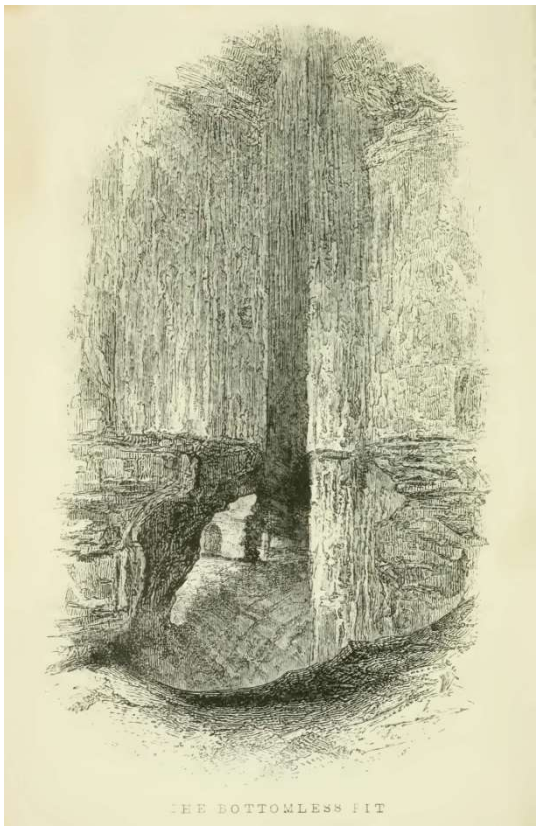

FIGURE 18. Star Chamber (left) and Bottomless Pit (right) were two popular features associated with antebellum cave tours. (Source: Horace Martin, *Pictorial Guide to the Mammoth Cave, Kentucky* (New York: Stringer and Townsend, 1851), 40 (left), 46 (right))

FIGURE 19. Boats and tourists at Echo River. (Source: Source: Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 3.3)

Having been sold by Gorin to Croghan as part of the purchase of Mammoth Cave, Stephen Bishop remained as a guide, helping to discover Mammoth Dome, Snowball Room, Cleaveland's Cabinet. Croghan asked Bishop to record his discoveries, leading to Bishop's highly accurate map of the known cave passages in 1845 (Figure 20). Upon his death in 1849 from tuberculosis, Croghan's will stipulated that his enslaved laborers, including Stephen Bishop, be granted their freedom in seven years.

Stephen Bishop, his wife, Charlotte, and son, Thomas, were given their freedom in 1856 under the terms of Croghan's will.[122] Shortly thereafter, Bishop purchased 75 acres of land near the cave. In 1857, at the age of 37, Stephen Bishop died of unknown causes. He was buried at the Old Guide's Cemetery, located west of the present-day Mammoth Cave Hotel.[123]

Physical improvements that Croghan made within the cave included the excavation of Houchins Narrows to increase the height of the passage to 8 feet by 1845; prior to this excavation visitors were forced to crouch to pass through this section. Croghan also added wood stairs into Gothic Avenue by 1840, built safety railings around Side Saddle Pit by 1844, and widened and excavated the passage used to reach the rivers beyond Bottomless Pit soon thereafter. Boats were recorded as in use on Echo River during the early 1840s (Figure 21). In 1847, the original cave entrance door was removed for repair. By 1850, additional features included a safety railing around the Dead Sea, excavation of Purgatory to allow passage, ladders at Gorin's Dome, the passage to River Styx, and a wood staircase at Labyrinth. Additional physical features associated with this early tourism period include signatures on the walls and ceiling of several passages inscribed through etching into the stone, or through the use of charred wood and candle smoke writing. The candle smoke writing is most prevalent in Gothic Avenue and largely dates to the nineteenth century. Today, only the signatures and the widened and deepened form of manipulated passages survive from the features established during this period.

122. Lyons, *Making their Mark,* 20, citing Will of John Croghan, January 10, 1849, Book 4, page 181, Jefferson County Court Clerk, Louisville, Kentucky.
123. Ibid., 21.

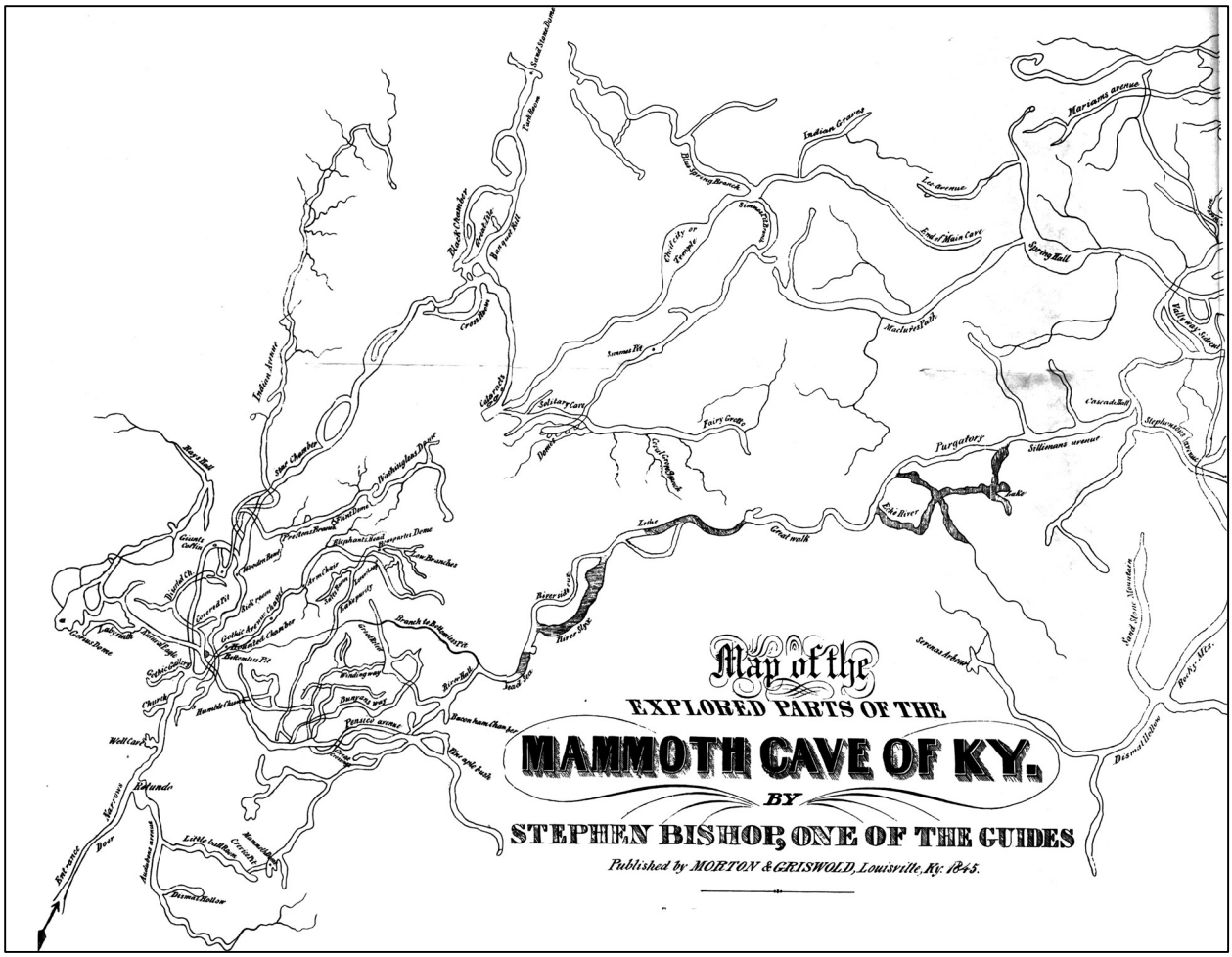

FIGURE 20. Stephen Bishop's map of Mammoth Cave, 1845. (Source: Mammoth Cave National Park)

FIGURE 21. View of stairs built circa 1840s to reach Gothic Gate/Avenue (left) and early safety railings (right). (Source: Martin, 1851, 27 (left); Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 3.5 (right))

Consumptive Huts, 1842–1843. The alleged preservative qualities of the cave piqued Dr. John Croghan's original interest in Mammoth Cave. Croghan read accounts in journals stating the timbers from the old nitre mine, which were now more than 30 years old, had not begun to rot. It was also reported that the bodies of dead bats, and even the bodies of American Indians which had been found in the cave, remained perfectly intact and undecayed.[124] This suggested to Croghan the use of the cave as an experimental tuberculosis hospital, which he established in 1842. A trough of water used to water oxen in the room beyond Wandering Willie's Spring later served tuberculosis patients living in the cave. Other surviving features from cave use in this period include the stone structures Croghan built in Main Cave to house his office and the kitchen dining hall. Patients lived in wooden huts that are no longer present. These were located along Audubon Avenue. Supposedly Eastern red cedar trees were planted near the huts but died due to lack of sun and water. The experiment was abandoned within eighteen months. Today, the ruins of two stone huts survive in Main Cave (Figure 22).

FIGURE 22. Illustration of one of the consumptive huts built by Croghan in the 1840s as published in *Harper's Weekly* in 1877 (top), and the hut in 2018 (bottom).

124. "Physician, Heal Thyself." Mammoth Cave National Park, U.S. Department of Interior. May 23, 2018, accessed August 2020, https://www.nps.gov/maca/learn/historyculture/physicianhealthyself.htm.

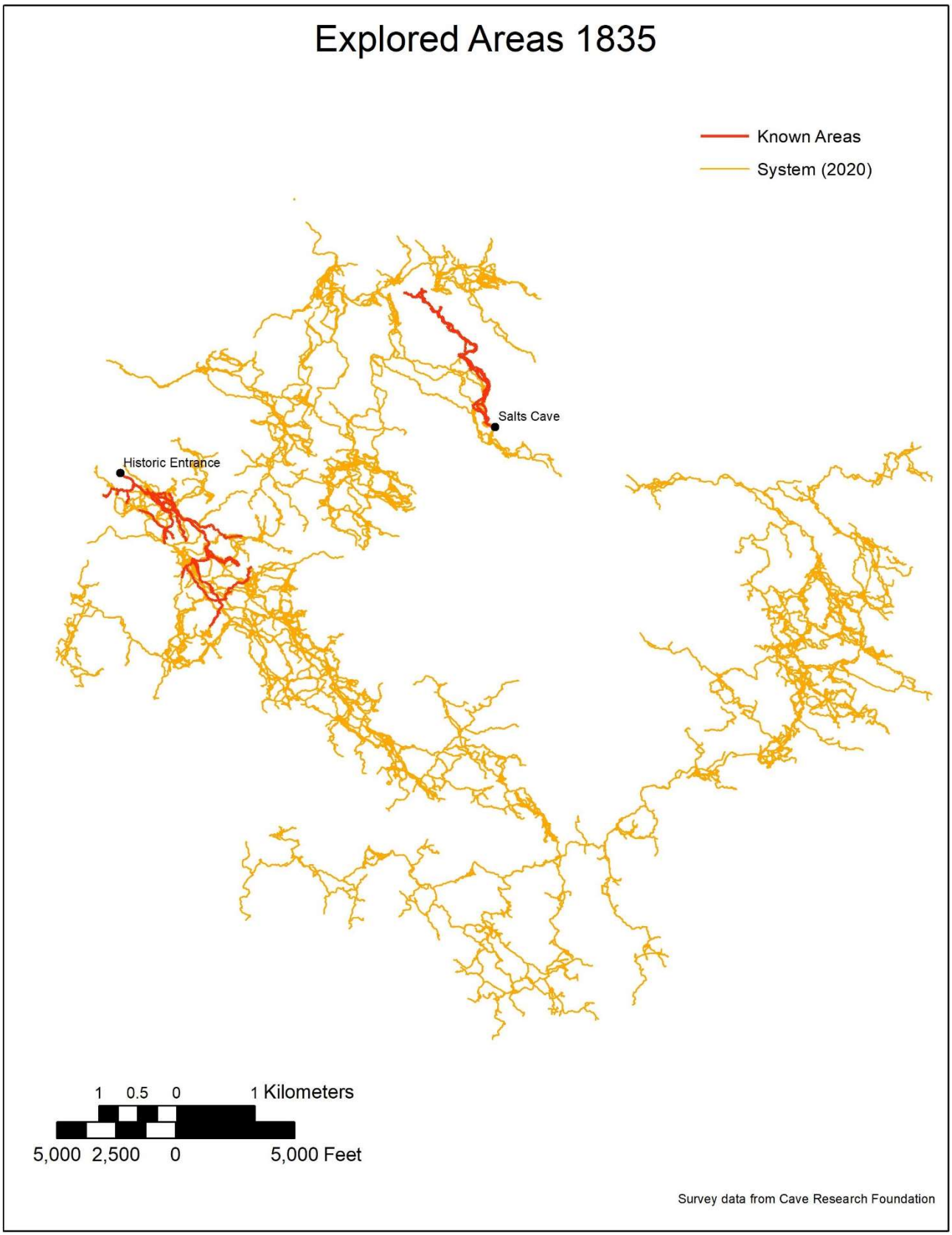

FIGURE 23. A diagram showing the explored portions of Mammoth Cave in 1835 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.7)

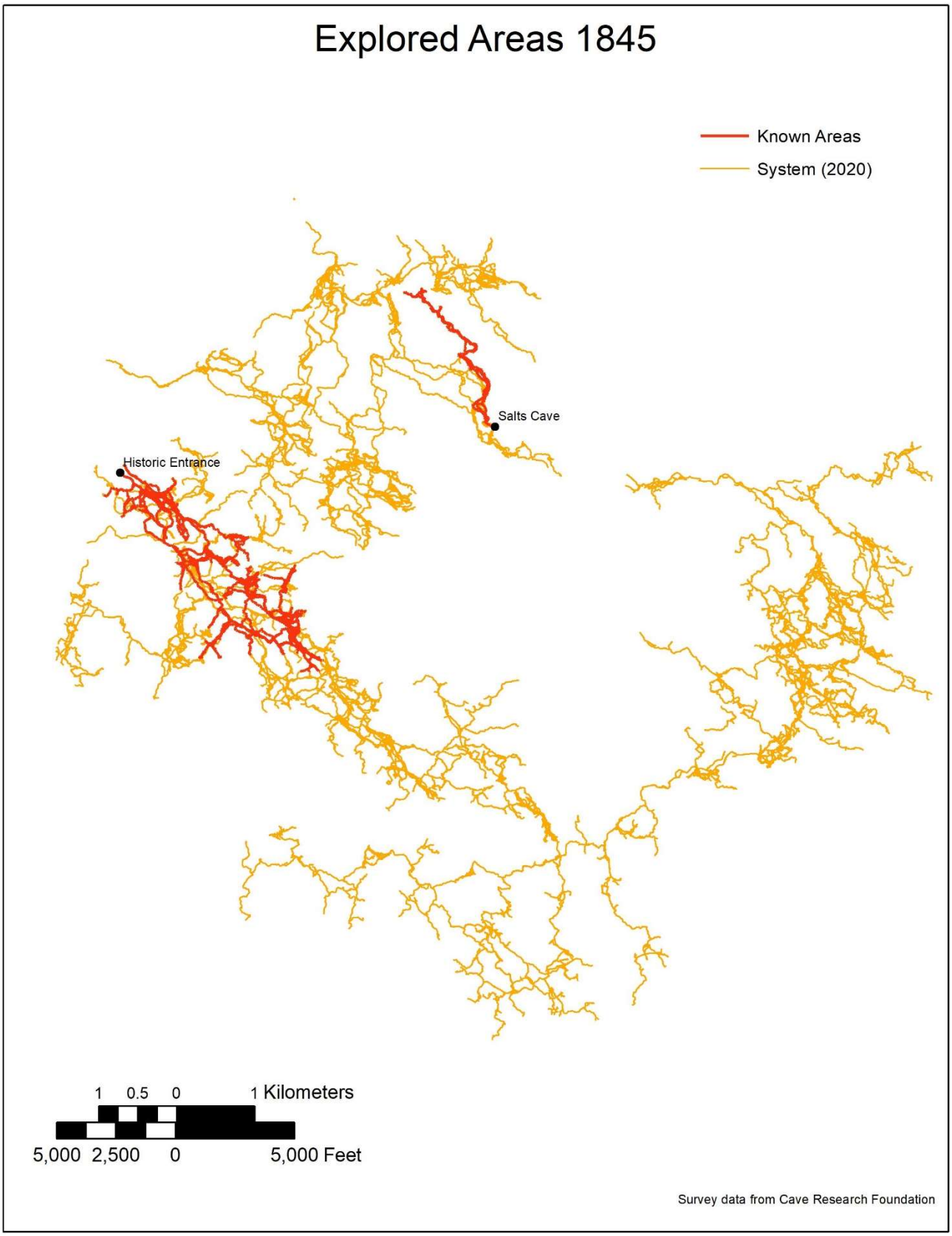

FIGURE 24. A diagram showing the explored portions of Mammoth Cave in 1845 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.8)

Expansion of Tourism at Mammoth Cave, 1850–1900

Tourism in the 1850s. Following Croghan's death in 1849, Joseph Underwood was named one of three trustees of the Mammoth Cave estate.[125] Underwood was responsible for handling the business affairs of the cave, which included finding lessors for the property. All day-to-day operations of the cave and surrounding property were overseen by managers who resided on site and leased the property from the heirs of John Croghan.[126] The first lessee of the hotel and cave following Croghan's death was Larkin J. Procter, who first leased the property in 1852. Procter operated the hotel until 1857, and then again after the Civil War until 1870.[127]

The popularity of Mammoth Cave as a tourist destination grew in the mid-nineteenth century. Renowned Swedish opera singer Jenny Lind traveled to the cave in April 1851.[128] While at the cave, Lind was photographed sitting in a rock formation in Gothic Chapel that resembles a seat. The photograph was turned into a post card and the formation was subsequently known as Jenny Lind's Armchair. The Louisville & Nashville Railroad, completed in 1859, brought travelers to nearby Bell's Tavern, where they could board stagecoaches that traveled to Mammoth Cave (Figure 25). In the summer of 1856, Oliver Shackelford operated a stage to transport visitors from the ferry landing at the Grayson Springs crossing on the Green River to the cave.[129]

Visitors to Mammoth Cave typically stayed at the Mammoth Cave Hotel while visiting the site (Figure 26). By the 1850s the hotel could accommodate up to 150 guests in single and double rooms, and also offered log buildings for families.[130] Water for the hotel was brought from the Green River. Men's and women's latrines were located north of the hotel building.

Several stores catering to visitors to the cave operated in the vicinity of the hotel. One of the first stores was located northeast of the hotel on the north side of the Historic Entrance road. The store was operated by Smithy Hunt on behalf of J. J. Roberts.[131]

125. Hobart and Thompson, 68. The other two trustees named were George Gwathney, who died less than four years after Croghan, and William A. Bullock, who refused his role as trustee.
126. Lally, Multiple Property Documentation Form, Section III, C-1, citing John Croghan's will, Exhibit 1 in William Wyatt and Violet Janin Blair v. Mammoth Cave Development Company et al., United States District Court (August 1926), page 23.
127. Hobart and Thompson, 72–74.
128. Julius Benedict, "Made. Jenny Lind's Visit to the Mammoth Cave," in Horace Martin, *Pictorial Guide to the Mammoth Cave, Kentucky* (New York: Stringer and Townsend, 1851), 9–14. Although no exact date is given, it is stated that Lind visited the cave after her last performance in Nashville.
129. Shackelford, "An Account," 7.
130. Horace Martin, *Pictorial Guide to the Mammoth Cave, Kentucky* (New York: Stringer and Townsend, 1851), 18.
131. Hobart and Thompson, 50.

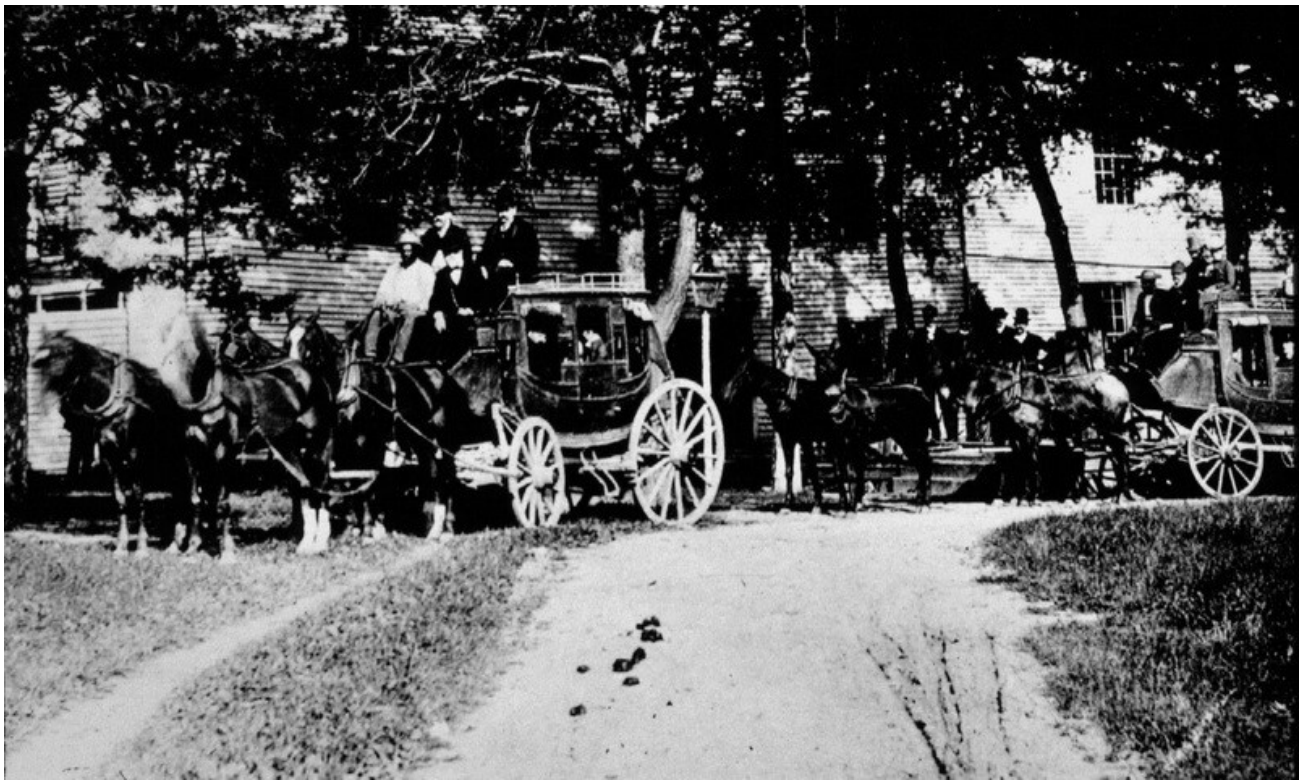

FIGURE 25. An undated nineteenth-century view of a stagecoach at Mammoth Cave Hotel. (Source: Mammoth Cave National Park)

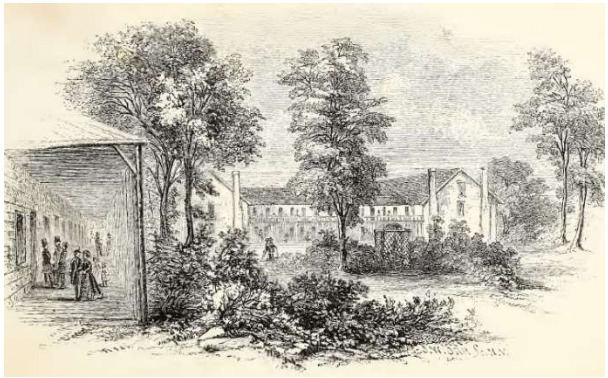

FIGURE 26. Sketch of the Mammoth Cave Hotel, 1851. (Source: Martin, 1851, frontispiece)

The Civil War, 1861–1865.[132] During the first months of the Civil War, Kentucky remained in the Union. However, on November 18, 1861, representatives from sixty-eight counties convened in Russellville, Kentucky, to set up a new state government aligned with the Confederacy. This government declared Bowling Green its capital, and the state was admitted to the Confederate States of America on December 10, 1861. The state government at Frankfort remained loyal to the Union.

On February 1, 1862, Confederate troops raided the Mammoth Cave Hotel, which at that time was managed by E. K. and John Owsley. A significant quantity of furnishings, supplies, and business records were removed from the hotel or damaged. The hotel manager fled prior to the raid but returned soon thereafter, and the hotel was again open for business by mid-March.

On February 6, 1862, Union forces captured Fort Henry on the eastern bank of the Tennessee River, close to the border between Kentucky and Tennessee. Union forces then moved 12 miles east and captured Fort Donelson on the Cumberland River on February 16. With this Union advance, the position of the Confederate armies at Bowling Green and the surrounding areas of southern Kentucky became vulnerable. Confederate General Albert Johnson ordered the withdrawal of all forces from Bowling Green on February 11,

132. This section is derived from Mike Deacon, "Mammoth Cave and the Civil War in Kentucky," (October 19, 1995), manuscript in park files.

1862, and he abandoned Nashville, Tennessee, to Union forces shortly thereafter.

Later raids into Kentucky by irregular forces persuaded the Confederate commanders that an attack would be possible. General Braxton Bragg led a raid that reached Glasgow, Kentucky (20 miles southeast of Mammoth Cave), on September 13, 1862. Union forces at Bowling Green moved east to meet the threat, and several skirmishes occurred near Mammoth Cave in mid-September 1862. Ultimately, the Confederate advance was stopped at the Battle of Perryville on October 8, 1862, after which the Confederate forces retreated to Tennessee. Although irregular Confederate forces continued to mount raids into Kentucky occasionally, the state remained firmly in Union control for the rest of the war.

Tourism after the Civil War. Following the Civil War, the number of visitors to Mammoth Cave grew substantially.[133] During this period, a time when leisure travel was most prevalent among the wealthy, several noteworthy individuals visited the cave including actor Edwin Booth, brother of John Wilkes Booth, and George Armstrong Custer, who accompanied Grand Duke Alexei Alexandrovich of Russia to the cave in 1872.[134] Brazilian Emperor Don Pedro also toured the cave in February of the same year.[135] Publicity surrounding the visits by these individuals to the cave further increased Mammoth Cave's reputation as a tourist attraction.

In 1871, David L. Graves took over operations of the hotel and cave as the new lessee of the Croghan estate. Graves had a new water system installed for the hotel. Previously, water had to be brought up to the hotel from the Green River. Graves had pipes laid to the Three Springs area, which supplied storage tanks at the hotel.[136]

The lease held by Graves for the property ended in January 1873, however, he refused to leave the estate at the time. Following legal action, Graves was eventually forced to leave in March 1873. From 1873 through 1880, there were no lessees in control of the hotel and cave. During this time, William S. Miller Sr, the agent, served as manager until a new lessee could be found.[137]

As the number of tourists travelling to the cave increased, the stagecoach line was replaced by the new Mammoth Cave Railroad. The railroad was incorporated in 1874; however, work on the railroad did not begin until July 1886, when the Mammoth Cave Railroad Company engaged Jim McDaniel and Henry Chapman to begin construction. The railroad ran northwest from Glasgow Junction (present-day Park City, Kentucky) on the Louisville & Nashville Railroad main line to a site just east of the Mammoth Cave Hotel. The train line ended at an arch that marked the entrance to the Mammoth Cave estate. The 8.7-mile line was operated under contract by the Louisville & Nashville Railroad. A small double-wye track allowed the steam locomotives to be turned around and moved from one end of the train to the other at either end of the line. After 1900, the turning at the Mammoth Cave end of the line was converted to a single wye. Without the ability to rotate the locomotive at the Mammoth Cave terminus for the return journey to Park City, the locomotives were positioned at the head of the train but were oriented backwards and operated in reverse. The first passengers of the Mammoth Cave Railroad arrived at the site on November 8, 1886 (Figure 27). The railroad remained profitable into the early part of the twentieth century. In 1910, the railroad experimented with a rail bus, which could be rotated on a small turntable at the end of the line (Figure 28); however, the experiment was soon abandoned.[138]

133. Elmer G. Sulzer, "The Mammoth Cave Railroad," *The Railway and Locomotive Historical Society Bulletin*, no. 99 (October 1958): 31–32.
134. Bridwell, 26.
135. Lally, Multiple Property Documentation Form, Section III, page C-2.
136. Joy Medley Lyons, "A Village Lonely: Architectural History of the Old Mammoth Cave Hotel," (December 1992), manuscript in park collection, 12.
137. Hobart and Thompson, 74.
138. Elmer G. Sulzer, "Gay Nineties Rendezvous: The Mammoth Cave Railroad," *The Register of*

FIGURE 27. The Mammoth Cave Railroad (undated photograph). Steam engines were used on the railroad until 1929, when they were replaced with the rail bus. A steam engine was again used for the final run in 1931. Note the water tank on the wooden platform. (Source: Mammoth Cave National Park)

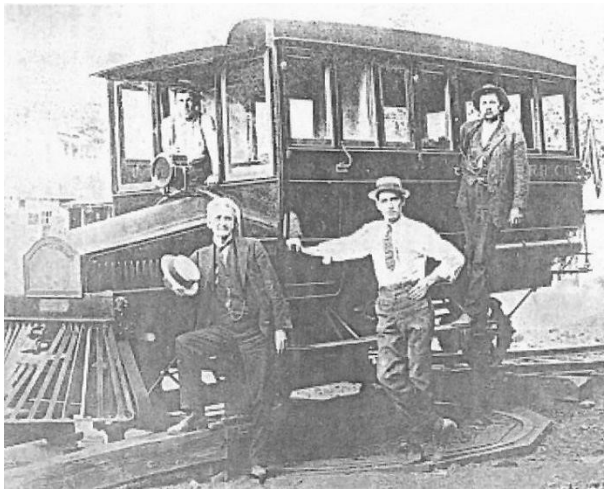

FIGURE 28. First rail bus and turntable of the Mammoth Cave Railroad, 1910. (Source: Mammoth Cave National Park)

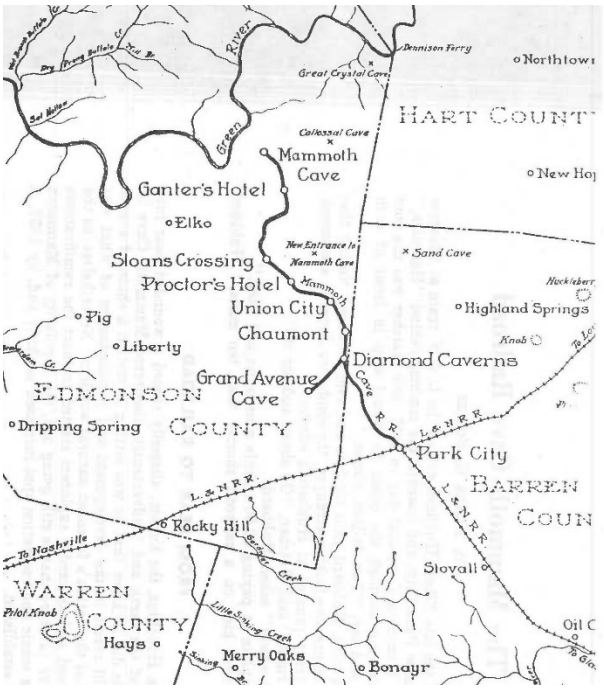

FIGURE 29. Map of the Mammoth Cave Railroad route from Park City to Mammoth Cave. (Source: Elmer G. Sulzer, "Mammoth Cave Railroad," in *The Railway and Locomotive Historical Society Bulletin No. 99* [Boston: Harvard Business School, Railway & Locomotive Society, Inc., October 1958], 31–41)

Visitors also continued to arrive by steamboat. In 1906, a new series of locks and dams raised the water level and made the Green River navigable. This allowed visitors to travel to the cave via steamboat. The *Chaperone*, *Emma*, and *The Evansville* were among the many steamboats that brought visitors to the cave.[139]

As late as the 1920s, excursion boats departed Evansville, Indiana, to travel up the Green River to Bowling Green and Mammoth Cave.[140] Stagecoaches also remained a common way to reach the cave through the latter part of the nineteenth century.

Beginning in 1881, Francis Klett managed the estate. Klett's lease ended in January 1883. Julia Clark Jesup, one of Croghan's heirs, took over management of the estate through August 1883.[141]

the Kentucky Historical Society 57, No. 2 (April 1959), 131.

139. Lally, Multiple Property Documentation Form, Section III, C-2.

140. James M. Hines, "Evansville & Bowling Green Packet Co.," (1952), manuscript in park files

141. Hobart and Thompson, 74.

In the 1880s, a Frenchman named Mazellar sought to grow mushrooms in the cave, believing that the uniform temperature was an ideal environment for this practice. His Mammoth Cave Mushroom Company leased a portion of Audubon Avenue, where Mazellar erected six mushroom beds. The venture proved unsuccessful, and the company went bankrupt within a year after no substantial harvest of mushrooms was made. The trustees of the Mammoth Cave estate, who initially hoped to profit off the venture, ended up losing several hundred dollars.[142]

The Mammoth Cave Hotel went bankrupt in 1888 after the Mammoth Cave Railroad Company failed to pay the specified rent.[143] With the railroad company terminating its lease of the Mammoth Cave estate, the trustees of the estate turned over its management to Henry C. Ganter, who served as the agent for the cave property. Ganter, who did not receive any additional compensation for his managerial duties, continued in the role through 1902, at which time the trustees asked that he stop serving in that capacity.[144] Willis Ranshaw was given a five-year lease to the estate in 1902. The lease was subsequently renewed in 1907.[145]

Character Study of the Expansion of Mammoth Cave Tourism Period, 1850–1900

Mammoth Cave remained a popular tourist attraction during the remainder of the antebellum period (Figure 30). Jenny Lind made a famous visit to the cave in 1851, singing a song while sitting in the Armchair formation that now bears her name. In 1858, cave explorers used a basket attached to a rope and pulley system to reach the Maelstrom. The area around Richardson's Spring is known to have been used as a dining area during tours (Figure 31).

During the Civil War, while little tourism occurred within the cave, soldiers are known to have visited the cave interior based on personal accounts and the dated signatures left behind.

After the Civil War, establishment of a stagecoach route and a rail line nearby helped to facilitate passage to the cave, while hotel accommodations improved (Figure 32). At the same time, circa 1869, the Croghan estate began to fall into disrepair, which undermined tourism within the cave.

In 1870, William Garvin discovered the Corkscrew, which became a popular route of passage from the upper to the lower reaches of the cave. Wooden ladders and stairs were used to make sections of the Corkscrew passable (Figure 33). Horace Hovey conducted many scientific studies within the cave during the 1870s and 1880s, and prepared an updated map in 1882.

142. Lally, Multiple Property Documentation Form, Section III, C-3–C-4.
143. Hobart and Thompson, 75.
144. Ibid., 77.
145. Ibid., 80.

FIGURE 30. Views of the historic entrance, 1850s. (Source: Martin, 1851, 18 (left); *[source to be added]* (right))

FIGURE 31. A group of twelve visitors and two guides having dinner in the cave, 1892. (Source: Mammoth Cave National Park, MACA_3727)

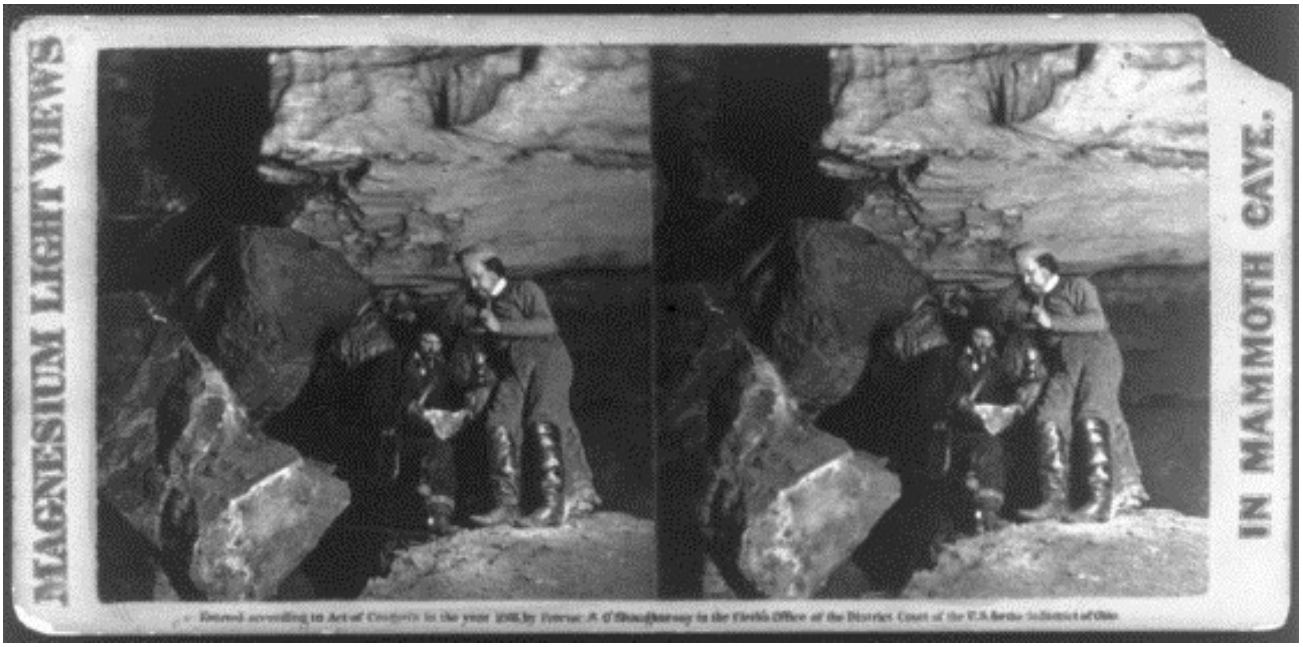

FIGURE 32. The first photographs taken in the cave were stereo pairs taken by Waldack in 1866. (Source: Library of Congress Prints and Photographs Division, cph 3b08121)

FIGURE 33. Ladder/stair feature providing access to the lower passages of Mammoth Cave via the Corkscrew, 1892. (Source: Mammoth Cave National Park, MACA_36626)

By 1880, there were approximately 300 monuments composed of stacked rock located throughout the cave.[146] The monuments, which consisted of stacked piles of loose rock, were constructed by tourists and representing states, fraternal societies, and other groups and organizations, especially in Gothic Avenue. Guides encouraged this activity because in constructing the rock piles, visitors incidentally cleared the paths of rocks.[147]

By 1882, the solid door at the Historic Entrance was replaced with an open gate or grated iron door as described by Hovey. Additional resources constructed during this period included to support tourism wood railings, stairs, ladders, and structures to cover pits (Figure 34 through Figure 35).[148] Trails were also cleared.

In 1896, a new passage was dug through a segment of softer limestone at the end of Darnell's Way to open into Gorin's Dome, and a bridge was constructed for passage.

146. Diehl and DiBlasi, 58. (The date of the solid door at the Historic Entrance that was replaced in 1882 is not known.)
147. Ibid., 58, from Hovey 1880:915.
148. Ibid., 50.

FIGURE 34. Old wooden bridge across the Bottomless Pit, 1890. (Source: Mammoth Cave National Park, MACA_3729)

FIGURE 35. Main Cave passage with the formation referred to as Martha Washington's Statue, 1892, suggesting that there was lighting to highlight features by this time. (Source: Mammoth Cave National Park, MACA_3743)

Surviving evidence of this period includes numerous signatures, artifacts, and the configuration of passages widened or deepened to accommodate visitor access, as well as hundreds of commemorative markers, many of which were constructed of stacked rocks, left by visitors.

Mushroom Beds, 1881–1883. In 1881, Horace Hovey convinced proprietor Francis Klett to try to develop a mushroom industry after observing some mushrooms growing along Echo River. He suggested locating the beds in Audubon Avenue where they would be close to a rich source of undisturbed bat guano deposits.[149] The venture ultimately failed due to the difficulty of getting good water to the beds and a lack of markets for the product.[150] Evidence of the venture survives today in the form of stacked stone walls and planting beds (Figure 36).

FIGURE 36. Surviving evidence of the mushroom beds used to cultivate commercial mushrooms, 2018.

Changes in Tourism and the Cave Wars, 1900–1941

The first automobiles arrived at the cave in 1903 from Chicago. This event heralded the start of increased visitation as automobiles increasingly became a popular mode of transportation and roads to the Mammoth Cave Hotel were improved (Figure 37).[151]

The original early nineteenth-century hotel building remained in use until early in the morning

149. Ibid., 59; from Hovey 1881 b:369.
150. Ibid., 60; from Bridwell 1952:26.
151. *The Horseless Age* XII, no. 4. New York, July 22, 1903.

of December 9, 1916, when it was destroyed by fire (Figure 38).

FIGURE 37. First automobiles arrive at Mammoth Cave, 1903. (Source: Mammoth Cave National Park)

A few log outbuildings near the original hotel survived the 1916 fire, and they were used for temporary guest accommodations in the years following the fire.[152] In 1919, a twenty-room hotel known as the "rooming house" was constructed near the 1912 cottage to accommodate overnight visitors.[153] Following the fire, the 1912 guest cottage was used as office space.[154] In 1923, an open-air pavilion was constructed adjacent to 1912 cottage.[155]

A new Mammoth Cave Hotel was constructed in 1925 (Figure 39). The two-story, wood-sided structure had a gable roof and a covered porch on one side.[156] The "rooming house" constructed in 1919 was known as the annex following the construction of the new hotel in 1925.[157] The new hotel was built in two phases, with the second phase extending the length of the original building and expanding the porch along the east side. The second phase was completed, and the hotel opened in 1930.[158] Water continued to be supplied from the Three Springs area and was stored in a wooden tank on an elevated platform west of the building.

The Demunbrun Store was constructed in 1919 near the terminus of the Mammoth Cave Railroad. It housed a general store, post office, telephone exchange, and train depot.[159]

Following the demolition of the Demunbrun Store in 1939, the post office moved to a small house occupied by Joseph McDaniel, the resident photographer at Mammoth Cave. The McDaniel house was situated near the saw mill on the historic entrance road.[160]

FIGURE 38. A photograph of the first Mammoth Cave Hotel, 1915, view looking northwest. The hotel complex is little changed from the earlier views, with the exception of the addition of a two-story porch at the side of the three-story gable portion, at right in this view. Photograph by Harry Pinson. (Source: Mammoth Cave National Park)

152. Hobart and Thompson, 52.
153. Ibid., 37.
154. Ibid., 34.
155. Ibid., 43.
156. Russell Jones, *Evaluation Report: Buildings at Mammoth Cave National Park, Kentucky* (Denver: National Park Service, Denver Service Center, Historic Preservation Team, 1972), 7–8.
157. Hobart and Thompson, 43.
158. Bridwell, 34. Mammoth Cave National Park Association brochure, n.d. [1930 stated in photo caption of hotel, same view as Figure 39].
159. Hobart and Thompson, 53–54.
160. Ibid., 57.

FIGURE 39. The second hotel, circa 1930. Note the open porch along the east side and water tank beyond, located on a platform west of the building. The two phases of construction are apparent in the offset in the plane of the porch roof. (Source: Mammoth Cave National Park, slide 720)

The "Cave Wars," 1910s and 1920s

The number of tourists visiting Mammoth Cave continued to increase during the late nineteenth century (Figure 40). In an attempt to capitalize on the popularity of Mammoth Cave, several local residents began searching for other caves in the area that might attract tourists. By the beginning of the twentieth century, approximately ninety caves had been discovered near Mammoth Cave, including Colossal Cavern, Great Onyx Cave, and Crystal Cave. During this period, owners of the newly discovered caves attempted to intercept tourists traveling to Mammoth Cave, directing them to their caves under the pretense of going to Mammoth Cave (Figure 41).

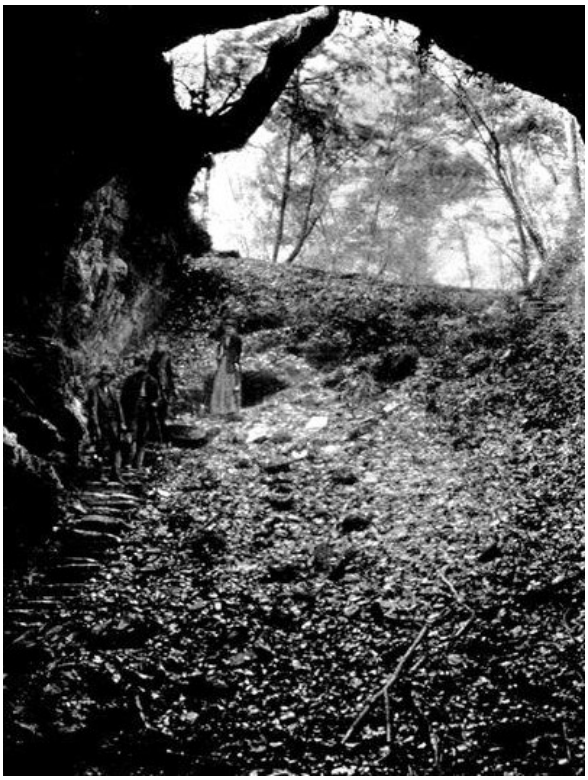

FIGURE 40. The Historic Entrance to Mammoth Cave, date unknown (circa early twentieth century). (Source: Mammoth Cave National Park)

FIGURE 41. Employees of the Great Onyx Cave solicit visitors attempting to travel to Mammoth Cave. (Source: Mammoth Cave National Park)

In early 1915, L. P. Edwards and Edmund Turner explored the property owned by Edwards on Flint Ridge, hoping to discover a major cave. In June 1915, Edwards and Turner created an entrance to Great Onyx Cave. Edwards opened the cave for tours the following year and constructed hotels and cottages adjacent to the new cave entrance over the next several years.

In 1916, George Morrison, a nearby land owner, began to survey Mammoth Cave. Morrison sought to find parts of the cave that extended past the boundaries of the property owned by the Croghan estate and a suitable location where an artificial entrance could be constructed. Morrison, a former oil prospector in Edmonson County, Kentucky, was confident that Mammoth Cave extended beyond the aboveground boundaries of the estate. Morrison paid an old Mammoth Cave guide to provide Morrison access to the cave at night. In 1921, Morrison created the Mammoth Cave Development Company and, during the same year, constructed a new entrance to the cave approximately 2-1/2 miles from the Historic Entrance. Morrison advertised the artificial entrance as the "New Entrance to Mammoth Cave" and, in 1923, he constructed a twenty-five-room hotel adjacent to the new entryway (Figure 42).[161]

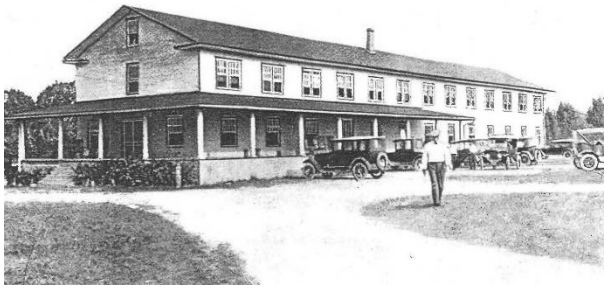

FIGURE 42. The "New Entrance Hotel," constructed 1923. (Source: Mammoth Cave National Park)

Upset by Morrison's actions, trustees of the Mammoth Cave estate filed a lawsuit alleging the illegal use of the Mammoth Cave name by Morrison, as well as his use of deceitful business practices. It was purported that Morrison had directed visitors away from the Historic Entrance of the cave to his new entrance. In 1928, Morrison was forced to explain on all of his advertising that visitors to his entrance to Mammoth Cave would not be provided views of the famous sites encountered when entering the cave through the Historic Entrance. Morrison continued to operate his site until it was sold to the Mammoth Cave National Park Association and the Mammoth Cave National Park Commission in 1931. The hotel constructed by Morrison was demolished by the National Park Service in 1945.[162]

In 1917, Floyd Collins discovered Crystal Cave on land owned by his father, Lee Collins, near Flint Ridge. Known locally as an avid cave explorer, Collins was trapped in a passage while exploring Sand Cave in 1925 and died after sixteen days in the cave. His death was highly publicized and was responsible for more tourists traveling to the Mammoth Cave region. Following the death of Floyd Collins, Dr. H. B. Thomas of Horse Cave, Kentucky, purchased the Crystal Cave property. Thomas placed Floyd Collins's remains in the cave and constructed a ticket office near the Collins

161. Lally, Multiple Property Documentation Form, Section III, C-5, citing William Wyatt and Violet Janin Blair v. Mammoth Cave Development Company et al., United States District Court (August 1926), page 10; Bridwell, 21–22. The entrance is now known as the Frozen Niagara Entrance.
162. Bridwell, 21–23.

family home to better accommodate the large number of visitors.[163]

The enactment of Congressional legislation establishing Mammoth Cave National Park in 1926 started a process through which most of the rival caves would be consolidated under the management of the National Park Service. (The Great Onyx and Crystal Caves were not added to the park until 1961.)

The idea of establishing a national park at Mammoth Cave was first broached in the late 1880s by representatives of the Louisville & Nashville Railroad, who thought that a national park would result in increased business for the railroad. Members of Congress became interested in creating a national park at Mammoth Cave as early as 1905, when Kentucky Congressman James M. Richardson began to lobby the Department of the Interior to establish Mammoth Cave National Park. Legislation to create Mammoth Cave National Park was soon introduced by Representative R. Y. Thomas, who succeeded Richardson in Congress. The legislation was unsuccessful, as there was not enough public support to establish the park.[164]

Mammoth Cave National Park Association, 1920s

In the early 1920s the Southern Appalachian National Park Commission was formed as a result of National Park Service Director Stephen Mather's desire to establish new national parks in the eastern United States. On February 21, 1925, President Calvin Coolidge signed legislation officially establishing the Commission. The legislation called for the Commission to survey proposed parks in the Shenandoah-Blue Ridge Mountains and Great Smoky Mountains areas and, after some last minute lobbying by the Kentucky congressional delegation, at Mammoth Cave. Members of the Commission visited Mammoth Cave in May 1925, and on April 8, 1926, they presented a report to Secretary of the Interior Hubert Work recommending that national parks be established at all three sites. In addition, the Commission stated that the parks could not be created with the use of federal funds.[165]

Due to the anticipated lack of federal funding for the establishment of Mammoth Cave National Park, the Mammoth Cave National Park Association was formed in 1924. The stated goal of the Association was to establish ". . . a national park in the Mammoth Cave region, in order to preserve for all people for all time one of the greatest of the natural wonders of the world."[166]

The initial objective of the Association was to lobby Congress to pass legislation authorizing the creation of a national park at Mammoth Cave. In an effort to boost local support, the Association promoted the park in the *Edmonson County News*. Advertisements noted the positive economic impact a national park would have on the area.[167]

Establishment of Mammoth Cave National Park and Land Acquisition, 1926 to 1941

On May 25, 1926, President Calvin Coolidge signed a bill authorizing the establishment of Mammoth Cave National Park. The legislation designated a maximum park area of 70,618 acres and a minimum of 45,310 acres. It further stipulated that the National Park Service could assume administrative control of the park land following the acquisition of 20,000 acres.[168]

In 1928, the Kentucky legislature established the Kentucky National Park Commission and granted it the power of eminent domain. The governor of

163. Ibid., 23–24.
164. Lally, Multiple Property Documentation Form, Section III, D-1, citing Cecil E. Goode, *World Wonder Saved: How Mammoth Cave Became a National Park* (Mammoth Cave, Kentucky: Mammoth Cave National Park Association, 1986), 33.
165. Bridwell, 47–48.
166. Lally, Multiple Property Documentation Form, Section III, D-2, citing Goode, 28.
167. Ibid., D-3.
168. Ibid., D-3–D-4, citing Goode, 30–32.

Kentucky was empowered to appoint six members to the commission from a list submitted by the Mammoth Cave National Park Association. This process ensured that the commission and the association would have a close working relationship.[169]

Initially, the acquisition of land proved to be difficult, despite the fact that several land owners were interested in selling land for inclusion in the park. The Louisville & Nashville Railroad donated more than 3,000 acres to the Mammoth Cave National Park Association in 1929. At the same time, the association purchased a two-thirds ownership of the Mammoth Cave estate for $446,400. The third owner of the estate refused to sell. The establishment of the Kentucky National Park Commission allowed the commission to take full ownership of the estate. Shortly thereafter, the Mammoth Cave National Park Association formed a committee to manage the operations of the cave and the Historic Entrance.[170]

In 1930, the Kentucky State Legislature passed the Strange-McBrayer Act, which called for 8 percent of property taxes for a two-year period to be given to the Commission to purchase additional park lands. The passage of the act provided the Commission with $1,380,000.[171]

In early 1931, the Kentucky National Park Commission purchased the Frozen Niagara Entrance to Mammoth Cave and began to oversee operations of the entrance.[172]

End of the Mammoth Cave Railroad. In the 1920s, as the automobile became an increasingly popular form of transportation, ridership on the Mammoth Cave Railroad began to decline. Starting on February 28, 1929, the company used the tracks for a motorized rail bus (Figure 43). In 1931, the Mammoth Cave National Park Association purchased the Mammoth Cave Railroad in order to obtain its right-of-way as part of the proposed national park. On August 31, 1931, the Mammoth Cave Railroad made its final trip from Glasgow Junction, using Engine No. 4 and Coach No. 2; Engine No. 3 ("Hercules") was too deteriorated to be operated. The railroad was dismantled by a Louisville & Nashville Railroad work crew in late 1931 and early 1932.[173] The rolling stock was sold for scrap, but Engine No. 4 and Coach No. 2 were retained for the park and left at a location near the former terminus of the line, where they would be visible in front of the hotel. A wooden canopy was built in the 1930s to protect the display (Figure 44).[174]

FIGURE 43. Rail bus of the Mammoth Cave Railroad Company, between 1929 and 1931. Note A.A. Demunbrun's store behind the rail bus. (Source: Mammoth Cave National Park)

169. Ibid., D-5–D-6, citing Goode, 32.
170. Ibid., D-4–D-6.
171. Bridwell, 49.
172. Ibid., 50.
173. Sulzer, "Gay Nineties Rendezvous" (April 1959), 141–142; Larry P. Asman, "Hercules and the Mammoth Cave Railroad" (1970), manuscript in park files.
174. This wooden canopy is visible in a photograph accompanying the article "Trail's End! The Mammoth Cave Railroad, 1886–1931," *The L&N Employees' Magazine* (May 1937): 6–9. (A new shelter would be constructed in 1967.)

FIGURE 44. Engine No. 4 (mistakenly identified as "Hercules") and Coach No. 2, view circa 1950s or early 1960s, with the wood-framed canopy built in the 1930s. (Source: Mammoth Cave National Park, slide 553)

Presumably, the water tank associated with the terminus of the railroad was also removed at this time. The two-story Demunbrun Store building located near the railroad terminus was ultimately demolished by CCC labor in October 1939.[175]

Mammoth Cave Joint Operating Committee. On July 17, 1933, the Mammoth Cave National Park Association and the Kentucky National Park Commission formed the Mammoth Cave Joint Operating Committee. The committee assumed all control over both the Historic Entrance and the Frozen Niagara Entrance. The Joint Operating Committee generated approximately $400,000 from entrance fees between 1934 and 1940, allowing it to provide funding for future land purchases and park improvements.[176]

Despite potential for condemnation in addition to land purchased with state funds, acquisition of more land for the park continued to prove difficult. In May 1934, new legislation was passed that allowed the US Secretary of the Interior to accept monetary donations for land purchases. This allowed the National Park Service to take the lead in acquiring land.[177] On May 22, 1936, the Secretary of the Interior accepted deeds to 27,561 acres of land, which allowed Mammoth Cave to be formally designated a national park. This transfer gave the National Park Service responsibility for the administration and protection of the land. Federal funds could not be used for administration or development of the park until the minimum 45,310 acres had been acquired.[178]

By the late 1930s, land acquisition began to proceed at a more rapid pace. In 1941, the amount of park-owned land surpassed the 45,310 acre threshold required by the 1926 legislation, allowing Mammoth Cave to be fully established as a national park.

Early Development at Mammoth Cave National Park during the New Deal Era, 1933 to 1942

Although federal funds were not immediately available for the development of the park, some work began in the mid-1930s. Funding was provided by the more than $400,000 in profits realized by the Mammoth Cave Joint Operating Committee from park visitors who rented hotel rooms and paid for guided cave tours between 1934 and 1940. The Committee turned this money over the NPS, which subsequently used the money to fund improvements to the new park land. The work was undertaken by the CCC.[179] CCC workers performed tasks such as making improvements to the site and demolishing existing structures on newly acquired land. Prior to CCC work, the area of the park was rugged, with scattered cleared areas used for farming. Roads in the area were merely dirt access routes for local

175. Memorandum for Acting Superintendent Hoskins, Subject: CCC Activities during the month of October 1939, November 2, 1939, copy in park archives.
176. Lally, Multiple Property Documentation Form, Section III, page D-6, citing Goode, 43.
177. Ibid., D-8–D-9, citing Edmund B. Rogers, *History of Legislation Relating to the National Park System through the 82nd Congress* (Washington, DC: US Department of the Interior, 1958), vol. 56: Mammoth Cave.
178. Ibid., D-13, citing Goode, 42; Bridwell, 52–53.
179. Ibid., D-13. The federal government was responsible for the salaries and overhead expenses for members of the CCC. As a result, the $400,000 was used to directly fund construction projects.

farmers. Development of the new park required new roads, residential and utility buildings, water and sewer facilities, removal of farm buildings, and erosion control and reforestation.[180]

Four CCC camps operated at the park between 1933 and 1942 (Figure 45). None of the camps, each of which housed 200 to 250 enrollees, was functional for this entire period. The first CCC camp, Camp NP-1 (Company 510), was established on Flint Ridge near Crystal Cave on May 22, 1933. The camp initially included both white and African American recruits. It was first established in log buildings of the former Bluegrass Country Club, an early twentieth-century golf course that had failed and been abandoned in 1925. By the spring of 1934, white enrollees had been transferred to three new camps in the park, leaving NP-1 staffed by African American enrollees.[181] Camp NP-2 (Company 543) was located near the Frozen Niagara Entrance to Mammoth Cave. Camp NP-3 (Company 582) was positioned on Joppa Ridge at the approach to the park from the direction of Brownsville, Kentucky, and Camp NP-4 (Company 516) was situated "at Cade on the north side of the Green River."[182] Each camp was composed of several buildings including three or four barracks, a kitchen and mess hall, latrines, and maintenance areas.

FIGURE 45. An aerial view of CCC camp NP-1 at Mammoth Cave during the 1930s. (Source: Superintendent's Report, July 7, 1939, Mammoth Cave National Park Archives)

Members of the CCC performed a variety of tasks at the park. Among the work accomplished was the construction of 65 miles of paved roads, 7 miles of trails, three steel-framed fire watchtowers, and two ferry boats. Erosion control was implemented along streams, with hundreds of check dams. More than 600 trees were planted, and the Frozen Niagara entrance was restored to a naturalistic state. Parking areas were landscaped. Approximately 1,700 former farm buildings in the park were razed, and 300 miles of fence were removed.[183]

Within the cave, CCC work included adding handrails, bridges, retaining walls, and causeways. Members of the CCC also cleared breakdown and constructed 8 miles of trails throughout the cave to improve the visitor experience.[184]

The CCC laborers from Camp NP-1 constructed 4 miles of foot trails in 1935. This work involved breaking large rocks and boulders to allow for the construction of new trails (Figure 46). An

180. Jeanne Cannella Schmitzer, "CCC Camp 510: Black Participation in the Creation of Mammoth Cave National Park," *Register of the Kentucky Historic Society* 93, no. 4 (Autumn 1995): 446.

181. Ibid, 446–453. For most of its existence, the CCC maintained racial quotas, limiting African American enrollment to 10 percent of enrollees. African Americans enrollees were generally organized into segregated camps with white supervisors. However, unlike many other industries or organizations in the period, African American enrollees received equal pay and comparable work conditions to white enrollees.

182. Lally, Multiple Property Documentation Form, Section III, D-21.

183. "The National Park is Now Worth Twice What It Cost," *The Courier-Journal*, August 14, 1938.

184. "The National Park is Now Worth Twice What It Cost," *The Courier-Journal*, August 14, 1938.

additional 2-1/2 miles of trails were constructed by workers from Camp NP-3 during the same period. This work also included alterations to stairways to allow for easier visitor access. The new trails were typically constructed of crushed macadam covered by a packed layer of sand to mimic the natural floor of the cave. As new trails were constructed over several years, CCC laborers also performed maintenance work on trails inside the cave.[185]

FIGURE 46. Breaking large rocks related to the construction of new cave trails, 1935. (Source: Mammoth Cave National Park)

On June 7, 1935, during work on the cave trails, workers from Camp NP-1 discovered mummified prehistoric human remains approximately one-half mile from the Violet City cave entrance.[186] The discovery was kept secret until senior NPS personnel could be notified. In addition to the mummified remains, additional material was excavated from the cave under the supervision of archeologist Alonzo W. Pond (Figure 47). The remains were moved to Broadway near Giant's Coffin and placed in a plate-glass case, with pipe railings around the case to prevent visitors from getting too close to them.[187]

FIGURE 47. Archeological work inside the cave following the discovery of mummified human remains, 1935. (Source: Mammoth Cave National Park)

Also in 1935, CCC laborers from Camp NP-2 constructed a temporary iron gate at the entrance to Colossal Cavern. The new gate was constructed to allow for the passage of bats in and out of the cave. Additionally, laborers from the camp constructed new parking spaces and retaining walls at the Violet City entrance in response to increased visitation related to the discovery of the mummified remains (Figure 48).[188]

In 1935, an eight-mile-long route connecting the Historic Entrance to the Frozen Niagara entrance was completed. To commemorate the occasion, a dedication ceremony was held in the Snowball Room on July 8. As part of the event, the first underground radio broadcast in history was made.[189]

FIGURE 48. The completed Carmichael entrance, 1938. (Source: Mammoth Cave National Park)

185. Emergency Conservation Work Narrative, Mammoth Cave, Kentucky, 1935.
186. Ibid.
187. Ibid.
188. Ibid.
189. Bridwell, 58.

The Snowball Room was converted to a dining room by the CCC and opened to the public in 1936.

In September 1936, improvements were made to the Historic Entrance to the cave. The work included relocating telephone and electric lines underground, and the removal of wooden stairs that were located directly outside the entrance.[190]

In 1937 and 1938, improvements were made to the Frozen Niagara entrance. This work included construction of a new parking area and the erection of limestone retaining walls that were designed to simulate a natural appearance.[191] Inside the cave, a new concrete bridge was erected over College Heights Avenue at the Frozen Niagara entrance.[192]

In October 1938, cave guides Carl and Pete Hanson and Leo and Claude Hunt came across a previously unknown portion of the cave known as New Discovery. The NPS officially announced the newly found area of the cave to the public in July 1940.[193]

In conjunction with ongoing maintenance of the cave trails, CCC laborers constructed a new retaining wall to replace the wood bridge at Mammoth Dome in early 1941.[194] At the same time, the wooden steps at Rocky Mountains were removed and replaced with a new ramp (Figure 49 and Figure 50).[195]

FIGURE 49. Wood stairs at Rocky Mountains prior to construction of new ramp, 1941. (Source: Mammoth Cave National Park)

FIGURE 50. New ramp at Rocky Mountains, 1941. (Source: Mammoth Cave National Park)

In December 1941, work began on a project to connect New Discovery with the main cave. A CCC crew began excavation at the end of Fossil Avenue (Figure 51). This work also involved the construction of new trails.[196]

190. Superintendent's Monthly Report. October 1, 1936. Robert P. Holland, Acting Superintendent.
191. Superintendent's Monthly Report. January 8, 1938. Robert P. Holland, Acting Superintendent.
192. Superintendent's Monthly Report. March 7, 1937. Robert P. Holland, Acting Superintendent.
193. Bridwell, 59.
194 Superintendent's Monthly Report. April 8, 1941. R. Taylor Hoskins, Superintendent.
195. Superintendent's Monthly Report. February 5, 1941. R. Taylor Hoskins, Superintendent.
196. Superintendent's Monthly Report. January 13, 1942. R. Taylor Hoskins, Superintendent.

FIGURE 51. Excavation work at the end of Fossil Avenue, 1941. (Source: Mammoth Cave National Park)

In addition to the work in the cave, CCC laborers constructed the park maintenance complex (1939–1941), a six-building housing complex for park employees (1937), a home for the Park Superintendent (1941), a chlorinator house (1940), and ranger station facilities (1942).[197]

In the visitor services area, work completed by the CCC included the construction of a comfort station west of the hotel (1936), infrastructure related to the construction of the Deluxe Cottages (1936–1937) and the Woodland Cottages (1938–1939), construction of the amphitheater (1938–1939), the construction of Green River Ferry Road (1939), and construction of a new picnic area and campground in (1940–1941). The CCC also constructed two water systems; two sewer systems; and a telephone system (Figure 52).

CCC enrollees also engaged in land conservation work such as erosion control, removal of dead trees and plant debris to reduce the risk of fire, draining and landscaping of old farm ponds and quarries, and tree planting.[198]

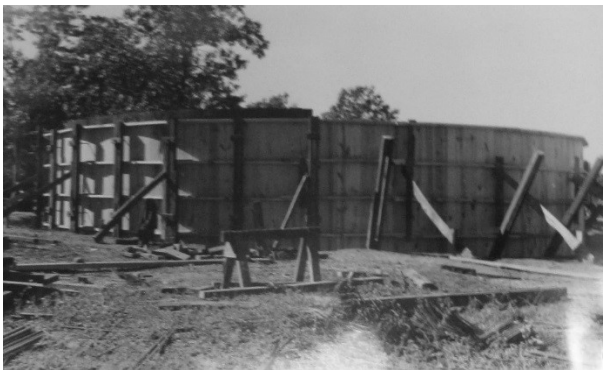

FIGURE 52. One of the concrete reservoirs under construction, October 1936. (Source: Mammoth Cave National Park)

CCC camp NP-3 at Joppa Ridge was disbanded in 1938.[199] The three remaining CCC camps at Mammoth Cave were disbanded in July 1942.[200] Former CCC Camp NP-4 was later used as the Maple Springs campground.[201] The former Camp NP-1 site was the first camp used by the Job Corps at Mammoth Cave.[202] Development at Mammoth Cave National Park slowed considerably following the entrance of the United States into World War II. During the war, visitation at Mammoth Cave decreased as well.

Character Study of the Changes in Tourism and the Cave Wars Period, 1900–1942

Refer to Figure 62 and Figure 63 for maps showing the explored portions of Mammoth Cave in 1908 and 1940, respectively.

Numerous physical developments that improved access and the experience for visitors occurred

197. Dallas huts were pre-fabricated wood housing structures assembled on site, developed during World War II to house US servicemen.
198. Lally, Multiple Property Documentation Form, Section III, D-13–D-14, citing Goode 43–44; "Eight-Mile Walk Is Built Inside of Mammoth Cave," *The New York Times* (June 6, 1935); Schmitzer, 461; R. Taylor Hoskins, "Memorandum for the Mammoth Cave Operating Committee," April 20, 1940.
199. Kelly A. Lally, "A History of the Civilian Conservation Corps at Mammoth Cave National Park" (December 1987), 7.
200. Schwitzer, 463. (The date of demolition of the camps was not identified in documentation reviewed for this study.)
201. William E. Giesecke, Jr., "The Civilian Conservation Corps at Mammoth Cave," Hart County Historical Quarterly XXIII, no. 3 (July 1991): 14.
202. Lally, "History of the Civilian Conservation Corps," 7.

during this period. These ranged from George Morrison's efforts to build new trails for visitors using stone and other materials, to the opening of several new entrances into the cave. Developments also included extensive work performed by Civilian Conservation Corps enrollees during the 1930s as plans to establish a national park at Mammoth Cave were implemented. George Morrison's work occurred on land to the southeast of the historic cave area that was administered by the Croghan estate. Morrison worked to develop passages on his land in an effort to attract tourists and compete with the owners of the historic cave area. Morrison opened several entrances into the cave in support of these efforts.

Monumentation and the placement of signatures on the cave walls and ceiling continued through this period. By 1912, within Ganter and Spark's Avenues, cave managers had protrusions removed and trenches constructed to facilitate passage. At the same time, a stairway that blocked Boone's Avenue was removed.[203]

Cave exploration was popular during this period. For example, Benjamin Einbigler of New York and his guide explored the Maelstrom in 1905, placing a monument there, while also following Boone Avenue to discover Mystic River, and naming Edna Dome.[204] Guide Ed Bishop also conducted important exploration, helping to discover Kentucky Avenue at Big Break. In 1909, Max Kaemper, a German engineer, surveyed and completed the most accurate map of the cave prepared to date. He and Ed Bishop explored beyond Ultima Thule, eventually breaking through to discover Violet City. The proprietors built an iron gate to protect access. Kaemper used explosives to try and connect Violet City with Sandstone Avenue, which led to an opening on the surface above.[205] The first electric lights were installed in Mammoth Cave in 1917.[206]

Radio broadcasts were initiated within the cave during this period. In 1923, a radio test was conducted within the historic cave area. The location was marked with a bronze plaque.[207] In the 1930s, radio broadcasts were transmitted from a room in the Frozen Niagara section of the cave. A description of the cave provided in a guide book by Helen Randolph in 1924 included reference to a barred iron door that could be locked at the entrance, and a telephone located inside the cave for the use of managers.[208] The rise in visitation during the cave war period led to an increase in signatures, damage to the cave interior through smoke from oil lamps and candles, removal of rocks, minerals, and formations by visitors as souvenirs, and the flight of the bat populations that had traditionally used the cave as a hibernaculum.[209]

Some trail paving was implemented using Kyrock, a local, naturally occurring asphalt-like material traditionally used in paving, roofing, and waterproofing. Evidence of Kyrock use survives within the cave today.

George Morrison. George Morrison acquired mining options on land southeast of the historic cave in 1915. Morrison formed the Mammoth Cave Development Company in 1921, after which he set out to find an entrance to the cave he could use for tours. He soon was able to establish New Entrance and later built wood stairs to lead into the cave interior. The side of a natural dome in the New Entrance area was removed to install the steps. Morrison followed these efforts with construction of a hotel nearby and excavation of a path through Morrison Avenue into the floor to facilitate passage by visitors, as well as numerous trails that he used for five tours. One dramatic route was the cliff walk overlooking Woodbury's Pass within the Grand or Kentucky Avenue passage. Morrison also built a dam to establish Crystal Lake near Frozen Niagara in 1924, which he used for a 100-foot boat ride in order to compete with those conducted on River Styx and

203. Diehl and DiBlasi, 72.
204. Diehl and DiBlasi, 51 and 68, from Hovey 1905: 24681.
205. Ibid., 70.
206. Ibid., 110.
207. Ibid., 72.
208. Ibid., 72–73.
209. Ibid., 76–77.

Echo River in the historic cave. Morrison also built the new entrance near Frozen Niagara in 1924, as well as an aerial tram to convey visitors across Aero-Bridge Canyon. In 1930, Morrison engineered an entrance into the cave near Cathedral Domes and an associated wood stairway, which are no longer extant. In 1931, he added an entrance at Carmichael.[210]

Surviving today are numerous examples of trail work including stacked stone stairs and walls, trail surfacing, Big Break, New Entrance, Frozen Niagara Entrance, Carmichael Entrance, and cable associated with the Aero-Bridge Canyon tram (Figure 53 and Figure 54).

FIGURE 53. Cable associated with Morrison's tram across Aero-Bridge Canyon, 2018.

FIGURE 54. Morrison's cliff walk associated with Grand Avenue at Woodbury's Pass, 2018.

National Park Establishment, 1920s–1941. Congressional legislation authorized establishment of Mammoth Cave National Park in 1926, requiring that land acquisition occur through state and private methods before the park could officially open. The Mammoth Cave National Park Association first attempted to acquire the historic section of Mammoth Cave in the late 1920s. George Morrison sold his property to the Kentucky National Park Commission in 1931.

Civilian Conservation Corps, 1933–1942. Through the Emergency Conservation Act, the CCC was established. Four camps of enrollees operated at Mammoth Cave between 1933 and 1942, even though the property had not yet achieved national park status. Work conducted at the entrances and inside the cave by the CCC was extensive. In 1935, the CCC was involved in constructing four miles of new foot trails within the cave, and in maintaining another ten miles of cave trails.[211] CCC enrollees graded trails and enlarged passages either by digging down or by removing protrusions and obstacles. The majority of the trail features were built using material from the cave, including rock and sediment deposits similar to those that had been used in saltpetre-mining operations more than a century earlier. A rock crusher was placed outside the Historic Entrance to prepare rock to be brought inside for construction needs (Figure 55). Enrollees from multiple camps, including the African American CCC camp, operated the rock crusher. Mules were used to haul the material into the cave. Metal, timber, and creosote, as well as concrete, were also used in construction projects within the cave by the CCC.

210. Ibid., 73–79.

211. National Park Service, 1935 Emergency Conservation Work Narrative referencing projects 34 and 34a.

FIGURE 55. Stationary crusher at Mill Branch, north side of Green River, 1941. (Source: Open Parks Network, Mammoth Cave National Park Nitrate Negatives Collection, MACA-98; Box 8 MACA 29395-29854)

A new parking area for the Violet City entrance was also completed in 1935. A specific achievement of the CCC was completion of a comfortable eight-mile-long trail route between the historic entrance and the Frozen Niagara Entrance. In 1936, CCC work led to the opening of the Snowball Dining Room to the public (Figure 56).[212] In 1936, the Frozen Niagara entrance was landscaped, with terracing and other earth work completed, while interior trails continued to be maintained (Figure 57). Iron gates were added at some entrances by the CCC in 1937, while trail maintenance continued. Trail work conducted by the CCC included construction of walls, building up of the trail base to diminish steep up and down sections, and surfacing of trails with compacted sediment mined within the cave (Figure 58 and Figure 59). The packed sediment was regularly sprayed with water and an application of calcium chloride and ammonium nitrate salts to help hold moisture and maintain a smooth surface. The Violet City and Carmichael entrance areas were excavated to increase the height of used passages. The Historic Entrance was also improved through leveling of the landing at the top, and construction of stone culverts and channels to control stormwater.

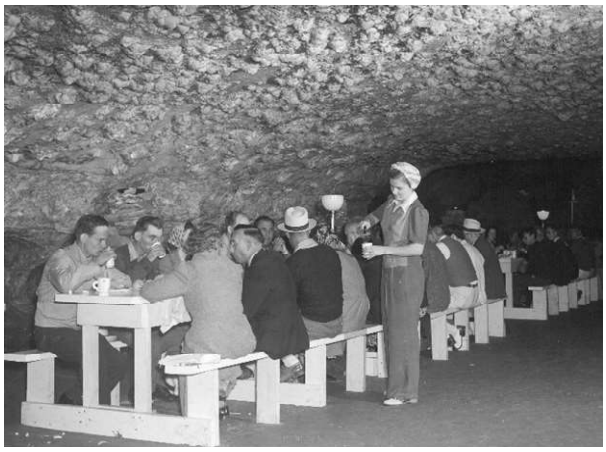

FIGURE 56. Snowball Dining Room, 1941. (Source: Mammoth Cave National Park, MACA_30510)

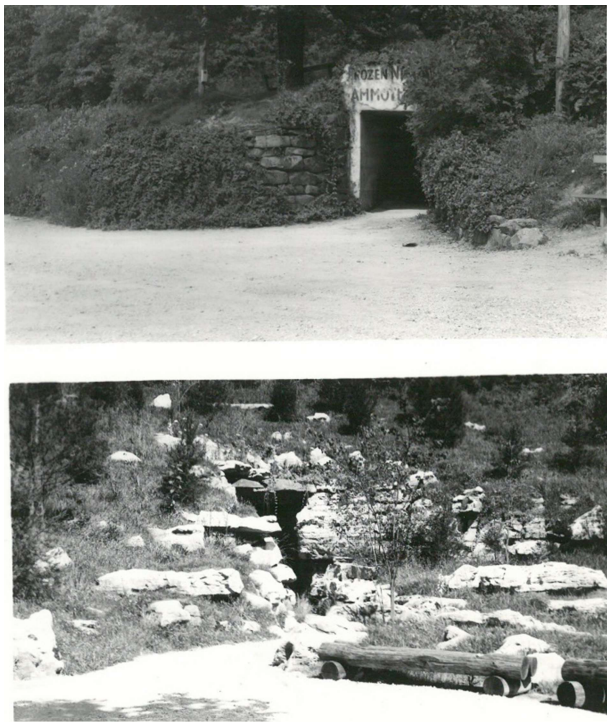

FIGURE 57. Images of improvements made to Frozen Niagara entrance from 1936 report. (Source Mammoth Cave National Park)

212. A comfort station and food preparation room was added in 1957 and 1958, respectively, as part of the Mission 66 program.

FIGURE 58. Image of enrollees improving cave trails showing pipe handrail. (Source: 1935 Emergency Conservation Work report)

FIGURE 59. Image of enrollees sweeping floors in the Snowball Dining Room; note typical bench type. (Source: 1935 Emergency Conservation Work report)

The work was described in a 1935 report as follows:

> We built 2.6 miles of foot-trails in Mammoth Cave, with an expenditure of 2394 man-days. The width of these trails depend[s] largely on the natural condition of the cave, as they were built in such a manner as to show no artificial work. The edges of these trails were either extended to the walls of the cave, or blended into the floor in such a manner as to make them look natural. No artificial walls were constructed and no straight lines or edges were established . . . . Special care was taken not to disturb the walls or ceiling, but all steps, and steep grades were either reworked or removed, to increase safety and ease of travel. The trails are built of napped rock, covered over with a heavy layer of packed sand, obtained in sections of the cave in which work is being done, and conforming with the natural floor found in that section.[213]

In 1935, while working near Waldach's Dome, CCC workers discovered mummified human remains of a prehistoric miner under a large boulder.[214] The CCC later constructed a wood frame, 27 feet above the floor of the cave, using 10x12 timber bolted together. Electric lighting was extended to the site to facilitate the work involved in raising the boulder so that the remains could be removed using a pulley cable system. The mummy was given the name "Lost John," and later was exhibited in a glass case fabricated by the CCC and moved to Broadway near Giant's Coffin.[215] The remains were kept at this location until 1978, after which they were reburied in an undisclosed location within the cave.

In 1935 and 1936, the cave interior was surveyed for the US Geological Survey by H. D. Walker. Walker placed a total of seventy-one bench marks within the cave composed of bronze markers set in concrete footers. In 1941, an older wood staircase at Rocky Mountains was replaced with a ramp.

Surviving evidence of CCC efforts is located throughout the cave. They include the cave soil trail segments; stacked stone walls and trail bases; the improvements at Violet City, Frozen Niagara, and Historic Entrances; the cable pulley system used to free the prehistoric miner and the glass case used to exhibit the mummy; and the Walker survey markers, a few of which have been lost to later construction projects.

Sleep Experiment, 1938. In June and July of 1938, Dr. Nathaniel Kleitman and his assistant Bruce Richardson conducted sleep cycle experiments inside Mammoth Cave (Figure 60). They established living quarters within Audubon

213. National Park Service, 1935 Emergency Conservation Work Narrative "Covering Activities at KY NP-3 For the Fifth Enrollment Period, April 1st ,1935 to September 30, 1935.

214. National Park Service, 1935 Emergency Conservation Work Narrative referencing project 83.

215. National Park Service, 1935 Emergency Conservation Work Narrative referencing project 83a.

Avenue and slept there for a month, attempting to adjust to a 28-hour day in the absence of sunlight.[216] No physical evidence of the sleep experiment survives within the cave today.

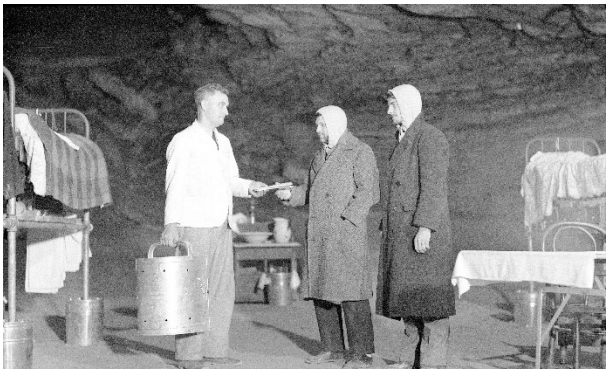

FIGURE 60. Mail being delivered to Dr. Nathaniel Kleitman and Bruce Richardson during the sleep experiment, 1938. (Source: Mammoth Cave National Park, MACA_28854)

Radio Broadcasts. During the 1920s, George Morrison arranged for a large room (Radio Room) near Frozen Niagara below the level of the main passage to be used for radio broadcasts to gain an advantage in his competition with Mammoth Cave (Figure 61). The broadcasts became a popular form of entertainment.

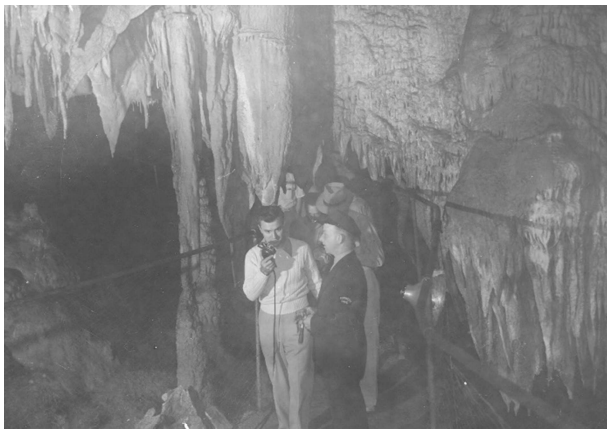

FIGURE 61. Radio broadcast from Frozen Niagara. (Source: Mammoth Cave National Park, MACA_29338A)

216. Diehl and Diblasi, 81, from Willis 1985.

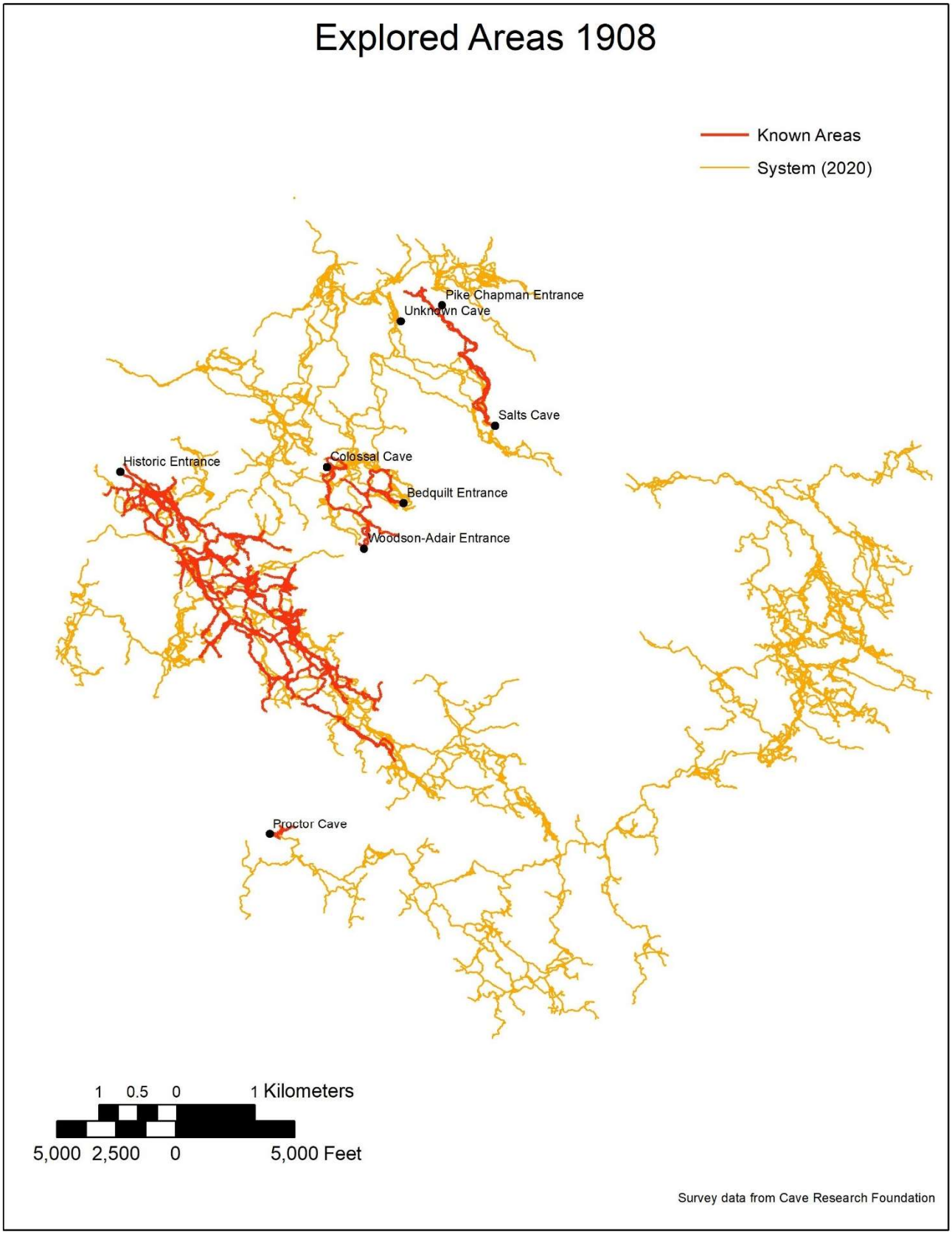

FIGURE 62. A diagram showing the explored portions of Mammoth Cave in 1908 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.9)

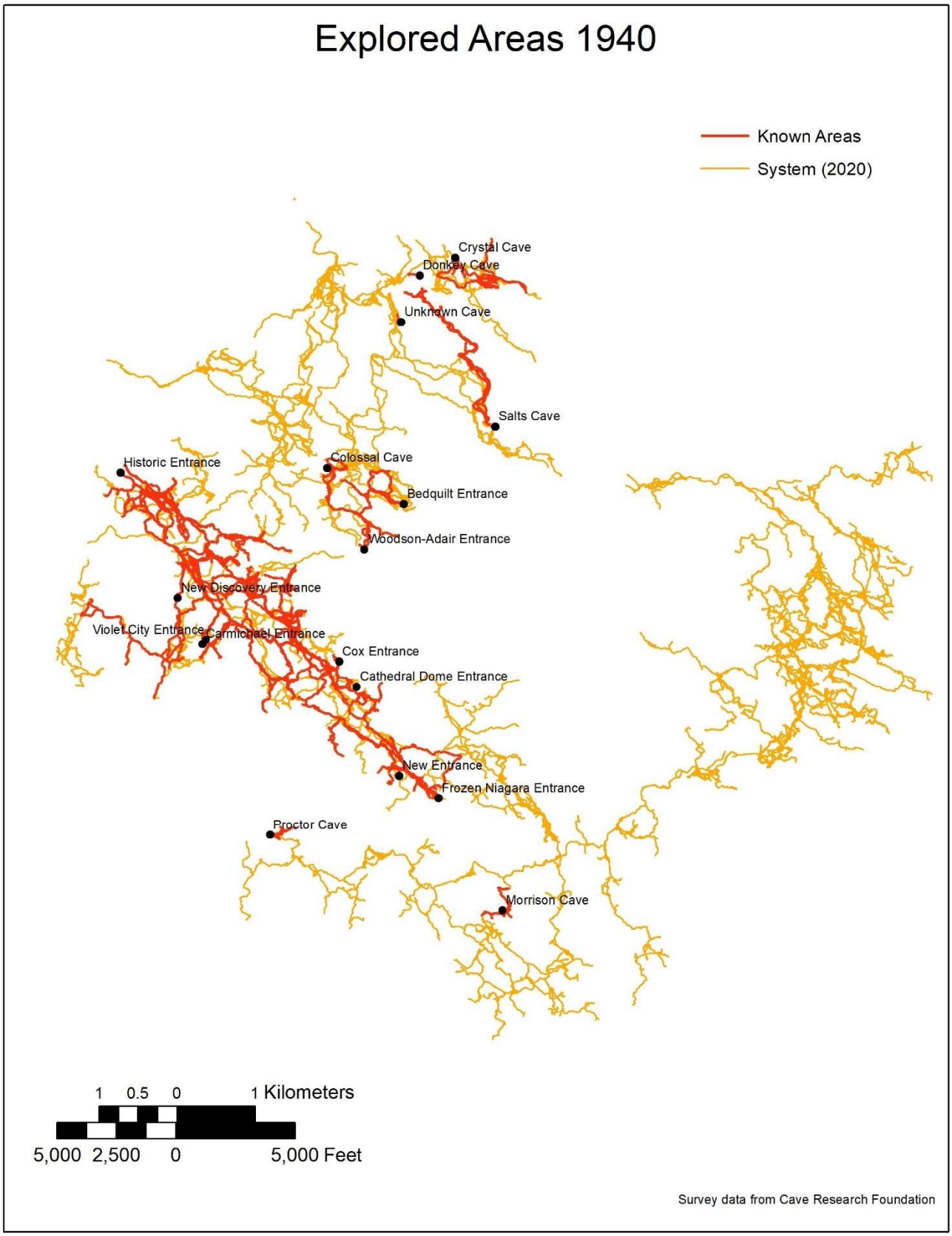

FIGURE 63. A diagram showing the explored portions of Mammoth Cave in 1940 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.10)

National Park Service Administration of Mammoth Cave, 1941–present

The National Park Service assumed full responsibility for the administration, protection, and development of Mammoth Cave National Park on July 1, 1941, which finally allowed the park to receive Congressional appropriations. Two months later, on September 16, 1941, the NPS was given administrative control of the cave itself. Despite receiving full designation as a national park in 1941, official dedication of the park was postponed until September 18, 1946, due to the involvement of the United States in World War II.[217]

Further Development at Mammoth Cave National Park, 1940s and 1950s

During and immediately following World War II, a few improvements to the park were implemented. Work in the cave during this period included maintenance and repair of trails, as well as the improvement of visitor facilities. In 1949, electric lights were added to the Rotunda, replacing outdated electric systems.

Mission 66 Development at Mammoth Cave, 1950s and 1960s

Background to the Mission 66 Program. By the 1950s, conditions at national parks were generally in a state of deterioration. Improvements had not been made to public facilities since the New Deal-era programs of the 1930s. The desperate need for building maintenance and funding was further amplified by the rapid increase in visitors to national parks following World War II. Despite the increase in visitation, park facilities remained essentially as they had been before the war. Limited National Park Service budgets led to cuts in staff, which, combined with the increasing number of visitors, jeopardized the integrity and condition of the existing natural and cultural resources. The increase in automobile usage further harmed the parks, which were generally ill prepared to accommodate an influx of vehicles.

In February 1955, NPS Director Conrad Wirth conceived a comprehensive conservation program to revitalize the national parks. The ten-year capital program aimed to modernize and expand the national park system.[218] Wirth chose to name the program "Mission 66," as he thought the word "mission" successfully expressed the urgency of the parks' situation to Congress, while the numeral 66 signified the end date of the program (1966), coinciding with the fiftieth anniversary of the establishment of the National Park Service. The Mission 66 plan not only sought to improve conditions at the parks through the construction of new roads, trails, and visitor facilities, but also through the establishment of increased operating budgets to maintain the parks in the future.

Building technologies developed during and immediately following World War II made construction faster and more economical, especially as compared to the labor-intensive construction required to construct the earlier, rustic-style park structures. While economics played an important role in the National Park Service's shift to modern design, many of the agency's in-house designers had previously abandoned the rustic style in favor of more progressive architecture. In 1939, construction began on an Art Moderne style museum and administration building at Ocmulgee National Monument in Georgia. Designed by NPS architect James T. Swanson, this structure marked a departure from the rustic style common in national parks buildings and heralded the changes

217. Lally, Multiple Property Documentation Form, Section III, D-15, citing Goode, 47, and R. Taylor Hoskins, "Annual Report Fiscal Year Ending June 1941," 6, and "Annual Report Fiscal Year Ending June 30, 1942," 1.

218. Ethan Carr, *Mission 66: Modernism and the National Park Dilemma* (Amherst: University of Massachusetts, 2007), 10.

in design that resulted in the architecture of the Mission 66 program.[219]

The goals of the Mission 66 program supported and accelerated a change in philosophy with regard to the design of buildings in the national parks. The postwar modernist architecture seen in national parks featured low profiles and horizontal massing in addition to muted colors, which helped the buildings visually blend in with their natural surroundings.[220]

The Mission 66 Program at Mammoth Cave. Mission 66 planning began at Mammoth Cave National Park in 1955, with the release of a prospectus that included a survey of existing conditions in addition to recommendations for future development. In 1956, proposals were made for development at Mammoth Cave National Park. The initial plan called for the construction of a visitor center and new campgrounds and picnic grounds, as well as improvements to existing trails in the cave, the addition of new comfort stations within the cave, and the improvement of roads and trails throughout the park. Improvements to cave wiring and other utilities and construction of new employee residences were also proposed.[221]

At the time Mission 66 planning began, approximately 15 miles of trails within the cave were actively maintained. The trails included bridges, stairs, benches, and railings. The initial Mission 66 prospectus recommended that all wood circulation structures be replaced with concrete, masonry, or corrosion-resistant metal structures. Additionally, it was recommended that trails should be reworked to remove any steep grades, and hazardous areas studied to improve visitor safety.[222]

The proposed Mission 66-era improvements at Mammoth Cave National Park were to cost approximately $5,000,000, with additional work planned for after 1966, when the program was set to end. By 1959, $1,167,850 had been provided for the work relating to buildings and utilities, while $1,474,000 had been provided for construction and maintenance of roads and trails.[223] Projects underway or completed at this time in the cave included new comfort stations at the Snowball Dining Room, a new service elevator, and improvements to cave wiring and utilities. Completion of new lighting in the cave and improvements to the cave trails were planned for later phases of the Mission 66 program.[224]

The new comfort station and preparation room and service counter at the Snowball Dining Room were completed in 1957 and 1958, respectively. The comfort station consisted of restrooms for men and women. The new structure was clad with stone and built along a cave wall, and extended to the ceiling of the cave. The concrete unit masonry food preparation room was built as a free-standing structure within the cave.

By the late 1950s, acquisition of the last privately owned lands within the park boundary, at Crystal Cave and Great Onyx Cave, was initiated. Both properties were acquired in late 1960.

A new visitor center was constructed at Mammoth Cave in 1959–1961 (Figure 64). The visitor center, designed by the Philadelphia architecture firm of Bellante & Clauss, was constructed east of the Historic Entrance and north of the existing hotel. The one-story structure with a walk-out basement

219. Ibid., 137–138.
220. Ibid., 134–135.
221. Summary of Mission 66 Objectives and Program for Mammoth Cave National Park, April 2, 1956. US Department of the Interior, National Park Service, Washington, DC
222. Mission 66 Prospectus, Mammoth Cave National Park, June 1956. US Department of the Interior, National Park Service, Washington, DC.
223. Mammoth Cave National Park Matters. Status, Mission 66 Program, 1959. National Archives, College Park, Maryland. Record Group 79, entry 41, box 12.
224. Mammoth Cave National Park Matters. Status, Mission 66 Program, 1959. National Archives, College Park, Maryland. Record Group 79, entry 41, box 12.

was constructed of brick masonry and steel, and consisted of two wings that housed park offices, a visitor lobby, ticket office, restrooms, an auditorium, and a museum. The two wings were connected by an open-air breezeway. A concrete ramp extended from the upper level of the visitor center to a path below, which led to the Historic Entrance. A 60-inch-by-50-inch, below-grade, concrete air tunnel ran southwest from the building to the cave to provide cool air to condition the building in summer. As part of the visitor center project, a concrete pedestrian bridge was also completed in 1961, extending from the visitor center south toward the hotel (Figure 65).[225] The new Mammoth Cave Hotel was completed in 1965 by National Park Concessions, Inc., between the existing hotel constructed in 1925 and the recently completed visitor center (Figure 66).

FIGURE 64. The Mammoth Cave National Park Visitor Center, view circa 2001–2007. (Source: Mammoth Cave National Park)

FIGURE 65. An undated view of the pedestrian bridge and visitor center, looking north. (Source: Mammoth Cave National Park)

Shortly after the opening of the new visitor center in 1963, improvements were made to the walkway and stairs leading to the Historic Entrance. The new asphalt walkway extended from a driveway east of the visitor center to the Historic Entrance. A single parking space was located at the end of the walkway adjacent to the Historic Entrance. A small asphalt plaza was provided at the end of the walkway, at the approach to the cave. A concrete staircase was constructed leading from the plaza down to the Historic Entrance.[226]

FIGURE 66. An undated postcard showing the new Mammoth Cave Hotel. (Source: Mammoth Cave National Park)

At the close of the Mission 66 era, Mammoth Cave National Park had been significantly reconfigured, with new roadways and parking areas, demolition of many older structures, and the creation of new

225. The bridge is visible in a photograph of the newly completed visitor center published in "Cave Purchases, Improvements Herald Bright Future for Mammoth Cave Park," *The Park City Daily News*, March 12, 1961.

226. NPS Drawing No. 135-3039A, "Approach Walk Steps and Parking at the Historic Entrance" (July 25, 1960).

lodging, camping, and visitor service facilities, as well as a new visitor center. Additionally, improvements to the cave had been made, including new and improved trails, updates to infrastructure, and construction of new visitor amenities.

In 1968, plans were made to construct a new concrete-paved trail leading from the new concrete stairs at the Historic Entrance, completed in 1963, to a new gate at the entrance to the cave.[227]

Construction of the new trail at the entrance was completed in 1969, and consisted of a new 8-foot-wide concrete-paved path with aluminum handrails. The new trail was approximately 126 feet long.[228]

Continued Development of the Park, 1972 to Present

Beginning in the 1960s, additional conservation efforts were implemented at the cave. These measures included closing artificial entrances with airlock doors in an effort to reestablish atmospheric conditions. Additionally, creosote, timber, and lint were removed from the cave, and activities in rivers within the cave were dramatically reduced in an effort to protect wildlife.[229]

Infrastructure improvements, including updates to lighting, electrical, sewage, and telephone systems have been made regularly.

In 1976, the underground tunnel that used air from the cave to cool the visitor center in summer was abandoned and sealed off, and new air conditioning equipment was installed in the building.[230]

In the 1970s, the NPS determined the 1925 hotel was a fire hazard and unsafe for guests, and the extensive repairs required were not economically feasible. Although the decision to demolish the hotel was controversial, demolition began in 1978 and was completed by the spring of 1979. Debris from demolition was buried at the Great Onyx Job Corps site.[231]

In 1982, Mammoth Cave National Park was named a World Heritage Site, recognized as a place of Outstanding Universal Value that contains the world's largest network of natural caves and underground passageways and is home to a variety of flora and fauna, including a number of endangered species. The World Heritage List documentation notes that Mammoth Cave meets several criteria for listing, as follows.

Per Criterion vii, Mammoth Cave contains ". . . superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance."[232]

> Mammoth Cave is the longest cave system in the world. The long passages with huge chambers, vertical shafts, stalagmites and stalactites, splendid forms of beautiful gypsum flowers, delicate gypsum needles, rare mirabilite flowers and other natural features of the cave system are all superlative examples of their type. No other known cave system in the world offers a greater variety of sulfate minerals.[233]

227. NPS Drawing No. 135-3232A, Improvement to Trail, Historic Entrance (November 1967).
228. NPS Drawing No. 135-3232B, Improvement to Trail, Historic Entrance - As-Constructed Drawings (February 4, 1970).
229. Allison Cohen Diehl and Phillip DiBlasi, Draft *Historic Chronology of Mammoth Cave* (Louisville, Kentucky: University of Louisville, July 1998), 85.
230. NPS Drawing No. 135-41013A, "Revised Air Conditioning, Visitor Center" (May 1976).
231. Correspondence by the authors with Joy M. Lyons, Mammoth Cave National Park, July 2012. Specific information about secondary structures, which are known from archival site maps to have been demolished after the 1960s, was not identified as part of this study.
232. "Mammoth Cave National Park," UNESCO World Heritage Centre web site, https://whc.unesco.org/en/list/150/. Accessed August 2020.
233. Ibid.

Per Criterion viii, Mammoth Cave is an outstanding example ". . . representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features."[234]

> Mammoth Cave exhibits 100 million years of cave-forming action and presents nearly every type of cave formation known. Geological processes involved in their formation continue. Today, this huge and complex network of cave passages provides a clear, complete and accessible record of the world's geomorphic and climatic changes. Outside the cave, the karst topography is superb, with fascinating landscapes and all of the classic features of a karst drainage system: vast recharge area, complex network of underground conduits, sink holes, cracks, fissures, and underground rivers and springs.

Per Criterion x, Mammoth Cave contains ". . . the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation."[235]

> The flora and fauna of the cave is the richest caverniculous wildlife known, numbering over 130 species, of which 14 species of troglobites and troglophiles are known only to exist here.[236]

Improvements to cave trails in the 1990s included the construction of stainless steel stairs at the New Entrance in 1996, replacing the original wood staircase. At the same time, the Historic Entrance was widened following the removal of a wall that dated to the era when saltpetre mining was active in the cave. A new open-barred gate at the entrance was also added at this time.

A new boardwalk was constructed in the Rotunda around the saltpetre vats in 1997, allowing visitors to better experience the area, while also eliminating the need for constant patching of the existing trail. The boardwalk was replaced with a new trail surface in 2015.

In 2004, the road leading to the Historic Entrance to the cave was rehabilitated, which included resurfacing and new curbing.

The electrical system for the cave was renovated, with new generators installed at the surface. This work was completed in 2007.

In 2008, plans were made for the rehabilitation of cave trails associated with the Historic, Frozen Niagara, and Lantern tour routes, as well as for the Gothic Avenue and Grand Avenue tour routes. The new trails consisted of hexagonal pavers that were installed at Houchins Narrows and at the Rotunda, and wood decking installed at the Main Cave. The paved trails were edged with lint guards and included stainless steel handrails. These trails were constructed over many of the dirt trails constructed by the CCC in the 1930s, which may remain below the new trail. The trail improvements began in 2015.

In 2007, the first phase of construction began at the visitor center. Most of the original Mission 66-era building was demolished, and a new Rustic-style visitor center, defined by exposed timber rafters and stone walls, was constructed in its place (Figure 67). The multi-phase project was completed in 2012.[237]

As of 2018, plans are being developed to continue to make trail improvements at the Grand Avenue tour route. Trail improvements are scheduled to occur at the Frozen Niagara section in 2021.

234. Ibid.
235. Ibid.
236. Ibid.
237. "Mammoth Cave celebrates its new visitor center," press release, Mammoth Cave National Park, November 16, 2012.

FIGURE 67. An image of the updated visitor center. (Source: Mammoth Cave National Park; https://www.nps.gov/maca/learn/news/mammoth-cave-increases-recreational-access-to-cave-tours-and-visitor-center.htm)

Character Study of the National Park Service Administration of Mammoth Cave Period, 1941–present

Refer to Figure 68, Figure 69, Figure 70, and Figure 71 for maps showing the explored portions of Mammoth Cave in 1962, 1972, 1983, and 2020, respectively.

Several projects were completed inside the cave during the decade or so following its establishment as a national park in 1941. In 1943, guard rails were installed at Bottomless Pit, Martha Washington's Statue, Lover's Leap steps, Side Saddle Pit, and Mammoth Dome. New boats were added for use on Echo River in 1943 and 1944. Nine miles of trails were also repaired in 1944, while steps were repaired in Mammoth Dome and Big Break in 1945. Sediments collected from side cuts were used to repair seven miles of trail in 1945. In 1947, a new restroom was built at River Hall, and two restroom facilities at Snowball Dining Room were repaired and creosoted, with a new comfort station containing two restrooms constructed. New boats continued to be built for Echo River tours in 1947 and 1948. In 1949, electric lights were added in the Rotunda, at Martha Washington's Statue, and Mammoth Dome; this replaced some older electrical system wiring that was in dangerous condition. New stairs were also added at Mammoth Dome in 1949.

In 1953, a steel tower was built to provide access to the lower area of Mammoth Dome from Little Bat Avenue.[238] A new restroom at Great Relief Hall was also built at this time.

Mission 66. The nationwide Mission 66 program provided much-needed funding for park improvements following more than a decade of reduced budgets resulting from World War II and its aftermath. At Mammoth Cave, several improvements were made including trail hardening using concrete, stair and bridge / causeway construction, installation of an elevator, construction of new restroom facilities, and lighting.

The Historic Entrance was improved through the redesign of the approach route, the landing, and the stonework above the cave, as well as the stair leading into the cave. An elevator was also constructed to provide access to the Snowball Dining Room area in 1957, while a preparation room and restroom were added in 1958. Concrete was used in the vicinity of the Snowball Dining Room and elevator to harden the trail and facilitate passage to the concession food service facilities. During the 1960s an air chamber was blasted into the wall of Houchins Narrows to allow the intake of air to the cave, and from the cave into the new Mission 66 visitor center and hotel. The shaft was later blocked off when radon was discovered to be entering the air of the two aboveground visitor facilities.

Restrooms were also added at Mt. McKinley. New concrete stairs and bridge and causeway structures were added to improve the safety and facility of the cave tour routes. This included trail work completed in 1966 and 1967.[239]

Echo River tours were discontinued in 1965, but they were reestablished for several years between 1980 and 1992.

238. Diehl and DiBlasi, 130.

239. Ibid., 91, from Mullin 1986: 3.

Post-Mission 66. Following Mission 66, the NPS initiated several new programs. One was a self-guided tour program. To support the program, small stone walls were built in several locations to limit visitor access to passages that were not open as part of the tour. Some of these survive within the cave today.

Conservation efforts conducted in the cave have increased since the 1960s. These have included closing unnecessary artificial entrances with airlock door to reestablish earlier atmospheric conditions; removal of creosote, timber, and lint; reduction of activities in cave rivers and other waterways to protect animals; and replacement with incandescent lights with cooler, ultraviolet (UV)-protected fluorescent lights to retard mold growth, fungus, and algae, and minimize temperature changes.[240]

Lighting, electrical, sewage, and telephone systems have been regularly upgraded in the cave.

In 1996, stainless steel stairs were used to replace the original wooden ones at New Entrance, while the Historic Entrance was widened through the removal of a saltpetre-era wall and the addition of an open-barred gate. Torch throwing as an interpretive activity was discontinued in 1990. In 1997, a new cypress boardwalk was added in the Rotunda to help visitors to see the saltpetre vats, and to eliminate the need for ongoing trail patching in the heavily used section of the cave. The boardwalk had raised curbs along the edges to trap lint.

Trail improvements were made in Main Cave in the 2000s. The new trails consisted of hexagonal pavers and were edged with lint guards and included stainless steel handrails.

Additional trail improvements are planned for 2019 along Grand Avenue between the Snowball Room and Grand Central. Trail surfacing in the improved sections is composed of hexagonal pavers and concrete bands edged by lint guards. Stainless steel handrails, causeways, and railings are being installed to replace earlier safety and barrier features and to control lint and algae growth.

HAER Documentation. In 1986, surviving evidence of the saltpetre-mining operations was documented by the Historic American Engineering Record (HAER No. KY-18) using photography and mapping. The HAER documentation also includes written data, consisting of historical research and resource description. Project documentation notes that the project was undertaken in the summer of 1986 by HAER in cooperation with Mammoth Cave National Park and the Southeast Preservation Center of the National Park Service. The documentation also notes that members of the Cave Research Foundation assisted in the fieldwork and reviewed drafts of the report, and the park historians and interpreters reviewed the drawings and report.[241]

Conservation. In 1990–1991, a plan was prepared to address restoration of the cave surfaces in Snowball Dining Room that had become covered with fungus that contained algae, lint, sediment particles, and carbon particles. The document indicated that Mammoth Cave was urgently in need of extensive resource cleaning and restoration work throughout all the passages. The document recommended that work begin in the Snowball Dining Room and along the Historic Tour.[242]

240. Ibid., 85.
241. Historic American Engineering Record, Creator, Charles Wilkins, Fleming Gatewood, and Hyman Gratz. *Mammoth Cave Saltpeter Works, Mammoth Cave, Edmonson County, KY*, HAER No. KY-18. Edmonson County, theyKentucky, Mammoth Cave, 1968. https://www.loc.gov/item/ky0272/. Accessed March 2019.
242. Thomas Aley and Catherine Aley, Ozark Underground Laboratory, *Snowball Dining Room, Phase II Restoration Studies, Mammoth Cave National Park*. January 1991. Documentation was not discovered during this study that indicates whether the recommended work was implemented.

Trail Improvements. In 2007, construction drawings were prepared by HDR Engineering, Inc. for rehabilitation of a section of the Gothic Avenue Walkway. The drawings addressed removal of wood steps, posts, handrails, and pipe anchors, and their replacement with new concrete stairs and ramps and stainless steel pipe handrails near Booth's Amphitheater.

In 2008, drawings were prepared for the rehabilitation of cave trails associated with the Historic, Frozen Niagara, and Lantern Tour routes, as well as for Gothic Avenue and Grand Avenue tour routes, based on a 2008 programmatic agreement. This project appears to have focused primarily on survey rather than new construction. These drawings show hexagonal pavers on trails through Houchins Narrows and the Rotunda, with wood decking along the Main Cave trail.

In 2015, the NPS entered into a Memorandum of Agreement with the Kentucky State Historic Preservation Office to address anticipated adverse effects related to trail improvements within Mammoth Cave. The projects indicated in the agreement included trail rehabilitation of portions of the Historic Tour route, cave lighting system improvements, and electrical line improvements. The trail improvements included new paving using hexagonal pavers and concrete to cover the CCC-era dirt trail surface, edged in places with lint guards, and new stainless steel handrails.

In 2018, the park embarked on an additional improvement project for segments of the Grand Avenue tour route that followed the construction details used in association with portions of the Main Cave tour route. The design is based on the following criteria:

- Protect and support the cave's rich natural and cultural resources
- Enhance the visitor cave experience
- Provide continuity amongst the trails in terms of materials and details
- Utilize innovative and flexible designs which respond to the unique character of each cave trail
- Accommodate flexibility for future management decisions regarding visitor circulation and tour use
- Respond to the unique contextual environment of the cave
- Be compatible with the interpretive vision for the cave trails
- Efficiency and economy in terms of constructability techniques
- Construction as funding becomes available

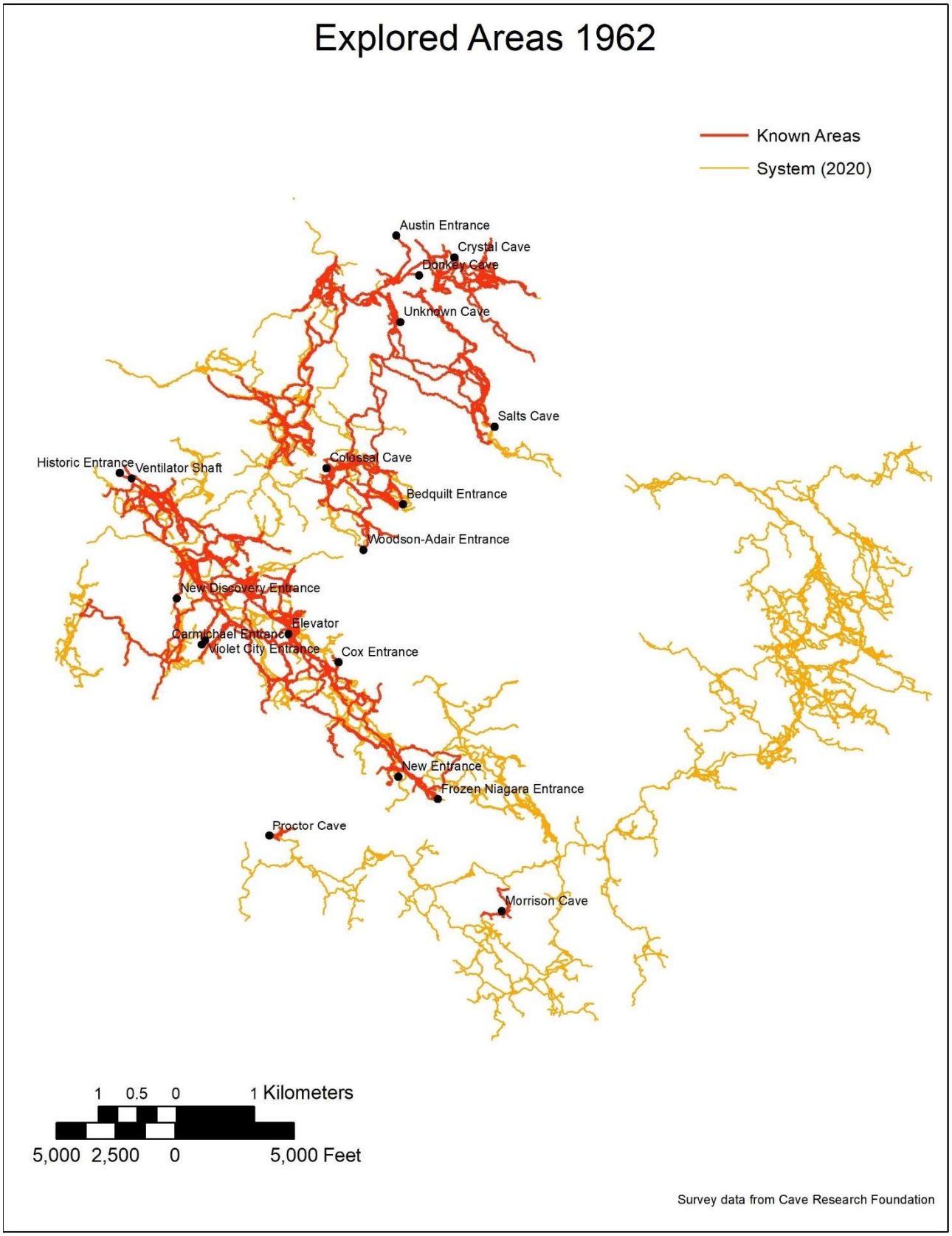

FIGURE 68. A diagram showing the explored portions of Mammoth Cave in 1962 (red), and the cave system in 20121 (tan). (Source: Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.11)

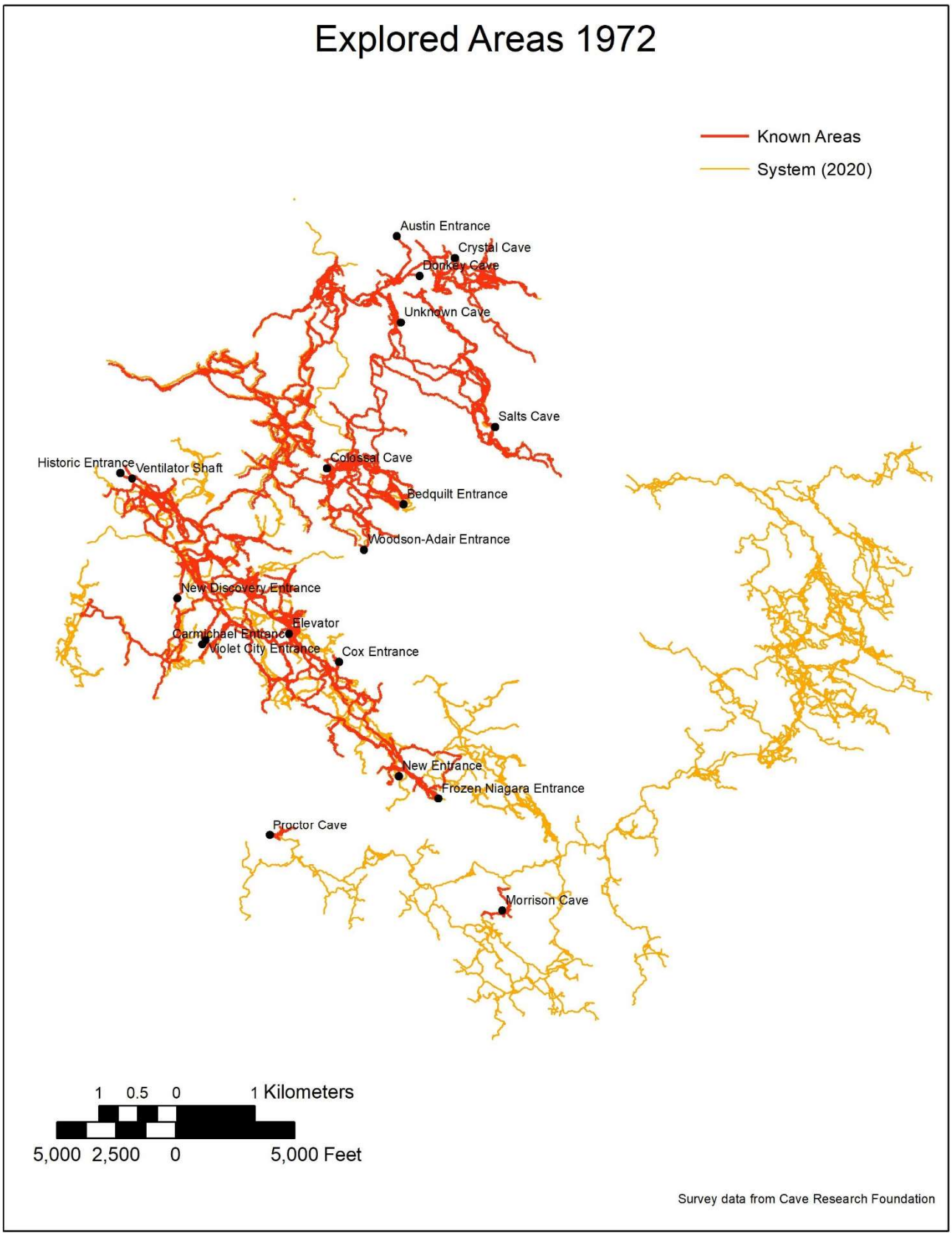

FIGURE 69. A diagram showing the explored portions of Mammoth Cave in 1972 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.14)

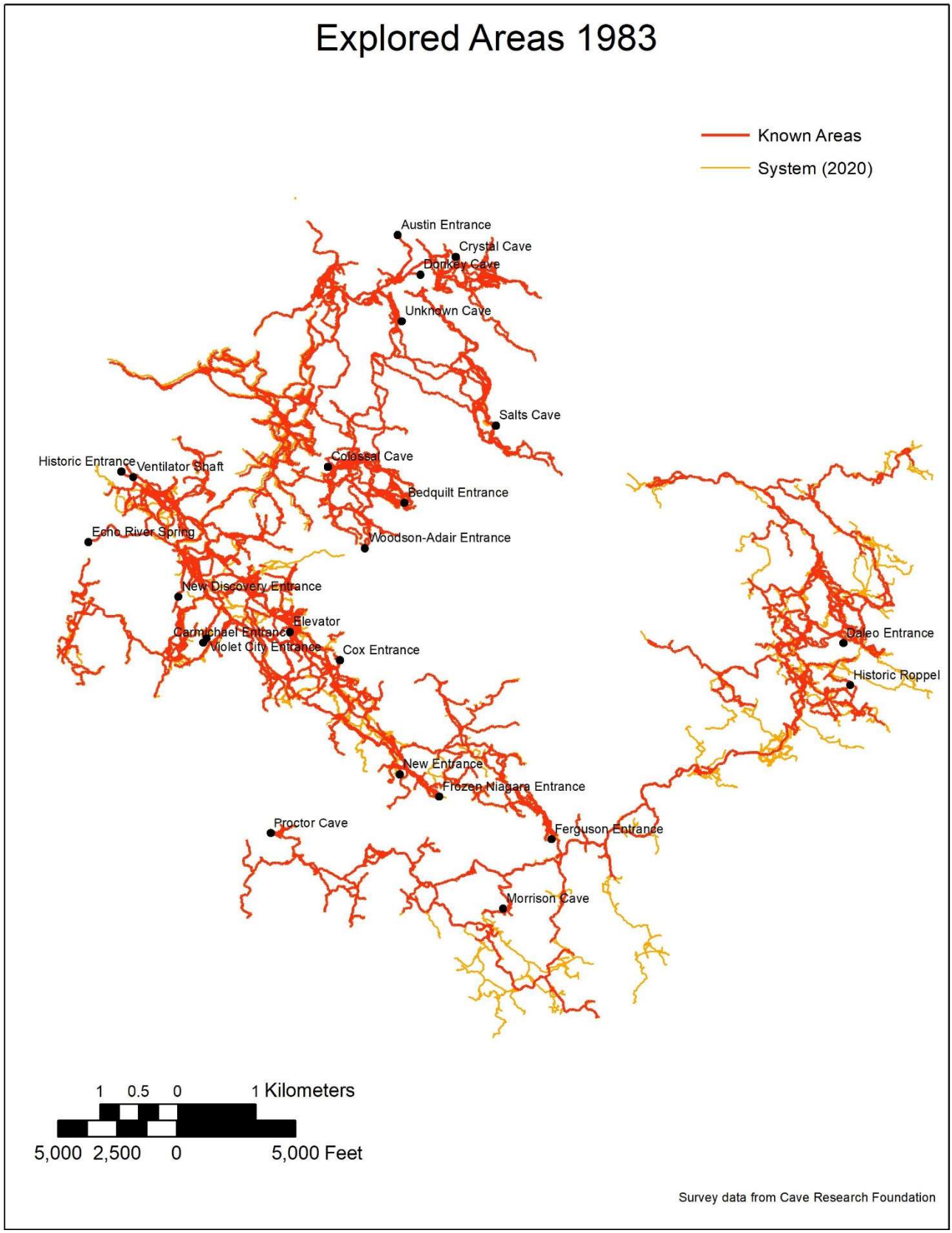

FIGURE 70. A diagram showing the explored portions of Mammoth Cave in 1983 (red), and the cave system in 2021 (tan). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.14)

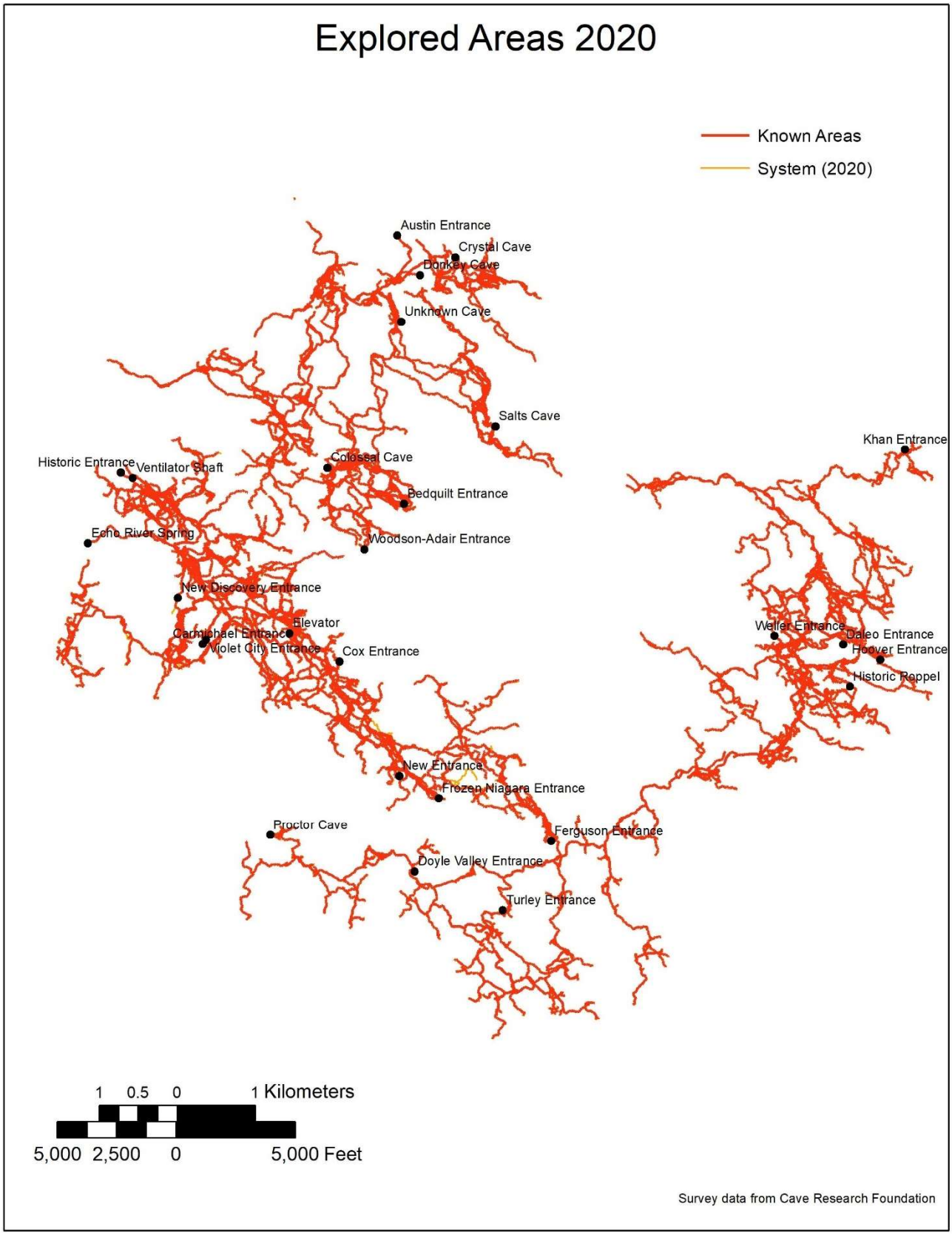

FIGURE 71. A diagram showing the explored portions of Mammoth Cave in 2020 (red). (Source: Rickard S. Toomey III, PhD. A version of this map, also prepared by Dr. Toomey, is included in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 1.14)

Mammoth Cave Ownership

Dates of Ownership	Owner	Notes
1798–circa 1799	Valentine Simons	Owned 200 acres of land, including Mammoth Cave.
Circa 1799–1808	John Flatt	Purchased cave and adjacent land for $116.47.
1808–1810	McClean Brothers	Purchased cave property.
1810–1812	Charles Wilkins and Fleming Gatewood	Purchased cave property for $3,000.
1812–1836	Hyman Gratz and Charles Wilkins	Gratz purchased Gatewood's interest in the cave for $10,000.
1836–1838	Franklin Gorin	Purchased the Mammoth Cave property.
1839–1849	Dr. John Croghan	Purchased the cave property and 1,600 acres of land for $10,000.
1849–1929	Croghan Estate	Following Croghan's death, the cave and related properties were placed in a trust for his nine nieces and nephews.
1929–1936	Mammoth Cave National Park Association/Kentucky National Park Commission	The Mammoth Cave National Park Association purchased a two-thirds ownership of the Mammoth Cave estate for $446,400. Third owner of estate refused to sell, but the establishment of the Kentucky National Park Commission allowed the commission to take full ownership of the estate.
1936–present	National Park Service	Secretary of Interior accepted deeds to 27,561 acres of land, allowing Mammoth Cave to be formally designated a national park.

Mammoth Cave Historic District Chronology

6,000–3,000 BCE	Pre-Contact peoples from the Archaic period believed to be the first to have entered Mammoth Cave.
1700s	European exploration.
1780s	Early settlement.
1798	Valentine Simons purchased the deed for 200 acres of land, which included Mammoth Cave.
circa 1799	Valentine Simons sold Mammoth Cave and adjacent lands to John Flatt, who operated a small saltpetre-mining business at the cave.
1808	The McClean brothers purchased the cave property from Flatt and subsequently expanded the mining operation at the cave.
1810	The McClean brothers sold the cave and adjacent property to Charles Wilkins and Fleming Gatewood. Wilkins and Gatewood expanded the saltpetre-mining operations significantly.
1812	Hyman Gratz purchased Fleming Gatewood's interest in Mammoth Cave and the surrounding property.
1816	Beginning of tourism at Mammoth Cave.
1836	Franklin Gorin purchased the Mammoth Cave property in April 1836 and began offering guided tours through the cave led by trained guides.

1839	Dr. John Croghan purchased the Mammoth Cave property in October and expanded visitor accommodations.
1840s	Boats began to be used on Echo River during the early part of the decade.
circa 1840	Wood stairs were added to Gothic Avenue.
1842–1843	Croghan oversaw an experimental tuberculosis hospital in the cave. Stone and wooden huts were constructed.
circa 1845	Excavation of Houchins Narrows occurred.
1847	The original cave entrance door was removed.
1849	Croghan died; his will placed the Mammoth Cave properties in trust for his nine nieces and nephews.
circa 1850	Excavation of Purgatory is completed, allowing passage.
1850s	The Louisville & Nashville Railroad was constructed, bringing travelers to nearby Bell's Tavern. Stagecoaches ran from the tavern to Mammoth Cave.
1870	William Garvin discovered the Corkscrew, a popular route of passage from the upper to the lower reaches of the cave.
1881–1883	Mushroom beds were established in the cave.
circa 1882	An open gate or grated iron door was installed at the Historic Entrance.
1886	Construction of the Mammoth Cave Railroad by the Mammoth Cave Railroad Company began; service between Bell's Tavern (later Glasgow Junction) and Mammoth Cave began in November.
1896	A new passage was dug through limestone at the end of Darnell's Way into Gorin's Dome. A bridge was constructed for passage.
Post-1900	The Guide House was constructed along a path to the Historic Entrance.
1916	The original Mammoth Cave Hotel was destroyed by fire.
1921	George Morrison formed the Mammoth Cave Development Company. He soon established the New Entrance into the cave.
1924	Morrison built an entrance near Frozen Niagara. An aerial tram was also constructed to convey visitors across Aero-Bridge Canyon.
1925	A new Mammoth Cave Hotel was constructed with forty-three guest rooms.
1926	President Calvin Coolidge signed a bill authorizing the establishment of Mammoth Cave National Park.
1930	An entrance near Cathedral Domes was established by Morrison.
1931	The Mammoth Cave Railroad ceased operation.
1931	An entrance was added to the cave at Carmichael.
1933	The first CCC camp was established on Flint Ridge near Crystal Cave. In all, four CCC camps operated at the cave.
1935	CCC workers constructed four miles of new foot trails within the cave, and also performed maintenance on an additional ten miles of foot trails.
1935	CCC workers discover mummified remains near Waldach's Dome.

1936	The Snowball Dining Room was opened to the public following work by the CCC.
1940	A sewer system and the chlorinator house were constructed by members of the CCC.
1941	Mammoth Cave National Park was established.
1941	A new ramp was constructed at Rocky Mountains, replacing an older wood staircase.
1942	CCC camps at Mammoth Cave disbanded.
1947	A new restroom was built at River Hall and two restrooms were constructed at Snowball Dining Room.
1949	Electric lights were added to the Rotunda.
1953	A steel tower was constructed to provide access from Little Bat Avenue to the lower area of Mammoth Dome.
1957	An elevator was constructed to provide access to the Snowball Dining Room.
1959–1961	A new visitor center was constructed north of the hotel by the NPS as part of the Mission 66 program. The visitor center included an underground air tunnel connected to Houchins Narrows in the cave for summertime cooling.
1963	Improvements including a new walkway and stairs were constructed at the Historic Entrance.
1996	New stairs were constructed at the New Entrance.
1997	A new boardwalk was added in the Rotunda.
2008	Design for the rehabilitation of save trails began.
2015	New paving was installed to cover the CCC-era trails at the Historic Trail route. Electrical improvements were also made.
2018	Additional improvement project for segments of the Grand Avenue tour route.

Existing Conditions Documentation

Introduction

This chapter describes, through narrative text, photographs, labeled base mapping, and analytical diagrams, the current conditions and extant landscape features associated with the Mammoth Cave Historic District.

The chapter is composed of four sections. The first section—Environmental Context and Setting—sets the Mammoth Cave Historic District within a regional and local context by discussing the larger systems that surround and encompass it. The second section—Cultural Context and Setting—describes the attractions and regional elements that provide a cultural framework for Mammoth Cave National Park, within which the Historic District is located. The third section—Cave Passages and Tour Routes—describes the Historic District as a whole through an understanding of how it is used to provide visitors with a variety of experiences. The fourth section—Mammoth Cave Cultural Landscape Features by Landscape Characteristic—provides detailed descriptions of the natural and cultural features that comprise the Historic District landscape. The feature descriptions are organized by landscape characteristic, the tangible and intangible aspects of the site that collectively convey its historic character and aid in the understanding of its cultural importance. The specific landscape characteristics used to organize the presentation of feature information are as follows:

- **Natural systems and features**. These are the environmental resources and qualities that have influenced the development and physical form of a landscape. They include the underlying geology, soils, and water resources.
- **Response to natural resources.** These describe the physical connections between the built and natural environment, such as the siting of buildings and structures and the use of native materials in construction.
- **Spatial organization.** These reflect the three-dimensional organization of physical forms and visual associations in a landscape, including the articulation of ground, vertical, and overhead planes that define and create spaces.
- **Land uses and activities.** These include the principal activities in a landscape that form, shape, and organize it as a result of human interaction.
- **Circulation.** This represents the patterns, features, and applied material finishes that constitute the systems of movement in a landscape.
- **Buildings.** These are elements constructed primarily for sheltering any form of human activity in a landscape.
- **Structures.** These are elements constructed for functional purposes other than sheltering human activities.
- **Views.** Views are generally defined as being expansive and panoramic prospects, whether naturally occurring or designed.
- **Small-scale features.** These are the elements providing detail and diversity for both functional needs and aesthetic concerns in a landscape.
- **Known and potential archeological resources.** These are the traces, or deposited artifacts in a landscape, evidenced by the

presence of either surface or subsurface features.[243]

A full inventory of all landscape resources documented in this chapter is included in Appendix A.

Environmental Context and Setting

Refer to Figure 72, Site Context and Location Map

Mammoth Cave Historic District falls within central Kentucky, in an area underlain by limestone geology described as a karst region. Karst describes a condition where the underlying limestone geology has been subject to dissolution through the action of acidic water. The dissolution produces a range of aboveground landforms and conditions, such as ridges, towers, fissures, and sinkholes, as well as belowground caverns and caves.

Mammoth Cave was produced through this dissolution process over many thousands of years. Today, it is considered the longest cave system in the world. The region within which it falls is also known to contain numerous other unconnected caves and cave systems. These caves were formed by underground movement of water related to regional hydrologic systems, including the Green and Nolin Rivers and their associated drainages.

Located near the Historic Entrance is the Green River, the hydrologic system that helped to form the cave passages, formed when acid compounds in the water dissolved the limestone bedrock. The cave continues to form in this way at the lowest reaches.

Mammoth Cave National Park encompasses and protects diverse geological, biological, and historical features both above and below ground. Highlights of the surface landscape include extensive tracts of native woodland, wetland, prairie, hemlock groves, and sinkhole microclimates, the diverse aquatic ecosystem associated with the Green and Nolin Rivers, and geologic features representative of classic karst terrain.

The park's diverse plant communities support a variety of wildlife. For example, the Green River, one of the most biologically diverse river habitats in the National Park System, contains more than 80 species of fish and 70 species of freshwater mussels. In 1988, Kentucky designated the Green River a wild and scenic river, and Green River and Mammoth Cave subsurface streams as outstanding resource waters.

On October 27, 1981, Mammoth Cave National Park joined the ranks of renowned locales such as Australia's Great Barrier Reef, Egypt's Pyramids of Giza, Nepal's Kathmandu Valley, and India's Taj Mahal Historic Park when the UNESCO designated Mammoth Cave National Park a World Heritage Site for its exceptional natural features and habitat for threatened and endangered species.[244] Mammoth Cave was later designated an Area Biosphere Reserve by UNESCO on September 26, 1990. The designation recognizes the property's unique "safeguarded, natural resources. Each biosphere reserve represents a specific ecosystem; a place for research, monitoring and education, and a place where government policy makers, scientists, and local people cooperate to manage land and water resources to meet human needs while conserving natural resources."[245] Biosphere reserves are studied to determine how to reconcile conservation of biological resources with their sustainable use. The Mammoth Cave Area International Biosphere Reserve was greatly expanded in 1996 to include the entire recharge area associate with the underground hydrologic system of the cave and its associated karst hydrogeology.

243. Derived from Robert R. Page, Cathy A. Gilbert, and Susan A. Dolan, *A Guide to Cultural Landscape Reports; Contents, Processes, and Techniques* (Washington, DC: Department of the Interior, 1998), 53.
244. National Park Service, "Mammoth Cave National Park, Preserving the Park." Accessed September 13, 2018, www.ohranger.com/mammoth-cave/preserving-park).
245. National Park Service, "Mammoth Cave National Park, Preserving the Park."

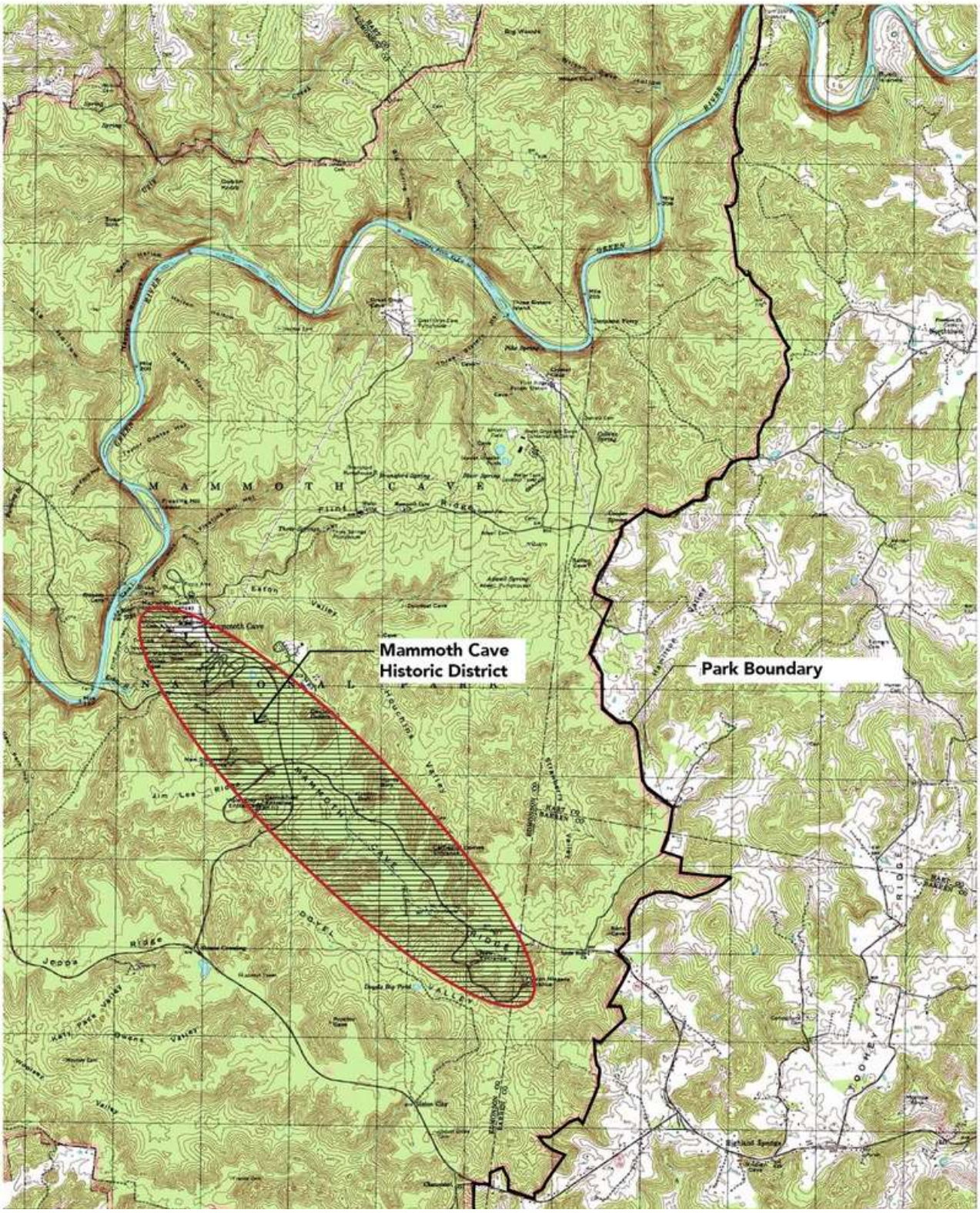

FIGURE 72. Site Context and Location Map. (Source: USGS, 1:24,000 Mammoth Cave quadrangle, 1997)

Physiography

Mammoth Cave National Park falls within the Mississippian Plateau physiographic province of south-central and western Kentucky near its boundary with the Western Kentucky Coalfields province (Figure 73). The Mississippian Plateau province is an upland region underlain by thick deposits of Mississippian-age limestones and shale (Figure 74). The resulting karst geology is characterized by tens of thousands of sinkholes, sinking streams, streamless valleys, springs, and caverns. These conditions result from the soluble nature of the limestone which can dissolve under the right conditions—primarily prolonged exposure to acidified water—which can occur due to the presence of underground streams.[246]

Most of the Mississippian Plateau is drained by the Green River and its tributaries. The river valley and associated karst drainage network are subtly controlled by the regional dip of the limestone beds toward the Western Coal Field region (Figure 75). The rugged topography of the region has developed as a result of headward erosion by the Green River and its tributaries. Mammoth Cave is the result of these forces. It has formed in an intensely dissected cuesta, defined as a ridge formed by gently tilted sedimentary rock layers. The steep outward-facing slopes of the cuesta are known as the Dripping Springs Escarpment.[247] Geology along the boundary between the Mississippian Plateau and the Western Kentucky Coalfields provinces sometimes includes isolated areas with hard sandstone overlying softer limestones, resulting in an environment conducive to cave formation.[248]

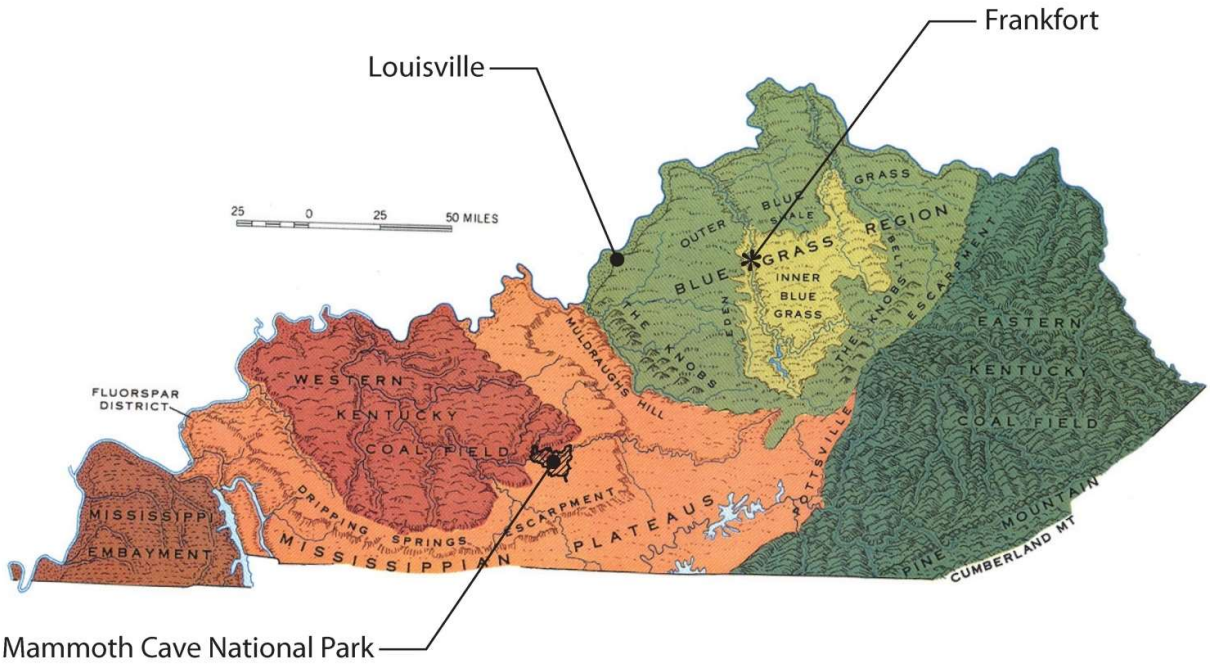

FIGURE 73. General Physiographic Provinces of Kentucky. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 92)

246. Wayne L. Newell, *The Geology of Kentucky: Physiography* (USGS Professional Paper 1151-H, January 9, 2001).
247. Ibid.
248. Palmer, 97–101.

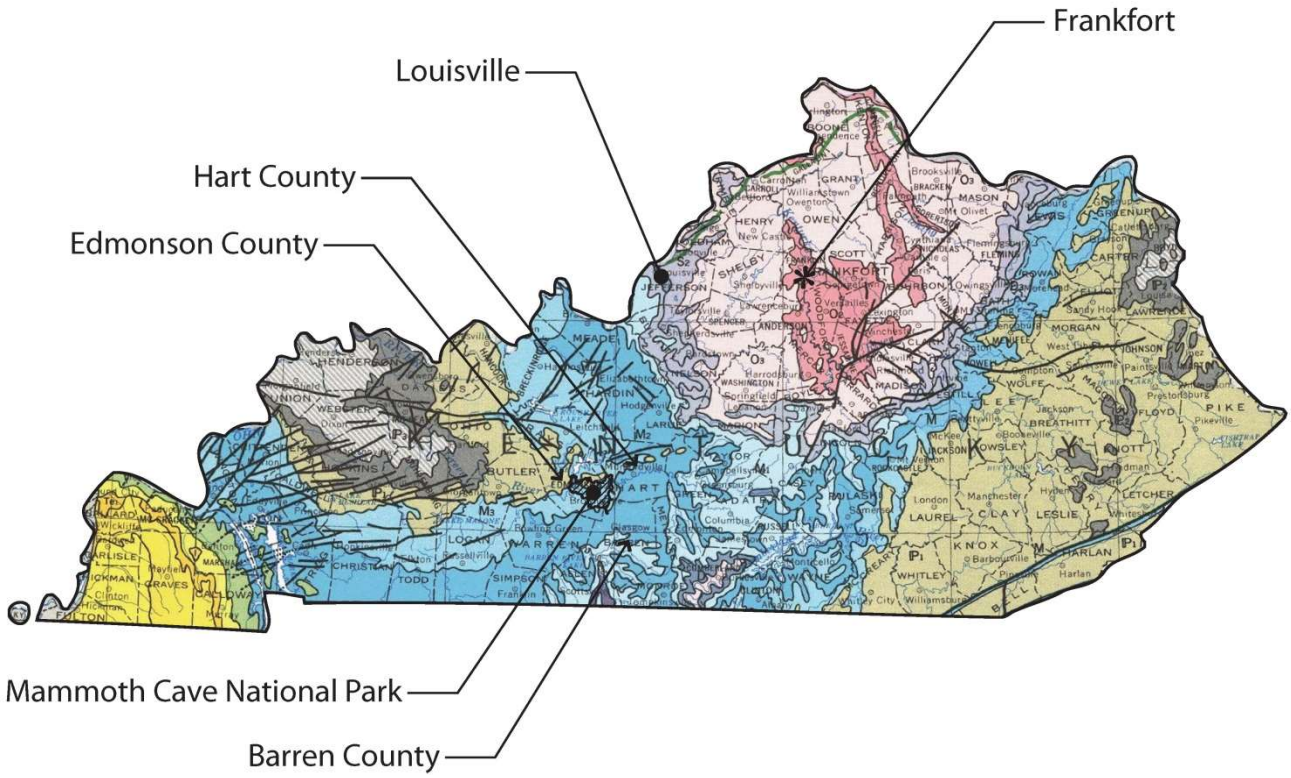

FIGURE 74 . Generalized Geologic Map of Kentucky. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 95)

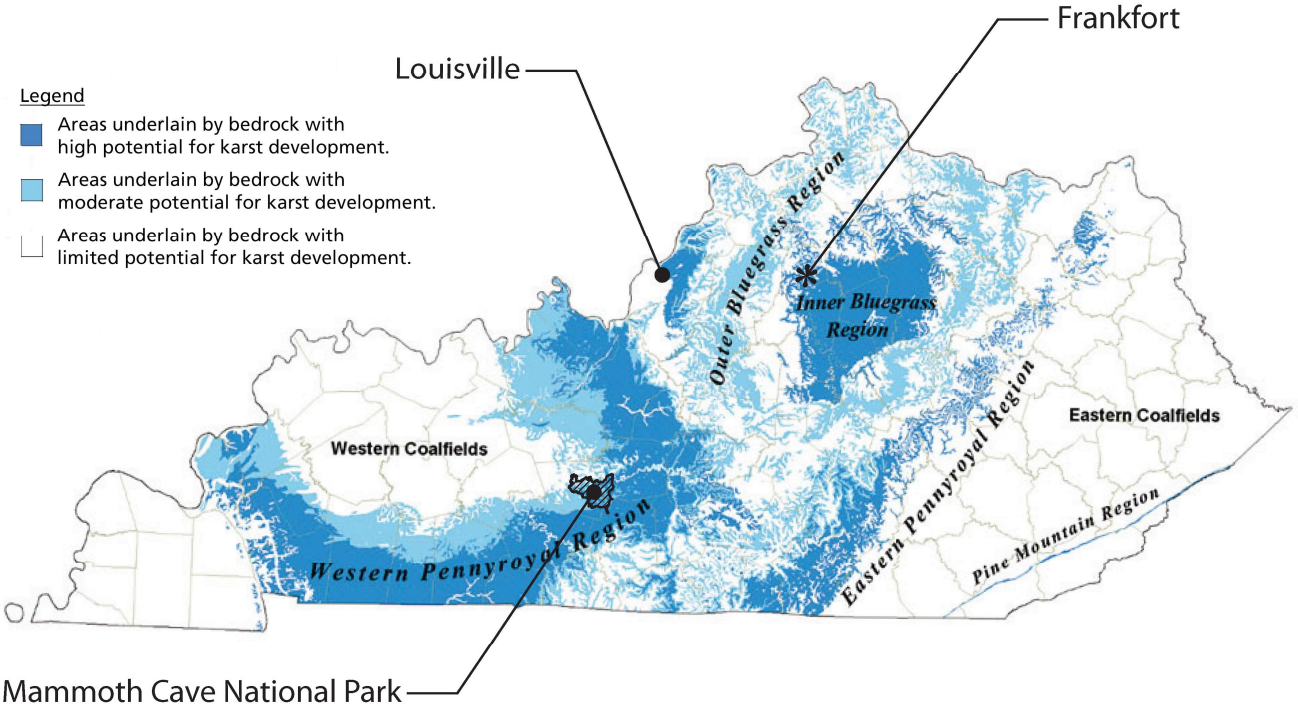

FIGURE 75. Karst areas in Kentucky. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 93)

Physical Geology

The geological process that produced the Mammoth Cave system began 350 million years ago. At that time, the North American continent was located much farther south, with Kentucky falling about 10 degrees south of the equator. A shallow sea covered the region. The warm waters of the shallow sea supported a dense population of marine organisms. As these creatures died, their skeletal fragments fell to the sea floor, leaving deposits of calcium carbonate ($CaCO_3$). Additional calcium carbonate precipitated from the water itself, adding to a 700-foot-high build-up of material over a 70-million-year period, and the formation of limestone and shale rock. Later, another 50 to 60 feet of sandstone formed through deposition of silts and clay deposited over much of the area by a large river system that emptied into the sea from the north.

About 280 million years ago, the level of the shallow sea began to drop, and the continent to rise, exposing the layers of limestone and sandstone. As the earth began to rise, forces beneath the earth's crust caused the rock to buckle and twist, and tiny cracks to form between and across the layers of limestone and sandstone. At the same time, the landform and topography, and resistance of underlying geological formations associated with the rising continent influenced the establishment of river systems. By about three million years ago, a sandstone-capped plateau stood above the Green River, while a low, almost flat limestone plain extended southeast of what is now Interstate 65.

In places, the limestone retained the sandstone cap deposited as a result of the earlier river system. This upper stratum is known as Big Clifty Sandstone. It includes sections that contain thin, sparse layers of limestone interspersed within the sandstones. These give rise to an epikarstic zone where tiny conduits are dissolved by the natural acidity of groundwater. These passages are very small, and too narrow for people to enter. The epikarstic zone concentrates local flows of runoff into high-elevation springs. The springs emerge at the edges of ridges. The resurgent water from these springs typically flows only briefly across the surface of the ground before sinking underground again where there is contact between the sandstone caprock and the underlying massive limestones. Water flowing into the underlying massive limestone layers has led to the dissolution forming the caves passages of Mammoth Cave and other caves within the region.

Mammoth Cave Ridge. Mammoth Cave Ridge is a northwest-southeast-oriented ridge that extends southeast from the Green River and covers much of the Mammoth Cave system. The ridge's uppermost rock strata are primarily Big Clifty sandstones, which are harder than the underlying limestones in which the cave system developed, protecting them from more extensive erosion typical across the Mississippian Plateau province to the south.[249] The Ridge is bounded by Houchins Valley to the northeast and Doyle Valley to the southwest.[250]

From shallowest to deepest, the Big Clifty Sandstone overlies Girkin, St. Genevieve, and St. Louis formations limestones (Figure 76). Together these layers form an approximately 120-meter-thick sequence. Each of these primary layers are divided further into named geological units and subunits.

The Girkin Limestone Formation, which sits at the top, consists of several limestone layers 10 to 20 feet thick, separated by soft beds of shaly limestone. The shaly component is responsible for producing recessed niches in the walls of Mammoth Cave walls. Overall, the Girkin Formation is approximately 130 feet thick. It can be seen at the beginning and end of the Historic Tour and along the descending staircase of the Frozen Niagara Tour.[251] The Girkin Formation is

249. Donald D. Haynes, *Geology of the Mammoth Cave Quadrangle, Kentucky* (Washington, DC: US Geological Survey, 1964); Palmer.
250. Palmer, 117.
251. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Wilker, and David C. Culver, eds., *Mammoth Cave, A Human and Natural History; Cave and Karst Systems of the World*

capped by the resistant sandstone of the Big Clifty Formation, which forms the top of Mammoth Cave Ridge where the Mammoth Cave National Park Visitor Center is located. The Big Clifty Formation is evidenced as small outcrops along the trail leading to the Historic Entrance.

The Ste. Genevieve Limestone Formation includes a variety of thin-bedded limestones and dolomites with a few thin shaly beds that produce recessed niches when eroded. The total thickness of the Ste. Genevieve Limestone is about 115 feet. Much of the Mammoth Cave Historic District falls within the St. Genevieve Limestone Formation.[252] The layers are easy to discern between Gothic Avenue and River Hall on the Historic Tour, as well as along nearly all of the Grand Avenue and Cleaveland Avenue Tours.

The St. Louis Limestone Formation contains dolomite, dark shaly beds, and many beds and nodules of chert. Chert is a hard, fine-grained sedimentary rock composed of small crystals of silica, easy to pick out within the limestone walls of the cave where it occurs. Parts of the cave in the St. Louis Formation features irregular walls that often contain projecting and recessed ledges. The chert occurs in beds that are highly irregular, with protrusions shaped like nodules, shelves, and balls. Evidence of fossils occurs frequently, as do the hardened burrows of invertebrate animals. The St. Louis Limestone is approximately 175 to 200 feet thick. Only the upper 130 feet is exposed in Mammoth Cave, and less than half of that is seen on current tour routes. The lower passages of the Wild Cave Tour are among the best places to experience St. Louis Limestone.[253]

(Cham, Switzerland: Springer International Publishing, 2017), 101.

252. Ibid.
253 Ibid.

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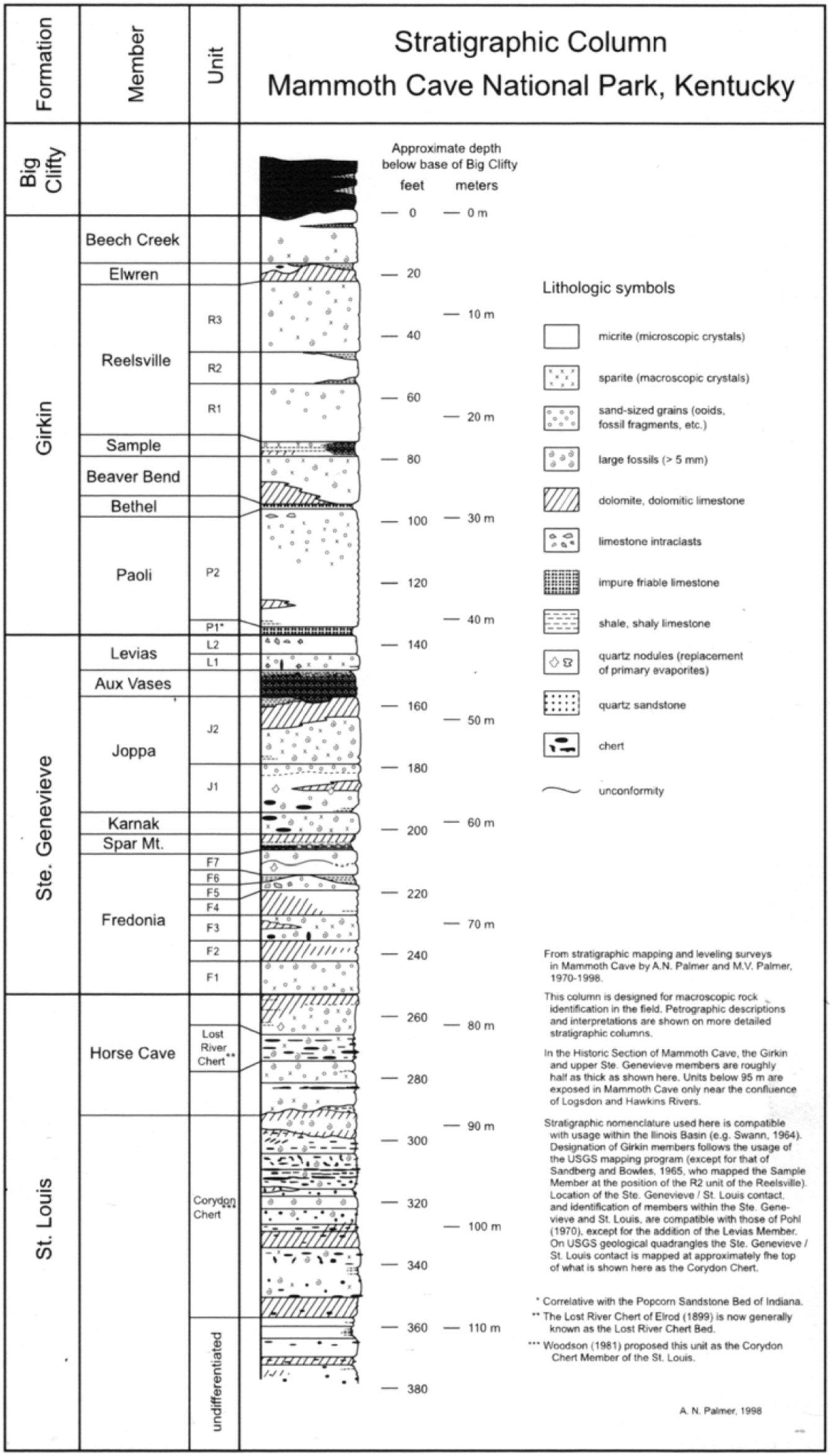

FIGURE 76. Stratigraphic column of geological formations within Mammoth Cave. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 96)

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Landform

Mammoth Cave is in the Mammoth Cave Plateau, a region of karst valleys eroded into the layers of soft limestone bedrock that underlie the harder sandstone capstones (Figure 77). The Pennyroyal Plateau, which is along the north edge of the Mississippian Plateau south of Mammoth Cave, is a region that was formerly covered with hard capstones but that have completely eroded. Its landscape is relatively level and includes numerous caves, sinkholes, and sinking streams; caves there are less interconnected and shorter than those in the Mammoth Cave Plateau. Other relatively stable caves are present under ridges covered with sandstone capstones near Mammoth Cave, such as Crystal, Salts, Bedquilt, and Colossal caves beneath the Flint Ridge system and Procter Cave under Joppa Ridge. The Chester Upland region, which extends north from the Green River near Mammoth Cave, is covered with thick layers of hard sandstone that permit minimal cave formation.[254]

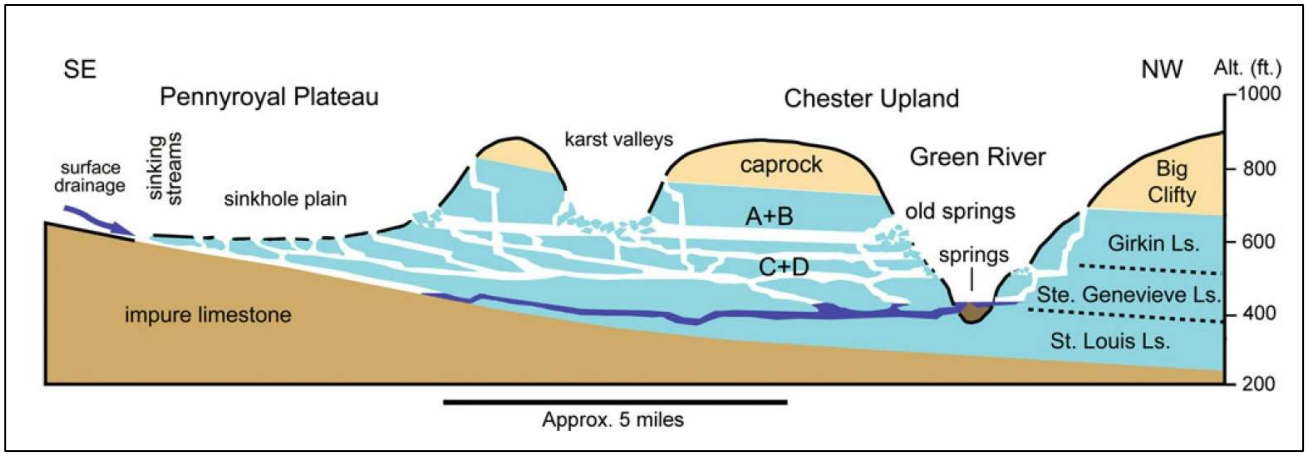

FIGURE 77. Schematic north-south geologic profile through the Mammoth Cave region (Source: "Geology of Mammoth Cave," 100).

254. Haynes; Palmer, "Geology of Mammoth Cave," 97-101; William B. White and Elizabeth L. White, "Hydrology and Hydrogeology of Mammoth Cave," in *Mammoth Cave: A Human and Natural History*, ed. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver (Cham, Switzerland: Springer, 2017), 126; Thomas L. Poulson, "Terrestrial Cave Ecology of the Mammoth Cave Region," in *Mammoth Cave: A Human and Natural History*, ed. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver (Cham, Switzerland: Springer, 2017), 199; together with Mammoth Cave, these "other" caves are actually parts of single large Mammoth Cave System, a fact gradually revealed by ongoing cave exploration: Richard S. Toomey III, Horton H. Hobbs III, and Rickard A. Olson, "An Orientation to Mammoth Cave and This Volume," in *Mammoth Cave: A Human and Natural History*, Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver, eds. (Cham, Switzerland: Springer, 2017), 1–28.

Hydrogeology

The Mammoth Cave karst aquifer is recharged primarily from areas outside Mammoth Cave National Park. This recharge, which occurs from precipitation or the injection of liquid wastes, enters the aquifer through numerous sinking streams and countless sinkholes. Thus, areas located within recharge areas can directly impact the park's water quality.[255] The primary activities that influence the park's water quality include domestic, municipal, industrial sewage, solid waste disposal, agricultural and forestry management practices, oil and gas exploration and production, urban land-use, and recreational activities.

The Mammoth Cave karst aquifer exhibits what is called convergent flow, a pattern that is similar to that of a dendritic surface stream system. While other aquifers may possess a more diffuse flow, in which contaminants slowly disperse, the convergent flow of the Mammoth Cave karst aquifer channels recharge toward a common trunk conduit or spring.[256] The convergent flow into Mammoth Cave begins at the Pennyroyal Plateau, a sinkhole plain, located to the south and east of the park, and continues through the ridges of the Chester Upland to springs along the Green River.

Flow through the Mammoth Cave karst aquifer can be very rapid, on the order of thousands to tens of thousands of feet per day. Contaminants entering the karst aquifer can thus be rapidly transported, unaltered, through the conduit system. The karst aquifer is highly dynamic, that is, it responds instantaneously to rainfall. Aquifer stages can rise tens of feet in a matter of hours. In a related way, the chemical and bacteriologic properties of the groundwater can thus change dramatically following rainfall events.[257]

The movement of water through the ground in this region formed Mammoth Cave through the action of acidified water on the soluble alkaline composition of limestone. Below ground, Mammoth Cave is characterized by a series of horizontal levels of current and former phreatic passages that formed in levels at times when the Green River stabilized during its long-term down-cutting of the river valley.[258] Cave levels can thus be tied to former water table levels in adjacent valleys.

Each of the individual cave passages associated with Mammoth Cave formed through the action of a discrete stream. Today, only a few passages still contain the streams that formed them. The shape of the cave passage relates to the nature of the water flow and the structure of the bedrock through which it moves. Water entering the limestone formations from above the water table, referred to as vadose, can also act on the limestone. Above the water table, water descends along the steepest available openings. At Mammoth Cave, these occur mostly down the dip of bedding-plane partings, where beds have split apart by stresses in the ground. The water serves to dissolve and erode the floor to form tall, narrow **canyons**, with sinuous patterns like surface streams (Figure 78).

FIGURE 78. A vadose canyon near Settles Gorge.

Many canyons expand or enlarge in a stepwise manner as waterfalls or rapids cut through entire beds, or several beds, while working their way

255. US Department of Agriculture and Natural Resources Conservation Service, *Soil Survey of Mammoth Cave National Park, Kentucky* (2010), 4.
256. William B. White and Elizabeth L. White, eds., *Karst Hydrology: Concepts from the Mammoth Cave Area* (New York: Van Nostrand Reinhold, 1989).
257. US Department of Agriculture, 4.
258. Phreatic refers to water at or below the water table within the zone of saturation.

upstream. Where vadose water encounters a vertical opening, such as fault or joint, it can enlarge the opening into **a shaft** (Figure 79). These formations look like the interior of a well or silo. The upper portions of shaft interiors are called **domes**, and deep lower parts are **pits**; as geologists Ann Livesay and Preston McGrain summarize, "if one looks up into such features, they are referred to as domes; if one peers down into them, they are called pits."[259] There are numerous named pits and domes throughout the cave system. The tallest known shaft in Mammoth Cave is Mammoth Dome, which has been estimated about approximately 200 feet deep.[260] Many of the shafts in Mammoth Cave continue to enlarge and are thus described as "active." This is especially true where drips become significant waterfalls after heavy rains as water enters the top, usually through **small canyons or vadose tubes**. Shafts also deepen with time as the water finds its way through fractures in the floor at the bottom of the formation, or it dissolves the limestone downward. The outflow of water is referred to as a **drain**. Each outflow tends to follow a different path, so a shaft can have drains leading to several passages at different elevational levels.

FIGURE 79. Bottomless Pit, an example of a shaft.

The phreatic passages that form at or below the water table follow the most efficient paths through the ground, rather than the steepest. Efficient paths are the routes that offer the least resistance to flow. They can thus depend to a great degree on the original width of the crack and the length of the flow path. Phreatic passages enlarge over their entire perimeters, forming tunnels with rounded contours called **tubes** (Figure 80). Tubes typically feature lens-shaped or elliptical cross sections that are elongated along the bedding planes. A few phreatic passages follow vertical or steeply inclined fractures. These develop into straight **fissures** with high, narrow cross sections (FIGURE 81). Phreatic passages tend to follow shallow slopes, but they can contain sections that loop up and down at various angles, like a garden hose draped over obstacles. Although some sections of phreatic passages can slope uphill, the surface inlets for water are invariably higher than the spring outlets, so the overall pattern of water flow through them is downward.[261]

FIGURE 80. Franklin Avenue, an example of a tube.

259. Ann Livesay, *Geology of the Mammoth Cave National Park Area*, Preston McGrain, rev. Kentucky Geological Survey, Special Publication 7 (Lexington, Kentucky: Kentucky Geological Survey, 1962).
260. Hobbs et al., 104.
261. Ibid., 105.

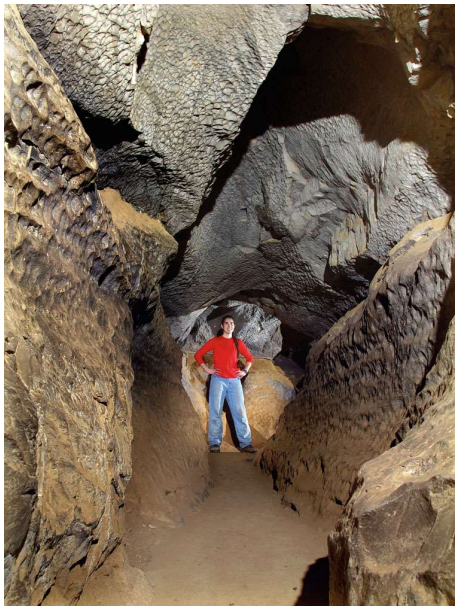

FIGURE 81. An example of a fissure at Leopard's Arch (also known as Leopold's Arch) in Sparks Avenue. (Source: Photograph by Art Palmer, published in in Hobbs et al., *Mammoth Cave: Human and Natural History*, Figure 6.6)

Hydrology

Mammoth Cave National Park falls within the Green River Basin (Figure 83). The Green River is part of the Ohio River drainage basin that covers most of the state of Kentucky. The Ohio River, as well as all other rivers in Kentucky, flow into the Mississippi River (Figure 82).

The headwaters of the Green River are characterized by bedrock of limestones, sandstones, and shales. The limestone areas have well-developed karst topography and are characterized by vast sinkhole plains which take in virtually all surface drainage and channel the water through caves and other underground passages. In karst aquifer systems, groundwater typically flows rapidly through caves and fractures of the rocks. Karst terrain is particularly vulnerable to contamination by human activities. Karst springs supply drinking water to several municipalities in the Pennyroyal Plateau, a sinkhole plain. Mammoth Cave and its associated drainage are the downstream portion of a much larger aquifer system which includes recharge from sinking streams at the southeastern edge of the sinkhole plain, internal runoff and diffuse infiltration from the sinkhole plain, and runoff from valley drains and the caprock of the Mammoth Cave Plateau.[262]

The groundwater that flows underground from the sinkhole plain south of the park into the Green River finds its outlet through innumerable springs in the Green River Valley. Among those present within the park are the River Styx Spring and the Echo River Spring.[263] Groundwater flow through Mammoth Cave is largely from a pair of relatively small catchments – River Styx and Echo River – that encompass Mammoth Cave Ridge and adjacent karst valleys. Water from both empties into the Green River via their eponymous springs.[264] During times of heavy rainfall, the large (244-square-km) Turnhole Spring Groundwater Basin, which is south of the cave's catchments, can overflow into the Echo River catchment.[265]

262. Ibid., 123.
263. National Park Service, *Mammoth Cave National Park* "Springs and Seeps." Accessed September 13, 2018, www.nps.gov/maca/naturescience/springs.htm.
264. White and White, 124; A. N. Palmer, "The Mammoth Cave System, Kentucky, USA," *Boletín Geológico y Minero* 127, no. 1. (2016), 133–135.
265. Joe Meiman, Chris Groves, and Shannon Herstein, "In-Cave Dye Tracing and Drainage Basin Divides in the Mammoth Cave Karst Aquifer, Kentucky," in *U.S. Geological Survey Karst Interest Group Proceedings*, Eve. L. Kuniansky, ed., *Water-Resources Investigations Report 01-4011* (Washington, DC: US Geological Survey, 2001), 179–182.

FIGURE 82. Mammoth Cave National Park falls within the Ohio River drainage basin. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 100)

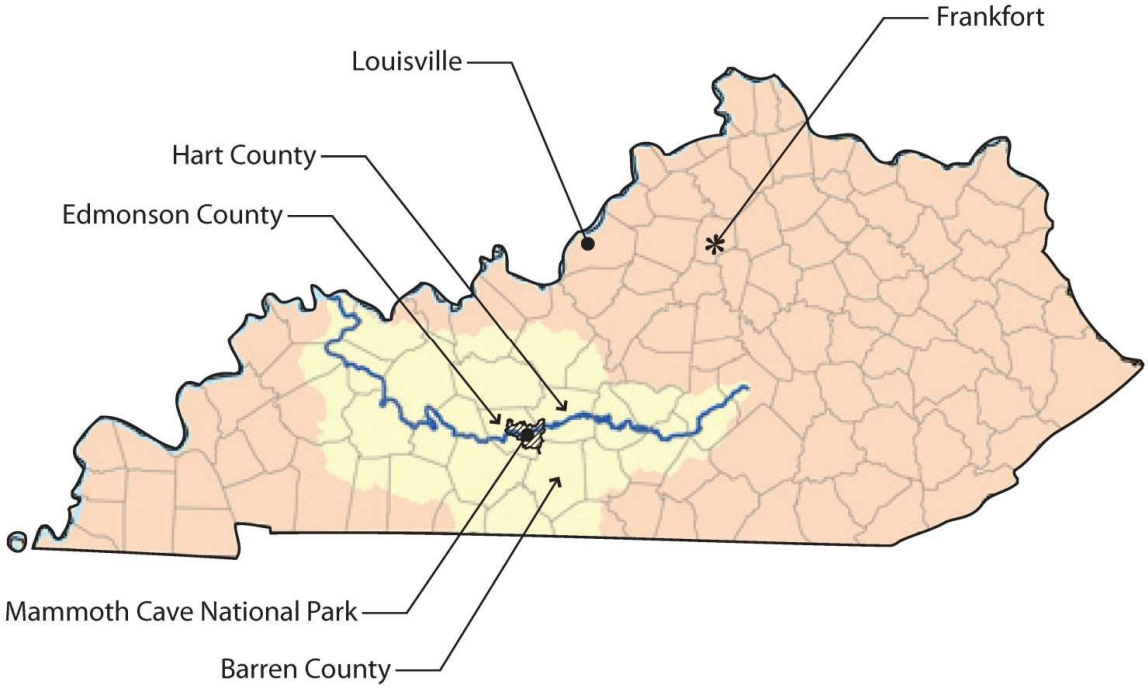

FIGURE 83. Mammoth Cave National Park within the Green River Basin. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 100)

Because the Green River Valley is narrow with little or no floodplain, increases in the discharge of Green River result in a substantial rise in water level, giving considerably higher flood stages than is typical of rivers with wide floodplains. Because of the low gradient of the master conduit systems draining to the Green River springs, rises in the level of Green River drive water into the springs and thus contaminate the aquifer with river water. This backflow is common in all river systems and is known as bank storage, but in karst regions the effect is extreme.[266]

The Green River is one of North America's most diverse riverine ecosystems and the most biologically abundant branch of the Ohio River system. The river flows unhindered for more than 100 miles through thirteen counties. The Green River is the base-level stream for the Mammoth Cave system, and it is also the primary hydrologic system supporting the aquatic wildlife community within the cave. The USDA and the State of Kentucky have targeted restoration of 99,550 acres of the south-central Kentucky's Green River Watershed through implementation of a Conservation Reserve Enhancement Program. The program would help protect Mammoth Cave National Park and the ecologically rich Green River from a decline in the health of the stream system and its associated wildlife community.[267]

Studies of the Mammoth Cave area over more than 50 years have established that, more often than not, drainage basins extend outside the park boundary. Furthermore, much of the water flowing through Mammoth Cave comes from sources well outside the park.[268] The base flow from the Mammoth Cave area is much lower than that of the Green River Basin as a whole.[269] Dry-season base flow is maintained in surface streams by groundwater discharging along the steam banks.

Modern base-level cave streams feed the six primary springs along the Green River (i.e., Pike, Great Onyx, Floating Mill, Styx, Echo, Turnhole).[270]

Wildlife

Mammoth Cave National Park is one of the greatest protectors of biological diversity in Kentucky and is home to over seventy threatened, endangered, or state listed species. These species include birds, crustaceans, fish, gastropods, insects, mammals, mussels, plants, and reptiles.

Inside the cave, there exists a very diverse and well-studied biology of creatures. In fact, Mammoth Cave is among the most investigated and understood cave ecosystems in the world. At least 160 species of animals regularly occur in the cave. Of these, 52 species are troglobiotic and stygobiotic organisms.[271] Mammoth Cave is considered to have one of the highest subterranean diversities in the world. [272] These organisms are highly cave-adapted and occur only in subterranean environments. Notable species include the endangered, endemic Mammoth Cave Shrimp (*Palaemonias ganteri*), two species of troglobiotic fish, and five co-occurring cave trechine beetle species.

Throughout the time cave passages have been open, some wildlife has entered them through passages connected to the aboveground environment. These species, primarily mammals, birds, and insects, have left behind evidence of their presence within the cave in the form of bones, mummies, guano, or physical marks like

266. Hobbs et al., 134.
267. US Department of Agriculture, Farm Service Agency, "Fact Sheet; Conservation Reserve Program – Kentucky Green River Conservation Reserve Enhancement Program." Accessed September 13, 2018 www.FSA.USDA.gov/Internet/FSA_File/greenrivercrepfactsheet.pdf.
268. Hobbs et al., 4.
269. Ibid., 132.
270. Ibid., 5.
271. Subterranean terrestrial environments are referred to as troglobiotic, while aquatic environments are stygobiotic.
272. Hobbs et al., 12.

tracks and scratches. Some evidence may be more than one million years old.

Bats, the only mammals that truly fly, have inhabited Mammoth Cave for millions of years. Mammoth Cave is known to support populations of at least three threatened or endangered species of bats. As described by the National Park Service,

> only 150 years ago, Indiana bats *(Myotis sodalist)* and to a lesser extent gray bats *(M. grisescens)* were prominent species in Mammoth Cave, but are today listed as endangered. Little brown bats *(M. lucifugus)* were also abundant with the big brown bat *(Eptisecus fuscus)*, and the tri-colored bat (formerly the eastern pipstrelle) *(Pipistrellus subflavus)* being less common. All together, these and more rare bat species such as eastern small-footed bat had estimated populations of 9-12 million just in the Historic Section. While these species still exist in Mammoth Cave, their numbers are now no more than a few thousand at best. Not all bat species in the park inhabit the caves. The red bat *(Lasiurus borealis)* is a forest-dweller, found underground only rarely.[273]

A fungal disease called white-nose syndrome that forms a white covering on some parts of the bats' bodies and devastates bat populations was first identified in the United States in 2006. It has since been connected with the deaths of five to six million bats. White-nose syndrome is known to be transmitted primarily from bat to bat, but spores of the fungus may be inadvertently carried between caves by humans on clothing, footwear, and caving gear. Significant evidence indicates that humans can and have transmitted the fungus from one cave to another, hastening its spread.

On January 6, 2013, Mammoth Cave National Park Superintendent Sarah Craighead announced that a bat found in Long Cave, an undeveloped cave that falls within the park and is one of the area's largest hibernaculums, was found to have white-nose syndrome. Long Cave houses endangered Indiana bats and gray bats, along with other non-threatened species. Long Cave is not connected to Mammoth Cave and has not been open to visitors for more than eighty years. While no tours at Mammoth Cave National Park enter areas used by colonies of bats for hibernation, bats do occasionally fly through toured sections of the cave year-round. Due to the spread of the disease in other states, the confirmed presence of the disease in Mammoth Cave National Park, and the potential lethal consequences to the bat populations, decontamination procedures to prevent spread of the fungal spores by humans was implemented following the discovery. Visitors follow the procedures as they leave their cave tours. The procedures include the use of nylon bio-security mats saturated in a solution of Woolite®, a laundry cleaning solution, at the Historic Entrance and the visitor center for tours returning by bus. Visitors are required to walk the length of the bio-security mats after exiting the cave (Figure 84). Visitors are also encouraged to visit the white-nose syndrome station at the visitor center to learn more about the disease and the efforts of the park to curtail its devastation.[274]

FIGURE 84. Bio-security mats at the Historic Entrance.

Other wildlife that inhabit the caves within the Historic District include the following:

Mollusks. The unpigmented shaggy cave snail (*Antroselates spiralis*) is among the animals that inhabit base-level aquatic habitats in Mammoth

273. National Park Service, *Mammoth Cave National* Park "Mammals," Accessed September 13, 2018, www.nps.gov/maca/naturescience/mammals.htm.

274. National Park Service, *Mammoth Cave National Park* "White-Nose Syndrome and Mammoth Cave" Accessed September 13, 2018, www.nps.gov/maca/whitenose.htm.

Cave (i.e., those parts of the cave that are at the same elevation as the Green River and are typically filled with water).[275] Three types of land snails also live in the cave, including *Carychium stygium*, *Helicodiscus punctallus*, and *Glyphyalinia specus*.[276]

Amphibians. Biological monitoring in the Roaring and Echo/Styx Rivers has identified the presence of aquatic vertebrates from the surface such as salamanders, frogs (*Rana palustris, R. clamitans*), toads (*Bufo woodhouse fowleri*), and surface fishes.[277] The spotted-tail salamander (*Eurycea lucifuga*) relies on cave crickets for food and is often found at cave entrances where cave crickets exit at night to feed. As dusk approaches, the salamanders line up along narrow crevices where the crickets must pass.

Crustaceans. The highly adapted Kentucky cave shrimp (*Palaemonias ganteri*) is found only in base level streams where the water table is present. A federally listed endangered species, the unpigmented, eyeless shrimp is thought to feed on microorganisms living in the sediment. [278] Other species, such as the Cave crayfish (*Orconectes pellucidus*), occupy habitats ranging from base level to tiny streams, and can travel out of water if necessary. Crustaceans found in aquatic cave habitats also include the amphipod *Crangonyx barri*, an unpigmented eyeless isopod (*Caecidotea stygia*), the amphipod *Stygobromus exilis*, the isopod *Caecidotea bicrenata*, and the unpigmented eyeless amphipod *Stygobromus vitreous*. The troglophilic or partially-cave-adapted amphipod (*Crangonyx packardi*) and some crayfish species (e.g., *Cambarus tenebrosus* and *Orconectes pellucidas*) often occur in organically rich streams.[279] Some smaller species also inhabit areas near cave openings where they can survive temporarily during wet intervals. Among them are cladocera, copepods, and ostracods.[280]

Fish. Fish associated with the Green River habitat of Mammoth Cave include eyeless species that have adapted to lightless, low-energy environments by ceasing to grow eye structures and unnecessary skin pigments.[281] The sculpin (*Cottus carolinae*) and the springfish (*Chologaster agassizi*) are examples of cave fish native to the underground rivers of Mammoth Cave. One of the more highly adapted cave fish is the Northern cave fish (*Amblyopsis spelaea*). It is a top predator that reaches its highest abundance in Roaring River, one of the base-level streams in the cave. Other species include the blind Southern cave fish (*Typhilichthys subterraneus*), which inhabits high-gradient streams above the base level.[282]

Insects, Arachnids, Centipedes, Millipedes. Many of the cave entrances support a variety of insects, arachnids, centipedes, and millipedes. These include the collembolans or springtails of the genera *Tomocerus*, *Hypogastrura*, *Sinella*, and *Arrhopalites* and *Litocampa* bristletails, as well as a species of watery flea (*Ptomaphagus hirtus*). Predators include beetles of the genus *Pseudanophthalmus*, and a rhagidid mite of the genus *Trombidiformes*, which lives on bat guano. The cave cricket (*Hadenoecus subterraneus*) is a keystone species that supports a high diversity and

275. Kurt L. Helf and Rickard A. Olson, "Subsurface Aquatic Ecology of Mammoth Cave," in *Mammoth Cave: A Human and Natural History*, ed. Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver (Cham, Switzerland: Springer, 2017), 216.
276. Integrated Taxonomic Information System [ITIS], electronic resource, 2017, www.itis.gov (accessed January 22, 2019); David C. Culver and Horton H. Hobbs III, "Biodiversity of Mammoth Cave," in *Mammoth Cave: A Human and Natural History*, Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver, eds. (Cham, Switzerland: Springer, 2017), 228.
277. Hobbs et al., 14.
278. Ibid., 216.
279. National Park Service, *Mammoth Cave National Park,* "Crustaceans." Accessed September 13, 2018, www.nps.gov/maca/naturescience/crustaceans.htm; ITIS; Helf and Olson, 210–217.
280. Helf and Olson, 210.
281. National Park Service, *Mammoth Cave National Park,* "Fish." Accessed September 13, 2018, www.nps.gov/maca/naturescience/fish.htm.
282. Hobbs et al., 215.

abundance of other species.[283] They exist in sandy passages with moderate moisture in the constant temperature zone of the cave. The blind cave beetle (*Neaphaenops tellkampfii*) feeds on their eggs. After cave crickets, this beetle has the highest population of any species in Mammoth Cave. Other insects in the cave include an ant-loving beetle (*Batrisodes henroti*) and a species of dung fly (*Spelobia tenebarum*).[284]

The large, orb-weaving spider, *Meta ovalis*, like the cave salamander, *Eurycea lucifuga*, also depends primarily on cave crickets as prey. These spiders are often discovered along relatively narrow cave passages where crickets are most vulnerable to capture. In winter, when many entrance slopes are too cold and dry for the spiders, they often die or enter into a hibernation-like state.[285] Other arachnid species that live in the cave include a fungus-eating mite (*Belba bulbipedata*), several other types of mites (*Linopodes mammouthia*, *Galumna alata*, *Laelaps cavernicola*, and *Macrocheles troglodytes*), a sheetweb spider (*Bathyphantes weyeri*), a type of harvestman spider (*Phalangodes armata*), three species of small spiders (*Anthrobia monmouthia*, *Phanetta subterranean*, and *Porrhomma cavernicola*), and four types of pseudoscorpions (false scorpions) (*Hesperochernes mirabilis*, *Kleptochthonius cerberus*, *K. hageni*, and *Tyrannochthonius hypogeus*). The cave's millipedes comprise two species: *Scoterpes copei* and *Chaetaspis fragilis*. [286]

Other invertebrates. Besides arthropods (i.e., crustaceans, arachnids, spiders, centipedes, and millipedes) and mollusks, other types of small invertebrates are found in nearly all parts of the cave. Examples that can live in the parts of the cave near the ground surface during wet times include aquatic earthworms (*Aeolosoma* and *Chaetogaster*), flatworms (*Sphallolpana* sp.), nematodes, and protozoa.[287]

Climate

It has generally been assumed for many years that the air temperature within Mammoth Cave remains constant at 54 degrees Fahrenheit all year round. However, this has recently been disproven, and park personnel now understand that variations in microclimate in terms of both temperature and humidity occur throughout the various passages and levels within the cave.[288]

At the lower levels, the base temperature of the air within the cave averages 57 degrees Fahrenheit, although the actual temperature in many areas of the cave varies substantially and changes seasonally. Because the Mammoth Cave system is relatively shallow and has thousands of places at different elevations where air can exchange with the surface, the main driver of airflow in the cave is the chimney effect. This means that air moves up according to gradients. During the winter, warmer air inside the cave rises out of higher elevation entrances because it is less dense than the cooler surface air. Cold surface air is then drawn into lower elevation entrances. In the summer, the opposite occurs. Cool dense air from the cave flows out of the lower elevation entrances, while warmer surface air is drawn into the upper entrances. In the summer, the cooler air at the cave entrances, most significantly at the Historic Entrance, provides visitors with welcome relief from hot and humid external conditions.

The temperature and humidity variations within the cave result in crucial differences in how well prehistoric and historic artifacts are preserved, where different animals live (and whether they can), and where various minerals will form.[289]

283. Ibid., 13.
284. Culver and Hobbs, 228-229; Helf and Olson, 210-217; ITIS.
285. Hobbs et al., 204.
286. Culver and Hobbs; ITIS.
287. Culver and Hobbs, 228–229; Helf and Olson, 210–217; ITIS.
288. Hobbs et al., 5, 11.
289. Ibid., 11.

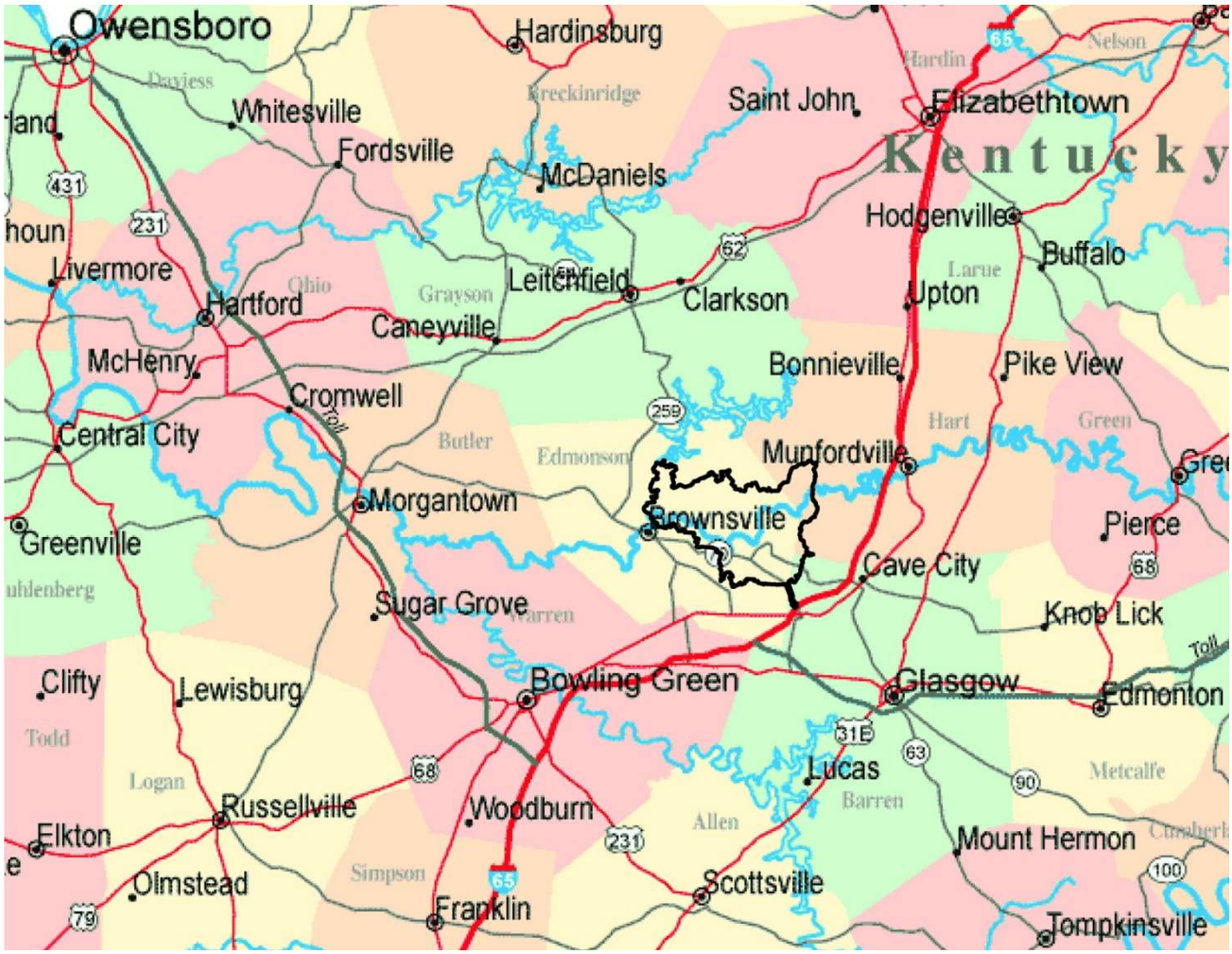

FIGURE 85. Regional map with features and transportation corridors. (Source: *Mammoth Cave Core Visitor Services Area CLR*, 107)

Cultural Context and Setting

Refer to Figure 85, Regional map of counties, towns, and transportation corridors.

Mammoth Cave National Park is located mostly in Edmonson County, Kentucky, although small portions of the park also extend into Barren and Hart Counties. The park lies approximately midway between the major cities of Louisville, Kentucky, and Nashville, Tennessee. Both are approximately 100 miles away. The closest town is Park City, Kentucky, located three miles to the south. Most visitors arrive at the park via Mammoth Cave Parkway, which arises from Interstate 65 near Park City.

Mammoth Cave National Park encompasses one fourth of the total land area of Edmonson County. Edmonson County and the adjacent Warren County make up the Bowling Green Metropolitan Statistical Area, a geographical region defined by the US Census Bureau. The Edmonson county seat is located in Brownsville. Kentucky State Highway 70 is the primary west to east route traversing the county and KY 101/259 is the main north to south route.

Mammoth Cave National Park is a major tourist attraction. It is one of seven units of the National Park System located within Kentucky; the other six include: Big South Fork National River and Recreation Area, Cumberland Gap National Historical Park, Abraham Lincoln Birthplace National Historical Park, the Trail of Tears National Historical Trail, Camp Nelson National Monument, and Mill Springs Battlefield National Monument.

Mammoth Cave has been the focus of industrial activities, exploration, and tourism since the late eighteenth and early nineteenth centuries. People have traditionally accessed the cave through various openings. However, the Historic Entrance has served as the most important access point due to its size. The Historic Entrance is located at the heart of the 52,830-acre park, but it falls at the northern end of the toured cave system. From the Historic Entrance, passages generally trend toward the southeast. Four other entrances currently provide access to the cave. These were developed at different times to enhance access for tourism. They include Carmichael, Violet City, and Frozen Niagara, which falls at the southern end of the toured cave system. An elevator installed in the 1950s along the ridge approximately half-way between the Historic Entrance and the New and Frozen Niagara Entrances serves as the fifth access point.

The region surrounding Mammoth Cave National Park is generally rural, but the preponderance of cave features in the area (which is known as "Cave Country") has contributed to a local heritage of tourism related industry. Visitors are also attracted to the region for its natural beauty and recreational amenities available in six nearby Kentucky State Parks including: Lake Cumberland State Resort Park, Nolin Lake State Park, Barren River Lake State Resort Park, Dale Hollow State Resort Park, General Burnside Island State Park, and Green River Lake State Park. Also located within a short distance are Cedars of Lebanon State Park and Standing Stone State Park in Tennessee.

Forming the core of the Mammoth Cave Area International Biosphere Reserve, the park is part of a larger conservation area designed to protect important biological resources; develop environmentally sound economic growth; and support research, monitoring, education, and information exchange related to conservation issues. The biosphere reserve is divided into three zones: a core area, a zone of cooperation, and a transition area. The core area is legally protected from activity that would adversely affect its natural features. It can be used for such activities as hiking, birdwatching, educational field trips, scientific research, and monitoring of plant and animal life. The zone of cooperation is a managed use area that can be used for lumbering, grazing, and fishing activities, settlements, and recreational facilities managed to benefit local residents and the local environment. The transition zone is an area in which residents, cultural groups, economic interests, scientists or managing agencies are to link conservation and economic development, guided by the cultural values of the local community. In the Mammoth Cave Area International Biosphere Reserve, the core area is Mammoth Cave National Park, which totals an area of 52,830 acres; the zone of cooperation is 94,365 acres to the immediate north and south of the park; and the transition zone is 762,133 acres in Edmonson, Hart, Barren, Metcalfe, Warren, and Butler Counties.

Cave Passages and Tour Routes

Refer to Figure 87, Existing Conditions Map Key Plan.

The Mammoth Cave Historic District consists of approximately 35 miles of underground passages that have been explored since the late eighteenth century and developed since the early nineteenth century to accommodate tourism and industry. The area contains natural and cultural resources as well as buildings and structures built to accommodate tourists, including restrooms and seating areas.

The Mammoth Cave Historic District is defined for the purposes of this study as the cave passages that were known by 1908 and illustrated on the map prepared by Max Kaemper, augmented by the passages that extend from those shown on Kaemper's map to New Entrance and Frozen Niagara Entrance. These passages became accessible following removal of rock and rubble in 1908.

The passages that comprise the historic district follow a nomenclature system that has built over time but has its origins in the early nineteenth century. Passages and the featured formations

visited since the nineteenth century have been named for places familiar to many visitors, such as Grand Central after Grand Central Station in New York City, for mythological places, for individuals, and for recognizable cave features.

Cave Passages

Overview. Mammoth Cave is composed of a vast number of individual cave passages. The majority of the passages no longer contain the streams that formed them. The mechanism through which they developed can be deduced through the caves' configurations and surface features. The passages formed over time with flows of water moving through bedrock. Above the water table, water typically descends following the steepest available openings. In Mammoth Cave, these occur down the dip of bedding-plane partings. Passages are formed when the water dissolves and erodes the floor, creating tall, narrow **canyons** with sinuous alignments similar to streams. The largest canyons providing access to cave interiors are referred to as **trunks**.

Canyons can enlarge over time in a stepwise manner when waterfalls or rapids cut through entire beds, or more than one bed, at a time, with the channels enlarging and/or lengthening as the waterfalls work their way upstream.

In addition to canyons, water can form **domes, domepits**, or **shafts**. These occur when vadose water encounters a vertical opening, such as fault or joint, and enlarges the opening through dissolution of the bedrock into a shaft, which resembles the interior of a well or silo.[290] The tallest known shaft in Mammoth Cave is Mammoth Dome. Many of the shafts within Mammoth Cave remain active, which means they are continuing to enlarge by active drips. These drips can become significant waterfalls after heavy rains. The openings through which the water enters the space can be canyons or vadose tubes. The shafts can deepen with time as this flow of water moves downward through fractures in their floors, or dissolves downward from bed to bed. As they deepen, new drains develop at lower levels. Each outflow can follow a separate path, so a shaft can provide access to several passages at entirely different levels. Shafts are typically larger in diameter than the inflow or outflow formations due to the action of water spray on the shaft walls. The walls of shafts are more vulnerable to dissolution than the inflow and outflow routes, the walls of which can be covered by relatively insoluble beds or sediment that are resistant to erosion.

As noted above, phreatic passages that form at or below the water table tend to follow the route of least resistance rather than the steepest and tend to enlarge across their entire perimeters.[291] This leads to the formation of tunnels with rounded contours, called **tubes**, although some phreatic passages develop into straight **fissures**.[292]

Located within most passages are varying depths of rubble, known as breakdown, which is composed of pieces of wall and ceiling rock that have collapsed or broken off and fallen to the floor. The term refers to both the process as well as the resulting material on the cave floor. Breakdown can include rock that ranges in size from small chips to large blocks or slabs.[293] When the breakdown blocks access to a shaft or passage it is referred to as a choke.

Set within the passages are numerous types of smaller geologic formations. These include **dripstones and flowstones**. Dripstones are calcium carbonate deposits that form from water dripping from the ceiling or wall of a cave or from the overhanging edge of a rock shelter. They include the rock in stalactites, stalagmites, and other similar speleothems and are sometimes composed of aragonite or gypsum. Flowstones are deposits of calcium carbonate, gypsum, and other mineral matter which have accumulated on the walls or floors of caves at places where water trickles or flows over the rock.

290. The vadose zone is the soil layer that sits above the saturated layer of the water table.
291. The phreatic zone is the inundated soil layer below the water table.
292. Hobbs et al., 104–105.
293. Ibid., 109.

Cave Passages by Section. The section that follows indicates the named passages that comprise the historic district (Figure 86). The "historic" area of the cave—that area located in close proximity to the historic entrance—is described first. This information is followed by sections of the cave moving generally in a southeasterly direction. Within the historic section of the cave, passages are also grouped by upper and lower systems, separated by approximately 100 feet of elevation, although this varies throughout. The dimensions and detailed geological information cited below are derived from the Mammoth Cave Gazetteer. The information provided herein is based on the research conducted to date by the National Park Service. Future documentation would benefit from additional oral history and in-depth study of particular sections of the cave for which less information was available.

One of the resources available to the CLR team were maps prepared by the National Park Service and the Cave Research Foundation, as well as maps prepared over time by cave explorers and guide. These are invaluable tools that indicate the general arrangement of primary passages in the western and eastern halves of Mammoth Cave. These maps are presented herein in association with an organization of cave passages introduced by the CLR team that includes four upper and four lower sections of passages. Given the linear nature of the resource, it was necessary to divide the mapping up into sections that could be reproduced at a scale sufficient for individual resources to be identified. The existing conditions documentation is presented at two scales—one that places the passages into context, and passage-specific mapping.

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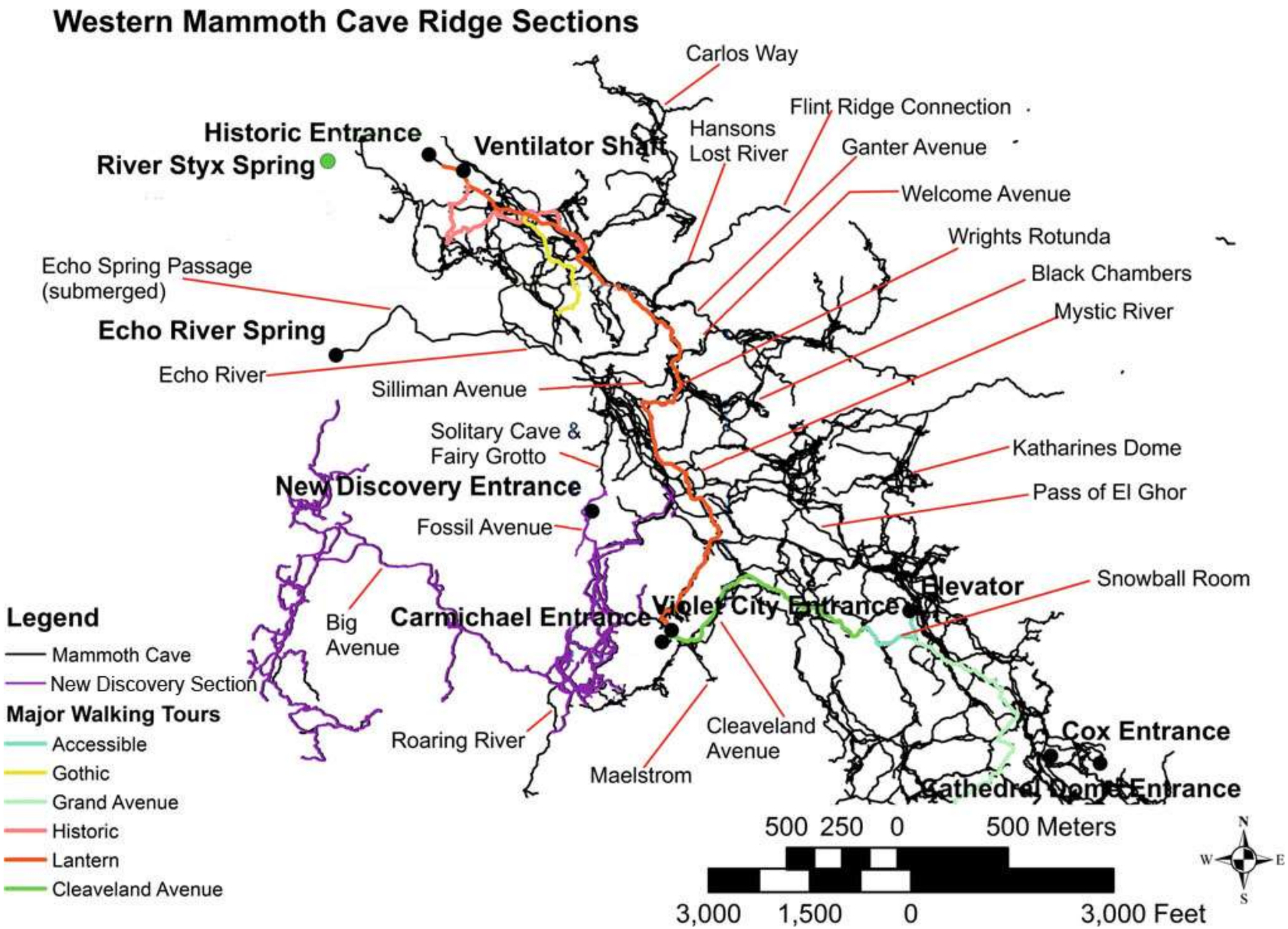

FIGURE 86. Diagram showing the configuration of passages within the western half of the Mammoth Cave Historic District. (Source: Hobbs et al., *Mammoth Cave: A Human and Natural History*, Figure 1.17)

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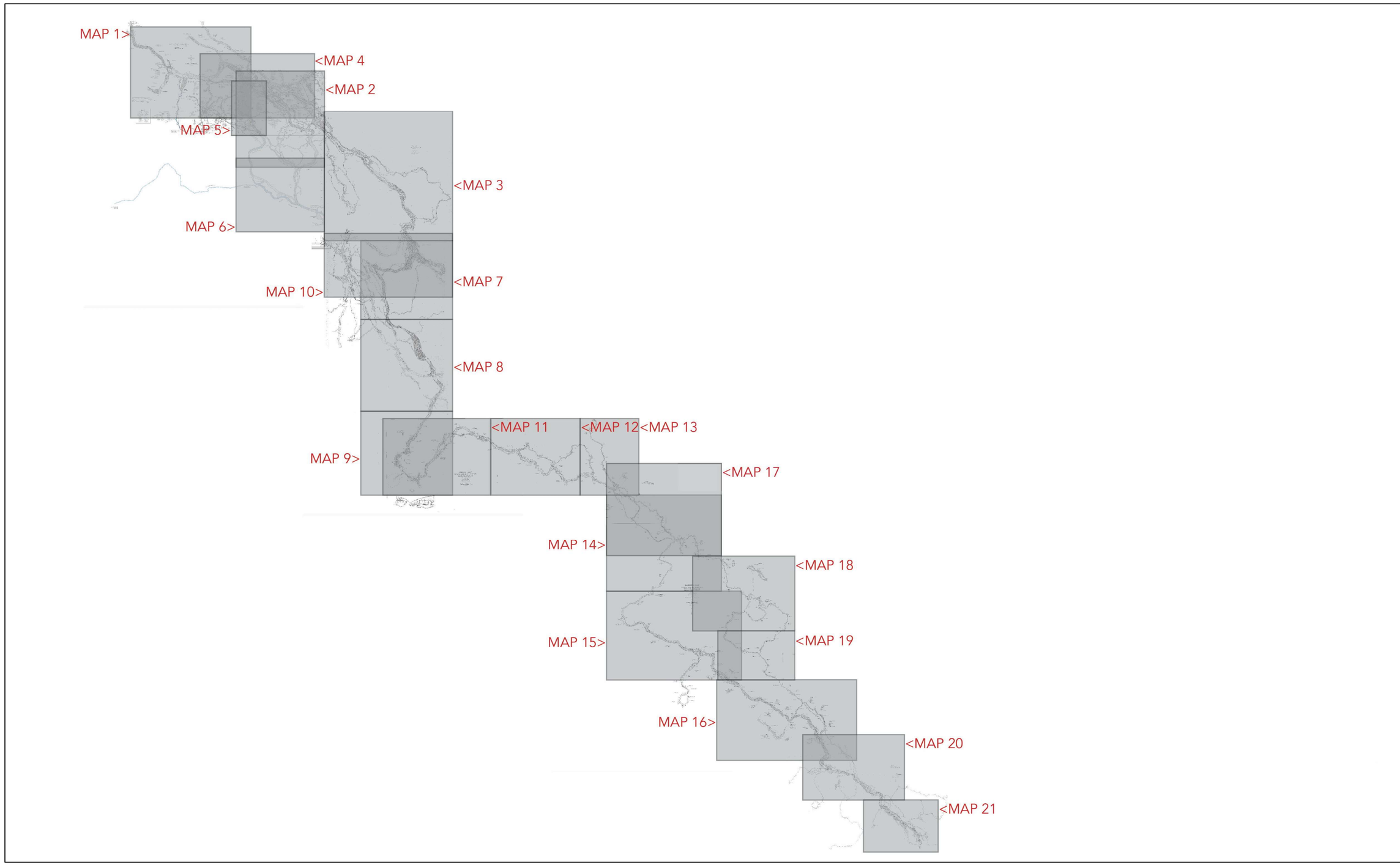

FIGURE 87. Diagram showing the configuration of passages within the western half of the Mammoth Cave Historic District. (Source: Cave Research Foundation, annotated by LSHLA)

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Section 1—Historic Cave Upper Level (Historic Entrance to "S" Bend at Main Cave)

(Refer to Figure 109 through Figure 111 that illustrate Section 1 at the end of this portion of the chapter)

Approach to the Historic Entrance. The Historic Entrance is approached by the Guide's Trail as well as an access road. Wood rail fencing and stone work edge the access road. Stone retaining walls, stairs, and drainage structures are associated with the base of the Guide's Trail, which was constructed by the CCC circa 1935–1941.

The historic district begins at the paved plaza that overlooks the descent into the cave (Figure 88). The plaza is concrete and edged by wood rail fencing, mortared stone walls that double as seating, a ramp with metal handrails, and a wayside exhibit. The plaza was developed during the Mission 66 period. A contemporary shoe cleansing station is located along the walk that visitors use to exit the plaza following their cave tour that is intended to prevent the spread of white nose syndrome, a fungal disease that affects bats.

FIGURE 88. Plaza overlooking the Historic Entrance into Mammoth Cave; the cave entrance is to the right, accessed via a flight of concrete stairs.

Historic Entrance. Concrete stairs edged by stone freestanding and retaining walls and metal handrails lead to the cave entrance (Figure 89). The concrete stairs and handrails were built circa 1990s and replaced Mission 66-era features. A large sinkhole that has been filled with debris from early nineteenth century saltpetre mining edge the stair to the north. At the base of the stair, a concrete walk edged by metal handrails (Figure 90) leads to a metal gate that limits access to the cave interior. The gate, added in 1990, consists of a door and an exit turnstile set in an open gridwork barrier that permits the free exchange and flow of air. Bats can also pass through the gate.

FIGURE 89. Concrete stairs connecting the plaza with the cave opening.

FIGURE 90. A concrete walk and metal handrails lead into the cave.

From the gate at the Historic Entrance, the passage that leads into Mammoth Cave is referred to as **Houchins Narrows** (originally the Narrows). This relatively narrow passage leads to a space known as the Rotunda where two additional passages can be reached—**Audubon Avenue**, and **Broadway**. Just past the gate, Houchins Narrows is surfaced briefly with cave soil. Utility features related to the electrical infrastructure are also located just inside the gate. The first cone lights appear to help illuminate the passage for visitors. Also located within Houchins Narrows is one of two ultrasonic anemometers placed in the cave in 2012 to

measure humidity and air flow. Within a short distance, the trail surface changes to hexagonal concrete pavers. These are edged by 18-inch-high lint guards topped by handrails. The lint guards protect the cave from dust, while the handrails prevent visitors from accessing the area to the south of the trail where hollowed logs, or saltpetre pipes, used to convey processed potassium nitrate during the early nineteenth century survive along the ground (Figure 91). Cone lights placed along the walk highlight these cultural resources. The park hides the wires for the lights and other utility cables that extend through the passage by covering them with rock and soil. The rock provides habitat for wood rats. Present within the side wall of the passage is a metal box that covers an opening established as a ventilation air shaft for the visitor center and hotel during the 1950s (Figure 92). The shaft is no longer in use. Nearby is a box of electrical switches and an electrical transformer.

FIGURE 91. The raised trail overlooking the saltpetre vats in the Rotunda.

FIGURE 92. Ventilation air shaft.

Rotunda (The Big Room). The Rotunda is a large, vaulted space located at the south end of Houchins' Narrows. The Rotunda is an example of a breakdown, formed when rock fell from the top of the opening to the cave floor in sufficient quantity that a large arched, stable, ceiling formed. The Rotunda contains extensive evidence of saltpetre mining conducted during the early nineteenth century, including oak and chestnut processing vats, and hollowed tulip poplar and oak log pipes (CRIS HS #07611) as conveyance systems, including saltpetre pipes, Leaching Vat #1 (CRIS HS #000887), Leaching Vat #2 (CRIS HS #005007), and Leaching Vat #3 (CRIS HS #005008), and the Rotunda Drain Tank (CRIS HS #005015).[294] These features are clustered within the center of the large open space of the Rotunda. Raised trails edged by stone walls lead to the north and west of the saltpetre relics. There are numerous sections of saltpetre pipes that range from 3 to 26 feet in length, with 2-inch diameters, found in the Rotunda. Some of the pipes are elevated on stone and wood supports, while others are located on the cave floor. The leaching vats are rectangular containers that measures approximately 9 to 12 feet in length and is 3 feet 6 inches tall. The walls of the container are of hand-hewn oak with hand-sawn poplar siding, built on mortise and tenon frames with hand-hewn vertical nailing studs. The vats rest on dry-laid stone walls. The Rotunda Drain Tank is a large wood collecting tank that measures approximately 10

294. In 2019, the LCS, CLI, ASMIS, and ERI databases were all combined into the NPS Cultural Resources Inventory System (CRIS). For historic structures, CRIS now refers to the LCS number as the Resource ID.

feet in width and is 3 feet tall. It was used to hold water in the leaching process. The saltpetre features date to 1810. Additional features are found in Broadway and Booth's Amphitheater.

The trail leading toward Broadway is surfaced with hexagonal pavers and edged by lint guards and metal handrails. It is set atop a raised area supported by a stacked stone wall (Figure 93.). A wayside exhibit titled "Salt-Petre Mining" is set along the trail. Cone lights provide illumination within the Rotunda. Also set within along the margin of the Rotunda is a pair of commemorative markers that recognize the contributions of local soldiers to World War I (Figure 94). These were installed circa 1922 and reset in 2018 following restoration by Harpers Ferry Center.[295] The monuments sit on piles of tailings, or cave dirt that was discarded following its use in the saltpetre mining operations.

From Rotunda, Audubon Avenue extends to the west and Broadway to the southeast.

FIGURE 93. Trail leading toward Broadway.

FIGURE 94. Commemorative markers recognizing local World War I soldiers.

Audubon Avenue (Big Bat Room, Hall of Audubon). Audubon Avenue extends to the west of the Rotunda as a trail surfaced with hexagonal pavers and edged by a cluster of wayside exhibits and artifact display cases. These interpret archeological features associated with American Indian use of the cave ("Evidence of Exploration"), geological processes resulting in "Cave Development," the role of water in the cave ("Connected"), historic era uses of the cave ("Unusual Cave Uses"), and the position of the passage at the edge between light and dark ("The Twilight Zone") at the start of Houchins Narrows. Beyond the exhibits, Audubon Avenue is gated for tour access only. The passage is a large upper-level trunk canyon that averages 60 feet in width and 30 feet in height with a sandy soil surfaced trail edged by placed rocks. The passage ends at a formation referred to as Olive's Bower, described with other features, below. Tall thin metal frame-supported atmospheric data stations occur periodically in the cave to measure humidity and air flow. One is located within Audubon Avenue.

The first feature encountered traveling west along Audubon Avenue is the opening in the south wall that provides access to a narrow south trending passage named **Little Bat Avenue**. Returning to Audubon Avenue past Little Bat Avenue, the trail expands and narrows again, edged by placed rock, as well as piles of breakdown, until the trail comes to Rafinesque Hall. **Rafinesque Hall** is a large open space to the south of Audubon Avenue. Just

295. Sources also indicate the date of origin as 1929.

past Rafinesque Hall is a space referred to as **Lookout Mountain**. Both contain a high concentration of breakdown. To the west of the Rafinesque Hall spur, the trail widens again before approaching the western wall terminus of Audubon Avenue that includes a dome known as **Bunker Hill**. At Bunker Hill, Audubon Avenue turns southwest. The trail is again a narrow passage edged by breakdown rock. Further along a low space edged by stacked rock walls and containing rectilinear soil beds, some edged by low rock walls, arises. This space is referred to as the **Mushroom Beds** for a former commercial mushroom growing enterprise represented by the soil beds (Figure 95). The trail passes between the beds to another pile of breakdown. Stone steps lead up a rise over top of the breakdown pile and lead to a narrow trail. Beyond the Mushroom Beds is **Vespertilio Hall**. Two named formations are present at the end of the passage—**Olive's Bower** and the **Sentinel**.

FIGURE 95. The Mushroom Beds, one of the most intriguing features located within Audubon Avenue.

Little Bat Avenue. This narrow passage extends south from Audubon Avenue for approximately 600 feet, connecting to Mammoth Dome. It is an upper-level canyon that measures approximately 20 feet in width and 12 feet in height. Along the route are the two formations—**Two Serpents** and **Little Pit**. The trail is surfaced with cave soil; rocks have been placed along the edge of the trail. Concrete stairs connect the passage level to the Mammoth Dome Tower. One of the atmospheric data stations used to measure air flow, and humidity is located within Little Bat Avenue.

- **Two Serpents. T**he Two Serpents are sinuous channels in the ceiling of Little Bat Avenue.
- **Little Pit.** Little Pit is a small domepit to the right at the end of Little Bat Avenue where stairs begin to lead down Mammoth Dome. Entered from a narrow crevice, the pit measures approximately 25 feet in depth and is 6 feet across.

(Audubon Avenue continued)

Rafinesque Hall

Located off Audubon Avenue, Rafinesque Hall is the continuation of the main Audubon Avenue canyon. Audubon Avenue as named follows a lower passage from here. Rafinesque Hall measures approximately 150 feet in length. The space ends in a massive valley-wall breakdown slope formed from stone fallen from the ceiling. The mass of stone is referred to as Lookout Mountain (see below). Within Rafinesque Hall is an example of a sediment cache left by ancient underground river movements. This sediment cache was used as a borrow pit by the CCC to collect fine silt deposits used to surface trails with cave soil from circa 1935-1941. One of the atmospheric data stations used to measure air flow and humidity is located within Rafinesque Hall.

Lookout Mountain (Dismal Hollow)

Rafinesque Hall terminates with the valley wall breakdown of Dismal Hollow at a 30-foot-tall pile of high angle, small-scale rubble. At the top of the pile there are some larger blocks. Water dripping from the roof has resulted in in some flowstone accumulation. There is a wooden platform situated in Rafinesque Hall which offers a wide view of Lookout Mountain.

Bunker Hill (First Chamber)

Located at the western end of Audubon Avenue is a shallow breakout dome referred to as Bunker Hill. The floor beneath the dome rises to form the hill featured in the name.

Mushroom Beds (CRIS HS #007610)

Located within the southwestern extension of Audubon Avenue are the remnants of a commercial mushroom growing enterprise established in 1882. The feature, referred to as the Mushroom Beds, includes six structures in.

Vespertilio Hall (Second Chamber, Bat Room)

Located within Audubon Avenue past the Mushroom Beds is Vespertilio Hall. It is edged by stacked stone walls and contains sediment deposits. One of the atmospheric data stations used to measure air flow and humidity is located within Vespertilio Hall.

The Sentinel (Lone Sentinel)

Located near Olive's Bower, the Sentinel is a lone stalactite that stands guard over the entrance to Olive's Bower. The large stalactite is surrounded by a group of smaller ones.

Olive's Bower (Pit of Stalactites)

Olive's Bower is a formation that occupies the terminal portion of the Audubon Avenue passage. The passage leading to Olive's Bower is northwest trending and raised above the space containing the Mushroom Beds. **Rock stairs and walls to Olive's Bower** (CRIS HS #007609) are associated with the trail in this section of Audubon Avenue. The walls are dry-laid limestone rubble built to clear a 40-yard-long path from the top of the stairs to Olive's Bower. The stair includes fourteen steps composed of limestone slabs that ascend approximately 10 feet in elevation. Olive's Bower is an 8-foot-high, 20-foot-wide dripstone formation, mostly desiccated (Figure 96). The largest stalactite in the formation is referred to as the Sentinel. The rear of the chamber has become extensively blackened with kerosene soot due to its popularity for tour groups since Olive's Bower is one of the most convenient of the smaller recesses in which stalactite formation may be seen in progress. Tree roots can be seen growing through the ceiling of Olive's Bower, and slight air flow can be felt within the space.

FIGURE 96. Olive's Bower.

Broadway (Great Gallery, Main Cave). Returning to the Rotunda intersection is Broadway, an upper-level canyon that extends southeast and is one of the primary routes associated with many park tours within the cave. The passage is named for Broadway in New York City. As defined herein, Broadway extends to the formation referred to as Booth's Amphitheater, which is associated with several saltpetre works, and is located at the intersection with **Gothic Avenue** and **Backslider's Alley** (Figure 97). The passage extends for approximately 1,000 feet and is generally wide—approximately 60 feet—and open. In addition to Gothic Avenue and Backslider's Alley, a vertical passage arises from Broadway known as the **Corkscrew**. There are several named formations within Broadway, including the **Kentucky Cliffs, the Pigeon Holes, Eagle's Nest, Methodist Church, the Pulpit, Booth's Amphitheater**, and **Tower Rock**.

FIGURE 97. Broadway trail and saltpetre vats.

The trail through this section of the cave is surfaced with hexagonal pavers, sometimes inset with concrete sections to prevent slipping of the

pavers, edged by lint guards and metal handrails. This trail was improved in 2017, replacing an earlier wooden deck or boardwalk and wooden handrails. Edging the trail are several relocated saltpetre pipes. Near Booth's Amphitheater, the trail includes an elevated catwalk and stair structure built in 2007 that replaced a wooden stair built during Mission 66 to protect the saltpetre beds.

Also located along the trail are large piles of tailings associated with saltpetre operations. Some of these piles are 10 feet tall, but even these have become compacted or deflated from years of visitors walking and climbing on them. One of the atmospheric data stations used to measure air flow and humidity is located within Broadway. One is located within Broadway. Cone lights illuminate the trail as well as some of the formations associated with the passage walls. Historic era signatures are present on the cave walls, including that of Ed Bishop. Bishop, the son of noted enslaved guide Stephen Bishop, became an important guide in his own right. There is an electrical transformer south of the trail that passes through Broadway.

Corkscrew. The Corkscrew is one of the few passable passages that links the upper cave to the lower passages within the historic cave area. It was used between the fourth quarter of the nineteenth century and the 1950s, with ladders and stairs helping to convey visitors through the trickier sections connecting upper and lower historic areas of the cave before the first stair was added at Mammoth Dome. It connects Broadway with the area of Vanderbilt Hall near the River Styx and was used traditionally by American Indians, as well as by nineteenth-century tour developers. A ladder was needed to reach the ground at the end of the Corkscrew. It is no longer used today after being abandoned in the 1950s due to the roughness of the passage. The Corkscrew also appears to have been used by bats and was a significant hibernation roost. It was due to the movement of bats into and out of the Corkscrew that led to its discovery circa 1837, and later exploration by nineteenth-century guide William Garvin circa 1871 led to a connection to Bandits Hall. Located within Corkscrew is an atmospheric data station. Victorian-era women's clothing has been recovered from the Corkscrew.

(Broadway continued)

- **Kentucky Cliffs (Cliffs of Kentucky, Kentucky River Cliffs).** Kentucky Cliffs refers to the high canyon walls of Broadway that resemble the cliffs along the Kentucky River at Highbridge, Kentucky. These are located between the Rotunda and Methodist Church.
- **Pigeon Holes (Pigeon Boxes).** The Pigeon Holes occur as a cluster of holes about 4 feet up the side of the wall in Broadway. These are solutional features or anastomosis channels. They are located between the Rotunda and Methodist Church.
- **Eagle's Nest.** Eagle's Nest is a feature named within Broadway for the suggestion of the wall form to an aerie. It is located west of Methodist Church.
- **Methodist Church (Cathedral, Church, Methodist Chapel, Sand Room).**[296] Methodist Church is a large alcove in the north wall of the Main Cave at Broadway where religious services were held during the mid-nineteenth century.
- **Pulpit Rock (The Pulpit).** Located in the Methodist Church along Broadway, Pulpit Rock is a large promontory on the walls of the alcove which forms the Methodist Church.
- **Booth's Amphitheater** (Booth's Theater, Gothic Gallery, Gothic Gate, Second City).[297] Booth's Amphitheater is a wide high space in Broadway at the intersection with Gothic Avenue that contains evidence of saltpetre mining. It is named for Edwin Booth, actor and brother of John Wilkes Booth, who used Tower Rock as a stage to give a recital of Hamlet's soliloquy. Located within the formation are several features associated with

296. *Mammoth Cave Gazetteer*, Methodist Church entry.

297. Ibid.

former saltpetre mining, including saltpetre pipes, Leaching Vat #1 (CRIS HS #005009), Leaching Vat #2 (LCS 005010), Leaching Vat #3 (CRIS HS #005011), Leaching Vat #4 (CRIS HS #005012), and Leaching Vat #6 (CRIS HS #005014). Leaching vat #5 is no longer extant. The leaching vats, which date to approximately 1810, are rectangular tanks between 9 and 12 feet long and 3 feet 6 inches tall, with hand-hewn oak and hand-sawn poplar walls built on mortise and tenon frames with hand-hewn vertical nailing studs. The vats rest on dry-laid stone walls approximately 16 to 20 inches thick and 18 inches to 2 feet in height. One of the atmospheric data stations used to measure air flow and humidity is located within Booth's Amphitheater.

- **Tower Rock.** Located at Booth's Amphitheater, Tower Rock is a prominence the overlooks Booth's Amphitheater that was used as a stage during Edwin Booth's Shakespearean recital of Hamlet's soliloquy.

Backslider's Alley (Gothic Gallery)

Backslider's Alley is located off Broadway opposite Gothic Avenue. It extends north of Broadway initially as a side open space and narrowing extensively. The name is an obvious reference to the Methodist Church, located not too far west along Broadway. Backslider's Alley and the Methodist Church (Archibald Avenue) appear to be disjointed fragments of the same passage.

Gothic Avenue (Gothic Galleries, Haunted Chambers, White Hall).

Gothic Avenue extends southeast from Broadway and the space known as Booth's Amphitheater. Named for the gothic appearance of some of its compartments, Gothic Avenue is a major upper-level trunk canyon that exhibits the character of the limestone bedding plain. It extends for approximately 2,200 feet to a breakdown near-choke at **Limitation Hill**. Gothic Avenue averages 50 feet in width and 12 feet in height. The walls feature massive deposits of dripstone, most old and inactive.[298] A single side passage extends from Gothic Avenue, which is referred to as **Elbow Crevice.** Stairs beyond Elbow Crevice lead to the cave's lower level and Gratz Avenue. Formations set within Gothic Avenue include **Seat of the Mummy, Register Hall, Post Oak Pillar, Dressed Turkey, Catacombs, Lava Beds, Hercules' Pillar, Caesar and Pompey, Gothic Chapel, Bridal Altar, Hornets Nests, Blacksmith's Shop, Napoleon's Breastworks, Loaded Camel, Jenny Lind's Armchair, Elephant's Heads, Lovers Leap,** Elbow Crevice, and Limitation Hill. Located within Gothic Avenue is one of two ultrasonic anemometers placed in the cave in 2012.

The trail that extends through Gothic Avenue is surfaced with CCC-era cave soil sometimes edged by rock. Steel stairs with FRP treads constructed in 2007 also extend into Gothic Avenue. A bench edges the trail near the stairs. There are transformer pads within the passage.

A rock wall edges the base of the Bridal Altar as well as Jenny Lind's Armchair to protect these formations from damage by the public. The rock wall at Bridal Altar was built circa 1933-1941 by the CCC (CRIS HS #007607). It is a semicircular, 21-foot 6-inch-long, irregularly coursed wall of limestone blocks that stands 2 feet in height. The rock wall at Jenny Lind's Armchair (CRIS HS #007604) was also built by the CCC circa 1933-1941. It, too, is semicircular in form. The wall measures 24 feet in length, by 1 foot in width, and 2 feet in height, and is composed of coursed limestone block and rubble some dry laid and some mortared in place.

Beyond Jenny Lind's Armchair near the end of Gothic Avenue is a single row, and then a cluster of benches edged by a curved rock wall etched with a date of 1953. The passage is marked at the end by another rock wall built by the CCC to block the passage where the ground drops away steeply. The wall is shaped like a question mark and measures 24 feet in length and is 2 feet tall. It is composed of limestone slabs mortared in place (CRIS HS #007603). Near the wall there are rock stairs that lead through Elbow Crevice (CRIS HS

298. *Mammoth Cave Gazetteer*, Gothic Avenue entry.

#007608). These may occupy an area excavated to support the work of the saltpetre operations in establishing passage through Gothic Avenue. The irregularly shaped limestone slab stairs are believed to date to the late nineteenth century, although the actual time frame is not currently known. Twenty-seven stairs remain of the original forty-five. The others were lost when a concrete stair was built adjacent to the older stair feature. The date of the concrete stair is undetermined, but it may pre-date the park due to the saw marks evident in association with the wooden formwork used to construct the stairs. Metal handrails are set in the stair.

There are also a large number of signatures on the walls and ceiling of Gothic Avenue, monuments, and walls in the passage (CRIS HS #007602). The number has been estimated at between 5,000 and 6,000, including that of nineteenth-century guide Stephen Bishop (Figure 98).

FIGURE 98. Signature of slave and cave guide Stephen Bishop.

To either side of the trail are piles of breakdown. On top of these are numerous rock cairns (Figure 99). There are stacked rock walls along the edge of the trail. There is also an atmospheric station in Gothic Avenue.

- **Seat of the Mummy (Mummy Hall, Mummy's Seat, Seats of the Mummies).** Located just beyond Booth's Amphitheater is a formation known as the Seat of the Mummy. It is the reported location of a discovery of two mummified bodies in an alcove or niche in the left wall. These individuals are in storage at the Smithsonian Institution's National Museum.

FIGURE 99. Rock walls, piles, cairns, and signatures associated with Gothic Avenue.

Register Hall (Register Chamber, Register Room, Register's Room, Registry Room(s)).

Register Hall is a section of Gothic Avenue, known for its profusion of historic signatures on its flat, smooth ceiling. The space also contains numerous stone "monuments" composed of stacked piles of loose rock, constructed by tourists and representing states, fraternal societies, and other groups and organizations.

- **Post Oak Pillar (Oak Pillar, Oak Tree, Post Oak Cavern).** Located at the east end of Register Hall, the Post Oak Pillar is a narrow, desiccated column, about 10 feet high, that resembles an oak tree.
- **Dressed Turkey.** Located within Gothic Avenue about 600 feet from Booth's Amphitheater is the Dressed Turkey, a stalactite about 2 feet long, wider at the bottom than the top, although the bottom appears to have been broken.
- **The Catacombs**. Located about 200 feet north of the Bridal Altar is the Catacombs, a small, recessed ledge on the wall divided into shallow partitions by a row of small, desiccated columns reminiscent of catacomb niches.
- **Lava Beds.** Located between the Catacombs and Hercules's Pillar, the Lava Beds are a formation reminiscent of volcanic flow due to a bank of blackened popcorn and flowstone.
- **Hercules Pillar (Hercules Pillar Grove, Pillar of Hercules).** Located along Gothic Avenue east of the Catacombs is Hercules Pillar, a massive stalagmitic column at the

center of the passage. The formation includes two columns that have become fused into one mass. Hercules Pillar measures 7 feet in height and is about 10 feet wide.

- **Caesar and Pompey (Caesar, Pompey and Caesar).** Located east of Hercules Pillar, Caesar and Pompey are twin dripstone columns on either side of the trail in Gothic Avenue, framing the Bridal Altar. The columns measure 10 feet in height; the northern thicker column is Caesar, while the southern more slender column is Pompey, according to Ganter postcards.

Gothic Chapel (Bridal Chamber, Chapel, Church, Gothic Avenue Chapel, Gothic Cathedral, Gothic Church, Stalagmite Hall, Wedding Room).

Forming the space around the Bridal Altar, the Gothic Chapel was the subject of the first Mammoth Cave photograph taken by Cincinnati photographer, Charles Waldack, in 1866.

- **Bridal Altar (Altar, Bridal Stand).** Located in Gothic Avenue just east of Caesar and Pompey is an unusual cluster of five dripstone columns that measure 9 to 10 feet in height and form a tight semicircle referred to as the Bridal Altar (Figure 100). The formation is framed by the twin columns of Caesar and Pompey. At the base of the formation is a stacked stone wall built to protect the formation.

FIGURE 100. The Bridal Altar.

- **Hornets Nests (Wasps Nests).** Located in Gothic Avenue beyond the Bridal Altar is a cluster of twelve robust stalactites about 2 feet long that extend for approximately 60 to 70 feet along the passage ceiling. They are considered to resemble a hornet's nest.

- **Blacksmith Shop (Devil's Blacksmith Shop, Vulcan's Furnace, Vulcan's Shop, Vulcan's Smithy, Vulcan's Workshop).** Located in Gothic Avenue between the Bridal Altar and Jenny Lind's Armchair is a pile of small, blackened, stumpy stalagmites referred to as the Blacksmith Shop. The cluster, which sits in the center of the passage, resembles the molten clinker of a forge.

- **Napoleon's Breastworks (Bonaparte's Breastwork, Napoleon's Fortresses).** Located along Gothic Avenue near Jenny Lind's Armchair are the Napoleon's Breastworks, a row of breakdown blocks that stand about 6 feet in height and extend in a line for a 100-foot-long stretch of the passage.

- **Jenny Lind's Armchair (Armchair, Devil's Armchair, Old Armchair, Wilkin's Armchair).** Jenny Lind's Armchair is a formation that resembles a seat (Figure 101). Jenny Lind was photographed sitting in the formation, and the photograph turned into a post card. A rock wall sits at the base of the formation to protect it. Near the formation is a sitting area with wooden benches. Beyond the wall is a CCC-era cave soil trail and two staircases.

FIGURE 101. Jenny Lind's Armchair and adjacent cluster of wooden benches.

- **Loaded Camel.** Located on the west side of Gothic Avenue just beyond Jenny Lind's Armchair is Loaded Camel, an irregular group of dripstone that measures 4 feet in length and 5 feet in height. Two narrow columns form the

legs while thicker columnar masses compose the body and head.

- **Elephant's Heads (Elephant's Trunk).** Located in Gothic Avenue immediately north of Lover's Leap, the Elephant's Heads is composed of three short, robust, coalesced stalactites forming a row on the left of the trail with an elephantine profile.
- **Lover's Leap.** Located in Gothic Avenue at Elbow Crevice is the original Mammoth Cave Lover's Leap. It a large, pointed rock projecting about 10 feet over a dark and gloomy hollow. It forms the end of the tour route within Gothic Avenue.
- **Elbow Crevice (Devil's Elbow, Elbow).** Located at the junction of Gothic and Gratz Avenues, the Elbow Crevice is a steeply descending open joint, about 40 feet deep, that curves sharply to the left as it exits Gothic Avenue. It is lit using electrical wiring that has been in place since 1935. Two flights of stairs lead down the crevice to Gratz Avenue (Figure 102) (see Section 2 below). One is stone, the other concrete (Figure 103).
- **Limitation Hill.** Also located at the end of the Gothic Avenue trunk is Limitation Hill, a breakdown pile that was once considered to block Gothic Avenue. It is possible to bypass Limitation Hill via a crawlway that provides access to an additional passage not included within the historic district.

FIGURE 102. Concrete stair leading down to Gratz Avenue from Elbow Crevice.

FIGURE 103. The older stone staircase has been replaced by the concrete stair.

Main Cave. Continuing east from Broadway at Booth's Amphitheater is Main Cave. This is the primary passage used by visitors to Mammoth Cave. It extends all the way the Violet City Entrance. Only a portion of Main Cave is addressed in Section 1, which, as mapped, extends as far as the "S" Bend near Wright's Rotunda. The remainder is addressed as part of Sections 3, 5, and 7 as part of this the CLR. As understood by nineteenth-century visitors, this main upper-level trunk canyon of western Mammoth Cave Ridge continued to Ultima Thule, an end point documented by Max Kaemper in 1908. Kaemper and guide Ed Bishop later excavated an opening in the wall at Ultima Thule that extended the passage to the entrance at Violet City (see Section 3 and Map 10).

Main Cave has been described as extending "like a deserted river-bed, through a succession of noble arches and domes," for about 2 miles. Culturally, Broadway was discussed above as a separate passage, but geologically it should be considered a section of Main Cave. Other sections that are identified by name but discussed as part of Main Cave below include **Proctor's Arcade** and **Kinney's Arena**. There are also several named features within this section of Main Cave, including (from west to east): **Ball Room, Standing Rocks, Wandering Willie Spring, Water Clock, Martha Washington's Statue, Figured Ceiling, the Anteater, Giant's Coffin, Acute Angle, Giant, Wife and Child, Star Chamber, Snow Room, the Whale, Devil's Looking Glass, and S Bend.** Passages that extend off of Main Cave include (from west to east):

Cyclops Gateway, Dante's Gateway, and Harvey Avenue.

Portions of Main Cave are paved with hexagonal pavers edged by lint guards and retained on slopes by periodic concrete thresholds, while other sections are CCC-era cave soil. The pavers were added in 2007. High visitation through this section of the cave has created dense cave dust that rises into the air and coats the cave walls and rocks on the passage floor. Cave tours are controlled using fence and gate features. One of these is located within Main Cave in association with access to Dante's Gateway. American Indian artifacts observed within this section of the cave include evidence of gypsum mining, gourds, sunflower heads, and a wooden climbing pole.

- **Ball Room.** Ball Room is located in Main Cave just east of the junction with Gothic Avenue. It is a space that historically was considered well suited to having a band and dances. No historical reference could confirm such activities ever occurred at this location.
- **Standing Rocks** (Sail-Boat, Standing Rock). Standing Rocks is a set of four breakdown slabs that measure about 7 feet high. The rocks lean on edge against each other along the trail between Booth's Amphitheater and Wandering Willie Spring. Screened behind the formation is an electrical transformer. The rock also contains pre-Contact rock art, historic signatures, and a portrait. One of the atmospheric data stations used to measure air flow and humidity is located within Standing Rocks.
- **Wandering Willie Spring** (The Spring, Willie's Spring). This named formation is found in Main Cave about 400 feet east of Booth's Amphitheater. It is a fluted niche that occurs in the north wall, formed from the regular flow of water trickling into a shallow pool on the floor of the passage. The niche is a small solutional half-dome, 15 feet high.
- **Water Clock** (The Clock, The Timepiece, Water Clocks, The Well, Well Cave). Located just west of Cyclops Gateway, the Water Clock is an active, solutional domepit in the north wall of Main Cave. The pit extends to about 20 feet below trail level, and feeds Richardson's Spring in Black Snake Avenue directly below. During drier periods, water enters the pit in a steady, metronomic drip. With rains, the stream becomes continuous, and the clock effect ceases.

Cyclops Gateway (Horn Room, Rocky Cave, Rocky Hall).

Cyclops Gateway extends north from Main Cave as a dead-end side passage about 400 feet long. At 40 feet, the passage is relatively tall (Figure 104). This is the passage where Lost John, a mummified body discovered in the cave, was displayed to the visiting public for many years in a glass case. The case is still in the passage, although the body has been relocated. There is evidence that this passage was mined for saltpetre.

FIGURE 104. Cyclops Gateway.

(Main Cave continued)

- **Martha Washington's Statue (The Statue, Statue of Martha Washington, The Woman in White).** Located in the Main Cave, this named formation appears as a backlighted silhouette reminiscent of a profile of Martha Washington when viewed from just east of Cyclops Gateway. It is formed by the walls of Main Cave at a bend 400 feet to the west. The park lights the formation for effect.

- **Giant's Coffin (Coffin, Great Sepulchre, Steamboat).** Located in Main Cave at Dante's Gateway, Giant's Coffin (Figure 105) is a large breakdown block that partly hides the entrance into **Dante's Gateway**, which leads to the Wooden Bowl Room.

Dante's Gateway

Dante's Gateway is a passage that extends between Main Cave and the **Wooden Bowl Room**. The series of passages located beyond Dante's Gateway provide a connection between the upper and lower historic cave tour routes. Many of the park tours follow this route. The feature is named from Dante's *Divine Comedy* and refers to the gateway to hell.

FIGURE 105. Giant's Coffin.

FIGURE 106. Stairs leading to Gratz Avenue from the Wooden Bowl Room.

- **Wooden Bowl Room (Vestibule of the Deserted Chambers, Wooden Bowl Cave or Chamber).** This large, circular room features an 8-foot-high ceiling and a floor of red silt. The room forms the junction of four passages—Dante's Gateway, **Lost Avenue**, Ganter Avenue, and (via the Steps of Time, Figure 106) Black Snake Avenue (see Section 2).

Lost Avenue (Harvey Avenue, Harvey's Lost Way, Lost Way Found)

Lost Avenue is a 2-foot-high, 15-foot-wide sandy-floored tube about 400 feet long that leads from the Wooden Bowl Room to **Harvey Avenue**.

Harvey Avenue (Harvey's Avenue, Harvey's Lost Way, Lost Avenue, Sick Room).

Harvey Avenue is a major side passage, approximately 1,700 feet long, that arises from Main Cave directly opposite the **Acute Angle**. It trends eastwards as a 4- to 5-foot-high, 15- to 20-foot-wide tube. A former connection to Main Cave near Booth's Amphitheater is now blocked at the Main Cave floor. Harvey Avenue also connects to Wilson's Way (see Section 2). Just inside the passage is a mortared limestone rubble wall used to limit access to the passage during the era of self-guided tours in the 1970s.

(Main Cave continued)

- **Acute Angle (Great Bend).** This sharp bend within Main Cave occurs near the junction with Harvey's Avenue.

Two stone cottage structures referred to as Consumptive Hut #1 (CRIS HS #000888) and Consumptive Hut #2 (CRIS HS #005019) (Figure 107) are located within Main Cave between Acute Angle and Star Chamber. These structures were built in 1842–1843 by cave owner Dr. John Croghan as office and dining hall facilities supporting his experimental treatment of tuberculosis. Hut #1 is approximately 7 to 8 feet tall with a front façade that measures 17 feet. The cave wall serves as the rear wall while the other walls are dry-laid limestone blocks. The hut has unglazed wood frame window and door openings and plank flooring. Hut #2 measures 16 by 20 feet 6 inches in plan and is 8 feet high. Also built of dry-laid limestone blocks, Hut #2 has one framed doorway and a partially collapsed wall. Tuberculosis patients were housed within the cave

elsewhere in wooden structures that no longer exist.

FIGURE 107. View of Consumptive Hut #1.

Star Chamber (Chamber of Stars, Star Cavern, Starry Chamber).

This room was a featured destination of nineteenth-century tours. Guides staged shows in Star Chamber involving lights depicting day and night and lighting the ceiling to illuminate the starry appearance. The Star Chamber ceiling stands about 35 feet in height. There are two rows of benches for visitors located in Star Chamber.

The Side Cuts (leading to Indian Avenue and Ganter Avenue). A side cut is a generic term for a passage that leaves and later rejoins the main passage. Three of these features comprise the Side Cuts formation—one at Star Chamber that leads to Indian Avenue and Ganter Avenue; a second being Proctor's Arcade; and the third at the Snow Room. The Side Cuts are passages that are lower in elevation than Main Cave. The ceiling is generally wavy with sweeping arches and covered with black incrustations.[299]

Proctor's Arcade

Proctor's Arcade is a side cut along Main Cave between Star Chamber and the **Snow Room**. The space is exceptionally tall and the passage uniform, with a relatively smooth ceiling and vertical walls. Set within the space is the **Snow Room** and the **Whale**. The terminus of the space is **Kinney's Arena**.

FIGURE 108. The Snow Room.

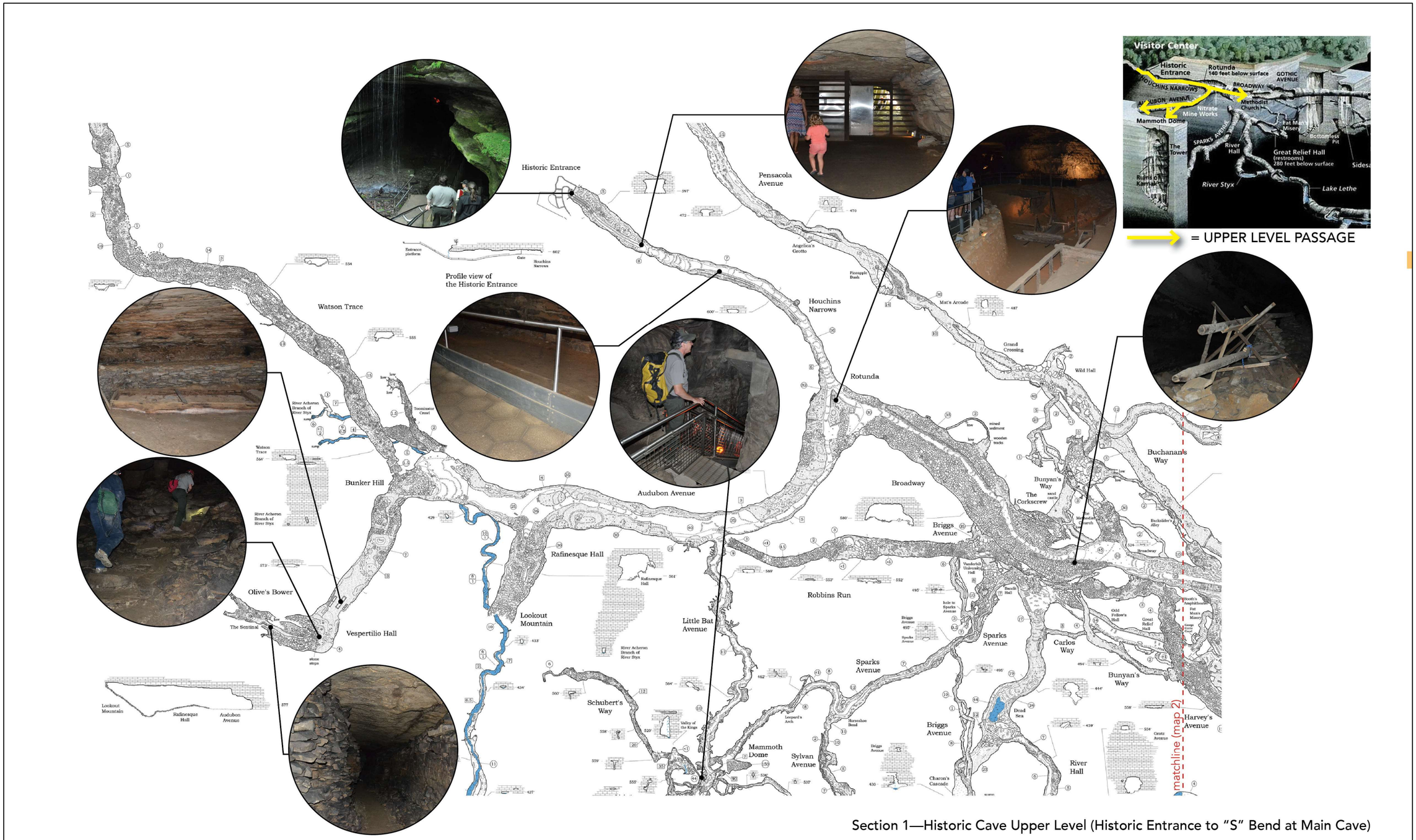
Snow Room (Salts Room, Snow Chamber). The Snow Room is a large space located between Proctor's Arcade and Kinney's Arena (Figure 108). This space is a large breakdown section of Main Cave. The breakdown slabs are covered with crystalline materials including gypsum and mirabilite, a hydrous sodium sulfate mineral that forms when sodium sulfate brines evaporate, that have the appearance of snow.

- **The Whale.** Located within Main Cave between the Snow Room and Kinney's Arena, the Whale is a 70-foot-long rock.
- **Kinney's Arena.** Kinney's Arena is the terminal feature of Proctor's Arcade. It is a large, uniform stretch of the cave that measures approximately 250 feet in length, 60 feet in width, and 40 feet in height.
- **The Devil's Looking Glass (Devil's Blackboard).** Located in Main Cave between Kinney's Arena and the S Bend, the Devil's Looking Glass is a thin, flat slab about 7 feet high by 6 feet wide. The rock is standing on its edge along the trail. One side is light tan, the other dark gray. The dark side contains aboriginal inscriptions, in the form of a zigzag line and several curves, dashes, and a horned figure. Many historic signatures cover both sides, partly obscuring the pre-Contact drawings.

299. *Mammoth Cave Gazetteer*, Side Cuts entry.

S Bend (Double S, Sigma Bend).

This part of Main Cave is comprised of a long sweeping meander.



Section 1—Historic Cave Upper Level (Historic Entrance to "S" Bend at Main Cave)

FIGURE 109. Map 1 showing a portion of Section 1, Historic Cave Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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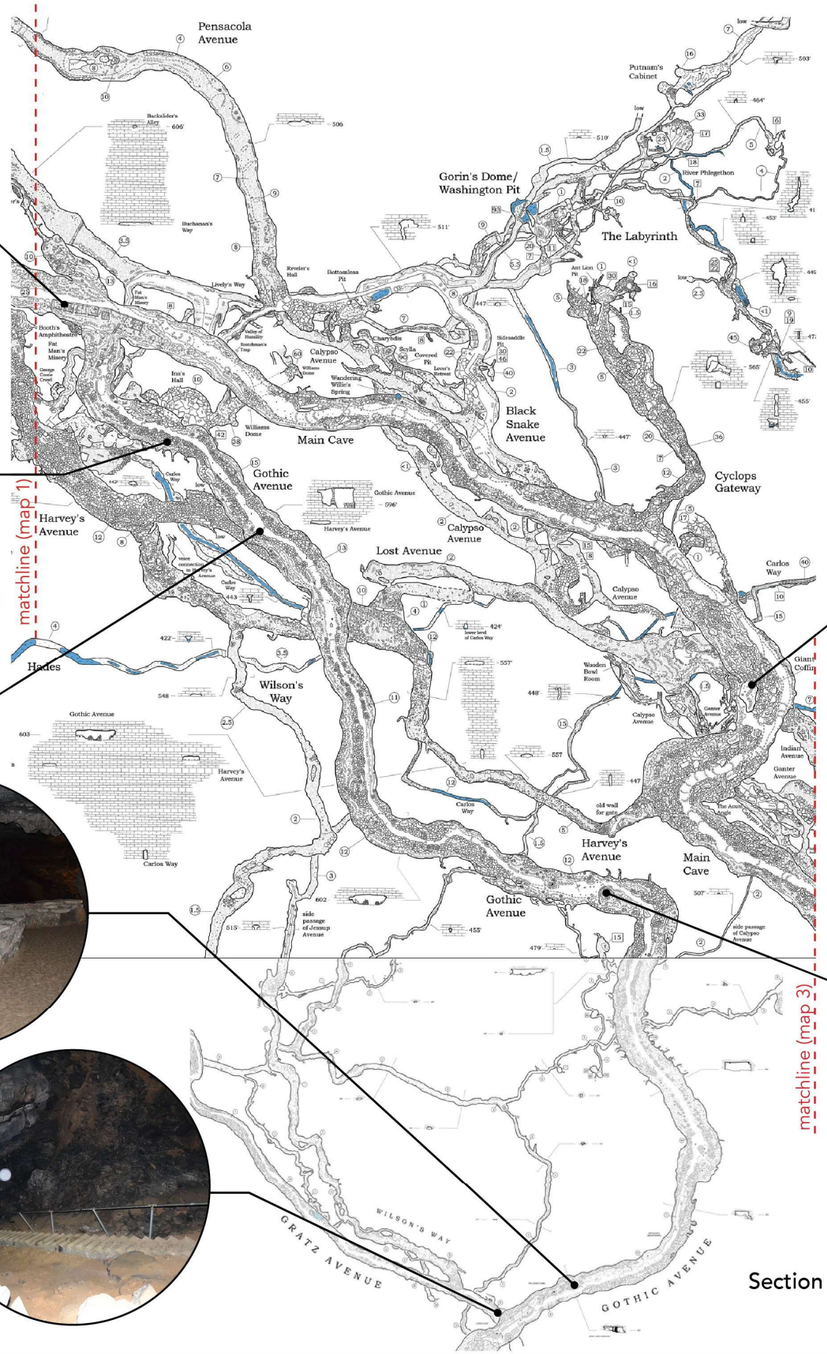

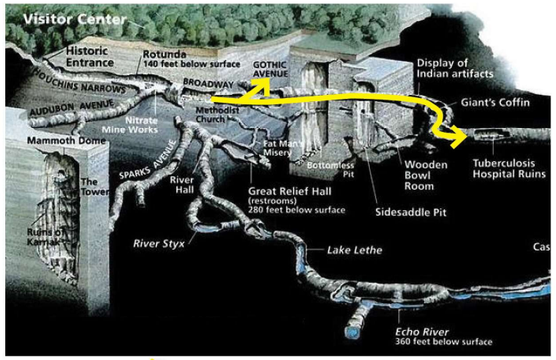

= UPPER LEVEL PASSAGE

Section 1—Historic Cave Upper Level (Historic Entrance to "S" Bend at Main Cave)

FIGURE 110. Map 2 showing a portion of Section 1, Historic Cave Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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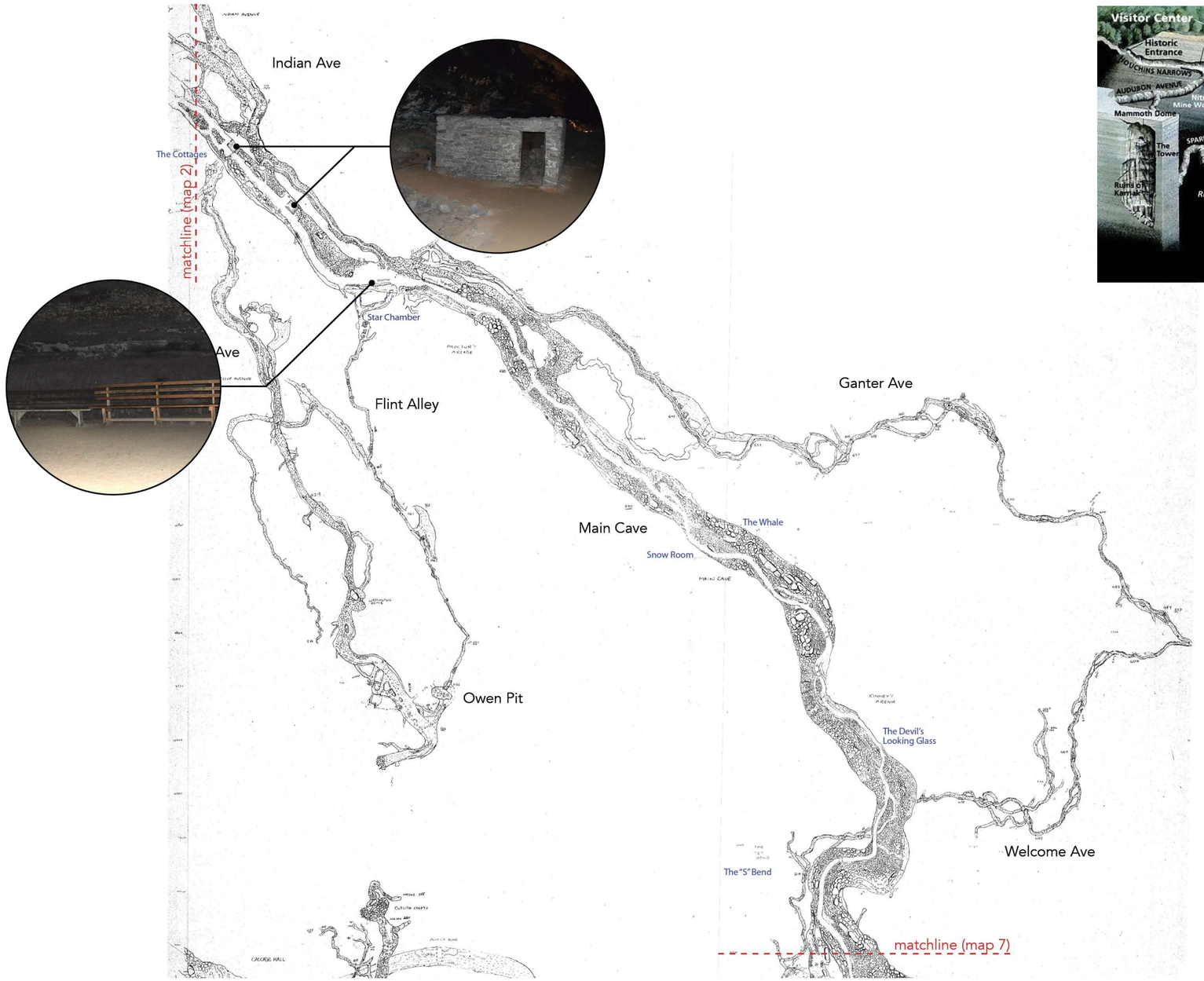

Section 1—Historic Cave Upper Level (Historic Entrance to "S" Bend at Main Cave)

FIGURE 111. Map 3 showing a portion of Section 1, Historic Cave Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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Section 2—Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)

Refer to Figure 125 through Figure 127 that relate to Section 2 at the end of this portion of the chapter

The lower cave passages beneath the historic cave comprise the Lower Historic Cave. Several routes connect the Upper and Lower parts of the Historic Cave. These include Black Snake Avenue from Wooden Bowl Room, Gratz Avenue from Gothic Avenue, and the stair tower in Mammoth Dome connected with Little Bat Avenue (refer to Section 1).

Black Snake Avenue (Arched Way, Bottomless Pit Branch, Ganter Avenue). The Steps of Time that extend from the Wooden Bowl Room lead to Black Snake Avenue. This circulation feature is composed of twenty-seven concrete steps edged by 2-inch diameter double pipe metal handrails on one side, and at the base.

The passage is a medium-sized tube, about 800 feet long that leads to Bottomless Pit. Portions of the passage are referred to as **Deserted Chambers**. Arising from the passage are several side routes. From east to west these passages include **Payne's Path, Calypso Avenue, Lover's Retreat,** and **Darnall's Way.** Named features include the **Owl Room, Richardson's Spring, Side Saddle Pit, Bottomless Pit**, and **Covered Way**. The passage is named for its serpentine-shaped windings and was originally known as Ganter Avenue. Portions of the trail through Black Snake Avenue are paved with concrete (Figure 112) and sometimes edged by placed rock or metal handrails and guardrails.

FIGURE 112. Concrete walk extending through Black Snake Avenue.

Deserted Chambers (Black Snake Avenue, Deserted Chamber). This is a generic term for the rooms and passages followed by the Historic Tour from the Wooden Bowl Room, through Black Snake Avenue to Bottomless Pit.

Owl Room (Little Owl Room)

Located within the Deserted Chambers, this space is a circular room about 30 feet wide by 12 feet high. It is the first room below the Wooden Bowl Room, and the Historic Tour trail passes through it. A one-foot-high flat piece of breakdown propped up on a ledge has a supposedly owl-like profile with marks representing eyes and a beak.

Richardson's Spring

Located along Black Snake Avenue between Owl Room and Payne's Path, Richardson's Spring is a basin of water that comes from a tiny undercut in the wall into a small concrete catchment basin (Figure 113). The overflow quickly sinks in rubble. The spring is fed by the Water Clock pit in Broadway, directly above.

FIGURE 113. The small concrete catchment basin associated with Richardson's Spring.

Payne's Path.

Payne's Path is a 6-foot-high tube, 150 feet long, forming a closely parallel side cut to Black Snake Avenue that connects to the larger passage at several points.

Lover's Retreat (Lover Avenue).

Two passages branch off the trail, which is part of the Historic Tour, in Black Snake Avenue, and unite after 100 feet at Lover's Retreat, a small sand-floored room, 3 feet high. The left route is a hands and knees crawl; the right route is high enough to walk through. These are located near Calypso Avenue.

Calypso Avenue. Calypso Avenue extends between Black Snake Avenue and **Scylla and Charybdis**. The passage is a low crouchway, averaging 20 feet in width. It leads to a series of pits including **Covered Pit**, Scylla and Charybdis, and **Bottomless Pit**, and in fact, provides a safe and technically easy route to the far side of the latter, somewhat calling into question the legend of the hazardous first crossing of Bottomless Pit on a cedar pole. The entry from the floor of Black Snake Avenue is mostly walled off, leaving only a small gap, but it would have been conspicuous prior to building the wall. In Greek mythology, Calypso was a nymph, daughter of Atlas and the captor and consort of Odysseus. Calypso means something like "hidden" or "hider"—perhaps suggesting it as the hidden route to beyond Bottomless Pit.[300]

- **Covered Pit**. Located along Calypso Avenue, Covered Pit is 12 to 15 feet in diameter and mostly covered by a thin rock. A narrow crevice extends around the edge of the thin rock, supported by ground by a small point on one side. A large rock rests on the center of the cover. A waterfall can be heard from the pit, but not seen.
- **Scylla**. Located along Calypso Avenue, Scylla is part of the same migrated canyon as Covered Pit. Scylla pit includes an initial drop of about 30 feet, and a second drop that reaches a total depth of about 100 feet. There is a narrow neck between Scylla and the adjacent pit Charybdis that can be traversed with a belly crawl.
- **Charybdis**. Located adjacent to Scylla, Charybdis pit is also barely separated from Bottomless Pit, to which it is connected part way down.

(Black Snake Avenue continued)

- **Side Saddle Pit.** Located along Black Snake Avenue, Side Saddle Pit is a 40-foot deep occasionally active solutional pit along the Historic Tour that named for its resemblance to a lady's saddle. Visitors cross Side Saddle Pit via a metal grate catwalk edged by 2-inch diameter stainless steel railings. Handrails also edge the trail as it follows the edge of the pit.
- **Bottomless Pit (Bottomless Well).** Located at the end of Blacksnake Avenue, Bottomless Pit (Figure 114) is a large active domepit and canyon about 110 feet deep.[301] For many years Bottomless Pit presented a challenge for continuing in the cave until a structure was added to span the opening in 1843. Today, a steel grate bridge structure edged by stainless steel railings inset with metal mesh panels crosses the pit. A routed wood sign is attached

300. *Mammoth Cave Gazetteer*, Calypso Avenue entry.

301. *Mammoth Cave Gazetteer*, Bottomless Pit entry. The entry does not indicate the diameter of Bottomless Pit.

to the metal railing on the structure across the pit (Figure 115). The trail connecting Side Saddle and Bottomless Pits is edged in places by stainless steel metal railings inset with mesh panels. A segment of the trail east of the steel grate structure is paved with concrete to ensure safe footing.

FIGURE 114. Bottomless Pit.

FIGURE 115. The metal guard rail and sign at Bottomless Pit.

- **Covered Way.** Covered Way is a deep trench located between Bottomless Pit and Darnall's Way, partially covered in one spot by breakdown block. The trench leads into the **Labyrinth** via Darnall's Way.

Darnall's Way

Extending northeast from Black Snake Avenue just past Bottomless Pit is Darnall's Way. This passage extends to **Gorin's Dome** and beyond to the **Window**. At the base of Gorin's Dome is **Garvin's** or **Washington's Pit**.[302]

Gorin's Dome (Goran Dome, Goran's Dome, Goram's Dome, Gorin Dome, Goring Dome, Gorius Dome, Grand Dome).

Located along Darnall's Way, Gorin's Dome is a large solutional domepit, among the most impressive in the cave, that is 105 feet in depth from the level of the bridge.[303] It is not currently featured on any of the cave tours. A rather decrepit wooden footbridge crosses one arm of the domepit.

Garvin's or Washington's Pit. Located below Gorin's Dome is a pit referred to as Garvin's or Washington's Pit. It is connected to a passage known as William Garvin's Way. Water pools at the bottom of the pit. The pit is 95 feet deep with a 35-foot dome above.

The Window. The Window, which opens onto Gorin's Dome, is said to have been used by guides to light up the dome. It is an overlook at the far side of the dome from the passage used by visitors, accessible from a ledge along the edge of Gorin's Dome.

William Garvin's Way (Garvin Way)

This passage branches off Garvin's Pit. It is a low-level passage that extends beyond Bottomless Pit to Carlos Way near River Hall.

The Labyrinth (Winding Labyrinth)

Also extending north from the area around Bottomless Pit is the Labyrinth. Named features associated with the Labyrinth include **Louisa's Dome** and **Putnam's Cabinet**. The name is attributed to the winding character of the passage. A side passage, the **Ramble**, extends from the Labyrinth.

- **Louisa's Dome**. Located through an opening in the wall of Labyrinth is a passage that

302. *Mammoth Cave Gazetteer*, Darnall's Way entry.

303. *Mammoth Cave Gazetteer*, Gorin's Dome entry. The entry does not indicate the diameter or depth of the domepit.

extends to the cave above and 20 feet beyond to Louisa's Dome. Louisa's Dome comprises two adjoining domes separated by a saddle, each about 25 feet high by 15 to 20 feet wide.

- **Putnam's Cabinet.** Located between the Labyrinth and the Ramble, Putnam's Cabinet is a small dome that features a concretion type referred to as cave pearls. Also associated with the formation is fine quality alabaster and oolitic limestone.

The Ramble (Hovey's Ramble, Ray's Hall)

This 300-foot-long fragment of a larger passage is entered from the Labyrinth and extends to Ariadne's Grotto.

- **Ariadne's Grotto.** Located in the Ramble, Ariadne's Grotto is the terminal feature of this passage.

(Black Snake Avenue continued)

Reveller's Hall (Revelers Chamber, Deville's Hall)

Reveller's Hall is located along the southwestern end of Black Snake Avenue beyond Bottomless Pit near the junction with Pensacola **Avenue** and the **Valley of Humility**. The Historic Tour passes through this space. The room is about 20 feet high by 30 feet wide, with a breakdown pile occupying one side.

Pensacola Avenue (Pensicola Avenue, Pensico Avenue)

Pensacola Avenue branches off Black Snake Avenue at Reveller's Hall. The passage begins as a large tube, later transitioning to a magnificent trunk tube with incised canyon at the point where **Bunyan's Way** enters. Pensacola Avenue is 2,200 feet long. It ends at a flowstone choke. Named features include the **Sea Turtle, Echo Chamber, Wild Hall, Snowball Arched Way, Grand Crossing, Mat's Arcade, the Pineapple Bush,** and **Angelica's Grotto**. The passage is said to have been named for the dry and sandy floor that was reminiscent of the city in Florida.[304]

- **Sea Turtle.** Located near the beginning of Pensacola Avenue, Sea Turtle is a rock, or large isolation block, approximately 30 feet in diameter that has fallen from the ceiling and nearly blocks the entrance to the passage. It contains a notable Stephen and Charlotte Bishop inscription.
- **Echo Chamber** (Resonator Hall). Located along Pensacola Avenue near the junction with Bunyan's Way, Echo Chamber is described historically as a space where vibrations could be heard.

Bunyan's Way

Bunyan's Way extends approximately 900 feet from Pensacola Avenue and heads south to **Great Relief Hall.** Bunyan's Way first passes over Great Relief Hall before descending to enter the space a short distance from **Fat Man's Misery.** The junction at Great Relief Hall is partially obstructed by concrete restroom buildings. Named features include **Ina's Hall**. The passage was most likely named for the author of *Pilgrim's Progress*, John Bunyan.

- **Ina's Hall.** This is a wide room covered in breakdown and reached by an ascending rubble slope behind Great Relief Hall. It is possible to reach the top of William's Dome from a passage that extends from the space.

(Pensacola Avenue continued)

- **Wild Hall**. Located in Pensacola Avenue beyond the Bunyan's Way Junction, Wild Hall is similar in size and appearance to Bandit Hall, with many large rocks strewn around the interior under a roof of elaborate lancet arches.
- **Snowball Arched Way** (Snowball Arch, Snow Ball Chamber). Located along Pensacola Avenue just at the junction with Grand Crossing, this formation is a narrow crevice

304. *Mammoth Cave Gazetteer*, Pensacola Avenue entry.

that leads to Snowball Arch, the ceiling of which is encrusted with white gypsum. This is the lower level tube, 12 feet high, 10 feet wide, between the two crossings of the large upper canyon (Mat's Arcade) in Pensacola Avenue.

- **Grand Crossing**. Located in Pensacola Avenue between Wild Hall and Angelica's Grotto, Grand Crossing is a large upper loop that crosses and recrosses the large lower passage.
- **Mat's Arcade.** Located in Pensacola Avenue between Grand Crossing and Angelica's Grotto is Mat's Arcade. This formation is approximately 150 feet long, 30 feet wide, and 60 feet high. There are four terraces between the floor and the ceiling. The Pineapple Bush is set within one of the terraces.
- **The Pineapple Bush**. Located in Pensacola Avenue at the far end of Mat's Arcade, Pineapple Bush is a large mound of nodular dripstone perched on a high ledge at the junction of the upper and lower levels of the passage.
- **Angelica's Grotto**. Located in Pensacola Avenue beyond the Pineapple Bush, Angelica's Grotto is a cross-joint about 20 feet high in the ceiling of the upper level in Mat's Arcade. A cluster of nodular stalactites 3 to 4 feet long descend from the center of the ceiling.

Valley of Humility (Humility Road, Vale of Humility, Valley of Humiliation)

Valley of Humility is a passage that arises from Pensacola Avenue between Reveller's Hall and **Scotchman's Trap**, the Valley of Humility is a small, irregularly arched tube, through which it is necessary to crouch for a short distance. The floor appears to have been lowered to enhance the passage for tourism.

Scotchman's Trap

Located between the Valley of Humility and Fat Man's Misery, Scotchman's Trap descends beneath these popular formations via a flight of stone stairs. It is a narrow circular opening that passes beneath a suspended rock. Although the block of rock is in no danger of moving, it is disconcerting. A side passage crawl at the top of the space leads to William's Dome.

- **William's Dome.** Located near Scotchman's Trap, William's Dome is a 60-foot-high, 30-foot-wide migrated canyon with a floor of sloping rubble. The bottom of the dome is entered by a narrow descending canyon of the Valley of Humility. The top of the dome can be reached from Ina's Hall, off Great Relief Hall.

Buchanan's Way

This passage extends 500 feet from the bottom of Scotchman's Trap. It is a wide, arched tube with a floor of red silt. The Historic Tour follows its western end for 80 feet before branching off into Fat Man's Misery. It extends below Pensacola Avenue.

Lively's Pass (Lively Avenue)

Lively's Pass is a tubular, dirt-floored passage, about 10 feet wide by 9 feet high, that branches off Buchanan's Way. It is part of the Historic Tour. It leads to an overlook partway down Bottomless Pit. The passage continues past Bottomless Pit via an exposed traverse.

Grecian Bend (Grecian Bend Avenue)

This passage extends between Scotchman's Trap and Fat Man's Misery. It is part of the Historic Tour.

Fat Man's Misery (Fat Man's Hell, Winding Way). Located between Buchanan's Way and Great Relief Hall, Fat Man's Misery is a highlight of the Historic Tour. It is reached from Bottomless Pit via a trail that is variously paved with cave soil and concrete. Before reaching Fat Man's Misery, the trail follows a stair downward that turns sharply to form a 90-degree angle, and then turns again. The stair is edged by a metal handrail. A small, routed wood sign announces the formation (Figure 116). Fat Man's Misery sits within a small canyon, 6 feet high, with a deep, narrow, meandering trench in the floor surfaced with cave soil. For about 100 feet, the passage is constricted

going due to the proximity of the walls both to either side and overhead. The ceiling is higher through the section referred to as Tall Man's Misery, which occurs near the end of the meandering trench.

FIGURE 116. Fat Man's Misery sign.

Great Relief Hall (Clay's Cave, Hall of Great Relief, Happy Relief)

Great Relief follows Fat Man's Misery, and it was named for the sudden ability of visitors to move about more freely. This room is 30 feet wide and 10 feet high. A concrete stair edged by a stone wall leads into the hall. The space features the Great Relief Restroom building constructed in 1953 (Figure 117). The Great Relief Restrooms includes men's and women's restroom, equipped with six toilets and two sinks all made by American Standard®. It measures 18 feet 6 inches by 29 feet by 8 inches. The walls are mortared limestone blocks. A double-door opening is in the middle of the principal façade, a single door opens into each space. A storage space is in the rear of the building. which is connected to a sewage lift station located opposite the entryway. Behind the building is a sewage lift station. Past the restroom building the trail is edged by a stone wall. Outside the building is a row of stone and concrete benches. The trail around the restrooms and benches is paved with hexagonal pavers edged by lint guards (Figure 118). Great Relief Hall gives way to Odd Fellows Hall.

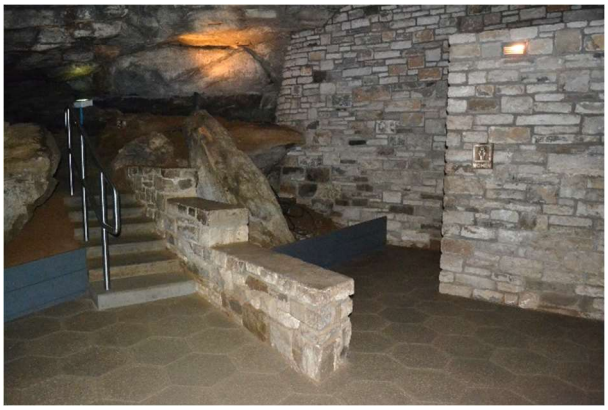

FIGURE 117. Great Relief Restrooms.

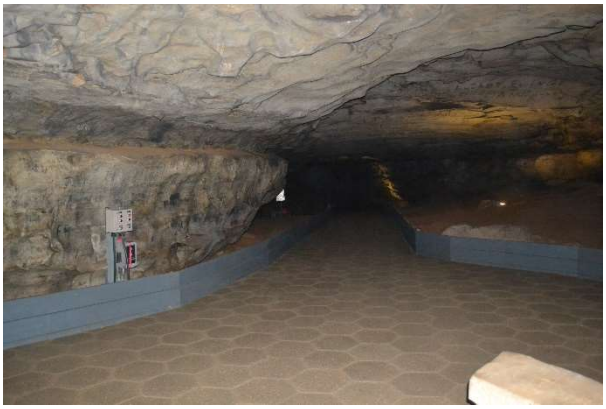

FIGURE 118. Path leading toward River Styx.

Odd Fellows Hall

Located between Great Relief and River Hall, Odd Fellows Hall is the continuation westward of Great Relief Hall. The passage is a large, rectangular canyon about 200 feet long. Chert concretions on the ceiling supposedly resemble the Odd Fellows Links. Other chert concretions are named for the Ohio and Mississippi Rivers. A concrete stair composed of 18 steps leads down into River Hall from the passage west of Odd Fellows Hall.

River Hall (River Avenue)

River Hall is located between Bandit's Hall and Echo River. It is a large, austere room east of and below Bandit Hall. River Hall contains rows of metal benches for visitors to sit on while their tour guides provide information about this area of the cave (Figure 119). A flight of twenty-three concrete stairs, within a single landing, connects River and Bandit Halls. The stairs are edged by stainless steel handrails. Located in the rock adjacent to and west of the stairs are a series of

high-water markers composed of 2-inch brass disks. These mark flood waters documented in 1937 and 1982. River gauge features are located to the east of the stairs.

FIGURE 119. Rows of benches in River Hall.

Bacon Chamber (Bacon Ham Chamber, Bacon Room, Meat Room, Smoke House, Witches' Hams)

Bacon Chamber is located in River Hall near Bandit's Hall. It is a room below the River Hall and Bandit's Hall junction that is partially separated off by a stone wall. The room measures 25 feet across and 6 feet in height. The small masses of rock that project from the ceiling have the appearance of bacon hams. This is a splendid example of an intensely eroded anastomosis net, with channels up to 1 foot deep separating the "bacon hams."

Bandit Hall (Bandit's Chamber, Bandit's Grotto, Robber's Cave, Robber's Hall)

Located between River Hall and Vanderbilt's University Hall, Bandit Hall is a large, breakdown floored room along the Historic Tour, as noted by Kirchoff in 1870, "a primeval chamber of rocks, nothing less than idyllic for highwaymen who, comfortable among the rocks and safe from the police, could carouse in the bowels of the earth." The Corkscrew extends to the back of Bandit Hall. The stairs leading to Bandit Hall connect to a concrete-paved trail section edged by stainless steel handrails that becomes Sparks Avenue.

FIGURE 120. Former restroom features within Vanderbilt University Hall.

FIGURE 121. Vanderbilt University plaque.

Vanderbilt University Hall (Vanderbilt Avenue)

This is a large breakdown floored room adjacent to **Bandit Hall** and located near Sparks Avenue. Briggs Avenue begins at the back of the hall. It contains former restroom features (Figure 120) as well as a plaque dedicated by Chancellor J. H. Kirkland in 1907 in tribute to the students and alumni of the university (Figure 121). Within the space is a large, mortared rock wall.

Carlos's Way

Arising from River Hall, Carlos's Way is a low-level tributary to Echo River, entering the river near River Hall. A long extension to Carlos Way was discovered in 1973.

Briggs Avenue

This passage arises from the northern end of Vanderbilt University Hall. It extends southwards

for about 1,200 feet, where it connects with Silvan Avenue via several pits.

FIGURE 122. Steel I-beams installed along Sparks Avenue to protect against rock fall.

Sparks Avenue (Bishop's Gorge)

This passage is located between Vanderbilt University Hall and Mammoth Dome. It measures approximately 700 feet in length, and is a wide, low tube that follows the Ste. Genevieve/St. Louis limestone contact. The walls are often obscured by banks of sand and gravel. The passage ends at the base of Mammoth Dome where visitors can use the Mammoth Dome tower to access the upper passages. Concrete stairs lead to the tower. Sparks Avenue includes trail surfaces of newer and older concrete, some edged with metal handrails, as well as cave soil. There is a transformer set on a concrete pad located at a bend along the trail where it is still concrete, and a pad in the section that is surfaced with cave soil. There is a section where the incline of the rocks suggested the potential for rock fall. For the safety of visitors, a series of metal I-beams were installed based on the design of a structural engineer (Figure 122). A side passage extends off Sparks Avenue that is known as **Silvan Avenue**. Along the route are named features that include **Newman's Spine, Horseshoe Bend,** and **Leopard's Arch**.

- **Newman's Spine.** Located along Sparks Avenue between Vanderbilt's University Hall and Silvan Avenue, Newman's Spine is about 10 feet in length and consists of a crevice in the center of the ceiling, which has the appearance of a gigantic backbone.

- **Horseshoe Bend** (Bennett's Point). This is an acute bend that forms the junction between Sylvan Avenue and Sparks Avenue. The trail curves sharply around a shallow sediment bank.

- **Leopard's Arch.** Located along Sparks Avenue between Horseshoe Bend and Mammoth Dome, Leopard's Arch is a formation in the ceiling of the tube that is cut by numerous cross joints. For approximately 30 feet, the passage follows two closely parallel joints, giving a high arched profile. The dense, small-scale scalloping on walls and ceiling give a "leopard spot" appearance. The arch is about 8 feet high.

Silvan Avenue (Sylvan Avenue)

Silvan Avenue branches from Sparks Avenue at Horseshoe Bend. It measures approximately 500 feet in length and ends in a domepit complex that features **Clarissa's Dome and Wyatt's Domes**. The passage is named for several ferruginous limestone logs, which vary from 5 to 15 inches in diameter. Some appear to be chopped in half; others have lost a portion of bark, displaying a white surface of petrified wood. Others appear as though they were in a state of partial decay.[305]

- **Clarissa's Dome.** Located within Silvan Avenue, Clarissa's Dome is a smaller version of Gorin's Dome.[306]

- **Wyatt's Domes**. These domes terminate Silvan Avenue. [307]

305. *Mammoth Cave Gazetteer*, Silvan Avenue entry.
306. *Mammoth Cave Gazetteer*, Clarissa's Dome entry. The entry does not indicate the dimensions of the formation.
307. *Mammoth Cave Gazetteer*, Wyatt's Domes entry. The entry does not indicate the dimensions of the formation.

Mammoth Dome (Crevice Pit, Great Dome, Great Hall, Smith's Mammoth Dome)

Mammoth Dome is among the largest solutional shafts in the cave (Figure 123). Its walls are formed mostly of the Fredonia Member (Ste. Genevieve limestone). Sparks Avenue enters the shaft near its base. Visitors exit the lower level of the cave via a large metal stair tower in Mammoth Dome that extend to Little Bat Avenue. The dome features the **Ruins of Karnak** and three named side passages--**Fort's Way**, **Gault's Way**, and **Gallow's Way**.

- **Ruins of Karnak** (Corinthian Columns, Hall of Karnak). Located in Mammoth Dome, this formation is a series of four or five bedrock half pillars each about 20 feet tall. These are eroded in the wall of Mammoth Dome near the base of the tower. The name derives from the Egyptian temple ruins of the same name.

FIGURE 123. Mammoth Dome.

Fort's Way

This passage extends between the bottom of Mammoth Dome and Gallows Way. It is the higher level of two parallel routes between the two features. The other is Gault's Way.

Gault's Way

Gault's Way is set below Fort's Way and connects Mammoth Dome to Gallows Way.

Gallows Way

This third side passage is about 700 feet long. It is entered from Fort's Way or Gault's Way.

- **Dead Sea** (Infernal River) (Map 5). The Dead Sea extends between River Hall and the River Styx. It is a deep hole or pit that is filled with water. It forms part of the Echo River overflow system, which occupies the main Echo River trunk beyond the point where the main flow exits through a smaller flooded passage. It is likely named for the fact that the Dead Sea between Israel and Jordan has the lowest land elevation on Earth, and for its association with the River Styx. A metal bridge structure with chain link fencing guard rails crosses the river (Figure 124). A dirt path follows the stream to one side. Chain-link fencing edges the trail.
- **Charon's Cascade**. Located at the head of the River Styx or Dead Sea, this cascade is fed by another cascade at the entrance.[308]

FIGURE 124. Bridge across the River Styx below River Hall along the Dead Sea.

Orpheus's Pass (Orin's Pass, Orion's Pass, Pass of Orpheus, River Side Cut)

This is the upper-level passage, about 300 feet long, followed by the old tour trail between the Dead Sea and the River Styx, where it rejoins the main Echo River tube. The name is in keeping with the other Greek mythological underworld references in this area—River Styx, Lake Lethe, etc. In Greek mythology, Orpheus journeyed to

308. *Mammoth Cave Gazetteer*, Charon's Cascade entry.

the underworld in a failed attempt to rescue his wife, Eurydice, from Hades.

- **Rapier's Pit.** Located within Orpheus' Pass, Rapier's Pit is a small pit, about 15 feet deep, located alongside the trail in Orpheus' Pass.
- **River Styx.** This is the downstream end of the Echo River/Lake Lethe/River Styx base-level tube. The passage forms part of an active distributary network, with most of the flow pirated via a flooded tube to Echo River Spring, and Lake Lethe and River Styx functioning primarily as part of an overflow route. Downstream from River Hall, the River Styx passage is siphoned. According to Croghan (1839), the Styx was apparently discovered by Franklin Gorin and others in 1839. In Greek mythology, the River Styx, over which Charon ferries the souls of the dead, encircles Hades.
- **Charlotte's Dome.** This is a dome near the west end of River Styx, possibly named for Stephen Bishop's wife.
- **The Natural Bridge.** Located between the River Styx and Lake Lethe, The Natural Bridge is a ledge where Orpheus' Pass crosses the lower level River Styx, "a narrow path or ledge around a projecting rock, bridging the river." The present trail (now disused) which crosses the ledge, is considerably less hazardous.
- **Lake Lethe** (Lethe, Oblivion, River Lethe). Lake Lethe is a base-level pool, part of the Echo River complex. In Hovey's 1907 account, flooding from the Green River dam forced him to cross Lake Lethe by boat, "instead of skirting its margin." In Greek and Roman mythology, Lethe is the river of forgetfulness, flowing through Hades.

Great Walk

This passage extends between Lake Lethe and Echo River.

- **Shakespeare's Face and Gallery** (Shakespeare's bust, Shakespeare's face in egg, Shakespeare's Head, Shakespeare's Masque). Located along the Great Walk is a formation that can be seen overhead that has the appearance of William Shakespeare's "death mask." It is part of an area referred to as Shakespeare's Gallery.

Echo River (River Jordan)

Echo River is a large, base level tube, filled wall to wall with ponded water. Most of the flow drains to Echo River Spring via a flooded passage approximately at the Second Arch. One end of the passage was formerly constantly flooded following construction of Green River lock and dam no. 6. These structures were removed during the 2010s. Overflow continues along the Echo River passage into the River Styx and hence to Styx Spring on the Green River. Featured formations along the way include the **Alligator, First Arch, Second Arch, Saharan Desert, Purgatory, Fourth Arch,** and **Minnehaha Island**.

- **The Alligator**. Located along the Echo River west of the First Arch is a formation composed of a piece of bedrock that projects from the Echo River wall. The scalloping of the rock conveys an alligator-hide-like appearance.
- **The First Arch**. Located in Echo River, this is the first of three arches. The first is composed of a sharp ceiling drop where the Saharan Desert Branches off. Even at low water, the air space above it is very limited. Usually, it is sumped.
- **The Second Arch.** Located along Echo River, this is a short side slough off Echo River where the Saharan Desert trail drops back to water level; also it is the point where the flooded outlet conduit leaves the main Echo River passage to head for Echo River Spring.

Purgatory

Located off Echo River, this is an upper-level bypass of Echo River between Third and Fourth Arches, with a mud trail.

- **Saharan Desert** (Great Sandy Walk, Great Walk, Purgatory, Sahara Desert, Sands of the Sahara, Sandy Desert). Located off Echo River, this is the dry bypass between the Second and Third Arches of Echo River, followed by the old Echo River trail. It is

named for the deep sandy silt deposits over the floor. The tourists used to ascend a steep sandy "dune" from Second Arch.

- **The Fourth Arch**. Located in Echo River, Fourth Arch is the boat landing at the end of the Echo River Tour trail.
- **Minnehaha Island**. Located along the Echo River, Minnehaha Island is the site of the old Echo River landing at **Cascade Hall** where visitors could take a boat ride. No evidence of an earlier boat landing remains. A causeway takes the tour trail out onto this island of fine sandy sediment. Minnehaha Falls in Minneapolis were immortalized in Longfellow's poem "Hiawatha."

Gratz Avenue (Cinder-bank Cave, Lower Branch)

Gratz Avenue is a long tube, averaging 8 to 10 feet in height and 10 to 15 feet in width, with a floor of dirt. It extends westward from below Gothic Avenue for about 1,000 feet. Named features include the **Napoleon's Dome**, **Devil's Cooling Tub, Joseph's Pit, Pool of Clitorius, Lee's Cisterns, and Annetta's Dome**. There are also several portraits within Gratz Avenue. A single named side passage arises from Gratz Avenue—Wilson's Way. Two steep staircases lead down to Gratz from Gothic Avenue. One is stacked stone, one is very narrow concrete with a handrail on one side.

- **Napoleon's Dome** (Bonaparte's Dome). This feature is located along Gratz Avenue (east of Gothic Avenue) near Elbow Crevice. It is an inactive dome that extends across the ceiling of Gratz Avenue into a short alcove. It measures approximately 30 feet in height. **Alina's Dome.** Located within Gratz Avenue, Alina's Dome is numbered and keyed as such on the Kaemper Map, but it may be contiguous with Napoleon's Dome.
- **Devil's Cooling Tub** (Cooling Tub, Devil's Frying Pan). Located along Gratz Avenue a short distance east of Elbow Crevice (east of Gothic Avenue), this feature is composed of a hollowed rock that contains a basin of water 6 feet wide and 3 feet deep formed from a small stream of water that pours down 5 feet from a small hole in the ceiling. The tub overflows into a small channel, and empties into Joseph's Pit 20 feet away.
- **Joseph's Pit** (Flint Pit). This pit is located within the floor of Gratz Avenue (east of Gothic Avenue). It is approximately 25 feet deep and 10 feet wide. The water arises from the Devil's Cooling Tub.
- **Pool of Clitorius** (Lake Purity, Lee's Cistern, The Pool, Pool of Clitorius). This named feature occurs within Gratz Avenue (west of Gothic Avenue). It measures about 12 feet in length and is about 6 feet wide and 2 feet deep.
- **Lee's Cisterns.** Located along Gratz Avenue (west of Gothic Avenue) near Annetta's Dome, Lee's Cisterns are the pool into which Shaler's Brook flows that arises from Annetta's Dome.
- **Annetta's Dome** (Annett's Dome, Annette's Dome, Annetti's Dome, Waterfall). Located near the western end of Gratz Avenue, Annetta's Dome is an attractive small dome with sides hung with stalactite draperies. A stream cascades down the dome into Lee's Cisterns.

Wilson's Way (Salt Room)

This long, dry crawlway is located between Gratz Avenue and Harvey's Avenue. It measures approximately 1,400 feet in length and includes many American Indian artifacts. Named features include **Dry Pit** and the **Indian Mounds**.

- **Dry Pit** (Salts Room Pit). Located along Wilson's Way is a pit in the floor approximately 25 feet deep, with an opening at the top that is 3 by 4 feet, but immediately expands outward. Water can be heard falling in wet weather.
- **Indian Mounds.** Located in Wilson's Way near its junction with Harvey's Avenue is a formation referred to as Indian Mounds, for which little information is available.

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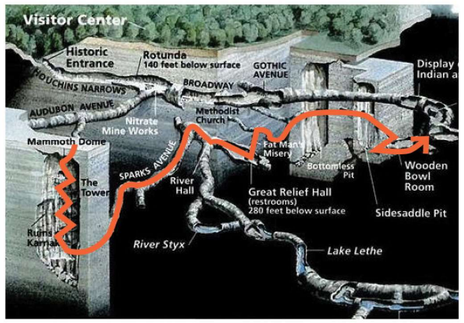

= LOWER LEVEL PASSAGE

To Historic Entrance

Grand Crossing
Rotunda
Pensacola Avenue
Broadway
Bunyan's Way
The Corkscrew
Briggs Avenue
matchline (map 5)
Robbins Run
Sparks Avenue
Carlos Way
Gorin's Dome
Washington Pit
The Labyrinth
Black Snake Avenue
Main Cave
Gothic Avenue
Calypso Avenue
Lost Avenue
Mammoth Dome
Sylvan Avenue
Ruins of Karnak
Fort's Way
Gault's Way
Wilson's Way

Section 2—Historic Cave Lower Level
(Black Snake Avenue and Gratz Avenue
to River Styx)

FIGURE 125. Map 4 showing a portion of Section 2, Historic Cave Lower Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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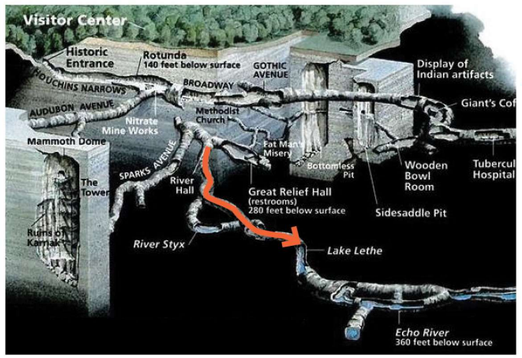
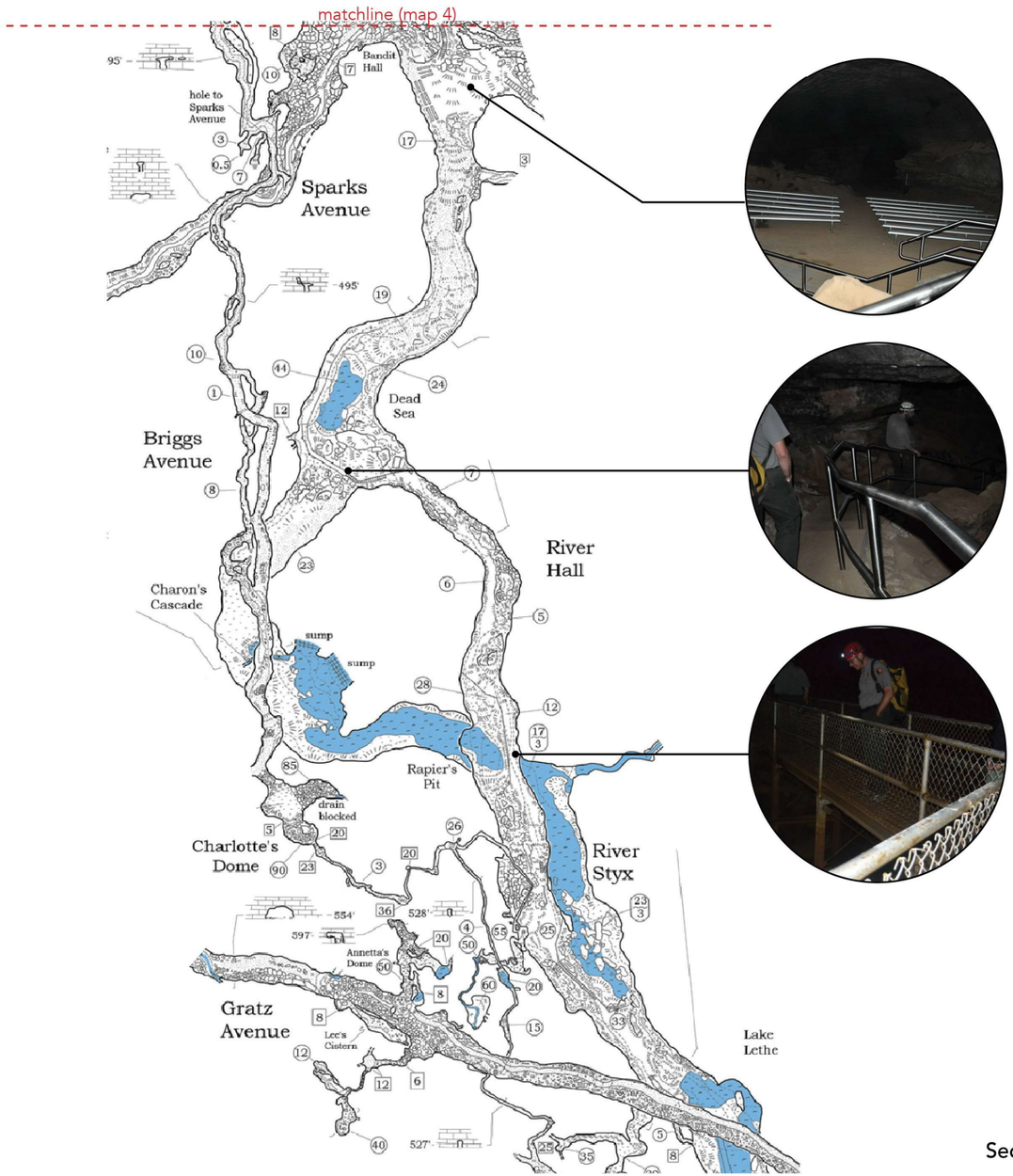


= LOWER LEVEL PASSAGE



Section 2—Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)

FIGURE 126. Map 5 showing a portion of Section 2, Historic Cave Lower Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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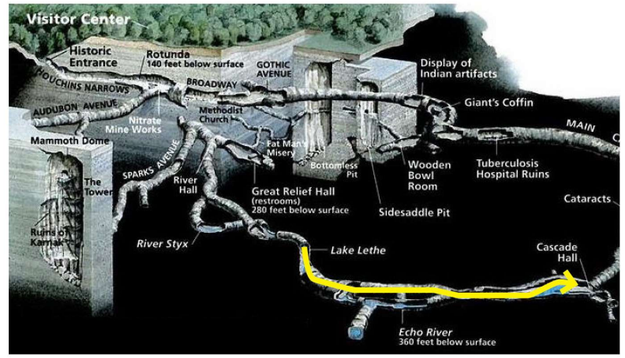

Section 2—Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)

FIGURE 127. Map 6 showing a portion of Section 2, Historic Cave Lower Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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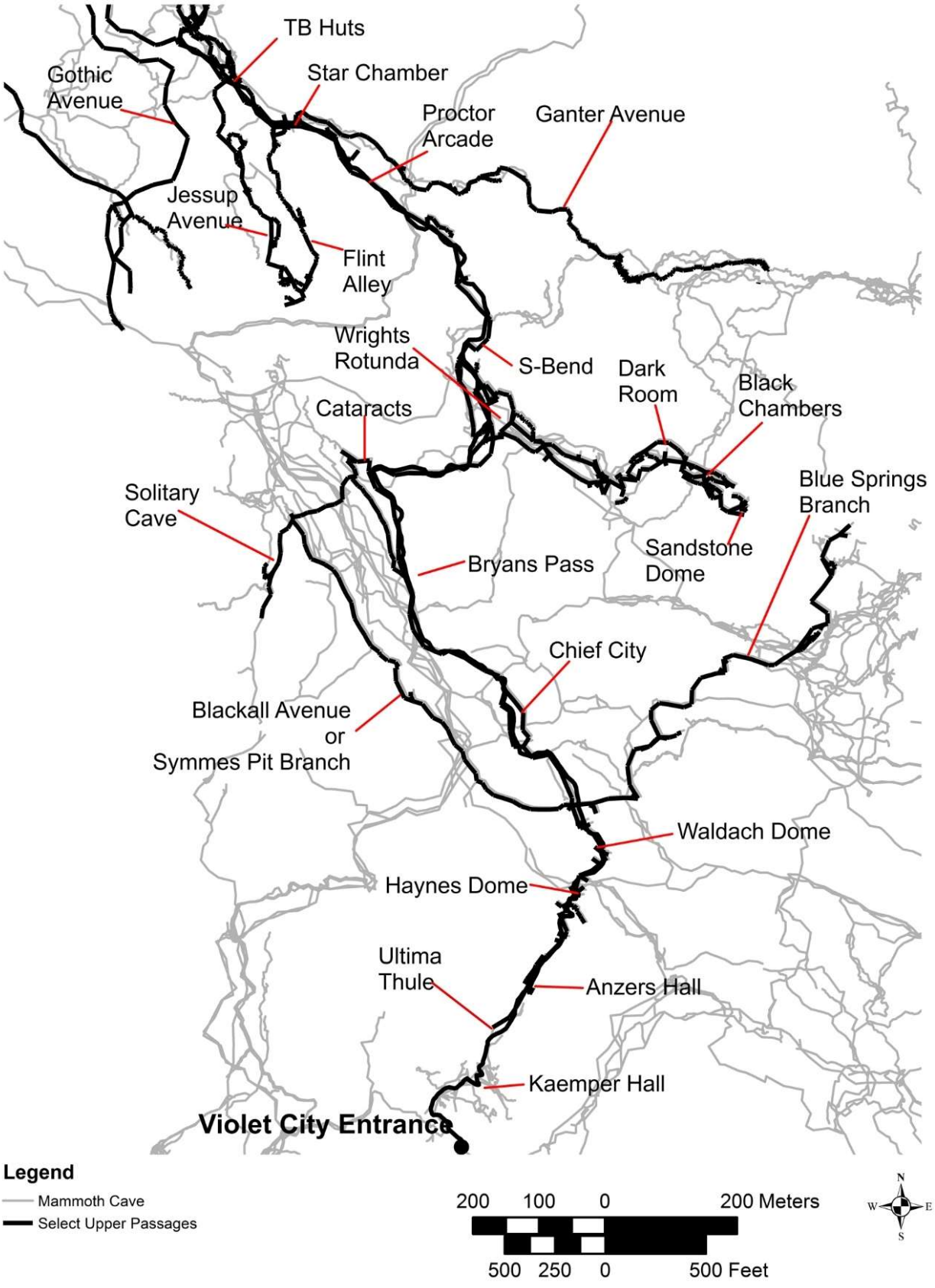


FIGURE 128. Diagram showing the configuration of passages within the middle section of the Mammoth Cave Historic District. (Source: Hobbs et al., *Mammoth Cave: A Human and Natural History*, Figure 1.18)

Section 3—Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance

Refer to Figure 141 through Figure 143 that relate to Section 3 at the end of this portion of the chapter

This section describes the upper-level passages and formations of Mammoth Cave that extend between the "S" Bend near Wright's Rotunda and the Violet City Entrance.

Main Cave. Section 3 includes the continuation of the Main Cave passage from the Upper Historic section of the cave described in Section 1 above as it extends to Violet City. It is the primary route of the Lantern Tour. The features associated with Main Cave through this section include **Wright's Rotunda, Nicholas' Monument, Hanson's Cañon, Potter Hall, the Cataracts, Bryan's Pass, Settle's Gorge, Chief City, Saint Catherine City, Sea Serpent, Waldach Dome, Mummy Ledge, Tribble's Trouble, Hains Dome, Epsom Salts Room, Mayme's Stoop, Anzer's Hall, Ultima Thule, Kaemper Hall, Parrish's Pits, Bishop's Pit, Elisabeth's Dome, Elise's Dome, Lena's Dome, Well's Dome, Chimes, The Marble Temple, Walhalla, Grand Portal, and Violet City.** Passages that arise from Main Cave through this section include **Fox Avenue, Solitary Cave, Blue Spring Branch, Blackall Avenue, Ranshaw Avenue,** and **Ganter Avenue.** Much of the trail is composed of cave soil. In some locations, such as Kaemper Hall, the trail is edged by placed rocks. There are stone stairs (Figure 129), concrete stairs, wood and concrete benches, wooden dust catchers, and Walker survey markers located along this route. Pre-Contact artifacts within this section include upright rocks with petroglyphs. As Main Cave approaches Violet City, there is a steep double flight of stone stairs that leads from Elisabeth's Dome into Violet City. It is known as Albert's Stairway. **Albert's Stairway** (Jennings' Stairway).

Albert's Stairway (CRIS HS #013016) was built in 1908 and altered in 1933-1938 by the CCC. The stairway is composed of fifty-two limestone rubble steps leading to the Violet City Entrance. The CCC added a metal railing for visitor safety.

A second set of stairs lead up to the Violet City Entrance. Main Cave also contains many signatures on the walls and artifacts associated with American Indian activities in the cave.

FIGURE 129. Stone stairs constructed prior to CCC involvement in the cave used to accommodate tours.

Wright's Rotunda (Chief City, Cross Rooms, Great Crossings, Six Corners, Wright's Chamber)

Wright's Rotunda is an enormous room, about 100 feet in diameter, which is characterized by a jumbled floor of breakdown. The space edges Main Cave to the east and leads to **Black Chambers**. Guides once lit rags soaked in flammable materials and flung them into crevices in the walls of the room to light it for visitors, which remains obvious today due to darkened cave walls (Figure 130). USGS survey markers from the 1935–1936 Walker survey are located within the space.

FIGURE 130. Rock ledges where torches were burned to light the cave for visitors by the guides.

- **Nicholas' Monument** (Ship Pillar). At the eastern end of the space are several bedrock pillars. The largest of these, Nicholas' Monument, is considered the dividing line between Wright's Rotunda and Black Chambers.

Fox Avenue (Fox Alley, Fox's Hall, Miss Fox's Hall)

Fox Avenue arises from Main Cave at Wright's Rotunda. The wide canyon measures approximately 200 feet in length and is 8 feet high. The western entrance is partially blocked, while the eastern entrance is easily accessed. There are many signatures, including entries dated 1832.

Black Chambers (Deserted Chambers, Devil's Chamber, Hall of the Black Chambers, Hell's Hole, Second City, Dark Chamber)

Black Chambers is a large space east of Wright's Rotunda. The walls are dark in color and rough. Like Wright's Rotunda, there is a large amount of breakdown on the floor of the space. The many large blocks are believed to resemble architectural elements such as walls, pedestals, and cornices. The space has two levels. Associated with the ceiling of the lower level, which is regularly arched, there is a space referred to as the Chimneys. It is possible to ascend through the **Chimneys** into the upper room, which is about the size of Main Cave.[309] Black Chambers is also connected to **Ranshaw Avenue.** Named formations include the Chimneys**, the Closet, the Dark Room, Dragon Pit, Double Branch, Great Isle, Mountain Dome, Mrs. Gatewood's Dining Room,** and **Sandstone Dome.**

- **The Chimneys** (Big Chimney, Little Chimney, passage of the chimney). Located within Black Chamber is a named formation The Chimneys. The formation includes two routes that lead from the lower to the upper level of Black Chambers.
- **The Closet.** This is a small, sandy-floored tube that turns sharply westward at the base of Sandstone Dome. It is considered something of a register room, due to the many historic signatures on the walls.
- **The Dark Room.** The Dark Room is a very low branch that leads to a dry dome filled with rocks. It is a low-level cut-around passage that branches north from the upper room of Black Chambers. The cut-around is 250 feet long and 40 feet wide, with breakdown on the floor. It leads to Ranshaw Avenue.

Ranshaw Avenue

Ranshaw Avenue extends between Black Chambers and Ganter Avenue. It is a moderately small sandy-floored tube that measures between 5 and 6 feet in height. The passage is about 1,000 feet long. Ranshaw Avenue leads to Ganter Avenue (see below). **Dragon Pit** is a named formation at the east end of Ranshaw Avenue, supposedly named for a dragon-shaped rock at the lip of the pit.

- **Dragon Pit**. This pit features a rock along its lip that resembles a dragon.
- **Double Branch** (Black Chamber)**.** Double Branch is two rooms set about 30 feet apart vertically and parallel to one another. These rooms fall in the northern arm of the east section of Black Chambers.

309. *Mammoth Cave Gazetteer*, Black Chambers entry.

- **Great Isle** (Grand Isle)**.** Grand Isle is a large pillar that stands between the two branches at the western lower level of Black Chambers.
- **Mountain Dome.** Mountain Dome is the breakout dome that forms the upper level eastern terminus of Black Chambers.
- **Mrs. Gatewood's Dining Room.** This is in the lower trunk at the east end of Black Chambers, leading to Sandstone Dome. It has a white ceiling and a sand floor. Several piles of stone in the room are said to have been used as altars.[310]
- **Sandstone Dome.** Sandstone Dome is an active dome that measures 80 feet in height. It is located at the end of Black Chambers. It is partially filled with breakdown.

(Main Cave continued)

Features within Main Cave continued.

- **Hanson's Cañon.** This feature is located in Main Cave between Wright's Rotunda and the Cataracts. It is a straight walled, canyon-like segment.
- **Potter Hall** (Cataract Hal, Odd Fellows Hall, Potter's Hole, Proctor's Hall, Third City). Potter Hall is a wide area of Main Cave where the **Cataracts** and **Solitary Cave** joins the passage at a sharp angle. The space is named for Potter College, a private women's college in Bowling Green that conducted an annual visit to Mammoth Cave and were served lunch here by the management of Mammoth Cave circa 1940, when Violet City was being shown to visitors for the first time.[311]
- **Cataracts.** The Cataracts is located along Main Cave near Potter Hall. It includes a large chasm formed on one side by gigantic misshapen rocks that hang over the passage, and two streams of water that cascade from holes in the ceiling about 10 feet apart. The water falls about 30 feet to a sink or drain covered by rubble (Figure 131). The water later appears in the domes at the end of Shelly Avenue.

FIGURE 131. The Cataracts.

Solitary Cave (Solitary Chambers, Solitary Way)

Located south of the Cataracts, Solitary Cave is a long, complicated side passage of Main Cave that extend for about 1,600 feet. It features **Coral Grove** side passage and the **Rat Hole Branch**. Named features include **Humble Chute, Fairy Grotto, Solitary Spring, Tecumseh's Grave, and Long Pond**.

- **Humble Chute.** Located at the entrance to Solitary Cave, Humble Chute is a horizontal fissure about 15 feet wide. Visitors must pass through the fissure to reach Solitary Cave and Solitary Chambers.

Coral Grove Branch

Coral Grove is a side passage that arises from Solitary Cave and ends in a cluster of stalactites.

- **Solitary Spring.** Solitary Spring is a basin of water that is related to Coral Grove Branch at a higher level.
- **Tecumseh's Grave.** The Tecumseh's Grave feature is a drop off to the right side of Solitary Cave that is about 15 feet deep.

Rat Hole Branch

Located in Solitary Cave, Rat Hole Branch is a small water vein and side passage between

310. *Mammoth Cave Gazetteer*, Mrs. Gatewood's Dining Room entry from Lee, 1835.

311. *Mammoth Cave Gazetteer*, Potter Hall entry.

Tecumseh's Grave and Fairy Grotto, that contains a nest-like formation with features that appear like sticks and moss.

- **Fairy Grotto** (Fairies Grotto, The Grotto). Located near the end of Solitary Cave is a grove of stalactites and stalagmites that has been impacted by people taking the formations. To reach the Fairy Room it is necessary to crawl through a narrow passageway.
- **Long Pond.** Long Pond is a pool of water 40 feet long, 15 feet wide, and 2 feet deep at the end of Solitary Cave beyond Fairy Grotto.

(Main Cave continued)

Bryan's Pass (Rocky Pass, Slooping Way)

This relatively low, 12-foot-high, section of Main Cave was named for William Bryan, a passenger agent with the L&N Railroad and early Mammoth Cave photographer.

Settle's Gorge (The Gorge)

This section of Main Cave is a relatively narrow, high canyon about 150 feet long. Set within Settle's Gorge is a collection of rock cairns known as **Monument Hill** (Figure 132). Many of these monuments date to the nineteenth and early twentieth centuries and were likely piled by visitors to the cave in an ad hoc fashion.

FIGURE 132. Rock cairns at Monument Hill.

- **Chief City** (Fifth City, Grand Temple, Hall of the Chief City, The Temple, Third City). Chief City is located along Main Cave between Settle's Gorge and Saint Catherine City. It is a huge breakout room, one of the largest in Mammoth Cave. The floor is covered with piles of rock that convey the appearance of an ancient city. Although it once contained numerous American Indian artifacts, many have been taken away by visitors. Wooden benches set on concrete bases are present within Chief City and edge Main Cave trail to either side in two sets (Figure 133). A little farther east is a wooden dust catcher inset in the trail.

FIGURE 133. Benches in Chief City.

- **Saint Catherine City** (Crossings, Fourth City, Little Temple, St. Catherine's City, St. Katherine's City, Three Forks). Saint Catherine City is a widening of Main Cave with a shallow breakout dome at a major intersection that includes the upper-level trunk of Blue Spring Branch and Blackall Avenue, which cross Main Cave at right angles.

Blue Spring Branch (Blue Spring Avenue, Branch of the Blue Spring)

Blue Spring Branch arises from Main Cave across from Blackall Avenue. This major upper-level trunk extends for approximately 2,700 feet in the form of a wide, shallow canyon that is generally 10 feet high and 30 feet wide, with a floor of breakdown. The eponymous spring is at the terminal collapse. Several side passages extend from Blue Spring Branch, all of which are dead ends.

- **Blue Spring.** This feature is near the left-hand side of the terminal collapse of Blue Spring Branch where there is a regularly wet area of active flowstone and dripstone accumulation.

The spring is a pool contained by a basin about 1 foot long and 4 inches wide overhung by an umbrella-shaped rock covered with a blue, transparent incrustation.[312]

Blackall Avenue (Symmes Pit Branch)

This passage extends west from Main Cave at Saint Catherine City. It is a major high-level canyon, contiguous with Blue Spring Branch and Gothic Avenue, that is approximately 2,400 feet in length. It ends at a massive valley wall breakdown above Solitary Cave. Dimensions vary throughout, but the cave averages 30 to 40 feet in width and 10 to 12 feet in height. Features in the passage include **Symmes Pit** and the **Cul de Sac.** Stone steps are present within Blackall Avenue (Figure 134).

FIGURE 134. Stone steps near Blackall Avenue.

- **Symmes Pit** (Symme's Hole, Simme's Pit). This feature occurs along Blackall Avenue. Located at the bottom of a deep hollow, Symmes Pit forms the shape of a funnel and is edged by loose rocks. A trail leads via a separate crawlway around the north side of the pit to an overlook.
- **Cul de Sac**. Located along Blackall Avenue about 450 feet from Saint Catherine City, Cul de Sac is a short niche below the main passage that was once disorienting to exit as the rocks appear to have fallen and cut off the way out. Guides and cave managers excavated enough of the loose sediments that filled the passage to create a passage that now measures 120 feet in length and 5 feet in height. The niche ends at a solid wall of fine sediment where the excavators stopped their work.

(Main Cave continued)

- **Sea Serpent**. Sea Serpent is located along Main Cave just east of Saint Catherine City. It is a narrow, serpentine ceiling channel, about 6 inches wide and deep, and about 30 feet long. The channel is clearly visible in the otherwise flat ceiling. It is very similar to the Sea Serpent of Serpent Hall in Silliman Avenue and to the Two Serpents of Little Bat Avenue.
- **Waldach Dome** (Waldach's Dome, Waldack Dome). This feature is located along Main Cave south of the Blue Spring Branch and Blackall Avenue crossing. It is a circular breakout dome about 25 feet high. There is a pre-Contact climbing pole located in this general vicinity.
- **Mummy Ledge** (Campbell Ledge). Located in Main Cave at Hains Dome, this is the ledge where CCC workers discovered the mummified remains of a prehistoric miner under a limestone block in 1935 while constructing a trail through Main Cave. The mummy was nicknamed Lost John. It was released from beneath the rock by CCC enrollees using a cable and pulley system (Figure 135). The individual was later displayed in a glass case for visitors in Cyclops Gateway.

FIGURE 135. Mummy Ledge.

312. Mammoth Cave Gazetteer, Blue Spring entry.

- **Tribble's Trouble** (The Garrett). Tribble's Trouble is located in Main Cave near Hains Dome. It is associated with mirabilite salts on the walls of the cave.
- **Hains Dome.** This is a circular breakout dome about 20 feet high named for a photographer who took the images on many postcards from the 1890s-1920s.
- **Epsom Salts Room.** This formation is coincidental with Hains Dome.
- **Mayme's Stoop** (Mamie's Stoop, Mayme's Stoopway, Stoopway). Located in Main Cave between Hains Dome and Anzer's Hall, this 200-foot-long section has a ceiling that is only 6 to 7 feet high. The trail has been improved to provide easier passage for visitors (Figure 136).

FIGURE 136. Mayme's Stoop.

- **Anzer's Hall** (Albany Basin, Antechamber). Located in Main Cave between Mayme's Stoop and Ultima Thule is an enlarged room where the passage widens to 100 feet just before Ultima Thule. The room is full of breakdown.
- **Ultima Thule** (Full Room). Located in Main Cave between Anzer's Hall and Kaemper Hall, this feature is a wall of breakdown that served as the terminus of cave tours until Hovey, Kaemper, and Bishop broke through it by blasting and using rock-breaking equipment in 1908 following their realization that there was a passage beyond it (Figure 137). These cave explorers also recognized that they were close to the side of a hill, and they could potentially create an entrance into the cave from the passages beyond. Hovey named the spot Ultima Thule, a term coined by ancient Greeks and Romans meaning the most remote areas of the habitable world.

FIGURE 137. Ultima Thule.

- **Kaemper Hall.** This large room in Main Cave measures 150 feet long by 100 feet wide and is 20 feet high. The floor is breakdown. There are several deep pits in the floor, including **Parrish's Pit** and **Bishop's Pit.** The room was discovered in 1908 after excavation of a passage at Ultima Thule.
- **Parrish's Pits.** This feature is a 45-foot-deep pit at the southernmost point of Kaemper Hall. The pit leads to a short side passage.
- **Bishop's Pit.** Located in Main Cave on the southeast side of Kaemper Hall, Bishop's Pit is a 62-foot-deep active pit. Hovey named it for the guide after they successfully broke through at Ultima Thule.
- **Elisabeth's Dome.** This is a large breakout dome in Main Cave between Kaemper Hall and Violet City. It measures 55 feet in height and about 80 feet in diameter. The floor is large breakdown. At the easternmost point of the room is Elise's Dome. A steep double flight of stone stairs that leads from Elisabeth's Dome into Violet City (Figure 138). This feature is known as **Albert's Stairway**.
- **Elise's Dome.** This small solutional dome is 24 feet high. It is located in an alcove off of Elisabeth's Dome.

FIGURE 138. Albert's Stairway.

- **The Grand Portal.** This huge archway forms the divide between Elisabeth's Dome and Violet City within which ascends Albert's Stairway. An iron gate once protected the formations.

Violet City

Violet City is a large 80-foot-high breakout room at the easternmost end of Main Cave noted for its calcite decorations. It was discovered by Max Kaemper and Ed Bishop in 1907. The room measures approximately 200 feet in length and 100 feet in width, with a floor of jumbled breakdown, and calcite decorations at the far end. The Violet City Entrance provides access to the cave at the southeast end of the room via a flight of sixty-one concrete stairs (Figure 139) that is broken by a single landing. The room was first lit electrically in the 1930s. Named features include **Walhalla, the Marble Temple, the Chimes, Lena's Dome,** and **Well's Dome**.

FIGURE 139. Concrete stair built by CCC that extended past some of the formations at Violet City.

- **Walhalla** (Mountain, Valhalla). This is the large terminal breakdown slope in Violet City. The top of the breakdown forms the Violet City Entrance.
- **The Marble Temple.** The Marble Temple is the much-photographed row of large stalactites and stalagmites that form the centerpiece of the Violet City formation.
- **Chimes.** The Chimes is a wall of flowstone and draperies covering the northeast wall of Violet City along the trail. These formations have been described as emitting musical tones when struck softly.
- **Lena's Dome.** This small dome is located off the southwest wall of Violet City.
- **Well's Dome.** This small dome is off the north wall of Violet City.

FIGURE 140. Violet City Entrance.

Violet City Entrance

The Violet City Entrance (CRIS HS #090187) was built in 1931. The entrance is built into a steeply sloped hillside and consists of a concrete headwall edged by concrete approach walls. The entry is a pair of Gothic-shaped iron doors with strap hinges (Figure 140). The door has been modified to control air flow into and out of the cave. Violet City Entrance serves as the exit point for the Lantern Tour.

The entrance is reached via a paved walk that descend to a space edged by dry-laid sandstone walls. Culverts and stone edging are used along the walk to address stormwater management.

Ganter Avenue (Black Snake Avenue, Indian Avenue, Welcome Avenue)

Ganter Avenue, which arises from Ranshaw Avenue as it extends from Black Chamber, is a 4,200-foot-long midlevel canyon passage that is relatively narrow. It contains a high concentration of American Indian artifacts. The passage extends to **Rider Haggard's Flight**, a stone stairway of 100 steps that connects Ganter Avenue with Welcome Avenue. The stair was built in the 1880s. The canyon is fairly complex, with numerous cut-arounds. Named side passages are (west to east) **Jesup Avenue, Flint Alley, Montie's Pass, Lee's Way, Welcome Avenue, and Boiled Egg Passage**. Cultural features include the long stone stair that leads to Welcome Avenue.

Jesup Avenue (Jessup Avenue, Ganter Side Avenue, Preston's Branch)

This branch that leads southeast from Ganter Avenue extends for 1,400 feet. A breakdown modified canyon with smaller braided parallel channels, Jessup Avenue averages approximately 12 feet in width. It ends in a breakdown choke near its junction with **Flint Alley**, an area known as **Owen Pit**. Other named features within the passage include **Washington Dome and Flint Dome**.

- **Owen Pit.** Located between Jesup Avenue and Flint Alley, Owen Pit is a domepit about 40 feet wide. The pit lies across Flint Alley.
- **Washington Dome** (Dome of Washington, Rotunda, Washington's Grand Dome). Located along Jesup Avenue, Washington Dome also lies across the passage about 500 feet before its terminus. It is nearly round with regular walls that measures approximately 15 feet across at the base and 75 feet in height.
- **Flint Dome** (Dome Spring). Located in Jesup Avenue about 800 feet from Ganter Avenue, Flint Dome has white bands and nodules of flint that project from its circular walls.

Flint Alley

Flint Alley is a narrow passage that averages 5 feet in width that extends south from Ganter Avenue for approximately 850 feet. It exhibits relatively high concentrations of chert deposits, with prominent flint bed crops.

Montie's Pass

Montie's Pass is a long, meandering passage that leads southeast off Ganter Avenue, intersecting Lee's Way and Ranshaw Avenue.

Lee's Way

Lee's Way is a very narrow, winding passage that extends for 700 feet south of Ganter Avenue.

Minna's Way

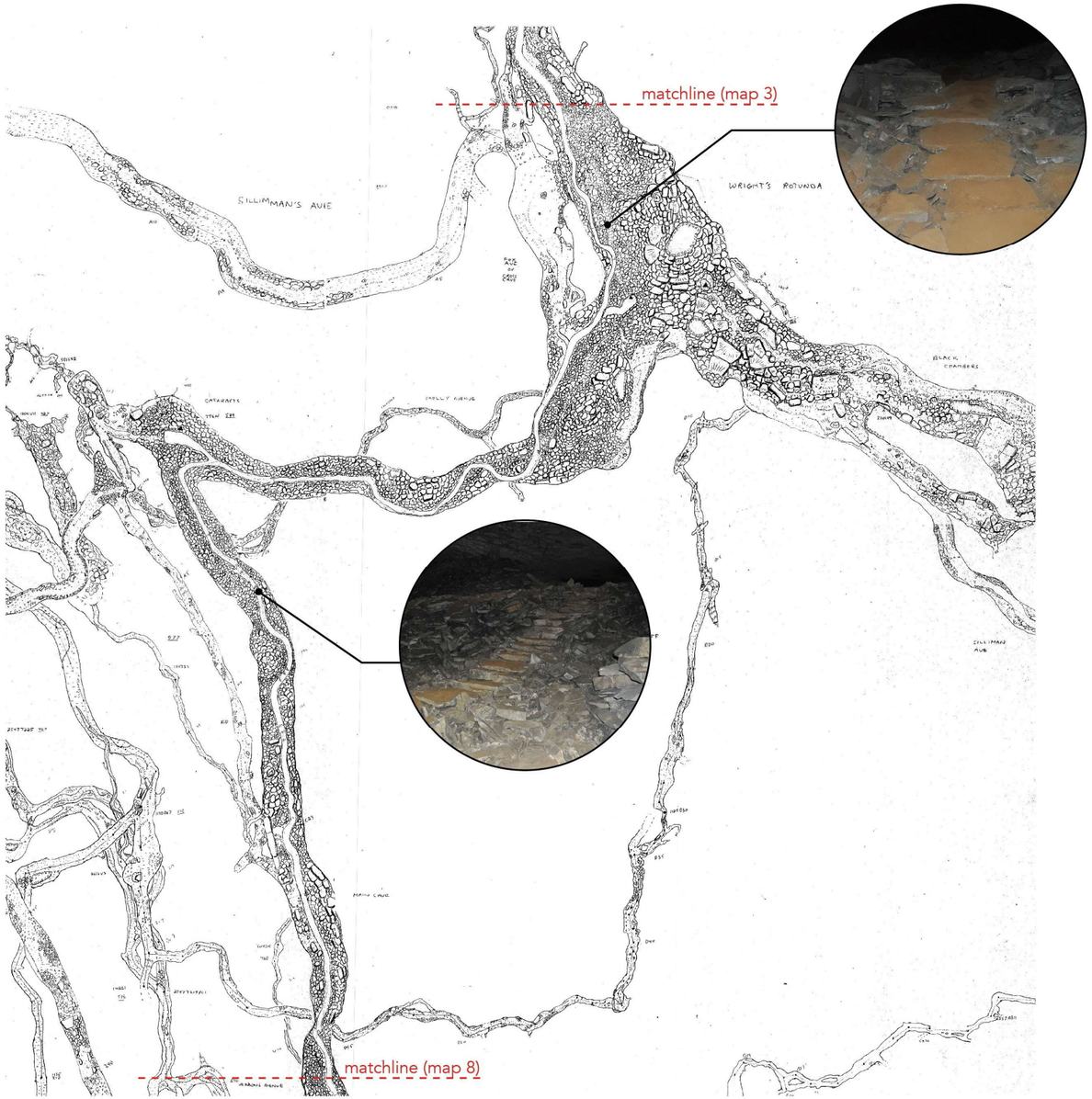
Minna's Way extends east of Ganter Avenue. It is a large dead-end upper-level passage. The western section is Minna's Way, while the eastern section is Edith's Avenue.

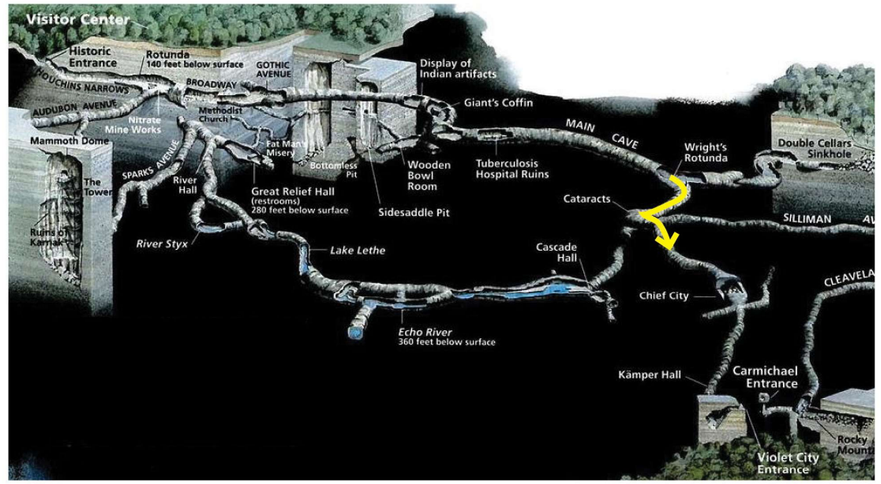
Edith's Avenue

Edith's Avenue is the eastern extension of Minna's Way, a dead-end upper-level passage.

Boiled Egg Passage

This side passage extends off Ganter Avenue. Boiled Egg Passage is connected at Rider Haggard's Flight and leads to **Henry's Dome**. It is named for a boiled egg lying on a shelf, presumed to be from the historic period.





Section 3—Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance

FIGURE 141. Map 7 showing a portion of Section 3, Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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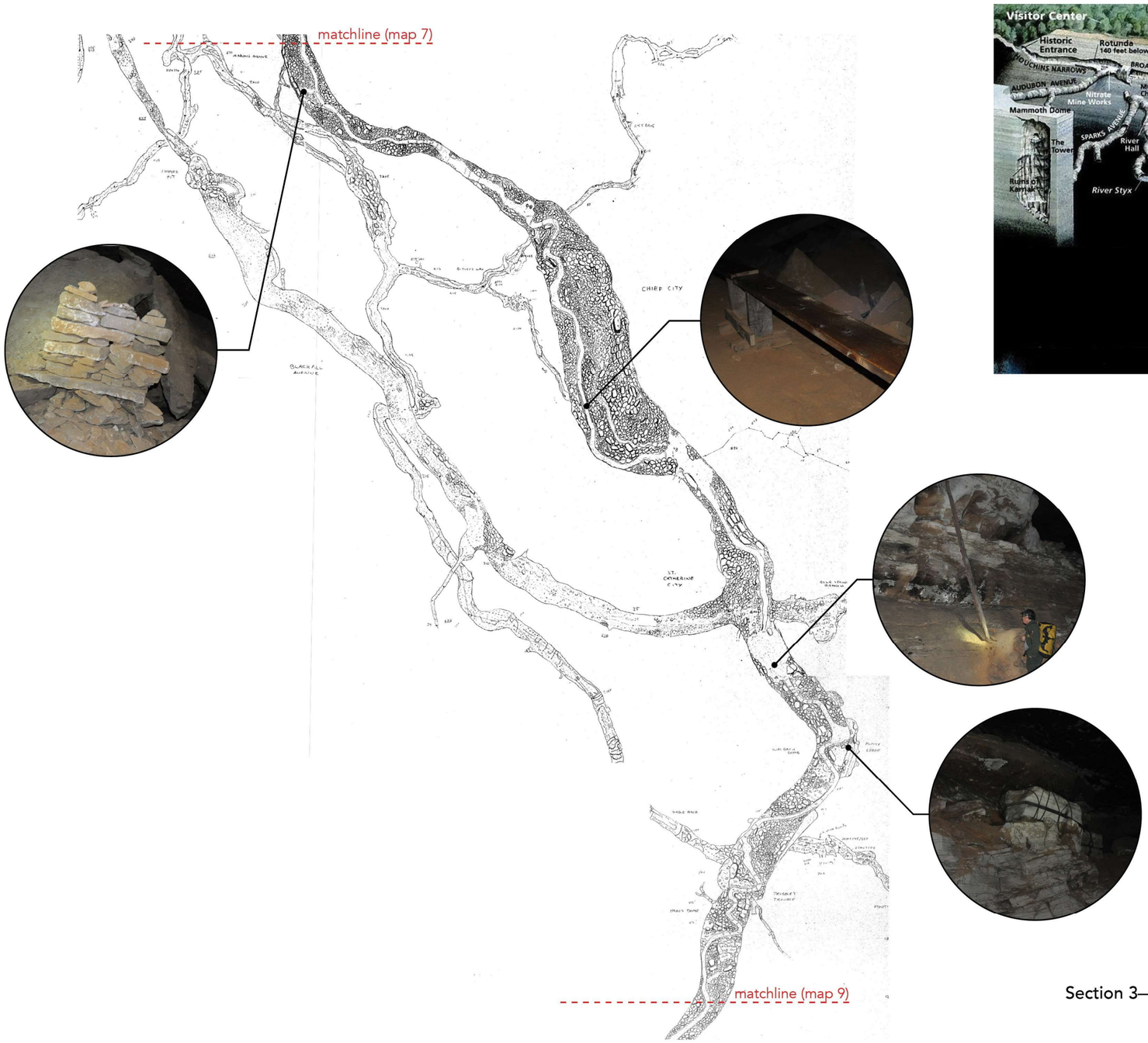

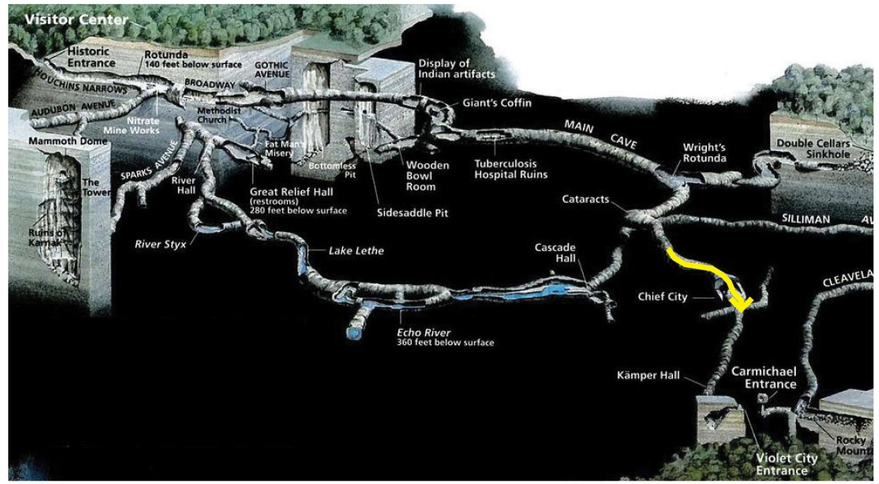

Section 3—Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance

FIGURE 142. Map 8 showing a portion of Section 3, Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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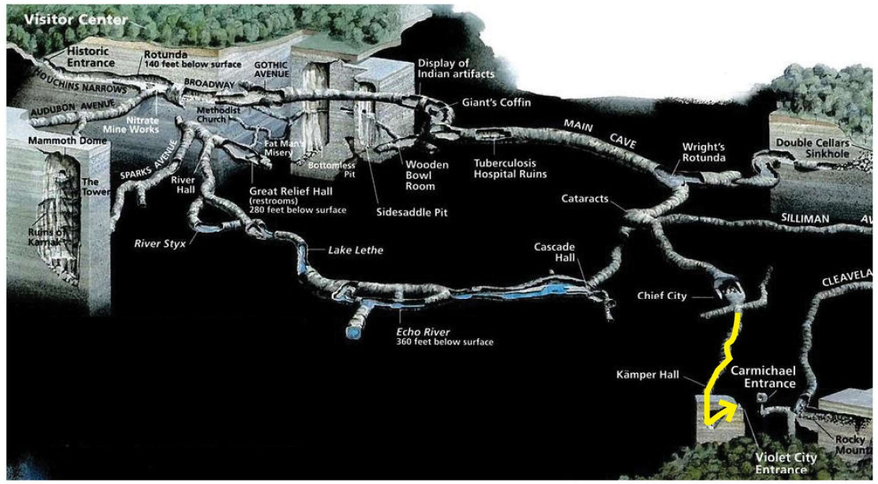

= UPPER LEVEL PASSAGE

Section 3—Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance

FIGURE 143. Map 9 showing a portion of Section 3, Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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Section 4—Carmichael Entrance to Aero-Bridge Canyon

Refer to Figure 148 that relates to Section 4 at the end of this portion of the chapter

Section 4 encompasses the lower portion of the cave as it extends southeast from Ganter Avenue as well as the Echo River corridor at Cascade Hall.

Cascade Hall (Waterfall Chamber). Cascade Hall is a space and passage located at the eastern end of the Echo River near the junction of **Silliman Avenue** and **Stevenson Avenue**. The defining feature of this space is the small stream of water that flows from an opening in the ceiling and splashes onto rocks 30 or 40 feet below before disappearing through a funnel shaped hole in the floor. From Cascade Hall, a causeway extends out to the now abandoned Echo River boat landing. At low water it is possible to enter Hanson's Lost River. Stevenson Avenue begins immediately behind the cascade.

Silliman Avenue (El Ghor, Infernal Regions, Railroad Tunnel, Sillamon Avenue, Silliman's Avenue, Sillimon's Avenue). Silliman Avenue extends between Cascade Hall and **Joe's Pit.** Silliman Avenue is a mid-level trunk canyon that has a very regular profile, and once formed a mainstay of one of the longer tours (Figure 144). Ascending from Cascade Hall through the **Infernal Regions**, passing **Dripping Spring**. Silliman Avenue levels off at **Serpent Hall** where it is intersected by **Welcome Avenue**. Nearby is the **Hill of Fatigue**. Other side passages include **Valley Way Side Cut, Roaring River, Hooflands Avenue, Burley's Way, Rhoda's Arcade, and the Pass of El Ghor**. East of El Ghor, the passage is smaller due to breakdown. It ends at **Joe's Pit** soon thereafter. The length of Silliman is approximately 4,250 feet. It is named for a distinguished professor of chemistry and physics at Yale Benjamin Silliman Jr. Silliman published several important articles on Mammoth Cave.

FIGURE 144. Silliman Avenue.

- **Infernal Regions.** The Infernal Regions are located east of Cascade Hall along Silliman's Avenue. This section of Silliman's measures approximately 1,000 feet in length. The floor is wet clay and considered miserable as a passage. The way in which the formation was named was described by Taylor (1883) as based on the fact that the floor ". . . was so sticky that someone had left the sole of his boot there, which was pointed out by the guide as one lost soul gone to those regions!" Named features located within the passage include **Great Western**, **Valley of Flowers**, **Ole Bull's Concert Hall**, **Old Scratch Hall,** and **Pluto's Dome.**
- **Great Western.** This formation is an acute angle that forms the silhouette of the stern of a ship.
- **Valley of Flowers.** This formation is decorated with gypsum and including a large flat rock once used as a dining spot.
- **Ole Bull's Concert Hall.** This formation is a wide, high section of the canyon forming the eastern limit of a large canyon section of Silliman Avenue.
- **Old Scratch Hall.** This space has a ceiling marked all over with scratch marks. Guides once described the marks as the work of the devil.[313]
- **Pluto's Dome.** This formation is a large dome in the ceiling of the Infernal Regions. A small

313. *Mammoth Cave Gazetteer*, Old Scratch Hall entry.

wet-weather stream falls from the dome to a shallow muddy pit in the floor.

- **Dripping Spring**. Located along Silliman Avenue at the Infernal Regions, Dripping Spring is a pool of water supplied from the ceiling, with stalagmites and stalactites.
- **Serpent Hall.** Serpent Hall is located along Silliman Avenue at the intersection with Welcome Avenue and Valley Way Side Cut. It includes a narrow, sinuous channel within the flat ceiling formed by running water.
- **Hill of Fatigue**. Located in Silliman Avenue between the ends of Valley Way Side Cut is Hill of Fatigue, a small rise located beyond Serpent Hall.
- **Joe's Pit.** Joe's Pit is a small 17-foot-deep pit that terminates the eastern arm of the passage beyond the El Ghor junction.

Welcome Avenue (Fox Avenue, Ganter Avenue, Sunset Avenue)

Welcome Avenue is a narrow, multilevel canyon that descends from the floor level of Ganter Avenue to Silliman Avenue near Serpent Hall. It extends for 2,800 feet, crossing beneath Main Cave between 'S' Bend and Wright's Rotunda. Arising from Welcome Avenue is Mayfield's Avenue. Welcome Avenue was considered an important "escape" route from the remote areas of the cave when discovered in 1879. Guides widened the route to make it passable.

Mayfield's Avenue

Mayfield's Avenue arises at the eastern end of Welcome Avenue east of Rider Haggard's Flight. A named formation associated with the passage include **Henry's Dome.** Arising from the passage is **Elmore's Pass**.

- **Henry's Dome.** Henry's Dome is located between Mayfield's Avenue and Elmore's Pass. It is a large, active domepit. A passage from Henry's Dome leads to Janet's River and the second connection to Flint Ridge.

Elmore's Pass

Located between Henry's Dome and **Albert's Domes**, Elmore's Pass is a narrow passage, about 400 feet long, named for Elmore Smith, a cook at the Mammoth Cave Hotel. It adjoins Mayfield's Avenue.

- **Albert's Domes.** Located at the end of Elmore's Pass, Albert's Domes is a series of large, active domepits.

Valley Way Side Cut

This passage arises from Silliman Avenue at Serpent Hall. It is a tube about 1,100 feet long with white gypsum deposits that parallels Silliman Avenue and connects at both ends near the ceiling level. Arising from Valley Side Cut is **Shelly Avenue**. **Cutliff's Way** falls within Valley Way Side Cut.

- **Cutliff's Way.** This small tube appears to arise from Valley Way Side Cut.

Shelly Avenue

This passage extends south from Valley Way Side Cut near Serpent Hall. The winding side passage ends in a series of domes known as **Sidney's Domes** and a stream passage beneath the Cataracts, which is the source of the stream.

- **Sydney's Domes**. These are the domes that form the terminus of Shelly Avenue; they are directly under the Cataracts, and water from the Cataracts feeds the domes. The water then sinks and is next seen at the Cascade in Cascade Hall.

Roaring River

Roaring River is a stream passage that falls between Silliman Avenue and New Discovery. It is named for the continual sound of water associated with a small cascade near the downstream end of the long, base-level route.

Hooflands Avenue

This passage extends between Silliman Avenue, Burley's Way, and the **Lucy's Dome** drain. Hooflands is a maze-like system of small passages that form the paleo-upstream section of Burley's Way. It underlies Rhoda's Arcade and Silliman Avenue. A hole in the north wall of Silliman Avenue provides access to the passage. An advertisement for "Hooflands Tonic" is painted on the wall near the opening. A similar sign appears in the Snowball Dining Room that is dated 1869.

Pass of El Ghor (El Ghor, Pass of Algore, Pass of Elchor, Pass of Eli Ghor, Pass of El Gau)

This passage is located between Silliman Avenue and Boone Avenue. The Pass of El Ghor is a narrow, high gradient canyon that averages about 15 feet in width and 20 feet in height. El Ghor means a narrow, difficult pass between rocks. It is a westward continuation of the Boone Avenue lower level. Historically, **Jacob's Ladder** connected El Ghor with Mary's Vineyard. Today, **stone steps** afford this access (Figure 145). **Ike's Path** is the only side passage. Named features associated with the Pass of El Ghor include **Queen Victoria's Crown, Black Hole of Calcutta, Stella's Dome, Corinna's Dome, the Mule Stall, the Sheep Shelter, Fly Chamber,** and **Hanging Rocks.**

FIGURE 145. Stairs that replaced Jacob's Ladder.

- **Queen Victoria's Crown** (The Crown, Queen's Crown, Victoria's Crown). Located along El Ghor, this is a speleogen of eroded chert, about 5 feet in diameter, located on a ledge (Figure 146). It bears a resemblance to an ornate crown.

FIGURE 146. Queen Victoria's Crown.

- **Black Hole of Calcutta** (Tartarus). The Black Hole of Calcutta is located along El Ghor east of Queen Victoria's Crown. It is a pit, 12 feet deep, at the side of the passage (Figure 147). A route from the Black Hole leads to Frances Dome off Marion Avenue.

FIGURE 147. Black Hole of Calcutta.

- **Stella's Dome.** Stella's Dome is a solutional dome a short way north of El Ghor at the Black Hole of Calcutta.
- **Corinna's Dome.** Located in El Ghor about 1,350 feet north of Mary's Vineyard, Corinna's Dome is a 35-foot-high blind dome in the ceiling of El Ghor.
- **The Mule Stall.** Located in El Ghor, the Mule Stall is a small, shallow, semicircular pit in the east wall about 50 feet north of Corinna's Dome.
- **The Sheep Shelter.** Located in El Ghor between Fly Chamber and Queen Victoria's Crown, the Sheep Shelter is a broad jutting ledge.
- **Fly Chamber.** Located in El Ghor between Queen Victoria's Crown and Hanging Rocks, the ceiling of Fly Chamber features crystals of black gypsum the size of house flies.
- **Hanging Rocks.** Located in El Ghor between Ike's Path and Fly Chamber, Hanging Rocks is a cluster of large, jammed breakdown blocks that are hanging over the trail.

Ike's Path

This crawl and crouchway passage extends for approximately 500 feet from El Ghor to Emily's Avenue near the junction with Silliman Avenue.

Stevenson Avenue (Stephen Avenue)

Stevenson Avenue is located between Cascade Hall and **Opossum Avenue**. It forms the western portion of an approximately 4,200-foot-long south-flank, mid-level trunk that includes Opossum Avenue and Belfry Avenue (see Section 6). Stevenson Avenue exits Cascade Hall high up on the side wall, forming a relatively large canyon that measures 10 feet high and 20 feet wide. There are periodic piles of breakdown. Side passages include **Burley's Way**, and a route to Roaring River. Named features include the **Hurdle Race** and **Neptune's Cups**.

- **Hurdle Race.** Hurdle Race is located along Stevenson Avenue approximately 1,000 feet east of the junction with Burley's Way. It includes a series of large, dry rimstone dams that create hurdle-like obstacles across the floor of the passage for several hundred feet.
- **Neptune's Cups.** This feature is located about 600 feet west of Opossum Avenue. The Mammoth Cave Gazetteer does not provide information about the nature of the formation or the source of the name.

Burley's Way

Burley's Way arises from Stevenson Avenue and extends to **Rhoda's Arcade**. The southern end of the passage near Stevenson Avenue is a large tube with fill about 500 feet north of the junction. It continues north into a lower side passage that extends for 2,000 feet beneath Silliman Avenue, while also connecting with it, and further on ending in a maze below **Rhoda's Arcade** and **Lucy's Dome**. Burley's Way is characterized by numerous cut-arounds and complicated passage morphology, including several unnamed side passages. Arising from Burley's Way is **Sitgreave's Pass**.

Sitgreave's Pass

Sitgreave's Pass extends between Burley's War and Thorpe's Avenue (see Section 6). It is a narrow canyon, higher and narrower than the Thorpe's Avenue section. It is named for Lorenzo Sitgreave married Lucy Ann, daughter of General Jesup, one of the last of the Croghan heirs.

Opossum Avenue

This passage extends east southeast from Stevenson's Avenue, and connects to Belfry

Avenue (see Section 6 below). It is the central section of a main midlevel east-west trunk formed by Branford, Belfry, Opossum, and Stevenson Avenue.

Rhoda's Arcade

This passage is located between Silliman Avenue and Lucy's Dome. It is a medium-sized canyon with an associated lower level channel. It enters Silliman from a 20-foot-high ledge and continues for 750 feet. It is approximately 5 to 10 feet in height. The walls and ceiling are encrusted with gypsum and carbonate of lime. The floor features white crystals of limestone. There is no fallen rock on the floor.

- **Olivia's Dome** (Jesup's Domes, Olivia's Domes). This is a large dome, about 50 feet high and 30 feet wide. It occurs along a passage connecting Rodgers Avenue and Rhoda's Arcade. The feature is actually two adjacent domes separated by a lower-ceilinged section. From the top of the dome, it is possible to access another narrow dome.
- **Lucy's Dome** (Jesup's Dome, Lucy's Hall). Lucy's Dome forms the end of Rhoda's Arcade. It was once a highlight of tours. It is a high, narrow canyon, rather than a dome, approximately 100 feet in height, with solutional features on the walls. Passages that extend behind the walls of Lucy's Dome can only be accessed by climbing about 20 feet up the walls. The drain in a small pit in the floor of the dome extends to Mystic River, as well as Hooflands Avenue to Burley's Way.

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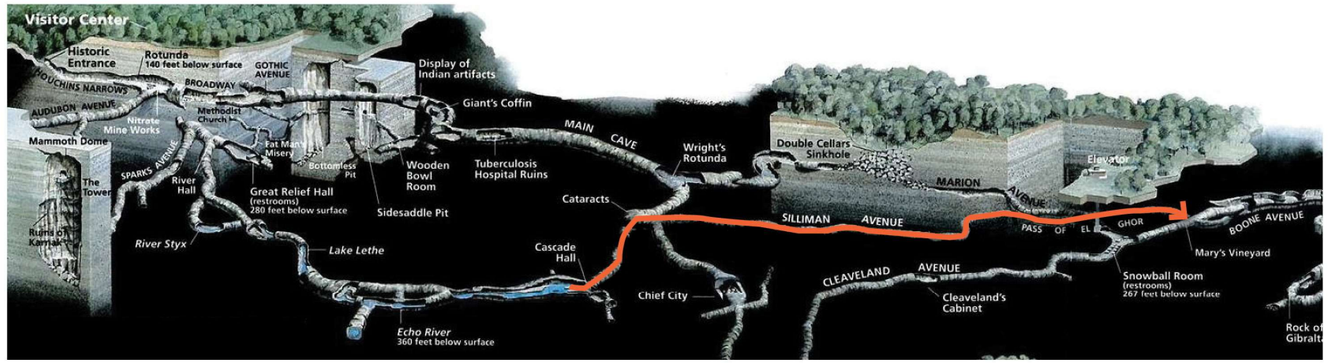

= LOWER LEVEL PASSAGE

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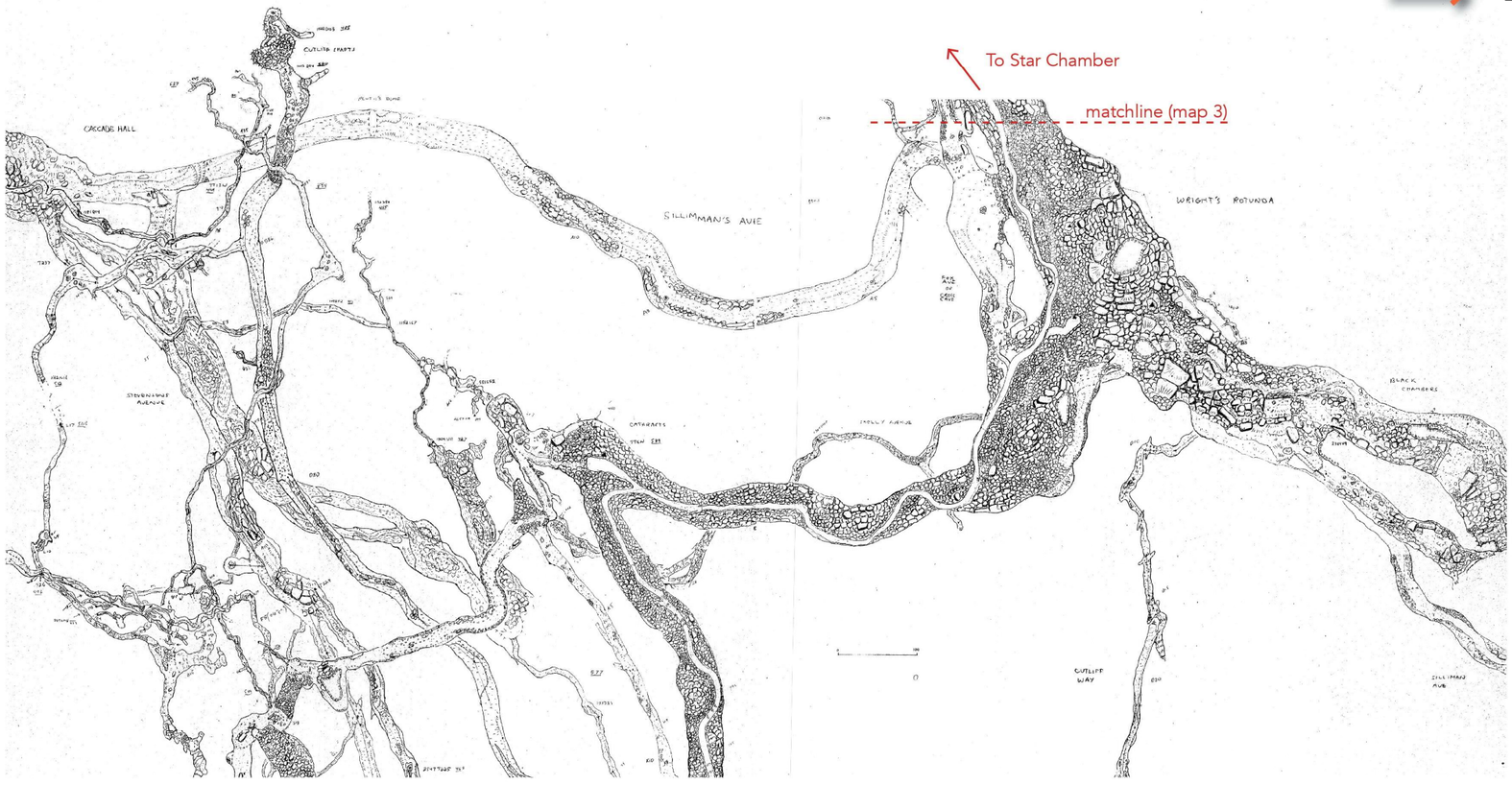

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Section 4—Carmichael Entrance to Aero-Bridge Canyon

FIGURE 148. Map 10 showing Section 4, Carmichael Entrance to Aero-Bridge Canyon. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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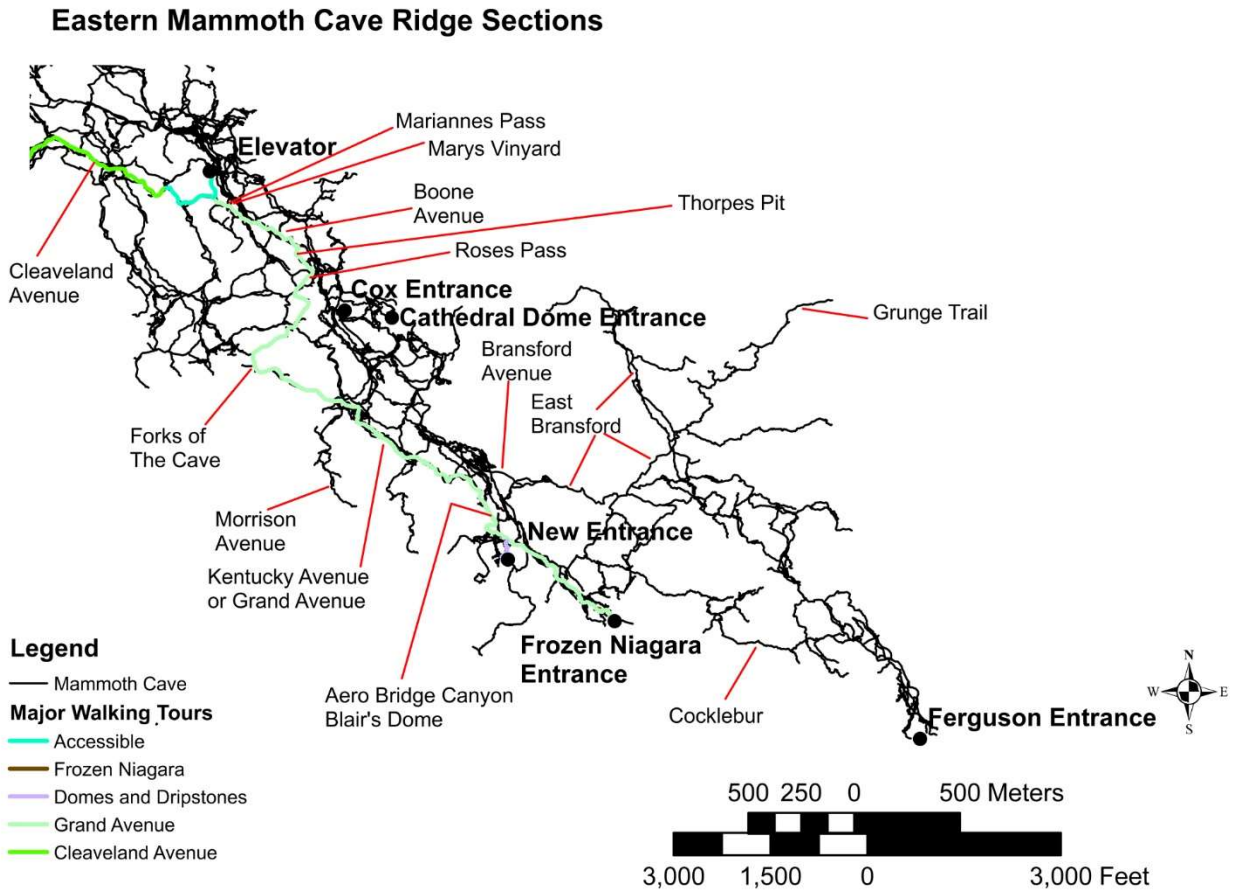


FIGURE 149. Diagram showing the configuration of passages within the eastern half of the Mammoth Cave Historic District. (Source: Hobbs et al., *Mammoth Cave: A Human and Natural History*, Figure 1.16)

Section 5—Upper Cave East of El Ghor to Aero-Bridge Canyon

Refer to Figure 167 through Figure 172 that relate to Section 5 at the end of this portion of the chapter.

Section 5 of Mammoth Cave encompasses a series of upper-level passages that extend between El Ghor and Woodbury Pass near Ultima Thule. It includes passages that extend from Carmichael Entrance as well.

Carmichael Entrance (Cleaveland Entrance). Carmichael Entrance (CRIS HS# 090173) is located at the base of a large sinkhole in the angle formed by the Mammoth Cave Ridge and Jim Lee Ridge, near the Violet City Entrance. Visitors are dropped off along a paved road with a walk leading to an open-air shelter. They follow a concrete walk and stairs downhill, passing dry laid stacked stone and concrete walls to a landing that extends in one direction to the cave entrance and the other to stormwater management basin. These features were constructed in the 1930s by the CCC and were known as Entrance No. 4 or No. 4 Route. The Carmichael Entrance is composed of a concrete wall inset with a pair of Gothic iron doors with strap-like hinges set into the concrete outer walls (Figure 150). The doors were replaced in kind in the 1970s. The concrete wall is edged by coursed rubble wing walls. Today, this serves as the entrance point for the Grand Avenue Tour.

Once inside, visitors descend through rock that retains evidence of blasting via stairs with metal treads and handrails (Figure 151). Overall, there are 182 stairs. The stairs are treated with asphalt and sand surfaced shingles to create a non-skid surface. There are also sections surfaced with composite materials.

FIGURE 150. Carmichael Entrance.

FIGURE 151. Carmichael Entrance stairs.

Sandstone Avenue (Sandstone Mountain). This passage extends between the Carmichael Entrance and the **Rocky Mountains**. It is a 300-foot-long fragment of the major upper-level trunk canyon of Mammoth Cave Ridge, contiguous with **Main Cave** to the west and **Croghan Hall** and **Grand (Kentucky) Avenue** to the east. Sandstone Avenue is representative of a dry, breakdown floored trunk. The passage measures approximately 40 feet in width, 7 feet in height and is 30 feet tall. The Carmichael Entrance tunnel enters the cave near the western terminus of the passage. Passage along Sandstone Avenue begins to the right of the stairs leading into the cave from the Carmichael Entrance. The trail is surfaced with cave soil. The passage end in sandstone breakdown, lending the passage its name. This point is only 50 feet from the breakdown terminus

of Main Cave at Violet City, although they are not connected.

Franklin Avenue. Franklin Avenue is a dark and gloomy passage (Figure 152) that once was part of the most remote area of the cave visited by tours until new entrances were established in the area in the early twentieth century. Franklin Avenue is the continuation of Cleaveland Avenue as it moves southwest beyond Rocky Mountains, a breakdown of the upper-level Sandstone Avenue/Croghan Hall trunk that cuts the lower Cleaveland Avenue/Franklin Avenue tube into two segments. The disjunct downstream continuation of Franklin Avenue is Big Avenue in New Discovery. Named formations include **Serena's Arbor**. The walls contain many signatures and other inscriptions, including Stephen and Charlotte Bishop surrounded with a heart.

FIGURE 152. Franklin Avenue.

- **Serena's Arbor** (Fairy Grotto, Serena's Arbor, Serena's Bower, Serena's Harbor, Zerena's Bower). This formation is located at the end of Franklin Avenue. The walls and ceiling are covered with stalactite cornices, columns, grooves, and ogees.
- **Rocky Mountains** (Call's Rotunda, Dismal Hollow). Rocky Mountains occurs at the junction of Sandstone, Cleaveland, and Franklin Avenues. It is a 60-foot-diameter, 50-foot-high breakdown floored hollow formed from the collapse of the floor of the upper-level trunk canyon formed by Sandstone Avenue and Croghan Hall into the Cleaveland Avenue/Franklin Avenue tube. Although the area was once described as having several features, it is generally referred to as the Rocky Mountains today.

Croghan Hall (Groghan's Hall, Grophan's Hall)

This is a fragment of trunk canyon to the southeast of the Rocky Mountains. Along with Sandstone Avenue, it is a disjointed section of the main Mammoth Cave Ridge upper-level trunk lying between **Grand Avenue** and **Main Cave**. Croghan Hall measures 45 feet in width and is 7 feet high. The floor is breakdown. The most notable feature in the passage is the **Maelstrom**, a deep pit. Also located within Croghan Hall is a formation referred to as the **Blarney Stone**, as well as **Old Maiden's Kitchen** and **Cleopatra's Needle**.

- **Old Maiden's Kitchen**. This is a shallow depression in the breakdown floor of Croghan Hall.
- **Cleopatra's Needle.** Located in Croghan Hall, is a stalagmite, 2 feet high, and 6 inches in diameter.
- **Blarney Stone.** This formation is located approximately 20 feet from the brink of the Maelstrom.
- **Maelstrom**. This pit occurs at the west end of Croghan Hall. It is named for a famous whirlpool off the west coast of Norway.

Cleaveland Avenue (Carmichael Passageway, Cleaveland's Cabinet, Cleveland Avenue, Crystal Avenue, Crystal Chambers, Elindo Avenue, Rodes Avenue of Roses and Diamonds, Sparkling Gypsum Avenue)

This trunk passage is a long tube, 40 to 50 feet wide by 8 to 15 feet high, developed in the lower Joppa Member (Ste. Genevieve limestone). It is famous for its profusion of gypsum speleothems, which convey the appearance of alabaster flowers. The tube extends from the Rocky Mountains to the Snowball Room at the Marion Avenue junction with Washington Hall, a distance of about 4,450 feet.

A curving flight of concrete stairs occurs at the junction of Sandstone and Cleaveland Avenues within the area of Rocky Mountains. The trail

through this passage is surfaced with cave dirt. The passage also continues beyond Marion Avenue to the Boone Avenue-El Ghor junction at **Mary's Vineyard**. This additional segment extends for approximately 500 feet over which the tube gradually changes to a high-ceilinged canyon. The tube is somewhat modified by breakdown towards its western end, but generally shows a classic elliptical tube cross-section, with a thin layer of sediment over the bedrock floor. The passage is followed for its entire length by a tour trail. Cleaveland Avenue and its downstream continuation, Franklin Avenue, are paleo-upstream sections of Big Avenue in New Discovery.

Side passages from west to east include **Helen's Grotto, Rodgers Avenue, Orpha's Garden, Clark's Avenue, Dollar Pass, Miller Avenue, Marion Avenue,** and **George's Path**. There are many named features in historical accounts of the passage, only a minority of which can be positively identified.

Named features include (from west to east) **Charlotte's Grotto, Diamond Grotto, Edison Monument, Vale of Diamonds, the Post Office, Jenny Lind's Dining Table, Last Rose of Summer, Mammary Ceiling, Floral Cross, Flora's Garden, Snowball Room, Washington Hall,** and **Mary's Vineyard**. There are survey markers present from the 1935-1936 Walker Survey located within the passage, as well as concrete pads. Near Orpha's Garden and the intersection with Rogers Avenue is a wet area with stones located within the trail. Further east, the Edison Monument edges Cleaveland Avenue west of Jenny Lind's Dining Table. As the passage approaches Snowball Room, the trail becomes paved with concrete. This segment is included in the accessible tour. The upside down well is located along the paved section of the trail relatively close to Snowball Room.

- **Charlotte's Grotto.** Charlotte's Grotto, named in honor of Stephen Bishop's wife, is located at the western end of Cleaveland Avenue about 1,100 feet east of the Rocky Mountains. It is a section of the passage decorated with clean white gypsum crust and flowers.
- **Diamond Grotto** (Diamond Hall). This is a short section of Cleaveland Avenue lined with sparkling crystals of selenite, the gem after which the grotto is named. It is located approximately 500 feet west of the junction with Rodgers Avenue.

Helen's Grotto (Helen's Hall)

This passage runs parallel to on the south of and is connected with Cleaveland Avenue in at least eight locations. Four of these have been named—Fish Rock, Four Roses, Bare Hole, and Snake Pit Hole. It is composed of a series of tubular crawlways and small rooms that are visited as part of the Wild Cave Tour. It extends for about 1,200 feet. Passage heights average about 3 feet, and the width ranges from 2 to 20 feet. **Split Rock** is a named formation along Helen's Grotto.

- **Split Rock.** Located within Helen's Grotto, this is a small natural bridge that spans a low tubular passage.

Rodgers Avenue (Specimen Avenue). Rodgers Avenue extends north from Cleaveland Avenue to **Lucy's Dome**. It is a long tube with notable gypsum decorations in the southern section. It extends for approximately 3,000 feet, gradually lowering, and becoming a crawlway as it ends near the top of **Julia's Dome**. It passes **Sarah Margaret's Dome**. Other named features include **Cornelia's Grotto, Grace's Grotto, Nannie's Grotto, and Lucy's Dome**. It may have formed after Cleaveland Avenue tube became blocked downstream.

- **Sarah Margaret's Dome.** This large domepit occupies most of the floor halfway along Rodgers Avenue. It leads to a series of further pits and small canyons, with a drain that leads to the Hooflands Avenue maze off Silliman Avenue.
- **Cornelia's Grotto.** This room features profuse gypsum decoration. It is located within Rogers Avenue near the intersection with Cleaveland Avenue.

- **Grace's Grotto.** This is a section of Rodgers Avenue, a 20-foot wide, 6-foot-high space decorated with gypsum.
- **Nannie's Grotto.** Located within Rodgers Avenue, this space may have been notable for formations at one time but is no longer remarkable.
- **Lucy's Dome.** This dome connects with the end of Rhoda's Arcade. It was once a tourist highlight. The dome is a high, narrow canyon rather than a true dome. Solutional features are present on the walls. The drain is a small pit in the floor that connects to Mystic River.
- **Julia's Dome** (Jesup's Dome). Julia's Dome is located between Rodgers Avenue and Olivia's Dome. It is a 50-foot high, 30-foot wide active domepit. Rodgers Avenue ends near the top of the dome. The bottom extends via Olivia's and Lucy's Domes to Rhoda's Arcade.

(Cleaveland Avenue continued)

- **Veil of Diamonds** (Vale of Diamonds, Valley of Diamonds). This named formation is located along Cleaveland Avenue west of the intersection with the side passage leading to Orpha's Garden. It features shallow alcoves in the south wall decorated with gypsum.
- **The Post Office.** This named formation is located along Cleaveland Avenue near the passage leading to Orpha's Garden. It was a place where tourists were encouraged to leave their calling cards. No calling cards remain there today.

Orpha's Garden (Donna's Garden, Orpheus's Garden)

Located off Cleaveland Avenue about 1,550 feet west of Snowball Room, Orpha's Garden is a relatively tall side passage that is 6 feet high and 20 feet wide that leads northeast for 250 feet before ending in a sediment and breakdown choke. The passage intersects **Clark's Avenue** near its terminus.

Clark's Avenue (Marion Avenue, Dollar Pass)

This passage is located between Orpha's Garden and Cleaveland Avenue. It is a 900-foot-long shallow, 3-to-6-foot high, 10-foot-wide canyon that runs from the end of Orpha's Garden and continues under Cleaveland Avenue below a natural bridge, rejoining Cleaveland Avenue on the south side. **Dollar Pass** branches off Clark's Avenue.

Dollar Pass

Dollar Pass extends between Clark's and Marion Avenues. It forms part of the Wild Cave Tour. Dollar Pass is a canyon about 7 feet high and 1,000 feet long, with a knot of side cuts halfway along. The passage connects with Marion Avenue at the so-called **Mole Hole**, an opening about 1 foot high that is tight for many people to pass through.

(Cleaveland Avenue continued)

- **Edison Monument.** Edison Monument is a large upright slab located along the trail in Cleaveland Avenue west of Jenny Lind's Dining Table. It is covered with signatures, including one prominent "Edison."
- **Jenny Lind's Dining Table** (Cornelia's Table). This named formation is a landmark along Cleaveland Avenue. It is a conspicuous, low, flat, breakdown block, 25 feet across on the floor of the passage. It is reported that Jenny Lind, the "Swedish nightingale," stood under the Last Rose of Summer and sang the song for which the gypsum flower was named. However, when Jenny Lind visited the cave on April 5, 1851, Echo River was too high to cross; the party went only as far as River Hall, also visiting Gothic Avenue and Star Chamber.[314] The rock was already known as Cornelia's Dining Table.
- **Last Rose of Summer.** This named feature is located along Cleaveland Avenue near Jenny Lind's Dining Table. It is a large, isolated

314. *Mammoth Cave Gazetteer*, from Benedict, in Martin, 1851.

gypsum flower about 8 inches in diameter and pure white in color.

- **Mammary Ceiling.** This formation is located in Cleaveland Avenue between the Floral Cross and the Last Rose of Summer. It has gypsum flowers that reflect the name.
- **Floral Cross** (Catholic Hall, The Cross, Cross in Flowers, Natural Cross). This named formation is located in Cleaveland Avenue east of the Last Rose of Summer. It is a conspicuous 2-foot-deep cross joint in the middle of the ceiling. The joints, each about 6 feet long, contain a profusion of gypsum flowers. This is about 60 feet west of the end of the concrete trail for the Mammoth Cave Accessible Tour.
- **Flora's Garden** (Donna's Flower Garden, Florist's Garden). This named formation is located along Cleaveland Avenue just west of the intersection with Miller Avenue. It is a large pyramidal breakout structure, rising to 8 feet above the level of the ceiling. At its apex is a nice display of large, grayish gypsum flowers.

Miller Avenue. Miller Avenue arises from Cleaveland Avenue and extends southeast before turning southwest. This is a major south trending side passage off Cleaveland Avenue, which joins the latter about 300 feet west of Snowball Room. The junction is partly walled off. Just beyond the start of the passage is the **Upside Down Well**. The main passage is about 3,000 feet long. It is generally a narrow canyon. A major extension to the passage was discovered in 1976.

(Cleaveland Avenue continued)

Snowball Room (Snowball Arched Way, Snowball Chamber, Snow Ball Chamber, Snow Chamber). Located along Cleaveland Avenue near the intersection with Boone Avenue, Snowball Room is famous for its gypsum 'snowballs' that cover the ceiling (Figure 153). Located adjacent to the Snowball Room is the Preparation Room, a Mission 66-era concessionaire's cafeteria, tables, and the Snowball Dining Room Restroom. The Snowball Room measures 150 feet long by 50 feet wide and is 8 feet tall. This space was first used as a dining room in 1935.

FIGURE 153. Snowball Room.

Washington Hall (Washington's Dining Hall). This is a large, circular room at the junction of Marion and Cleaveland Avenues overlooking the Snowball Room cafeteria. The space also contains a food storage and preparation structure and men's and women's restroom buildings. Stone and concrete benches line the passage to the east of the restroom buildings.

The **Preparation Room** is accessible from the Elevator built during Mission 66 located approximately 282 feet away along Marion Avenue. The Preparation Room measures 12 by 16 feet and sits on a concrete slab that is integral to the floor of this area. The walls of the structure extend 7 feet 9 inches in height is built of 4-inch CMU, a portion of which are painted, and other portions of which are plastered and painted. There is a walk-in cooler that measures 6-by-6-by-6-foot 10 inches integral with the wall on one corner. A steel fascia painted black surrounds the top of the outside wall. The structure has no roof. The door is a walk-in freezer door covered outside with plywood. A rubber seal is between the plywood and the outside wall, and there are three hinges and a latching mechanism. There is a water heater inside the Preparation Room.

The **Snowball Room Dining Room Restroom** sits along the passage that edges the dining room. There is a Men's and a Women's restroom. Each is equipped with six toilets and four sinks, all made by American Standard. The interior floor is red tile, while the interior walls are terra cotta tile. The

exterior walls are stacked limestone along the passage and natural cave walls inside. The restroom measures 19 feet 3 inches by 30 feet 6 inches. The tile work and the fixture all appear to be original.

Marion Avenue. This passage extends northwest from Cleaveland Avenue at the Snowball Room and Washington Hall. It provides a connection with the Elevator. The passage is lit with upright lights. Marion Avenue is a long trunk tube averaging 20 feet in width and extending for about 4,000 feet. The passage eventually ends in a pile of sediment at the edge of **Houchins Valley**. Side passages include (from south to north) Dollar Pass (see above), **George's Path**, **Sophy's Avenue, Dan's Avenue**, and **Stephen's Way**. Named formations include **Christopher's Dome** and **Katherine's Domes**. Located along the lighted trail in Marion Avenue near the Elevator are the **stone foundation ruins of former women's restroom facilities** (Figure 154). There is also a **concrete platform** provided for visitors to use in placing their lanterns. A **metal bridge structure** is used to convey the trail over a pit near Mary's Vineyard.

FIGURE 154. Foundation ruins of former women's restrooms along Marion Avenue.

George's Path

Located between Marion and Cleaveland Avenues, George's Path is a lost passage that is currently blocked but was once a continuation of Dollar Pass. George's Path originally extended for several hundred feet from Marion Avenue to join Cleaveland Avenue east of the Snowball Room. Both ends of the passage have been thoroughly blocked by later trail building.

Elevator Entrance (Snowball Entrance)

The elevator service and accessibility entrance is connected to Marion Avenue near the Snowball Room, approximately 300 feet north of the Cleaveland Avenue junction. It was established in 1958 to service the cafeteria. The elevator shaft is approximately 250 feet deep. The Elevator Building sits in a sink to help screen it from view. The elevator has been altered to accommodate later needs. New utility chases have been drilled to install updated electrical and telephone, and water and sewer lines into the cave. The rubble created by the original construction of the elevator remains in evidence along the margins of trails nearby. At the ground level, the **Elevator Building** measures 26 by 52 feet in plan. It features a 4 in 12 pitch gable roof at two levels with continuous ridge vents. The roof is covered with brown, three-tab fiberglass shingles. The upper level features a ridge that stands 29 feet 4 inches above grade while the lower level has a ridge 18 feet above grade. The principal façade has cut point sandstone walls on each end and a breezeway and a small two-story board and batten section between. The south gable end is board and batten painted light tan with no doors or windows.

Sophy's Avenue

Sophy's Avenue arises from Marion Avenue past the Elevator. Named formations include the series of domepits that end the passage—**France's Dome** and **Kennedy Domes**.

- **France's Dome.** This named formation is located in Sophy's Avenue about 350 feet from Marion Avenue.
- **Kennedy Domes.** This named formation is a series of domepits at the end of Sophy's Avenue. A passage connects to El Ghor from the domes.

(Marion Avenue continued)

- **Christopher's Dome.** This active domepit is approximately 70 feet high. It is located at the

end of a short canyon that is a continuation of **Stephen's Way** on the opposite side of Marion Avenue.

- **Katharine's Domes.** Katharine's Domes consists of a cluster of active domepits, the largest of which is 100 feet high. They are located along a side passage of Marion Avenue, a short distance beyond Dan's Avenue.

Dan's Avenue

Dan's Avenue is a 1,200-foot-long west trending trunk passage that arises from Marion Avenue. It averages 5 to 8 feet in height. It is the disjointed eastern section of the Silliman Avenue canyon, much modified by breakdown and separated from Joe's Pit at the eastern end of Silliman by only about 150 feet. The two passages have been severed by the **Double Cedars sinkhole**.

Stephen's Way (Walnut Avenue)

Stephen's Way is a fairly long western trending passage that arises from Marion Avenue near its northern end. The passage commences as a narrow canyon, later becoming a crouch and crawlway that extends to **Runt's Dome,** passing **Maud's Grotto** and **Tan's Pit**. Gypsum adorns the walls throughout.

- **Maud's Grotto.** Maud's Grotto is not a distinct room, but an area of Stephen's Way that features gypsum decoration that is particularly dense. The passage is only 4 feet high here. Maud was Ed Bishop's daughter.
- **Tan's Pit.** This 12-foot-deep blind pit occurs near the end of Stephen's Way. The name is indicated on the wall in Kaemper's writing. Tandy Bishop was one of Ed Bishop' sons.
- **Runt's Dome.** Runt's Dome is a 25-foot high dome with a breakdown floor that forms the western terminus of Stephen's Way.

(Cleaveland Avenue continued)

- **Mary's Vineyard** (Martha's Vineyard, St. Mary's Vineyard). Located at the intersection of Cleaveland Avenue and Boone Avenue/El Ghor, Mary's Vineyard is a named formation composed of an active water input at the eastern end of Cleaveland Avenue that has resulted in a protrusion of white and gray botryoidal (grape-like) speleotherms. The protrusions convey the appearance of ripe grapes, ergo the name vineyard. There are actually two inputs in the area, located approximately 6 feet apart.

Boone Avenue (Boone's Avenue, Martel Avenue)

Boone Avenue extends between El Ghor and Pilgrim Avenue. It is a high, narrow, multilevel canyon (Figure 155). The Grand Avenue Tour follows this passage for most of its length. As defined here, the passage is the eastward continuation of El Ghor beginning at Mary's Vineyard. It extends eastwards for about 2,000 feet, continuing beyond the junction with Rose's Pass, and ends in sediment fill a short way beyond the **stairs** leading down to Pilgrim Avenue. The upper-level canyon forming the eastern end of Cleaveland Avenue crosses the passage at Mary's Vineyard, rejoins it 300 feet farther east, and eventually splits off again to form Rose's Pass. Boone Avenue is generally about 10 feet wide by 25 feet high but widens considerably at Thorpe's Pit. Named side passages include **Cox Avenue, Rose's Pass,** and **Pilgrim Avenue**. Named features include **Thorpe's Pit, Ellen's Dome,** and **Holy Sepulchre**. The passage is probably named for Daniel Boone (1734–1820), Kentucky native and frontiersman. Some accounts (e.g., Whittle, 1932) have Boone as the discoverer of Mammoth Cave. Numerous concrete stair segments are associated with Boone Avenue. These are edged by metal handrails, primarily contemporary steel, but also fashioned of aluminum. Trail segments are paved with concrete, and sometimes edged with placed rock. The trail later transitions to cave soil. There are also many signatures of interest.

FIGURE 155. Boone Avenue.

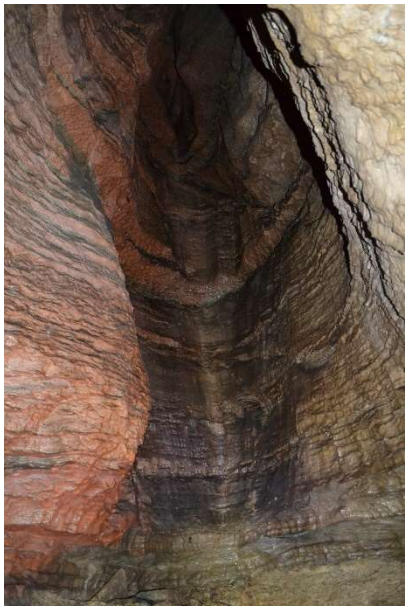


FIGURE 156. Ellen's Dome.

- **Thorpe's Pit.** Located along Boone Avenue, Thorpe's Pit is a wide, spectacular pit that forms a semicircular channel in bedrock on the south side of the passage. The pit drops about 30 feet into a deep hollow that includes a huge pile of high-angle breakdown. A stream emerges from a low bedding plane channel at the top of the pit and cascades down to the sink at the base of the rubble floor. In wet weather, the waterfall becomes quite impressive.
- **Ellen's Dome.** Located along Boone Avenue, Ellen's Dome is a 40-foot-high half dome that carries a small trickle of water in wet weather in the south wall of the passage (Figure 156). It is located at the base of a long flight of stone steps about 1,050 feet east of Mary's Vineyard.
- **Holy Sepulchre** (Chapel of the Holy Sepulchre, Hill of the Holy Sepulchre). This named formation is believed to be located above Mary's Vineyard, although the location today is not clearly known. The formation was considered to resemble a grave hewn out of the rock.

Cox Avenue (Genie's Pass)

This passage extends from the blocked **Cox Entrance** to Boone Avenue and includes **Markolf's Dome, Anna's Dome, and Blanche's Dome**.

- **Markolf's Dome.** Markolf's Dome is a large domepit, modified by breakdown, located off Cox Avenue approximately 350 feet from the Boone Avenue junction. It is named for William Schiller Markolf (January 3, 1876–February 5, 1934), a chief clerk for the L & N Railroad Co.
- **Anna's Dome**. Anna's Dome is located at the end of Cox Avenue. It is possibly named for Ed Bishop's daughter.
- **Blanche's Dome**. Blanche's Dome is located off a mid-level side passage south of Cox Avenue.

Rose's Pass (Boone Avenue, New Discovery Route, Rose's Way)

Located between Boone Avenue and **Jeanne's Avenue,** Rose's Pass is a narrow canyon averaging 8 to 10 feet wide by 20 to 30 feet high and about 1,100 feet long (Figure 157). The passage is the upstream section of a long, high-gradient canyon that drained Grand and Jeanne's Avenues. It is contiguous with the upper levels of Boone Avenue and with the easternmost canyon section of Cleaveland Avenue. The only named feature in the passage is **Saratoga Springs**. Set within the passage is the attachment for an old light fixture from the 1960s or 1970s, including embedded nails in the cave wall.

FIGURE 157. Rose's Pass.

- **Saratoga Springs**. This feature located within Rose's Pass is composed of a small, intermittent trickle.

Jeanne's Avenue (Boone Avenue, New Discovery Route). Located between the Rose's Pass/Ella's Grotto junction and Forks of the Cave, Jeanne's Avenue is a moderately large canyon about 1,100 feet long and averaging 15 feet in width and 25 feet in height. Jeanne's Avenue forms part of the Grand Avenue Tour. The passage formed an early drainage route from Grand Avenue. At its northeastern end, beyond the junction with Rose's Pass, the passage ends in a sediment choke at Ella's Grotto. Side passages, from south to north, include an unnamed crawl leading to Felicia's Dome and **Rose's Pass**. Named features include the **Rock of Gibraltar, the Harbor**, and **Felicia's Dome**. Well-developed gypsum flowers are present within Jeanne's Avenue (Figure 158). Portions of the passage are filled with sediment. Evidence of former electrical wiring attached to the wall of the cave using a concrete slurry is evident in the passage.

FIGURE 158. Gypsum flowers in Jeanne's Avenue.

- **Rock of Gibraltar** (Island Rock). Located along Jeanne's Avenue approximately 250 feet from the Rose's Pass junction is the Rock of Gibraltar. It is a large bedrock pillar in the middle of the passage that measures 20 feet high and 50 feet long, around which the trail divides. Jeanne's Avenue exhibits a complex hydrological history as exemplified by two-directional scalloping in the Rock of Gibraltar side cut.
- **The Harbor.** The Harbor is located along Jeanne's Avenue beyond the junction with Rose's Pass. It is a widening of Jeanne's Avenue, with a deep upper-level alcove above the northwestern wall.
- **Felicia's Dome.** Felicia's Dome is a small, high level domepit along a side passage that extends west from Jeanne's Avenue toward Bishop's Dome.

Ella's Grotto (Chaperon, Sheep Shelter)

Ella's Grotto is located at the northeastern end of Jeanne's Avenue beyond Rose's Pass. It forms the dead-end continuation of Jeanne's Avenue beyond Rose's Pass. The sediment floor rises steeply, and the passage is blocked with silt and clay 60 feet beyond Rose's Pass. The sediment has been excavated as a source of fill for tour trails.

(Jeanne's Avenue continued)

- **Forks of the Cave.** The intersection of Grand Avenue and Jeanne's Avenue is known as Forks of the Cave. The space is a high, flat-floored room about 50 feet wide.

FIGURE 159. Grand Avenue.

Grand Avenue (Kentucky Avenue, Crystal Avenue, Majestic Avenue, Onyx Avenue). This passage extends from Forks of the Cave to Morrison Avenue. Grand Avenue is a major upper-level trunk canyon, followed almost in its entirety by the Grand Avenue Tour (Figure 159). Grand or Kentucky Avenue is the disjointed eastern continuation of Main Cave. The passage has a total length, from a breakdown choke west of Forks of the Cave to the Frozen Niagara Entrance, of approximately 1.6 miles. Dimensions vary greatly, but average around 40 feet in width and 20 feet in height. Some areas, especially to the west, are relatively simple, straight-walled canyon, while others are extensively modified by breakdown and rise and fall over multiple levels. The eastern end is noted for its profusion of calcite mineralization. The only named side passage within this segment of Grand Avenue is **Woodbury Pass.**

Named features include **Covington's Cabinet, Crystal Chamber, Wycliffe's Dome, Alice's Grotto, Devil's Bathtub, Bismarck Dome, Mount McKinley, the Narrows, the Precipice, the Saddle, Black Onyx, Grand Canyon, Cliff Walk, Cecil's Accident, Ellen's Grotto, Moving Mountain, Gist's Dome,** and **Aero Bridge Canyon.** The passage contains several sediment banks. There are many features built to support tours within this passage, including **built up trail on stacked stone, causeway structures,** and **stone piled to form wide platforms with switchback trails edged by metal handrails.**

- **Covington's Cabinet.** Located along Grand Avenue between Forks of the Cave and Crystal Chamber, this formation is decorated with gypsum.
- **Crystal Chamber.** Located along Grand Avenue between Covington's Cabinet and Wycliffe's Dome, this formation is decorated with small gypsum speleothems (structures within a cave formed through the deposition of minerals from water, such as stalactites and stalagmites) in a location where the ceiling is relatively low.
- **Wycliffe's Dome.** Located along Grand Avenue approximately 500 feet east of the Forks of the Cave is Wycliffe's Dome, a shallow, 12-foot-high breakout dome between Crystal Chamber and Alice's Grotto. An electrical drop pipe extends from the floor to the ceiling (Figure 160).

FIGURE 160. The pipe associated with an electrical drop near Wycliffe's Dome.

- **Alice's Grotto** (Margaret's Fountain). Located along Grand Avenue between Wycliffe's Dome and Morrison Avenue, Alice's Grotto features flowstone and draperies that decorate the south wall while

the floor is covered with old, muchtrampled rimstone. The speleothems are dry and weathered, with jagged, corroded edges. A 5-foot-deep hole in the floor leads to the **Devil's Bathtub**.

- **Devil's Bathtub.** The Devil's Bathtub is a 5-foot-deep hole in the floor of Grand Avenue at Alice's Grotto. The hole in the floor is dry, but a small stream runs underneath in a very tight passage and can be heard from Grand Avenue.
- **Bismarck Dome.** Located within Grand Avenue west of Mount McKinley, Bismarck Dome is a large breakout dome, 65 feet high, that is located along the trail west of Mount McKinley. A low passage at the top connects with Denali Trail that leads to Cathedral Dome.

FIGURE 161. Mount McKinley.

FIGURE 162. Mount McKinley restrooms.

- **Mount McKinley** (Moltke Dome). Mount McKinley is located along Grand Avenue between Bismarck Dome and the Narrows. It is a large breakout dome which the trail ascends on a series of steep switchbacks (Figure 161). The room is named for the highest mountain in North America. At the summit are the Mount McKinley restroom and a cluster of concrete benches faced with stone veneer.
- **The Mount McKinley r**estroom is located at the summit of Mount McKinley. This building was completed in July 1966 (Figure 162).
- **The Narrows.** Located along Grand Avenue east of Mount McKinley, the Narrows is a bedrock narrows where the passage briefly pinches down to 15 feet in width just past the Mount McKinley restrooms. Considerable air flow can usually be felt at the constriction.
- **The Precipice.** Located at the west end of Woodbury Pass along Grand Avenue, The Precipice is an overlook set 30 feet above the trail that provides a panoramic view of the **Grand Canyon**, including its trail switchbacks.
- **The Saddle** (Arena). This formation is a large breakdown-floored dip in Grand Avenue between Mount McKinley and the Grand Canyon. The causeway crosses the dip via supported drystone walls.
- **Black Onyx.** This formation is a black onyx stalagmite located at the end of the Narrows.
- **Grand Canyon.** Located along Grand Avenue between Black Onyx and the western junction with Woodbury Pass is the Grand Canyon, a large, breakdown-floored void, where the upper level diverges as Woodbury Pass. The space reaches a height of about 70 feet. The tour trail descends the Grand Canyon from the Black Onyx level down a steep breakdown slope on a set of switchbacks, passing under an enormous, jammed breakdown block that marks the western end of Woodbury Pass (Figure 163). The Cliff Walk extends along the south wall from the Black Onyx level. After Cliff Walk was abandoned, the trail was relocated to the bottom of the room.
- **Cliff Walk.** Located in Grand Avenue, Cliff Walk is a narrow, exposed ledge leading from the west end of Woodbury Pass to the top of the Grand Canyon (Figure 164). It formed part of Morrison's New Entrance tour route and

was edged by handrails no longer present except for the cut off bases. The length of the ledge is approximately 50 feet, but even with hand rails, this must have been challenging. The route is no longer usable since a footbridge over a gap in the ledge at the Woodbury Pass end is no longer present.

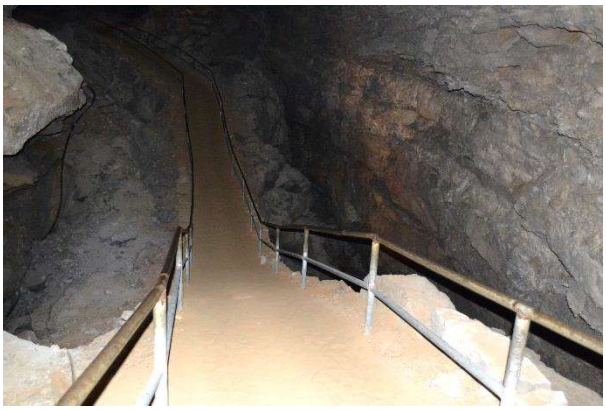


FIGURE 163. Grand Canyon trail features.

FIGURE 164. Cliff Walk.

- **Cecil's Accident.** Located along Grand Avenue at the junction of Woodbury Pass with Grand Canyon and Ellen's Grotto, Cecil's Accident is a wide, steep slope of breakdown leading from the Grand Avenue Tour trail up to Woodbury Pass.
- **Ellen's Grotto.** Located in Grand Avenue between **Cecil's Accident** and Gist's Dome, Ellen's Grotto is a 55-foot-high room at a right-angled bend along Grand Avenue, with a ceiling channel connecting to Woodbury Pass. The south wall is well decorated with flowstone and popcorn, and flowstone extends onto the floor. Ellen's Grotto is directly below an area of flowstone (part of Virginia's Grotto) in Woodbury Pass.
- **Moving Mountain**. Located between Ellen's Grotto and Gist's Dome, Moving Mountain is a steep, narrow defile along the tour trail between the wall and a series of enormous breakdown blocks. The largest of the blocks, which measures 20 by 30 feet and is 9 feet high, moved slightly to trap a maul left by a worker during the CCC era of the 1930s. The head of the maul can still be seen, as indicated by an arrow etched into the rock supporting the maul from below (Figure 165).

FIGURE 165. Moving Mountain.

- **Gist's Dome.** Located along Grand Avenue between Ellen's Grotto and Aero-Bridge Canyon, Gist's Dome is a shallow breakout room, 100 feet long, 50 feet wide and 15 feet high. It is at a higher altitude than neighboring sections of Kentucky Avenue but is not very dome-like; the ceiling is flat and there is a more or less flat floor of breakdown. An inconspicuous route to Woodbury Pass exits from the far west end of the room.

Woodbury Pass. Woodbury Pass is an 1,800-foot-long loop that extends from Grand Avenue between **Aero-Bridge Canyon** and **Grand Canyon.** Woodbury Pass is a high-level medium sized tube averaging 8 feet high by 8 to 10 feet wide, with a canyon running beneath for much of its length. At either end it intersects Grand Avenue at a spectacular overlook; the eastern end anchors one end of the Aero-Bridge cable, the western end overlooks the Grand Canyon at the Precipice. There are several intermediate connections to

Grand Avenue, including Cecil's Accident. A side passage leads to **Diamond Dome**. Named features include **Virginia's Grotto and Register Hall.** The passage formed part of George Morrison's tour route, and it contains a hard-packed trail throughout.

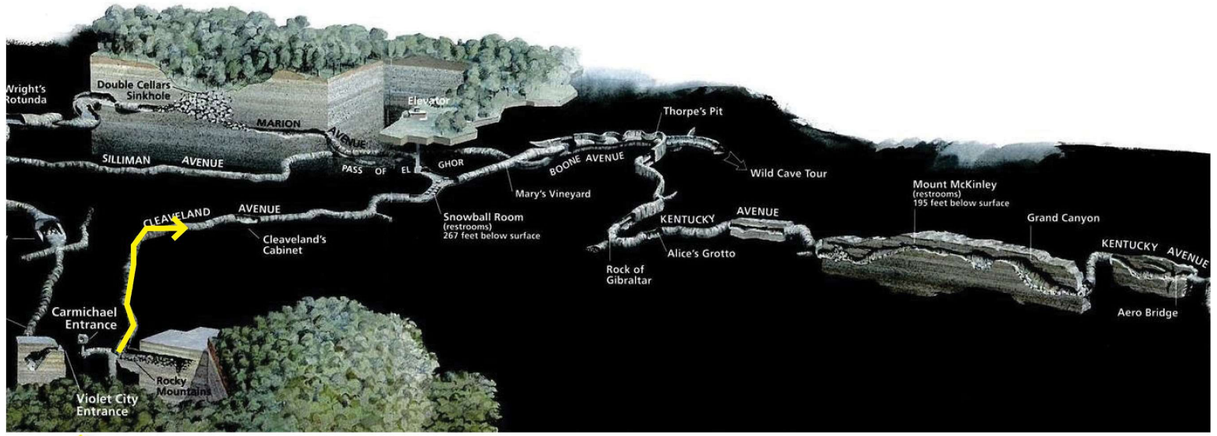
- **Diamond Dome.** This is a relatively small dome that measures 15 feet in diameter and is approximately 25 feet high. It forms the center of a maze of small canyons located off Woodbury Pass that extend for 1,100 feet. It is named for pieces of pure white calcite spar found on the walls.
- **Virginia's Grotto.** Located within Woodbury Pass, Virginia's Grotto is an extensive area of dripstone and flowstone. It includes a flowstone encrusted dome, a flowstone slope over Ellen's Grotto, and a lower level alcove with stalactites and columns.
- **Register Hall.** Located in Woodbury Pass, Register Hall is a block of stone used by visitors to write their names during the early twentieth century.

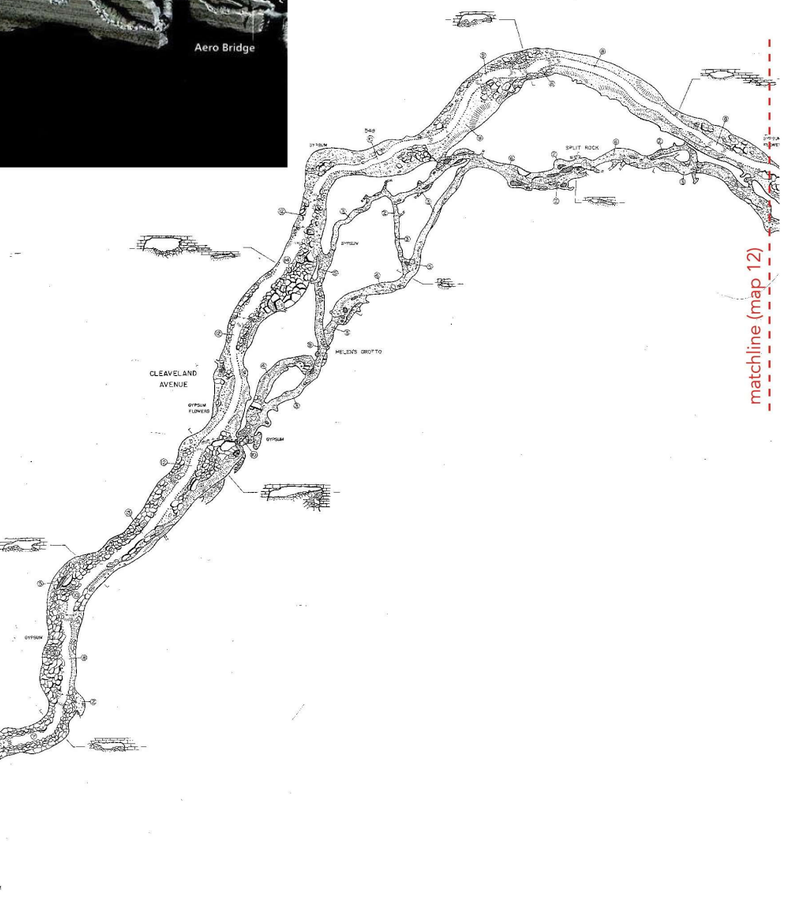
FIGURE 166. Aero-Bridge cable.

Aero-Bridge Canyon (Aero Bridge, Aero Canyon, Blair's Dome)

Located along Grand Avenue at the east end of Woodbury Pass is the Aero-Bridge Canyon. Located within the space near the ceiling is the remnant of the **Aero-Bridge Canyon cable** that stretches from the top of Heart Attack Hill across the void of the Aero Canyon into Woodbury Pass (CRIS HS #007606). The 200-foot long, 1-inch this steel cable was used by George Morrison for a period of only a few months circa 1921 or 1922 to transport trail construction materials into Woodbury Pass (Figure 166). A wooden platform and cable car associated with the cable are no longer extant. The canyon is one of the larger voids along Grand Avenue, rising to a height of 90 feet. Located within the canyon are **Blair's Dome** and **Heart Attack Hill**.

- **Heart Attack Hill.** The trail follows a steep route through this section of the canyon via a series of switchbacks.
- **Blair's Dome**. A high solutional dome in a cut-around south of the canyon.





Section 5—Upper Cave East of El Ghor to Aero-Bridge Canyon

FIGURE 167. Map 11 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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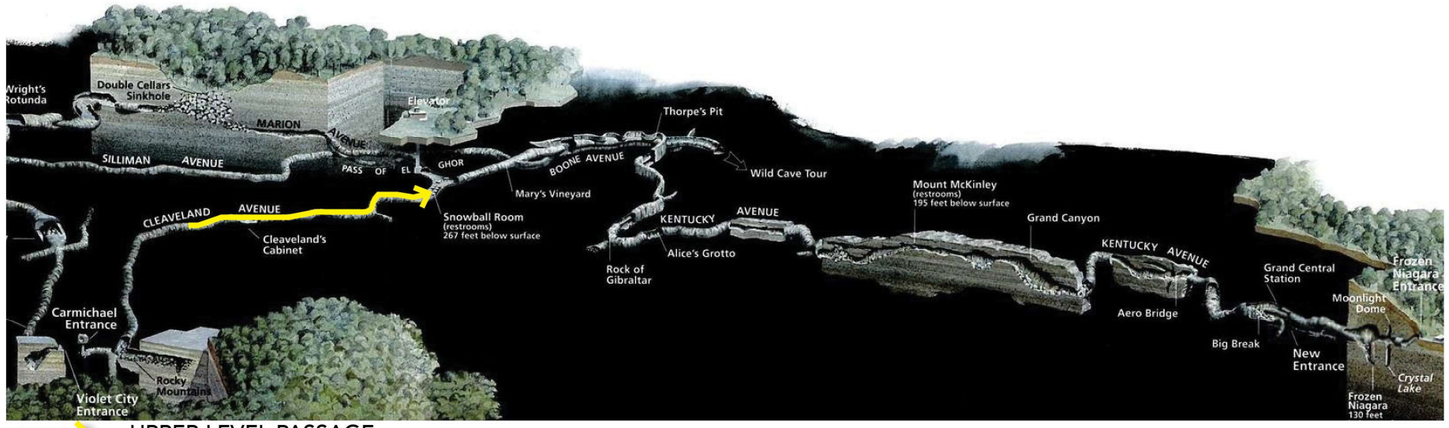

= UPPER LEVEL PASSAGE

Section 5—Upper Cave East of El Ghor to Aero-Bridge Canyon

FIGURE 168. Map 12 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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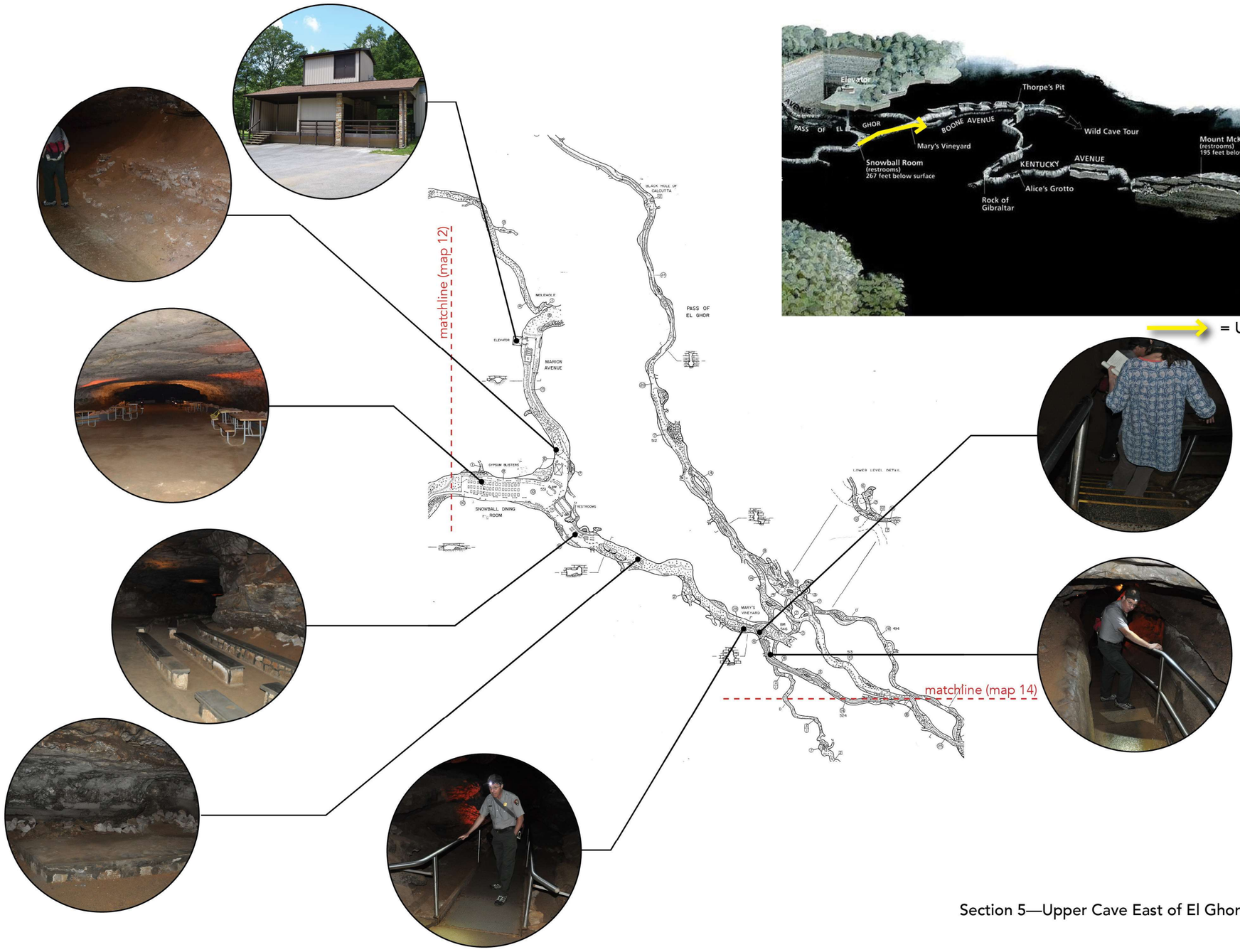

FIGURE 169. Map 13 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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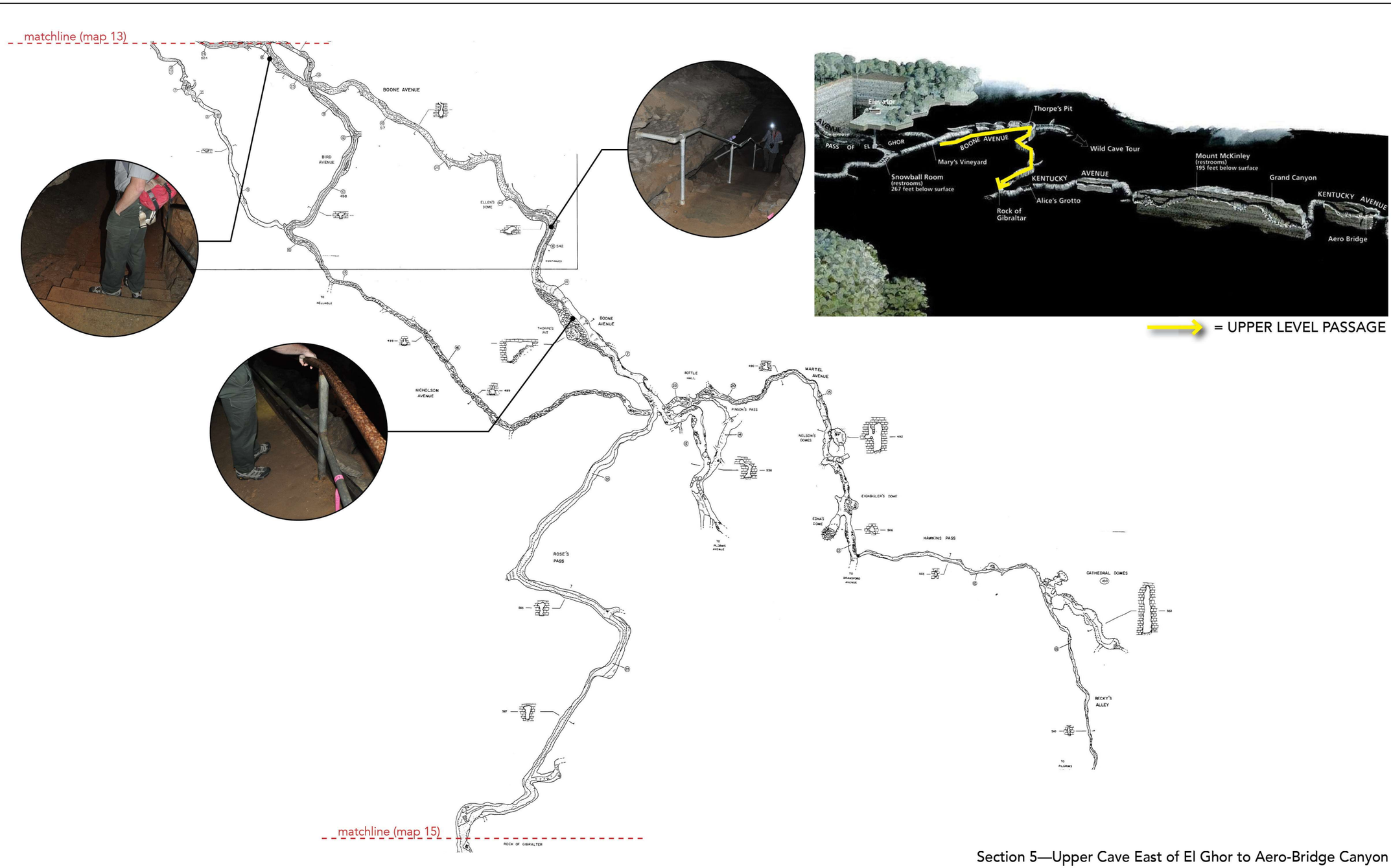

FIGURE 170. Map 14 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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matchline (map 14)

ROCK OF GIBRALTER

JEANNE'S AVENUE

FORKS OF THE CAVE

KENTUCKY AVENUE

RUTH'S DOME

BISMARK DOME

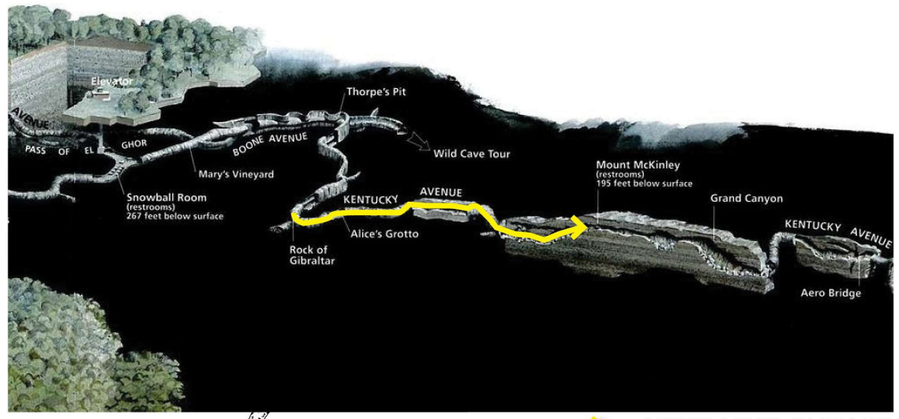
KENTUCKY AVENUE

matchline (map 16)

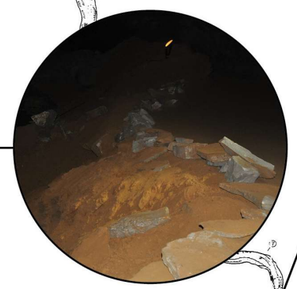
METRES

DIMENSIONS IN FEET

N



= UPPER LEVEL PASSAGE



Section 5—Upper Cave East of El Ghor to Aero-Bridge Canyon

FIGURE 171. Map 15 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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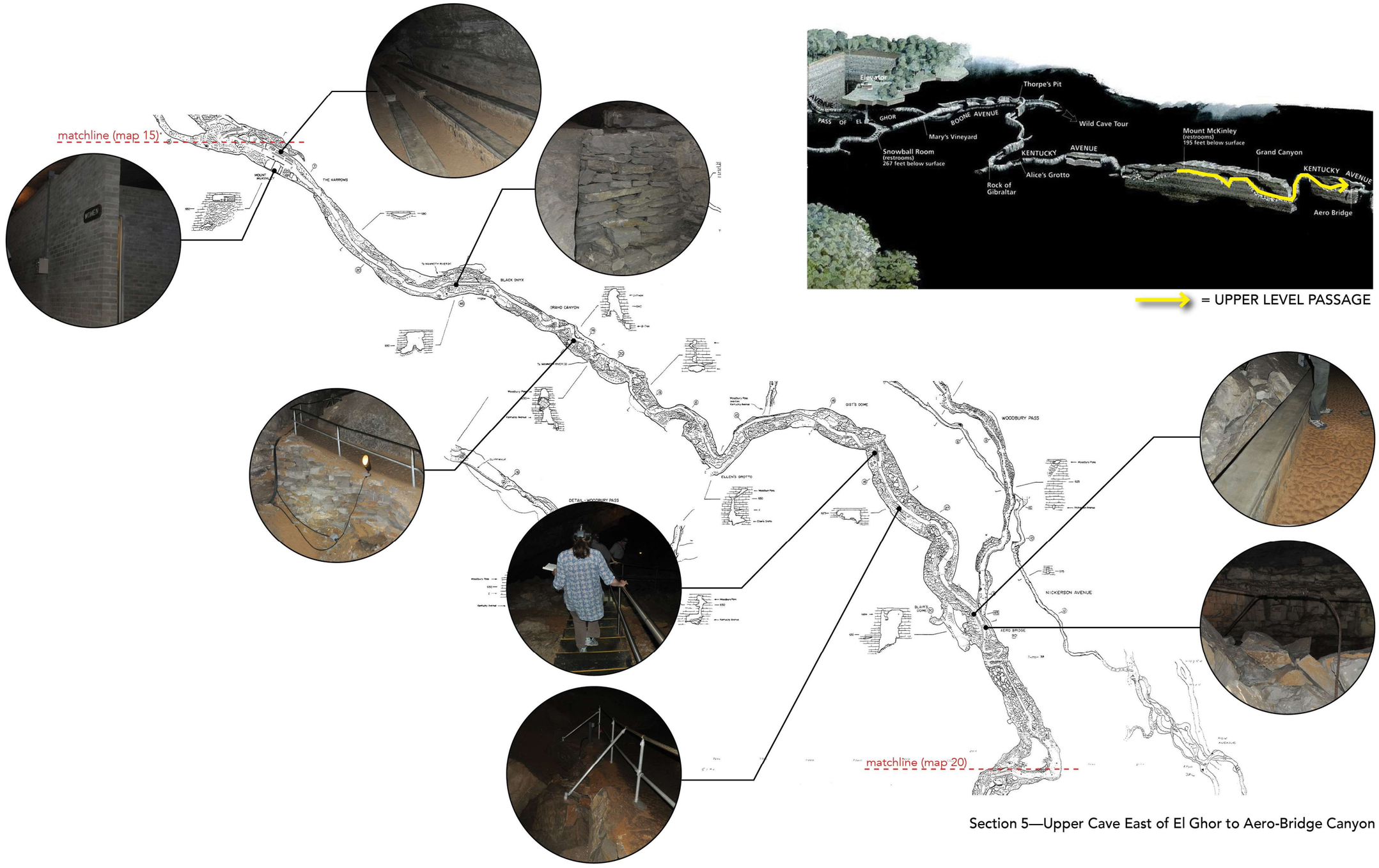

FIGURE 172. Map 16 showing Section 5, Upper Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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Section 6—Lower Cave east of El Ghor—Belfry Avenue to Ultima Thule

Refer to Figure 178 through Figure 180 that relate to Section 6 at the end of this portion of the chapter

Section 6 includes the continuation of some passages that span the break between Sections 4 and 6 at El Ghor as well as passages wholly contained within the portion of the cave that exists east of El Ghor and west of Aero-Bridge Canyon.

Belfry Avenue (Coral Avenue, Black Kettle Avenue). This passage extends between Opossum Avenue and Bransford Avenue. The passage is a long, relatively low, cherty tube, a major section of the midlevel east-west trunk of Eastern Mammoth Cave. Belfry Avenue generally averages about 5 feet in height and is between 15 and 20 feet wide. It is a continuation of the upper level of Bransford Avenue (with the lower level retaining the Bransford Avenue name and diverging northwards). About 500 feet west there is a short break caused by a flowstone blockage composed of a series of small, sharp-edged rimstone dams known as Turtle Hurdles located within a low belly crawl section. This occurs near the intersection with Mammoth River. Named side passages, from east to west, are **Blackstone Avenue, Coral Avenue, Hell Hole, Mammoth River,** and Opossum Avenue (see Section 4 above). Opossum Avenue carries the trunk line westward, while Belfry Avenue diverges northwards. Features include **Turtle Hurdles, Black Kettles, Helictite Hall, and Mary's Grotto**.

- **Turtle Hurdles.** Located within Belfry Avenue, the Turtle Hurdles are composed of small, sharp-edged rimstone dams on the floor of the passage over which visitors have to belly crawl due to the low height of the ceiling.
- **Black Kettles.** Located within Belfry Avenue, the Black Kettles are two deep solutional potholes.
- **Mary's Grotto.** This named feature is located along Belfry Avenue between Blackstone and Opossum Avenues.
- **Helictite Hall.** This formation is located along Belfry Avenue near the junction with Blackstone Avenue.

Blackstone Avenue

This passage arises from Belfry Avenue and extends southeast. A side passage contains **Galloway's Dome**.

- **Galloway's Dome.** This formation is a domepit 10 feet high and 20 feet deep in a side passage of Blackstone Avenue.

Coral Avenue

This passage extends from Belfry Avenue to Bishop's Domes. It is part of the main low-level east-west trunk of Mammoth Cave Ridge.

- **Bishop's Domes.** Located within Coral Avenue is the formation known as Bishop's Domes, named for Ed Bishop, nephew of Stephen Bishop.

Hell Hole. Hell Hole extends between Nicholson and Belfry Avenues. It is composed of a 1,600-foot-long damp crawlway along a small tube. The access point at Belfry Avenue is a hole in the wall 8 feet above floor level, suggesting the name of the passage. It may have been the route used by Ed Bishop to discover Belfry Avenue in 1907.

Mammoth River (Hickel's Trickle, Little Roaring River). Mammoth River is a long stream canyon that is decorated with flowstone and gypsum, with dripstone in the upstream section. It is considered one of the longest accessible stream courses within the cave at nearly 4,000 feet. The passage is a narrow canyon, approximately 5 feet wide and 15 feet high. There are signatures in the passage of Morrison-era guides.

Nicholson Avenue. Nicholson Avenue extends between Bird Avenue and Bottle Hall and is part of a canyon system that includes **Emily's Avenue**, **Bird Avenue**, and **Martel Avenue** and extends west from **Bottle Hall**. To the east of Bottle Hall, the passage is known as Martel Avenue. Other side passages include **Emmet's Ramble**. Nicholson

Avenue is about 10 feet wide by 15 feet high with a floor of breakdown. With a perceived dividing line at Hell Hole junction, Nicholson Avenue is about 950 feet long.

Emmet's Ramble. Emmet's Ramble is located between **Nicholson Avenue** and Hell Hole. It is a small, winding canyon, at least 1,400 feet long, forming an alternative route from Nicholson Avenue to Hell Hole. It is possibly named for the tight confines of the passage, since "emmet" is an archaic Old and Middle English term for ant.

Emily's Avenue. Emily's Avenue extends between Bird Avenue and Thorpe's Avenue. The passage is a long, medium size, midlevel canyon, part of a major east-west route from Bottle Hall to **Stevenson Avenue**. The dividing line between Emily's Avenue and Bird Avenue is considered the junction with an unnamed passage to Rhoda's Arcade. The passage contains Stephen Bishop's signature.

Emily's Puzzle. Emily's Puzzle is located between Emily's Avenue and **Mystic River**. Emily's Puzzle lies around and beneath Emily's Avenue. It is a complicated tangle of small, closely spaced channels, much more extensive in area than indicated on the Kaemper map. Two routes lead through the Emily's Puzzle to Mystic River.

Mystic River (Elephant Trunk). Mystic River is an extensive series of base-level, flood-prone tubes, with several lengthy tributaries. The stream system feeds into Roaring River and Echo River via a series of distributary sumps near Cascade Hall.

Bird Avenue (Byrd's Avenue). Bird Avenue is a relatively narrow canyon, 5 to 10 feet wide by 10 to 12 feet high, continuous with Nicholson and Emily Avenues. It forms part of a major midlevel east-west route.

Clinton Avenue. Clinton Avenue extends between Emily's Avenue and Nicholson Avenue. The passage is a narrow, low-level canyon. To the west, it forms the lower levels of Emily's Avenue. To the east it is included in the lower levels of Nicholson Avenue. In between, it follows a separate course from the upper level, which is Bird Avenue.

Bottle Hall (Lantern Hall). Located at the intersection of Nicholson Avenue, Martel Avenue, and Pinson's Pass, Bottle Hall is a breakout room with a breakdown covered floor that measures 30 feet in width by 20 feet in height.

Martel Avenue (Bransford Avenue, Nicholson Avenue). Martel Avenue is located between Bottle Hall and the **Hawkins Pass/Bransford Avenue** junction. This passage is a fairly large, low level canyon with a rocky floor (Figure 173). It constitutes the easternmost section of the **Sitgreave's Pass/Thorpe's Avenue/Emily's Avenue/Bird Avenue/Nicholson Avenue** passage. As defined by Kaemper's 1908 map, Martel Avenue is about 650 feet long, averaging about 12 feet wide by 15 feet high. Named features include **Nelson's Domes, Einbigler's Dome, and Edna's Dome**. The passage was named by Hovey (1907) for Edouard A. Martel (1859–1938), the famous French speleologist, who later spent three days at Mammoth Cave in October 1912.

FIGURE 173. Martel Avenue.

- **Nelson's Domes** (Nelson's Pit). Nelson's Domes are located along Martel Avenue. The domes include a solutional dome and neighboring domepit about 370 feet east of Bottle Hall. The solutional dome is directly

above the trail and about 30 feet high, while the domepit is larger and located off the east wall of the passage. It extends for 30 feet in height and is 30 feet deep.

- **Einbigler's Dome.** Einbigler's Dome is located along Martel Avenue, 120 feet north of Hawkin's Pass/Bransford Avenue junction.
- **Edna's Dome.** Edna's Dome is located off Martel Avenue, 100 feet north of the Hawkins Pass/Bransford Avenue junction near Einbigler's Dome (Figure 174). It is larger than Einbigler's dome, about 25 feet in diameter at the end of a short alcove.

FIGURE 174. Edna's Dome.

Bransford Avenue (Black Kettle Avenue, Bransford Way, East Bransford Avenue, Martel Avenue, West Bransford Avenue). Bransford Avenue is located south of the Martel Avenue-Hawkins Pass junction. Bransford Avenue is a major east-west low level trunk tube, notorious for its long chert crawls. The passage is divided into East and West Bransford Avenues by Bransford Barrier Pit.

Hawkins Pass (Hawkins' Way). Located near the Martel Avenue/Bransford Avenue junction on the way to Cathedral Domes, Hawkins Pass is a dry, narrow canyon about 450 feet in length. The passage averages 5 feet in width and is approximately 12 feet high. It formed part of Morrison's grand tour and is currently part of the Wild Cave Tour. Beyond Cathedral Domes, the passage continues eastward as **Becky's Alley**.

- **Cathedral Domes.** Cathedral Domes are among the most spectacular sights in Mammoth Cave, the highlight of the Wild Cave Tour. The domes are composed of a 140-foot-high regressing canyon. The canyon is 150 feet long. At least three distinct domes are distinguishable (Figure 175). A waterfall—Bridal Veil Falls—cascades down the terminal dome; the small stream usually sinks under the wall. This dome was also the entry point of **Morrison's Cathedral Domes Entrance wooden stairway**, which is no longer extant.

FIGURE 175. Cathedral Domes.

- **Bridal Veil Falls.** This waterfall at Cathedral Dome may have been named for the waterfall at Yosemite.

Becky's Alley (The Narrows, Lida's Pass). Becky's Alley is located between Cathedral Domes and Robertson Avenue. It is a high, dry, narrow, multilevel canyon, part of George Morrison's Grand Tour, and constitutes the upstream continuation of Hawkins Pass beyond Cathedral Domes. There is also an upper level which diverges to the west as Pilgrim Avenue; at the east end, the levels again diverge, the upper level being Robertson Avenue and the lower level Lida's Pass.

Lida's Pass (Carrie's Pass). Located between Becky's Alley and Gerta's Grotto, Lida's Pass is the lower level continuation eastwards of Becky's Alley, extending for about 200 feet and consisting of a maze of braided channels that range in height between 3 and 20 feet.

- **Gerta's Grotto.** Located within Lida's Pass, this named formation is at the nexus of a complicated maze of braided channels constituting Lida's Pass. There is flowstone with a stream running beneath.

Pilgrim Avenue (Lower Boone Avenue, Miriam Avenue, Pilgrims Avenue). Located between Boone Avenue and Becky's Alley, Pilgrim Avenue is a large, multilevel upper-level canyon with a good deal of breakdown on the passage floor. Pilgrim Avenue is actually the continuation of Boone Avenue. It is reached by a metal stair/ladder feature (Figure 176), with access to **Thorpe's Pit Trail**. The ladder is rusted and pitted in places, but it remains sturdy. The upper level diverges eastwards as **Bishop's Way**. The passage intersects **Pinson's Pass, Boone Avenue, and Becky's Alley**. Named features include **Florence William's Dome**. A metal stair leads to Pilgrim Avenue from Boone.

FIGURE 176. Stairs leading to Pilgrim Avenue.

- **Florence William's Dome.** This named formation, located in Pilgrim Avenue, is a large domepit that sits across the passage. The top is accessible from above Cathedral Domes.

Thorpe's Pit Trail. This passage extends from the junction of Boone and Pilgrim Avenues to Thorpe's Pit. To access the trail, it is necessary to climb down a ladder.

Pinson's Pass. Pinson's Pass is located between Pilgrim Avenue and Bottle Hall. This passage is a short, narrow, winding canyon, about 70 feet long (Figure 177). It connects the upper level of Pilgrim Avenue with the lower level Nicholson Avenue and Martel Avenue at Bottle Hall.

Bishop's Way. Located between Pilgrim Avenue and Cathedral Domes, Bishop's Way is the upper level of the Pilgrim Avenue canyon, which diverges as a separate passage leading to the top of Cathedral Domes. The passage continues beyond the top of Cathedral Domes.

Fishback Avenue. Located between Gerta's Grotto and Carrie's Pass, Fishback Avenue is the lower level route, about 700 feet long, from Gerta's Grotto to Carrie's Pass. Aubrey Clark Fishback's mother operated the Mammoth Cave Hotel.

Carrie's Pass. Carrie's Pass is the continuation of Lida's Pass eastward from Gerta's Grotto. It is generally a 15-foot high and 8-foot-wide canyon.

FIGURE 177. Pinson's Pass.

Emerson's Pass (Dave's Lost Sea, Goat Alley). Located between Carrie's Pass and Sansom's Domes, Emerson's Pass is a narrow, multilevel canyon leading south from Carrie's Pass for about 450 feet. It continues to the Goat Alley junction after which it becomes a complex mixture of domes and mazy crawls, culminating in **Sansom's Domes**, with one level diverges southwards as Goat Alley. It is perhaps named for Ralph Waldo Emerson

Goat Alley (Dave's Lost Sea, Emerson's Pass). Located between Emerson's Pass and Robertson Avenue, Goat Alley is a smallish canyon extending for about 600 feet northward from Robertson Avenue. At the northern end associated with Emerson's Pass, the passage is 20 feet high with two interconnecting levels. Near the southern end near Robertson Avenue, there is a small but intricate maze. This route is used by the Wild Cave Tour.

- **Sansom's Dome.** Sansom's Dome is located off Goat Alley at the end of Emerson's Pass. It is a series of three fairly large solutional domes, the middle one with a stream inlet. They are most easily entered via a crawlway side passage off Goat Alley. The highest dome is 60 feet tall. There are several complicated small canyons accessible at different levels from various points in the domes.

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SECTION NOT SHOWN ON PARK DIAGRAM

Section 6—Lower Cave east of El Ghor—Belfry Avenue to Ultima Thule

FIGURE 178. Map 17 showing Section 6, Lower Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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SECTION NOT SHOWN ON PARK DIAGRAM

Section 6—Lower Cave east of El Ghor—Belfry Avenue to Ultima Thule

FIGURE 179. Map 18 showing Section 6, Lower Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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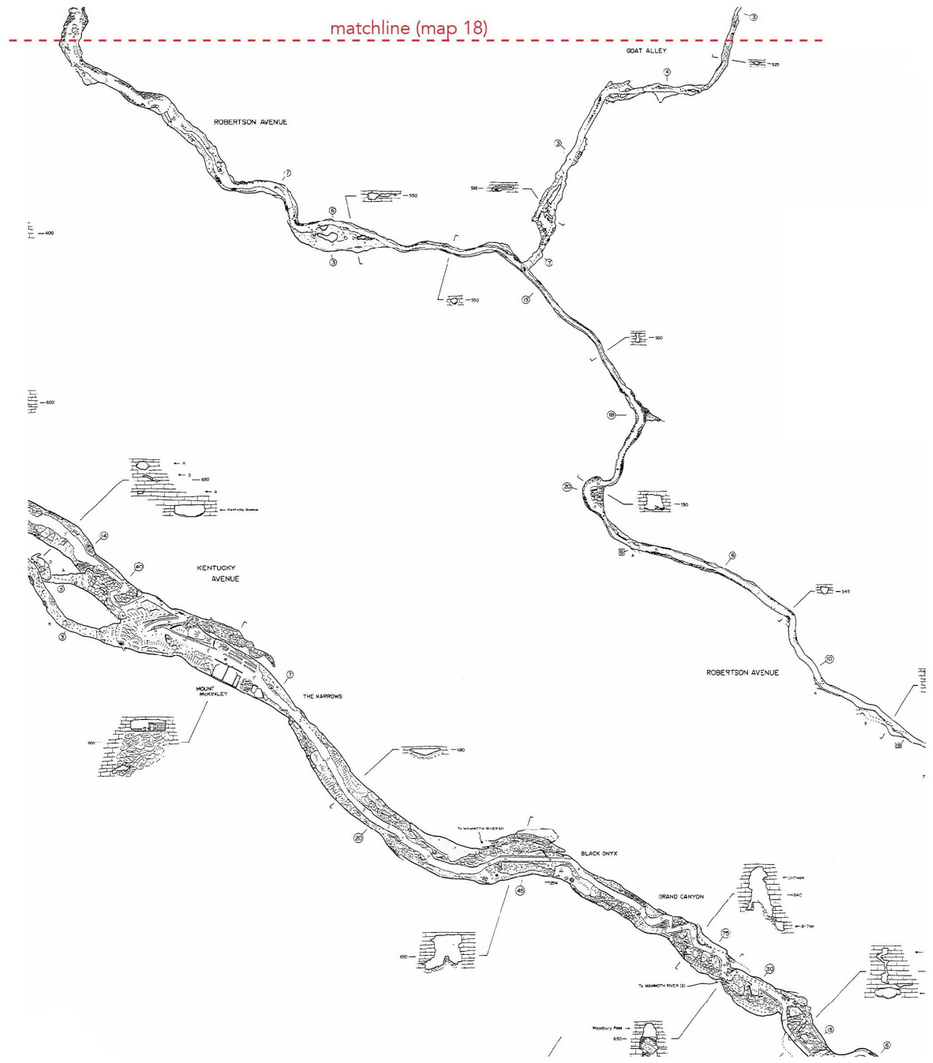

SECTION NOT SHOWN ON PARK DIAGRAM

Section 8—Lower Level Ultima Thule to Frozen Niagara

FIGURE 180. Map 19 showing Section 8, Lower Cave. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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Section 7—Upper Level Aero-Bridge to Frozen Niagara

Refer to Maps 20 and 21 that relate to Section 7 at the end of this portion of the chapter

Section 7 includes the continuation of Grand Avenue from Aero-Bridge into Grand Central Station and as it continues to the Frozen Niagara Entrance, as well as side passages at the upper level of the cave system.

Grand Avenue (Kentucky Avenue, Crystal Avenue, Majestic Avenue, Onyx Avenue). This passage continues east from the Woodbury Pass / Blair's Dome/Aero-Bridge Canyon area to Frozen Niagara. This is a major upper-level trunk canyon, followed almost in its entirety by the Half-day (Grand Avenue) Tour trail. Also referred to as Kentucky Avenue, Grand Avenue is the disjointed eastern continuation of Main Cave. Dimensions vary greatly from 10 to 60 feet in width and 6 to 50 feet in height. Some areas are extensively modified by breakdown and show multiple levels. The eastern end is noted for its profusion of calcite mineralization. Named side passages from west to east are: **Lover's Leap Route, Adeline Avenue, New York Subway, Big Gypsum Avenue, Sandy Avenue, Fox Avenue** (via many routes)**, College Heights Avenue,** and the **Radio Room**.

Named features include **New York Hippodrome, Lover's Leap, Grand Central Station, Big Break, Fairy Ceiling, No Man's Land, another Lover's Leap, Flat Ceiling Room, Compass Needle, Thanksgiving Hall, Frozen Niagara, Onyx Colonnade, Crystal Lake/Moonlight Dome, Rainbow Dome, St. Peter's Dome.** The **Frozen Niagara Entrance** also occurs within this section.

Grand Avenue contains numerous examples of early trail building, including Morrison-era steps and rock trails, CCC-piled rock trails surfaced with cave soil and causeway features (Figure 181), and Kyrock surfaced trails. The terrain varies greatly, and the trail passes numerous drop off points. Metal handrails and guardrails have been added in many locations by the National Park Service to ensure the safety of visitors. Beyond Fairy Ceiling is a series of concrete stairs edged by metal handrails. As the passage enters Grand Central, there are several sections of concrete stairs edged by metal handrails.

FIGURE 181. Causeway located along Grand Avenue likely constructed by the CCC.

- **New York Hippodrome.** Located along Grand Avenue, the New York Hippodrome is a very large, breakdown floored room between Aero-bridge Canyon and Grand Central Station (Figure 182). It is the largest single room along Kentucky Avenue. The trail extends through the space, built up on piled rock and edged by metal handrails.

Lover's Leap Route. Located between Grand Central Station and New York Hippodrome, this is an old tour trail, presumably dating from Morrison's New Entrance tours. It follows the upper level of Grand Avenue between Grand Central Station and New York Hippodrome. From Grand Central Station, it ascends steeply through breakdown, crosses back over itself, and levels out along a wide tube, passing the second Lovers Leap before rejoining the main trail via switchback.

Adeline Avenue (Adeline's Avenue, Adeline's Passageway). Located in Grand Avenue between the New York Hippodrome and Grand Central Station, Adeline Avenue falls where Grand Avenue splits into three levels. Adeline Avenue is the low-level route followed by the Grand Avenue Tour. It is a narrow passage with a south wall defined by breakdown. Here the passage connects in several places to the other higher levels. There is a gypsum wall that has been protected with a chain-link fence. A narrow stairway connects the two sub-levels.

FIGURE 182. Trail through New York Hippodrome.

- **Lover's Leap** (Old Lover's Leap). This formation overlooks the New York Hippodrome in Grand Avenue. This is the first of two Lovers Leaps along Morrison's New Entrance trails. It is a promontory giving a spectacular overlook of the large void of the New York Hippodrome. A tour trail, no longer used, branches from the main trail in the Hippodrome, ascends to Lovers Leap, and continues at the upper level, rejoining the main trail at Grand Central Station.
- **Grand Central Station.** Located along Grand Avenue at the junction with New Entrance, Grand Central Station is a junction of several passages. This junction is the room below Big Break where the Adeline Avenue and Lover's Leap Routes join Grand Avenue and connect with the passage from the New Entrance. The room is 20 feet high and is occupied by twenty rows of wooden benches (**Figure 183**). Metal stairs and steep trails provide access to the space.

Figure 183. Grand Central Station.

- **Big Break**. Located in Grand Avenue at the east end of Grand Central Station, Big Break is a large, high breakdown pile. The tour trail rises up the breakdown pile by a series of switchbacks and narrow stairs. In places the passage is greatly constricted by breakdown walls and ceiling. Located in this vicinity are stone steps and a causeway likely constructed by the CCC.
- **Fairy Ceiling** (Plaster Ceiling, Smooth Ceiling). Located within the Grand Avenue passage, Fairy Ceiling is in a 15-foot-high room along the tour trail east of Big Break. The ceiling is flat and unadorned, except for two clusters of thick, 1-foot-long desiccated stalactites, and a line of smaller stalactites following a minor joint. The decorations are clearly visible due to a wide expanse of light-colored ceiling. There is a set of wooden benches beneath the stalactites.
- **No Man's Land.** Located in Grand Avenue between Lover's Leap and Fairy Ceiling, No Man's Land is a 30-foot-deep canyon of jumbled breakdown that diverges steeply down from the tour trail to the west. It crosses beneath Grand Avenue before ending in breakdown.

Sandy Avenue. Located off Grand Avenue at No Man's Land, Sandy Avenue is mostly covered with massive breakdown, but there could be one sandy stretch. No Man's Land and Sandy Avenue are disjointed ends of the same passage. The trail through Sandy Avenue is surfaced with cave soil. It is sometimes edged by metal handrails.

FIGURE 184. Lover's Leap.

- **Lover's Leap** (Standing Rock). This is the second formation referred to as Lovers Leap in Grand Avenue. Located between No Man's Land and Flat Ceiling, the formation is a large, narrow breakdown block, standing on edge, and

angling out from the tour trail to overlook Lover's Leap Canyon (Figure 184). The drop off its end is only 15 feet.

- **Flat Ceiling Room.** Located in Grand Avenue between Lover's Leap and Thanksgiving Hall, Flat Ceiling Room is a wide, low room. The pale cream-colored ceiling (Figure 185) extends 7 to 8 feet above the trail and is remarkably flat and almost 100 feet wide.

FIGURE 185. Flat Ceiling Room.

- **Compass Needle** (Compass Point). The Compass Needle is located in the Flat Ceiling Room in Grand Avenue. It is a long, needle shaped piece of breakdown that protrudes from the south wall of Kentucky Avenue at the west end of the Flat Ceiling Room. It resembles the needle of an old-fashioned compass. The needle is somewhat curved, but it does point approximately north.
- **Thanksgiving Hall.** Located immediately west of Frozen Niagara, Thanksgiving Hall is a large, breakdown-floored room, about 50 feet wide by 100 feet long. The tour trail crosses the room on a causeway of breakdown. There is a formation on the south wall that resembles a bird or a turkey more specifically.
- **Frozen Niagara** (Niagara Falls reproduced in Onyx, Onyx Chambers) (Figure 186). Located in Grand Avenue about 350 feet from the Frozen Niagara Entrance is the most famous of the Mammoth Cave formations. Frozen Niagara is a massive flowstone cascade, the highlight of the eponymous tour. The cascade is about 30 feet wide and 50 feet high and extends below the level of the trail in some places. The formation is generally desiccated, and dark gray-green in color. The trail provides access to the Onyx Colonnade, while a causeway crosses Crystal Lake. A flight of stairs leads to the Drapery Room. From the rotating door at the entrance to Frozen Niagara, the trail is surfaced with metal causeway. After a sharp turn, the trail is surfaced with concrete and periodically edged by stainless steel railings with metal mesh. Steps and portions of the concrete trail have applied non-skid coating. Transformer pads are located along the trail in some places. Galvanized steel stairs lead to the Drapery Room. The trail is later surfaced with cave soil. Concrete stairs edged with handrail occur within the trail.

FIGURE 186. Frozen Niagara.

- **Onyx Colonnade** (Hindu Temple). Located at Frozen Niagara, this formation is a line of pale, desiccated, dripstone columns and stalagmites that extends for 25 feet along the tour trail, between Frozen Niagara and Crystal Lake. The speleothems have been named the Wedding Cake, Hindu Temple, Chinese Pagoda, and the Lion's Den. A metal fence separates the Onyx Colonnade from the trail to protect the formations from visitors.
- **Crystal Lake/Moonlight Dome.** Located above Crystal Lake is Moonlight Dome, a 35-foot-high dome associated with the Crystal Lake domepit. The dome is somewhat active in wet weather, and features cascades of flowstone and draperies.
- **Rainbow Dome.** Located along Grand Avenue between Crystal Lake and Saint Peter's Dome, Rainbow Dome is a 40-foot-high dome along the trail. The dome is active in wet weather. Its walls

are covered with multicolored flowstone known as the Onyx Theater Curtain. The floor is also covered with rimstone, flowstone, and dripstone.

- **Saint Peter's Dome.** Located near Frozen Niagara, Saint Peter's Dome is a large stalagmite that forms the centerpiece of Onyx Chamber at the south end of Rainbow Dome.
- **Drapery Room** (Old Tutt's Tomb) (Figure 187). The Drapery Room is a dome-like space located beneath the flowstone cascade of Frozen Niagara. From the metal stairs leading into the room and within the room itself visitors can observe closely spaced, massive draperies that hang from the ceiling of the room about 40 feet above. The walls are covered with flowstone and dripstone that have been given names such as the Golden Fleece and the Chinese Temple.

FIGURE 187. Drapery Room.

- **Radio Room.** Located off Grand Avenue near Frozen Niagara, this is a large room branching below the level of the main passage that was used for radio broadcasts in the 1930s.
- **Frozen Niagara Entrance.** The Frozen Niagara Entrance (LCS 005566) provides access to the eastern end of Grand Avenue. The entrance was excavated by George Morrison in 1924, enabling him to establish a door-to-door tour from his New Entrance. The exterior area is accessed by a paved road that leads to a looped drop-off for visitors. A concrete walk leads to the entrance. A shelter protects a cluster of benches beside the walk for queuing. The entrance occurs via a steel door set into a coursed sandstone wall that leads to a revolving door that controls air flow within the cave. Once inside, visitors follow a metal catwalk to a set of metal stairs (Figure 188). At the base of the stairs, the trail is surfaced with concrete and edged by metal handrails and lint guards. The entrance extends through an excavated tunnel that slopes gently down to intersect Grand Avenue. Lighting in this area is aluminum LED lights installed in 2011.

FIGURE 188. Frozen Niagara Entrance.

New York Subway. Located between Grand Central Station and New Entrance, New York Subway is a narrow, relatively low, sandy-floored tube, about 150 feet long. It is traveled as part of the Frozen Niagara Tour. Part of the trail is surfaced with a manufactured grate with a non-skid coating, while the section that approaches Grand Central is concrete.

Big Gypsum Avenue (Gypsum Avenue). Located between Grand Avenue at Big Break and Fox Avenue, Big Gypsum Avenue is a moderately large midlevel canyon. It features a gypsum wall with flowers and crusts. It was included on Morrison's grand tour.

New Entrance (Hotel Entrance). Located on the southeastern flank of Mammoth Cave Ridge, New Entrance leads to Grand Central Station. The entrance is at the bottom of a deep sinkhole and leads into an impressive series of pits. It was excavated and blasted out in 1921 under the

direction of George D. Morrison to set up competition with the Mammoth Cave estate. Evidence of blasting remains on the walls of the cave access corridor. Morrison built a hotel on the hillside near his New Entrance for visitors. The exterior features concrete steps and handrails leading down to a concrete box entrance. Inside, visitors descend via a metal staircase to concrete walks, a concrete causeway, and metal catwalks added in the 1990s. Some of the concrete walks are older based on the visibility of saw marks in the formwork used to construct the walks. These replaced Morrison's original use of wooden stairs.

Features in the New Entrance shafts include **Roosevelt Dome, Jawbone Dome, Fossil Dome, Wilson Dome, Silo Pit, and King Solomon's Temple**. At the bottom of the shafts, the New York Subway leads into Grand Central Station in Grand Avenue. The entrance was closed in September 1967, due to concern over possible instability. In 1987, a new series of aluminum stairs were installed (Figure 189). The Frozen Niagara Tour enters the cave at New Entrance.

FIGURE 189. New Entrance.

- **Roosevelt Dome.** Located in the New Entrance shafts, Roosevelt Dome is the central domepit in the New Entrance complex. The dome is approximately 130 feet in height.
- **Jawbone Dome.** Located in the New Entrance shafts, Jawbone Dome is located near Fossil Dome. The half dome is about 35 feet high; the "jawbone," which was still visible until recently, seems to have been vandalized.
- **Fossil Dome** (Crescent Dome). Located in the New Entrance shafts, Fossil Dome is a beautiful 35- to 40-foot-high crescent-shaped dome and abounds in fossils. The fossils consist mainly of masses of crinoid stems on a ledge. But there are also many mollusks and other small, shelly fossils.
- **Wilson Dome.** Located in the New Entrance shafts between Roosevelt Dome and Silo Pit, Wilson Dome is a 20-foot-wide, 70-foot-deep solutional domepit.
- **Silo Pit.** Located in the New Entrance shafts between Wilson's Dome and King Solomon's Temple, Silo Pit is a 95-foot-deep dome and pit, circular in cross section.
- **King Solomon's Temple.** Located at the bottom of the New Entrance shafts, King Solomon's Temple is the largest of the New Entrance domepits, with the highest section reaching 100 feet. The tour trail crosses it on a causeway partway down the main shaft.

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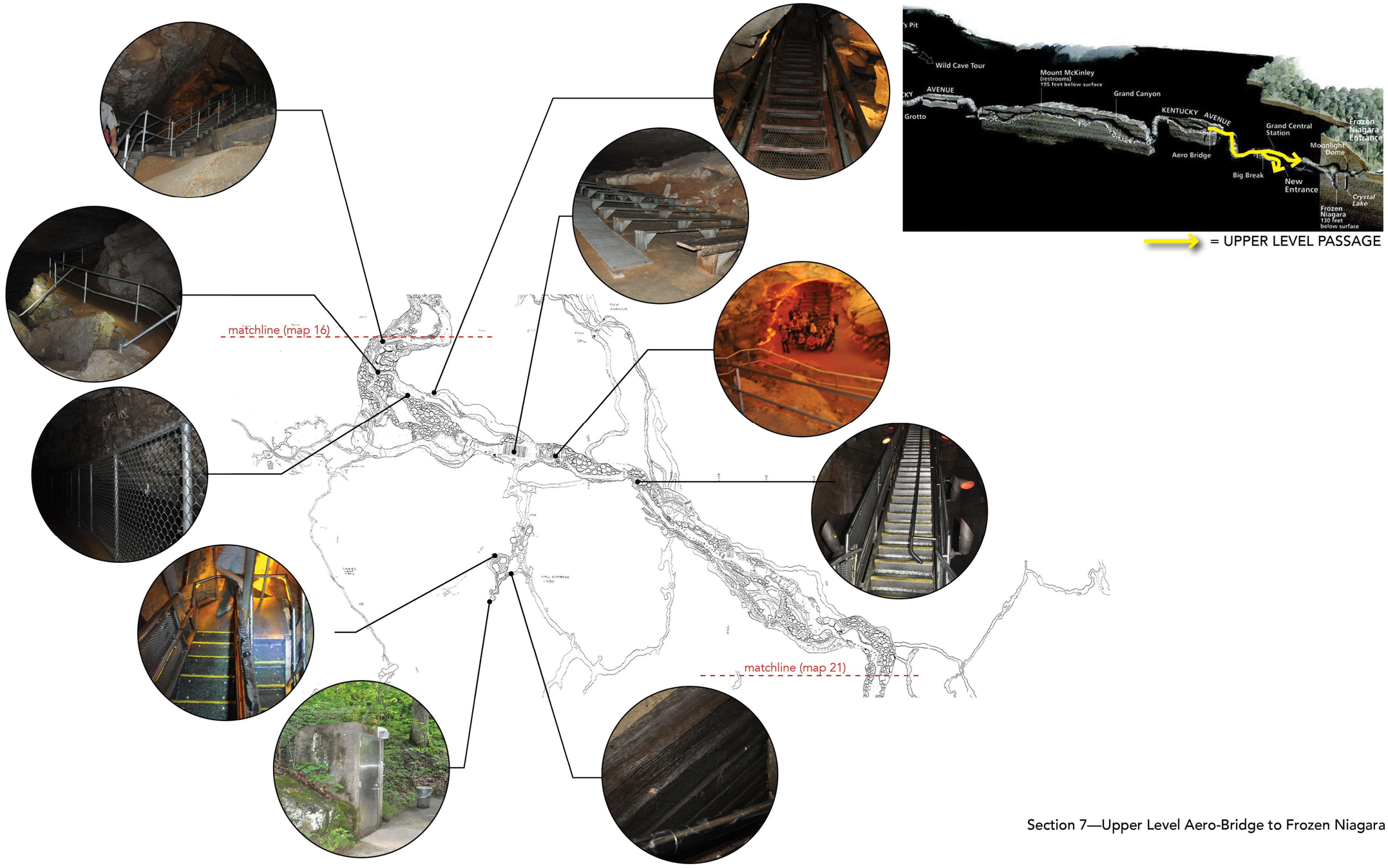

FIGURE 190. Map 20 showing Section 7, Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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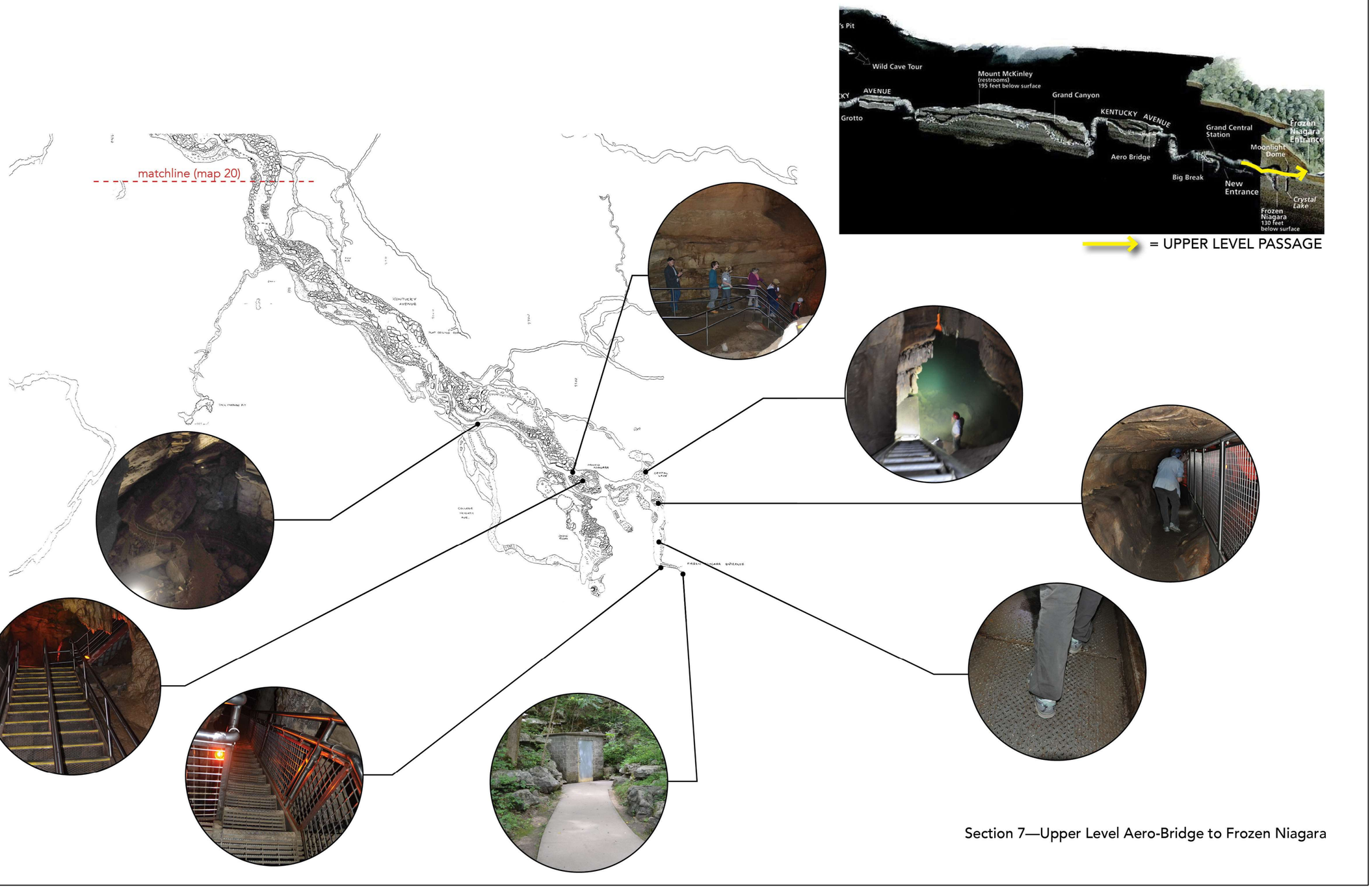

FIGURE 191. Map 21 showing Section 7, Upper Level. (Source: LSHLA, incorporating National Park Service and Cave Research Foundation imagery)

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Section 8—Lower Level Ultima Thule to Frozen Niagara

Section 8 includes the continuation of passages from Section 6. Section 8 is indicated on Figure 180.

Fox Avenue (via many routes). Fox Avenue extends under the east end of Grand Avenue before diverging to pass Big Gypsum Avenue and Nickerson Avenue. There are two Fox Avenues in Mammoth Cave. This is the eastern of the two. The passage is a long, multilevel canyon that measures 15 to 20 feet in height and is 6 to 10 feet wide. Named side passages, from east to west, include **College Heights Avenue, Logan Avenue, Big Gypsum Avenue**, and **Nickerson Avenue**. The latter two passages are part of the same upper-level channel that connect with a lower level of Grand Avenue at one end via Big Gypsum Avenue, and Robertson Avenue at the other via Nickerson Avenue. Fox Avenue splits into two branches at its northwestern end. Both end within several hundred feet. A side passage at the end of the left fork leads into a complex of small active domes and canyons referred to as **Great Gushing Mammoth Cascades**, which lead to Bransford Avenue at Bransford Barrier Pit.

- **Great Gushing Mammoth Cascades**. This formation is located between Fox Avenue and Bransford Barrier Pit. It is a complex series of small waterfalls and canyons. A 25-foot-long rope descent lands on the West Bransford Avenue brink of the pit.

College Heights Avenue. College Heights Avenue extends below Grand Avenue as a side passage of Fox Avenue. There is a plaque at the entrance to the passage that reads "College Heights Avenue. Honoring Western Kentucky State Teacher's College whose class in physiography was the first party to explore these passages October 20, 1928. Dedicated May 20, 1929." The passage is an 8-foot-high canyon, about 500 feet long, with several cut-arounds. It ends beneath the Radio Room located off Frozen Niagara.

Logan Avenue. Logan Avenue branches off Fox Avenue and leads to East Bransford Avenue. This is a relatively small, complex, multilevel canyon that cuts down from Fox Avenue, where it is entered via a small window in the wall. The passage continues to the lower level East Bransford/Cocklebur complex.

Bransford Avenue (Black Kettle Avenue, Bransford Way, East Bransford Avenue, Martel Avenue, West Bransford Avenue). Located between the Martel Avenue/Hawkin's Pass junction and the Little Hope J Survey, Bransford Avenue is a major east-west low level trunk tube that can only be followed with long chert crawls. The passage is divided into East and West Bransford Avenues by Bransford Barrier Pit.

- **Bransford Barrier Pit.** Located within Bransford Avenue, Bransford Barrier Pit is a 20-foot-high domepit that spans the passage and forms the division between so named East and West Bransford Avenues. The dome connects via a series of small canyons that are part of the Great Gushing Mammoth Cascades to Fox Avenue. It is possible for experienced persons to free climb the pit.

Robertson Avenue. Located between Becky's Alley and Nickerson Alley. Robertson Avenue is a 3,800-foot-long passage that alternates between a tube and a canyon. The original tube appears to have undulated in the vertical plane. The passage is contiguous with Nickerson Avenue to the east and with the upper level of Becky's Alley to the west. At the western end, Becky's Alley splits into upper and lower level routes. Robertson Avenue follows the upper-level route, and Lida's Pass the lower level route. The eastern end includes a small wood bridge. There is a sign on the wall just west of the bridge that indicates the passage name. The western end of the passage features an exceptionally broad meander.

Goat Alley. Goat Alley extends between Emerson's Pass and Robertson Avenue, with contemporary usage incorporating the entire route from Carrie's Pass. The passage has also been referred to as Dave's Lost Sea. Goat Alley is

generally a smallish canyon extending for about 600 feet northward from Robertson Avenue. At the northern end where it meets Emerson's Pass, Goat Alley reaches a height of 20 feet, but has two interconnecting levels. Near the southern end at Robertson Avenue, there is a small intricate maze of passages. This area is often visited by the Wild Cave Tour.

Nickerson Avenue (Carl Avenue, New Avenue). Located between Fox Avenue and Robertson Avenue, Nickerson Avenue is a 1,400-foot-long, austere, relatively narrow canyon. This was included in Morrison's New Entrance tour route. It is now followed by the Wild Cave Tour. The canyon averages 10 feet in height and is 4 feet wide. There is occasional breakdown on the passage floor. Nickerson Avenue branches off from Fox Avenue about 15 feet farther along the passage. It is a paleo-downstream continuation of Big Gypsum Avenue. Partway along, East Robertson Avenue, considered to be a disjointed continuation of Fox Avenue, reenters, at which point the floor drops to the level of the latter. After this point, the passage is known as Robertson Avenue. The dividing line between Nickerson and Robertson Avenues is a wooden bridge that crosses the entrance to East Robertson Avenue—the division is labeled as such on the wall of the passage just west of the bridge. There is a small but extensive high-level cut-around known as Upper Nickerson Avenue, and several small, short side passages.

Mammoth Cave Tours and Tour Routes

Refer to Figure 86 and Figure 149 for maps showing selected Mammoth Cave tours.

The NPS currently manages Mammoth Cave through carefully orchestrated access to the cave interior that includes several options for guided tours. The NPS currently offers fifteen different cave tours. These include the Historic Tour, Frozen Niagara Tour, Domes and Dripstones Tour, Grand Avenue Tour, Violet City Lantern Tour, Star Chamber Tour, River Styx Tour, Gothic Tour, Broadway Tour, Cleaveland Avenue Tour, Discovery Tour/Mammoth Passage Tour, Mammoth Cave Accessible Tour, Wild Cave Tour, Introduction to Caving, and Trog Tour. Many of the tours begin at the Historic Entrance, which is located within walking distance of the park visitor center, hotel, and restaurant. Entry via other cave entrances requires the use of tour buses that shuttle visitors to and from the visitor center. According to park records, 40 percent of people choose the Historic Tour, and another 40 percent choose either the Frozen Niagara or Domes and Dripstones Tour. The Wild Cave Tour is the most strenuous. It is offered only once per day and includes groups of no more than fourteen individuals who are at least 16 years of age.

The tours have been designed to accommodate a range of physical abilities and time availability on the part of visitors. Each tour follows a pre-determined route and focuses on a curated presentation of the natural and cultural history of the cave. Typically, two park rangers accompany each tour, including a lead interpreter at the front, and an individual who follows the tour to ensure the safety of visitors and cohesion of the group. The tours are staggered to allow each tour group to experience the cave without overlapping other groups, and to protect the cave resources. The NPS provided tours for approximately 500,000 visitors in 2017. The relationship among tours and the carrying capacity of the cave are currently the focus of a cave management plan.

Each of the tours is summarized below.

Historic Tour (Red)[315]

The Historic Tour leads to several well-known Mammoth Cave landmarks, including those visited by notable writers, scientists, military figures, and celebrities during the nineteenth and early twentieth centuries prior to National Park designation. The tour is indicated as moderately difficult, 2 miles in length, with 440 stairs and an

315. Color designations relate to the National Park Service delineation of tour routes for visitors. Not all the tour offerings are identified by color. See River Styx tour below, for example.

elevation change of 300 feet. The tour lasts for two hours. It is offered seven times per day during the summer months. A maximum of 110 people can participate in each tour. The Historic Tour overlaps in places with the **Violet City Lantern, Star Chamber,** and **Gothic Tours.** It is seen in its entirety on the **River Styx Tour.**

FIGURE 192. A tour group exiting Mammoth Cave after finishing the Historic Tour.

The Historic Tour begins and ends at the Historic Entrance (Figure 192). It follows Houchins Narrows to the Rotunda. Here, visitors learn about the various artifacts on display that relate to the saltpetre-mining efforts that made Mammoth Cave famous during the War of 1812. The tour then follows Broadway to Booth's Amphitheater, a wide high space formed in the soluble limestone at the intersection of Broadway and Gothic Avenue. Booth's Amphitheater, named for Edwin Booth, an actor, who used Tower Rock as a stage to give a recital of Hamlet's soliloquy, contains additional extensive evidence of saltpetre mining. Continuing along Broadway, visitors learn about Native American use and activities within the cave. The next stop is the so-called Giant's Coffin, a large breakdown block that disguises the entrance into the Wooden Bowl Room beyond. Visitors pass into the Wooden Bowl Room via Dante's Gateway, and then travel downward via a flight of stairs to Black Snake Avenue. Following Black Snake Avenue, visitors experience Side Saddle Pit as well as Bottomless Pit. The next stop if the popular Fat Man's Misery, which is followed by Great Relief, a space that was named for the joy visitors felt for open space after their journey through Fat Man's Misery. Restrooms are also located in Great Relief. The tour continues past Vanderbilt University Hall to Sparks Avenue, which leads to the Ruins of Karnak, a formation of dramatic bedrock pillars. Just past the Ruins of Karnak is Mammoth Dome, the tallest of this formation type within Mammoth Cave. Visitors are afforded dramatic views of the dome before walking up Mammoth Tower, a steel staircase structure that returns them to the upper level of the cave interior. From Mammoth Dome, visitors travel Little Bat Avenue to Audubon Avenue, which features several interpretive exhibits. Audubon Avenue leads to the Rotunda, where visitors can retrace their steps through Houchins Narrows to the Historic Entrance to Mammoth Cave.

Frozen Niagara Tour (Orange)

The Frozen Niagara Tour is indicated as one of the less challenging tours for visitors to Mammoth Cave. It follows a route that totals 1/4-mile in length through a passage that contains dense displays of flowstone and dripstone formations. The tour is scheduled to last 1-1/4 hours, and traverses fairly level terrain and few stairs. The focus of the tour is the formations known as Frozen Niagara, the largest single travertine deposit of the cave. Frozen Niagara is a large mass, 75 feet high and 45 feet wide, formed through centuries of slow deposition of limestone from water flowing and dripping over blocks of fallen wall and ceiling rock. Visitors have the option of walking a staircase with ninety-eight risers to view the impressive Drapery Room, named for the curtains formed by rows of stalactites growing together and flowstone deposits of limestone over the surfaces of fallen rocks. Visitors can also experience a small passage called the Onyx Colonnade, which contains a variety of columns, stalactites, and stalagmites. Many of the deposits have been given evocative names, such as Wedding Cave and Lion's Cage. Many of the dripstone and flowstone deposits are tinted with reds, purples, and yellows due to the oxidation of minerals such as iron and manganese during interruptions in the growth of the formations. On one side of the Onyx Chamber is Rainbow Dome, a 45-foot-high vertical space that displays many of the same color effects. A maximum of thirty people participate in each tour. The Frozen Niagara Tour is offered

four times per day during the summer months. Visitors enter and exit the cave at the Frozen Niagara Entrance, and must travel by bus with the group to and from the entrance. The same section of Mammoth Cave is visited as part of the **Domes and Dripstones, Grand Avenue,** and **Wild Cave Tours.**

Domes and Dripstones Tour (Orange)

The Domes and Dripstones Tour features a dramatic series of domes and pits, large trunk passageways, and dripstone formations. It follows the same route as the Frozen Niagara Tour as well as a portion of the Grand Avenue Tour. The tour is scheduled to last two hours and follows a route that extends over 3/4-miles. Visitors traverse a total of 500 stairs, 280 of which are associated with the initial descent into the cave from New Entrance. The tour is listed as a moderate difficulty level. Visitors must travel by bus between New Entrance and the visitor center to participate. The tour is offered eight times per day during the summer months. A maximum of 110 people can participate in each tour.

In addition to the Frozen Niagara features, visitors experience Crystal Lake, a water body formed through damming of flowing water, Grand Central Station, a large space located at the junction of several passages, most notably including Grand (Kentucky Avenue), and Big Break, a tall and large breakdown pile that is traversed via a series of switchbacks and narrow stairs. In places the passage is greatly constricted by breakdown walls and ceiling.

Grand Avenue Tour (Pink, Orange, and Yellow)

Grand Avenue is listed as the most physically demanding tour offered in Mammoth Cave, with the exception of the Wild Cave Tour. It provides an exceptional overview of the size and complexity of the Mammoth Cave passage and formation system. Grand Avenue Tour lead rangers interpret the interwoven cultural and natural history of the cave as visitors traverse some of the most dramatic passages, including gypsum lined tubes and narrow canyons, steep underground hills, large rooms, and spaces featuring dripstone formations. The tour includes all the **Frozen Niagara and Domes and Dripstone Tours**, with the exception of the staircase associated with New Entrance, as the tour enters at the Carmichael Entrance. The tour lasts for four hours and covers a total of 4 miles. Visitors must be 6 years of age and older. Indicated as strenuous, the tour is listed as including nearly 700 stairs on route. The tour is offered once per day and is limited to seventy-eight persons.

The Grand Avenue Tour extends from the Carmichael Entrance to Cleaveland Avenue, where visitors experience the Snowball Room and Washington Hall, where restrooms are located. They then visit Mary's Vineyard, Boone Avenue, Thorpe's Pit, the Rock of Gibraltar, and Alice's Grotto. The tour continues via Grand (Kentucky) Avenue to Mount McKinley, where restrooms are again available. After passing through Grand Canyon, visitors experience Aero-bridge before reaching Grand Central Station and Big Break. The tour then travels to Frozen Niagara to experience the features of the Frozen Niagara Tour.

Violet City Lantern Tour (Green solid and dashed lines)

The Violet City Lantern Tour is also indicated as a strenuous cave experience. It is also offered as a unique atmospheric visit to the cave as the tour is conducted entirely by lantern light. The tour is intended to recall the period of early cave exploration during the nineteenth century. Visitors navigate steep hills and uneven terrain through some of the oldest toured passageways where there are no handrails or electric infrastructure. Lanterns are carried by visitors age 16 and older. With a minimum age limit of six, and a maximum of thirty-eight people per tour, the three-hour tour covers a distance of 3 miles, and traverses 160 stairs. Portions of this tour are also experienced during the **Historic**, River Styx, and **New Discovery / Mammoth Passage Tours**.

The Violet City Lantern Tour enters the cave via the Historic Entrance, following Houchins Narrows through the Rotunda and along Broadway past the Giant's Coffin. Visitors learn about the experiment conducted by cave owner

Dr. John Croghan in the 1840s with tuberculosis patients while viewing two stone cottage ruins that served as an office and dining room for the endeavor. The tour continues along Main Cave past the Star Chamber to Wright's Rotunda and Black Chambers, and on to Cataracts, Chief City, and Kaemper Hall. The tour exits the Violet City Entrance after passing the various formations at Violet City.

Star Chamber Tour (Pink and Yellow-Orange)

The Star Chamber Tour is also experienced by lantern light. It is offered only in the evening. The tour focuses on the experience of early guides and visitors during the nineteenth century, including the tuberculosis patients who sought a cure inside the cave. The tour highlights the various rock monuments and signatures left by visitors more than 100 years ago. The Star Chamber Tour lasts for 2-1/2 hours and covers a distance of 2 miles. Traversing more than 200 stairs, the tour is considered moderate in terms of challenge level. The minimum age for visitors is six. Those aged 16 and over may carry lanterns. The duration for the tour is 2.5 hours, covering a distance of 2 miles with 200 stairs. It is offered once per day with a limit of forty people. The tour overlaps portions of the Historic, River Styx, and Gothic Avenue Tours.

Visitors enter Mammoth Cave via the Historic Entrance, following Houchins Narrows to the Rotunda. The tour follows Broadway to Main Cave past the Giant's Coffin to the stone cottage ruins associated with the tuberculosis treatment experiment. The tour continues to Star Chamber before returning to the Historic Entrance.

River Styx Tour

This tour lasts for 2-1/2 hours. The 2-1/2-mile-long route follows much of the Historic Tour route, as well as limited sections of the Star Chamber, Violet City Lantern, and Broadway Tours. The tour, indicated as moderately strenuous, extends 360 feet vertically to the lower regions of the cave where the River Styx flows. A total of 560 stairs must be traversed to reach the lower level passages. The tour is described as tracing the stages of cave development from solid layers of limestone to the world's longest known cave system. It follows the course of water from ridge top to river bottom and reveals the power of water to dissolve stone and create Mammoth Cave.

Gothic Avenue Tour

This tour lasts for 2 hours. It focuses primarily on Gothic Avenue, described as magical. The tour enters Mammoth Cave at the Historic Entrance, and passes through Houchins Narrows and the Rotunda, stopping at Methodist Church. The tour then enters Gothic Avenue, which showcases features left by visitors since the early nineteenth century, including signatures and monuments. Portions of this tour are experienced by the Historic, Star Chamber, and Violet City Lantern Tours. It extends for 1 mile, and traverses 230 steps. It is indicated as moderately strenuous.

Broadway Tour

The Broadway Tour is indicated as a 2-hour cave experience that enters the cave at Historic Entrance and follows Houchins Narrows to Rotunda. Thereafter it follows Broadway where visitors experience the gently lit ambience of a large trunk passage in the world's longest cave. This tour overlaps the Violet City Lantern Tour and the Historic Tour.

Cleaveland Avenue Tour

The Cleaveland Avenue Tour lasts for 2-1/2 hours. Visitors travel by bus to the Carmichael Entrance, where they descend nearly 200 stairs into the cave. During the moderate-level tour, they pass the craggy breakdown of the Rocky Mountains and enter the gypsum-encrusted elliptical tube of Cleaveland Avenue. This tour showcases gypsum in various crystalline shapes and sizes. The tour ends at the Snowball Room, a popular visitor destination since the 1840s. Visitors return via Cleaveland Avenue to the Carmichael Entrance. The entire route is encompassed as part of the Grand Avenue Tour. Restroom facilities and water fountains are available at the Snowball Room.

Discovery Tour/Mammoth Passage Tour (Blue)

The only self-guided option at Mammoth Cave is the Discovery Tour, which provides a short introduction to the cave system and its history through the provision of wayside exhibits. Park rangers are also stationed along the tour route and provide short talks about pre-Contact Native American explorers, saltpetre-mining operations, and cave geology. Visitors enter via Historic Entrance and travel Houchins Narrows to the Rotunda and Audubon Avenue. Visitors experience these same spaces as part of the Historic Tour and other tours that enter via the Historic Entrance. This option is available between 10:00 a.m. and 2:00 p.m. This tour is listed at 3/4-mile in length and containing 160 stairs to traverse. The same experience is available as a guided tour as part of the Mammoth Passage Tour.

Mammoth Cave Accessible Tour (Lime Green) The Mammoth Cave Accessible Tour follows a distance of up to 1/2 mile. It passes unique gypsum formations, historic cave signatures, and passages that contain evidence of geologic processes. The tour is accessed via the Elevator located along Marion Avenue. It follows Marion Avenue to Washington Hall and the Snowball Room, thereafter, traveling along Cleaveland Avenue. This tour overlaps portions of the **Cleveland Avenue Tour** and **Grand Avenue Tour.** Wheelchairs, scooters, and other assistive devices are permitted on the tour. There are accessible restrooms available at the Snowball Room. This tour is offered twice per day for a maximum of fourteen people per tour.

Wild Cave Tour

Considered the most adventurous and strenuous of all the guided options, the Wild Cave Tour provides experienced guides for a small group of up to fourteen adults once per day. The tour follows passages considered to be among the most beautiful within the cave system. However, they are also physically demanding and require visitors to climb, crawl, squeeze, hike, and canyon walk. Visitors under age 18 must be accompanied by an adult; no one under 16 years of age is allowed on the tour. The tour lasts for 6 hours and covers 5 miles of ground.

Introduction to Caving

This tour is for families. It is described as featuring hiking, climbing, and crawling through parts of Mammoth Cave that most tours do not visit. The route of this tour is not indicated on the park website.

Trog Tour

This tour offers an off-trail adventure for children 8 to 12 years of age without parents. It travels both above and below ground. The tour is indicated as 2-3/4-miles long and of moderate difficulty. Rangers interpret the connections between what is happening on the surface with the cave interior, accessed via the Historic Entrance. The route of this tour is not indicated on the park website.

Interpretive Themes

Based on review of the park's 2014 Foundation Document, the following interpretive themes are expressed through available tours, wayside exhibits, and other media provided by the NPS to visitors:

> The Mammoth Cave landscape shelters an underground labyrinth unmatched in size and complexity; the mysteries of this diverse natural laboratory have inspired human discovery for thousands of years.
>
> We share with our ancestors an avid curiosity and sense of wonder that guides us to experience adventure and excitement, create works of imagination, and explore the unknown.
>
> Knowledge from ongoing scientific endeavors in the Mammoth Cave area helps to alleviate threats to the park's resources, expand understanding of complex natural systems, and enrich the visitor experience.
>
> For more than 12,000 years people have interacted with the Mammoth Cave landscape using natural resources to ensure their survival and improve their quality of life.

The ever-changing karst landscape of south central Kentucky exemplifies the power and persistence of water through time in creating the world's longest known cave system, Mammoth Cave.

The diverse flora and fauna of Mammoth Cave National Park, some of international significance and endangered, is faced with external and internal challenges that not only affect visitor use and management of the park, but the very survival of those species.[316]

Feature Descriptions by Landscape Characteristics

Natural Systems and Features

Hydrologic Features

Green River. The Green River drains the region through which Mammoth Cave passes. As it has cut down through the associated river valley, the water table has lowered. Underground water passing through the limestone of the regional geology has formed and enlarged the cave of several million years. During stable period without downcutting, water within the water table has formed the horizontal passages present today. Streams within Mammoth Cave have moved down with the water table, so that the higher passages are the oldest. At times, when the Green River has filled its valley with sediments, with an associated raise in its level, passages within Mammoth Cave has also been filled with sediments. Today, River Styx, Echo River, and Crystal Lake at the lowest level of the cave are watered stream corridors that approximate the elevation of the Green River. They feed springs that empty into the Green River.

River Styx. One of the base level streams located within the cave that feed six primary springs feeding the Green River. Current streams within the cave continue to form flat-ceiling canyon-like vadose passages that are rarely completely filled with water and erode downward where dissolution occurs, primarily along their floors.

- **Echo River**. One of the base level streams located within the cave that feed six primary springs feeding the Green River. Current streams within the cave continue to form flat-ceiling canyon-like vadose passages that are rarely completely filled with water and erode downward where dissolution occurs, primarily along their floors.[317]

River Acheron. Located near the end of Gallows Way behind Ruins of Karnak is a shaft that drains into a stream called River Acheron. This is a tributary of River Styx within the cave beneath the Historic Section.[318]

- **Shaler's Brook.** This is another small flowing water feature.

Waterfalls. Waterfalls occur as vadose water enters the top of a shaft or dome and falls to the drain at the bottom. There are various domes that feature waterfalls after a rain within Mammoth Cave (and some that carry water even during dry spells). These include Thorpe's Pit, Edna's Dome, and Cathedral Dome. Other waterfall features include the Water Clock, Charon's Cascade, and Great Gushing Mammoth Cascades.

Springs. Named spring features include Wandering Willie's Spring and Richardson's Spring.

Pools. Named pools where water collects within Mammoth Cave include the Pool at the Blacksmith's Shop, the Dripping Spring, and Lee's Cisterns.

Cave Passage Types

- **Tubes.** Tubes are linear, horizontal openings in the limestone geology that mark where water has flowed through and dissolved an underground channel. Tubes are typically elliptical in form. Cleaveland Avenue is an example of a tube passage. Tubes are often formed by phreatic water, or that which is traveling beneath the water table.

316. National Park Service, Foundation Document, 11.

317. Hobbs et al., 4.
318. Ibid., 75.

- **Canyons.** Canyons are passages that dip vertically to convey water to a lower level. The Pass of El Ghor is an example of a canyon. These are typically formed by vadose water (i.e., water flowing above the water table.

Vertical shafts. Shafts are vertical openings shaped like wells where water is able to descend straight down along fractures in the limestone that cut across layers.[319] They are formed by vadose water. Many of the shafts in Mammoth Cave continue to enlarge by active drips. These can become waterfalls during and after rains. Water enters the top of the shaft through small canyons or vadose tubes and drains out at the bottom through similar passages. Shafts can also deepen over time as water dissolves the limestone floor. Because each outflow finds a new path, shafts can provide access to different passages at various levels.

- **Domes.** Domes are shafts. The tallest known dome in Mammoth Cave is Mammoth Dome.
- **Fissures.** Fissures are narrow passages that tend to occur at major joints and faults.[320]

Pits. Pits are open spaces that lie below the elevation of the adjacent passage. Bottomless Pit is one of the best known pits in Mammoth Cave.

Rock, Mineral, and Soil Features

Breakdown. Breakdown is rock that has collapsed from the cave ceiling or walls. It relates to the process as well as the resulting material. Breakdown ranges in size from small pieces to large blocks. The Giant's Coffin is an example of a large breakdown block. Breakdown usually occurs slowly over time. Breakdown processes may lead over time to the formation of an arch, which forms a stable ceiling, and an oval or circular dome-shaped room. An example is the Rotunda.[321]

- **Scallops.** Scallops are wave-shaped hollows that have dissolved within the limestone surface of the cave walls through the action of flowing water. They occur in most of the canyons and tubes within the cave and range in size from a half inch to several feet. They can be observed today in dry passages such as The Alligator or Leopard's Arch.[322]

Flutes. Flutes are parallel vertical grooves formed by the dissolution of limestone walls by water falls or water draining following a high-water event. Fluted walls are evident in association with most shafts, and in canyons that have been formed by the upstream retreat of waterfalls.[323]

Anastomoses. Anastomoses are small sinuous tubes that form a braided pattern along bedding planes of the limestone. The tubes associated with the anastomoses are semicircular or circular in cross section. They typically enlarge upward in chambers with floors of erosion-resistant sediment, and they form during floods when water fills a cave passage under pressure and is injected into adjacent bedding plane partings.[324] Pigeon Holes in Broadway is an example of small anastomosis channels. Lida's Pass is an example of a large, braided channel.

Sediment. Within side pockets of many tubes are soil deposits of sediment. This material was mined for saltpetre manufacture during the early nineteenth century and by the CCC for use in constructing soil surfaced trails for visitors. The sediment was deposited by underground rivers hundreds of thousands to millions of years ago. Prehistoric guano is present in some sediment deposits. There are also deposits of clay, sand, and gravel within the cave left by flowing water. The grains of the sediment can tell the story of how fast the water was moving, and where it flowed.[325]

Chert. Chert is a fine-grained silica-rich rock found in limestone formations. Sometimes referred to as flint, chert is very hard, and it was used by American Indians to make tools. Notable chert deposits, which are in beds and nodules, occur in several places within the cave. They

319. Ibid., 97.
320. Ibid., 102.
321. Ibid., 109.
322. Ibid., 107.
323. Ibid., 108.
324. Ibid.
325. Ibid., 108–109.

appear as irregularly shaped nodules, shelves, and balls. The ceiling of Great Relief Hall contains chert bodies, while Queen Victoria's Crown is formed of eroded chert.

- **Black onyx.** Onyx is a banded variety of the oxide mineral chalcedony. Within Mammoth Cave, it forms the Naked Lady speleothem. Grand Avenue was also historically known as Onyx Avenue for the presence of this mineral.

Aragonite. The Fairy Grotto contains aragonite speleothems. Aragonite is not a compound that remains stable under cave conditions, and eventually reverts to calcite.

Speleothems. Water that infiltrates downward through the soil and into the cave absorbs CO_2 from the organic layer. This CO_2 dissolves the rock. Once it reaches the cave passages, much of the CO_2 is lost to the air, and the limestone to be precipitated as speleothems. Speleothems are cave formations composed of calcium carbonate in a purer form than the surrounding limestone. These include stalagmites and stalactites, referred to as flowstone and dripstone. Olive's Bower and Frozen Niagara have good examples of these formations. Dolomite leads to crust formation. When the water infiltrates rapidly, it tends to contribute to the formation of shafts and canyon passages rather than speleothems.[326] Passages located beneath the cave's sandstone caprock tend to contain many evaporative minerals. These form white, delicate features, with curving bundles of mineral fibers or straight needle-shaped spears. Calcite speleothems form beneath the edges of the ridges where infiltrating water is more abundant. Violet City is known for its calcite speleothems.

Gypsum. Gypsum, a type of speleothem, is forms by evaporation in dry parts of the cave where moisture is drawn from bedrock walls.

326. Ibid., 109.

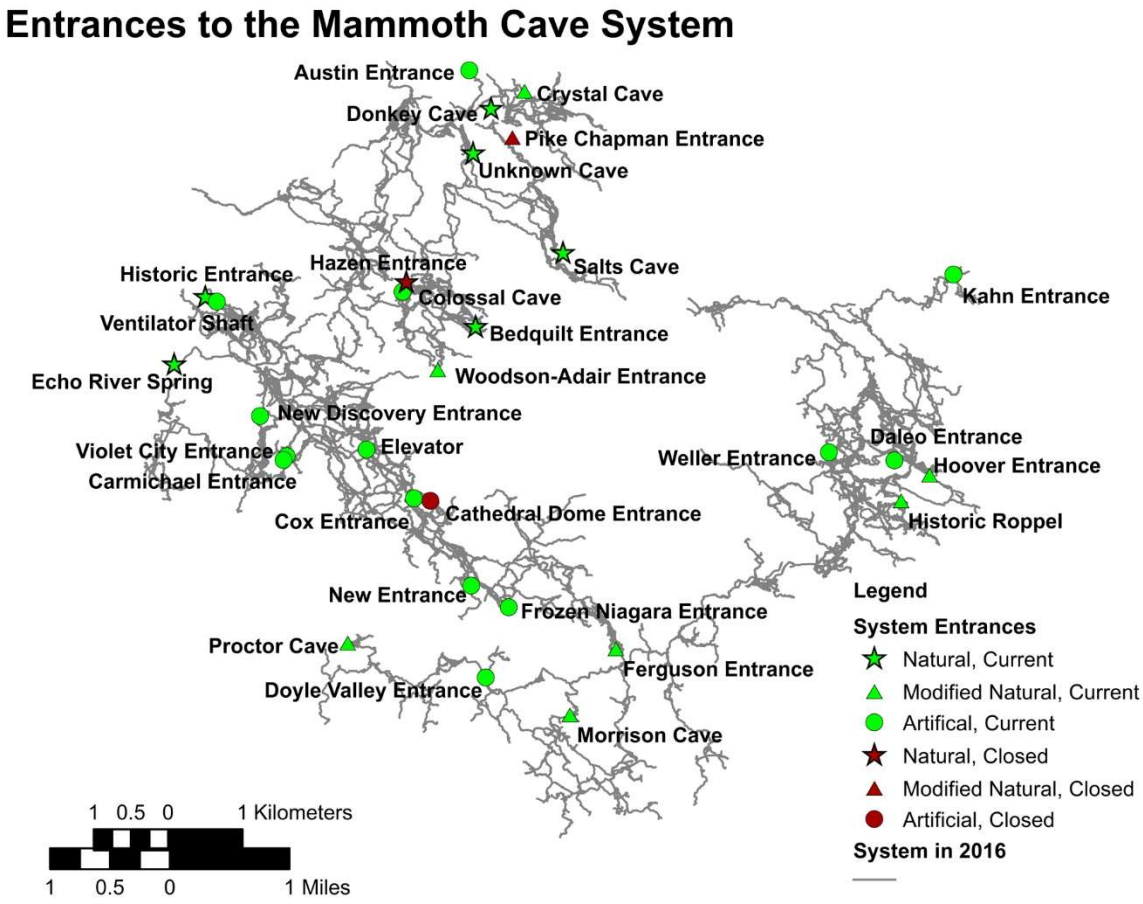


FIGURE 193. Diagram showing the entrances to the Mammoth Cave System. (Source: Rickard S. Toomey III, PhD)

Responses to Natural Resources

Cave entrances. The existing, and former now collapsed, cave entrances are natural locations where cave passages were either open to the outside or located within sufficient proximity to the outside that rock and soil could be excavated and removed to create an entrance. Historic Entrance was an accessible opening that has been enlarged over the years. Many of the other entrances have been engineered. In some locations, air passage and tree roots demonstrate a proximity to the ground surface. Bats have used these passages for egress. Olive's Bower is an example.

Metal gate that allows air passage. Gates are in place at the Historic Entrance that allow for air exchange, but limit visitor access. The gates are composed of horizontal bars with space between them that allow for both air flow and movement of bats.

Saltpetre mining and manufacture using cave dirt. Saltpetre, or potassium nitrate, is a chemical compound that occurs naturally as a mineral in the soil. It is also known as nitre and is a source of nitrogen. Potassium nitrate is used today in fertilizers, rocket propellants, and fireworks. It was used historically to manufacture gunpowder. One of the best sources of saltpetre historically was cave dirt caked with bat droppings. The cave dirt of Mammoth Cave was mined in the early nineteenth century, and the nitre extracted. Evidence of this industrial activity is present in the Rotunda and along Broadway.

Tuberculosis treatment facilities. The stone huts that survive within Main Cave convey an association with Dr. John Croghan's 1843 experiment in the treatment of tuberculosis that entailed the use of cave air.

- **Site of sleep study.** The site of a 1938 sleep study within Audubon Avenue suggests the

use of the constant darkness to test human sleep and wake cycles without the influence of sunlight.

- **Mushroom beds.** Several stone walls and wood structures survive in Audubon Avenue to suggest a late nineteenth century attempt to commercially cultivate mushrooms using cave soil and low light conditions inside the cave.

Development of trails, bridges to facilitate tourism within the cave. Passages that have traditionally served as tour routes within Mammoth Cave have been developed using a range of surfaces and structures. Piled rock, cave dirt, concrete, Kyrock asphalt, bridges, causeways, overlooks, ladders, stairs, and landings have all been created using the material present within the cave, as well as material brought into the cave, to accommodate access for visitors, particularly paying tourists.

Addition of lighting to address darkness. Electricity has also been brought into the cave to light certain passages since the early twentieth century. Lanterns were carried, and continue to be used for some tours today, by visitors in passages that were not lit, and before there was lighting. American Indians used cane reeds that were lit on fire to light their way.

- **Handrails, guardrails, and fencing for safety.** The cave offers a wide range of passages and floor types, with sudden changes in elevation, pits, and other conditions that can lead to falls. Handrails, guardrails, and fencing has been added since the twentieth century to protect visitors along the edge of trails that overlook sudden changes in elevation.

Spatial Organization

Horizontal Passages (tubes, canyons). Mammoth Cave is generally arranged into two major levels often connected by vertical passages. The Historic section of the cave offers the best evidence of the layering of upper and lower horizontal passages that reflect the stream-like movement of water through the rock through dissolution of the limestone. Visitors typically travel the horizontal passages that comprise these two levels, which are connected by domepits and other vertical passages that have been adapted through the development of stairs and ladders to connect the levels.

Rooms (Rotunda, Star Chamber, Wright's Rotunda, Black Chambers, River Hall, Snowball Room, Grand Central). Within the system of horizontal passages large spaces periodically open up where two passages join, or breakdown has enlarged the passage.

- **Vertical** Passages (domes, pits, canyons). Vadose water acting on the limestone has formed domes and pits, while breakdown has contributed to the formation of canyons.

Entrances. Mammoth Cave is currently entered through five passages: Historic Entrance, the elevator, New Entrance, Violet City Entrance, Carmichael Entrance, and Frozen Niagara Entrance. The various tours use each of these entrances either to enter or exit Mammoth Cave. Stairs generally lead from the entrances down into the cave. These portals include both natural features and access points, and human-enhanced and created accessways. Several other entrances developed historically have collapsed and are no longer in use.

Land Uses and Activities

Conservation. Conservation is associated with the World Biosphere Reserve aspect of Mammoth Cave, and the management of the cave to protect water resources. Current efforts to remove accumulations of dust from the walls of the cave is to conserve the historic passages, and associated signatures.

Museum/Interpretation/Education. The NPS provides guided tours of Mammoth Cave to the public. The tours feature interpretive information conveyed to visitors. Wayside exhibits within the cave are also associated with this land use.

Recreation. Tours of the cave also constitute an enjoyable recreational use. The cave trails have traditionally supported this land use.

Scientific Research. Mammoth Cave contains interesting biological as well as geological and hydrological features that have been, and continue to be studied by scientists, including National Park Service personnel and others.

Circulation

Trails

Cave trails vary to a great degree in terms of width, surface material, edging materials, cross slope, profile grade. Cross slopes range from 0 to 10 percent, while profile grades range from 0 to 50 percent. Profile slopes are addressed through the use of ramps and stairs. Trail widths are dependent on several factors, including the presence of breakdown and rock, hazards such as drop offs and pits, moisture, passage width, and proximity to attractive nuisance factors like formations. Trail surfaces include concrete paving and hexagonal pavers, metal causeways and bridges, and cave dirt that generally reflects a tight clay and silt mixture installed by the CCC. The subgrade consists of a course or bedding of broken rock, often laid by the CCC. The dirt trails are currently being disturbed due to high visitation levels and foot traffic, leading to dust that settles on cave walls and breakdown. Cast-in-place concrete has been used to construct trails since the 1930s, hexagonal pavers since the 2010s. Trail edging ranges from natural cave floor to loose hand-placed stone and boulders. Since the 2010s, lint guards composed of composite plastic have been added along some trails to protect against deposits of lint and other material brought into the cave by visitors. Stairs are composed of cast-in-place concrete, stainless steel, and Fiber Reinforced Polymer. Older stairs exist, not generally in use, which were built of stacked stone. There are older surviving examples of metal prefabricated stairs. Trails, overlooks, and stairs are sometimes edged by handrails. These are composed of stainless steel, aluminum, and welded wire mesh.

Much of the cave is not universally accessible. Currently, there is one cave entrance and trail that are classified as accessible based on the Americans with Disabilities Act criteria. This route utilizes the elevator to the Snowball Room and continues along Cleaveland Avenue, which is part of the Grand Avenue Tour. There are no accessible trails beyond the Snowball Room towards Boone Avenue.

Leveled stone trails (nineteenth and early twentieth centuries). Examples of pre-NPS tour-related trails are evident in numerous passages of Mammoth Cave (Figure 194 and Figure 195). Notable examples occur along Main Cave and along Grand Avenue. Many of those located in the southern portion of the cave are believed to have been developed by George Morrison. They are composed of flat rocks arranged to form a relatively stable trail surface where there is an uphill or downhill slope. The rocks can become stairs where the trail is steeper. These trails are generally very narrow, between 2 and 4 feet in width.

FIGURE 194. Stone stairs, main cave.

FIGURE 195. Early path adjacent to CCC trail.

Cave soil surfaced trails (New Deal era). Between 1935 and 1941, the Civilian Conservation Corps undertook extensive improvements within Mammoth Cave to enhance tour routes (Figure 196). One of the signature features established by the CCC was a leveled trail surface hardened with the use of cave soil mined from sediment deposits. The cave soil trails were treated with saline as a maintenance and upkeep treatment. Today, the large numbers of visitors to Mammoth Cave who traverse these cave soil trails tend to scuff and dislodge the surface, leading to dust particles rising into the air. The evidence of this process is notable within Main Cave where dust coats the walls and breakdown, as well as the cultural resources, associated with the passage. These trails vary to a great degree in width, from about 2 or 3 feet to up to 20 feet in width.

FIGURE 196. Cave soil trail at the entry into Rose's Pass.

Kyrock asphalt trails. Kyrock, or Kentucky Rock Asphalt, is one of the first asphalt road building materials used in the United States (Figure 197). This natural asphalt is composed of an angular silica sand that is skid resistant. The aggregate was mined, and the asphalt manufactured in Edmonson County, Kentucky. It was used in limited quantities to pave short segments of trail within Mammoth Cave at an unspecified time, although its use began circa 1917, and increased in popularity during the 1920s.[327] It is likely that these areas were paved between 1917 and the late 1920s. Examples occur near Big Break and Grand Central and Silliman Avenue. The Kyrock paving that is evident typically only extends for 2 to 4 feet in width and occurs in relatively short runs.

FIGURE 197. Kyrock asphalt trail.

327. Justin Story, "Man publishes Kyrock history in photos," *Bowling Green Daily News* (August 28, 2016). The Kentucky Rock Asphalt Co., from which Kyrock derives its name, operated eight quarries in Edmonson County where thick deposits of rock asphalt were mined, processed, and shipped via local rivers to locations where it was used to pave roads.

Exposed aggregate concrete walks (Mission 66). Segments of trail, such as Cleaveland Avenue and the passages around Fat Man's Misery, are examples of this path type (Figure 198). The width of the paths vary depending on the width of the passage from 2 to 3 feet to as wide as 8 to 10 feet.

FIGURE 198. Exposed aggregate concrete walk.

Brushed concrete walks (post-Mission 66 / 1980s, 1990s, 2000s, 2010s). Several passages have been upgraded by the NPS since the Mission 66 era using concrete surfaced walks (Figure 199). The concrete typically has a brushed or broom swept finish to promote a non-skid surface for the safety of visitors. Examples include Little Bat Avenue and the walk extending from the base of the stairs at New Entrance. The width of the paths vary depending on the width of the passage, and range from about 3 feet to 10 feet.

FIGURE 199. Concrete path with rock edging.

Dust catcher wood plank decking. Located near Chief City is wooden dust catcher set within the trail surface to trap particles from the shoes of visitors (Figure 200). This may have been an experimental attempt to address the dust problem. There appears to be only one dust catcher currently located within Mammoth Cave. It is approximately 10 feet in width, and 20 feet in length.

FIGURE 200. Wooden dust catcher set within the trail near Chief City.

Hexagonal paver walks (2000s-2010s). Segments of Mammoth Cave passages that are heavily used by visitors due to their inclusion in several tours have been upgraded since 2000 with a hexagonal paver surface (Figure 201). In many locations, this path type is edged by a lint guard to catch airborne particles that might otherwise be deposited on the cave passage and feature surfaces. The pavers are composed of concrete. Concrete bands are set within the walks where the trail is sloped to prevent slippage. Segments of hexagonal paver walks are located within the Rotunda and along Broadway. These walks are quite wide to accommodate large tour groups, potentially up to 20 feet in width, but they vary.

FIGURE 201. Pavers with concrete break.

Fiber Reinforced Polymer (FRP) walk and stair segments (2000s–2010s). Another contemporary addition to the trail and walk system within Mammoth Cave is FRP or fiberglass grating (Figure 202). This material is used in short segments and on stairs. It is fabricated as a mat of thin boards connected at the ends. This material provides a slip resistant surface that has been added to steep and wet slopes and inset in some concrete walks where ponding was occurring. It is evident as part of the trail system at River Hall and along trails near the base of the New Entrance stairs. These segments are typically narrow, around 6 feet in width.

FIGURE 202. Fiber Reinforced Polymer (FRP) paving.

Rock edging. Rock is placed along the margins of some cave soil, sand, and concrete walks and trails within the cave to encourage visitors to remain on the path (Figure 203). The path leading from the Wooden Bowl Room is concrete edged with rocks. Audubon Avenue is also edged by rock. The size of the rock varies, but it is typically graded for consistency along individual trail segments.

FIGURE 203. Sandy floor with rock edging.

Lint guard edging. Lint guards edge portions of the upgraded trail segments in Upper Historic and Frozen Niagara. These features are composed of two 2x8 boards of composite, recycled plastic stacked on edge along the edge of the trail. Segments of the lint guards include metal sleeves that support handrail/guardrail features (Figure 204). These are held into place with stakes on the outer edge, creating narrow and rigid linear edge alignments that are not necessarily visually compatible with the cave environs.

FIGURE 204. Lint guard within Broadway.

Steel edging. This material occurs in a few locations to address trail edge support and reinforcement. It is a flexible material available in stainless and galvanized steel.

Handrail and guardrail edging (metal, wood). There are numerous examples of metal handrails and guardrails present throughout the cave (Figure 205). These are associated with stairs, causeways, bridges, and locations where the trail edges a steep drop off. Metal handrails include single rail structures supported by regularly placed posts, both in stainless steel and aluminum, metal mesh, and wood railings. Aluminum railings likely date to the 1950s. There are several examples of heavily rusted steel railings and bent and misshapen railings that may pre-date the 1950s. Stainless steel handrails and guardrails appear to post-date Mission 66 and are the most recent addition.

FIGURE 205. Handrail and guardrail edging, Grand Canyon.

Stone stairs (mortared, unmortared) (Morrison era, CCC, Mission 66). Numerous examples of stone stairs are evident throughout the cave (Figure 206). Many of these are associated with former trail systems that have been bypassed with newer concrete stair structures.

FIGURE 206. Stone stairs to Olive's Bower.

Concrete stairs (Morrison era, CCC, Mission 66, post-Mission 66). Numerous examples of concrete stairs are present throughout Mammoth Cave and are used to navigate steep segments of passages and connections between upper and lower passages (Figure 207). Concrete, as well as metal, stairs are also used at many of the cave entrances. Concrete stairs vary in their dates of origin. Some exhibit evidence of saw marks on the formwork, suggesting an early date or origin. Others have a patina of age suggesting construction during the CCC or Mission 66 eras. There are also relatively contemporary examples of concrete stairs.

FIGURE 207. Concrete stairs to lower level.

(See also metal stairs, bridges, causeways, and chain-link fencing listed as Structures.)

Buildings

Consumptive Hut #1 (CRIS #000888). Located along Broadway, Consumptive Hut #1 dates to circa 1843, when it was constructed by Dr. John Croghan. The building, which is rectangular in plan, consists of three limestone walls, while the wall of the cave serves as the fourth wall at the rear of the building. The limestone walls are dry-laid on the exterior, with mortar added later, during the twentieth century, as a stabilization treatment, on the interior. A wood-framed door opening is present in side elevation, while a wood-framed window opening is present in the stone wall parallel to the cave wall. There is no roof structure over the building.

Consumptive Hut #2 (CRIS #005019). Located along Broadway, Consumptive Hut #2 dates to circa 1843, when it was constructed by Dr. John Croghan. The building, which is rectangular in plan measures 16 feet wide by 20 feet, 6 inches long, and is constructed of dry-laid limestone. A wood-framed doorway is present at one end of the structure. The opposite wall is in a state of collapse. There is no roof structure over the building.

Snowball Room Preparation Room. The snowball room preparation room sits in the snowball dining room behind a serving counter. The preparation room is a concrete masonry unit structure that is rectilinear in plan. The concrete masonry walls are painted with a flat roof that

slightly overhangs the exterior walls. A single panel steel door is present along a wall of the room.

Snowball Room Restrooms. The snowball room restrooms are located in the snowball dining room. The exterior of the rooms consists of irregularly shaped stone set mortar that somewhat mimics the walls of the caves. The walls of the restroom extend to the cave ceiling. The structure consists of two restrooms, one designated for men and one for women. No doors separate the interior of the restrooms from the rest of the cave and the snowball room. The interior of the restrooms consists of floors covered with red-colored square tile, and walls clad with cream-colored rectangular-shaped tile. Both the men's and women's rooms are equipped with six toilets and four sinks, all made by American Standard that appear to be original.

Great Relief Restrooms. The great relief restrooms consist of ashlar stone walls set in a random pattern. The stone walls extend to the ceiling of the cave. The structure consists of two restrooms, one designated for men and one for women. No doors separate the interior of the restrooms from the rest of the cave and the snowball room. The interior of the restrooms consists of floors covered with red-colored square tile, and walls clad with cream-colored rectangular-shaped tile. The men's and women's restrooms are equipped with six toilets and two sinks all made by American Standard.

Mount McKinley Restrooms. The Mount McKinley restrooms consist of brick masonry walls set in a running bond pattern. A flat concrete slab roof sits atop the brick masonry clad walls. The structure consists of two restrooms, one designated for men and one for women. A small storage room is also present in restroom building. Single steel doors lead from the cave into the restrooms and the storage room. The interior of the restrooms consists of floors covered with red-colored square tile, and walls clad with cream-colored rectangular-shaped tile. There are six toilets and three sinks in the women's room and two toilets, four urinals, and three sinks in the men's room all by American Standard.

Structures

Historic Entrance (LCS). The historic entrance consists of a concrete stair that extends downward through historic entrance into the cave, ending at a concrete walkway. The stair walls are clad with ashlar stone set in a random pattern. Aluminum pipe railings line the edges of the stair, with a double railing running down the center of the staircase. The pipe railings continue at the concrete walk.

Frozen Niagara Entrance (LCS). The Frozen Niagara entrance is located on the south slope of Mammoth Cave Ridge. The entrance consists of a sandstone wall with a single steel door. A set of ten concrete steps leads from the steel doorway down into the cave. Limestone boulders, added in the 1930s, are also present at the entrance.

Carmichael Entrance (LCS). The Carmichael Entrance is accessed by a set of concrete stairs that descend from an access road to a concrete structure with set of double, iron doors set in an arched opening. A concrete walk lined with a concrete knee wall leads from the stair to the arched doors. Strap hinges set into the concrete wall extend the width of each door. The current doors are replacements of the original doors, which were removed in the 1970s. The Carmichael Entrance is similar to the Violet City Entrance. Sloped concrete retaining walls are present on each side of the door.

Violet City Entrance (LCS). The Violet City Entrance is built into a hillside and is accessed by a limited access road. A concrete sidewalk lined with concrete knee walls leads from the access road to the entrance. The entrance consists of a concrete structure with a set of two iron doors set in an arched opening. Strap hinges set into the concrete wall extend the width of each door. The Violet City Entrance is similar to the Carmichael Entrance.

New Entrance (LCS). The new entrance consists of a small cast-in-place concrete structure with a metal-framed door that leads into the cave. The structure is only slightly wider than the cave. A series of concrete stairs and walks lead to the New

Entrance. Steel pipe railings line the stairways. Once inside the entrance, a metal staircase leads down into the cave. Pipe railings line the staircase.

Elevator (Asset). The elevator near the snowball room is a concrete structure that rises to the ceiling of the cave (Figure 208). A glass and steel revolving door allows visitors to enter into the cave from elevator landing. The revolving door helps prevent the exchange of air between the cave and the elevator landing. A pair of metal doors are present on each end of the structure.

FIGURE 208. Elevator landing.

Steel gate inside Historic Entrance. At the base of the concrete stair providing access at the historic entrance, a steel gate controls access to the cave. The gate consists of horizontal steel members that prevent unauthorized access to the cave, but allow for wildlife, particularly bats to continue movement in and out of the cave. The gate structure steps back near its center where there is a set of steel doors. The gate extends from the floor of the cave to the ceiling.

Albert's Stairway (LCS). Albert's stairway is located along a wall in Elizabeth's Dome. The stairway consists of fifty steps constructed of limestone rubble which descend further into the cave from the Violet City entrance. A steel pipe railing is present along the side of the staircase opposite the cave wall.

Saltpetre Pipes (LCS). Originally used to carry liquids for mining in the rotunda, Booth's Amphitheater, and along Broadway, the remaining 2-inch diameter saltpetre pipes range in length from approximately 3 feet long to 26 feet long. Approximately fifty pipe sections are still present. The pipe sections are typically constructed of hollowed out poplar and white oak logs.

Leaching Vat #1, #2, #3, Rotunda (LCS) (HABS). Three leaching vats are present in the rotunda, remnants of saltpetre-mining operations. The vats, which are constructed of hand-hewn oak with poplar siding, sit on mortise and tenon frames with vertical nailing studs. The wooden vats sit on a dry-laid stone wall. The vats, which are rectangular in plan, range from 9 feet to 12 feet in length and are typically 3 feet 6 inches tall.

Rotunda Drain Tank (LCS) (HABS). Situated in the Rotunda, adjacent to the leaching vats, the rotunda drain tank is a wood collecting tank approximately 10 feet wide and 3 feet high.

Leaching Vat #1, 2, #3, #4, #5, and #6, Booth's Amphitheater (LCS) (HABS). Six leaching vats are present in Booth's Amphitheater. The vats, which are remnants of saltpetre-mining operations, are constructed of hand-hewn oak with poplar siding. The vats rest on mortise and tenon frames with vertical nailing studs. The wooden vat structures sit on a dry-laid stone wall that measures 16 inches to 20 inches thick and 18 inches to 2 feet high.

Mammoth Tower. Mammoth Tower is a steel frame stair tower. The tower structure consists of a structural steel-framed tower that supports the steel stair. Steel pipe railings line the staircase which is made up of five landings.

Bridge at Bottomless Pit. The bridge at the bottomless pit consists of a concrete walk with steel railings. The steel pipe railings support a steel screen panel which is centered between the vertical pipes.

Steel structural bracing system. Near the Mammoth Dome, a structural steel bracing system is present supporting the stone at the ceiling and walls of the cave. The bracing system is comprised of structural steel I-beams. The I-beams are installed both vertically and horizontally, with the vertical columns, which are often set at an angle,

extended from the cave floor to the ceiling. Horizontal beams connect the columns.

- **Bridge across Crystal Lake.** The existing bridge replaced the original deteriorated wooden structure in the 1950s or 1960s.
- **Metal catwalk/bridge** across River Styx
- **Prefabricated metal stairs.** A prefabricated metal staircase leading through the cave consists of steel channel stringer with steel treads and steel mesh risers. Pipe railings line each side of the staircase. Structure steel columns extend from the base of the stair down into the cave floor.

Mushroom Beds (LCS 007610; HS IC-02). The Mushroom Beds are located along Audubon Avenue (Figure 209). The beds are the remains of a failed commercial mushroom operation. Altogether there are six beds. The beds are 4 by 12 by 1-foot wood plank frames set on a bed of soil on the cave floor. Three of the beds are elevated on 3-foot-high limestone rubble platforms filled with soil.

FIGURE 209. Mushroom Beds.

Rock Stairs and Walls to Olive's Bower (LCS 007609; HS IC-03). Built circa 1880, the rock stairs and walls leading to Olive's Bower, which is located at the end of Audubon Avenue, are composed of dry-laid limestone rubble that was built to create clear path for 40 yards from the top of the stairs to the formation (Figure 210). The stairs are constructed of slabs of limestone. There are fourteen steps altogether, ascending approximately 10 feet in height.

FIGURE 210. Rock Stairs and Walls to Olive's Bower.

Rock Stairs End of Gothic Avenue, Through Elbow Crevice (LCS 007608; HS IC-04). The rock stairs at the end of Gothic Avenue were built between 1880 and 1900 to provide access to the lower passages of the Historic Cave. The stair is composed of twenty-seven irregularly shaped limestone slabs that extend through Elbow Crevice. A contemporary stair was built circa 1966-1975 to provide safer passage for visitors. The contemporary stair is constructed of concrete. Eighteen of the original stairs were destroyed in construction of the concrete stair.

Rock Wall at Bridal Altar (LCS 007607; HS IC-05). The rock wall positioned at the base of the Bridal Altar, located on Gothic Avenue near Booth's Amphitheater, is believed built circa 1950s. It is semicircular in form, 21.5 feet long, and fashioned of irregularly coursed limestone blocks. The wall stands 2 feet high and is designed to protect the formation from damage by visitors.

Rock Wall at Jenny Lind's Armchair (LCS 007604; HS IC-08). Jenny Lind's Armchair is a formation located on Gothic Avenue. The formation is protected from damage by visitors with a low, semicircular stacked limestone wall. The wall measures 24 feet in length, 1 foot in width, and is 2 feet high. The wall is fashioned from irregularly coursed limestone block and rubble. Some sections have mortar. The wall is believed to have been built circa 1950s.

Rock Wall at the End of Gothic Avenue (LCS 007603; HS IC-09). A rock wall is located at the end of Gothic Avenue that is believed to have been built circa 1950s (Figure 211). It was built to block

the passage, which ends at a steep drop. The wall is shaped like a question mark. It measures 24 feet in length and is 2 feet tall. It consists of coursed limestone slabs, laid with cement.

FIGURE 211. Rock Wall at the End of Gothic Avenue.

Gothic Avenue Rock Monuments, Walls, and Signatures (LCS 007602; HS IC-10). Within the Gothic Avenue passage there are several cultural features added between circa 1825 and 1925. These include dry laid limestone rubble walls that range in height from 2 to 5 feet, pyramidal stacks of rubble stone that range in height from 3 to 12 feet, and signatures on the walls and ceiling that were made with soot and torches. Some of the graffiti is associated with states or tour groups.

Cable in Aerobridge Canyon (LCS 007606; HS IC-06). Located at the top of the passage known as Aerobridge Canyon, near the New Entrance, is a 200-foot-long, 1-inch-diameter steel cable (Figure 212). The cable is a remnant of a cable car system installed by cave operator George Morrison in 1921. It was only used for one year before use was discontinued. Anecdotally, there are reports of people crossing Aerobridge Canyon on trams suspended on the cable.[328] The cable car used to convey construction materials and a wood platform are no longer in the cave.

FIGURE 212. Cable in Aerobridge Canyon.

Crystal Lake Landing (LCS 007605; HS IC-07). Built circa 1923 by cave operator George Morrison, the Crystal Lake Landing is a 3 by 11-foot concrete slab set at the base of a canyon and accessed by a series of three metal ladders. Morrison dammed the stream near the Frozen Niagara Entrance to form Crystal Lake. He offered boat tours through the Frozen Niagara section for visitors, in competition with the Echo River offering in Historic Lower Cave. The landing includes four concrete steps opposite the landing that served as the departure point.

Sewage lift station behind Great Relief restrooms. Replacing earlier septic systems, the sewage lift station behind the Great Relief restrooms includes a concrete storage tank for effluent, a grinder, a pump, and a pipe system that sends the waste up to the ground level through a hole in the ceiling of the cave (Figure 213).

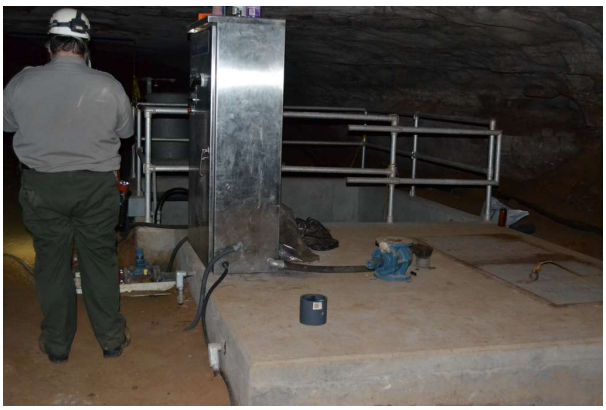


FIGURE 213. Sewage lift station behind Great Relief restrooms.

328. Personal communication, Stan Sides, 2004.

Pulley cable system at Lost John site. Cables used by the CCC to move a large breakdown block and free the mummified body referred to as a prehistoric miner remain present on a ledge today (Figure 214).

FIGURE 214. Pulley cable system at Lost John site.

Stone walls. Numerous stacked stone walls occur throughout the cave (Figure 215). These relate to different periods of development including nineteenth century, early twentieth century, CCC-era, and Mission 66-era. Some of these walls are stacked and dry-laid, while others are mortared. They are of various levels of finish in terms of construction. The older walls that date to the nineteenth century such as those associated with the mushroom beds and Olive's Bower are of the highest construction quality. Walls built by the CCC are also of good quality. Stacked stone walls and stairs constructed by George Morrison to support his tour operations are impressive for their vernacular engineering, but not of the highest quality. Mission 66-era stonework is often mortared in place, with excessive use of mortar. It is of higher quality than the stone walls that represent the control of visitors during the 1970s period of self-guided tours.

FIGURE 215. Stone walls.

Stacked stone trail support structures. There are numerous trail segments that are built on massive, stacked stone support structures, notably along Grand Avenue (Figure 216). These are believed to have been completed by the CCC.

FIGURE 216. Stacked stone trail support structures.

Chain-link fencing along River Styx. Several chain-link fences have been placed in various portions of the cave which require limited access, mainly for safety reasons (Figure 217). These gates date from the 1950s to the present.

FIGURE 217. Chain-link fencing along River Styx.

Barrier fencing. Barrier fencing edges the trail in several locations to prevent visitors from touching adjacent sensitive formations (Figure 218).

FIGURE 218. Barrier fencing.

Metal ladders. Several metal ladders are present within the cave, such as the one shown leading to Pilgrim Avenue (Figure 219).

FIGURE 219. Metal ladders.

Concrete catchment basin at Richardson's Spring. A small concrete basin is preset at Richardson's Spring.

Ventilation shaft. A ventilation shaft was added along Houchins Narrows within the cave by the National Park Service to use to bring cool air to the visitor center circa 1959. It is no longer in use.

Views

Views along horizontal passages. The cave consists of numerous linear passages that extend generally through the limestone bedrock in a horizontal fashion. Views are afforded along these passages, with variations related to the extent of winding of the passage, the amount of light available, and obstructions along the passage, such as breakdown material. These linear views are ever changing throughout the cave.

Views into vertical domes and pits. Cave passages are often edged or end at domes and pits. From the trail it is often possible to gain a long view up or down into these vertical spaces, many of which have dramatic forms. The extent of the view depends on the availability of light.

Views within large rooms. Cave passages frequently open into large spaces or rooms. Junctions of passages also often occur within large rooms. Depending on changes of elevation, the availability of lighting, and the nature of breakdown, views can be afforded across these expansive spaces.

Views into crevices and small openings. Also occurring along the cave passages are crevices and small openings that can be viewed into depending on the availability of light.

Views from overlooks and trail platforms. Bridges, causeways, and paths often edge pits or other types of descending spaces that afford longer views depending on the availability of light. Some rock features, such as the two distinct Lovers Leap formations, provide opportunities for viewing across wider spaces.

Small-scale Features

Site Furnishings

Picnic tables. Picnic tables are provided in Snowball Room.

Drinking fountains. Drinking fountains are located in two places within the cave (Figure 220). At Snowball Room, there is a pair of exposed aggregate drinking fountains installed during the

Mission 66 period. The other drinking fountains are white porcelain features attached to the outside wall of the Great Relief restrooms structure.

FIGURE 220. Drinking fountains.

Upright light poles. Located along Marion Avenue between Snowball Room and the Elevator are a series of upright light poles (Figure 221). These features comprise thin aluminum poles that support a conical globe. They are set within the cave passage floor, with a curved anchor at the base. This may be the only example of this light type within the cave. They may have been installed with the Elevator during the Mission 66 period.

FIGURE 221. Upright light poles.

Cone lights. The majority of the cave tour route system is illuminated using cone lights (Figure 222). These relatively small features are connected by black wires. They can be positioned carefully to highlighted specific features of the cave, or to ensure the safety of visitors by lighting the trail or proscribed route of travel. The cone lights are being updated with amber colored bulbs or shades, which diminishes the potential for algal growth on cave formations.

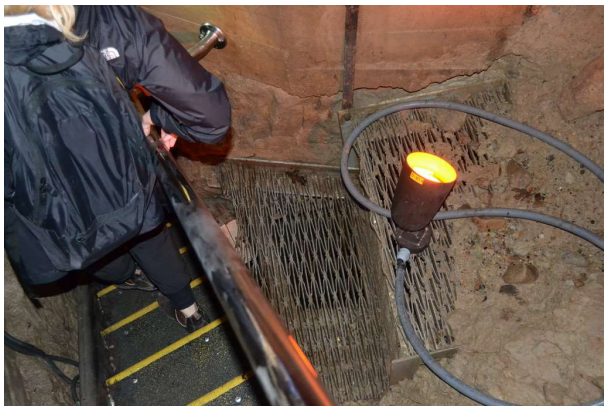


FIGURE 222. Cone lights.

Safety lights. Safety lights are located in cave passages where they are important to illuminate the route but could be subject to damage, such as in the stairwell at Frozen Niagara (Figure 223). These continue to contain white bulbs; algal growth is evident in association with current and former white light locations.

FIGURE 223. Safety lights.

Benches. Benches are found in several locations within the cave where visitors are able to rest or gather for presentations (Figure 224). There are several styles of benches associated with these clustered site furnishings. Outside the Snowball Room, Great Relief, and Mount McKinley restrooms are clusters of backless benches

constructed of mortared stone bases and concrete slab seats. Other examples of this bench type occur in Washington Hall. Along the trail near Star Chamber is a line of wooden benches with backs. There are other examples near Aerobridge Canyon. Groups of aluminum backless benches occur at River Hall, while wooden backless benches are grouped within Grand Central Station where tours gather. At Chief City, there are benches composed of concrete bases and wooden seats.

FIGURE 224. Benches.

Trash receptacles. There are very few trash receptacles within Mammoth Cave. The only examples observed were gray plastic receptacles located outside of the Mount McKinley restrooms.

Signage

Wayside exhibits. There are only a few wayside exhibits located within Mammoth Cave as of 2018 (Figure 225). These include one addressing saltpetre mining in Rotunda, and four on various topics within Audubon Avenue. Another wayside addresses the contributions of the CCC to trail development. It is titled "To Follow the Beaten Path." These wayside exhibits are examples of the standard feature used by the National Park Service in National Park Units throughout the United States. They are composed of steel carriers inset with an information panel that is angled toward the reader. These signs vary in their date of origin between circa 1980s–2010s.

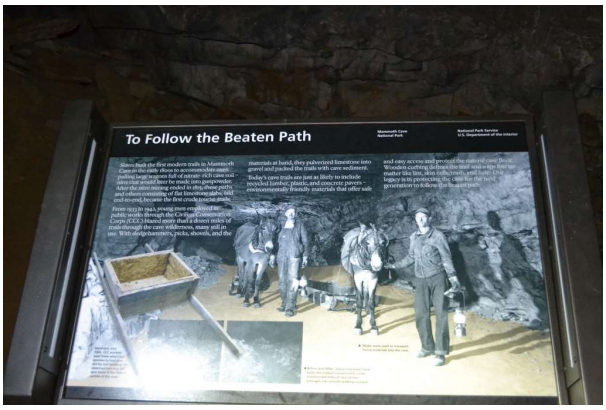


FIGURE 225. Wayside exhibits.

Information panel. Also located within Audubon Avenue is a single upright information panel that supports visitor understanding of cave development (Figure 226).

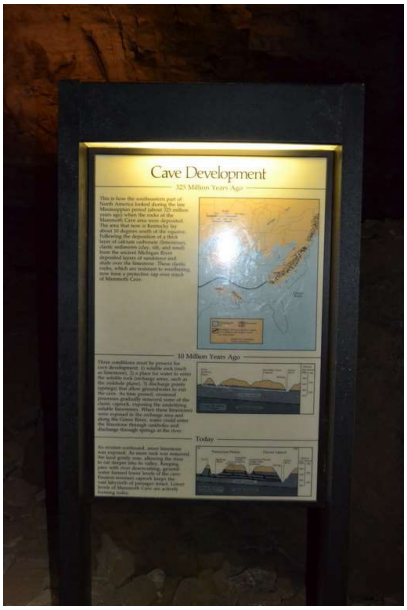


FIGURE 226. Information panel.

Artifact cases. Included with the cluster of interpretive information provided in Audubon Avenue are several artifact cases that contain evidence of American Indian activities in the cave (Figure 227). These cases are small metal canisters, both cylindrical and square, that are lighted and contain a glass-covered display area with an artifact and a label explaining what the artifact is.

FIGURE 227. Artifact case.

Signage. Signage within the cave is limited (Figure 228). The majority of the signs are small wooden plaques with routed letters painted white. Many of the signs are mounted on structures, including the restroom walls and fence and guard rail features. These are found at Side Saddle Pit and Bottomless Pit and the Drapery Room at Frozen Niagara. A small sign located on the ground marks Fat Man's Misery. There are also free-standing signs on metal stands that are movable and impermanent located along Houchins Narrows and along Rotunda and Broadway that direct visitors to appropriate tour locations.

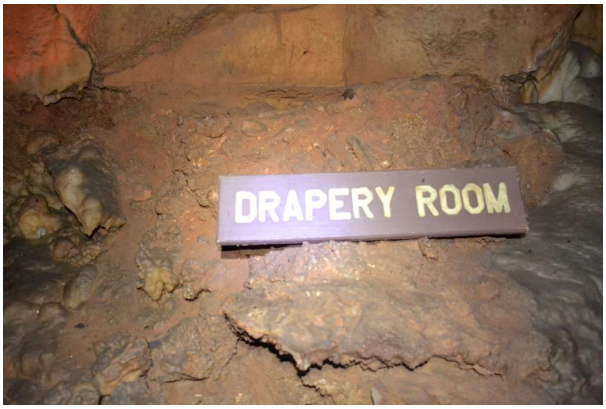


FIGURE 228. Signage.

Interpretive Features

Lost John display case. Located near the terminus of Cyclops Gateway is a glass case with a metal frame standing on metal legs (Figure 229). The case measures about 6 feet in length and stands about 3-1/2 feet in height. This was used to display a mummy found in the park to visitors for many years.

FIGURE 229. Lost John display case.

Wooden boxes to store interpretive props. Low rectangular wooden boxes set on the cave floor are located in certain rooms of the cave, such as Star Chamber and Wright's Rotunda, where tour guides store props. These boxes are relatively small and unobtrusive, standing approximately 1 foot in height and 6 feet long.

Flood level measuring instruments and markers. Located within River Hall at the base of the stairs leading into the space is a cluster of wooden poles with incremental markings that indicate the height of river flooding, and the high water marks associated with several flood events (Figure 230).

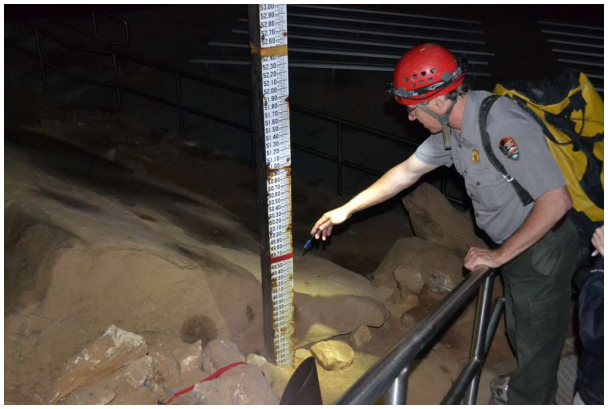


FIGURE 230. Flood measuring pole.

Commemorative Features

Commemorative markers, monuments. Commemorative monuments can be found in various locations within Mammoth Cave (Figure 231). The majority are grouped in several locations, including the Rotunda, Main Cave, and Gothic Avenue. One of these monuments is

located in Cyclops Gateway, and another in Vanderbilt University Hall. The markers were erected by groups and individuals, and honor specific themes, such as the Good Roads Movement, or recognize the contributions of individuals, such as the World War I monuments in the Rotunda.

FIGURE 231. Commemorative marker.

Rock cairns. Rock cairns occur in several locations throughout the cave (Figure 232). A large concentration occurs within Gothic Avenue. Other sites include Monument Hill. These features comprise rocks piled into a pyramidal form. They are believed to relate both to American Indian activities as well as historic era tourism.

FIGURE 232. Rock cairns.

Utilities

Power lines. Power and telephone lines are present throughout segments of the cave that are electrified for lighting or contain telephone boxes. The power lines are hidden from view behind and beneath rocks wherever possible.

Electrical drops. Electrical service drops are found within several locations in the cave. These include one at Snowball Dining Room Elevator, one at Mt. McKinley, and one at Grand Central Station. Another is located along Grand Avenue near Wycliffe's Dome composed of a pipe that extends to the cave floor. These are connected to a distribution panel. From each distribution panel, a feeder line is routed along the floor of the cave and tapped at various splice boxes, each serving a transformer. These in turn feed a branch panel to serve cave lighting. Cave lighting is controlled by relays, with multiple, push button switches located along the trail.

Pipe to convey water to drain at Cathedral Dome.

Upside down well. This feature is located within Cleaveland Avenue. It reflects a 1950s effort to convey water into the cave interior near the Snowball Dining Room. It is composed of a metal pipe that extends through the ceiling of the passage.

Electrical and telephone station boxes. Located throughout the cave passages that are currently used for tours are periodic electrical and telephone station boxes (Figure 233). They are generally sited to be out of view of primary tour routes or screened as possible. These are part of the electrical lighting and communication system that is regularly upgraded by the National Park Service to ensure the safety of visitors and staff. These features all post-date the period of significance.

FIGURE 233. Electrical and telephone station boxes.

Light system relay/switch boxes. At regular intervals along the toured cave passages, the NPS has installed light system switch boxes that illuminate a segment as indicated on the box (Figure 234). The electric lighting system has evolved since the NPS first installed lighting in the 1950s. Other features of the system include light fixtures such as upright lights, cone lights, and box lights, wiring, and transformer boxes. The addition of electricity has radically affected visitor experiences in the cave. The system is regularly upgraded. Current features post-date the period of significance.

FIGURE 234. Light system relay/switch boxes.

USGS geodetic survey markers. Approximately 21 miles of Mammoth Cave trunk passages contain approximately forty brass benchmark elevation and survey markers placed by H. D. Walker during a transit survey undertaken circa 1935–1936 (Figure 235). The elevation and survey markers are generally placed in proximate pairs. The Walker survey, completed in 1936, served to establish an accurate baseline through the cave and tied entrances to each other. The highly accurate bench-marked survey provided entrance control, and a subsequent base line for later *Cave Research Foundation surveys of Mammoth Cave.[329]

FIGURE 235. USGS Geodetic Survey markers.

Known and Potential Archeological Resources

The stable, relatively dry environment in large parts of Mammoth Cave is conducive to preservation of the suite of items that pre-Contact-period people brought into nearly all its passages. New soils do not accumulate in the dry parts of the cave, so artifacts left during their visits are visible on its floor in places not covered with walkways, pavement, or dust displaced by pedestrian traffic. In dry areas that were intensively utilized in pre-Contact times (notably during the Late Archaic and Early Woodland mining period) the floor is covered with layers of artifacts. These items and other indications of human behavior (such as scars left from mining) are nearly ubiquitous and are of sufficient volume that they contribute substantially to the landscape in the cave. They are also an important landscape characteristic that has made the cave a popular destination since the nineteenth century. Finally, they serve as a persistent visual reminder of the abundance of buried archeological materials that are not visible at the ground surface, as well as the voluminous amounts of artifacts that have been lost during historical mining and tourism activities.[330]

329. Ray L. Nelson compiled the Walker survey, the New Discovery survey, and three additional miles into a 28-mile Nelson map in 1956. Between the Kaemper map and Nelson map, Quinlan tallied a total of 46 miles of surveyed and mapped passages.

330. For example, buried archeological deposits that contain paleofeces, gourd fragments,

The prominent roles of the pre-Contact material in the cave's landscape are atypical relative to aboveground pre-Contact archeological sites without architectural features in the North American Eastern Woodlands. Seldom do non-architectural pre-Contact archeological deposits form a significant part of an extant landscape. Beyond this, the volume and extent of material in them at Mammoth Cave is likely singular in the Eastern Woodlands (possibly excepting other cave contexts). These factors necessitate two novel approaches for the current report: first, that the pre-Contact-period artifacts be included in the documentation of existing conditions; and second, that the discussion of the pre-Contact material comprise descriptions of classes of artifacts grouped by common morphology and function, rather than descriptions of individual items or deposits.

Two extensive and ongoing archeological programs have contributed the majority of information concerning the distribution of archeological materials in Mammoth Cave: the Cave Research Foundation Archaeological Project, begun in 1963 by Patty Jo Watson, and the National Park Service / Earthwatch Cultural Resource Survey, which has been conducting work since 1993.[331] Important earlier work in the cave includes Nelson's 1916 excavations in the Historic Entrance vestibule and Pond's and Neumann's publications about the "Lost John" mummy following its discovery in 1935.[332]

In the most general sense, visible pre-Contact-period artifacts and features in Mammoth Cave are either directly related to Late Archaic/Early Woodland Period mining or are non-mining materials that were left by the miners themselves or by other cavers throughout its period of use (which include the less intensive activities in the

shell, and pieces of stone tools and debitage are present throughout large parts of the Historic Tour Trail area and Gothic Avenue and along the Lantern Tour Route, where they have been covered by historical-period walkways and other deposits. Steven R. Ahler and George M. Crothers, "Archaeological Investigations for Proposed Trail Rehabilitation within Mammoth Cave," in *Mammoth Cave National Park's 10th Research Symposium: Celebrating the Diversity of Research in the Mammoth Cave Region* (Mammoth Cave National Park, February 14-15, 2013), 118-125; Steven R. Ahler and Rebecca L. Hummel, "Archaeological Excavations in Advance of the Historic Tour Trail Rehabilitation," in *Celebrating Diversity of Research in the Mammoth Cave Region: 11th Research Symposium at Mammoth Cave* (Mammoth Cave National Park, April 18–20, 2016), 9–15.

331. George M. Crothers, "The NPS/Earthwatch Archeological Project in Mammoth Cave," in *Proceedings of Mammoth Cave National Park's Eighth Science Conference* (Mammoth Cave National Park, October 5–6, 2000), 125; Crothers, "Prehistoric Archeology, 35; George M. Crothers and Robert H. Ward, "The National Park Service/Earthwatch Cultural Resource Survey: Discerning Patterns of Prehistoric Activity in Main Cave Despite 200 Years of Historic Use," in *Proceedings of Mammoth Cave National Park's Fourth Science Conference* (Mammoth Cave National Park, July 6–7, 1995), 27–28; George M. Crothers, Charles Swedlund, Robert Ward, Katherine Robinson Mickelson, and Andrew Mickelson, "The National Park Service/Earthwatch Cultural Resource Survey: Overview of the First Three Years, 1993–1995," in *Proceedings of the Fifth Annual Mammoth Cave National Park Science Conference* (Mammoth Cave National Park, August 1–2, 1996), 175–181; Watson, "Cave Research Foundation, 171–174.

332. Nels C. Nelson, "Archaeology of Mammoth Cave and Vicinity: A Preliminary Report," *Proceedings of the National Academy of Sciences of the United States of America* 3, no. 3 (1917):192–195; Nelson, *Contributions*; Alonzo Pond, "Lost John of Mummy Ledge," *Natural History* 39 (1937):176-184; Georg K. Neumann, "The Human Remains from Mammoth Cave, Kentucky," American Antiquity 4 (1938), 339–353; Kenneth C. Carstens, "A Historiography of Archaeological Research in the Mammoth Cave Area of Kentucky: 1824-2000," in Proceedings of Mammoth Cave National Park's Eighth Science Conference (Mammoth Cave National Park, October 5–6, 2000), 105–124.

years before and after the mining).[333] Artifacts and features related to mining include: mining tools; climbing sticks/poles; piles of breakdown; scars from mining left on the cave walls; and possible sorting beds. Non-mining features and items include torch materials (which are frequently so abundant they completely obscure the cave floor and other types of artifacts); 'snubbing marks' / charcoal smudges on cave walls and surfaces left when the lit ends of torches were refreshed; charcoal; rock art; paleofeces; gourd containers and fragments; textiles; and food remains of seeds and nuts.[334] Although the frequencies of artifacts on the floor are greater in parts of the cave that are less-heavily trafficked, they are still present in even the most-visited dry areas.[335] Wet parts of the cave are not conducive to artifact preservation and contain minimal pre-Contact period remains.[336]

Pre-Contact-period materials related to mining

Mining tools. Mining tools comprise the implements Mammoth Cave's pre-Contact miners employed to remove mineral deposits from the cave walls. They are sometimes present in low numbers near cave surfaces that show evidence of mining and are made from either stone collected for use at the mining site or gastropod shell transported from aboveground. Watson noted clam shell and limestone specimens in Ganter Avenue (of which one limestone implement had a convenient label reading, "Indian hammer," that had been applied during an earlier period of historical cave tourism); tools in Bryan's Pass and the 'S' Bend; and a possible implement in Hains Dome.[337] Ahler and Crothers found a mussel shell during a 2008 investigation for trail improvements and Ahler and Hummel note that several were found during a 2014–2015 trail improvements study at Giants Coffin.[338] Crothers notes that the Mammoth Cave mummy found in 1935 ('Lost John') had a mussel shell on a cord around his neck that was probably also a digging tool.[339]

Climbing poles. Climbing poles are fragments of wood (mostly tree limbs) up to approximately 10 feet in length and several inches in diameter that were presumably employed by the cave miners to access mining locations that were otherwise challenging to reach. Small numbers of poles are scattered through the cave; some are leaning against walls, while others are laying on the ground surface, are in small crevices, or wedged into small openings along walls. While most are simply repurposed relatively straight tree limbs, several have rungs attached with plant fibers (Figure 236). The University of Michigan collected a core sample from a pole at the east end of St. Catherine's City (the pole shown in Figure 237) during an investigation aimed at establishing a dendrochronological sequence for the Eastern Woodlands in the 1950s.[340] Watson noted probable climbing poles in Hain's Dome, Saint Catherine's City, near the Snow Room, and a 23-cm-long log fragment that might also have been used for climbing in Ganter Avenue.[341]

333. This discussion is limited to types of artifacts that are visible above the cave floor.
334. Crothers and Ward, 38. Undoubtedly much of the torch and torch-related materials were left by individuals engaged in mining, but lighting implements would also have been necessary for people moving through the cave for non-mining enterprises.
335. Crothers and Ward, 31–34; Mary C. Kennedy, George Crothers, Robert Ward, and Patty Jo Watson, "Report of Fieldwork, Mammoth Cave National Park, Expedition into America, 1993," in Proceedings *of Mammoth Cave National Park's Third Science Conference* (Mammoth Cave National Park, July 5–6, 1994), 29–31.
336. Patty Jo Watson, "Observations in Upper and Lower Mammoth," in Archaeology of the Mammoth Cave Area, ed. Patty Jo Watson (New York: Academic Press, 1974), 185–192.
337. Watson, "Observations in Upper and Lower Mammoth," 185–192.
338. Ahler and Crothers, 118-125; Ahler and Hummel, 9-15.
339. Crothers, "Prehistoric Archeology," 34.
340. George M. Crothers, personal communication, 2017.
341. Watson, "Observations in Upper and Lower Mammoth," 185–192.

FIGURE 236. Possible climbing pole with attached rung in a narrow wall crevice near the tuberculosis structures.

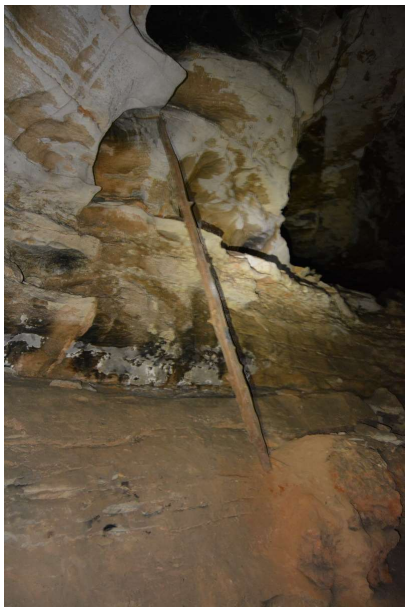


FIGURE 237. Possible climbing pole at the east end of St. Catherine's City.

Breakdown piles. Deposits or individual pieces of breakdown adjacent to mined cave surfaces may have been employed by pre-Contact-period miners to access elevated mineral deposits. Watson noted the presence of breakdown on top of torch cane in Mayme's Stoopway.[342] Although some of the breakdown that covers artifacts in the cave may be naturally deposited or historically disturbed material, Crothers notes that there are neatly-stacked 'cairns' of breakdown directly beneath mined ceiling surfaces in the newly-discovered Watson Trace, an area that has not been visited in historic times.[343] The presence of the cairns indicates pre-Contact miners did not hesitate to move breakdown for climbing.

Scars from mining. Indications of the extent of pre-Contact mineral mining are present in many of the dry portions of the cave. They comprise battered and scarred limestone surfaces of formerly covered with gypsum and, in far less-common instances, epsomite, and mirabilite (Figure 238). Watson noted indications of mining in Mayme's Stoopway, Hain's Dome, St Catherine City, Wright's Rotunda, the S Bend, Kinney's Arena, the Snow Room, Flint Alley, Ganter Avenue, Boiled Egg Passage, Ranshaw Avenue.[344] Crothers has observed numerous mining scars in Watson Trace.[345] Watson also recorded evidence of chert mining in Jessup Avenue and Flint Alley.[346]

Possible sorting beds. There are a small number of features that may be remains of sorting beds associated with mining in the cave around Chief City. The beds are on pieces of flat-topped breakdown that are up to ten feet in breadth and are made up of rock fragments and sediment that may have been left when pre-Contact miners separated them from more-desirable materials (Figure 239). However, the features have been subjected to little investigation and further work is needed to ascertain whether they are actually related to pre-Contact-period cave uses.[347]

342. Ibid.
343. Crothers, personal communication, 2017.
344. Watson, "Observations in Upper and Lower Mammoth," 185–192.
345. Crothers, personal communication, 2017.
346. Watson, "Observations in Upper and Lower Mammoth," 185–192.
347. Crothers and Ward, 33.

FIGURE 238. Heavily mined portion of a wall in the Main Cave; lighter-colored areas have been mined.

FIGURE 239. Possible mining sorting bed at Chief City.

Pre-Contact-period features not directly related to mining

Torch material. By far, remains of pre-Contact-period torches make up the majority of the visible archeological material in the cave. In passages away from the heavily visited Historic Entrance and Rotunda area, the cave floor is littered with partially-charred fragments of torch material, which is mostly cane (genus *Arundinaria*) (Figure 240).[348] Watson observed torch pieces in Mayme's Stoopway, Saint Catherine City, Chief City, Wright's Rotunda, Kinney's Arena, Jessup Avenue, Ganter Avenue, Flint Alley, Boiled Egg Passage, Ranshaw Avenue, and a crawlway near Ranshaw Avenue.[349] They have also been found below walkways and other historical deposits in areas that have been intensively visited in historical times; for example, Ahler and Crothers found 1,359 cane pieces in 42 archeological units excavated during a 2008 investigation for trail improvements.[350] Because of the large numbers of cane fragments scattered across large parts of the cave, quantification of the torch material is challenging, but totals of over a million pieces are likely.

Although present in far lower numbers than torch cane fragments, more-complete remains from torches are also present in the cave. These comprise torch bundles made from several canes held together with ties made from bark or possibly vine. Watson noted bark ties in Boiled Egg Passage and Ranshaw Avenue and a possible vine tie in Boiled Egg Passage. There are also plant fiber ties in parts of the Main Cave (Figure 241).[351]

348. Rick Olson, "Torch Fuels Used by Prehistoric Indian Cavers: Their Utility and Botanical Significance," in Proceedings, Mammoth Cave *National Park's Seventh Science Conference* (Mammoth Cave National Park, July 31, 1998), 5–8.
349. Watson, "Observations in Upper and Lower Mammoth," 185–192.
350. Watson and Crothers, 121.
351. Crothers, "The Prehistoric Archeology of Mammoth Cave," 32; Watson, "Observations in Upper and Lower Mammoth," 185–192; Crothers, personal communication, 2017.

FIGURE 240. Torch cane fragments covering the cave floor at Chief City.

FIGURE 241. Plant fiber torch tie between the Star Chamber and the Snow Room.

Charcoal smudges. Smudges of charcoal are abundant and moderately visible features in the cave closely related to the pre-Contact torch materials. They are present on walls, floors, ceilings, and breakdown and were left when torchbearers rubbed the lit ends of their torches to refresh their flames or embers (Figure 242).[352] Watson noted them in Mayme's Stoopway, Chief City, Potter Hall, Jessup Avenue, Ganter Avenue, Flint Alley, Boiled Egg Passage.[353]

FIGURE 242. Charcoal torch smudges on breakdown in Chief City.

Charcoal. Charcoal—nearly all of which was left from cane torches—is an abundant but minimally visible artifact class. Watson observed it in Mayme's Stoopway, Saint Catherine City, Wright's Rotunda, Kinney's Arena, Snow Room, Jessup Avenue, Ganter Avenue, Flint Alley, Boiled Egg Passage, Ranshaw Avenue, and in a crawlway near Ranshaw Avenue.[354]

Rock art. The cave's pre-Contact-period rock art is a highly visible, but relatively uncommon set of features. The three most prominent instances of rock art are panels of petroglyphs and pictographs on vertically oriented pieces of breakdown in parts of the cave included in several tour routes. One, called the Devil's Looking Glass (Figure 243), is near Kinney's Arena; another, called Standing Rock, is east of Booth's Amphitheater (Figure 244); and the third is on an unlabeled piece of breakdown at the Cataracts (Figure 245). Depictions include repeating geometric designs and somewhat abstracted anthropomorphic figures. Much of the art at the three locations is partially obscured by historic-period petroglyphs. Earthwatch participant Logan Kistler argues the art represents images in hallucinations experienced by pre-Contact cavers' during altered states of consciousness, perhaps related to rites of passage. Additional rock art is found in the lower levels of Mammoth Cave.[355]

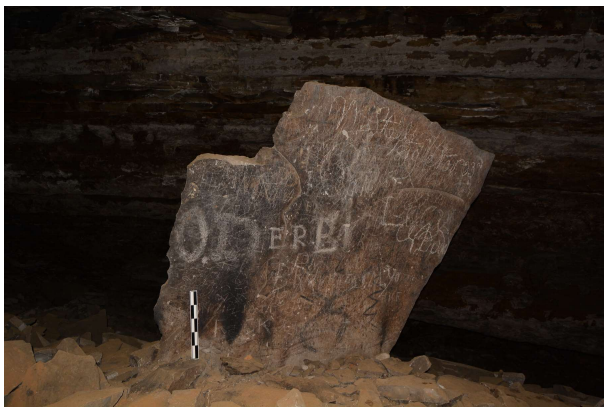


FIGURE 243. Devil's Looking Glass rock art.

352. Crothers, "The Prehistoric Archeology of Mammoth Cave," 32.
353. Watson, "Observations in Upper and Lower Mammoth," 185–192.
354. Ibid.
355. Logan Kistler, "Prehistoric Drawings in Mammoth Cave," *Kaleidoscope* 6 (2007):69-82; Crothers, personal communication, 2017.

FIGURE 244. Part of the rock art at Standing Rock.

FIGURE 245. Rock art at the Cataracts.

Paleofeces. Pre-Contact-period paleofeces are a minimally visible, moderately abundant class of artifact in the cave (Figure 246). Crothers estimates there are thousands of specimens and Watson noted examples in the 'S' Bend area, Kinney's Arena, near the Snow Room, Jessup Avenue, Ganter Avenue, and a crawlway near Ranshaw Avenue.[356] They are also present on the cave floor near Chief City and 255 and 32 were found below the floor during the archeological investigations for the 2008 and 2014–2015 trail improvements, respectively.[357] Analysis of paleofeces samples from the cave—which frequently contain seeds and seed fragments—have substantially contributed to knowledge concerning the development of agriculture in the Eastern Woodlands.[358] Other studies of them have permitted insight concerning the seasonal timing of visits to the cave and determination of the cavers' sex (to date, all were male).[359]

Gourd containers and container fragments. Complete and fragmentary gourd containers are a moderately-visible, low-frequency category of artifacts in Mammoth Cave. Watson observed pieces of warty squash and other gourd fragments near the Snow Room (Figure 247) and there are complete containers in a hollow beneath breakdown between the Star Chamber and the Snow Room (Figure 248).[360] One of the gourd fragments near the Snow Room is in a highly visible location atop a piece of breakdown adjacent to historical artifacts and is possibly not in situ. The complete gourd containers, however, are largely obscured and likely have not been moved in historic times. Twelve gourd fragments were also found below the cave floor during the 2014–2015 trail improvements archeological investigation at Giants Coffin.[361]

356. Crothers, "The Prehistoric Archeology of Mammoth Cave," 36; "Observations in Upper and Lower Mammoth," 185–192.
357. Crothers, personal communication, 2017; Ahler and Crothers, 122; Ahler and Hummel, 14.
358. Watson, "The Cave Research Foundation Archaeological Project: An Update," 172; Patty Jo Watson, "Of Caves and Shell Mounds in West-Central Kentucky," in Of Caves & Shell Mounds, ed. Kenneth C. Carstens and Patty Jo Watson (Tuscaloosa: University of Alabama Press, 1996).
359. James Schoenwetter, "Rethinking the Paleoethnobotany of Early Woodland Caving," Midcontinental Journal of Archaeology 23, no. 1(1998), 23–44; Kristin D. Sobolik, Kristen J. Gremillion, Patricia L. Whitten, and Patty Jo Watson, "Technical Note: Sex Determination of Prehistoric Human Feces," *American Journal of Physical Anthropology* 101(1996), 283–290.
360. Watson, "Observations in Upper and Lower Mammoth," 185–192; Crothers, personal communication, 2017
361. Ahler and Hummel, 14.

FIGURE 246. Paleofeces in a crevice near Chief City.

FIGURE 247. Gourd fragment near the Snow Room.

FIGURE 248. Complete gourd containers in a breakdown void between the Star Chamber and the Snow Room.

Textiles. Textile artifacts, comprising complete slippers and slipper and bag fragments, form a rare, moderately visible class of artifacts in the cave. They were formerly more abundant along the historic trail routes, but many were removed by cave visitors. Slippers were of twined construction and made from rattlesnake master (*Eryngium yuccafolium*).[362] Most were likely discarded by their pre-Contact-period wearers as they wore out through use.[363] There is a textile fragment on a piece of breakdown near Wright's Rotunda (Figure 249) and another in a void amongst breakdown fragments south of Kinney's Arena (Figure 250).[364] The piece near Wright's Rotunda, which might be from a slipper, is in an easily accessible location and might have been moved historically. The fragment in the breakdown void is in an obscured and protected location and is probably *in situ*. A pair of replica slippers is on display in a protective enclosure at Audubon Avenue (Figure 251).

362. Crothers, personal communication, 2017; Joan Miller, "Experimental Replication of Early Woodland Vegetal Fiber Slippers," Southeastern Archaeology 7, no. 2(1988): 132-137.
363. Crothers, "The Prehistoric Archeology of Mammoth Cave," 32-33.
364. Crothers, personal communication, 2017.

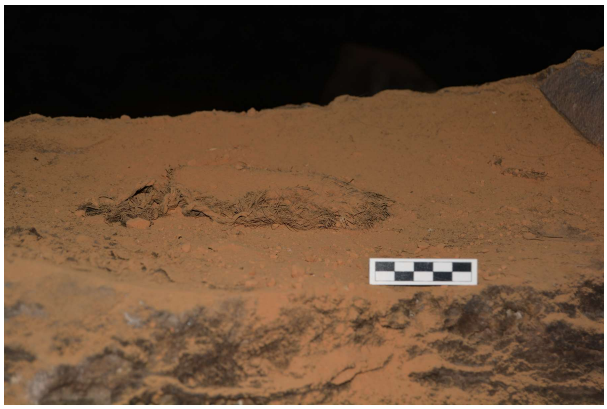


FIGURE 249. Textile fragment (possible slipper) on breakdown near Wright's Rotunda.

FIGURE 250. Textile fragment in a void among breakdown fragments near Kinney's Arena.

FIGURE 251. Replica pre-Contact-period twined slippers on display in Audubon Avenue.

Nut and seed food remains. Remains of nuts and seeds from food are a minimally visible and fairly uncommon class of artifacts on cave surfaces (although they are far more common in buried contexts). Watson observed seed pods and a hickory nut shell at Kinney's Arena, hickory shell fragments along Ganter Avenue, a seed pod in the Boiled Egg Passage, and a piece of an acorn and hickory nut fragments in a crawlway near Ranshaw Avenue.[365] Far greater numbers of seeds and nut remains have been found in buried contexts beneath historical and modern cave walkways and other deposits. For example, 483 seed and nut fragments were found during the 2008 trail improvements archeological investigation; plant types include Chenopodium, panic grass, sunflower, marsh elder, maygrass, gourds, and nutshells.[366]

365. Watson, "Observations in Upper and Lower Mammoth," 185–192.

366. Ahler and Crothers, 121.

Condition Issues and Concerns Associated with the Features of the Mammoth Cave Historic District

The following condition related issues were derived from field investigation, discussions with park personnel, and review of the 2014 Mammoth Cave National Park Foundation Document.

- Cave features, including sediments, formations, and speleogens are generally in good condition, although areas with a longer history of tourism show damage from visitation and tour related infrastructure. In many locations, sediment deposits have been removed from their original locations and used either in saltpetre mining operations or in the construction of cave trails. Borrow pits are evident in many locations. Evidence of visitor abuse of cave formations is also present in many locations. Gypsum discoloration resulting from torch use and disturbance from pre-Contact mining, as well as oil and smoke staining from lanterns and now-discontinued cave passage lighting activities for the benefit of visitors is also evident.
- Where cave soil trails have been extensively used, dust particles have entered the air and settled on cave formations, altering the character of the passages and obscuring views of the geology and the aesthetics of the cave. The dust is widespread but localized in toured areas of the cave. Lint is also contributed to the cave interior by visitor access. Both dust and lint obscure and potentially threaten cave ecosystem, paleontological resources, and cultural resources. The park has embarked on a test cleaning effort to determine the best method for removing dust deposits without otherwise harming the cave geology or signatures.
- Certain fragile organic and biological cave resources (including both archeological materials and paleontological materials) in some areas are deteriorating due to altered cave climates that are the result of the addition of artificial entrances, lighting use, and visitor activities. Modification of cave entrances (mostly in the past, but also continuing to some extent) originally altered natural airflow patterns within the cave. However, the NPS has endeavored to develop lock systems that have helped to restore conditions prior to alterations.
- Cave biota and ecosystem are generally in good condition, although biota near some toured areas are impacted by visitors.
- Many portions of Mammoth Cave are no longer used by bats as a hibernaculum due to the extent of human activity within the cave, diminishing its value as habitat.
- Nonnative algae and cyanobacteria growth (lamp-flora) caused by cave lighting is widespread but localized in lighted tour areas of the cave. Lamp-flora threatens cave ecosystem, some cultural resources, and cave aesthetics. The park has been working to replace lighting systems that contribute to lamp-flora. In some areas, particularly Mammoth Dome and parts of the New Entrance and Frozen Niagara, conditions seem to be improving with updated lighting. Evidence of former lighting locations that led to lamp-flora remains on the cave walls in some places. However, some areas still have major growth due to current lights, and legacy algae from previous lighting still exists.
- Corroding material from both current and previous tour infrastructure, which includes aluminum and steel handrails, electrical wiring, material used to affix wires to the cave walls, former septic systems, and fixtures, has introduced compounds that may harm cave biota. Such materials are located along both current and former tour routes in several caves in the park.
- Cave stream water quality has improved over the last twenty-five years, but storm events still introduce contaminants into the cave from above. The park continues to work with state, local, and federal officials to reduce contamination entering the caves. Because the land contributing to the watershed of the cave is a World Biosphere Reserve, additional

guidance on appropriate management practices is warranted to address this concern.

- Dust and lint is widespread but localized in toured areas of the cave. In some areas, particularly parts of Upper Historic and Frozen Niagara, cave trail modifications have reduced the amount of dust and lint migrating off trail. However major areas still have significant (and worsening) dust and lint problems. Legacy dust problems still exist in Upper Historic.
- Cave trails may be reaching their carrying capacity. Further deterioration of cave geology, biota, and infrastructure may result from the introduction of too many visitors. Improvements that protect fragile resources may be needed. Because many of the trails are historic features, special care and consideration will need to be taken in the design and implementation of any protection or rehabilitation strategies. Challenges include limited Americans with Disabilities Act accessibility, deterioration of trail surfaces, the difficulties associated with effective maintenance, and visitor and park personal safety.[367]

367. National Park Service, *Mammoth Cave National Park Foundation Document*, 13.

Analysis and Evaluation

Introduction

This chapter consists of three sections: an evaluation of the significance of the Mammoth Cave Historic District landscape in accordance with the National Register of Historic Places (National Register); an integrity assessment; and a comparative analysis of historic and existing landscape conditions.

The significance evaluation that forms the first section of the chapter identifies the current National Register status of the Mammoth Cave Historic District. This is followed by a detailed discussion of the property's important historical associations over time, as well as its architectural, archeological, and social value. The property's significance is tied to a discrete period of time in which its important contributions were made, and to a series of historic contexts, defined as patterns and trends in history and prehistory that can be used to understand a specific occurrence, property, or site, and to make clear its meaning and importance.

The second section of the chapter is composed of an integrity assessment that summarizes to what degree the property retains its ability to convey its historic associations with the identified period of significance, both as a whole and through each of the seven aspects of integrity that are used to assess properties.

The third section of the chapter uses both the significance evaluation information as well as the integrity assessment to compare historic and existing conditions to determine which resources contribute to the significance of the historic district. In addition to identifying contributing resources—defined as those features that survive with integrity from the identified period of significance and relate to the significant historic contexts associated with the property, the CLR also identifies non-contributing resources—those that originated after the period of significance, have lost integrity, or do not relate to significant historic contexts. Finally, the CLR identifies features that existed during the period of significance but do not survive today. These are described as missing historic resources.

Current National Register Status of Mammoth Cave National Park

Mammoth Cave National Park, located in Edmonson County, Kentucky, has long been recognized as a unique and important natural resource by various cultural groups over hundreds if not thousands of years. The historic significance of the cave as a focus of cultural activity was previously recognized in a 1991 Multiple Property Documentation Form (MPDF), NR 64500237, and several related National Register nominations and Determinations of Eligibility.[368] The Mammoth Cave Historic District was listed in the National

368. Kelly A. Lally and Bruce Noble, *Mammoth Cave National Park Historic Resource Study*, National Register of Historic Places Multiple Property Documentation Form (NR 645007, accepted May 8, 1991).

Register of Historic Places in 1991. The nomination references the four historic contexts articulated in the MPDF:

- Context A: Exploration and Settlement in the Mammoth Cave Area, circa 1754–1927
- Context B: Discovery and Early Uses of Mammoth Cave, 1798–1849
- Context C: Commercial Cave Development and the Growth of Tourism in the Mammoth Cave Area, 1849–1926
- Context D: Establishment of Mammoth Cave National Park, 1924–1941[369]

Four National Register nominations were prepared in conjunction with the MPDF to address the property's contributions to American history under these historic contexts. These nominations addressed the following historic districts and building, resulting in currently listed properties as follows:

- *Mammoth Cave Historic District* (NR 91000503), composed of the Historic Cave Entrance, Frozen Niagara Entrance, and fifteen additional features of the cave interior and listed in 1991.[370]
- *Residential Area District* (NR 91000502), composed of six New Deal-era buildings and listed in 1991.[371]
- *Maintenance Area District* (NR 91000501), composed of four New Deal-era buildings and listed in 1991.[372]
- *Superintendent's House* (91000501), composed of one New Deal-era building and listed in 1991.[373]

The National Park Service and Kentucky State Historic Preservation Office (SHPO) have documented the National Register eligibility of several additional resources. These include:

- Thirty-three New Deal-era buildings, determined eligible for listing in 2009.[374]
- Cave interior trails developed by the Civilian Conservation Corps, determined eligible for listing in 2015.[375]

In 2017, WJE and Liz Sargent HLA prepared documentation to support NPS assessment of additional resources located within Mammoth Cave National Park relating to the existing historic contexts addressed by the MPDF as well as resources that might be considered eligible for listing under a proposed expanded period of significance. The additional documentation considered features built in support of the establishment of Mammoth Cave National Park, and thus related to Context D of the MPDF, both during the existing period of significance (1926–1941) and during an extended period encompassing park developments completed from the end of World War II through completion of the Mission 66 program. The suggested period of significance extends to 1969 to include the timeframe associated with the Mission 66 program itself (1956–1966) as well as completion of various projects at Mammoth Cave National Park, proposed as part of Mission 66, between 1966 and 1969. These resources were not

369. Ibid, 89; Kelly A. Lally, *National Register of Historic Places Registration Form, Mammoth Cave Historic District* (NR 91000503), listed May 8, 1991. There is some inconsistency within the Mammoth Cave Historic District nomination as to the end date for Context D (typically given as 1941 but on page Section 8-1 as 1942).
370. Lally, National Register of Historic Places Registration Form, Mammoth Cave Historic District.
371. Kelly A. Lally, *National Register of Historic Places Registration Form, Residential Area District* (NR 91000502), listed May 8, 1991.
372. Kelly A. Lally, *National Register of Historic Places Registration Form, Maintenance Area District* (NR 91000501), listed May 8, 1991.
373. Kelly A. Lally, *National Register of Historic Places Registration Form, Superintendent's House* (NR 91000502), listed May 8, 1991.
374. *Consensus Determination of Eligibility for Thirty-Three New Deal-Era Buildings at Mammoth Cave National Park*, 2009.
375. "Memorandum of Agreement, Rehabilitation of Cave Tour Trails at Mammoth Cave National Park, Edmonson County, Kentucky," April 24, 2015.

considered in the 1991 MPDF in part because they had not reached the fifty-year age consideration for National Register eligibility at that time.[376] (See further discussion of period of significance, below.)

Mammoth Cave Historic District

The 1991 National Register nomination for Mammoth Cave Historic District indicates the property to be significant at the national level under Criterion A within the areas of Entertainment/Recreation, Industry, and Health/Medicine, and identifies an overarching period of significance of 1806 to 1941.[377] Within this broad period, the nomination indicates the historic district to be significant in the area of Entertainment/Recreation between 1816 and 1941; in the area of Industry between 1806 and 1814; and in the area of Health/Medicine between 1842 and 1843. The 1806 start date is based on the approximate beginning of saltpeter mining in Mammoth Cave, while the end date appears to be tied to fifty years before the date of the nomination.[378] (See further discussion of period of significance, below.)

The nominated area begins at the Historic Entrance and extends for approximately 12 miles of underground passages, including the portions of the cave that were used historically for mining, medical, and other commercial purposes. The nomination indicates that:

> The Mammoth Cave Historic District is an exceptionally rare resource. . . . Based on the critical role which Mammoth Cave saltpetre played in supporting the American military effort during the War of 1812, the importance of Mammoth Cave as an American tourist destination, the significance of the tuberculosis huts as an experimental effort to control a fatal disease, and the excellent state of preservation exhibited by the historic resources within the cave, national significance has been assigned to the Mammoth Cave Historic District.[379]

The nomination listed a total of seventeen contributing resources—five sites, eleven structures, and one object—and one non-contributing site.[380] These resources include:

- Historic Entrance
- Mushroom Beds
- Rock Stairs and Walls to Olive's Bower
- Saltpetre Mining Works
- Rock Monuments, Walls, and Signatures in Gothic Avenue
- Rock Wall at the Bridal Alter
- Rock Wall at Jenny Lind's Armchair
- Rock Wall at End of Gothic Avenue
- Rock Stairs at End of Gothic Avenue
- Tuberculin Huts
- Albert's Stairway
- Violet City Entrance
- Carmichael Entrance
- Cable at Aerobridge Canyon
- Landing at Crystal Lake
- Frozen Niagara Entrance

The non-contributing site is the New Entrance to Mammoth Cave. The non-contributing structures include the gate at the Historic Entrance, the electrical system, modern metal handrails, the metal bridges, and the metal gates and fences.

376. Ethan Carr, Elaine Jackson-Regondo, PhD, Len Warner, Rodd L. Wheaton, John Feinberg, and Carly M. Piccarello, ed., *National Register of Historic Places Multiple Property Documentation Form, National Park Service Mission 66 Era Resources*, certified August 13, 2015, F-58.
377. Lally, *National Register of Historic Places Registration Form, Mammoth Cave Historic District.* As noted, there is some inconsistency within the nomination as to the end date for Context D (typically given as 1941 but on page Section 8-1 as 1942).
378. Ibid.
379. Kelly Lally, *National Register of Historic Places Multiple Property Documentation Form, Mammoth Cave National Park Historic Resource Study* (1991), NR 64500237, B-7.
380. Based on a later amendment, nine non-contributing structures were added to the listing. Some of the listed features may require additional evaluation to confirm that they date to New Deal era construction, such as some of the rock walls.

The nomination also notes, however, that the historic district could be expanded in the future:

> Mammoth Cave itself should receive future study as a historic resource. In both prehistoric and historic times, the cave has served as the site of a variety of human activities. The extent of recent survey activity resulted in the nomination of the Mammoth Cave Historic District located within the cave's Historic Entrance. The cave should ultimately be evaluated as a historic resource whose limits extend beyond the current boundaries established **for the Mammoth Cave Historic District.**[381]

Evaluation of Significance

National Register Criteria for Evaluation

In order for a property to be eligible for inclusion in the National Register, it must possess significance under one of four criteria. The Criteria for Evaluation state:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. That are associated with the lives of persons significant in our past; or
>
> C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. That have yielded, or may be likely to yield, information important in prehistory or history.[382]

In addition, the Criteria for Evaluation identify the following Criteria Considerations:

> Ordinarily cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past fifty years shall not be considered eligible for the National Register. However, such properties *will qualify* if they are integral parts of districts that do meet the criteria or if they fall within the following categories:
>
> A religious property deriving primary significance from architectural or artistic distinction or historical importance; or
>
> A building or structure removed from its original location but which is primarily significant for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
>
> A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building associated with his or her productive life; or
>
> A cemetery that derives its primary importance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
>
> A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

381. Lally, *National Register of Historic Places Multiple Property Documentation Form, Mammoth Cave National Park Historic Resource Study,* C-12.

382. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation.*

> A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or
>
> A property achieving significance within the past 50 years if it is of exceptional importance.[383]

National Register Significance of Mammoth Cave Historic District

Based in research conducted for this CLR, Mammoth Cave Historic District is significant at the national level under Criteria A in the areas of Entertainment/Recreation, Exploration, Politics/Government, and Science; at the statewide level in the area of Industry, and at the local level in the area of Health/Medicine; under Criterion C at the local level in the area of Engineering; and under Criterion D in the area of Archeology (Historic, Non-Aboriginal). Further consideration is needed to identify the level of significance associated with Criterion D.

Criterion A

Entertainment/Recreation

The 1991 National Register nomination indicates Mammoth Cave Historic District to be significant in the area of Entertainment/Recreation. The nomination addresses issues of importance considered as part of this CLR as follows:

> Mammoth Cave's most prominent claim to fame is and always has been its use as a major tourist attraction. From the earliest commercial tours circa 1816 to the day it was established as a part of Mammoth Cave National Park in 1941, Mammoth Cave has received national and international attention and acclaim which continues into the present. Among the prominent nineteenth century visitors to the cave were Jenny Lind, the famous Swedish opera singer, and the Grand Duke Alexis of Russia. A number of British travelers wrote of their cave experiences in their travel accounts and diaries. Most of the historic sites in the Mammoth Cave district, mainly the entrances, rock walls, stairs, and monuments, and the candle smoke signatures reflect the cave's use for the entertainment of countless numbers of visitors who have come to see the most extensive of the world's caves.[384]
>
> Though Mammoth Cave is nationally significant in several different areas, this resource has also had considerable impact on local and state history. Beginning in the early nineteenth century, local residents were employed to work in the hotel and in the cave as tour guides. During ownership by the Croghan heirs in the late nineteenth and early twentieth century, the controversial period known locally as the "cave wars" came about as owners of other caves began to compete with Mammoth Cave for the lucrative tourist business. Finally, this unique resource, which serves as the central attraction of Kentucky's only national park, continues to bring hundreds of thousands of tourists yearly to the state of Kentucky from all over the world.[385]

The growing popularity of the cave as a tourist destination in the mid-nineteenth century can be seen by the number of prominent visitors to the cave, including Jenny Lind, the Swedish opera singer, who visited the cave following a performance in Nashville, and was photographed sitting in a rock formation in Gothic Chapel that resembles a seat. The rock formation is now known as Jenny Lind's Armchair.

In the 1920s, George Morrison arranged for a room near Frozen Niagara to be used for radio broadcasts, in an attempt to gain an advantage in his competition with Mammoth Cave. The broadcasts proved to be a popular form of entertainment. To help commemorate the completion of the 8-mile-long route between the Historic Entrance and the Frozen Niagara entrance in 1935, an underground radio broadcast was made from the Snowball Dining Room.[386]

383. *Code of Federal Regulations, Title 36, Part 60,* "The National Register Criteria for Evaluation."
384. Lally, National Register Nomination, Mammoth Cave Historic District, 8-1.
385. Ibid., 8-2.
386. Bridwell, 58.

The Mammoth Cave Historic District is also significant for the efforts of the tour guides who explored the cave and led visitors on tours. In particular, Stephen Bishop is considered by many to be "unquestionably one of the greatest explorers Mammoth Cave has ever known."[387] Bishop, who was born into slavery, was brought to Mammoth Cave in his late teens in 1838 by Franklin Gorin, and was acquired by Dr. John Croghan when he purchased Mammoth Cave in 1839. Bishop helped to explore and locate numerous passages within the cave that became favorite tour spots. Word spread of Bishop's knowledge, and many who visited Mammoth Cave requested that Bishop serve as their guide. With the tips he received, Bishop was able to buy his and his wife's freedom.

> He learned the toured routes from white guides Joe Shackelford and Archibald Miller Jr. However, Stephen Bishop ventured beyond the toured areas and discovered many miles of the Mammoth Cave no eye had ever seen. The gateway for modern exploration of the cave could be attributed to Stephen's crossing of a deep vertical shaft known as the Bottomless Pit. The areas he discovered beyond the Bottomless Pit can still be viewed by visitors today. Places such as Fat Man's Misery, Cleaveland Avenue and Mammoth Dome are among the most notable.[388]

> Stephen was a showman and visitors wrote of his speech and singing voice. Perhaps visitor Bayard Taylor described what today's perception of Stephen Bishop was when he wrote:

> > He is a slight, graceful, and very handsome mulatto of about thirty-five years of age, with perfectly chiseled features, a keen, dark eye and glossy hair, and mustache. He is the model of a guide - quick, daring, enthusiastic, persevering, with a lively appreciation of the wonders he shows, and a degree of intelligence unusual in one of his class . . . . I think no one can travel under his guidance without being interested in the man, and associating him in memory with the realm over which he is chief ruler.[389]

> Stephen gained his freedom in 1856, but sadly died at the age of thirty-seven in the following year, leaving behind his wife Charlotte and son Thomas.[390]

Other cave guides included Matt Bransford and Nick Bransford. Bishop and the Bransfords are representative of a long-standing tradition of African American guides who played an important role in cave exploration and the development of tours and tourism. As noted on the park website:

> African Americans played a vital role in the development of cave tour routes and the visitor experience throughout the 19th and early 20th century. The first black guides were slaves and through their efforts opened up the golden age of cave exploration for Mammoth Cave. Their discoveries and story continue to live on within the avenues and guided tours of the cave today. While each slave guide eventually saw his freedom, their life was fraught with hardship in a time where the country was divided on their place in society. During their life they may have never realized the importance of their existence. However, today they are not viewed as slaves or lower class citizens. They are legends.[391]

Exploration

Extensive efforts have been made over the years by various groups and individuals to explore the cave and expand knowledge of the extent of accessible passages. These efforts have entailed many logistical and physical challenges. Efforts to explore the cave interior contributed to settlement in the Mammoth Cave area. These efforts are well documented and include the work of cave guides

387. National Park Service, "Black History at Mammoth Cave" *Mammoth Cave National Park.* Accessed October 22, 2018, https://www.nps.gov/maca/learn/historyculture/black-history.htm.
388. Lally, *National Register Nomination, Mammoth Cave Historic District*.
389. Ibid.
390. Ibid.
391. Ibid.

such as Stephen Bishop (discussed above) and John Nelson, as well as Max Kaemper, Ed Bishop, Horace Carter Hovey, and George Morrison. Their efforts led to ever-increasing knowledge of passages available to tour by the visiting public. Without these efforts, the cave would not have achieved the international recognition that led to its popularity as a tourist destination.

Max Kaemper was a German mining engineer who surveyed the cave in 1908. Kaemper prepared a map that represents the first accurate instrument survey of portions of the cave system. His efforts to explore passages and expand the area available to visitors, as well as the map were notable contributions to our understanding of the cave.

George Morrison obtained mining options on land southeast of the historic cave in 1915 and began to explore the cave in 1916. After establishing the Mammoth Cave Development Company in 1921, he created New Entrance; constructed a hotel nearby; and created numerous trails for tours. In 1924, Morrison built a dam to establish Crystal Lake (near Frozen Niagara) for boat rides; built a new entrance near Frozen Niagara; and constructed an aerial tram to convey visitors across Aero-Bridge Canyon. In 1930, he engineered an entrance into the cave near Cathedral Domes and an associated wood stairway, which are no longer extant. In 1931, he added an entrance at Carmichael. Surviving today from Morrison's efforts are numerous examples of trail work including stacked stone stairs and walls, trail surfacing, Big Break, New Entrance, Frozen Niagara Entrance, Carmichael Entrance, and cable associated with the Aero-Bridge Canyon tram.

The Exploration area of significance was not addressed as part of the 1991 MPDF or National Register nomination. It is proposed herein as an additional area for consideration in a potential future updated nomination.

392. National Park Service, "Hidden History: Tuberculosis in Mammoth Cave." Accessed March 19, 2021, https://www.nps.gov/articles/tuberculosis-mammoth-cave.htm.

Health/Medicine

The 1991 National Register nomination indicates Mammoth Cave Historic District to be significant in the area of Health/Medicine, primarily as associated with the efforts of Dr. John Croghan. Before acquiring Mammoth Cave in 1938, Croghan helped to establish the United States Marine Hospital in Louisville, Kentucky. Between 1842 and 1843, Croghan conducted experiments in the treatment of tuberculosis and established a sanatorium within Mammoth Cave:

> Having observed that timber and animals did not decay within the cave, Dr. Croghan hoped the environment would be restorative and therapeutic for tuberculosis patients and subsequently established an experimental hospital treatment facility within the cave.[392]

The 1991 nomination notes:

> Dr. John Croghan (the owner of Mammoth Cave from 1839 to 1849) and other contemporary medical experts had believed that the even temperature and humidity would prove beneficial to the health of people stricken with tuberculosis. In 1842-1843, a number of people with this disease from as far away as New York and Pennsylvania were hospitalized in the cave, living in stone and wood huts. After several patients died, the experiment ended, deemed a failure by the medical world of the nineteenth century. However, the results of this experiment on a then common, but little-understood and often fatal illness paved the way for an eventual cure for the ailment.[393]

Although Croghan's experiment failed, his work at Mammoth Cave contributed to the later understanding of the disease and more successful treatments.

Supporting this significance are two stone hut ruins that survive from Croghan's experiment.

393. Lally, National Register Nomination, Mammoth Cave Historic District.

Industry

The 1991 National Register nomination indicates Mammoth Cave Historic District to be significant in the area of Industry. The nomination addresses issues of importance considered as part of this CLR, including the following:

> In the years before and during War of 1812 (1806–1814) when trade with British-controlled India was cut off, Mammoth Cave was a major source for saltpetre, an essential ingredient in gunpowder. Mined and processed by slave labor, it is estimated that the Mammoth Cave facility produced over 400,000 pounds of the mineral in 1814 alone. Without the gunpowder made from Mammoth Cave saltpetre, it is possible that the War of 1812 could have ended in a British victory. The remains of the saltpetre mining works in the cave provide a remarkably intact picture of an important early nineteenth century extractive industry.[394]

Numerous wood vats and piping features survive within the cave that relate to this aspect of the property's significance.

Assessment conducted for this CLR suggests the state level for this area of significance.

Community Planning and Development (Park)

In the 1930s, as efforts were made to establish Mammoth Cave National Park, government agencies such as the Civilian Conservation Corps (CCC) were instrumental in the development and establishment of the park, including improvements made within the cave. Work performed by the CCC inside the cave included trail improvements, alterations to existing cave entrances, and the addition of the Carmichael Entrance.

The Mission 66 program, which extended from 1956 through 1966 (with projects completed at Mammoth Cave through 1969), provided additional funding for improvements within the cave. Work funded by this program included circulation improvements, such as the addition of concrete trails and new stairs at the historic entrance, as well as other improvements, such as the addition of the comfort station and food preparation room at the Snowball Dining Room.

This area of significance is not addressed in the National Register nomination, and it is proposed herein as an additional area for consideration in a potential future updated nomination.

Science

Significant efforts of scientific study have been conducted within Mammoth Cave since the mid-twentieth century. These investigations have encompassed the fields of geology, biology, chemistry, and physics. Efforts conducted within the cave to document and study geologic formations and minerals, and rare plant and animal species, have contributed to conservation efforts including establishment of an International Biosphere Reserve in 1990.[395] The International Biosphere Reserve extends over 909,295 acres, including the land above Mammoth Cave. Land use and management practices are recommended for the Reserve as a way to adequately protect the sensitive natural resources associated with the region from development that would potentially lead to pollution of important aquifers.

As noted in the UNESCO World Heritage Site description of the outstanding universal value of Mammoth Cave:

> Mammoth Cave is the most extensive cave system in the world, with over 285 miles (458 km) of surveyed cave passageways within the property (and at least another 80 miles [128 km] outside the property). The park illustrates a number of stages of the Earth's evolutionary history and contains ongoing geological processes and unique wildlife. It is renowned for its size and vast network of extremely large horizontal passages and vertical shafts. Nearly every type of cave formation is known within

394. Ibid., 8-1.

395. "Mammoth Cave National Park," UNESCO World Heritage List website, accessed March 2021, https://whc.unesco.org/en/list/150/.

> the site, the product of karst topography. The flora and fauna of Mammoth Cave is the richest cave-dwelling wildlife known, with more than 130 species within the cave system.[396]

The statement of outstanding universal value also describes the scientific importance of Mammoth Cave as a natural resource, noting the following:

> . . . Mammoth Cave is the longest cave system in the world. The long passages with huge chambers, vertical shafts, stalagmites and stalactites, splendid forms of beautiful gypsum flowers, delicate gypsum needles, rare mirabilite flowers and other natural features of the cave system are all superlative examples of their type. No other known cave system in the world offers a greater variety of sulfate minerals.
>
> . . . Mammoth Cave exhibits 100 million years of cave-forming action and presents nearly every type of cave formation known. Geological processes involved in their formation continue. Today, this huge and complex network of cave passages provides a clear, complete and accessible record of the world's geomorphic and climatic changes. Outside the cave, the karst topography is superb, with fascinating landscapes and all of the classic features of a karst drainage system: vast recharge area, complex network of underground conduits, sink holes, cracks, fissures, and underground rivers and springs.
>
> . . . The flora and fauna of the cave is the richest caverniculous wildlife known, numbering over 130 species, of which 14 species of troglobites and troglophiles are known only to exist here.[397]

Mammoth Cave National Park is also recognized as the core area of the Mammoth Cave Biosphere Region, part of the UNESCO Man and the Biosphere (MAB) Programme. The biosphere region, which includes Mammoth Cave National Park and the six surrounding counties, was established in 19990 and substantially expanded in 1996. The main goal of the biosphere region is to achieve sustainable development in the area around Mammoth Cave National Park, especially with respect to preventing groundwater pollution. The biosphere region functions under an agreement between Mammoth Cave National Park, the Barren River Area Development District, and Western Kentucky University. It is directed by the Mammoth Cave Biosphere Region Advisory Council and works cooperatively with other international groups and biosphere reserves.[398]

The Mammoth Cave International Center for Science and Learning was established through a partnership between Mammoth Cave National Park and Western Kentucky University in 2004. The center, which is part of a national network of learning centers located within national parks, "facilitates the use of parks for scientific inquiry, supports science-informed decision making, and promotes science literacy and resource stewardship . . . . [and] has contributed to . . . agreements with other World Heritage sites (China and Slovenia) that protect cave and karst resources.[399]

Scientific research conducted within the cave has ranged from studies of the conservation of fragile karst resources, to studies of water and air quality, hydrogeology, to research on the evolution of the caves themselves, as well as assessment of the cave bat populations and how to protect them against white nose bat syndrome. Discoveries within caves within Mammoth Cave National Park have included the fossil remains of ice age mammals and ancient marine organisms, preserved within the limestone.[400] In 2020, a team of paleontologists, cave specialists, and park rangers conducting an ongoing paleontological resources

396. Ibid.
397. Ibid.
398. Ibid. See also "Mammoth Cave Biosphere Region" at WikiMAB.org, *Online Encyclopedia for UNESCO Biosphere Reserves*, accessed March 2021, https://wikimab.org/mammoth-cave-area-biosphere-reserve/.
399. Ibid.
400. "Sharks, Fossils, and Caves: Secrets Revealed at Mammoth Cave," Mammoth Cave National Park," accessed March 2021, https://www.nps.gov/subjects/fossils/paleontological-discoveries-at-mammoth-cave.htm.

inventory at Mammoth Cave discovered fossils representing least forty different species of sharks and related fauna, including six new species.[401]

The Cave Research Foundation (CRF) also conducts research at Mammoth Cave. The CRF is a private, nonprofit organization that facilitates research, management, and interpretation of caves and karst resources; forms partnerships to study, protect, and preserve caves and karst areas; and promotes the long-term conservation of caves and karst ecosystems. At Mammoth Cave, the CRF has developed extensive mapping of the cave and its many passages.[402]The Science area of significance was not addressed as part of the 1991 MPDF or National Register nomination, and it is proposed herein as an additional area for consideration in a potential future updated nomination.

Criterion C

Engineering

Although the 1991 National Register nomination did not determine the historic district to be significant under Criterion C, research conducted for this CLR suggests that it is significant under this criterion in the area of Engineering. Evidence of past feats of engineering associated with the cave entrances and interior access systems are found throughout the historic district. Entrances, some set within the hillside, include Historic Entrance, Violet City Entrance, New Entrance, and Frozen Niagara Entrance, feature structural support systems, doors and air-lock systems, and elaborate stairways. Other engineering features include an elevator, extensive stairs that pass through rock walls with clear evidence of blasting and other rock excavation, stone reinforcing systems within the cave interior, and the use of steel beams to protect against rock fall. Several entrances and other examples of the engineering efforts that have been used to provide and enhance access to Mammoth Cave during the period of significance survive to convey this significance.

Criterion D

Archeology (Historic, Non-Aboriginal)

Although the 1991 National Register nomination did not determine the historic district to be significant under Criterion D, research conducted for this CLR suggests that it is significant under this criterion in the area of Archeology (Historic, Non-Aboriginal). Mammoth Cave Historic District is significant under Criterion D for Archeology (Historic, Non-Aboriginal). The historical archeological record in Mammoth Cave Historic District has the potential to contribute important new information about the past. Numerous resources remain within the historic district which are related to this area of significance. The area around the saltpetre works may contain archaeological deposits below the present cave floor that can contribute to knowledge concerning the methods and technology of early nineteenth-century saltpetre mining, as well as the lives of those involved in the industry. Elsewhere, the distribution of historical artifacts and features both above and below the cave floor can provide information about historical cave exploration and use, such as the timing of earliest cave visits, logistics of early cave explorers (i.e., what hardware and other types of equipment were early cavers using), and perhaps even the identities of the early spelunkers. Spatial analyses of artifact density can also shed light on historical patterns of cave use, such as the relative frequencies with which different parts of the caves were visited. (Further assessment of these resources is needed to determine whether they are of local or national significance.)

Archeology (Prehistoric/Pre-Contact)

The 1991 National Register nomination also did not determine the historic district to be significant under Criterion D in the area of Archeology (Prehistoric), specifically noting that prehistoric (pre-Contact) resources within the cave were

401. Ibid.

402. Cave Research Foundation website, accessed March 2021, https://www.cave-research.org/about/index.html.

outside the scope of the nomination.[403] Research conducted for this CLR suggests that the historic district is significant under this criterion in the area of Archeology (Prehistoric/Pre-Contact). The CLR also recommends that pre-Contact archeological resources be addressed in an amendment to the existing National Register nomination for Mammoth Cave Historic District, relating to pre-Contact-era American Indian use of the cave interior for many purposes, most notably gypsum mining. Extensive evidence of American Indian use of the cave exists in the form of artifacts and features. The likely significance of the cave under Criterion D in the area of Archeology (Prehistoric) is considered below.

The cave's archeological record has yielded and will continue to yield important information concerning the pre-Contact past of not only west-central Kentucky, but of the Eastern Woodlands as well. The conditions in the cave that are conducive to preservation of artifacts made from organic materials permit the survival of items, such as textiles, gourd containers, uncharred wood and nut remains, and paleofeces, which are rarely seen in other contexts. The survival of these materials permits analyses not possible at locations with conditions less favorable to artifact preservation, such as the examination of slipper manufacture. Meanwhile, analyses of food remains found in paleofeces has significantly contributed to knowledge of the history of agriculture the eastern part of North America. The fact that seed and nut remains are abundant in contexts below the cave floor hints at their potential for future research concerning the development of horticulture. Further investigation of the pre-Contact-period mining in the cave will also contribute to our understanding of the purpose(s) for which the materials were extracted and how they relate to other aspects of the miners' lifeways.

Historic District Boundary

The CLR recommends that consideration be paid to expanding the boundary of the current Mammoth Cave Historic District to encompass all passages that have been the focus of visitor use and tours from the pre-Contact era through the 1940s, between the Historic Entrance and Frozen Niagara. (Note that areas toured did not change from the 1940s through the end date of the period of significance in 1969.) The expanded boundary includes a total area of approximately 22.5 miles of passages associated with tour routes, as well as 10.4 miles of passages associated with pre-Contact use (refer to Figure 11). The two categories of passages overlap for a total of 7.0 miles, thus the expanded boundary would encompass 25.9 miles of passages overall.

Overall, the expanded boundary would encompass the area mapped in 1908 by Max Kaemper and the additional cave passages located southeast of Ultima Thule that were discovered and made accessible after the Kaemper map was published. Also included are the landscapes located just outside the original four entrances noted in the 1991 nomination, as well as the elevator added during Mission 66 in the 1950s. For example, at the Historic Entrance, the aboveground area to be included in the boundary would encompass the constructed entrance walls and staging area and the buried archeological features at the entrance from pre-Contact use and historic mining/furnace activity.

The justification for the proposed boundary is to include all areas used and improved for tourism, based on exploration of the cave by several guides and other key individuals, during the nineteenth and twentieth centuries during the proposed period of significance. The same passages would also encompass sites and resources associated with the areas of significance identified in the 1991 NRHP nomination–Industry and Health/Medicine. Cultural activities that are associated with the historic contexts recommended for inclusion as part of an expanded boundary include saltpetre mining, tours, tuberculosis treatment experiment, mushroom farm, sleep experiment, civil defense, religious services, radio transmissions, dances,

403. Lally, National Register Nomination, Mammoth Cave Historic District, 7-1.

musical and dramatic performances, exploration, collecting fish for sale, and scientific research.

The passages proposed for inclusion in the expanded historic district include Hovey Route I— Echo River, Pits and Domes; Hovey Route II— Star Chamber Gothic; Hovey Route III— Main Cave and New Discovery (Violet City); Hovey Route IV— To the Maelstrom and to Hovey's Cathedral; Morrison Long Route; and other side toured areas.

As shown in Figure 11, the park has recommended that the expanded boundary of the Mammoth Cave Historic District include areas related specifically to pre-Contact cave activity and all tour routes in used by the 1940s. Further research would likely result in adjustment of the recommended start date for the period of significance from 1798 to the pre-Contact era, circa 550 BCE, matching the areas of the cave included in the expanded boundary shown in Figure 11.

Period of Significance

Based on the associations of the historic district with the historic contexts indicated in the MPDF and those developed as part of additional documentation (New Deal era and Mission 66), as well as contexts related to Conservation and Science articulated by the park, the CLR recommends extending the period of significance to circa 1798–1969. The beginning date of 1798 encompasses the first known historic period exploration of the cave that led to later industry and tourism. The end date of 1969 reflects the completion of many Mission 66 programs and projects.

The 1991 National Register nomination for the Mammoth Cave Historic District indicated periods of significance related to the three historic contexts discussed in that documentation—Discovery and Early Uses of Mammoth Cave (circa 1798–1849), Commercial Cave Development and the Growth of Tourism in the Mammoth Cave Area (1849–1926), and Establishment of Mammoth Cave National Park (1924–1941)—as follows: 1806–1814 for Industry, 1842–1843 for Health/Medicine, and 1816–1941 for Entertainment/Recreation.[404] Based on research completed on behalf of this CLR, additional improvements were made in the cave during the Mission 66 era that occurred between 1956 and 1966. This suggests that the Mammoth Cave Historic District period of significance should be extended to include projects undertaken in the cave during Mission 66.

The National Register Multiple Property Documentation for "National Park Service Mission 66 Era Resources" prepared in 2015 establishes an overarching period of significance for this period that extends between 1945 and 1972, beginning with the influences of post-World War II modernism and the use of contemporary materials, continuing through the Mission 66 program of 1956–1966, and concluding with the Parkscape USA construction program of 1967 through 1972 that completed many of the planning initiatives articulated during Mission 66.[405] One of the programs that implemented park improvement projects during the same era as Parkscape was the Job Corps program. Mammoth Cave is known to have benefitted from the Job Corps program, with

404. Lally, Mammoth Cave Historic District nomination, 8-1. The National Register nomination cites the latter three contexts established by the MPDF, but it uses a different title and dates for the last context, identifying it as "The Development of the Mammoth Cave Area into a National Park (1926–1942)." As the nomination and MPDF were in progress simultaneously, it is possible that the nomination referenced this context as defined in a draft rather than the final MPDF.

405. Carr et al., *National Register of Historic Places Multiple Property Documentation Form, National Park Service Mission 66 Era Resources*, F-58.

enrollees completing many projects within the Mammoth Cave National Park in 1969. It is not presently known whether any of these projects were completed within the cave, as documented projects identified by the park and through research only include aboveground work. Should further research reveal the role of Job Corps in completing important projects in the cave, consideration could be paid to further extending the end date for the period of significance to 1972 for the Mammoth Cave Historic District.

As noted previously, the CLR recommends that the National Park Service consider amending the period of significance associated with Mammoth Cave Historic District to reflect additional efforts conducted to develop Mammoth Cave as a unit of the National Park System during the period following World War II through implementation of the Mission 66 program. This would suggest extending the end date of the period of significance from 1941 to 1969, or to 1972 if additional research indicates that Job Corps activities were conducted in the cave through that date.

Historical research and assessment of the Mission 66-era of National Park Service construction suggests that consideration be given to expanding Context D, Establishment of Mammoth Cave National Park,1924–1941, to include the Further Development of Mammoth Cave National Park and the Mission 66 Era, 1941–1969 (or 1941–1972, as noted above). Individual resources or districts within the park could be considered eligible for listing in the National Register under this context if they represent significant components of the evolution of Mammoth Cave National Park or exemplify the design, planning, and interpretation of the park that characterize post World War II and Mission 66 construction.

Consideration could also be given to extending the end date of the period of significance to 1971, fifty years before the present, given that the Entertainment/Recreation and Science areas of significance continue to this day.

Boundary Expansion

The assessment completed as part of the CLR also suggests that expansion of the historic district boundary be considered from the current estimated 12 miles of cave passages and four cave entrances, to a larger area of approximately 35 miles of cave passages. Overall, this would encompass the area mapped in 1908 by Max Kaemper and the additional cave passages located southeast of Ultima Thule that were discovered and made accessible after the Kaemper map was published. Also included are the landscapes located just outside the original four entrances noted in the 1991 nomination as well as the elevator added during Mission 66 in the 1950s. For example, at the Historic Entrance, the aboveground area to be included in the boundary would encompass the constructed entrance walls and staging area and the buried archeological features at the entrance from prehistoric use and historic mining/furnace activity.

The justification for the proposed boundary is to include all areas used and improved for tourism, based on exploration of the cave by several guides and other key individuals, during the nineteenth and twentieth century proposed period of significance. The same passages would also encompass sites and resources associated with the areas of significance identified in the 1991 NRHP nomination–Industry and Health/Medicine. Cultural activities that are associated with the historic contexts recommended for inclusion as part of an expanded boundary include saltpetre mining, tours, tuberculosis treatment experiment, mushroom farm, sleep experiment, civil defense, religious services, radio transmissions, dances, musical and dramatic performances, exploration, collecting fish for sale, and scientific research.

The passages proposed for inclusion in the expanded historic district include:

- **Hovey Route 1—Echo River, Pits and Domes**. Modern Historic Tour Route. Corkscrew, Labyrinth, Pensacola Avenue, Echo River.

- **Hovey Route II—Star Chamber Gothic**. Historic Entrance to Star Chamber. Gothic and Gratz Avenues, Audubon Avenue—Rotunda to Olive's Bower.
- **Hovey Route III—Main Cave and New Discovery (Violet City).** Historic Entrance to Violet City.
- **Hovey Route IV—To the Maelstrom and to Hovey's Cathedral.** Historic Entrance to Echo River (via Corkscrew or Fat Man's Misery). Echo River to Silliman or Historic Entrance to Wooden Bowl. Ganter-Welcome to Silliman, Silliman-El Ghor to Snowball. Valley Way Sidecut, Snowball to Maelstrom (via Cleaveland Avenue), Franklin Avenue, Snowball to Cathedral Domes (via Boone, Martel, Hawkins Pass).
- **Morrison Long Route.** New Entrance, Grand Central, Kentucky Avenue, Aerobridge, Woodbury Pass or Grand Canyon, Mount McKinley, Morrison Avenue, Forks of the Cave, Jeanne's Avenue-Rose's Pass, Cathedral Domes via Martel—Hawkins Pass, Becky's Alley and Lida's Pass, Gerta's Grotto, Robertson-Nickerson, Big Break, Frozen Niagara
- **Other side toured areas.** Solitary Cave-Fairy Grotto, Cyclops Gateway, Wrights Rotunda-Black Chambers, Briggs Avenue-Charlotte's Dome, Sylvan-Wyatt's Domes, Blue Spring Branch, Blackall Avenue, Marion Avenue, Radio Room.

The historic resources that contribute to the significance of the expanded historic district are described and assessed in the sections that follow.

Integrity Assessment

Historic integrity is the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic period of significance. Integrity is the composite of seven qualities or aspects considered individually—location, design setting, feeling, materials, workmanship, and association.[406]

In assessing the historic integrity of Mammoth Cave Historic District, consideration has been paid to understanding the character and composition of the property between 1798 and 1969 through review of historic documentation, including photographs, maps, and aerial images.

Overall Integrity Assessment

Based on comparison of archival documentation and contemporary conditions, Mammoth Cave Historic District appears to possess a high degree of integrity due to the presence of numerous historic landscape features and the limited changes that have been made to accommodate visitor access and safety, and to protect sensitive natural features, since the end of the period of significance.

Numerous features survive from the historic period of significance within the historic district. These include evidence of saltpetre mining during the early nineteenth century ranging from ox carts, to wooden bored pipelines, leaching vats, an oxen cart trail, and pump tower ruins;[407] of tuberculosis treatment conducted within the cave during the mid-nineteenth century composed of stone building ruins; improvements to accommodate visitors dating to the nineteenth and twentieth centuries through the Mission 66 era encompassing trail surfacing, trail structural systems such as walls, bridges, stairs, causeways, constructed cave entrances, benches, drinking fountains, restroom structures, lighting systems, electrical systems, waste management systems, survey benchmarks, and signage. Other historic features that contribute to the significance of the cave and retain integrity include numerous examples of historic graffiti present on the walls, rocks, and ceiling of the cave passages.

Later additions that diminish the integrity of the historic district include replacements to the trail surfacing, bridges, stairs, signage, lighting, and utility systems that occur in discrete locations throughout the cave to better ensure the safety of visitors, and to accommodate the large numbers of people who wish to visit the cave, while protecting the natural cave environment.

Some of the earlier historic cave access features have been removed, or now occur adjacent to or beneath later additions to the cave interior landscape. These include stairs, handrails, and trail surfaces. The introduction of dust and lint brought into the cave or raised from visitor use of soil surfaced trails has contributed a layer of non-historic material over the surfaces of walls and other cave features, while green algae growth on cave walls resulting from the introduction of lighting elements, as well as increases in humidity associated with visitor access is having an impact on the stability of fragile materials. These changes also diminish the integrity of the historic district.

Integrity Assessment by Aspect

Location. *Location is the place where the cultural landscape was constructed or the landscape where the historic event occurred.*

Mammoth Cave Historic District retains integrity of location. The cave passages and entrances, as well as the passages that have served as the focus of tourism, remain present, even if some are not currently in use as part of National Park Service led tours. The property currently administered by the National Park Service is consistent with that incorporated into Mammoth Cave National Park in 1941.

406. National Park Service, *National Register Bulletin: How to Complete the National Register Registration Form*.

407. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 33–34.

Design. *Design is the combination of elements that create form, plan, space, structure, and style of a cultural landscape.*

Mammoth Cave Historic District retains diminished integrity of design. Integrity is conveyed by the many historic features that survive with integrity, such as the entrances, trail surfacing, stairs, bridges, and other features that reflect development of the cave interior between the nineteenth century and mid twentieth century. However, more recent changes since the end of the period of significance (1969) that have been made to enhance visitor safety and access and to control lint and algae growth, including new trail surfacing, lint guards, stainless steel handrails and bridge structures, new lighting features, and concrete walks and other structures, have introduced a new vocabulary of design elements that diminish the integrity of the historic landscape. Overall, however, the cultural landscape of the cave continues to exhibit the original design intent and composition associated with development of entryways, passages, and routes of travel to accommodate visitor tours.

Setting. *Setting is the physical environment of the cultural landscape.*

The property possesses integrity of setting and character of place due to the ongoing approach to the cave entrances through the park landscape, and cave entrances that survive from the period of significance.

Feeling. *Feeling is a cultural landscape's expression of the aesthetic or historic sense of a particular time period.*

Mammoth Cave Historic District retains integrity of feeling as a result of the many surviving features that characterized the property during the period of significance and help to evoke the aesthetic of evolving accommodation of visitors over more than 100 years through the provision of commodious trails and access systems. The historic signatures on the walls and ceiling of the cave, the early stone steps, stacked stone walls, evidence of historic use of various interior spaces for different activities often reflected in the presence of historic artifacts, and cave soil trail surfacing that survives in some areas all help to convey the historic feeling of the cave as a popular destination for tourists throughout the nineteenth and twentieth centuries, with many layers surviving today.

This integrity is diminished through the replacement of earlier passage trail systems with new systems composed of materials that have been introduced since the period of significance.

Materials. *Materials are the physical elements that were combined or deposited during the particular period(s) of time and in a particular pattern of configuration to form the cultural landscape.*

Mammoth Cave Historic District also possesses integrity of materials where historic stone, cave soil surfaced trails, concrete, and different iterations of metal that preceded present-day use of stainless steel are present. The ongoing presence of historic building materials helps to convey the historic associations of cave development over time to accommodate visitors.

Workmanship. *Workmanship is the physical evidence of the crafts of a particular culture or people during a given period in history or prehistory.*

Where historic materials survive, and where evidence of cave entrance establishment that includes blasting cores exist, Mammoth Cave Historic District retains integrity of workmanship. Historic concrete stairs often exhibit evidence of the wood used in their formwork, while stacked stone walls often exhibit the care and workmanship of earlier eras, including the careful training of the CCC. The caves soil surfaced trails also exhibit the workmanship of the CCC to use local materials to effect a carefully considered trail system. Some examples of historic workmanship are being lost as earlier trail access features are replaced with contemporary features, diminishing integrity of workmanship.

Association. *Association is the direct link between an important historic event or person and a cultural landscape.*

The property also possesses integrity of association due to its ongoing use for tourism, and evidence of former industrial, medicinal, and commercial enterprises. The signatures and monuments erected by visiting groups found in many cave passages provide a direct connection with historic tourism as well, helping to convey integrity.

Comparative Analysis

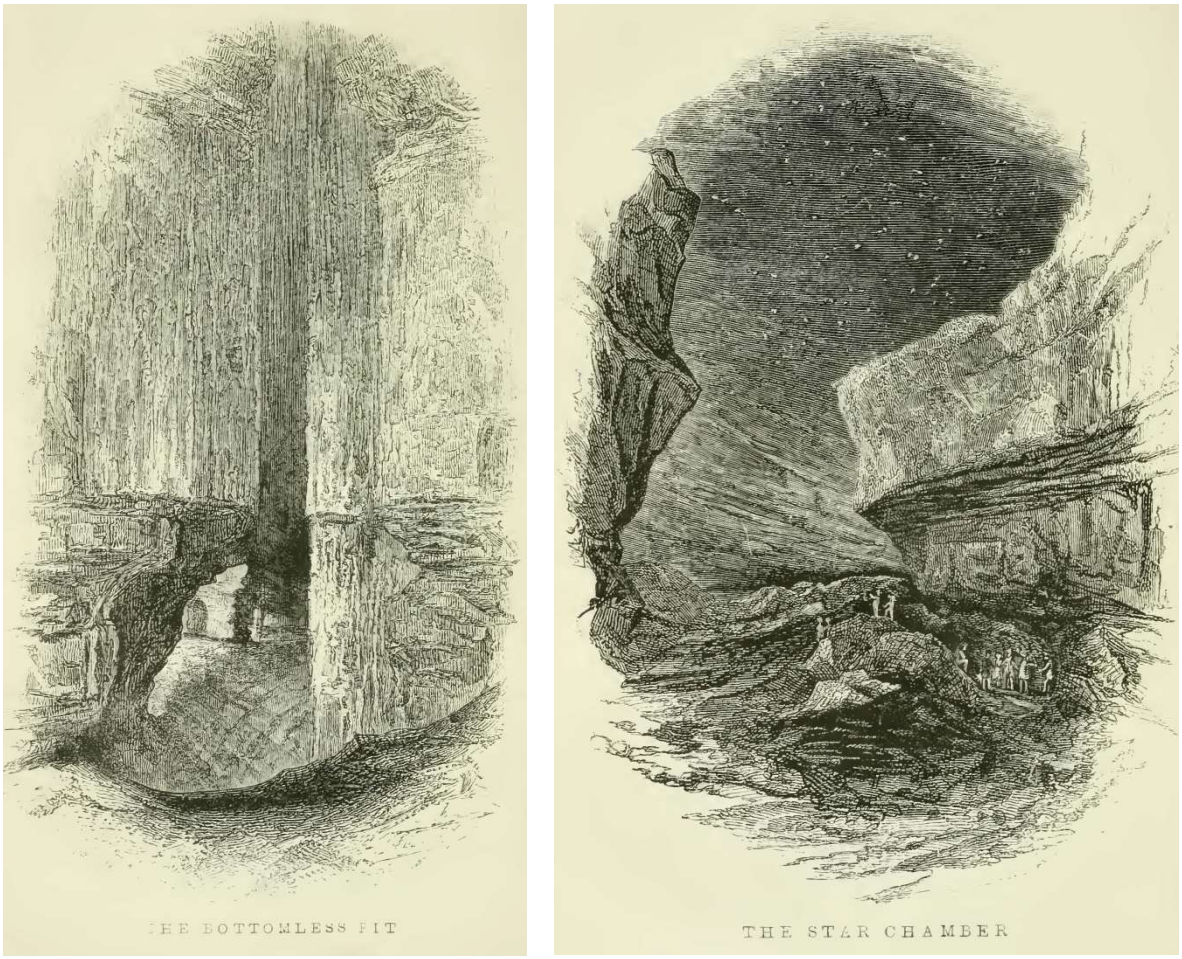


FIGURE 252. Nineteenth-century illustrations of popular cave features highlighted in tours conducted for visitors include solutional domepits like Bottomless Pit and large rooms like Star Chamber.

Natural Features and Systems

The Mammoth Cave Historic District landscape encompasses the naturally occurring cave system as formed in the karst geology through epochs of dissolution afforded by the movement of water across the land and through the ground. Mammoth Cave is the longest known cave in the world. Aboveground landform and topography, associated entrances that take advantage of landform conditions, and the underground configuration of passages comprise the district's natural features and systems. Also associated with the historic district are water resources that include Echo River and River Styx. In addition to the geological resources in evidence within the cave system are gypsum, flowstone, and dripstone formations that grow over time.

The significance of Mammoth Cave's natural resources is recognized through its designation by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as a World Heritage Site, and designation as an International Biosphere Reserved. Exploration of the cave has

led to a better scientific understanding of the principles associated with speleology, hydrology, and cave biology.[408] The karst geology that can be experienced while inside the cave is integrally tied to the aboveground terrain, with water serving as a binding thread between the surface and subsurface landscapes. The cave exhibits numerous elements of the karst process including drainage systems, vast recharge areas, sinkholes, solutional domes and pits, and complex networks of conduits and springs. Within the cave interior, the interplay of water, limestone geology, and mineral components has led not only to the formation of passages, large rooms, and the formation of breakdown (Figure 252). Within the cave dramatic flowstone and dripstone features as well as gypsum flowers and needles, mirabilite flowers, and other natural features adorn the walls and ceiling of the cave. The cave also features one of the highest diversities of cave-adapted organisms in the world. Many are superlative examples of their type. The natural wonders of Mammoth Cave have been touted throughout the world and served as the focus of tourism since the 1810s.

The integrity of the natural features associated with Mammoth Cave has been impacted to a degree by pre-Contact American Indian activities, and historic era (including the years that postdate the proposed period of significance) visitor access that has led to discoloration and removal of gypsum and other formations, dust overlying cave walls and breakdown where cave soil trails have eroded, and interior air flow due to the establishment of new entrances and openings. Visitation has contributed to the disturbance of bats and reduced use of the cave as a hibernaculum.

Otherwise, all natural features and systems survive with integrity from the period of significance and contribute to the setting of the historic district.

Contributing Natural Features and Systems

Rock, Mineral, and Soil Features

- Breakdown
- Scallops
- Flutes
- Anastomoses
- Sediment
- Chert
- Black onyx
- Aragonite
- Speleothems
- Gypsum

Cave Passage Types

- Tubes
- Canyons
- Vertical shafts
- Domepits
- Fissures

Hydrologic Features

- River Styx
- Echo River
- River Acheron
- Mammoth River
- Mystic River
- Roaring River
- Dead Sea
- Lake Lethe
- Crystal Lake
- Waterfalls—Bridal Veil Falls, The Water Clock, Charon's Cascade, Great Gushing Mammoth Cascades, Saratoga Springs

408. National Park Service, Mammoth Cave National Park Foundation Document (June 2014), 7, 8.

- Springs—Wandering Willie's Spring, Richardson's Spring, Dripping Spring

Geologic Formations (named)

Section 1

- Sinkhole at Historic Entrance
- The Rotunda (breakdown space)
- Verspertilio Hall
- Olive's Bower
- The Sentinel
- Rafinesque Hall
- Bunker Hill
- Lookout Mountain (Dismal Hollow)
- Two Serpents
- Little Pit
- Booth's Amphitheater
- Kentucky Cliffs
- Pigeon Holes
- Eagle's Nest
- Methodist Church
- Pulpit Rock (The Pulpit)
- Tower Rock
- Corkscrew
- Limitation Hill
- Elbow Crevice
- Seat of the Mummy
- Register Hall
- Post Oak Pillar
- Dressed Turkey
- Catacombs
- Lava Beds
- Hercules' Pillar
- Caesar and Pompey
- Gothic Chapel
- Bridal Altar
- Hornets Nest
- Blacksmith's Shop
- Napoleon's Breastworks
- Loaded Camel
- Jenny Lind's Armchair
- Elephant's Heads
- Lovers Leap
- Proctor's Arcade
- Kinney's Arena
- Ball Room
- Standing Rocks
- Martha Washington's Statue
- Figured Ceiling
- The Anteater
- Giant's Coffin
- Wooden Bowl Room
- Acute Angle
- Giant
- Wife and Child
- Star Chamber
- Snow Room
- The Whale
- Devil's Looking Glass
- S Bend

Section 2

- Owl Room
- Side Saddle Pit
- Bottomless Pit
- Covered Way
- Scylla
- Charybdis
- Covered Pit
- Gorin's Dome
- The Window
- Garvin's or Washington's Pit
- Louisa's Dome
- Putnam's Cabinet
- Ariadne's Grotto
- Reveller's Hall
- Sea Turtle
- Echo Chamber
- Wild Hall
- Snowball Arched Way
- Grand Crossing

- Mat's Arcade
- The Pineapple Bush
- Angelica's Grotto
- Great Relief Hall
- Ina's Hall
- William's Dome
- Fat Man's Misery
- River Hall
- Bandit Hall
- Bacon Chamber
- Vanderbilt University Hall
- Newman's Spine
- Horseshoe Bend
- Leopard's Arch
- Clarissa's Dome
- Wyatt's Domes
- Ruins of Karnak
- Mammoth Dome
- Rapier's Pit
- Charlotte's Dome
- The Natural Bridge
- Shakespeare's Face and Gallery
- The Alligator
- The First Arch
- The Second Arch
- Purgatory
- Saharan Desert
- The Fourth Arch
- Minnehaha Island
- Napoleon's Dome
- Alina's Dome
- Devil's Cooling Tub
- Joseph's Pit
- Pool of Clitorus
- Lee's Cisterns
- Arnetta's Dome
- Dry Pit
- Indian Mounds

Section 3

- Wright's Rotunda
- Nicholas's Monument
- Hanson's Cañon
- Black Chambers
- The Chimneys
- The Closet
- The Dark Room
- Dragon Pit
- Double Branch
- Great Isle
- Mountain Dome
- Mrs. Gatewood's Dining Room
- Sandstone Dome
- Potter Hall
- Cataracts
- Humble Chute
- Solitary Spring
- Tecumseh's Grave
- Fairy Grotto
- Long Pond
- Bryan's Pass
- Settle's Gorge
- Chief City
- Saint Catherine City
- Blue Spring
- Symmes Pit
- Cul de Sac
- Sea Serpent
- Waldach Dome
- Mummy Ledge
- Tribble's Trouble
- Hains Dome
- Epson Salts Room
- Mayme's Stoop
- Anzer's Hall
- Ultima Thule
- Kaemper Hall
- Parrish's Pits

- Bishop's Pit
- Elisabeth's Dome
- Elise's Dome
- Grand Portal
- Violet City
- Walhalla
- The Marble Temple
- The Chimes
- Lena's Dome
- Well's Dome
- Owen Pit
- Washington Dome
- Flint Dome
- Henry's Dome

Section 4

- Infernal Regions
- Great Western
- Valley of Flowers
- Ole Bull's Concert Hall
- Old Scratch Hall
- Pluto's Dome
- Serpent Hall
- Hill of Fatigue
- Joe's Pit
- Henry's Dome
- Albert's Domes
- Cutliff's Way
- Sydney's Domes
- Queen Victoria's Crown
- Black Hole of Calcutta
- Stella's Dome
- Corinna's Dome
- The Mule Stall
- The Sheep Shelter
- Fly Chamber
- Hanging Rocks
- Hurdle Race
- Neptune's Cups
- Olivia's Dome
- Lucy's Dome

Section 5

- Sinkhole associated with the Carmichael Entrance
- Serena's Arbor
- Rocky Mountains
- Old Maiden's Kitchen
- Cleopatra's Needle
- Blarney Stone
- Maelstrom
- Charlotte's Grotto
- Diamond Grotto
- Split Rock
- Sarah Margaret's Dome
- Cornelia's Grotto
- Grace's Grotto
- Nannie's Grotto
- Lucy's Dome
- Julia's Dome
- Veil of Diamonds
- The Post Office
- Edison Monument
- Jenny Lind's Dining Table
- Last Rose of Summer
- Mammary Ceiling
- Floral Cross
- Flora's Garden
- Snowball Room
- Washington Hall
- France's Dome
- Kennedy Domes
- Christopher's Dome
- Katharine's Domes
- Double Cedars Sinkhole
- Maud's Grotto
- Tan's Pit
- Runt's Dome
- Mary's Vineyard
- Thorpe's Pit

- Ellen's Dome
- Holy Sepulchre
- Markolf's Dome
- Anna's Dome
- Blanche's Dome
- Rock of Gilbraltar
- The Harbor
- Felicia's Dome
- Forks of the Cave
- Covington's Cabinet
- Crystal Chamber
- Wycliff's Dome
- Alice's Grotto
- Devil's Bathtub
- Bismark Dome
- Mount McKinley
- The Narrows
- The Precipice
- The Saddle
- Black Onyx
- Grand Canyon
- Cliff Walk
- Cecil's Accident
- Ellen's Grotto
- Moving Mountain
- Gist's Dome
- Diamond Dome
- Virginia's Grotto
- Register Hall
- Aero Bridge Canyon
- Heart Attack Hill
- Blair's Dome

Section 6

- Turtle Hurdles
- Black Kettles
- Helicite Hall
- Mary's Grotto
- Galloway's Dome
- Bishop's Domes
- Nelson's Domes
- Einbigler's Dome
- Edna's Dome
- Cathedral Domes
- Gerta's Grotto
- Florence William's Dome
- Sansom's Dome

Section 7

- New York Hippodrome
- Lover's Leap
- Grand Central Station
- Big Break
- Fairy Ceiling
- No Man's Land
- (Second) Lover's Leap
- Flat Ceiling Room
- Compass Needle
- Thanksgiving Hall
- Frozen Niagara
- Onyx Colonnade
- Moonlight Dome
- Rainbow Dome
- St. Peter's Dome
- Drapery Room
- Radio Room
- Sinkhole associated with the New Entrance
- Roosevelt Dome
- Jawbone Dome
- Fossil Dome
- Wilson Dome
- Silo Pit
- King Solomon's Temple

Section 8

- Bransford Barrier Pit

Non-contributing Natural Features and Systems

- None

Responses to Natural Resources. Responses to Natural Resources encompass the cultural activities and establishment of specific built features that address environmental conditions. Several historic responses to natural resources can be understood by documenting and assessing the district landscape. These include the naming of the cave, which occurred in 1810 in a newspaper article in the Richmond *Enquirer*; establishment of cave entrances that take advantage of existing openings, and proximity of cave passages to the ground surface; evidence of early nineteenth-century saltpetre mining directed at deposits of potassium nitrate, also known as nitre, and the remains of stone structures used for an experimental tuberculosis treatment using the controlled environment of the cave in the 1840s. Cave sediments were mined for saltpetre. Later, during the 1930s, the CCC excavated cave sediments, as evidenced today in the form of borrow pits, and used the material to create a trail surface from a slurry of water mixed with the sediments.

The subterranean conditions in the cave were used for two medical experiments, one for tuberculosis patients to test whether the cave air would offer restorative properties in 1842-1843, and the other a circadian rhythm and sleep experiment that took advantage of the absence of light to test the human internal clock in 1938. Evidence of the tuberculosis experiment survives in the form of two stone structures located in Main Cave. There is no surviving evidence of the sleep experiments.

Commercial agricultural activities that took advantage of the underground conditions included establishment of a mushroom farm in 1882. Evidence of the mushroom farm survives in the form of stone and wood structures in the passage leading to Olive's Bower.

Visitors have been leaving signatures on the cave walls and ceilings in the form of candle smoke and etchings. The majority of the signatures found on the walls and ceiling dates from the 1830s to 1888, when this was classified as vandalism and made unlawful. There are also earlier signatures, one dating to 1812, and petroglyphs that can be traced to American Indian presence in the cave some 2500 years B.P.

The majority of the other surviving historic features that constitute responses to natural resources relates to tourism and the accommodation of visitors. These include the establishment of tour routes that connect popular unique and dramatic cave formations (Figure 253); establishment of several entrances into the cave, and excavation of openings to allow passage between areas of the cave during the early to mid-twentieth century; development of trails using materials found in the cave, such as sediment deposits (as noted above) and breakdown stone; the addition of electricity to provide lighting to guide visitors through the cave, water and sewer to accommodate bathroom and cooking facilities, and a ventilation shaft to cool buildings above ground, all within the twentieth century. Efforts have been made since the nineteenth century to address safety for visitors taking tours of the cave by adding handrails, guardrails, and fencing at steep drops. Evidence of these efforts survives from the New Deal and Mission 66 eras.

The National Park Service has continued to enhance visitor safety since the end of the period of significance by updating these features, while also protecting sensitive formations from visitor access using barriers and railings. More recently, the cave entrances have been fitted with air-lock functions and gates that allow for proper air flow and the passage of bats and other cave dwellers to enter and exit the interior.

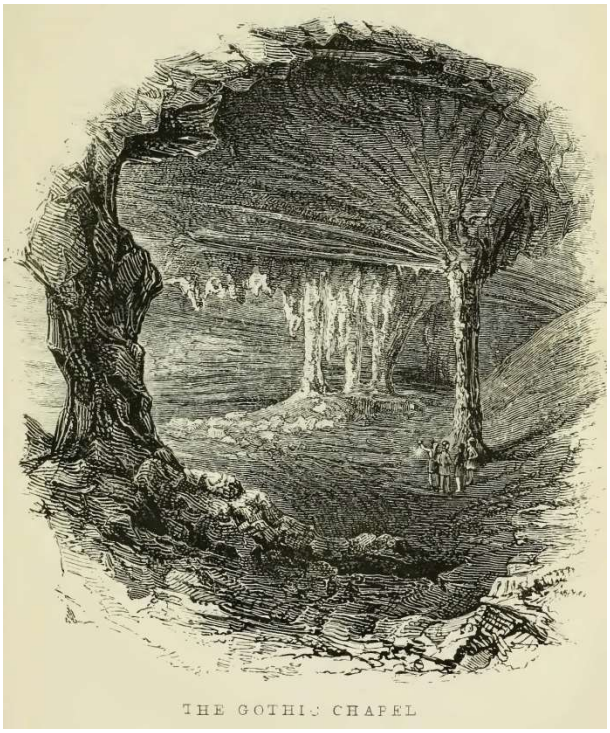


FIGURE 253. Most cave passages and formations that have been popular tourism destinations since the nineteenth century remain the focus of park tours today such as the Bridal Altar in Gothic Avenue shown above. Some modifications have been made to facilitate access and protect natural cave features, such as the wall constructed at the base of Bridal Altar, to protect them from visitors.

Early visitors experienced Mammoth Cave by lantern light. The flickering and limited light cast by lanterns afforded a much different sense of space within the cave than present-day cone lighting, which illuminates the floor, walls, and sometimes the ceiling of the cave. Electric lighting has been in use in some areas since the early twentieth century but became a standard feature of some tour routes in the 1960s. Lighting associated with many of the tours was updated in 2009, with light fixtures replaced in 2017, to reduce the impact of lamp flora. The electrical system was upgraded as part of the project. The Lantern Tour follows portions of Main Cave that remain unlighted purposefully to allow visitors to experience the cave as it felt historically.

The majority of the responses to natural resources present within the historic district was established during the period of significance and constitute contributing resources.

Contributing Responses to Natural Resources

- Use of the name Mammoth Cave (early nineteenth century)
- Historic Entrance at a natural sinkhole (since nineteenth century)
- Use of candle smoke and etching rocks to produce cave wall and ceiling signatures (circa 1812–late nineteenth century)
- Tour routes established to connect unique and dramatic cave features (nineteenth and twentieth centuries)
- Development of trails, bridges, causeways, stairs, and elevated passages to provide access to toured portions of the cave (nineteenth and twentieth centuries)
- Use of materials found in the cave to construct circulation features including cave sediment and breakdown rock (nineteenth and twentieth centuries)

- Use of handrails, guardrails, and fencing for safety (nineteenth and twentieth centuries)
- Excavation of a passage through Ultima Thule (1908)
- Addition of lighting to facilitate passage through the darkness of the cave within some toured areas (Morrison added lighting in 1915, modern electrical lines were laid in the 1950s and upgraded in the 1960s)
- Opening of Violet City Entrance to allow for tourism (1915; 1931)
- Excavation of a breakdown pile at Grand Central to reach Frozen Niagara (1923)
- Opening of Frozen Niagara Entrance to allow for tourism (1924)
- Opening of Carmichael Entrance to allow for tourism (1931)
- Establishment of an Elevator to provide food service and other access (1958)

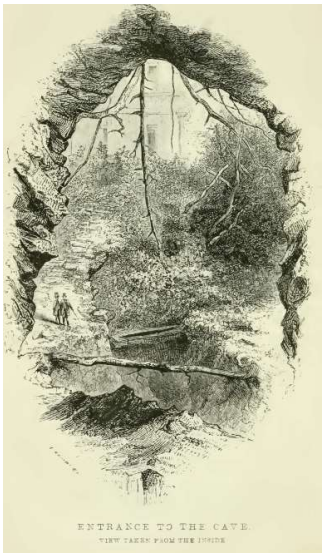
Non-contributing Responses to Natural Resources

- The addition of entrance air-lock features to address air flow and animal movement (1990s)
- Replacement of the cave electric supply, control systems, and lights with new upgraded systems to control algal growth and reduce lamp flora problems (2009).[409]
- Replacement of the light fixtures and bulbs in 2017 with standardized fixtures to a smaller number and aid in the east of replacing bulbs.[410]

Missing Responses to Natural Resources

- Industrial development of the cave to mine saltpetre (1806–1815)
- Establishment of tuberculosis treatment facilities designed to take advantage of cave air conditions (1842–1843)
- Commercial cultivation of mushrooms to take advantage of cave soil and darkness conditions (1882)
- Opening of New Entrance for tourism (1921) closed in 1967
- Opening of Cathedral Domes Entrance for tourism (1930) collapsed in 1931
- Use of the constantly dark conditions in the cave to conduct a sleep and circadian rhythm study (1938)
- Use of the cave as a civil defense shelter (1950s-1960s)
- Use of ladders and wooden stairs to access vertical passages such as the Corkscrew (nineteenth and twentieth centuries to 1972)
- Boating tours within the cave (nineteenth and twentieth centuries, discontinued in 1965; reopened in 1980 and were discontinued in 1992)
- Fishing in the cave rivers (nineteenth and twentieth centuries, no longer permitted)
- Capturing of wildlife and taking of geological features as souvenirs (nineteenth and twentieth centuries, no longer permitted)
- Torch throwing by guides to light toured spaces (nineteenth and twentieth centuries, discontinued in 1990)
- Use of a ventilation shaft blasted into the wall of Houchins Narrows to cool the visitor center (circa 1960) (later discontinued due to the discovery of radon gas)

409. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 40.
410. Ibid.



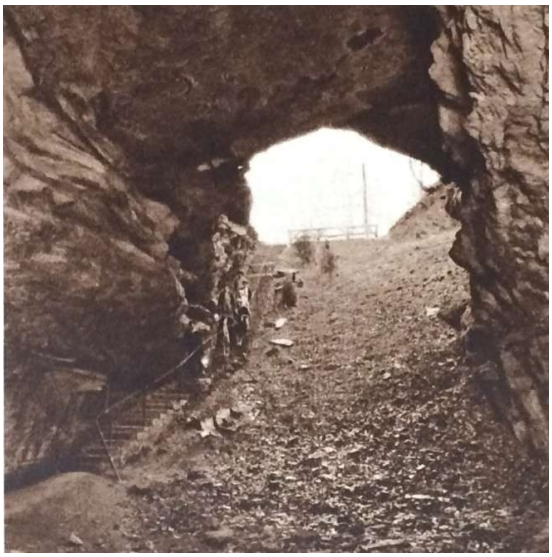


FIGURE 254. Historic Entrance has been the primary route of access into the cave since pre-Contact. During the mid-nineteenth century, visitors followed a sloped trail into the cave, avoiding a large pit. The pit was filled by the early twentieth century and stairs and handrails added to facilitate passage into the cave. As of 2018, Historic Entrance features rock work, stairs, and handrails, as well as a gate that have been added since the establishment of Mammoth National Park in 1941.

Spatial Organization

Spatial organization associated with the Mammoth Cave Historic District landscape primarily encompasses the naturally occurring cave system and associated culturally generated entrances that take advantage of landform conditions. Segments of the cave passage system have been expanded, connected, and improved for use by explorers and for visitors and tourists since the early nineteenth century. Spatial organization has also been impacted through the development of entrances into the cave from the exterior, construction of stairs, ladders, handrails and railings, bridges, causeways and catwalks, overlooks, walls, trails, aerial tram systems, lighting systems, and clusters of monuments that include rock cairns.

The Historic Entrance has served as a gateway into the passages of Mammoth Cave since prehistoric peoples began exploring and seeking to extract gypsum for unknown purposes some 5,000 years ago (Figure 254). American Indian activity in the cave is believed to have ceased some 2,200 years

ago for an unknown reason. The Historic Entrance first appears in historic records through indication on European-American maps beginning in 1799. The Historic Entrance was used as the primary route of access to the cave during the era of saltpetre mining between circa 1810 and 1815. It remained the only known entrance into the cave until the 1920s. The opening has been regularized through the filling of a former pit, the addition of stairs and handrails, and gates to limit access (refer to Figure 254). Historic Entrance continues to provide access to the cave for hundreds of thousands of visitors each year. Circulation and stormwater-management improvements were made in the 1930s by the CCC and by the National Park Service during the Mission 66 era.

Over the decades the knowledge of the extent of the cave passage system has expanded through exploration and recordation using mapping (refer to Figure 19, Figure 20, Figure 58, Figure 59, Figure 63, Figure 64, and Figure 65). Expanded knowledge also led to the addition of other entrances beginning in the 1920s. These have impacted tour routes, and thus an understanding of spatial organization within the cave.

Within the cave passages, the addition of features that improve visitor access and safety, direct views and facilitate viewing, and mark key locations impact that experience of visiting the cave by forming edges, viewpoints, and focal points. Many of the features added since the early nineteenth century for the enhancement of the visitor experience date to the period of significance, and thus contribute to the historic setting of the historic district. Features added after Mission 66 do not contribute to the setting of the district. Otherwise, all patterns of spatial organization survive with integrity from the period of significance and contribute to the setting of the historic district.

Contributing Spatial Organization Features

- Cave Entrances—Historic Entrance (nineteenth century), Violet City Entrance (1915 / 1935), New Entrance (1921), Frozen Niagara Entrance (1924), Carmichael Entrance (1935), Elevator (1958 – the elevator structure has been extensively altered and does not retain integrity, although use of the Elevator as an entrance as a pattern of spatial organization is contributing)
- Horizontal Passages—Adeline Avenue, Audubon Avenue, Backslider's Alley, Becky's Alley, Belfry Avenue, Bird Avenue, Big Gypsum Avenue, Bird Avenue, Bishop's Way, Blackall Avenue, Black Snake Avenue, Blackstone Avenue, Blue Spring Branch, Boiled Egg Passage, Boone Avenue, Bransford Avenue, Briggs Avenue, Broadway, Bryan's Pass, Buchanan's Way, Bunyan's Way, Burley's Way, Calypso Avenue, Carlos's Way, Carrie's Pass, Clark's Avenue, Cleaveland Avenue, Cliff Walk, Clinton Avenue, the Closet, College Heights Avenue, Coral Avenue, Coral Grove Branch, Cox Avenue, Cyclops Gateway, Dan's Avenue, Dante's Gateway, the Dark Room, Darnall's Way, Deserted Chambers, Dollar Pass, Edith's Avenue, El Ghor, Ella's Grotto, Elmore's Pass, Emerson's Pass, Emily's Avenue, Emily's Puzzle, Emmet's Ramble, Fat Man's Misery, Fishback Avenue, Flint Alley, Fort's Way, Fox Avenue, Franklin Avenue, Gallows Way, Ganter Avenue, Garvin Avenue, Gault's Way, Goat Alley, Gothic Avenue, Grand Avenue (Kentucky Avenue), Grand Crossing, Gratz Avenue, Great Relief, Great Walk, Grecian Bend, Harvey Avenue, Hawkins Pass, Helen's Grotto, Hell Hole, Hooflands Avenue, Houchins Narrows, Ike's Path, Infernal Regions, Jeanne's Avenue, Jesup Avenue, Kinney's Arena, Labyrinth, Lee's Way, Lida's Pass, Little Bat Avenue, Lively's Pass, Logan Avenue, Lost Avenue, Lover's Leap Route, Lover's Retreat, Main Cave (including Broadway, Hanson's Cañon, Proctor's Arcade, Kinney's Arena, Settle's Gorge), Marion Avenue, Martel Avenue, Mayfield's Avenue, Mayme's Stoop, Miller Avenue, Minna's Way, Montie's Pass, New York Subway, Nicholson Avenue, Nickerson Avenue, No Man's Land, Opossum Avenue, Orpheus's Pass, Pass of El Ghor, Payne's Path, Pensacola Avenue, Pilgrim Avenue, Pinson's Pass, Proctor's Arcade, Purgatory, Ramble, Ranshaw Avenue, Rat Hole Branch, Rhoda's Arcade, Roaring River, Robertson Avenue,

Rodgers Avenue, Rose's Pass, Saharan Desert, Sandstone Avenue, Sandy Avenue, Second Arch, Settle's Gorge, Shelley Avenue, the Side Cuts, Silliman Avenue, Silvan (Sylvan) Avenue, Sitgreave's Pass, Solitary Cave, Sophy's Avenue, Sparks Avenue, Stephen's Way, Stevenson Avenue, Thorpe's Avenue, Thorpe's Pit Trail, Valley of Humility, Valley Way Side Cut, Welcome Avenue, William Garvin's Way, Wilson's Way, Woodbury Pass

- Vertical Passages—Corkscrew, the Chimneys, Scotchman's Trap
- Large Rooms, Halls, or Alcoves—Aero-Bridge Canyon, Anzer's Hall, Bacon Chamber, Ball Room, Bandit's Hall, Black Chambers, Booth's Amphitheater, Bottle Hall, Cascade Hall, Chief City, Croghan Hall, Deserted Chambers, Double Branch, Drapery Room, Echo Chamber, Flat Ceiling Room, Forks of the Cave, Frozen Niagara, Gothic Chapel, Grand Canyon, Grand Central Station, Ina's Hall, Kaemper Hall, Methodist Church, New York Hippodrome, Odd Fellows Hall, Old Scratch Hall, Ole Bull's Concert Hall, Owl Room, Potter Hall, Radio Room, Rafinesque Hall, Register Hall, Reveller's Hall, River Hall, Rotunda, Saint Catherine City, Scylla, Serpent Hall, Snow Room, Snowball Room, Snow Room, Star Chamber, Thanksgiving Hall, Vanderbilt University Hall, Vespertilio Hall, Violet City, Washington Hall, Wild Hall, Wooden Bowl Room, Wright's Rotunda
- Elevated Positions—Aero-Bridge, Bottomless Pit, Bunker Hill, Lookout Mountain, Lover's Leap promontory (3), spaces overlooking Mammoth Dome, the Precipice, Pulpit Rock, Side-saddle Pit
- Narrow Crevices, Niches, Sharp Turns— the Acute Angle, Catacombs, Elbow Crevice, Fat Man's Misery, Grecian Bend, Horseshoe Bend, Humble Chute, Mole Hole, the Narrows, Pigeon Holes, "S" Bend, Seat of the Mummy, Snowball Arched Way, Snowball Arcade, Veil of Diamonds
- Domes and Pits— Albert's Domes, Alina's Dome, Anna's Dome, Annetta's Dome, Bishop's Dome, Bishop's Pit, Bismarck Dome, Black Hole of Calcutta, Blair's Dome, Blanche's Dome, Bottomless Pit, Bransford Barrier Pit, Bunker Hill, Cathedral Domes, Charlotte's Dome, Charybdis, Christopher's Dome, Clarissa's Dome, Corinna's Dome, Covered Pit, Crystal Lake / Moonlight Dome, Dead Sea, Diamond Dome, Dragon Pit, Dry Pit, Edna's Dome, Einbigler Dome, Elisabeth's Dome, Elise's Dome, Ellen's Dome, Felicia's Dome, Flint Dome, Fossil Dome, Florence William's Dome, France's Dome, Galloway's Dome, Garvn's Pit, Gist's Dome, Gorin's Dome, Great Gushing Mammoth Cascades, Hains Dome, Henry's Dome, Jawbone Dome, Joe's Pit, Joseph's Pit, Julia's Dome, Katherine's Domes, Kennedy Domes, King Solomon's Temple, Lena's Dome, Little Pit, Louisa's Dome, Lucy's Dome, Maelstrom, Mammoth Dome, Markolf's Dome, Moonlight Dome, Mountain Dome, the Mule Stall, Napoleon's Dome, Nelson's Domes, Olivia's Dome, Owen Pit, Parrish's Pits, Pluto's Dome, Putnam's Cabinet, Rainbow Dome, Rapier's Pit, Roosevelt Dome, Runt's Dome, St. Peter's Dome, Sansom's Dome, Sarah Margaret's Dome, Scylla, Sandstone Dome, Side-saddle Pit, Silo Pit, Skinley's Domes, Stella's Dome, Sydney's Domes, Symmes Pit, Tan's Pit, Thorpe's Pit, Waldach Dome, Wandering Willie Spring, Washington Dome, Washington's Pit, Water Clock, Well's Dome, William's Dome, Wilson Dome, Wyatt's Dome, Wycliff's Dome

Non-contributing Spatial Organization Features

- None

Missing Spatial Organization Features

- Entrances—Cox Entrance (1916-1917); Cathedral Dome Entrance (1930)
- Passages—George's Path

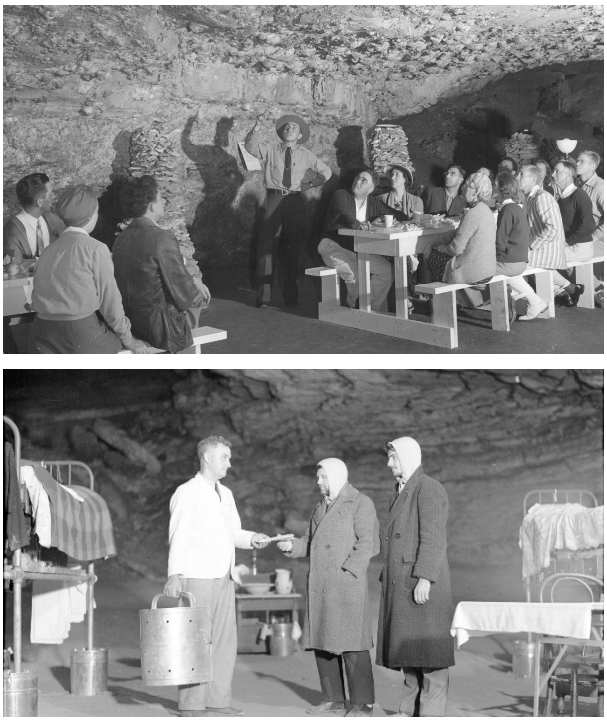


FIGURE 255. Museum / educational / interpretive land uses remain one of the most important land uses associated with Mammoth Cave. This use has remained popular since the early nineteenth century. Some historic land uses proved to be temporary such as medical investigations involving tuberculosis treatment and sleep experiments.

Land Uses

Land uses associated with the Mammoth Cave Historic District that survive from the period of significance include exploration, recreation, commerce, scientific study, commemoration, visitor services, and museum / interpretive / educational. These land uses were implemented during the period of significance and continue today. Exploration relates to the various efforts conducted by cave guides and others such as Max Kaemper to expand the knowledge of the extent of the cave passage system. This exploration, however, continues today, including the work of the Cave Research Association. Exploration and survey of Mammoth Cave initially identified the relationship between cave passages and the potential of the cave and its aboveground environs for commercial development for tourism. Later exploration entailed the location of passages and formations with potential to delight visitors, and methods for constructing entrances, walkways, and lighting systems.

Recreational land uses are associated with the development and use of entrances, trails, overlooks, and other features that support visitor access to and enjoyment of the cave interior. These features have been established since the early nineteenth century and continue today.

Commerce has been associated with the charging of a fee for tours of the cave. Fees have been a part of the visitor touring experience since the nineteenth century and continue today.

Scientific study relates to investigation of the cave regarding the geology, biotica, and hydrology. Scientific study has been a component of cave land use since the 1930s; prior to this time, access to the caves for scientific study was generally denied by those engaged in commercial tourism. The first discovery made based on scientific analysis of Mammoth Cave was that caves were not formed above the water table as most believed, but through the action of underground water acting on bedrock beneath the water table.[411] Later field investigation would eventually prove this theory. Modern exploration and scientific study within Mammoth Cave began in 1947, with formalized study and research introduced in 1957 with the establishment of the Cave Research Foundation (CRF) with a mission of furthering scientific research and understanding of caves.[412] The work of this group has led to a better understanding internationally of cave formation including how vertical shafts form and how breakdown occurs, identified many new speleotherms, and documented archeological information.[413] CRF also adopted a method of systematic exploration that involved mapping cave passages, correlating the surveyed cave passages and their elevations with topographic maps, aerial photographs, and

411. Patricia Kambesis, "The Importance of Cave Exploration to Scientific Research" in *Journal of Cave and Karst Studies* 69 (No. 1): 47.
412. Kambesis, 47.
413. Kambesis, 47.

elevation controls such as geographic surface benchmarks.[414]

Commemoration occurs in the form of monuments, signs, and piled rock in the form of cairns, as well as signatures found on cave passage walls and ceiling.

Visitor services that exist within the cave relate to National Park Service administration of the site as part of Mammoth Cave National Park. These include restroom facilities, drinking fountains, and other amenities that support visitor needs within the cave. Similar facilities have been available to visitors since before Mammoth Cave National Park was established, including restroom facilities, and contained pools where visitors could get a drink of water. Specific natural cave features historically served regular use for specific activities, such as church services at Methodist Church and the use of Pulpit Rock, rocks that served as dining tables, and rooms with good acoustics used for musical performances and dances.

Also associated with National Park Service administration of Mammoth Cave are museum / interpretive / educational land uses that can be traced to the 1940s when the National Park Service began to offer tours providing historical and natural history information to visitors (Figure 255). One current expressions of this land use—namely wayside exhibits—postdate the period of significance.

There are no non-contributing land uses associated with Mammoth Cave Historic District.

Missing historic land uses include industry, medicine, agriculture, communications, industry, and military. Communications land uses were associated with radio broadcasts conducted from a room in the Frozen Niagara section of the cave during the 1930s.

Industrial land uses include the mining and processing of potassium nitrate to make saltpetre during the early nineteenth century. Evidence of this land use is present in the Main Cave area and includes vats and hollowed log pipes. The mushroom beds where mushroom cultivation was conducted is evidence of a former commercial land use. The tuberculosis treatment program conducted by Dr. Croghan occurred in the 1840s. Later, a sleep study was conducted in the cave (refer to Figure 255). These medicinal land uses no longer occur within the cave. Finally, military land uses occurred during the 1950s, when the cave served as a civil defense shelter during the Cold War. The cave was targeted for the potential to house 19,000 to 20,000 people, and necessary food and other supplies following an enemy nuclear attack. This remained in active use until the 1970s. Audubon Avenue was also used as a training center to locate radioactive materials, find hot spots, Cobalt lead pig, another cache.

Contributing Land Uses

- Exploration
- Recreation
- Commerce
- Scientific study
- Commemoration
- Visitor services
- Museum/interpretation/education

Non-contributing Land Uses

- None

Missing Land Uses

- Industry
- Medicine
- Agriculture
- Performance
- Communications
- Military

414. Kambesis, 47-50, from Brucker et al., 1966.

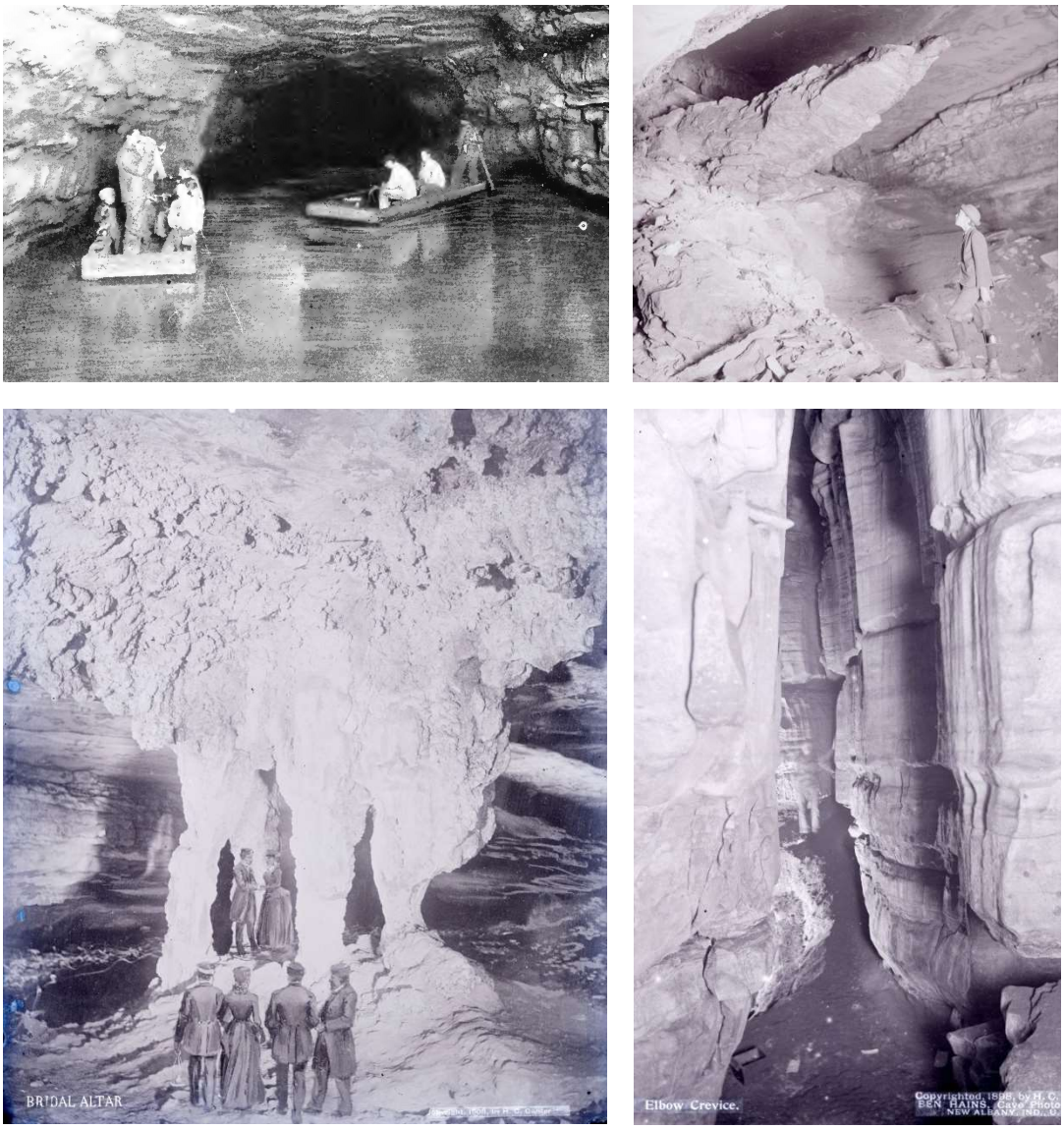


FIGURE 256. Mammoth Cave views have traditionally included linear horizontal passages, object focal points, dramatic vertical openings, and broad open spaces from overlooks and ledges.

Views

Views have remained relatively consistent within the cave since the early nineteenth century, with the various typologies reflected in the existing conditions documentation chapter of this report remaining present today. These typologies include views along horizontal passages, views into vertical domes and pits, views within large rooms, views into crevices and small openings, and views from overlooks and trail platforms (Figure 256). The naturally occurring opportunities for viewing have been made available to visitors through enhancement of the passages and trails leading to them, which have continued to evolve over time, the opening of passages through removal of impediments such as breakdown and other rock features and cave soil. Lighting has improved over time, from initial hand-held lanterns and fireworks to electrification and the placement of lights, enhancing viewing opportunities for visitors. Some of the lighting and the passage development postdates the period of significance but is generally consistent with practices established during the period of significance. Viewing from overlooks and trail platforms is also generally consistent with historic conditions established during the period of significance, although many of these features have been replaced with new bridges, platforms, causeways, and railings systems

designed to improve safety within the park. Most locations where viewing overlooks and trail platforms occur are consistent with historic features, even if the structures themselves have been replaced.

Contributing Views

- Views along horizontal passages
- Views into vertical domes and pits
- Views within large rooms
- Views into crevices and small openings
- Views from overlooks and trail platforms

Geological Focal Points—Alice's Grotto, the Alligator, Angelica's Grotto, the Anteater, Ariadne's Grotto, Big Break, Black Kettles, Black Onyx, Blacksmith's Shop, Blarney Stone, Booth's Amphitheater, Bridal Altar, Caesar and Pomfrey, Cataracts, Cecil's Accident, Charlotte's Grotto, Charybdis, the Chimes, Cleopatra's Needle, Compass Needle, Cornelia's Grotto, Covered Way, Covington's Cabinet, Crystal Chamber, Cul de Sac, Devil's Cooling Tub, Devil's Bathtub, Devil's Looking Glass, Diamond Grotto, Dressed Turkey, Eagle's Nest, Edison Monument, Ellen's Grotto, Elephant's Heads, Epsom Salts Room, Fairy Ceiling, Fairy Grotto, Figured Ceiling, First Arch, Flora's Garden, Floral Cross, Fly Chamber, Fourth Arch, Frozen Niagara, Gerta's Grotto, Giant, Giant's Coffin, Grace's Grotto, the Grand Portal, Great Isle, Hanging Rocks, the Harbor, Heart Attack Hill, Helcite Hall, Hercules' Pillar, Hill of Fatigue, Holy Sepulchre, Hornet's Nest, Hurdle Race, Indian Mounds, Jenny Lind's Arm Chair, Jenny Lind's Dining Table, Kentucky Cliffs, Last Rose of Summer, Leopard's Arch, Limitation Hill, Loaded Camel, Lookout Mountain, Mammary Ceiling, the Marble Temple, Martha Washington's Statue, Mary's Grotto, Mary's Vineyard, Mat's Arcade, Maud's Grotto, Minnehana Island, Mount McKinley, Moving Mountain, Mummy Ledge, Nannie's Grotto, Napoleon's Breastworks, Natural Bridge, Neptune's Cups, Newman's Spine, Nicholas's Monument, No Man's Land, Old Maiden's Kitchen, Olive's Bower, Onyx Colonnade, Orpha's Garden, the Pineapple Bush, Post Oak Pillar, Post Office, the Pulpit, Queen Victoria's Crown, Rock of Gibraltar, Rocky Mountains, Ruins of Karmak, the Saddle, Sea Serpent, Seat of the Mummy, Sea Turtle, Sentinel, Serena's Arbor, Shakespeare's Face, Shakespeare's Gallery, the Sheep Shelter, Split Rock, Standing Rocks, Tecumseh's Grave, Tower Rock, Tribble's Trouble, Two Serpents, Turtle Hurdles, Ultima Thule, Valley of Flowers, Veil of Diamonds, Virginia's Grotto, Walhalla, Wellington's Gallery, the Whale, Wife and Child, the Window

Non-contributing Views

- Contemporary electrical boxes, light switch boxes, light fixtures and other features that postdate the period of significance

Missing Views

- None determined

FIGURE 257. Historic circulation features include trails and stone steps built by George Morrison, cave soil trails built by the CCC, some with rock walls and bridging structures, and concrete trails built by the CCC and during the Mission 66 period.

Circulation

There have been four major episodes of trail building that have altered the passages adjacent to the Historic Entrance. The first occurred during the War of 1812 when paths for oxen carts were constructed of cave soil after it had been treated to extract the saltpetre compounds, and passage through the Historic Entrance and connected routes were regularized to facilitate the movement of people, animals, and materials into and out of the cave. Some of the trails in Broadway sit on top of the piles of mined cave soil. The dirt, however, also began to fill Houchins Narrows making it difficult to access over time without stooping.

The second episode of major trail building began under the direction of John Croghan in the 1840s. Croghan, who had visions of opening a hotel and stagecoach road through the cave, excavated Houchins Narrows to increase the height of the opening from a stoopway to 8 feet. He also had his guides clear trails of rocks, smooth out the trails both in their vertical and horizontal alignments, and installed stairs and ladders where needed. Boat tours were introduced within the lower passages and visitors traveled Echo River and River Styx in boats. This circulation system is no longer in use, having been discontinued in the 1990s.

Some circulation features can be dated to the late nineteenth and early twentieth centuries. These include Rider Haggard's Flight of stairs from the 1880s and Albert's Stairway from 1908, as well as rock stairs at the end of Gothic Avenue built between 1880 and 1900 to provide access to Lower Historic. Additional work occurred within Houchins Narrows and nearby passages in 1908–1909 to accommodate visitors, including the addition of ladders and stairs to support access between Upper and Lower Cave via the Corkscrew.

The third major episode of trail building occurred during the 1910s and 1920s when George Morrison opened sections of the cave that lie to the southeast of the Historic Cave. With the establishment of new entrances in the late 1910s, Morrison sought to attract tourists and compete with the Croghan family and their tourism operations. Within the area of the cave that extended between Violet City and Frozen Niagara, Morrison engineered trails through the passages using stone and cave soil, stairs (Figure 257), ladders, and bridges, as well as an aerial tram. Evidence of his efforts survive within the southeastern sections of Mammoth Cave. Morrison opened an entrance at Cathedral Domes that led to a wooden staircase. This entrance no longer survives.

There are several examples of the use of Kyrock paving within the cave. Kyrock is a locally sourced natural asphaltic material. The date of origin of these paving sections is not known but likely occurred during the 1920s or 1930s.

The fourth major episode of trail building occurred in the 1930s through the labor afforded by Civilian Conservation Corps (CCC) enrollees. Beginning in 1935, CCC enrollees continued the work begun by John Croghan, smoothing out the trails, applying a cave soil surface, adding rocks along some trail edges, adding concrete walks and stairs in some locations, and establishing overlooks (refer to Figure 257). The CCC most dramatically altered the trail system in the southeastern portion of the cave previously developed by George Morrison. The work of the CCC, which includes numerous dramatic stone structures, often parallels or deviates from Morrison's routes, providing opportunities to examine the different construction methods side by side. Many of the CCC trails survive within the cave today. Also present is the Carmichael Entrance, built as No. 4 Entrance by the CCC in 1935. The CCC also improved the Violet City Entrance and access way into the cave in 1935 (Figure 258). Wherever possible, the CCC built stairs to replace the historic use of ladders.[415] The Kentucky SHPO has determined the CCC trail improvements eligible for listing in the National Register of Historic Places.[416]

In 1948–1950, the stair system at Mammoth Dome was improved. In 1953, the National Park Service built a steel tower within Mammoth Dome to facilitate passage between Upper and Lower Historic Mammoth Cave. The tower replaced the use of the ladders and stairs at the Corkscrew (Figure 259); the original tower was in turn replaced with a new tower in 2008 (refer to Figure 259). The remains of the wooden stairs in the Corkscrew were removed in 1989. In 1950, a bridge crossing of Bottomless Pit was rebuilt with a timber structure 4 feet wide and 22 feet long. The trail leading to the wall was edged by a rock wall. In 1951, a timber bridge across the River Styx was replaced.

In 1953, a park master plan suggests the presence of several circulation features, some proposed for replacement or improvement. These included a bridge across Side-saddle Pit proposed to be rebuilt, a bridge across Washington Pit proposed for abandonment, and the presence of a bridge at the Dead Sea, wooden stairs at College Heights Avenue, wooden steps leading to the Crystal Lake boat landing, and bridge and stair features at Frozen Niagara crossing Crystal Lake and accessing the Drapery Room. Most of these features, which were indicated as constructed of wood, have since been replaced with metal and concrete structures since circa 1990.

415. Diehl and DiBlasi, 1998 Historic Chronology, 129-130; from James 1930:67.

416. "Memorandum of Agreement, Rehabilitation of Cave Tour Trails at Mammoth Cave National Park, Edmonson County, Kentucky," April 24, 2015.

FIGURE 258. Stairs built by the CCC in 1935 to improve access at the Violet City Entrance remain in use today.

FIGURE 259. Use of stairs within the Corkscrew to travel between Upper and Lower Historic Mammoth Cave was replaced by a steel tower in Mammoth Dome in 1953. The original steel tower was replaced in 2008.

Mission 66 program funding allowed the park to make improvements to the walkway and stairs leading to the Historic Cave Entrance. Plans for the work were prepared in 1960 and 1961.[417] Efforts involved construction of a new asphalt walkway from east of the visitor center to the Historic Cave Entrance, a single parking space at the end of the walkway adjacent to the Historic Cave Entrance, and a small asphalt plaza. A concrete staircase was constructed leading from the plaza to the Historic Cave Entrance. The walk was edged by new stone walls.[418]

In 1966 and 1967, some of the trails in Mammoth Cave were modified to include the addition of more concrete sections, concrete stairs, and new handrails. At this time, New Entrance was closed in 1967 for a short time. The National Park Service later implemented a self-guided tour program. To restrict visitors to certain acceptable passages, the National Park Service built a series of low mortared stone walls. One of these is located in Gothic Avenue. The National Park Service also built a new concrete stair at the end of Gothic Avenue between 1966 and 1975 to improve the safety of the passage through a stone stair built circa 1880–1900.

To address dust problems resulting from overuse of the cave soil treadways, heavily toured passages are undergoing trail improvement projects initiated in the 1990s and continuing through 2018. In 1993–1996, a new stainless-steel stairway was built at New Entrance. In 1997, the park initiated the Prototype Cave Trail project that replaced a small section of a cave-sediment-surfaced trail with a hardened surface, such as concrete. The trail section was also edged by lint curbs and railing. These efforts were intended to reduce the amount of lint and debris in the air with the ability to coat cave walls and other features. The lint curbs and railings also helped to reduce the potential for visitors to engage in graffiti and other vandalism. As part of this project, a cypress boardwalk was built around the saltpetre mining features in Rotunda. Between 2015 and 2017, these same approaches were applied to the Historic Tour trail. The surface of the entire route followed by the tour was replaced with hardened surfacing edged by lint curbs within the upper section. In addition, new stairs and handrails were added where needed to facilitate visitor passage through the heavily used route.[419]

Additional improvements made since the 1997 trail project are associated with portions of the Cleaveland Avenue and Grand Avenue Tours that have improved visitor safety, enhanced the visitor experience, and protected cave resources.[420]

In addition, Broadway was paved with hexagonal pavers in 2017. The cave soil trails have been maintained at times by using sprayed water to keep down dust and applications of calcium chloride and ammonium nitrate salts to help hold moisture.[421]

Contributing Circulation Features

- Stone steps at Scotchman's Trap (likely by 1969)
- Stone and concrete stairs leading from Gratz Avenue to Gothic Avenue (circa early twentieth century)
- Stone steps within Blackall Avenue (1930s)
- Rider Haggard's Flight of stone steps (1880s)
- Albert's Stairway of stone steps (CRIS HS #013016) (1908)
- Stone steps between Pass of El Ghor and Mary's Vineyard (likely by 1969)

417. National Park Service, "Approach Walks, Steps and Parking Area, the Historic Entrance" Drawing No. NP MC 3039A, various dates in 1960 and 1961, 5 sheets.
418. National Park Service, Drawing No. 135-3039A, "Approach Walk Steps and Parking at the Historic Entrance" (July 25, 1960).
419. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 40.
420. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 47.
421. Diehl and DiBlasi, 129; from Olson 1996.

- Metal stair/ladder in Pilgrim Avenue connecting to Thorpe's Pit Trail (likely by 1969)
- Morrison-era packed soil paths over piled rocks or natural floor (highlight ingenuity of the team to access challenging areas of the cave) (1910s and 1920s)
- Morrison-era stone steps constructed of stacked flat rock (often parallel to current trail system and no longer in use) (1910s and 1920s)
- Examples of Kyrock paving (date undetermined, circa 1920s or 1930s)
- CCC-era stabilized packed soil paths sometimes edged by rocks or boulders (introduced real trail design methods and skills, more than just clearing a path. Capacity and grade concepts came into play with these trails rather than cutting a narrow scramble through the cave) (1930s)
- CCC-era sloped ramps with stone bases and soil treadways (1930s)
- CCC-era concrete stairs (with form work evident) (1930s)
- Mission 66-era trail construction to replace earlier routes for improved traction and safety (not to improve capacity or expand tour routes) (1956–1969)
- Mission 66-era concrete stairs (1956–1969)
- Metal superstructure causeways built by 1969
- Prefabricated metal stairs installed by 1969
- Overlooks and platforms built by 1969
- Mammoth Cave Historic Entrance (CRIS HS #000119) (nineteenth century)
- Violet City Entrance (CRIS HS #090187) (1915; 1931)
- Carmichael Entrance (CRIS HS #090173) (1931)
- Tunnel and stairs between Carmichael Entrance and Cleaveland Avenue (1931, stairs likely by 1969)
- New Entrance (CRIS HS #000121) (1915; 1931) (1921)
- Elevator Entrance (1958)
- Frozen Niagara Entrance (CRIS HS #005566) (1924; 1934; 1937–1938)

Non-contributing Circulation Features

- Steel stairs with FRP treads in Gothic Avenue (2007)
- Concrete trails with stainless steel handrails in Bandit Hall (likely postdates 1969)
- Aluminum stairs at New York Subway entrance to Grand Central Station (1987)
- Causeway across Crystal Lake (likely postdates 1969)
- Galvanized steel stair leading to Drapery Room (likely postdates 1969)
- Manufactured grate and concrete surface of trail in New York Subway (likely postdates 1969)
- NPS-era brushed finish concrete surfaced trails and stairs (1970s–2020)
- NPS-era hexagonal paver and concrete trails, some edged by lint guards and handrails (2000s–2020)
- Mammoth Dome Tower (2008)

Undetermined Circulation Features

- Paving and railing improvements in Black Snake Avenue (date of origin undetermined)
- Steps of Time (date of origin undetermined)
- Stair leading to Fat Man's Misery edged by metal handrail (date of origin undetermined)
- Paving and safety improvements in Fat Man's Misery (date of origin undetermined)
- Paving and safety improvements in Odd Fellows Hall (date of origin undetermined)
- Concrete stairs and metal handrails connecting River and Bandit Halls (date of origin undetermined)
- Steep double flight of stone steps from Elisabeth's Dome to Violet City (date of origin undetermined)

- Concrete steps between Violet City and Violet City Entrance (date of origin undetermined)
- Concrete trail improvements for accessible trail through Cleaveland Avenue (date of origin undetermined)
- Curving concrete steps at the junction of Sandstone and Cleaveland Avenues (date of origin undetermined)
- Concrete trail improvements in Marion Avenue for accessibility trail (date of origin undetermined)
- Metal bridge over a pit near Mary's Vineyard in Marion Avenue (date of origin undetermined)
- Switchbacks and narrow steps ascending Big Break (date of origin undetermined)
- Concrete steps edged by metal handrails beyond Fairy Ceiling in Grand Avenue (date of origin undetermined)
- Concrete steps edged by metal handrails at the entrance into Grand Central (date of origin undetermined)
- Concrete trail and metal safety improvements in Boone Avenue (date of origin undetermined)
- Steps connecting Boone Avenue and Pilgrim Avenue (date of origin undetermined)
- Narrow stairway connecting sections of Adeline Avenue (date of origin undetermined)

Missing Circulation Features

- Morrison's Cliff Walk in Grand Avenue at Grand Canyon / Woodbury's Pass
- Cathedral Domes Entrance (CRIS HS #000120) (collapsed 1931)
- Entrance from New York Subway to Grand Central (closed 1967)
- Ladders—Jacob's Ladder from El Ghor to Mary's Vineyard, ladders in the Corkscrew
- Wooden staircases in several locations including Cathedral Domes Entrance (CRIS HS #000120) and the Corkscrew
- 1953 steel tower in Mammoth Dome
- Aero-Bridge tram system used briefly by George Morrison (1922)
- Wooden bridges
- Segments of CCC trails replaced by concrete trails
- Boat tours on River Styx, Echo River, use of Minnehana Island as the Echo River boat landing at Cascade Hall, accessed from causeway. Fourth Arch also served as a boat landing. Boat tours were finally discontinued in 1992
- Cypress boardwalk in Rotunda to help visitors understand saltpetre mining features (1997, later replaced with paver trail)

Buildings

There are only six buildings associated with the Mammoth Cave Historic District. They include two stone huts, three restroom buildings, and a food preparation room near Snowball Room. All were constructed during the period of significance. Two—Consumptive Hut #1 and #2—date to the 1840s, while the others were built during just prior to or during Mission 66.

Consumptive Hut #1 and #2 were built in 1842 in Main Cave beyond Giant's Coffin as part of Dr. John Croghan's experiment in treating tuberculosis patients. These two structures served as an office and a dining room. Patients were housed in wooden huts in several other passages within the cave; these no longer survive today. Croghan believed subjecting his patients to an environment with a constant temperature and humidity would be beneficial to those suffering from tuberculosis. Croghan's experiment ended in spring 1843 after seven patients died and others saw their health worsen.[422] The surviving stone

422. "Mammoth Cave Invalids," *The Illinois Free Trader* (May 26, 1843); "The Mammoth Cave," *Vermont Phoenix* (May 12, 1843).

structures are in ruins due to the loss of the original wood roofs and interior features, which were likely salvaged and reused elsewhere within the cave. As such, the structures possess diminished integrity. They however retain sufficient integrity to convey their historic associations and contribute to the significance of the historic district.

The three restroom buildings were built between 1953 and 1965. These replaced earlier slit trench facilities located near Snowball Dining Room and River Hall. The first of these built was the Great Relief Restroom in 1953. It is located at the far end of Fat Man's Misery and includes both a men's and a women's restroom. The exterior landing around the building has been improved, diminishing integrity of setting. The building otherwise retains sufficient integrity to convey its historic associations and contributes to the significance of the historic district.

The Snowball Room Restroom was constructed in 1957. It is located adjacent to the Snowball Room near the Elevator entrance and features both a women's and a men's restroom. The restroom spaces are formed by dramatically constructed stacked stone walls that are original. The interior walls, fixtures, and partitions also appear to be original. Alterations to the original design include the addition of soap dispensers and hand dryers. The Snowball Room restroom appears to retain a high degree of integrity and contributes to the significance of the historic district.

The Mount McKinley Cave restroom located about a mile from the Elevator along Grand Avenue. This brick structure was built from materials dropped through a hole in the cave ceiling in 1965. It appears little changed from its initial construction and survives with sufficient integrity to convey its historic associations. Mt. McKinley Cave Restroom contributes to the significance of the historic district.

The final building located within the Mammoth Cave Historic District is the preparation room near the Snowball Dining Room. Constructed in 1958, the preparation room was completed by National Park Concessions, Inc., to support food preparation needs, and is representative in materials and form of Mission 66 modern design principles. The preparation room appears to have been little altered since its original construction. It appears to possess sufficient integrity to convey its historic associations and contributes to the significance of the historic district.

Outside the cave is a building that houses the Elevator entrance. The original elevator was built in 1958. The structure has been highly modified since its original construction to meet contemporary engineering standards and to accommodate improved utility chase systems leading into the cave. It does not retain integrity. It is non-contributing.

Contributing Buildings

- Consumptive Hut #1 (CRIS HS #000888) (1842)
- Consumptive Hut #2 (CRIS HS #005019) (1842)
- Great Relief Restrooms (Park Building #201) (1953)
- Snowball Room Preparation Room (Park Building #205) (1958)
- Snowball Room Restrooms (Park Building #204) (1957)
- Mount McKinley Restrooms (Park Building #045) (1965)

Non-contributing Buildings

- Elevator (cave exterior) (1958)

Missing Buildings

- Wooden huts built by Dr. John Croghan for tuberculosis patient dwellings (1842–1843)

FIGURE 260. Old wooden bridge across Bottomless Pit and contemporary replacement constructed of concrete and steel with stainless handrails inset with metal mesh for visitor safety.

FIGURE 261. The character of the rock walls within the cave varies. Nineteenth century examples such as those near Olive's Bower are carefully cut and fit together, while the work of the CCC also exhibits a consistency and care of workmanship. The rock work implemented during Mission 66 does not necessarily exhibit characteristics of mid-century modern architectural design or the quality of workmanship associated with some other work from that era. Examples include a wall at Vanderbilt University Hall (above).

FIGURE 262. The nineteenth-century iron gate and the current Historic Entrance gate installed in 1990.

Structures

Structures located within Mammoth Cave fall within several categories. These include entrance features, gates, saltpetre-industry features, prefabricated stairs, ladders, trail-support systems, towers, bridges and causeways, engineering systems, utilities, walls, monuments, landings, fencing, and basins. The cave entrances typically include several structural components such as walls, doors, airlocks, and stormwater-management systems. Many of the structures located within Mammoth Cave were constructed during the period of significance. These can be traced to early nineteenth-century saltpetre mining and nineteenth- and twentieth-century development of the cave for tourism. Surviving structures reflect the efforts of George Morrison, the Croghan estate, the Civilian Conservation Corps, and the National Park Service.

Contributing structures include surviving evidence of saltpetre-mining activities that date to circa 1810–1815 and range from oak and chestnut vats to pump tower features and pipes. These features are located within Houchins Narrows, the Rotunda, and Broadway.

Croghan and Morrison-era structural elements appear to have mostly been removed from the cave. These included wooden stairs, ladders, and bridges across pits (Figure 260). Carefully crafted walls located at the end of Audubon Avenue (Figure 261) near the mushroom beds and along the margins of the passage leading to Olive's Bower were likely built in the late nineteenth century. Other features surviving from this period are the many rock monuments and walls located alongside the trail in Gothic Avenue that likely date from circa 1825–1925. Evidence of an aerial tram built by George Morrison in Aero-Bridge Canyon in 1921 also survives, as does a concrete boat landing at Crystal Lake completed circa 1923. A concrete catch basin at Richardson's Spring may date to this period to provide drinking water to visitors.

An entrance at Violet City Entrance was first opened circa 1908 by Max Kaemper and Ed Bishop. In 1909, Hovey wrote about Kaemper and Bishop attempting to blast through from Violet City to Sandstone Avenue at the end of their so-called Long Route. The project was halted when the group feared they might be beyond the boundaries of the Mammoth Cave estate. Six years later, Ganter showed this secret new entrance to George Morrison, who used it for running illegal nighttime surveys into the cave in an attempt to open a competing entrance on land he controlled. This was the first section of the cave to be electrically lit in circa 1910-1915. After the two competing enterprises had been absorbed into Mammoth Cave National Park, the Violet City Entrance was developed for tours. It was officially opened in 1931.[423]

Structures built by the CCC include cave entrances, walls, bridges, landings edged by metal pipe handrails, and surviving evidence of a pulley system used to lift a rock from on top of the mummy found while constructing trails. The CCC improved the walk, stormwater-management system, and landings leading to Historic Entrance in the 1930s. Stonework and stormwater-management systems survive across the access road from the entrance plaza today. The CCC was also responsible for constructing a new entrance structure at No. 4 Entrance, which is known today as Carmichael Entrance. The CCC improved the Violet City Entrance, adding a new concrete structure over top of the opening to protect it from collapse. One of the walls built by the CCC was a stone retaining wall around the saltpetre vats that served to elevate the walk and allow visitors to look down into the historic features. The CCC also built extensive retaining wall systems used to elevate walks through undulating terrain, as well as rock walls at the base of the Bridal Altar and Jenny Lind's Armchair. The metal pipe used to construct handrails and guardrails is often in deteriorated condition.

Structures built by the National Park Service between park establishment in 1941 and the end of

423. *Mammoth Cave Gazetteer*, Violet City Entrance entry.

the Mission 66 period include stonework at the plaza overlooking the Historic Entrance and a ventilation shaft along Houchins Narrows to convey cool cave air to the new visitor center. This survives today. The date of origin of several prefabricated metal stairs is not currently known. These were likely added between 1941 and the end of the Mission 66 period. Several wooden bridges and stairs were built by the National Park Service during this period to cross Bottomless Pit, Side-saddle Pit, Washington Pit, the River Styx, Dead Sea, Crystal Lake, Frozen Niagara, and College Heights. Aluminum handrails appear to have been used within the cave during the 1950s and 1960s; some survive but are in deteriorated condition. While the River Styx structure survives, the others appear to have either been abandoned from use or replaced with steel and concrete structures for safety (refer to Figure 260). Stone walls were built in some locations that were not of the same quality of those constructed by the CCC or earlier, such as one at Vanderbilt University Hall to limit access to a former restroom area (refer to Figure 261).

Structures that postdate the period of significance include the existing stainless steel Mammoth Dome tower was built in 2008 to replace a similar structure installed in the cave in 1953. The new tower is wider and allows for more commodious passage by visitors and facilitates emergency service needs, the existing metal gate at Historic Entrance, which was installed in 1990 and consists of a door and an exit turnstile set in an open gridwork barrier that allows free air movement (Figure 262), and the various steel and concrete stairs, landings, causeways, and bridges that have replaced earlier wooden structures to cross pits and drops, and provide access to lower areas and rooms. The use of stainless steel to fabricate handrails and guardrails, as well as barriers to visitor access that protect natural cave features has replaced earlier use of steel pipe and aluminum. A steel bracing system was added to protect against rock fall in the passage that approaches the base of Mammoth Dome in the 1970s. A more recent addition is the sewage lift station located behind the Great Relief Restrooms that include a concrete storage tank, grinder, pump, and pipe system connected to the ground level through a hole in the cave ceiling. In 1999, airlocks were added to many of the entrances, including Frozen Niagara, to control changes in temperature, humidity, air flow, and wildlife. Later, an airlock was also added at the bottom of the Elevator to control air flow.[424] Problems with air flow resulting from the open bat gate at Historic Entrance were controlled after 1990 through the placement of plexiglass panels during the winter months.[425]

Structures built by the National Park Service between 1941 and 1969 that retain integrity appear to contribute to the significance of the Mammoth Cave Historic District. Those that postdate 1969 are non-contributing. Many of the structures built after 1969 replaced earlier structures built for a similar purpose. The replacements that postdate the period of significance are often intended to enhance the safety of visitors, or to introduce more durable materials.

Missing structures include a several iterations of gate features at Historic Entrance, such as the so-called Iron Gate built circa 1884 (refer to Figure 262) "as a safeguard against secret surveys, spoliation, and the escape of fugitives from justice."[426] Several of the structures built by the CCC no longer exist within the cave. These include rock steps and a handrail / guardrail system at Mammoth Dome, rock steps and guardrails at Cathedral Domes, wooden stairs and bridges at drops and across pits, and a boardwalk built by the CCC in the 1930s between River Styx and Echo River. The 1,110-foot-long boardwalk facilitated tours to Cleaveland Avenue and beyond by eliminating the need for boats in River Styx. Treatment of the wooden support members with creosote, however, led to deleterious effects on cave life. Several decades later, volunteers with the National Speleological Society removed the boardwalk, and carried the pilings and other wood

424. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 40.

425. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 46.

426. Hovey.

materials to Vanderbilt Hall where they were cut into pieces and bagged, with the bags carried out of the cave via Mammoth Dome by an army of volunteers.[427]

Contributing Structures

- Mammoth Cave Historic Entrance (CRIS HS #000119) (diminished integrity due to stair and gate replacement)
- Ventilation shaft in Houchins Narrows (1959)
- Tulip poplar saltpetre pipes (CRIS HS #007611) (circa 1810)
- Leaching vats at Rotunda—#1 (CRIS HS #000887), #2 (CRIS HS #005007), and #3 (CRIS HS #005008) (circa 1810)
- Rotunda Drain Tank (CRIS HS #005015) (circa 1810)
- Leaching vats at Booth's Amphitheater--#1 (CRIS HS #005009), #2 (CRIS HS #005010), #3 (CRIS HS #005011), #4 (CRIS HS #005012), #5 (CRIS HS#005013), and #6 (CRIS HS #005014) (circa 1810)
- Metal catwalk and stair structure near Booth's Amphitheater (Mission 66)
- Stacked rock walls along Audubon Avenue (nineteenth century)
- Mushroom beds (CRIS HS #007610) (1882)
- Rock steps and walls leading to Olive's Bower (CRIS HS# 007609) (circa 1880)
- Rock wall at the base of Bridal Altar (CRIS HS #007607) (1950s)
- Rock wall at the base of Jenny Lind's Armchair (CRIS HS #007604) (1950s)
- Rock walls in Gothic Avenue (CRIS HS #007602) (1825-1925)
- Curved rock wall in Gothic Avenue (1953)
- Rock wall at the end of Gothic Avenue near the entrance to Elbow Crevice to protect visitors from drop (CRIS HS #007603) (circa 1950s)
- Concrete catchment basin at Richardson's Spring (likely by 1969)
- Mortared rock wall at Vanderbilt University Hall (likely by 1969)
- Former restroom features in Vanderbilt University Hall (early twentieth century)
- Boat landing at Echo River (likely by 1969)
- Metal bridge structure and chain link fencing crossing of Dead Sea (likely by 1969)
- Cable and pulley system used to free the mummified remains of a prehistoric miner at Mummy Ledge (1935) Violet City Entrance (CRIS HS #090187) (1931)
- Carmichael Entrance (CRIS HS #090173) (1935)
- Stone foundation ruins of former women's restroom facilities in Marion Avenue (likely by 1969)
- Concrete platform for visitor placement of lanterns (likely by 1969)
- Aero-Bridge Canyon tram cable (CRIS HS #007606) (1921)
- Frozen Niagara Entrance (CRIS HS #005566) (1924)
- New Entrance (CRIS HS #000121) (1921)
- Crystal Lake Landing (CRIS HS #007605) (circa 1923)
- Rock walls built by 1969
- CCC stacked stone trail support and retaining wall work (circa 1934–1937)

Non-contributing Structures

- Metal gate at Mammoth Cave Historic Entrance (1990)
- Rock wall used to limit passage at the end of Harvey Avenue (1970s)

427. Hobbs et al., 266.

- Steel grate bridge edged by stainless steel railings inset with metal mesh panels over Bottomless Pit (likely postdates 1969)
- Sewage lift station behind Great Relief restrooms (likely postdates 1969)
- Stone wall outside Great Relief Restrooms (likely postdate 1969)
- Stone wall edging the trail beyond Great Relief Hall (likely postdate 1969)
- Rock walls built after the end of the period of significance
- Mammoth Dome Tower (2008)
- Historic Entrance gate (1990)
- Steel bracing system (1970s)
- Causeway across Crystal Lake (likely postdates 1969)
- Stainless steel handrails and guardrails with metal mesh, and barrier fencing (postdate 1969)

Undetermined Structures

- Stacked stone retaining walls that elevate the visitor walks within the Rotunda to view inside the leaching vats (date of origin undetermined)
- Wooden platform in Rafinesque Hall for viewing Lookout Mountain (date of origin undetermined)
- Metal grate catwalk used to cross Side Saddle Pit (date of origin undetermined)
- Wall blocking entry from Black Snake Avenue to Bottomless Pit (date of origin undetermined)
- Wooden bridge across Gorin's Dome (date of origin undetermined)
- Steel I-Beams in Sparks Avenue (date of origin undetermined)
- Steel bridge structure that conveys Marion Avenue over a pit near Mary's Vineyard (date of origin undetermined)

Missing Features

- Leaching Vat #5 at Booth's Amphitheater (Circa 1810)
- Historic Entrance gates prior to existing
- Wooden stairs, ladders, bridges, causeways
- Cathedral Domes Entrance wooden stair structure (1930-1931)

FIGURE 263. Benches in Mammoth Cave include wooden, concrete, and stone features, some with backs and others backless. Wooden benches were present within the cave in the 1930s.

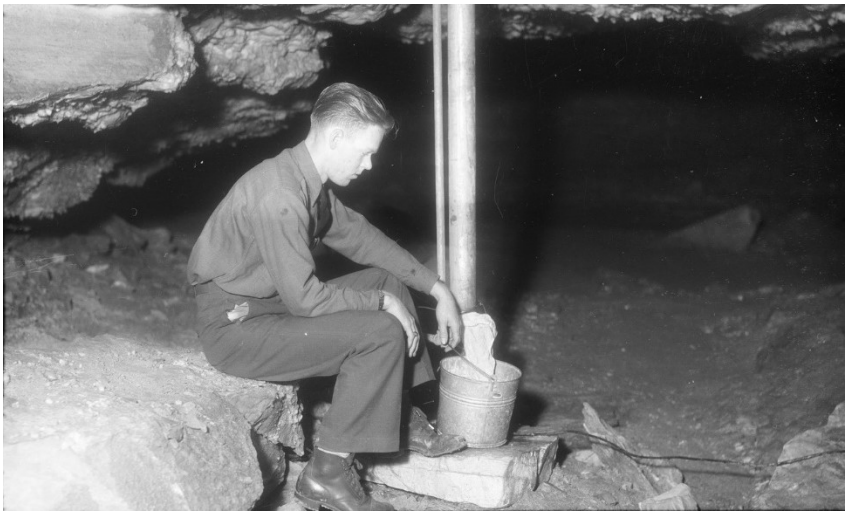


FIGURE 264. The upside down well within Cleaveland Avenue appears in a 1938 photograph and remains present today.

Small-scale Features

Small-scale features associated with the Mammoth Cave Historic District include site furnishings—benches (Figure 263), trash receptacles, lighting, and drinking fountains—as well as signage, survey benchmarks, and some utility features.

The oldest surviving historic small-scale features likely include the remnants of lantern hangers used by visitors and guides to hang their lights when the grouped stopped for longer periods, as well as some of the numerous commemorative markers and monuments located throughout the cave. These are all historic and contribute to the significance of the historic district. They range from rock cairns, to signs, masonry monuments, and plaques. There are also bronze USGS geodesic survey markers that survive from the 1935-1936 Walker Survey. These are located throughout the cave and mark global positions as well as elevation. Another older small-scale feature located within the cave is the glass case once used to display the Lost John mummy and is currently stored at the end of Cyclops Gateway. Remnants of some historic utilities can be found in isolated locations throughout the cave, including the upside down well (Figure 264), an electrical drop, and a pipe to carry water flow near Cathedral Dome. These are all historic and contribute to the significance of the historic district. Electric lights were installed in Rotunda, at Martha Washington's Statue, and Mammoth Dome in 1949.

Small-scale features that survive from the Mission 66 era include stone and concrete benches located near the Mission 66-era restroom facilities and in Washington Hall. Drinking fountains located at

the Snowball Dining Room and Great Relief Restrooms also appear to date to the Mission 66 period. Lighting along Marion Avenue between the Elevator and the Snowball Room may also have been installed during Mission 66 to connect the two areas that were a focus of Mission 66 development. These are all historic and contribute to the significance of the historic district.

The majority of the small-scale features present in the cave today postdate the period of significance and are associated with contemporary cave access and administration by the National Park Service. These include wayside exhibits, artifact cases, information panels, and other signs, trash receptacles, lighting, and numerous utility features. The utility features that postdate the period of significance include electrical power lines, telephone and electrical junction boxes, and lighting controls, as well as updated sewage systems. The cone and safety lights present within the cave today also appear to be contemporary additions that postdate the period of significance and are non-contributing. Wooden boxes located in the cave to store interpretive props are also likely contemporary additions to the cave landscape.

In 2009, the cave electric supply, control systems, and lights were replaced with new upgraded systems. The lighting system was designed to reduce lamp flora problems. In 2017, the light fixtures and bulbs from the 2009 project were replaced with standardized fixtures to a smaller number and aid in the east of replacing bulbs.[428]

Undetermined features include the flood measurement markers in River Hall, the picnic tables in the Snowball Room, the wooden benches in Star Chamber and near Aero-Bridge Canyon, the concrete and wood benches at Chief City, and the aluminum benches in River Hall and wooden benches in Grand Center.

Contributing Small-scale Features

- World War I commemorative markers in Rotunda (1922)
- Gothic Avenue monuments and cairns (CRIS HS #007602) (1825-1925)
- Vanderbilt University plaque (1907)
- Monument Hill cairns and monuments (late nineteenth and early twentieth centuries)
- College Heights Avenue plaque (1929)
- Benches by curved rock wall in Gothic Avenue (1953)
- Lantern hangers (nineteenth and twentieth centuries)
- Wood and concrete benches along the trail in Chief City (two sets) (likely by 1969)
- Glass case used to display Lost John (after 1935)
- Walker Survey markers (1935–1936)
- Drinking fountains near the Snowball Room (1950s)
- Drinking fountain near the Great Relief restrooms (circa 1950s)
- Hooflands Tonic advertisement panel painted on wall in Hooflands Avenue (circa 1869)
- Upright light poles (circa 1950s)
- Upside down well (1936)
- Pipe to convey water near Cathedral Dome (likely by 1969)
- Electrical chase

Non-contributing Small-scale Features

- Trash receptacles (post 1969)
- Wayside exhibits, artifact cases, and information panels in Rotunda and Audubon Avenue (post 1969)

428. National Park Service, *Mammoth Cave National Park Cave and Karst Management Plan/Environmental Assessment* (July 2019), 40.

- Electrical light systems composed of black cable and cone lights and light system switchboxes (1990s-2010s)
- Electrical transformers / junction boxes (1990s-2010s)
- Light fixture attachments to cave walls (1960s or 1970s)
- Atmospheric stations (ultrasonic anemometers) (1996, 2012)
- Telephone boxes (likely postdate 1969)
- Transformer pads in Gothic Avenue, Sparks Avenue, Frozen Niagara

Undetermined Small-scale Features

- Wooden benches near Jenny Lind's Armchair (**date of origin undetermined**)
- Two rows of benches in Star Chamber (**date of origin undetermined**)
- Stone and concrete benches outside Great Relief Restrooms (date of origin undetermined)
- Row of metal benches in River Hall (**date of origin undetermined**)
- Picnic tables in Snowball Room (**date of origin undetermined**)
- Stone and concrete benches near the Snowball Room Restrooms (**date of origin undetermined**)
- Stone veneered concrete benches near the Mount McKinley Restrooms (**date of origin undetermined**)
- Twenty rows of wooden benches in Grand Central Station (**date of origin undetermined**)
- Wooden benches beneath the stalactites associated with Fairy Ceiling (**date of origin undetermined**)
- Fat Man's Misery identity sign (**date of origin undetermined**)
- Bottomless Pit identity sign (**date of origin undetermined**)
- High water markers in River Hall and river gauge features in Odd Fellows Hall and Bandit Hall (**date of origin undetermined**)
- Chain-link fencing, railings, and barriers to protect visitors and formations (**date of origin undetermined**)
- Evidence of former electrical wiring attachments to walls using concrete slurry (**date of origin undetermined**)
- Electrical drop pipe in Grand Avenue (**date of origin undetermined**)
- Wooden boxes for guides to store interpretive props (**date of origin undetermined**)

Missing Small-scale Features

- Former telephone booth inside Rotunda
- Former telephone and power lines
- Radio transmission equipment in Radio Room

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Treatment Plan

Introduction

Treatment is a preservation strategy for long-term management of a historic property, intended to direct physical work on the landscape so that the distinguishing characteristics and features that contribute to the significance of the property are preserved. This treatment plan has been prepared to provide the National Park Service with an overall vision for the cultural landscape of the Historic District of Mammoth Cave National Park. The plan is intended to guide and support long-term management and interpretation of the historic district and its resources. The plan includes both treatment recommendations, which suggest what actions should be taken to meet the goals, issues, and concerns for long-term management of the cave and its resources, and treatment guidelines, defined as the preferred method for performing the tasks associated with the recommendations. The treatment plan also includes a section on proposed implementation projects that assemble one or more treatment recommendations into a specific actionable task.

The Mammoth Cave Historic District CLR treatment plan carefully considers the needs and goals for site management identified in various park planning documents, including the 1970 Mammoth Cave Master Plan, the 1983 General Management Plan (GMP), the 1991 Cultural Resources Management document, and the 2019 Cave and Karst Management Plan. In conjunction with these documents, the treatment plan responds to the specific management issues, concerns, and objectives conveyed to the CLR team by park and regional National Park Service personnel as part of the project statement of work and during meetings conducted over the course of the performance period. Beyond addressing the specific goals, issues, and concerns voiced by the National Park Service, the CLR treatment plan also considers appropriate stewardship of the natural and cultural resources associated with the cave's cultural landscape in accordance with federal guidelines.

As noted in the project statement of work:

> At Mammoth Cave National Park (MACA), increased visitor use, ongoing and planned facility improvement projects, and the potential deterioration of cultural landscapes due to age, environmental stresses, and other factors are serious threats to the continued preservation of the park's significant cultural resources. Completion of a cultural landscape report (CLR) for each identified park cultural landscape is needed to support informed planning for landscape stabilization, preservation, and/or rehabilitation. Treatment guidelines, recommendations for specific treatment projects, and implementation strategies provided in the CLR will identify and prioritize actions needed to ensure resource preservation while balancing the goals of historic preservation with contemporary park use and management concerns.[429]

One of the important considerations for the Mammoth Cave Historic District is designation of Mammoth Cave National Park as an International Biosphere Reserve.[430] As such, all treatment

429. National Park Service, Statement of Work "Mammoth Cave Historic District Cultural Landscape Report" (May 2016).

430. "Mammoth Cave National Park," UNESCO World Heritage List web site, accessed March 2021, https://whc.unesco.org/en/list/150/. See

recommendations have been made with the understanding that the Biosphere Reserve must fulfill three basic functions: 1) conservation of important biological resources; 2) development of environmentally sound economic growth; and 3) support for research, monitoring, education, and information exchange related to conservation issues. Guided by this mandate, the CLR treatment plan assumes that both natural and cultural resources merit careful stewardship and conservation strategies, which in and of themselves may at times suggest the need for further research and archeological investigation, and the support of the public, which can be solicited through education and interpretation.

This treatment plan is divided into six sections.

1. **Park Management Goals, Issues, and Concerns** describes the topics raised by park and regional National Park Service personnel for consideration within the CLR treatment plan, as well as the issues introduced in the Mammoth Cave National Park Cave and Karst Management Plan.

2. **Recommended Treatment Approach** presents the four approaches recognized by the Secretary of the Interior for treating historic properties, and identifies the approach recommended to be adopted for the Mammoth Cave Historic District as part of this CLR.

3. **Treatment Concept** conveys the overarching vision or concept for landscape treatment within the park to meet the National Park Service issues, goals, and concerns identified as part of this project.

4. **General Management and Design Guidelines for Treatment** provides an overarching set of guidelines that applies to all resource management activities conducted within the Mammoth Cave Historic District regardless of which treatment recommendations are implemented.

5. **Treatment Recommendations** provides cultural landscape treatment recommendations that identify the individual actions required to address the park's management goals, issues, and concerns.

6. **Implementation Projects** identifies projects that could be used in the future to effect implementation of the CLR treatment recommendations, once additional recommended research, investigation, documentation, and planning efforts are completed.

Park Management Goals, Issues, and Concerns

The management goals, issues, and concerns to be addressed by this treatment plan were identified in several ways. The statement of work issued to the CLR team identified a series of considerations anticipated to be addressed through preparation of the study. Park personnel conveyed additional issues to the team during the project start-up meeting held on November 14, 2016, at the park. Completed while the CLR was in process, the 2019 Mammoth Cave National Park Cave and Karst Management Plan also provided key issues to be considered by the CLR treatment plan. Finally, National Park Service personnel further articulated issues, goals, and concerns to be addressed by the CLR during meetings to discuss review of the 75 percent draft document by teleconference. Specific topics identified by the

also "Mammoth Cave Biosphere Region" at WikiMAB.org, *Online Encyclopedia for UNESCO Biosphere Reserves*, accessed March 2021, https://wikimab.org/mammoth-cave-area-biosphere-reserve/. Mammoth Cave National Park is also recognized as the core area of the Mammoth Cave Biosphere Region, part of the UNESCO Man and the Biosphere (MAB) Programme. The biosphere region, which includes Mammoth Cave National Park and the six surrounding counties, was established in 19990 and substantially expanded in 1996.

National Park Service for consideration in the CLR are summarized below.

- **Clearly defining the Mammoth Cave Historic District, associated period of significance, distinguishing characteristics, features, and boundaries.** The current Mammoth Cave Historic District is limited to only a fraction of the underground passages known to have supported early mining, medical, exploration, commercial industry, and tourism. The CLR should propose a clearly defined boundary for the Historic District that takes into consideration the history of cultural use of the cave, an appropriate period of significance, and all the relevant areas and criteria, while also identifying the resources that contribute to its significance.

- **Sustaining management of cave tour trails when meeting the needs of more than 450,000 visitors each year.** The park is challenged to provide suitable opportunities for visitors to experience the interior of Mammoth Cave in a sustainable manner. With rising numbers of visitors, it becomes increasingly difficult to meet the demand in a manner that provides a meaningful experience and adequate resource protection.

- **Considering ways to expand the areas accessed by cave tours, tour capacity, and address circulation dynamics, and enhance the visitor experience.** One of the ways that the National Park Service has envisioned meeting the needs of rising numbers of visitors is to expand the number of passages used for tours. Consideration should be paid to identifying opportunities for expanded tour routes in the CLR, and what infrastructure and resource protection needs would require further evaluation.

- **Managing and developing cave tour trails and associated supporting infrastructure.** Visitor safety and comfort, and cave accessibility for the public are important considerations that relate to infrastructure needs involving electricity and lighting, operational telephone systems, drinking water, restroom facilities, and waste management. The CLR should consider how these needs are addressed with the least impact on the integrity of the Mammoth Cave Historic District. Some of the current and previous tour infrastructure has had negative impacts on the cave environment. For example, electric lighting along some of the trails has encouraged the unnatural growth of algae and other lamp flora. The replacement of earlier tourism-era infrastructure has adversely affected the integrity of the associated cultural landscape yet has also improved the visitor experience and visitor safety. Replacing historic infrastructure or adding modern infrastructure on historic trail routes needs to be carefully considered and balanced with protecting and preserving the integrity of the Mammoth Cave Historic District. The 2019 Cave and Karst Management Plan proposes limits on the number of visitors on tours. Additional capacity studies may be needed to guide future decisions related to managing cave tours and the need for additional enhanced infrastructure.

- **Increasing visitor understanding and enjoyment of the cave resources and history through enhanced interpretive opportunities**. Mammoth Cave has a long and unique history of industrial activities, medical experiments, scientific research, pre-Contact-era American Indian use, and tourism among other activities of interest. Determining what stories might be told to visitors and what strategies might be appropriate for telling the stories is an important part of National Park Service stewardship of national park units. The CLR should provide suggestions for how to enhance visitor understanding and enjoyment of the cave resources and history. Expanding the historic district boundary to allow a larger extent of Mammoth Cave to be explored by visitors would provide new opportunities for interpretation at Mammoth Cave. Topics that might be further developed for interpretive exhibits and tours include the

lives of the African Americans who played a vital role in the development of cave tour routes, the long history of cave exploration and surveying, the pre-Contact-era American Indian use of the cave interior, and efforts conducted during the period following World War II through implementation of the Mission 66 program to further develop Mammoth Cave as a tourist destination.

- **Addressing the long-term preservation of the character-defining features of each cave entrance and vegetation management approaches to maintain the integrity of the historic scene.** Visitors approaching the cave as part of a tour group begin their journey at one of the historic entrances. As visitors continue to be drawn to explore underground, additional pressure is being placed on the cave's entrance to accommodate the visitors. Establishing clear guidance for the long-term preservation of the character-defining features of the cave entrances is essential to protect and preserve the integrity of the Mammoth Cave Historic District. The CLR should provide recommendations for maintaining the historic character and integrity of the entrances while accommodating large groups of visitors, including appropriate methods for maintaining vegetation.

- **Identifying, through coordination with SERO and park staff, where cultural landscape features are adequately identified in the Facilities Management Software System (FMSS), and which FMSS assets might need updating or inclusion**. Documenting cave resources as part of the preparation of the CLR will result in a detailed inventory that can be used to update FMSS, supporting park management and funding appropriations.

- **Addressing potential impacts of climate change.** Anticipating the impacts of climate change and the ways in which increased severity and intensity of storms and temperatures and rainfall pattern fluctuations may affect the cave, its resources, and visitors will be important information to be used in planning for the future. The CLR should provide suggestions for how to address anticipated changes in weather and associated conditions resulting from climate change. Archeological resources are anticipated to be particularly impacted by climate change.

- **Addressing specific resource management needs such as repair of masonry, metal, and wood, removal of modern graffiti versus protection of historic signatures, and protection of artifacts and formations from visitor impacts. T**he CLR team should provide specific recommendations for how to address the resource preservation needs of features located within Mammoth Cave Historic District taking into consideration National Park Service management practices and protocols and the way public access occurs. The CLR should provide specific recommendations for documenting, evaluating, and protecting pre-Contact period resources.

- **Considering ways to reduce lint and dust, decrease the opportunity for graffiti on or vandalism of cave resources.** In addition to the principles outlined above, the Cave and Karst Management Plan suggests specific approaches to address three issues having a deleterious impact on cave resources—lint, dust, and vandalism.[431] The CLR should build on the guidance afforded in the plan with additional recommendations and implementation plans.

- **Meeting the "desired conditions" articulated in the 2019 Cave and Karst Management Plan.** The 2019 Mammoth Cave National Park Cave and Karst Management Plan outlines "Desired Conditions" for the park which are defined as "statements of aspiration that describe resource conditions, visitor experiences and opportunities, and

431. National Park Service, Cave and Karst Management Plan, 48.

facilities and services that an agency strives to achieve and maintain in a particular area." The CLR treatment plan should consider each these desired conditions, which include the following:

- The natural function, diversity, complexity, and resiliency of park caves are protected.
- Impacts on fragile natural and cultural resources are minimized by locating facilities in areas that can support such use without sustaining unacceptable environmental damage.
- Cave use-related impacts are minimized or mitigated by management strategies.
- Infiltrating water is protected to ensure good water quality to support cave functions and organisms.
- Cave habitats and communities, especially cave-obligate endangered species, are maintained and protected.
- Archeological resources are preserved and protected from unintentional, adverse impacts and/or disturbance associated with cave use.
- Cultural resources—including archeological sites, historic structures, cultural landscapes, and ethnographic resources—are identified, documented, and protected, to the extent possible.
- A variety of cave tours are readily available to provide visitors with a high-quality experience, and an opportunity to learn about and enjoy Mammoth Cave's iconic cultural and natural resources.
- Visitor congestion and conflict are managed to provide visitors with a high-quality experience.[432]

Cave Tour Management

The 2019 Mammoth Cave National Park Cave and Karst Management Plan provides clear direction on cave tour management. The information is summarized below and used to frame the treatment plan.

Ranger-led cave tours are among the most popular activities offered by Mammoth Cave. Over the last decade, average visitation to the park has steadily increased with approximately 16,000 visitors added each year, many of whom come for the cave tours.[433]

Mammoth Cave offers a wide variety of cave tours catered to a range of physical abilities, tour lengths, and visitor experiences. But visitor tours often come with many challenges, particularly when crowd numbers become high. For example, during peak times, there can be up to 500 visitors per hour participating in the Discovery Tour, which is considered the maximum number of visitors that park staff can interact with while also overseeing needed resource protection.[434] Crowding within the tours diminishes the visitor experience, increases emergency response times to incidents, and escalates the risk of damage to the natural and cultural resources in the cave.

The 2019 Cave and Karst Management Plan proposes limits on the number of visitors on tours. It also proposes a system of zoning which identifies the appropriate level of development and intervention within the cave that both protects its resources while allowing for public enjoyment and education. The CLR supports both strategies. Future capacity studies may help guide decisions

432. National Park Service, Cave and Karst Management Plan, 2.
433. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 35.
434. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 35.

related to managing cave tours and the need for additional enhanced infrastructure.

In addition, the CLR proposes establishing strictly timed tour schedules that focus on limiting the encounters of different tour groups intersecting within the cave environs. As much as possible, tour groups should be staggered to allow only one tour group within each section at a time. When it is necessary for tour groups to pass one another, designated gathering areas should be utilized where visitors are able to wait while others pass (Figure 265). These designated areas should be located where the cave passages are broad and where there is minimal risk of visitors impacting the cave's natural and cultural resources. Some examples include areas near Snowball Dining Room and within Grand Central Station.

FIGURE 265. Example of a widened area designated for trail groups.

While groups are assembling prior to starting tours, etiquette for tour encounters should be relayed to the groups with an emphasis on preservation of the cave environment.

Tour Infrastructure by Tour Zone. The 2019 Cave and Karst Management Plan proposes a system of cave zoning that draws and expands on the system outlined in the 1983 General Management Plan "to assure that park activities occur in the areas where they are most suited."[435] The 1983 plan includes a six-zone system that varies in intensity of use and development. The 2019 Cave and Karst Management Plan condenses and simplifies the zones into a total of three while modifying some of the management intentions and approaches. The 2019 plan also includes an overlay zone that places restrictions on some activities within the three zones to protect historic resource values. The zones indicated as proposed in the 2019 plan are:

- **Zone A.** Zone A includes cave passages used for public tours that have been improved to accommodate large groups through the inclusion of paved surfacing, electrical lighting, telephone communications systems, and other infrastructure such as benches in spaces where guides give longer presentations. Passages within Zone A have been improved to support use by large numbers of visitors, including the provision of visitor services to address visitor comfort. Visitors who participate in tours within Zone A are immersed in the sights and sounds of the cave, although rising numbers of visitors sometimes leads to overlap of groups within some spaces, and the sounds associated with some groups reaching other groups. Due to the large volume of visitors within these passages over the years, the impacts of visitation on cave resources are sometimes visible, such as graffiti, vandalism, and dust on cave walls. Zone A is also designed to accommodate special events with a permit.

  Examples of passages falling within Zone A include: Cleaveland Avenue, Snowball Room, Kentucky Avenue, Grand Central Station, Frozen Niagara, Boone Avenue, Rafinesque Hall, Houchins Narrows, Broadway, Main Cave between Giant's Coffin and Star Chamber, Blacksnake Avenue, Fat Man Misery, Great Relief, Sparks Avenue, Mammoth Dome, Little Bat Avenue, and Audubon Avenue.

- **Zone B.** Zone B encompasses passages within the cave that are designed to allow for a less developed and more primitive cave experience for visitors. Trail surfaces remain unpaved for

435. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 13.

the most part, and the passages are not lighted. Visitors carry lanterns or flashlights, and/or wear headlamps for lighting. There are examples of improved trails within Zone B made to address problematic situations such as wet or muddy areas, slippery surfaces, and other conditions that might be of concern for the safety of visitors. Those who take tours within Zone B, however, are advised that conditions are sometimes challenging and that they will need to take care with their footing.

Zone B also accommodates approved educational groups and activities. It also allows visitors to learn basic caving skills and practice the use of caving gear.

Management of passages within Zone B focuses on protection and enhancement of the natural function, diversity, complexity, and resiliency of the cave. The naturally occurring sights and sounds of the cave are an important part of the visitor experience and explored by the guides. Some passages within Zone B exhibit evidence of visitor-caused impacts, such as dust on the cave walls, graffiti, and vandalism. In appropriate areas, research opportunities are afforded within this zone with a permit.

Examples of passages falling within Zone B include: Main Cave from Star Chamber to Violet City, Great Onyx Cave, Clark Avenue, Cathedral Domes, Becky's Alley, Nickerson Avenue, Big Break, Ganter and Jessup near Wooden Bowl, El Ghor-Silliman Avenue, Woodbury Pass, Colossal Entrance to Bedquilt Route, Historic Crystal Cave Trails, Historic Proctor, Long Cave, Upper Salts Cave, Olive's Bower, Briggs Avenue, Black Chambers, Blue Spring Branch, Echo River (end of Styx Catwalk to Minnehaha), Pensacola Avenue, Sylvan Avenue, and Emily's Avenue.

- **Zone C.** Zone C encompasses passages with few improvements designed to accommodate visitors and tour groups. Zone C affords a more intensively primitive cave experience reflective of the conditions experienced by earlier explorers. The passages within Zone C are entered less frequently by visitors than those within Zones A and B. It includes the majority of the 35-mile system of passages within Mammoth Cave, as well as most of the other caves located within the park. Minimal development is anticipated to occur within this zone in the future. Examples of development envisioned within this zone includes the establishment or use of existing narrow trails for traversing areas and other minimal modifications to allow for safe exploration, mapping, research, and/or management. As a result, visitors to Zone C should expect a more physically demanding and challenging experience. Trails would not necessarily be marked.

  The primary users of Zone C would be NPS resource managers and researchers with caving skills and experience. Within this zone, there would be opportunities to study cave systems that have been minimally impacted by human activity. A permitting process would be used to determine appropriate uses and exploration activities in this zone, which would not generally be available to the public. The zone includes newly discovered passages requiring further survey and assessment by highly skilled cavers and resource experts. In appropriate areas, opportunities for research would be available in this zone with a permit.

  Examples of passages falling within Zone C include: East Bransford Avenue, Carlos Way, and River Acheron.

- **Restriction Overlay Zone D.** The Restriction Overlay Zone D is used to delineate exceptional passages and areas of Mammoth Cave that require seasonal and/or special conditions for entry. The overlay zone would be managed to limit human impacts on cave resources and is designed to protect pristine caves/passages with highly sensitive resources or specific resources that require additional safeguards. The overlay zone would be used to designate areas where protection is needed from dangerous conditions. Should environmental conditions change and lead to

additional dangerous conditions, the overlay district could be expanded.

Examples of passages falling within Restriction Overlay Zone D include passages requiring seasonal or year-round closure to protect bat habitat; areas with sensitive archeological and historic resources; delicate formations and/or minerals; and areas where there are safety concerns.[436]

The CLR supports these updated management zone designations and the recommendations included herein are designed to be consistent with the approach outlined in the 2019 plan.

Treatment Approach

The four treatment approaches recognized by the Secretary of the Interior for historic properties were considered in conjunction with the park's objectives in developing this CLR to determine the approach most suitable for the Mammoth Cave Historic District of Mammoth Cave National Park.

The four treatment approaches include: preservation, rehabilitation, restoration, and reconstruction. Described in *The Secretary of the Interior's Standards for Historic Properties* as forming "the philosophical basis for responsible preservation practice and enable long-term preservation of a landscape's historic features, qualities, and materials," the approaches are defined as follows:

> **Preservation:** the act or process of applying measures necessary to sustain the existing form, integrity, and material of a historic property. Includes stabilization work, where necessary, as well as ongoing preservation maintenance and repair of historic materials and features.
>
> **Rehabilitation:** the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values.
>
> **Restoration**: the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by removing features from other periods in its history and reconstructing missing features from the restoration period.
>
> **Reconstruction**: the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.[437]

Recommended Treatment Approach for the Mammoth Cave Historic District

Based upon the park's need to meet current and projected future interpretive, functional, and management goals, **rehabilitation** is recommended as the most appropriate overarching treatment approach to be adopted for management of the Mammoth Cave Historic District of Mammoth Cave National Park. Because rehabilitation is defined as the act or process of making possible a compatible use for a property, this approach allows for protection of the site's historic character and resources while carefully addressing the need for limited enhancement of interpretive opportunities and circulation routes, ecological maintenance and restoration, and the improvement of visitor amenities.

As part of rehabilitation, stabilization, protection, and preservation of historic and natural resources are assumed even when new uses are accommodated. Areas of the landscape that are particularly sensitive to change and disturbance, such as sites of known and potential archeological

436. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 14–15.

437. Robert R. Page, Cathy A. Gilbert, and Susan A. Dolan, *A Guide to Cultural Landscape Reports; Contents, Processes, and Techniques* (Washington, D.C.: Department of the Interior,1998), 82.

resources—alterations to which cannot be repaired through rehabilitation—should be treated with great care. In general, the CLR recommends preservation of archeological resources unless a compelling research question or informational need justifies disturbance or excavation, or mitigation to accommodate unavoidable change as necessary.

In considering the other treatment alternatives recognized by the Secretary of the Interior for the Mammoth Cave Historic District, the CLR found them inappropriate for the following reasons:

Preservation (exclusive of cases involving archeological resources) is overly restrictive because it does not allow for the changes to the landscape to accommodate contemporary needs, such as universal accessibility enhancements.

Restoration and **reconstruction** are not practical because they assume, as a prerequisite, that sufficient documentation exists to accurately portray a lost historic condition. At this time, it does not appear that there are documentary sources detailed enough to support comprehensive restoration or reconstruction of the Historic District cultural landscape to a particular time period, and because too much change has occurred both within this area of the park to render this approach successful. Removal of some features that postdate the likely period of significance is also not currently recommended.

Secretary of the Interior's Standards for Rehabilitation

The following section summarizes the standards for rehabilitation espoused by the Secretary of the Interior for historic properties. The ten basic principles that comprise the standards are intended to help preserve the distinctive character of a site while allowing for reasonable change to meet new needs. The standards (36 CFR Part 67) apply to historic properties of all periods, locations, sizes, conditions, and uses. These standards create a baseline of guidance to which intended changes to the historic landscape must be compared. These standards are neither technical nor prescriptive but promote responsible preservation practices. They include:

- A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
- The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
- Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.
- Changes to a property that have acquired historic significance in their own right will be retained and preserved.
- Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
- Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.
- Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
- Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.

- New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work will be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.

- New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.[438]

Treatment Concept

Treatment of the Mammoth Cave Historic District cultural landscape considers a range of issues and needs that include natural and cultural resource protection and stewardship while also accommodating public access and addressing safety considerations. The section that follows is intended to convey the overarching vision or concept for landscape treatment intended to meet these issues and needs. The Treatment Concept builds on the 2019 Cave and Karst Management Plan prepared by the National Park Service.

Mammoth Cave Historic District is designated a World Heritage Site and listed in the National Register of Historic Places for several heritage values. It has served industrial, medicine, scientific study, and recreational purposes over the course of a long period of significance. It was also visited by American Indians in the pre-Contact era, and contains numerous archeological deposits related to their activities. In addition to its value as a significant historic landscape, Mammoth Cave falls within a designated International Biosphere Reserve that recognizes the importance of the park's rich diversity of biological resources and sensitive watershed and aquifer recharge area.

Treatment of the Mammoth Cave Historic District needs to address the needs of both historic cultural resources and notable natural resources.

The overarching treatment concept for the cultural landscape of the Mammoth Cave Historic District is to balance the protection and enhancement of the site's historic integrity with contemporary park visitor access and interpretation needs, within a broader framework of sustainable land management practices that protect the sensitive natural resources of the International Biosphere Reserve. The CLR treatment plan recognizes a mandate to protect evidence of cultural heritage within this World Heritage Site, while also meeting the conservation needs of natural resources in the park's role as an International Biosphere Reserve. To that end, the vision for treatment of the cultural landscape and its resources first and foremost seeks to do no harm. The CLR treatment plan recommends taking a conservative approach where possible to ensure preservation of cultural resources. All decisions related to cave management and accommodating the public should recognize and protect to the extent possible sensitive natural resources, promote biodiversity, and protect against contamination of water resources and disruption of natural plant and animal communities. Materials used to facilitate access to the cave and used in the repair and maintenance of cave resources should not contaminate or negatively impact the natural resources recognized through designation as an International Biosphere Reserve.

Strategies for protecting the natural formations from both cultural impacts such as vandalism and flora caused by lighting, as well as anticipating any threats posed by climate change are recommended as part of the treatment plan. The plan also indicates the need to protect and maintain all cultural resources by applying maintenance protocols and protection strategies that themselves do no harm. Over the past years, the

438. The Secretary of the Interior's Standards for Rehabilitation. Available at ttps://www.nps.gov/tps/standards/rehabilitation/rehab/stand.htm, accessed March 2021.

popularity of the Historic District and use by most visitors to the park, has taken its toll on the condition of some landscape features. Modifications, including updating safety railing and rehabilitation of cave trail surfaces where they are worn, are warranted to improve the condition of the cave for visitors. Protection, repair, and when necessary, replacement in kind of historic features, such as stonework, as originally designed are also recommended to ensure the cultural landscape survives and that the historic character of the cave is protected. The treatment plan indicates situations where altering and updating maintenance and management practices and adding new features to support sustainability goals will provide a positive impact without affecting the integrity of the historic landscape.

Climate change and visitation, for example, are anticipated to lead to condition issues of concern for pre-Contact artifacts and deposits. The plan considers alternative strategies for the park to consider in addressing the anticipated threats.

In addition to balancing cultural and natural resource protection, the National Park Service must allow for public access to the cave while controlling the impacts of visitors. Current pressures to better accommodate large numbers of visitors who wish to tour the cave, while addressing universal accessibility needs in conjunction with aging historic resources, are of a particular challenge. The CLR suggests means for enhancing visitor access and understanding of the site, while limiting the potential for visitors to impact natural and cultural resources. Stewardship on the part of the public is envisioned to be engendered through enhanced interpretation.

Treatment builds on the documentation and assessment developed in the Part 1 CLR, which recommends expansion of the Mammoth Cave Historic District from the property encompassing 12 miles of underground passages to the extent of the area used historically for tours and by pre-Contact visitors, an area that encompasses 25.9 miles of underground passages (refer to Figure 11 and Appendix B). Recognition of the importance of additional passages to the heritage of touring the cave may suggest options for the National Park Service to alter or expand some current tours to better accommodate the public and enhance interpretation. Inclusion of additional passages, however, will need to occur within a framework of study, design of tours, and the implementation of necessary and appropriate trail and safety features. Work conducted since the 1990s by the National Park Service to improve the Historic Tour and Grand Avenue Tour routes serve as models for future efforts and can be evaluated for any adaptations that will improve the performance and stewardship of the cave. The National Park Service's 2019 Cave Management Plan also serves as a springboard and baseline for many of the treatment plan recommendations provided herein.

General Management and Design Guidelines for Treatment

The section that follows provides a set of overarching general guidelines that apply to the treatment of the Mammoth Cave Historic District. These guidelines are intended to support the rehabilitation approach discussed above, and to be used in concert with the treatment recommendations that follow this section regardless of what recommendations are implemented. The guidelines relate to a philosophy of cultural landscape treatment based on *The Secretary of the Interior's Standards for the Treatment of Historic Properties* with *Guidelines for the Treatment of Cultural L*and*scapes*, and a comprehensive view of the Mammoth Cave Historic District.

Natural Systems and Features

- Recognize the critical importance of natural resources to the cultural landscape and site history and strive to maintain ecological health.
- Minimize vegetative disturbance, soil compaction and exaction, and drainage pattern alteration.
- Undertake site design that incorporates holistic, ecologically based strategies aimed at

contributing to the repair and restoration of natural systems.

- Avoid disturbing sensitive ecosystem habitats and resources.
- Encourage stewardship of park resources by developing resource education programs that address cultural resources, natural systems, and their interrelationships over time.
- Avoid the use of chemical or physical treatments that cause damage to natural features and systems.
- Control and monitor visitor access, use, and impacts to the natural resources of Mammoth Cave, including sensitive ecological areas.

Land Use

- Monitor and regulate use of the landscape to minimize immediate and long-term damage to natural and cultural resources.
- Avoid land use activities, permanent or temporary, which threaten or impair known or potential archeological resources.
- Limit, monitor, and control access to areas that are vulnerable to damage from human access or use.
- Consider equally both natural and cultural features in treatment and land use decisions.
- Evaluate all proposed new uses in consultation with a historical landscape architect and other appropriate professionals to ensure that the appropriate cultural resource professionals are consulted, and to help avoid problems with SHPO and Section 106 compliance.
- Avoid altering the habitats of rare, threatened, or endangered species or species of special concern. Evaluate the potential impact to wildlife habitat prior to undertaking any construction or removal project.

Spatial Organization

- Avoid altering the contiguous spatial organization of cave entrances and rooms connected via horizontal and vertical passages.

Buildings and Structures

- Consider the interpretive value of non-intrusive, non-contributing buildings and structures, and retain them wherever possible.
- Consider the removal of non-contributing structures that are intrusive to the historic landscape only if they are found to be without historical or functional merit or value.
- Avoid conjectural reconstruction of historic buildings and structures.[439]

Circulation

- Consider the impact on existing trails when proposing new circulation systems. Also consider noise and other impacts that trails will have on the visitor experience and historic resources.
- Minimize the visual impacts of pedestrian access systems.
- Provide a range of cave routes and accessibility/difficulty levels to serve a wide variety of visitors.
- Construct new circulation systems in as minimal a fashion as possible to access points of interest or to create loop systems for the benefit of visitors.

439. Restoration and reconstruction are recommended only when adequate documentation exists to authentically return a historic missing condition. The term "conjectural" is applied to restoration or reconstruction efforts not supported by adequate documentation. This term appears throughout the Secretary of the Interior's Standards as an approach to the treatment of historic properties to be avoided.

- Incorporate historic circulation routes whenever possible into pedestrian trail systems.

Small-scale Features

- Erect the minimal number of signs possible for identity, directional, interpretive, and regulatory needs.

- Keep the number of contemporary small-scale features to the minimum required for visitor and staff comfort and safety.

- Design site furnishings to be compatible with the character of the cultural landscape in concept and materials. Ensure that the style of site furnishings is uniform throughout the cultural landscape. Develop a plan that identifies a palette or suite of site furnishings appropriate for use within the cultural landscape.

Archeological Resources

- Continue efforts to identify, document, and map archeological resources.

- Protect and preserve archeological resources in place. Identification of resources is a prerequisite for their protection. Project planning should proceed only after the presence / absence and / or condition of archeological resources have been established at proposed project locations. Protection measures can include avoidance and / or protection through burial of soils with archeological materials (in cases where the archeological resource is already below the cave floor) or construction of other types of protective barriers. If archeological resources must be disturbed, undertake mitigation measures such as data recovery, curation, and documentation.

- Limit the use of destructive techniques, such as archeological excavation, to application only as needed to provide information required to support research, interpretation, and management goals.

New Design and Construction

- Avoid adding new features or altering existing features in ways that adversely affect the landscape's historic character. Introduce features to facilitate access and interpretation in ways that minimize any adverse impacts.

- Limit new construction to those alterations and additions that are necessary for visitor access, interpretation, and management. New or altered features should be as unobtrusive as possible while allowing for accessibility and safety. Whenever possible, taking into consideration the visitor experience without compromising visitor safety, utilize off-site facilities, such as the visitor center, to accommodate contemporary uses like ticketing, sales, and orientation as is currently occurring.

- Retain and maintain historic materials, features, finishes, construction techniques, spaces, and spatial relationships wherever possible when changes to the cultural landscape are considered.

- Design and site new additions or alterations to the landscape in such a way to avoid destroying historic materials, features, archeological deposits, and spatial relationships that characterize the cultural landscape. Design all new additions and alterations to be a product of their time, and compatible with the historic resources in materials, size, scale and proportion, and massing. Differentiate new work from existing historic resources.

- Design and site new additions and alterations to the landscape in such a way that, if removed in the future, the essential form and integrity of the cultural landscape would be unimpaired.

- Retain and maintain changes to the cultural landscape that have acquired historic significance in their own right.

- Repair, rather than replace, deteriorated historic features. Replacement of severely deteriorated features should be based on archeological, documentary, or physical evidence. Such new features should also be based on archeological, documentary, or physical evidence; the new feature should match the old in design, color, texture, and, where possible, materials.

- Avoid, when possible, landscape changes that create a false sense of historical development, including the addition of conjectural, typical, or representative features. Consider interpretation of typical features in cases where restoration is not possible, but the provision of information is important to the visitor experience.

- Design new features, systems, and programs to be as accessible as possible to the widest audience.

- Establish new waysides in the least intrusive manner possible to fulfill proposed new interpretive goals.

- Avoid the use of chemical or physical treatments that cause damage to cultural resources. Undertake the surface cleaning of structures using the gentlest means possible.

- Minimize disturbance associated with the installation of visitor access facilities.

Interpretation

- Provide an alternative means for interpretation, such as a visitor center exhibit, for those features located in areas that cannot be made universally accessible or where new interpretive features would be a visual intrusion.

- Develop an interpretive program that addresses cultural resources, natural systems, and their interrelationships, as well as layers of landscape history.

- Minimize the visual and physical impacts of interpretive and visitor access facilities on cultural resources and natural systems. Develop the least-intrusive interpretive and visitor access improvements possible.

- Develop interpretive programs and media to be as accessible as possible for the widest range of visitors.

Role of Preservation Specialists

- Undertake all treatment projects under the direction of appropriate specialists, which could include historical landscape architects, historical architects, archeologists, conservators, natural resource management specialists, and qualified technicians and artisans.

- Evaluate all proposed new uses in consultation with a historical landscape architect and other appropriate professionals. This step is added to ensure that the appropriate cultural resource professionals are consulted, to help avoid problems with SHPO and Section 106 compliance.

- Undertake sufficient study and recordation of landscape features requiring modification, repair, or replacement before work is performed to protect research and interpretive values.

Documentation

- Undertake sufficient study and recordation of landscape features requiring modification, repair, or replacement before work is performed to protect research and interpretive values.

- Document, through drawings, photographs, and notes, all changes and treatments to the historic landscape. Consider the use of the most current cartographic technology in documentation efforts, including 3D technology that may be made available for interpretation purposes as well. Maintain records of treatments and preserve this

documentation according to professional archival standards.

Sustainability

- Institute cultural and natural resource treatment and maintenance methods that are environmentally and culturally sensitive and sustainable over the long term.

- When establishing new interventions, use mitigating devices that involve cut and fill sparingly. Implement the least-intrusive measures and those involving stabilization first, and subsequently proceed to more invasive measures as necessary. To the extent possible, limit major new interventions to areas that have previously been disturbed.

- Take into consideration life cycle costing of materials to assess their long-term wearing capacity and maintenance costs. Consider materials that are non-toxic, durable, long-lived, and low maintenance.

Treatment Recommendations

General Recommendations

- Preserve and maintain all cultural landscape features contributing to the significance of Mammoth Cave Historic District. Avoid replacing contributing cultural landscape features unless preservation or repair is not feasible. *See Implementation Project: Develop preservation, repair, and replacement protocols for historic features*.

- Address repair issues associated with cave cultural landscape features, such as metal structures exhibiting rust and pitting, wood exhibiting warping due to damp conditions, unsafe hand- and guardrails in heavily visited areas, trails that include trip hazards, cave walls and breakdown coated with dust and lint, lamp flora growth on cave walls. *See Implementation Projects: Repair or replace hand and guardrails to address safety concerns; Repair and maintain trails to address safety concerns; Clean dust from cave walls; and Clean and prevent lamp flora growth.*

- Complete Historic Structures Reports for each of the contributing buildings and structures located within the Mammoth Cave Historic District, including the saltpetre-mining structures; stacked and mortared stone walls; mushroom beds; metal and wood catwalk, stair, and bridge structures; cave entrance structures; Consumptive Huts #1 and #2; the Great Relief, Snowball Room, and Mount McKinley restroom buildings, the Snowball Room Preparation Room; Aero-Bridge Canyon tram remnants; and boat landings.

- Consider undertaking a detailed survey to document all cultural landscape resources within the proposed expanded Mammoth Cave Historic District. Record the dimensions, materials, and form of all discrete cultural landscape features. Use CRF maps to identify all cultural features by location and photograph each feature. The survey could build on the documentation provided as part of the CLR. *See Implementation Project: Complete a cultural landscape survey and research sufficient to document and assess all cave resources*.

- Complete additional cultural landscape-related directed research to tie the features identified in the survey to an era of origin. Some sections of paved trails, stairs, bridges, causeways, railings, walls, and benches are examples of features for which insufficient documentation has been located to complete assessments sufficient to list in the National Register of Historic Places. *See Implementation Project: Complete a cultural landscape survey and research sufficient to document and assess all cave resources*.

- Consider conducting personal interviews with National Park Service personnel involved in managing and maintaining cave resources to record information anticipated to be of value to the proposed survey and documentation effort.

- Prepare updated National Register nomination for the expanded Mammoth Cave Historic District. Consider including the criteria, areas, and period of significance identified herein, and identifying all relevant cultural resources as contributing to the significance of the district based on the CLR and the comprehensive survey recommended above. The expanded historic district would encompass all passages that have been the focus of visitor use and tours from the pre-Contact era through the 1940s, between the Historic Entrance and Frozen Niagara. *See Implementation Project: Prepare a National Register of Historic Places Amendment and Expanded Boundary Nomination for Mammoth Cave Historic District*.

- Update the Cultural Resource Information System (CRIS) database to include all resources considered to contribute to the significance of the Mammoth Cave Historic District.

- Use the information gathered through the survey to inform the park's FMSS records to include all discrete cultural landscape features documented herein, and in the survey recommended above.

- Consider setting up repeat photography stations to record condition issues over time that might include dust accumulation, impacts of climate change on artifacts, and flora growth associated with lighting.

- Consider establishing standards for site furnishings and signage associated with the historic district. *See Implementation Project: Establish cave site furnishings and signage standards for the historic district*.

- Consider expanding interpretive programming within the cave and through virtual means to include the full extent of the history of cultural use, beginning with pre-Contact-era American Indian activities within and exploration of the cave interior. Include information about the long history of cave exploration and surveying, Mammoth Cave as a tourist destination, stories about the lives of the African Americans who played a vital role in the opening and development of cave tour routes, as well as the history of segregation that occurred within national parks, including Mammoth Cave, during the Jim Crow era. Continue through the Mission 66 period to present-day efforts to improve trail routes and protect natural and cultural resources of the World Heritage Site and International Biosphere Reserve. Personal interpretation, the use of digital exhibits within the self-guided section of the cave, virtual interpretation online or through an app that visitors can access while within the park could all be considered. *See Implementation Project: Enhance interpretation*.

- Remove stored material including garbage bags of old broken concrete and wood decking removed from the cave in the 1980s that is being held in storage near Vanderbilt University Hall.

Natural Features and Systems

Natural features and systems serve as the principal milieu for the cave's cultural landscape, and their protection is essential both for the visitor experience and for their role in the International Biosphere Reserve. Hydrologic, geologic, and soil resources, along with unique flora and fauna are significant elements of the cultural landscape.

- Conserve the hydrologic resources of the cave and follow the guidance afforded by the UNESCO World Network of Biosphere Reserves in protecting water quality.

- Protect the rock, mineral and soil features of that comprise the Mammoth Cave Historic District.

- Protect the cave passages that comprise the Mammoth Cave Historic District.

- Protect natural cave biota and ecosystems, particularly around heavily toured areas, including surviving bat hibernacula.

- Monitor the natural features and systems of the cave to rapidly identify issues of concern as they arise.

- Continue to ameliorate the impact of artificial entrances, lighting, and visitor access on the climate within Mammoth Cave.

- Preserve, protect, and maintain the cultural features that were built or added as a response to the environmental conditions and natural resources. These include the locations of cave entrances, the alignment and surfacing of trails and causeways, and the siting of overlooks, and other important viewing locations.

- Manage vegetation at the cave entrances so that trees, shrubs, vines, and other plants are not growing on the structures or into the cave openings.

- Protect cave walls from the growth of lamp flora arising from the introduction of lighting by limiting the use of lighting both in terms of location and illumination time, using modern LED technology, and positioning fixtures away from walls as possible. Ensure that all lighting meets the most efficacious standards for reducing the growth of lamp flora.

- Repair or address issues of concern related to natural features and systems, including dust and lint deposition on cave walls and floors, formations, and breakdown features and the growth of lamp flora.

- Clean lamp flora algae and cyanobacterial growth in lighted areas of the cave using non-toxic materials (Figure 266). *See Implementation Project: Clean and prevent lamp flora growth.*

FIGURE 266. Example of lamp flora on the cave walls. Should the flora be removed, care will need to be taken to protect the historic signatures.

- Continue to conduct cave surface cleaning efforts to remove accumulations of dust resulting from visitor use of CCC-era cave sediment-surfaced trails (Figure 267). *See Implementation Project: Clean dust from cave walls.*

FIGURE 267. Accumulated dust on breakdown and walls within Main Cave near Consumptive Huts #1 and #2.

- Continue to limit the number of visitors in areas where dust is formed by passage along cave soil trails.

Spatial Organization

While the proposed Mammoth Cave Historic District is comprised of 25.9 miles of cave passages, they can generally be organized into groups of upper and lower passages, with a limited number of specific vertical connections between them. The passages generally trend in a northwest to southeast direction, with the naturally occurring Historic Entrance located near the northwestern

terminus of the system. The other entrances are culturally derived but can be used to help organize an understanding of the passages.

- Retain the overall patterns of spatial organization present since the period of significance. Avoid altering existing patterns of spatial organization, such as opening new passages, closing existing passages, or adding new entrances unless the changes are considered important to the protection of natural resources.

Land Uses

Several current land uses contribute to the significance of Mammoth Cave Historic District by perpetuating historic activities and associations. These include the provision of tours for visitors, visitor services, commemoration, interpretation and education, and scientific research.

- Continue to perpetuate historic land uses that contribute to the significance of the Mammoth Cave Historic District, including providing tours, visitor services, and interpretation and education; maintaining commemorative features; and conducting scientific research and study.

- Document, evaluate, preserve, and maintain the borrow pits where cave sediments were removed for saltpetre mining and for trail development by the CCC.

Circulation

Circulation features provide access to the cave for visitors and allow for safe passage through uneven terrain marked by falling and trip hazards such as pits, drop offs, wet areas, and piled breakdown. Circulation features in evidence today represent several eras of construction—nineteenth- and early twentieth-century stone steps, walks, and artificial entrances built by George Morrison, cave sediment-surfaced trails, sometimes supported by stacked stone walls and causeways, and stone and concrete stairs built by the CCC (Figure 268), Mission 66 concrete trails and stairs and associated stone wall features. Since the 1990s, the National Park Service has been updating historic trail surfaces within the most-heavily toured parts of the cave to address pothole and dust issues associated with soil sediment trails and to address safety concerns. Much of the Upper Historic Cave and portions of Lower Historic have been improved, in addition to Grand Avenue. While the changes impact integrity of materials, workmanship, design, and feeling, they are in many cases essential to support ongoing visitor access to the cave interior.

FIGURE 268. Concrete stairs constructed by the CCC along Black Snake Avenue.

- Preserve and maintain all historic trails to the extent possible given the need to reduce dust, lint, access to sensitive resources, and promote visitor safety. Contributing circulation features include nineteenth- and early to mid-twentieth-century trail surfacing and trail structural systems such as piled rock and walls, stone and concrete steps, metal ladders and stairs, and causeways associated with George Morrison's tour development, the work of the Civilian Conservation Corps, and improvements made as part of the Mission 66 program.

- Preserve and maintain the historic cave entrances, including the paved plaza at the approach to the Historic Entrance.

- Address safety needs within the cave by evaluating whether handrails and guardrails meet applicable codes and require

replacement.[440] Identify where hand and guardrails need to be replaced. *See Implementation Project: Repair or replace handrails and guardrails to address safety concerns*.

- Consider using stainless-steel railings that match those included in Grand Avenue trail improvement projects where wooden or metal pipe handrails have become bent, splintered, corroded, rusted, or broken and cannot be repaired, or where their replacement is necessary to meet safety codes. Ensure that new handrails and guardrails are muted in color and finish to avoid drawing attention away from the cave passages.

- Consider strategies that allow the historic handrail or guardrail to be retained when installing new features to serve as an example of historic treatments in the cave (Figure 269).

- Where features, such as railings, have become obsolete consider maintaining representative examples in situ as records of the past (refer to Figure 269). The identification of which obsolete features might be considered the most suitable to retain as representative examples may occur based on the results of the cultural resource survey recommended herein.

FIGURE 269. An old railing post near Consumptive Hut #1.

- Document, as part of the survey process recommended herein, the locations of all surviving historic trails. Also, document stair locations. Endeavor to tie stairs to a particular period of construction by conducting further research and through empirical evaluation.

- Complete more detailed documentation prior to making any changes to historic trails. Include photographs and sketches and information related to trail width, materials, and construction techniques.

- Regularly evaluate the condition of trails used for visitor tours. Identify any issues requiring repair. Maintain trail surfaces in smooth and repaired condition (see recommendations for maintaining cave sediment trails below). Where path supports and edging are loose or have shifted such as within Main Cave (Figure 270), reposition rocks and shim trail surfaces with dirt or rock to establish a stable walking surface and edge to the trail.

FIGURE 270. A passage within Main Cave where a boulder has been dislodged from the edge and sits within the pathway. This boulder may serve as a trip hazard for visitors.

- Where trail surfacing materials change, ensure that the transition is smooth and there is no trip hazard due to gaps or differences in trail levels.

440. The National Park Service is self-regulating in terms of enacting and enforcing building code standards.

- Repair trails in fair to poor condition. Ensure that rehabilitated pavements are consistent with historic conditions in material, finish, and location. *See Implementation Projects: Develop preservation, repair, and replacement protocols for historic features; and Repair and maintain trails to address safety concerns.*

- Consider utilizing either a brush concrete finish (Figure 271) or a floating emory surface (aluminum oxide sapphire) for slip resistance along trails and stairs. For larger paths or where surfacing is particularly unstable, consider fiberglass reinforced plastic surfacing (FRP), such as at River Hall.

FIGURE 271. Detail of a brushed concrete finish that helps protect visitors from slipping.

- Continue to utilize lint guards in high traffic areas to protect the cave from fibers and other materials brought into the cave by visitors.

- Continue the use of lights placed along the walk to highlight such areas as Sidesaddle Pit and Bottomless Pit. Ensure that wires from lights and other utility cables are hidden from view by rock and soil. Update outdated electrical wiring as needed for safety and functional requirements.

- Continue to use the route across River Styx for environmental education tours. Consider in-kind replacement of the worn boardwalk and fencing that currently marks the route (Figure 272) with a compatible material.

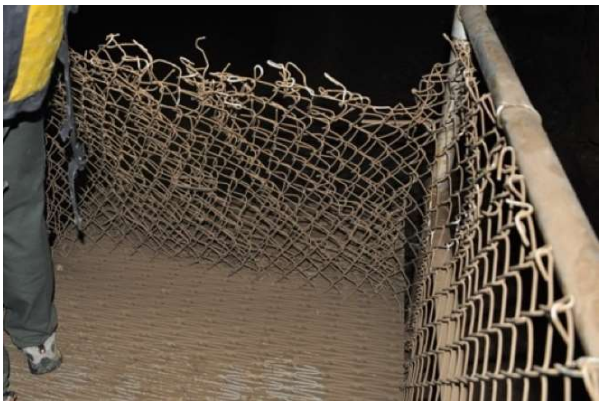

FIGURE 272. Badly deteriorated boardwalk and fencing at the trail near River Styx.

- Consider options for maintaining the margins of trails through the provision of edging material that helps visitors remain on the path, supports safety goals, and helps to protect artifacts from damage, loss, or vandalism. *See Implementation Projects: Repair and maintain trails to address safety concerns.*

- Consider maintaining cave sediment trails using a hardening technique that combines sediment with a small amount of Portland cement and water. Historically, cave sediment trails were maintained using salt (calcium chloride), which is corrosive and likely to negatively impact cave resources and biota. As new treatments become available, consider implementing alternatives to Portland cement-based concrete that are more eco-friendly.

- Avoid using cave sediment deposits located within Mammoth Cave for the purposes of securing fill material to address trail maintenance needs given the historic use of these sediments and the potential to treat them as cultural resources. Investigate the possibility of using cave soil that may be stockpiled based on trail improvements involving the use of concrete in some passages, such as Grand Avenue. Otherwise identify an appropriate source for compatible soil to be used in the cave. Ensure that any earth used to fill dips and gaps in cave sediment trails is archeologically sterile.

- Continue to limit the size and number of tours traversing sections of the cave where soil

sediment trails are retained. Consider using future capacity studies to determine the appropriate number of visitors and size of tours permitted within these sections per day.

- Consider options for building new trails in locations that do not require destruction of historic trails as parallel systems. Interpret the preserved historic routes.

- Continue to carefully plan tour routes and associated improvements to accommodate visitors. Continue to limit improvements to the least necessary to ensure visitor safety.

Buildings and Structures

Many of the existing buildings and structures within the historic district are contributing features that date from the nineteenth through the mid-twentieth century. Exceptions include recent replacements of causeway and bridge structures, some cave entrance infrastructure, sewage-management systems, and some walls related to improved trails. There are photographs and etchings of some of the buildings and structures that existed during the nineteenth century that are no longer extant. Knowledge of these missing buildings and structures may be useful for future interpretive programming. The treatment plan discusses the value of knowing about these missing features to the park's interpretive program.

- Retain and maintain all contributing buildings and structures, including the consumptive huts; restrooms and waste-management systems (Figure 273); structures associated with Historic Entrance, Violet City Entrance, New Entrance, Frozen Niagara Entrance, Carmichael Entrance, and the Elevator; saltpetre mining pipes, tanks, and tailings (Figure 274); mushroom beds; and structures related to circulation—bridges, stacked stone walls, causeways, ladders, and stair structures.

FIGURE 273. Great Relief Restrooms.

FIGURE 274. One of the saltpetre mining leaching vats located in Broadway.

- Stabilize and repair historic buildings and structures assessed as being in poor condition, including the fencing and bridging features at the Dead Sea and River Styx (Figure 275).

FIGURE 275. The current boardwalk and fencing that crosses River Styx is in deteriorated condition.

- Document, as part of the survey process recommended herein, the locations of all surviving historic buildings and structures.

Endeavor to tie structures to a particular period of construction by conducting further research and through empirical evaluation.

- Complete more detailed documentation prior to making any changes to historic buildings and structures. Include photographs and sketches and information related to dimensions, materials, and construction techniques.

- Avoid constructing any new buildings or structures within the historic district unless absolutely necessary.

- Avoid restoring or reconstructing missing buildings and structures.

- Interpret historic entrance and passage features no longer extant to the public as part of the guided tour process. Examples include features used to enter the cave at the Historic Entrance, features used to help visitors traverse Corkscrew, the stairs at Cathedral Domes and other entrances established by George Morrison, and the earlier iterations of bridge crossings associated with Bottomless Pit and other chasms. Also interpret historic boat tours and the infrastructure that supported them that is no longer extant.

Views and Vistas

Views are a key interpretive element of Mammoth Cave Historic District in terms of the visitor experience. Use of overlooks and viewing platforms, and appropriate lighting design allows visitors to understand cave formations, and the basis for the name or names historically attributed to them. Views and vistas should continue to play an important role in the development of tours and the design of lighting within the cave.

- Protect historic, natural, and cultural scenic resources, visual quality, and views associated with cave formations, many of which have served as focal points of tours since the nineteenth century.

Small-scale Features

Historic small-scale features are present throughout many of the improved passages, as well as elsewhere within the Mammoth Cave Historic District. These include commemorative markers and monuments, including rock cairns, signs and plaques, benches, drinking fountains, lantern hangers, a glass display case, survey markers, fencing, and outdated utility and lighting system features. Many of these small-scale features should be considered important artifacts associated with earlier eras in cave touring history that merit protection, preservation, and appropriate repair when condition threatens loss.

- Retain and maintain as possible all contributing small-scale features, including monuments and rock cairns, including the World War I commemorative markers in the Rotunda and the numerous monuments in Gothic Avenue and elsewhere (Figure 276); survey markers; lantern hangers (Figure 277); signs; drinking fountains; benches; hand and guardrails; benches; and utility systems that include historic period lighting and electrical systems and water and sewer systems.

FIGURE 276. A 1935 bronze plaque located near Rapier's Pit.

FIGURE 277. A historic lantern hanger.

- Stabilize and repair small-scale features assessed as being in poor condition.
- Repair historic small-scale features using the protocols established for feature types and materials. *See Implementation Project: Develop preservation, repair, and replacement protocols for historic features.*
- Document, as part of the survey process recommended herein, the locations of all surviving historic small-scale features. Include Walker Survey markers in the survey. Endeavor to tie structures to a particular period of construction by conducting further research and through empirical evaluation.
- Complete more detailed documentation prior to making any changes to historic small-scale features. Include photographs and sketches and information related to dimensions, materials, and construction techniques.
- Replace light fixtures installed at Mammoth Dome in 1949 that utilized florescent fixtures and have led to the growth of lamp flora.
- Retain at least one example of each historic lighting system as an artifact.
- Retain one example of the systems used to attach lighting to the cave walls as an artifact of historic cave uses. Otherwise, remove the cementitious material that was used to anchor lighting on cave walls using the gentlest possible means (Figure 278).

FIGURE 278. Evidence of remnant cementitious material used to anchor an electrical wire that has since been removed.

- Avoid constructing any new small-scale features within the historic district unless absolutely necessary.
- Avoid restoring or reconstructing missing small-scale features.
- Continue the use of lights placed along the walk to highlight relics in places such as Houchins Narrows. Ensure that wires from lights and other utility cables are hidden from view by rock and soil. Replace outdated electrical wiring.
- Replace light fixtures from the 1960s and 1970s that utilize florescent fixtures.
- Consider establishing cave-wide standards for site furnishings that take into consideration historic styles and design characteristics, as well as contemporary functional concerns.

Identify locations where historic styles and standards should be replaced in kind based on significance and integrity assessments. Consider replacing examples of non-historic site furnishings that detract from the significant character of the designed historic landscape. *See Implementation Project: Establish cave site furnishings and signage standards for the historic district.*

- Consider options for providing visitors with lanterns to be used during lantern tours that possess the same feeling, weight, and materials used historically, but with a light source that is powered using electric batteries or LED lights.

Archeological Resources

The entire historic district should be considered an archeological district with various sensitive historic and pre-Contact resources that merit special protection measures.

Appropriate compliance should be conducted prior to implementation of any treatment recommendations that require disturbance such as trail replacement or realignment, and safety structure construction. Subsurface archeological investigations should only be undertaken to address a specific goal or question about the historic landscape.

- Protect all cultural artifacts located within the cave, which include pre-Contact era cave art such as petroglyphs and pictographs (Figure 279), cane reed torches, and torch marks on cave walls and ceiling (Figure 280), twine slippers, textiles and other cordage, gourds and gourd vessels, basketry, climbing poles, and paleofeces or coprolites (Figure 281), as well as nineteenth- and twentieth-century wine bottles and food wrappers, newspapers, lanterns (Figure 282 and Figure 283), boat oars, and other historic features that contribute to the significance of the cave and the numerous examples of historic signatures and graffiti present on the walls, rocks, and ceiling of the cave passages (Figure 284).

FIGURE 279. Petroglyph at Devil's Looking Glass.

FIGURE 280. Snubbing marks along Briggs Avenue.

FIGURE 281. Paleofeces near Sparks Avenue.

FIGURE 282. One of the historic lanterns present within Main Cave.

FIGURE 283. Several artifacts of early tourism are stored near Vanderbilt University Hall.

FIGURE 284. Historic era signatures along Main Cave near Star Chamber.

- Ensure that all archeological investigations are fully documented, and that the findings as well as the artifacts are archived at the park. Utilize information gained through archeological investigations to guide interpretation of the historic landscape and the siting of proposed new park features.

- Develop a list of research questions to be addressed by archeology. The research questions could be addressed by excavations and / or other data-recovery operations completed for cave improvement projects.

- Continue to update the digital map layer showing the extent of archeological materials in the cave.

- Develop a digital map layer showing the locations of archeological investigations.

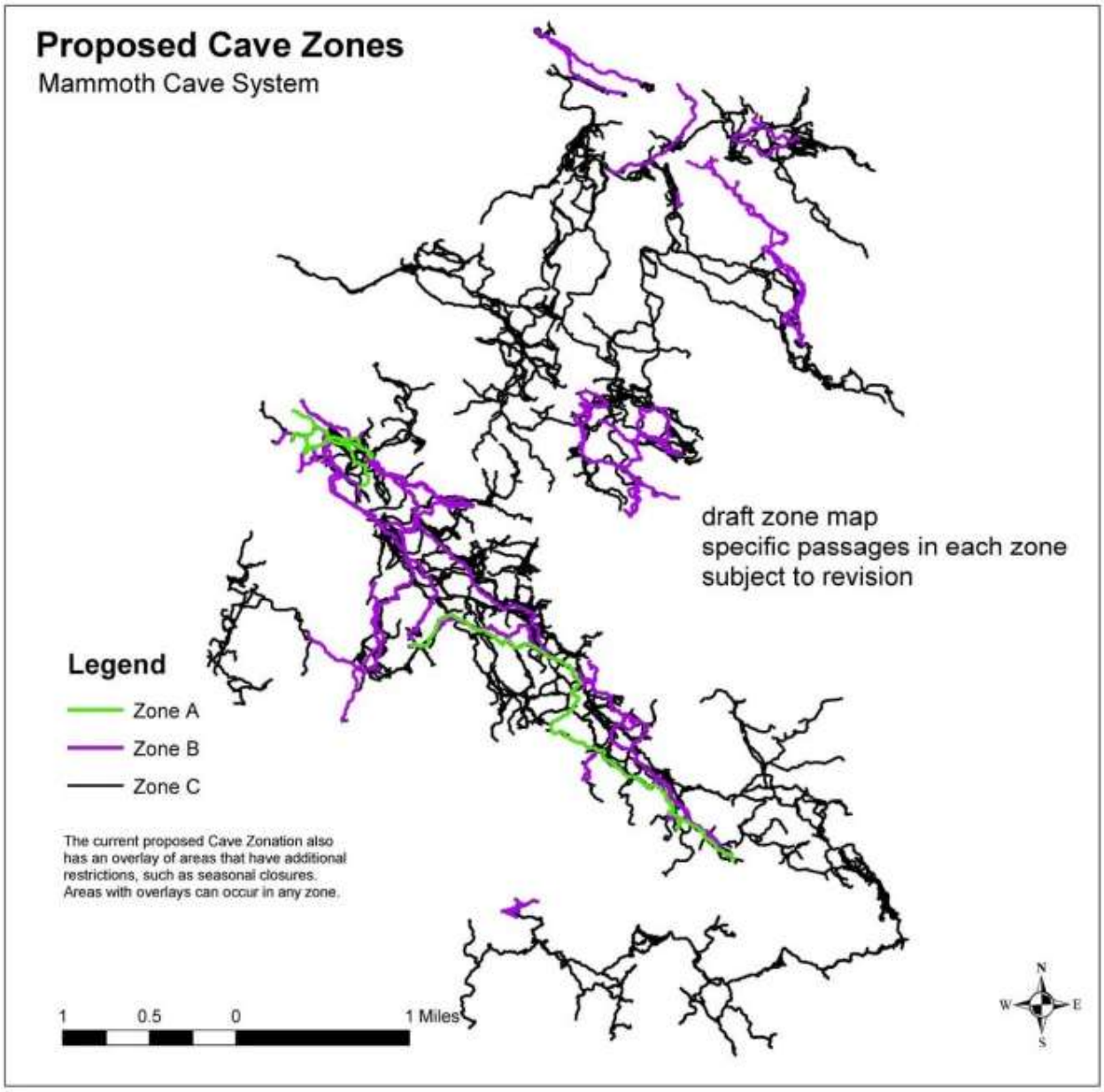

FIGURE 285. Diagram of proposed cave zones. (Source: National Park Service, Cave and Karst Management Plan, figure 5)

Recommendations for Tour Infrastructure

See Figure 285.

Zone A

- Zone A is designated for the most heavily utilized trail passages. Areas within this zone would provide opportunities for visitors with the widest range of experience and physical abilities to explore the cave environs. As such, trails within this zone should have the widest range of material options, to be selected based upon both existing trail conditions and overall cave context.

- **Trails.** Due to heavy pedestrian traffic and use, Zone A trails are recommended to be paved with cast-in-place concrete, concrete pavers, or fiberglass reinforced plastic (FRP) grating, or left as natural cave floor where appropriate, rather than surfaced with cave sediment, which is prone to creating dust that settles on cave walls and floors, and to breakdown when disturbed by large numbers of visitors.

- Maintain concrete trails in a clean condition and free of mud or residue. Establish periods for routine cleaning of paths when tours are not scheduled. Encourage visitors to remove any residue from their shoes prior to entering the cave for tours. *See Implementation Project: Repair and maintain trails to address safety concerns*.

- Avoid disturbing, impacting, or destroying historic cave sediment trails when constructing new concrete or FRP trails wherever possible.

- New trails that follow the alignment of historic routes should be designed as possible to incorporate special treatment strategies that avoid destroying earlier fabric, such as spanning, covering, or paralleling the older route. *See Implementation Project: Repair and maintain trails to address safety concerns.*

- Blend new cast-in-place concrete trails by using integral color designed to blend with the cave setting and existing colored concrete trails. *See Implementation Project: Repair and maintain trails to address safety concerns.*

- Treat the surface of new concrete trails with a broom finish to protect against slip hazards (Figure 286). Consider whether to include thin tooled joints or hand seeded emery placed and tooled into the concrete surface to enhance the non-slip quality of the concrete surface. In areas prone to wetness, consider using FRP grating (Figure 287). *See Implementation Project: Repair and maintain trails to address safety concerns*.

- Limit the use of hexagonal concrete pavers to areas where there is sufficient lighting for visitors to be able to observe the pattern due to the unfamiliar and unnatural patterning of the pavers. Also limit the use of hexagonal pavers to areas where the installation of self-leveling concrete would potentially damage cave resources (Figure 288).

FIGURE 286. Existing concrete trail with broom finish that offers a relatively non-slip surface for heavily used trails.

FIGURE 287. FRP grating used within a narrow passageway near Grand Central Station that affords another type of relatively non-slip surface for busy trails.

FIGURE 288. Hexagonal concrete pavers present a character that is incongruous with the cave's historic passages, and, thus, they should be limited in use to locations where large tour groups gather and the passages are relatively well lit.

- Ensure that the accessible trails present within Zone A follow Architectural Barriers Act Accessibility Standards (ABAAS) in terms of trail width, trail slope and cross-slope, and the composition of the surface. Where accessibility standards cannot be met, determine how to mitigate any deviations. Where slopes exceed 5 percent, there is a drop off to the side of the trail, or other safety concerns are present, accessible trails should be edged by handrails. *See Implementation Project: Repair or replace handrails and guardrails to address safety concerns*.

Lighting

- Path lighting should be provided in association with trails within Zone A. Historically, the use of electric lighting for cave tours has allowed the growth of mosses, fungi, and algae in the cave. Recent replacement of florescent lights and other aspects of the lighting system found to contribute to lamp flora have reduced the problem. Lighting within the cave should follow the most up-to-date guidance on reducing lamp flora such as the use of LED fixtures. and should only be used for the brief time that tours pass through the area. Lighting should otherwise remain off. One of the advantages of LED lighting systems is the relatively simplicity of their operation. The most effective method for protecting the cave's natural environment does not lie in the use of LEDs but by reducing the periods of illumination to a minimum.

- Evaluate lighting to ensure that passage illumination is kept at the minimum level necessary to provide visitors with the ability to find their way and understand the interpretive value of each passage.

Seating

- The more heavily utilized trails of Zone A should include amenities for the comfort of visitors to ensure their safety. Seating is one of the amenities to be considered for appropriate locations within Zone A. Seating in the form of benches and seat walls should be provided periodically along tour routes so that visitors do not become overcome with exhaustion. Benches constructed of wood, stone and wood, concrete, and metal are found in many of the large halls where guides typically stop for longer presentations (Figure 289 through Figure 291). Consideration should be paid to evaluating the need to provide additional benches based on assessment of tour groups by guides. Benches should be installed based on standards prepared for site furnishings and signage within the historic district. *See Implementation Project: Establish cave site furnishings and signage standards for the historic district*.

FIGURE 289. Aluminum benches are a more contemporary introduction to Mammoth Cave. They are used in River Hall to accommodate larger tour groups where longer presentations are made, and where there are high moisture conditions.

FIGURE 290. Older benches within Mammoth Cave include these wooden benches at Fairy Ceiling.

FIGURE 291. Likely Mission 66-era, there are several examples of historic benches with wood or concrete seats set on a stone-faced concrete base, such as these benches outside the Snowball Room Restrooms.

- Retain and maintain wherever possible, benches that date from the period of significance. If adjustments are required due to age and wear, consideration should first be given to modifying existing benches before replacement, such as adding a new seat to an existing stone wall base or replacing a deteriorated wooden base in-kind.

- Where repair or replacement in kind is not possible, for example original materials are not sustainable or available, or replacing the original feature in kind is damaging to the environment, new features, such as benches, should be a product of their own time. Composite wood may be considered in place of natural wood in contemporary replacements, while stainless-steel fasteners that resist corrosion may also be used after being treated with a coating that reduces their reflectivity. Where benches are added along accessible trails, provide accessible benches that include backs.

Large gathering areas

- Zone A allows for the large gatherings in specific locations where appropriate infrastructure can be provided. These locations should be large enough to provide sufficient surface area with the appropriate carrying capacity, but groups should be cautioned to adhere to size limitations that are appropriate for the space. Railings, posts with chains, or swing gates, some of which could be erected temporarily to meet a specific event need, should be considered as a means for containing visitors to the appropriate space, and to protect against falls where there is challenging breakdown present, or drops and pits.

Lint guards

- Where large groups regularly traverse historic cave passages, lint guards should be used along trail margins to collect the particles that enter the cave on the clothes and shoes of visitors. Current lint guards in use measure between 8 and 24 inches in height. These features have been found to capture a large percentage of the lint entering the cave but do not impede visitor enjoyment. The lint guards offer a secondary benefit of encouraging visitors to remain on the trail and limits access to sensitive cave resources. The design of lint guards should be continually evaluated to ensure that they successfully blend with and do not detract from the historic setting. For example, lint guards should be consistent in color with adjacent paving to limit their visual impact. The lint collected by the lint guards should be regularly removed using air vacuum filter systems that are effective in removing airborne particles such as HEPA (high-efficiency particulate air).

- Adopt a minimal palette of materials for use in constructing improvements to accommodate visitors within Zone A. Ensure consistency, and consider using the most muted and compatible, materials and colors possible to help contemporary interventions fade from view and allow the cave passages to remain prominent. Avoid drawing attention to new interventions by sight or by texture (Figure 292).

- Ensure that transitions between trail surfacing materials are smooth to avoid creating trip hazards.

FIGURE 292. An example of where multiple surface materials and colors abut one another, resulting in visual distractions from the natural cave environment.

FIGURE 293. Cave-sediment surfaced trails are prevalent throughout the Mammoth Cave Historic District. These were constructed by the CCC and constitute a historic resource. However, heavy visitor use is leading to the dislodging of particles that rise in the air and coat cave walls and floors, and to breakdown.

Zone B

- Limit the addition of new infrastructure to that which is necessary to safely accommodate visitors within Zone B, which is intended to provide a less formal and more primitive cave experience than Zone A. For example, new infrastructure may be provided to allow visitors to pass above standing water, mud, and silt, and/or to rehabilitate features such as the River Styx catwalk/boardwalk that was once part of the historic, All-Day Route.

Trails

- Manage trails in Zone B to allow for the retention of historic cave sediment-surfaced routes as possible, taking into consideration how well dust can be controlled. Consider options for hardening the cave sediment trails. Monitor the impact of visitor use on cave sediment trails to determine the need to replace the surface in specific areas experiencing dust problems (Figure 293). *See Implementation Projects: Develop preservation, repair, and replacement protocols for historic features.*

- Maintain existing trails clear of breakdown, mud, and rock. *See Implementation Project: Repair and maintain trails to address safety concerns.*

Lighting

- Consider ways to provide a more authentic trail experience by avoiding adding lighting within Zone B passages. Consider the use of head lamps, hand-held LED lanterns, and flashlights for those touring Zone B passages.

Seating

- Some tour and approved educational groups and research activities may be allowed within Zone B. As such, provisions for limited seating may be appropriate. Benches that date from the period of significance should remain in place for historic value and for use by visitors. If adjustments are required due to age and wear, consideration should first be given to replacing materials in kind before replacement is considered.

Lint guards

- Where pedestrian traffic is leading to a problem with lint or dust, consideration should be paid to introducing lint guards. The design of lint guards for trails within Zone B should be compatible with the more primitive conditions. For example, an appropriate treatment might incorporate breakdown stone or boulder edging, potentially in conjunction with a low wooden board, anchored to rock

for stability, at a height of 8 inches above the grade of the trail (Figure 294).

FIGURE 294. An example of breakdown stone that could be utilized to form a lint guard.

Zone C

- Zone C passages are to remain undeveloped with any minimal changes made to ensure clear and safe passage, potentially following deposition of breakdown. Visitors within Zone C passages are anticipated to experience the same conditions that early cave explorers encountered. Zone C passages will be visited far less frequently than Zone A and B passages. Those entering Zone C passages will be advised to wear hardhats and to bring lighting equipment to guide their safe travels. Any infrastructure found within Zone C should be minimal and limited to narrow trails with only slight modifications for resource protection and safety. Handrail and guardrail additions are not recommended, although historic examples of these features should be retained and maintained.

Trails

- Due to limited pedestrian traffic and use, Zone C trails should remain as natural cave floor or cave-sediment surfaced trails only where present. Visitors should be apprised that these cave passages may prove physically demanding and challenging.

Overlay Zone D

- As noted, Overlay Zone D relates to passages where access is restricted to protect sensitive natural and cultural resources. Consideration should be paid to developing a map that indicates passages that periodically or permanently require closure so that this information can be used appropriately. Should visitors be found to entering passages that are closed, the provision of gates or other barriers to entry may need to be considered.

Implementation Projects

To affect the specific recommendations included above the section that follows outlines a series of projects designed to guide implementation of the CLR treatment plan. The projects address implementation of recommendations relating to resource protection, care, and rehabilitation, as well as life safety, visitor accessibility, and interpretation considerations.

The projects are presented in a consistent format in six sections: 1) description; 2) considerations; 3) location; 4) additional studies recommended; 5) related implementation projects; and 6) project implementation process. The information as presented is consistent with that needed to develop Project Management Information System and Facility Management Software System forms utilized by the National Park Service to address funding.

The park can use this information to further develop the projects, generate costs estimates, enter them into PMIS, and submit them for funding requests.

The list of projects indicated below is prioritized based on immediate repair needs, followed by documentation and assessment needs, and projects that are less time sensitive.

1. Develop preservation, repair, and replacement protocols for historic features.

2. Repair or replace hand and guard rails to address safety concerns.

3. Repair and maintain trails to address safety concerns.

4. Clean dust from cave walls and floors.

5. Clean and prevent lamp flora growth.

6. Complete additional cultural landscape survey and research sufficient to document and assess all cave resources.

7. Prepare a National Register Amendment and Expanded Boundary Nomination for Mammoth Cave Historic District.

8. Establish cave site furnishings and signage standards for the historic district.

9. Enhance interpretation.

Develop preservation, repair, and replacement protocols for historic features

Description. Contributing and potentially contributing resources located within the Mammoth Cave Historic District are composed of several types of materials, each of which is impacted in a distinct way by the environmental conditions in the cave. Historic features include painted steel ladders, stairs, and pipe metal handrails and guardrails; chain-link fencing; aluminum handrails and guardrails; tin and steel monuments; bronze plaques and survey markers; masonry commemorative markers; stone walls and rock cairns; concrete walls, benches, and drinking fountains; wood bridges and benches; and bathroom tiles and porcelain fixtures. Each of these feature and material types requires specific maintenance to assure protection and preservation from damage and deterioration. Stewardship of historic signatures, etchings, and pre-Contact era petroglyphs is also needed. A guide related to the specific protocols should be developed to assist in appropriate stewardship of these historic resources.

The contributing or non-contributing status of some resources—such as many of the handrails, guardrails, ladders, and light fixtures—cannot be determined for purposes of this study because sufficient information is not available to identify dates of origin that would place these resources within the period of significance. For this reason, the CLR has recommended a cultural resource survey, which will assist in identifying dates of resources and features surviving from various eras of cave development. Further complicating the assessment of resources such as handrails and guardrails is that this type of feature is sometimes intended to be temporary, with future replacement planned. For each of the types of resources of undetermined contributing or non-contributing status, and pending development of further information about dates of origin, representative examples of the different styles and eras present should be retained and treated as cultural resources.

Considerations. The specific preservation needs and considerations for each of the historic feature and material types are indicated below in support of the development of the recommended maintenance and preservation protocols.

- **Painted steel ladders, stairs, and pipe metal handrails and guardrails.** Assess the condition of existing painted steel ladders, stairs, and pipe metal handrails and guardrails, as well as prefabricated metal catwalks and stairs present in several locations. Determine requirements for repair (if any; see also next Implementation Plan, below) and recoating. Consider recoating the existing railings that are in good condition but where existing coatings are deteriorated; take into consideration environmental issues in determining materials and methods for preparation of steel surfaces and application of coatings. (Components to replace severely deteriorated portions of railings, and any new railings installed, should be shop-coated to match existing historic railings.) Utilize a color palette that is consistent with the existing surfaces within the cave such as a warm grey.

- **Aluminum handrails and guardrails.** **Aluminum** handrails that appear to have been used within the cave during the 1950s and 1960s and are in deteriorated condition. Assess aluminum handrails and guardrails and determine the need for replacement/repair of handrail elements. Where severely deteriorated, replace elements with new pieces to match. Apply a coating to protect the aluminum; consideration can be given to a clear coat to retain the original color/appearance. Take into consideration environmental issues in determining materials and methods for preparation of surfaces and application of coatings.

- **Chain-link fencing.** Chain-link fencing **along** River Styx was installed in the 1950s and is damaged or deteriorated in localized areas. Assess chain-link fencing to identify needed repairs. Where severely deteriorated, replace

chain-link fencing with new fencing components to match original.

FIGURE 295. Aluminum handrails in use since the 1950s and 1960s are in a deteriorated condition.

FIGURE 296. Chain-link fencing installed in the 1950s along River Styx.

- **Tin and steel monuments.** Survey and document all tin and steel monuments with notes and photographs. Conduct archival research to identify archival photographs and other documentation of original materials and finishes. Assess and document current conditions as a baseline for monitoring future conditions and to determine needed repair and conservation measures. Implement repair and conservation measures using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration. Depending on existing conditions observed, consider application of surface finishes to protect existing materials against corrosion.

- **Bronze plaques and survey markers.** Survey and document all bronze plaques and survey markers with notes and photographs. Conduct archival research to identify archival photographs and other documentation of original materials and finishes. Assess and document current conditions as a baseline for monitoring future conditions, and to determine needed repair and conservation measures. Implement repair and conservation measures using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration. Depending on existing conditions and original finishes, consider application of microcrystalline wax to protect exposed bronze surfaces.

- **Masonry commemorative markers.** Survey and document all masonry commemorative markers with notes and photographs. Conduct archival research to identify archival photographs and other documentation. Assess and document current conditions as a baseline for monitoring future conditions, and to determine needed repair and conservation measures. Implement repair and conservation measures using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration. For example, repairs may include stabilization if markers have shifted or are unstable and pointing of open and deteriorated joints with compatible mortars.

- **Stone walls and rock cairns.** Survey and document all stone walls and rock cairns with notes and photographs. Conduct archival research to identify archival photographs and other documentation. Assess and document current conditions as a baseline for monitoring future conditions, and to determine needed repair and conservation measures. Implement repair and conservation measures using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration. For example, repairs may include stabilization if walls and cairns if stone units have shifted or are unstable; rebuilding of portions of walls or cairns using original

stone/rock (if archival documentation exists to confirm original construction) and pointing of open and deteriorated joints with compatible mortars.

- **Concrete walls, benches, and drinking fountains.** Assess and document current conditions as a baseline for monitoring future conditions and to determine needed repair measures. Conduct archival research to identify photographs and other documentation of original construction. Implement repairs using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration. For example, if repairs are required at concrete spalls, these should consist of formed concrete patches using a mix design matching the original concrete.

- **Wood bridges and benches.** Assess and document current conditions as a baseline for monitoring future conditions and to determine needed repair measures. Conduct archival research to identify photographs and other documentation of original construction. Implement repairs using best practices, including use of compatible materials, with minimal intervention needed to address conditions of deterioration.

- **Bathroom tiles and porcelain fixtures.** Assess the condition of bathroom tiles and porcelain fixtures to identify any required repair and maintenance needs, such as cracked or displaced tiles, or open joints. Repair using best practices for these materials. Where new materials matching the original cannot be identified, select materials that are similar to and compatible with the original and that are visually non-intrusive. Follow the Secretary of the Interior's Standards for Rehabilitation and guidance afforded by NPS preservation briefs for selection of substitute materials.[441]

Location. This implementation project addresses historic cultural features located throughout the historic district.

Additional Studies Recommended. Should preservation actions have the potential to result in sub-cave-floor disturbances or disturbances to artifact deposits, they should be preceded by archaeological investigation.

Related Implementation Projects

- Repair or replace handrails and guardrails to address safety concerns.

Project Implementation Process

1. Assess the condition of all steel ladders, stairs, and handrails and guardrails for repair (see also next Implementation Plan, below) and recoating. Consider recoating the existing railings that are in good condition but where existing coatings are deteriorated; take into consideration environmental issues in determining materials and methods for preparation of surfaces and application of coatings.

2. Assess the condition of all aluminum handrails and guardrails. Where severely deteriorated, replace elements with new pieces to match. Consider applying a coating to protect the aluminum.

3. Assess chain-link fencing to identify needed repairs. Where severely deteriorated, replace

441. The Secretary of the Interior's Standards for Rehabilitation, available at ttps://www.nps.gov/tps/standards/rehabilitation/rehab/stand.htm, accessed March 2021; Sharon C. Park, AIA, *Preservation Brief 16, The Use of Substitute Materials on Historic Building Exteriors*, https://www.nps.gov/tps/how-to-preserve/briefs/16-substitute-materials.htm#:~:text=It%20is%20also%20possible%20to,undertake%20this%20work%20are%20available, accessed March 2021. Although the preservation brief primarily addressed exterior materials, guidance provided is also relevant to interior materials such as tile.

chain-link fencing with new fencing components to match original.

4. Work with a historical architect to identify replacement elements and to determine appropriate preparation and coating methods for historic steel and aluminum elements.

5. Work with a historical architect/conservator to assess conditions of tin and steel monuments, bronze plaques and survey markers, and masonry commemorative markers, and stone walls and rock cairns, and to determine appropriate repair and conservation measures.

6. Work with a historical architect to determine appropriate repairs for concrete walls, benches, and drinking fountains; wood bridges and benches; and bathroom tiles and porcelain fixtures.

7. In designing and implementing repair, conservation, and selective replacement measures, seek opportunities to protect and improve the environment within the cave. Follow science in decision-making process to design and implement work. Balance preservation of historic features (entrances, access to passages) with protection of natural resources.

8. Implement all repair, conservation, and selective replacement measures following best practices and in accordance with preservation and conservation standards.

9. Document all components to be replaced before removal.

10. Assess whether the repair and conservation work have the potential to affect archeological resources and conduct archeological investigation, if necessary.

Repair or replace handrails and guardrails to address safety concerns

Description. Handrails and guardrails are important safety features to protect visitors from becoming injured while experiencing Mammoth Cave. Historic drawings and photographs indicate that wooden railings were used along the edges of pits and drop offs and along stairs to protect visitors. During the 1930s, it appears that pipe metal railings began to be added. Aluminum railings are also present within the historic district that may date to the 1950s and the Mission 66 era. Later additions and replacements that postdate the period of significance are typically galvanized and stainless-steel railings that sometimes include steel mesh for added protection. Historic handrails and guardrails typically do not meet contemporary safety codes. In many cases, they are also damaged or exhibit deterioration in the form of rust or pitting. Historic handrails and guardrails that are in fair to good condition, and which are determined to be contributing resources, should be repaired and maintained (see the implementation project above). Where handrails and guardrails within Zone A passages are in poor condition and are needed for safety and the protection of visitors, consideration should be paid to replacing them with features consistent with the Grand Avenue trail improvements.

Considerations. The determination to replace examples of historic handrails and guardrails should be based on careful evaluation of visitor safety and the risk posed that an existing railing might fail or is not sufficient to protect visitors. As noted earlier, replacement of historic handrails and guardrails should potentially occur in such a way as to leave the historic feature in place as an artifact of earlier cave treatment. Representative examples of the different styles of railings and eras present should be retained and treated as cultural resources. The decision regarding which representative examples are suitable to be maintained might be supported by the cultural resource survey recommended in the CLR, which is anticipated to identify the features surviving from various eras of cave development.

Handrails

Handrails are utilized at Mammoth Cave to both aid visitors along cave passageways and limit visitors from straying from designated routes. Metal handrails, typically aluminum or stainless steel, comprised of a single tube horizontal rail with regularly spaced steel posts are the most common type of railings at Mammoth Cave.

Throughout the cave, there are several examples of rusted, bent or misshapen railings (refer to Figure 295) that likely date to the period of significance. There are also many examples of handrails that do not meet safety codes (Figure 297).

FIGURE 297. Example of an aluminum handrail that does not meet current codes related to extensions.

Passages within Zone A that have been improved since the 1990s include the addition of stainless-steel handrails, which has introduced a new vocabulary of design elements. The shiny character of the stainless-steel features, such as the handrail along Sparks Avenue and guardrail at Bottomless Pit, is not always compatible with the character of the historic district that historically featured the matte finish of aluminum railings and painted pipe metal. At the same time, the stainless steel is corrosion resistant, an important consideration.

Consideration should be paid in the future to using stainless steel with a blast finish. Bead or shot blasted stainless-steel finishes produce a uniform matte surface with low reflectivity that would be more compatible with the historic character of Mammoth Cave. Stainless steel is recommended for its corrosion resistance.

Finishes should incorporate a color palette that is consistent with the existing surfaces within the cave, such as a warm grey.

The design of new railings should follow the form and pattern of historic rails, utilizing 1.5-inch tubular steel for both the horizontal rails and vertical posts (Figure 298). Consideration could be given to adding a horizontal mid-rail to maintain the rigidity of the handrail system. Concrete footers used to anchor railing posts should be the minimum depth and width necessary to avoid undue damage to the cave. All efforts should be taken to avoid drilling into cave walls to anchor railings. Examples of this approach used historically remain present in the cave and should be avoided in the future (Figure 299).

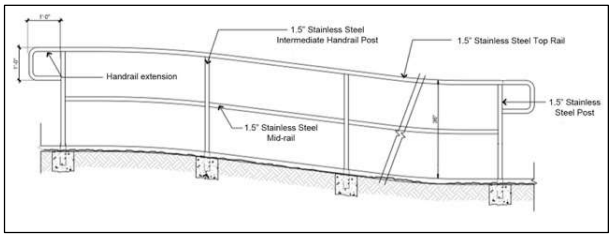

FIGURE 298. Handrail detail (source: VHB, with notations added by LSHLA)

FIGURE 299. Example of an aluminum handrail drilled into the cave wall.

Where handrails are replaced, consideration should be made to keeping historic components that date from the period of significance in place. If maintaining them *in situ* is not feasible, they should be carefully removed by severing the uprights at the base to avoid ground disturbance. All features slated for removal should be carefully documented ahead of time.

New railings should be designed to meet all applicable codes and should be reviewed and approved by a structural engineer.

Guardrails

Guardrails are like handrails in the way they are used to protect visitors at the edges of steep drops in elevation or pit margins. This practice has not been used comprehensively throughout Zone A passages, however, and there remain places where steep drops exist that are marked by handrails (Figure 300), or not marked at all. Consideration should be paid to improving safety conditions in the most heavily visited portions of Zone A passages.

FIGURE 300. A historic trail route near Frozen Niagara where there are limited safety precautions to protect visitors from a steep drop.

Appropriate guardrail treatments for future use in Zone A passages might include stainless steel panels with an interior steel mesh, as is already being used at various locations (Figure 301) but given a blast finish. Bead or shot blasted stainless-steel finishes produce a uniform matte surface with low reflectivity that would be more compatible with the historic character of the cave than shiny stainless steel.

FIGURE 301. Example of a stainless-steel guardrail with steel mesh panel inserts at the base of Mammoth Dome.

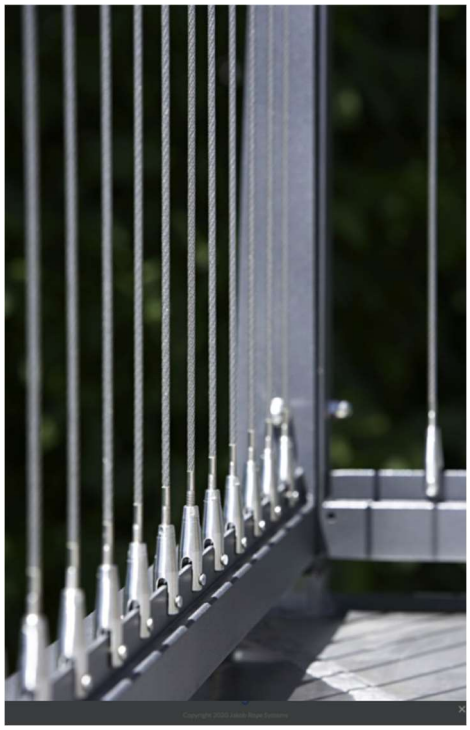

FIGURE 302. Example of a vertical cable rail system (source: Jakob Rope Systems: https://www.jakob-usa.com/cable-railing-system/)

Another option would be guardrails fashioned using stainless-steel top rails and posts inset with vertical steel cables (Figure 302). The thin cables and their relatively wide spacing would allow for more visual transparency and enhance views of cave features, particularly for younger or smaller visitors who are not tall enough to view over a top rail. An additional benefit of using steel cables is that they could be connected to railings that are angled along sloping surfaces, unlike mesh panels that require a flat and level surface. Similar systems could also be utilized as resource protection where applicable.

Regardless of the guardrail option selected, guardrails should follow the form and pattern of historic rails, utilizing 1.5-inch tubular steel for both the horizontal rails and vertical posts. Concrete footers that are required to anchor posts should be the minimum depth and width necessary to avoid undue damage to the cave. Every effort should be taken to avoid drilling into cave walls to anchor railings. Stainless steel is, again, recommended to have a blast finish to achieve a matte appearance. All railings should be designed to meet all applicable codes and should be reviewed and approved by a structural engineer.

Location. This implementation project applies to all handrails and guardrails located within Zone A passages.

Additional Studies Recommended. Each handrail and guardrail considered for replacement should be carefully studied and documented prior to decision making. Should replacement actions have the potential to result in sub-cave-floor disturbances, or disturbances to artifact deposits, they should be preceded by archaeological investigation.

Related Implementation Projects

- Develop preservation, repair, and replacement protocols for historic features
- Repair and maintain trails to address safety concerns

Project Implementation Process

1. Document and evaluate all handrails and guardrails for repair and replacement needs.
2. Follow the protocols for repair where needed.
3. Evaluate the need for safety improvements.

4. Consider the options presented herein for replacing handrails and guardrails and their viability for areas in critical need.

5. Work with a historical landscape architect and structural engineer to design and install new handrail and guardrail improvements.

6. Document existing handrails and guardrails slated for replacement before removal.

7. Assess whether the replacement has the potential to affect archeological resources and conduct archeological investigation, if necessary.

8. Install new handrails and guardrails.

Repair and maintain trails to address safety concerns

Description. Some trail segments located within Zone A may be unsafe due to the presence of trip hazards, slick surfaces, gaps between different surfaces, and other conditions. Concrete surfaced trails are typically in better condition than cave sediment-surfaced trails, regardless of their age. Within Zone A, it is important that heavily visited trails be regularly maintained and repaired to ensure the safety of visitors. The trail surface, associated handrails and guardrails, and steps and stairs are important to evaluate in terms of condition and the presence of trip hazards.

Cave sediment-surfaced trails are considered character-defining features of some toured cave passages that contribute to the significance of the historic district. However, the park has already, and is anticipated to continue to, upgrade major toured sections of Mammoth Cave, such as the Historic Tour and Grand Avenue Tour routes, through the installation of concrete surfaces. Concrete is used to protect visitor safety and limit the formation of dust that ends up coating cave walls and features on the cave floor. Cave sediment trail segments will remain in sections of the cave that are toured less frequently. The CLR treatment plan provides strategies for repair and maintenance of these, as well as the more recently installed concrete surfaces.

Considerations. Where trails and stairs are regularly slippery, wet, muddy, or otherwise unsafe, consider resurfacing with concrete with a brush finish (Figure 303), adding a floating emory surface (aluminum oxide sapphire) for slip resistance, or installing FRP surfacing (Figure 304 and Figure 305).

FIGURE 303. Brushed concrete walk near Scotsman's Trap.

FIGURE 304. A passage within Main Cave where FRP surfacing is used to prevent slick, unsafe conditions for visitors.

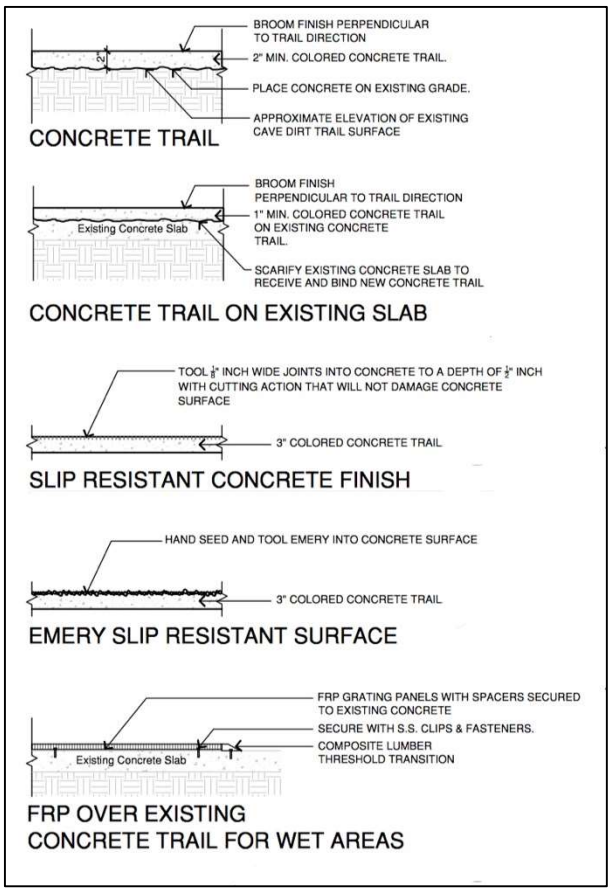

FIGURE 305. Paving details (source: VHB, with notations simplified by LSHLA)

Among the important considerations related to maintaining cave passage trails is to ensure that where surfacing materials change there are no trip hazards due to gaps or differences in the level of the adjacent trail sections (Figure 306). Where different materials meet, one strategy for making the trail passage cohesive is to bevel the edges approximately 1-/4 inch.

FIGURE 306. A trail where a new section of concrete was added and not sufficiently blended to meet the level of the existing surface, creating a potential trip hazard.

For cave sediment-surfaced trail sections, maintenance and repair should entail using a hardening technique that combines sediment with a small amount of Portland cement and water or by utilizing a biodegradable stabilizing agent on the paths (*See Implementation Plan: Clean dust from cave walls, floors, and other surfaces*). Should new treatment options emerge, consideration should be paid to substituting Portland cement with more eco-friendly materials that are less likely to release harmful chemicals into the cave environment and consume less energy in production.

Care should be taken when making repairs to cave sediment-surfaced trails to avoid disturbing the cave soil by cutting into it.

The use of cave sediment deposits to secure soil for trail repair should be avoided except where soil has been stockpiled from cave improvement projects, such as along Grand Avenue.

Any soil that is brought into the cave for repair work should be archeologically sterile.

New the existing cave sediment-surfaced trail does not meet necessary standards for visitor safety, every effort should be made to protect the existing trail when establishing a new trail surface. Consideration should be paid to design strategies that avoid destroying historic fabric, such as spanning, covering, or paralleling the older route (Figure 307).

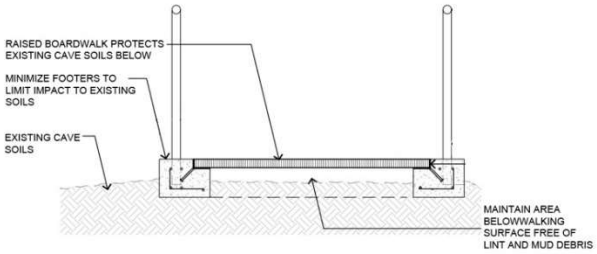

FIGURE 307. Detail of a proposed raised walk used in trail improvements at Grand Avenue. (Source: VHB, with notations by LSHLA)

Modified trails should be tied back into the adjacent existing grade as possible to avoid creating trip hazards.

Maintenance of concrete surfaces will require periodic cleaning to remove dirt or mud and any rock fall/breakdown. Some cleaning methods, such as sweeping, will not be appropriate due to the potential to raise dust that may coat the cave walls and floor. Use of a vacuuming system to remove unwanted dirt may be required. Removal of rock and breakdown should regularly occur to avoid the presence of trip hazards. This material should be moved beyond the trail margins where it will not interfere with cave tours.

To prevent unwanted dirt from being brought into the cave, visitors should pass through debris removal stations before entering the cave. These should be located outside each cave entrance. Removal could occur using a grated material such as stainless steel or FRP over a lower catchment area that visitors use prior to entering the cave to release any mud or debris on their shoes. Tour guides could use the process to educate visitors about the need to maintain the cave interior.

Location. This implementation project applies to passages located within Zone A.

Additional Studies Recommended. The park should continue to research paving options to enhance slip resistance. Should replacement actions have the potential to result in sub-cave-floor disturbances, or disturbances to artifact deposits, they should be preceded by archeological investigation.

Related Implementation Projects

- Develop preservation, repair, and replacement protocols for historic features
- Repair or replace handrails and guardrails to address safety concerns

Project Implementation Process

1. Document and evaluate all trail problem areas.
2. Follow the protocols for repair where needed.
3. Evaluate the need for safety improvements.
4. Consider adding concrete or other types of slip resistant paving where repair efforts have not been successful.
5. Work with a historical landscape architect to design new paving and related safety improvements.
6. Document existing trail conditions before any changes are made.
7. Assess whether the replacement has the potential to affect archeological resources and conduct archeological investigation, if necessary.
8. Install new paving and other safety improvements.

Clean dust from cave walls, floors, and other surfaces

Description. The large number of visitors to Mammoth Cave has led to an issue with dust and lint accumulation on cave walls, floors, breakdown, and artifact deposits. Where historic cave sediment trails built by the CCC are now used by large tour groups, dust particles are dislodged and raised into the air. They then fall or settle on the cave walls and breakdown on the cave floor, altering the character of the passages and obscuring views of geological formations, signatures, and artifact deposits. Lint is also introduced by visitors on shoes and clothing that can also migrate to the interior surfaces of the cave. Dust and lint now obscure many cave surfaces and cultural resources (Figure 308). The dust and lint on artifacts can contain microorganisms or retain moisture—both of which could be catalysts for mechanisms through which artifacts deteriorate. Strategies for reducing dust and lint accumulation and cleaning existing dust from cave interior surfaces are needed.

FIGURE 308. Dust along the trail and coating the breakdown in Main Cave.

Considerations. Since the 2010s, lint guards composed of composite plastic have been added along some of the primary tour trails to protect the cave resources, while cave sediment surfaces have been replaced with concrete. In areas like parts of Upper Historic and Frozen Niagara, cave trail resurfacing has reduced the amount of dust and lint migrating off the trails, but dust continues to be a problem in other passages surfaced with cave sediment (Figure 309). At the same time, the cave sediment trail surfacing is a character-defining feature of the Mammoth Cave Historic District. To address the problem, the park has embarked on a test cleaning effort to determine the best method for removing dust deposits without causing harm to cave resources.

Addressing the ongoing problem of dust and lint can be tackled from a few different angles. Minimizing the amount of loose surfacing and abrasive materials within the cave are two of the most successful strategies to limit dust and lint. Installing catchments and lint guards for dust and lint are also affective. Periodic lint camps where volunteers are engaged in cleaning the lint and dust within the cave has also proven useful at caves throughout the country.[442] Lastly, an educational campaign to make visitors aware of the damage caused by the kicking up of dust, and visitors' role in limiting its ability to travel, may also prove helpful in abating the impact of dust and lint accumulation within the cave.

FIGURE 309. Dust collected along the sides of cave passages near the Wooden Bowl Room.

Consideration should also be paid to the fact that dust can be generated during trail construction activities. Efforts should be made to minimize the uplift of dust during all construction activities that occur within the cave as well as at or near the entrances to the cave. Tarps or other types of

442. Rona Marech, "Fighting Fluff," in *National Parks Conservation Association*, Fall 2014, accessed August 4, 2020, https://www.npca.org/articles/950-fighting-fluff.

shields should be used within the construction area to contain dust associated with construction projects.

Minimize loose surfacing

To ensure that the ground visitors walk upon is not able to be scuffed and unsettled by foot traffic, the surface of well-traveled paths needs to be comprised of a stable and hardened material in most cases. Examples of existing hardened cave surfaces include concrete and hexagonal pavers. Historic cave-sediment-based trails developed by the CCC, however, are comprised of clay and silt and are prone to becoming airborne when visitors trample upon them, particularly when they are dry. Traditionally, the CCC maintained the cave sediment surfaces using salt, which is not appropriate for introduction into the cave and its role in regional ecology.

A potential strategy for maintaining the use of the cave-sediment-based trails is by utilizing a biodegradable stabilizing agent on the paths. Products such as powdered Soiltac may be considered as both a dust control agent and a soil stabilizer. Powdered Soiltac and similar products utilize a polymer to form bonds between the soil and aggregate particles. The result is a flexible-solid mass that is marketed as durable and water resistant. When used and applied properly, the material is not known to present any ecological problems, and "based on EPA guidelines, is classified as practically non-toxic to all species."[443] The product may either be distributed as a powder, followed by adding water to the application area, or can be pre-diluted with water prior to application. Because the product may be distributed as a powder, it offers the benefit of being lighter to transport into areas deeper within the cave. Test patches and mock-ups prior to full-scale implementation are essential to ensuring effective dust abatement as well as confirming there are no harmful effects to the cave ecosystem.

Remove abrasive materials

Lint accumulates most often at rest areas within the cave, particularly where visitors sit down. Longer times spent at sit-down locations and the nature of clothes rubbing against benches produces more lint (Figure 310).[444] As such, the surface of new benches and other seating within the cave should be as smooth and non-abrasive as possible to limit friction that may cause clothing to shed.

FIGURE 310. Benches at Chief City are made of wood which may tend to splinter or snag clothing.

Provide catchments for dust and lint at cave entrances

Lint fibers can get caught in shoes and are often tracked throughout tour routes. In addition to hardening the sediment-based trails in areas of high traffic, the placement of raised platforms that have a lower catchment area where lint and dust can be collected, such as FRP over concrete, may add another layer of protection.

Grated surfaces (Figure 311) with underlying tarps, particularly near the entrances to the cave, may prove successful at trapping lint before it is brought deeper into the cave environment. Traps should be designed to be easily removed and washed consistently. The grated surfaces must also be periodically cleaned because the gaps can become clogged with lint and other debris.

443. Soilworks Soiltac Safety Data Sheet.

444. Rodney D. Horrocks and Marc Ohms, "Cave Lint and Dust Removal Projects," in *Cave Conservation and Restoration*, ed. Jim C. Werker and Val Hildreth-Werker (Tampa: University of South Florida, 2006), 353.

FIGURE 311. An FRP grate with a lint guard located within Historic Upper Cave.

Install Lint Guards

In areas that are prone to high traffic, continue to utilize lint guards (Figure 312) to protect the cave from fibers and materials carried into the cave by visitors.

FIGURE 312. The use of a lint guard at the Rotunda.

Trails with lint guards 8 to 24 inches in height along their edges can capture a large percentage of lint brought in by visitors on their clothes and shoes (refer to Figure 312). Rough-surfaced curbs have been shown to catch lint better than smooth ones.[445] Where curbs are utilized, lint should regularly be cleaned from the edges.

Continue lint camps

Many individuals who have visited Mammoth Cave in large tour groups may be interested in opportunities to engage more fully in the cave environment with a smaller group of people. Engaging volunteers or providing camps for young people who are interested in clearing the caves of lint and dust could allow participants to experience the cave on a more intimate level. The experience would provide an enriching experience for them while also extending the reach of park management. The park is currently conducting such "lint camps," which are recommended to continue.

Cleaning camps would focus on appropriate training. The park would provide all necessary safety and specialty equipment such as UV black lights or head lamps to help participants spot lint and dust. Tools for removing lint might range from a polyester-bristled paintbrush which creates static electricity to attract lint, to tweezers and foam-cell brushes.[446] Small vacuums with HEPA filters or ultrasonic devices may also be appropriate for use by trained individuals. Lint and dust on artifact deposits is particularly problematic; items in the deposits have low mass and could easily be displaced during cleaning. They also have irregular surfaces to which dust and lint may stubbornly adhere. Artifacts that are already displaced could provide an opportunity for testing dust and lint removal techniques. However, even artifacts that have been moved may still have integrity and plans that involve any activity that includes interaction with, or otherwise may affect, archeological resources should be reviewed by an archeologist prior to implementation. Techniques for removing lint and dust may vary with the surfaces being cleaned.

Before work is begun, photographs of the areas to be cleaned would be taken. The work would be documented including the cleaning methods used and the date the work was undertaken. Evaluation of the efficacy of the methods used would be used to update the strategies employed as appropriate.

445. Horrocks and Ohms citing Jablonsky "Lint in Caves," in *Proceedings of the 1993 National Cave Management Symposium*: Carlsbad, New Mexico, October 27- 3D, 1993. (Huntsville (AL): National Cave Management Symposium Steering Committee, 1995); and Horrocks and Ohms, "Cave Lint and Dust Removal Projects," 354.
446. Horrocks and Ohms, "Cave Lint and Dust Removal Projects," 357-358.

Educate visitors to tread lightly

Efforts to limit the amount of lint and dust within the cave system should be initiated before visitors enter the cave. Creative means of communicating with visitors about the problems associated with dust and lint should be employed (Figure 313) to engage visitors to help protect the cave.

FIGURE 313. Example of a creative signage that could be located on the ground surface at entrances to help deter dust collection in the caves.

Cleaning stations should be provided at each cave entrance to encourage visitors to wash their shoes prior to entering.

Location. This implementation project applies to cave entrance and Zone A passages.

Additional Studies Recommended. The park should continue to research appropriate cleaning materials and methods for dust removal that will not cause damage to the cave's natural and cultural resources.

Related Implementation Projects

- Develop preservation, repair, and replacement protocols for historic features

Project Implementation Process

1. Document and evaluate all dust problem areas.
2. Follow the protocols for cleaning where needed.
3. Implement dust and lint reduction strategies at cave entrances, in construction areas, and in association with cave sediment surfaced trails used for tours.

Clean and prevent lamp flora growth

Description. There are several examples of places within Mammoth Cave where the current and historic use of electrical lighting has encouraged the growth of algae, moss, and other lamp flora on passage walls. The potential introduction of additional lamp flora should be discouraged while existing examples should be cleaned from the cave walls.

Considerations. Throughout the toured areas of Mammoth Cave, electric lighting has been used to enhance the visitor experience since its introduction during the early twentieth century. Electrical lighting has led to the unnatural growth of algae and other lamp flora in some areas (Figure 314). Lamp flora is both unsightly and unnatural looking and can cause degradation of bedrock and speleothems.[447] Additionally, the flora may emit gasses that do not naturally occur in the cave, destabilizing the environment that preserves its natural and cultural resources.

FIGURE 314. Example of algae caused by electrical lighting within the cave.

As documented in the 2019 Cave and Karst Management Plan, removal of lamp flora should be undertaken using water, spray bottles, and brushes. Chemical removal of algae using a combination of diluted bleach or hydrogen peroxide solutions may also be considered where less caustic techniques are not successful, and where this application will not damage other features. UV-C sterilization or the application of heat may also be appropriate to interfere with algae growth and reproduction.[448]

Lighting

Since 2017, the park has worked to replace many of the electrical full spectrum lighting fixtures and bulbs to reduce the growth of lamp flora (Figure 315). The 2019 Cave and Karst Management Plan proposes that this upgrade of lighting systems continue and that LEDs lights be used for this purpose.

FIGURE 315. Full spectrum lights of the type that is being replaced within Mammoth Cave (Horton H. Hobbs III, Rickard A. Olson, Elizabeth G. Winkler, and David C. Culver, eds., *Mammoth Cave: Human and Natural History*)

Use of LEDs for lighting should be coupled with a reduction in the amount of time lighting is used within the cave. Lighting should be switched on only during periods where tour groups are passing through specific cave passages and should otherwise be left off. Narrower and tighter passages can likely be interpreted and explore by visitors using less intense lighting than the large open passages that need more intense light to fill the space.

In various locations within Zone A passages, lighting conduit is exposed to view (Figure 316).

447. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 47.

448. National Park Service, *Cave and Karst Management Plan / Environmental Assessment Mammoth Cave National Park, Kentucky* (July 2019), 80-81

Every effort should be made to conceal conduit using boulders or chases designed into new paving systems. Alternately, consideration should be paid to replacing black conduit with a light grey conduit to help it blend into the natural setting.

FIGURE 316. Electrical conduit exposed near Side Saddle Pit.

Location. This project would encompass passages within Zone A that are currently lit or proposed to be lighted.

Additional Studies Recommended. The park should continue to research lighting technology that limits lamp flora growth within cave environments.

Related Implementation Projects

- Develop preservation, repair, and replacement protocols for historic features

Project Implementation Process

1. Document and evaluate all examples of lamp flora within the historic district.

2. Follow the protocols for cleaning where needed.

3. Implement improved lighting technology to limit the future growth of lamp flora and continue to conceal lighting conduit.

Complete a survey of cave cultural resources and related research to determine dates/periods of origin of the resources

Description. The CLR expanded on the documentation of cultural features located within Mammoth Cave but does not comprise a comprehensive inventory and survey due to limitations in scope and budget. The CLR does, however, identify the passages that merit further consideration for inclusion in an Expanded Boundary nomination for the Mammoth Cave Historic District. A comprehensive inventory and survey of cultural landscape resources (including historic-period archeological resources) would support many uses, including preparation of an updated nomination as well as the park's Section 106 and 110 responsibilities. The maps prepared by CRF would provide a useful tool for recording the locations of inventoried resources.

The survey would include both field investigations and documentation, as well as further research and assessment using consideration of construction methods, materials, and forms to help guide an understanding of the date or period of origin of many features. Research conducted on behalf of the CLR did not yield specific records related to the construction or installation of numerous features believed to have been added to the cave during and after the period of significance. Further research may yield insights into construction projects and help determine the origin of some of these features. Others may come to be recognized as a product of a particular period, such as Mission 66 through the efforts conducted to complete the survey.

Considerations. As noted, this project would entail both field investigations, documentation, and research.

Location. This project would encompass the proposed expanded historic district.

Additional Studies Recommended. Further research may be required not only into CCC and Mission 66 projects conducted within Mammoth Cave but also into later construction efforts to help date all existing cultural landscape resources.

Related Implementation Projects

- None

Project Implementation Process

1. Assemble up-to-date versions of all CRF maps of Mammoth Cave.

2. Design field investigations to collect photographic, dimensional, and materials-related information within the cave passages.

3. Establish typologies of trails, walls, stairs, bridges and causeways, fencing, signage, benches, drinking fountains, historic-period archeological resources, and other features located within the cave to be assessed and researched further.

4. Complete the survey and assessment.

5. Identify specific cultural resource studies for effective management of the cave, including cave cultural resource GIS database framework development, underwater archeological survey/remote sensing, historic structure report/study for dry laid rock structures and walls, component landscape studies to identify resources that should be categorized/prioritized under the scope of collections document.

Prepare a National Register of Historic Places Amendment and Expanded Boundary Nomination for Mammoth Cave Historic District

Description. This project entails preparation of a National Register Additional Documentation and Boundary Expansion for the Mammoth Cave Historic District. Since the historic district was listed in 1991, further research has been conducted into the history of the cave suggesting that consideration be paid to expanding the area of the cave encompassed by the district. The 1991 National Register nomination did not determine the historic district to be significant under Criterion D, in the area of Archeology (Prehistoric), specifically noting that prehistoric resources within the cave were outside the scope of the nomination.[449] Research conducted for this CLR suggests that the historic district is significant under this criterion, in the area of Archeology (Prehistoric). The CLR recommends that pre-Contact archeological resources be addressed in an amendment to the existing National Register nomination for Mammoth Cave Historic District.

In addition, Mission 66 resources, which had not reached the 50-year age consideration at the time the current nomination was prepared, are now considered historic, and their eligibility for listing assessed due to a Multiple Property Documentation Form prepared in 2015 for "National Park Service Mission 66 Era Resources." Preparation of an updated nomination will help the park meet their Section 106 and 110 responsibilities. The area to be considered for an expanded Mammoth Cave Historic District is commensurate with the CLR study area as defined in chapter one.

Considerations. The CLR recommends that a formal survey be conducted prior to the development of the nomination to inventory all the pre-Contact-period cultural resources in the cave. This may include a combination of document-based research for areas where the extent of the resources is relatively well-understood, and fieldwork in passages that are less-well-documented. Since it is infeasible to record each artifact, the survey should focus on defining the locations of archeological deposits. The extent of these features will define the extent of the district. Ongoing discoveries of new deposits and cave chambers will likely necessitate updates to the nomination. The CRF mapping of the cave passages will provide an important baseline for developing the survey.

In addition, the 1991 National Register nomination lists several buildings and structures as contributing features of the Mammoth Cave Historic District. Section 106 compliance coordination between the park and the Kentucky State Historic Preservation Office related to proposed trail improvements has identified several additional resources that appear eligible for listing and contributing to the historic district. The CLR recommends that a formal survey be conducted prior to the development of the Additional Documentation and Expanded Boundary nomination to inventory all cultural resources located within the district, and to assess which resources can be tied to the significant historic contexts. The CRF mapping of the cave passages within the district will provide an important baseline for developing the survey.

Location. The nomination would address the proposed expanded historic district (refer to Figure 11 and Appendix B).

Additional Studies Recommended. As noted, a formal survey of the pre-Contact and historic period cultural resources located within the proposed historic district. The survey would include further research and assessment to determine the date or period of origin of each resource to inform preparation of the nomination amendment.

449. Lally, National Register Nomination, Mammoth Cave Historic District, 7-1.

Related Implementation Projects

- Complete a survey of pre-Contact and historic period cave cultural resources. Conduct related research to determine dates/periods of origin of the resources.

Project Implementation Process

1. Complete the survey of cave pre-Contact and historic period cultural resources. To fully document and inventory cave resources, this survey is likely to occur over several years and be conducted as a series of projects.

2. Use the survey information in conjunction with the existing National Register nomination and Multiple Property Documentation Form to develop the Additional Documentation and Expanded Boundary Nomination that will address the 25.9 miles of cave indicated herein as potentially contributing to an expanded Mammoth Cave Historic District. Consideration will need to be paid to the inclusion of Mission 66 resources, with the development of a historic context that provides an overview of work completed after World War II to improve visitor access within toured passages.

Establish cave site furnishings and signage standards for the historic district

Description. Site furnishings within Mammoth Cave Historic District are limited, but important to meeting the needs of visitors. Site furnishings include benches at many of the cave entrances and queuing areas, in locations within the cave where tours typically pause for an extended ranger-led discussion or presentation, and outside of the three restroom buildings. There are also picnic tables in the Snowball Room, and drinking fountains associated with several of the restroom buildings. Many site furnishings present within Mammoth Cave are believed to survive from the period of significance. As such, they constitute resources contributing to the significance of the historic district and should be preserved and maintained. Elsewhere, benches postdate the period of significance and are not contributing. Efforts to improve some trail sections may result in the loss of historic benches. Future replacement of lost benches or the addition of new benches, picnic tables, and other site furnishings should be considered within the framework of a plan that articulates site furnishings standards. Such standards will help establish or perpetuate the park's unique identity, simplify the palette of materials that need to be maintained, and diminish the impact of non-historic features on the historic setting.

Signage standards are also needed within Mammoth Cave. Examples of wayside exhibits and artifact cases are currently cohesive and follow National Park Service Sign Standards. The only other signage present within the historic district includes a few examples of identity and regulatory signs. These signs appear to reflect a standardized approach to materials, typography, and presentation. If not already documented, the park should include this information in the standards recommended herein.

Considerations. Site furnishings standards for contemporary additions to the Mammoth Cave Historic District, including both outside the cave entrances as well as within the cave passages, would need to be compatible with National Park Service systemwide standards, the historic character of the park, clearly be a product of their own time, and be composed of simple, sturdy, attractive, yet unobtrusive materials. Site furnishings standards would need to address appropriateness of scale, materials, and physical composition to ensure visual compatibility, consistency, and integration with the historic district.

If not already developed, sign standards for the Mammoth Cave Historic District should follow the guidance afforded in the National Park Service Sign Standards Reference Manual, National Park Service Uniguide Sign Program, National Park Service Uniguide Standards Manual, and National Park Service Graphic Identity Program.

Location. This project applies to the historic district as a whole.

Additional Studies Recommended. In anticipation of preparing site furnishings standards, the park should collect information about all examples of extant site furnishings. The park should also collect information regarding National Park Service standards for contemporary landscape features.

Related Implementation Projects

- Preservation, repair, and replacement protocols for historic features
- Enhance interpretation

Project Implementation Process

1. Assemble a design team, including a landscape architect, architect, interpretive planner, and park maintenance staff to develop the site furnishing standards.
2. Consider carefully the character and identity appropriate for contemporary site furnishings to be used within the Mammoth Cave Historic District and will convey a unique identity while remaining compatible with the character of the historic landscape.

3. Review the assembled and collected materials illustrating current examples of site furnishings used within the historic district, both historic to remain, and contemporary. Consider how this information should be used to develop the site furnishings standards.

4. Review product catalogues for available products that might be appropriate for consideration in the site furnishings standards.

5. Establish a palette and suite of site furnishings to address each proposed condition while meeting the objective of establishing a cohesive character throughout.

6. Collect information related to the products, details, installation protocols, maintenance needs, and other supporting information and include it in the site furnishings standards.

7. Consider the palette and the installation and maintenance needs in totality before finalizing the site furnishings standards.

Enhance Interpretation

Description. Because most visitors experience Mammoth Cave through personal interpretation provided during tours, guides are the most important interpretive programming feature to help bring the natural and cultural history of the cave alive. Visitors benefit greatly from this opportunity for personal interpretation. The guided tours offered by the park are among the most popular attractions for visitors. The information conveyed during tours is based to a degree on standard information provided to the guides and their own customized story telling plan. The 2014 Foundation Document outlines the interpretive themes that are the goal for story telling.[450] Based on the research conducted on behalf of the CLR, and the viewpoint presented by thinking about the cave as a cultural landscape, additional interpretive themes are recommended for consideration for future guided tours. These include:

- Telling the full story of the contributions of African Americans in the development of cave tours and the visitor experience throughout the nineteenth and twentieth centuries.
- Articulating the ongoing use of storytelling by trail guides as reflective of the history of cave exploration.
- Expanding the archeological and prehistoric components of the underground cave tour experience.
- Relaying the history of cave exploration and speleology and its contributions to research, management, and the long-term conservation of caves and karst ecosystems.

Additionally, the CLR recommends consideration be paid to expanding the types of interpretive offerings to reach a broader audience. Suggestions include film projections, virtual experiences, and expanding interpretation on the park website.

Film or light projections

Current technology allows for expanded interpretive opportunities to provide visitors with new ways of seeing and experiencing their environment. Light and film projections are one tool that could be used in Mammoth Cave to expand interpretive programming. For interpretive purposes, LED lighting could be temporarily projected onto the interior walls of a cave to directly highlight cave features of interest to the guide's program.[451] The benefits of projection include its ability to convey complex geological and hydrological information in a larger-than-life format, along with the unique history of Mammoth Cave and cave exploration in general.

Virtual Experiences

The CLR suggests the consideration of new methods that provide or improve accessibility for visitors. Possibilities for expanded interpretation include the use of 3D modeling (Figure 317) or virtual reality that can be accessed in the visitor center or on a device connected to the Internet.

Digital learning tools such as Reality Capture, 3D, and spatial documentation strategies help educate and promote heritage preservation. Such technologies use a combination of survey strategies including terrestrial laser scanning (TLS) and imaging techniques. Collaborative programs like those at the University of South Florida Digital Heritage Archeological Center combine legacy photographs and historical maps and documentation in online digital formats to encourage the highest accessibility and use, both for management and for educational and curricular applications (Figure 318).[452]

450. National Park Service, Foundation Document, 11
451. LED Professional, "Technical Aspects Regarding the Equipment of Show Caves with Modern LED Systems (April 5, 2017)." Accessed on August 5, 2020, https://www.led-professional.com/resources-1/articles/technical-aspects-regarding-the-equipment-of-show-caves-with-modern-led-systems
452. Digital Heritage and Humanities Collections, University of South Florida Libraries. Accessed on August 5, 2020. https://dhhc.lib.usf.edu

FIGURE 317. An enlargement of the Russel Cave National Monument 3D model showing interactive components. (Source: University of South Florida Libraries Digital Heritage and Humanities Collections)

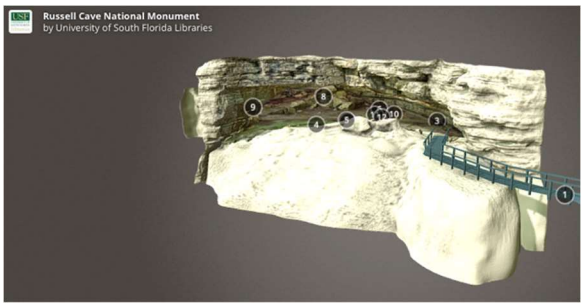

FIGURE 318. An example of a laser scanning survey used to create a digital model of Russel Cave National Monument in Alabama (source: University of South Florida Libraries Digital Heritage and Humanities Collections)

Considerations. Additional tour manual information based on the cultural landscape perspective could be provided to ranger guides to supplement available baseline information. The information could be updated regularly with current scholarship and any new relevant discoveries.

The introduction of technology into the natural environment should be done with the intent to directly highlight cave features present within the environment of the projection. Films that tell a story of processes or histories that could be understood and interpreted external to the cave, should do so. The purpose of introducing this technology is to potentially engages the viewer to explore and contemplate the cave features and resources in a new way.

When evaluating the potential use of projection within the cave environment, specific considerations and precautions should be taken as follows.

- The lighting and projection system and equipment should have the most minimal ecological impact.
- LED technology, where the intensity of the lighting is greatly reduced, should be utilized. The selected lamps and all other components must be suitable for operation within a cave.
- Installation should be done by individuals with speleological knowledge and a considerable understanding of subterranean conditions.
- Lighting that is considered dim is quite adequate for the interior of caves. Moreover, the natural ambience of the cave allows the visitor to experience the underground world like an explorer: in the dark.
- An important factor when installing projection systems is avoiding any blinding effects on the visitor and the potential to add to the lamp flora problem. Because the displayed lighted image would be short term in use, the potential to contribute to lamp flora is anticipated to be minimal to non-existent.
- Using only corrosion-free materials, such as stainless steel, for projection equipment. Contact between the different materials should be avoided completely to prevent corrosion of individual elements.
- The lighting should only be switched on when visitors are in the illuminated area. Otherwise, it should remain off. Lighted periods should also be reduced to a minimum. This is necessary not only to protect the environment but also to reduce costs through higher energy efficiency.
- The installation should be as invisible as possible. Visitors should be drawn in by what they see during the guided tour and not by a display of electrical equipment.

Location. This project relates to the cave entrances and passages that are the focus of guided tours, as well as web-based information.

Additional Studies Recommended. Investigation should be conducted into LED technology that will limit the potential for lamp flora.

Related Implementation Projects

- None

Project Implementation Process

1. Assemble an interpretive planning team to develop the programming for film projections, virtual reality, and enhanced web interpretation.

2. Develop interpretive programming.

3. Implement an initial trial program for film projection and virtual reality to test and evaluate.

4. Use the findings of the test evaluation, adapt the approach and expand implementation.

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Appendix A: Inventory of Landscape Features

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Natural Systems and Features (and associated cultural responses)					
Rock, Mineral, and Soil Features (breakdown, scallops, flutes, anastomoses, sediment, chert, black onyx, aragonite, speleothems, gypsum)		By period of significance		Sections 1 through 8	Contributes to the historic setting
Cave Passage Types (tubes, canyons, vertical shafts, domepits, fissures)		By period of significance		Sections 1 through 8	Contributes to the historic setting
Hydrologic Features (River Styx, Echo River, River Acheron, Mammoth River, Mystic River, Roaring River, Dead Sea, Lake Lethe, Crystal Lake Waterfalls: Bridal Veil Falls, The Water Clock, Charon's Cascade, Great Gushing Mammoth Cascades, Saratoga Springs, Springs: Wandering Willie Spring, Richardson's Spring, Dripping Spring)		By period of significance	Richardson's Spring, fed by Water Clock, has been developed with a small concrete catchment basin; a metal bridge edged by chain link fencing crosses the River Styx near the Dead Sea (see Structures)	Sections 1 through 8	Contributes to the historic setting
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave)					
Sinkhole at Historic Entrance		By period of significance; natural opening and sinkhole that has been a primary point of entry for millennia	Has been developed for public access through construction of concrete stairs, rock walls, and handrails; a metal gate restricts access to the cave passages (see Circulation and Structures)	Section 1	Contributes to the historic setting
The Rotunda (breakdown space)		By period of significance		Section 1 (intersection Houchins Narrows and Broadway)	Contributes to the historic setting
Verspertilio Hall		By period of significance	Nearby are the mushroom beds where commercial cultivation was attempted in 1882; atmospheric data station located here (see Small-scale features)	Section 1 (Audubon Avenue)	Contributes to the historic setting
Olive's Bower		By period of significance	Rock stairs developed for access late nineteenth century (see Structures)	Section 1 (Audubon Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
The Sentinel		By period of significance		Section 1 (Audubon Avenue)	Contributes to the historic setting
Rafinesque Hall		By period of significance	A wooden platform is located in the space to view Lookout Mountain (see Structures)	Section 1 (Audubon Avenue)	Contributes to the historic setting
Bunker Hill		By period of significance		Section 1 (Audubon Avenue)	Contributes to the historic setting
Lookout Mountain (Dismal Hollow)		By period of significance		Section 1 (Audubon Avenue)	Contributes to the historic setting
Two Serpents		By period of significance		Section 1 (Little Bat Avenue)	Contributes to the historic setting
Little Pit		By period of significance		Section 1 (Little Bat Avenue)	Contributes to the historic setting
Booth's Amphitheater		By period of significance	Evidence of saltpetre mining is present within this space. See also Structures	Section 1 (Broadway)	Contributes to the historic setting
Kentucky Cliffs		By period of significance		Section 1 (Broadway)	Contributes to the historic setting
Pigeon Holes		By period of significance		Section 1 (Broadway)	Contributes to the historic setting
Eagle's Nest		By period of significance		Section 1 (Broadway)	Contributes to the historic setting
Methodist Church		By period of significance	Used historically for religious services	Section 1 (Broadway)	Contributes to the historic setting
Pulpit Rock (The Pulpit)		By period of significance	Used historically for religious services	Section 1 (Broadway)	Contributes to the historic setting
Tower Rock		By period of significance	Used historically as a stage for performances	Section 1 (Broadway)	Contributes to the historic setting
Corkscrew		By period of significance	Ladders and other features developed to facilitate passage late nineteenth century. See also Circulation, and Small-scale Features	Section 1 (Broadway)	Contributes to the historic setting
Limitation Hill		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Elbow Crevice		By period of significance	Lit using electrical wiring in place since 1935; stone and concrete stairs lead down to Gratz Avenue (see Structures, Small-scale features)	Section 1 (Gothic Avenue)	Contributes to the historic setting
Seat of the Mummy		By period of significance	Reportedly the location of a discovery of two mummified bodies, now in storage in the Smithsonian Institution	Section 1 (Gothic Avenue)	Contributes to the historic setting
Register Hall		By period of significance	Many signatures, monuments, rock cairns (see Small-scale features)	Section 1 (Gothic Avenue)	Contributes to the historic setting
Post Oak Pillar		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Dressed Turkey		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Catacombs		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Lava Beds		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Hercules' Pillar		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Caesar and Pompey		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Gothic Chapel		By period of significance	With Bridal Altar, the site of several weddings	Section 1 (Gothic Avenue)	Contributes to the historic setting
Bridal Altar		By period of significance	Rock wall developed at the base to protect the dripstone columns (see Structures)	Section 1 (Gothic Avenue)	Contributes to the historic setting
Hornets Nests		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Blacksmith's Shop		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Napoleon's Breastworks		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Loaded Camel		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Jenny Lind's Arm Chair		By period of significance	Rock wall built at the base to protect the formation and as seating (see Structures section below)	Section 1 (Gothic Avenue)	Contributes to the historic setting
Elephant's Heads		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Lovers Leap		By period of significance		Section 1 (Gothic Avenue)	Contributes to the historic setting
Proctor's Arcade		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Kinney's Arena		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Ball Room		By period of significance	Anecdotal reports of being used for dances	Section 1 (Main Cave)	Contributes to the historic setting
Standing Rocks		By period of significance	Has signatures and petroglyphs; atmospheric data station nearby	Section 1 (Main Cave)	Contributes to the historic setting
Martha Washington's Statue		By period of significance	Lighting added to highlight the formation (see Small-scale features section below)	Section 1 (Main Cave)	Contributes to the historic setting
Figured Ceiling		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
The Anteater		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Giant's Coffin		By period of significance	Partially hides the entrance into Dante's Gateway	Section 1 (Main Cave)	Contributes to the historic setting
Wooden Bowl Room		By period of significance		Section 1 (Dante's Gateway)	Contributes to the historic setting
Acute Angle		By period of significance	Two stone building ruins located beyond Acute Angle related to tuberculosis treatments in 1842 (see Structures)	Section 1 (Main Cave)	Contributes to the historic setting
Giant		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Wife and Child		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Star Chamber		By period of significance	Destination of 19th century tours. Two rows of benches for visitors present (see Small-scale features)	Section 1 (Main Cave)	Contributes to the historic setting
Snow Room		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
The Whale		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Devil's Looking Glass		By period of significance	Has signatures and petroglyphs	Section 1 (Main Cave)	Contributes to the historic setting
S Bend		By period of significance		Section 1 (Main Cave)	Contributes to the historic setting
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Owl Room		By period of significance		Section 2 (Black Snake Avenue)	Contributes to the historic setting
Side Saddle Pit		By period of significance		Section 2 (Black Snake Avenue)	Contributes to the historic setting
Bottomless Pit		By period of significance	Bridge built across to allow visitor passage; wall blocks entry from Black Snake Avenue (see Structures section below)	Section 2 (Black Snake Avenue)	Contributes to the historic setting
Covered Way		By period of significance		Section 2 (Black Snake Avenue)	Contributes to the historic setting
Scylla		By period of significance		Section 2 (Calypso Avenue)	Contributes to the historic setting
Charybdis		By period of significance		Section 2 (Calypso Avenue)	Contributes to the historic setting
Covered Pit		By period of significance		Section 2 (Calypso Avenue)	Contributes to the historic setting
Gorin's Dome		By period of significance		Section 2 (Darnall's Way)	Contributes to the historic setting
The Window		By period of significance		Section 2 (Darnall's Way)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Garvin's or Washington's Pit		By period of significance		Section 2 (Darnall's Way)	Contributes to the historic setting
Louisa's Dome		By period of significance		Section 2 (The Labyrinth)	Contributes to the historic setting
Putnam's Cabinet		By period of significance		Section 2 (The Labyrinth)	Contributes to the historic setting
Ariadne's Grotto		By period of significance		Section 2 (The Ramble)	Contributes to the historic setting
Reveller's Hall		By period of significance	Anecdotally, this area was once used as a dining area	Section 2 (Black Snake Avenue)	Contributes to the historic setting
Sea Turtle		By period of significance	Includes a notable Charlotte and Stephen Bishop inscription	Section 2 (Pensacola Avenue)	Contributes to the historic setting
Echo Chamber		By period of significance	Described as a space where vibrations could be felt or heard	Section 2 (Pensacola Avenue)	Contributes to the historic setting
Wild Hall		By period of significance		Section 2 (Pensacola Avenue)	Contributes to the historic setting
Snowball Arched Way		By period of significance		Section 2 (Pensacola Avenue)	Contributes to the historic setting
Grand Crossing		By period of significance		Section 2(Pensacola Avenue)	Contributes to the historic setting
Mat's Arcade		By period of significance		Section 2 (Pensacola Avenue)	Contributes to the historic setting
The Pineapple Bush		By period of significance		Section 2 (Pensacola Avenue)	Contributes to the historic setting
Angelica's Grotto		By period of significance		Section 2 (Pensacola Avenue)	Contributes to the historic setting
Great Relief Hall		By period of significance	Developed with concrete restroom buildings in 1953, rock walls, stone and concrete benches, sewage lift station (see Buildings)	Section 2 (Bunyan's Way)	Contributes to the historic setting
Ina's Hall		By period of significance		Section 2 (Bunyan's Way)	Contributes to the historic setting
William's Dome		By period of significance		Section 2 (Valley of Humility)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Fat Man's Misery		By period of significance	Wood sign marks formation (see Small-scale features)	Section 2 (Fat Man's Misery)	Contributes to the historic setting
River Hall		By period of significance	Concrete stairs edged by handrails and river gauges present (see Circulation and Small-scale features)	Section 2 (River Hall)	Contributes to the historic setting
Bandit Hall		By period of significance	Corkscrew ends here	Section 2 (Bandit Hall)	Contributes to the historic setting
Bacon Chamber		By period of significance		Section 2 (River Hall)	Contributes to the historic setting
Vanderbilt University Hall		By period of significance	Evidence of former restroom features, 1907 plaque related to Vanderbilt (see Structures, Small-scale features)	Section 2 (Bandit Hall)	Contributes to the historic setting
Newman's Spine		By period of significance		Section 2 (Sparks Avenue)	Contributes to the historic setting
Horseshoe Bend		By period of significance		Section 2 (Sparks Avenue)	Contributes to the historic setting
Leopard's Arch		By period of significance		Section 2 (Sparks Avenue)	Contributes to the historic setting
Clarissa's Dome		By period of significance		Section 2 (Silvan Avenue)	Contributes to the historic setting
Wyatt's Domes		By period of significance		Section 2 (Silvan Avenue)	Contributes to the historic setting
Ruins of Karnak		By period of significance		Section 2 (Silvan Avenue)	Contributes to the historic setting
Mammoth Dome		By period of significance		Section 2 (Silvan Avenue)	Contributes to the historic setting
Rapier's Pit		By period of significance		Section 2 (Orpheus's Pass)	Contributes to the historic setting
Charlotte's Dome		By period of significance		Section 2 (River Styx)	Contributes to the historic setting
The Natural Bridge		By period of significance		Section 2 (River Styx)	Contributes to the historic setting
Shakespeare's Face and Gallery		By period of significance		Section 2 (Great Walk)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
The Alligator		By period of significance		Section 2 (Echo River)	Contributes to the historic setting
The First Arch		By period of significance		Section 2 (Echo River)	Contributes to the historic setting
The Second Arch		By period of significance		Section 2 (Echo River)	Contributes to the historic setting
Purgatory		By period of significance		Section 2 (Echo River)	Contributes to the historic setting
Saharan Desert		By period of significance		Section 2 (Echo River)	Contributes to the historic setting
The Fourth Arch		By the period of significance		Section 2 (Echo River)	Contributes to the historic setting
Minnehaha Island		By period of significance	Was used as the Echo River boat landing for tours (no longer extant)	Section 2 (Echo River)	Contributes to the historic setting
Napoleon's Dome		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Alina's Dome		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Devil's Cooling Tub		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Joseph's Pit		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Pool of Clitorus		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Lee's Cisterns		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Annetta's Dome		By period of significance		Section 2 (Gratz Avenue)	Contributes to the historic setting
Dry Pit		By period of significance		Section 2 (Wilson's Way)	Contributes to the historic setting
Indian Mounds		By period of significance		Section 2 (Wilson's Way)	Contributes to the historic setting
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Wright's Rotunda		By period of significance	Evidence of guides throwing lighted rags into crevices historically,	Section 3 (Main Cave)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
			Walker survey markers (see Small-scale features)		
Nicholas' Monument		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Hanson's Cañon		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Black Chambers		By period of significance		Section 3 (Fox Avenue)	Contributes to the historic setting
The Chimneys		By period of significance		Section 3 (Fox Avenue)	Contributes to the historic setting
The Closet		By period of significance		Section 3 (Fox Avenue)	Contributes to the historic setting
The Dark Room		By period of significance		Section 3 (Fox Avenue)	Contributes to the historic setting
Dragon Pit		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Double Branch		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Great Isle		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Mountain Dome		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Mrs. Gatewood's Dining Room		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Sandstone Dome		By period of significance		Section 3 (Ranshaw Avenue)	Contributes to the historic setting
Potter Hall		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Cataracts		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Humble Chute		By period of significance		Section 3 (Solitary Cave)	Contributes to the historic setting
Solitary Spring		By period of significance		Section 3 (Coral Grove Branch)	Contributes to the historic setting
Tecumseh's Grave		By period of significance		Section 3 (Coral Grove Branch)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Fairy Grotto		By period of significance		Section 3 (Rat Hole Branch)	Contributes to the historic setting
Long Pond		By period of significance		Section 3 (Rat Hole Branch)	Contributes to the historic setting
Bryan's Pass		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Settle's Gorge		By period of significance	A cluster of monuments are located in the space known collectively as Monument Hill (see Small-scale features)	Section 3 (Main Cave)	Contributes to the historic setting
Chief City		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Saint Catherine City		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Blue Spring		By period of significance		Section 3 (Blue Spring Branch)	Contributes to the historic setting
Symmes Pit		By period of significance		Section 3 (Blackall Avenue)	Contributes to the historic setting
Cul de Sac		By period of significance		Section 3 (Blackall Avenue)	Contributes to the historic setting
Sea Serpent		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Waldach Dome		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Mummy Ledge		By period of significance	CCC workers discovered the mummified remains of a prehistoric miner here in 1935, nicknamed Lost John	Section 3 (Main Cave)	Contributes to the historic setting
Tribble's Trouble		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Hains Dome		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Epsom Salts Room		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Mayme's Stoop		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Anzer's Hall		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Ultima Thule		By period of significance	Hovey, Kaemper, and Bishop broke through a wall of breakdown to reach passage beyond in 1908	Section 3 (Main Cave)	Contributes to the historic setting
Kaemper Hall		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Parrish's Pits		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Bishop's Pit		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Elisabeth's Dome		By period of significance	A steep double flight of stone stairs leads from here to Violet City	Section 3 (Main Cave)	Contributes to the historic setting
Elise's Dome		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Grand Portal		By period of significance	Albert's Stairway ascends through this space (see Circulation)	Section 3 (Main Cave)	Contributes to the historic setting
Violet City		By period of significance	The Violet City Entrance is reached via a flight of 61 concrete stairs (see Circulation)	Section 3 (Main Cave)	Contributes to the historic setting
Walhalla		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
The Marble Temple		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Chimes		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Lena's Dome		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Well's Dome		By period of significance		Section 3 (Main Cave)	Contributes to the historic setting
Owen Pit		By period of significance		Section 3 (Jesup Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Washington Dome		By period of significance		Section 3 (Jesup Avenue)	Contributes to the historic setting
Flint Dome		By period of significance		Section 3 (Jesup Avenue)	Contributes to the historic setting
Henry's Dome		By period of significance		Section 3	Contributes to the historic setting
Section 4 – Carmichael Entrance to Aero-Bridge Canyon					
Infernal Regions		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Great Western		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Valley of Flowers		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Ole Bull's Concert Hall		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Old Scratch Hall		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Pluto's Dome		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Serpent Hall		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Hill of Fatigue		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Joe's Pit		By period of significance		Section 4 (Silliman Avenue)	Contributes to the historic setting
Henry's Dome		By period of significance		Section 4 (Mayfield's Avenue)	Contributes to the historic setting
Albert's Domes		By period of significance		Section 4 (Elmore's Pass)	Contributes to the historic setting
Cutliff's Way		By period of significance		Section 4 (Valley Way Side Cut)	Contributes to the historic setting
Sydney's Domes		By period of significance		Section 4 (Shelly Avenue)	Contributes to the historic setting
Queen Victoria's Crown		By period of significance		Section 4 (Pass of El Ghor)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Black Hole of Calcutta		By period of significance		Section 4(Pass of El Ghor)	Contributes to the historic setting
Stella's Dome		By period of significance		Section 4(Pass of El Ghor)	Contributes to the historic setting
Corinna's Dome		By period of significance		Section 4(Pass of El Ghor)	Contributes to the historic setting
The Mule Stall		By period of significance		Section 4 (Pass of El Ghor)	Contributes to the historic setting
The Sheep Shelter		By period of significance		Section 4 (Pass of El Ghor)	Contributes to the historic setting
Fly Chamber		By period of significance		Section 4 (Pass of El Ghor)	Contributes to the historic setting
Hanging Rocks		By period of significance		Section 4 (Pass of El Ghor)	Contributes to the historic setting
Hurdle Race		By period of significance		Section 4 (Stevenson Avenue)	Contributes to the historic setting
Neptune's Cups		By period of significance		Section 4 (Stevenson Avenue)	Contributes to the historic setting
Olivia's Dome		By period of significance		Section 4 (Rhoda's Arcade)	Contributes to the historic setting
Lucy's Dome		By period of significance		Section 4 (Rhoda's Arcade)	Contributes to the historic setting
Section 5 – Upper Cave East of El Ghor to Aero-Bridge Canyon					
Sinkhole associated with the Carmichael Entrance		By period of significance	Carmichael Entrance blasted through rock. Visitors travel down metal stairs to reach Sandstone Avenue (see Circulation)	Section 5	Contributes to the historic setting
Serena's Arbor		By period of significance	Walls contain many signatures and inscriptions, including Stephen and Charlotte Bishop surrounded with a heart	Section 5 (Franklin Avenue)	Contributes to the historic setting
Rocky Mountains		By period of significance	Curving flight of concrete stairs nearby at junction of	Section 5 (junction Sandstone, Cleaveland, Franklin Avenues)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
			Sandstone and Cleaveland Avenues		
Old Maiden's Kitchen		By period of significance		Section 5 (Croghan Hall)	Contributes to the historic setting
Cleopatra's Needle		By period of significance		Section 5 (Croghan Hall)	Contributes to the historic setting
Blarney Stone		By period of significance		Section 5 (Croghan Hall)	Contributes to the historic setting
Maelstrom		By period of significance		Section 5 (Croghan Hall)	Contributes to the historic setting
Charlotte's Grotto		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Diamond Grotto		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Split Rock		By period of significance		Section 5 (Helen's Grotto)	Contributes to the historic setting
Sarah Margaret's Dome		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Cornelia's Grotto		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Grace's Grotto		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Nannie's Grotto		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Lucy's Dome		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Julia's Dome		By period of significance		Section 5 (Rodgers Avenue)	Contributes to the historic setting
Veil of Diamonds		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
The Post Office		By period of significance	The Post Office was a place where visitors were encouraged to leave their calling cards historically	Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Edison Monument		By period of significance	This upright slab of rock is covered with signatures, including one prominent "Edison"	Section 5 (Cleaveland Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Jenny Lind's Dining Table		By period of significance	Jenny Lind, a famous Swedish singer, reportedly stood on this low, flat breakdown block and sang "The Last Rose of Summer" under a gypsum flower	Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Last Rose of Summer		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Mammary Ceiling		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Floral Cross		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Flora's Garden		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Snowball Room		By period of significance	Was used as a dining room beginning in 1935 and further developed in the 1950s	Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Washington Hall		By period of significance	Developed in the 1950s with a concessionaire's cafeteria and food preparation room accessible from the Elevator. Restrooms nearby (see Buildings and Structures)	Section 5 (Cleaveland Avenue)	Contributes to the historic setting
France's Dome		By period of significance		Section 5 (Sophy's Avenue)	Contributes to the historic setting
Kennedy Domes		By period of significance		Section 5 (Sophy's Avenue)	Contributes to the historic setting
Christopher's Dome		By period of significance		Section 5 (Marion Avenue)	Contributes to the historic setting
Katharine's Domes		By period of significance		Section 5 (Marion Avenue)	Contributes to the historic setting
Double Cedars Sinkhole		By period of significance		Section 5 (Dan's Avenue)	Contributes to the historic setting
Maud's Grotto		By period of significance		Section 5 (Stephen's Way)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Tan's Pit		By period of significance		Section 5 (Stephen's Way)	Contributes to the historic setting
Runt's Dome		By period of significance		Section 5 (Stephen's Way)	Contributes to the historic setting
Mary's Vineyard		By period of significance		Section 5 (Cleaveland Avenue)	Contributes to the historic setting
Thorpe's Pit		By period of significance		Section 5 (Boone Avenue)	Contributes to the historic setting
Ellen's Dome		By period of significance		Section 5 (Boone Avenue)	Contributes to the historic setting
Holy Sepulchre		By period of significance		Section 5 (Boone Avenue)	Contributes to the historic setting
Markolf's Dome		By period of significance		Section 5 (Cox Avenue)	Contributes to the historic setting
Anna's Dome		By period of significance		Section 5 (Cox Avenue)	Contributes to the historic setting
Blanche's Dome		By period of significance		Section 5 (Cox Avenue)	Contributes to the historic setting
Rock of Gibraltar		By period of significance		Section 5 (Jeanne's Avenue)	Contributes to the historic setting
The Harbor		By period of significance		Section 5 (Jeanne's Avenue)	Contributes to the historic setting
Felicia's Dome		By period of significance		Section 5 (Jeanne's Avenue)	Contributes to the historic setting
Forks of the Cave		By period of significance		Section 5 (Jeanne's Avenue)	Contributes to the historic setting
Covington's Cabinet		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Crystal Chamber		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Wycliff's Dome		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Alice's Grotto		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Devil's Bathtub		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Bismark Dome		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Mount McKinley		By period of significance	The trail ascends through this dome via a series of steep switchbacks; restrooms and benches at the top (see Circulation, Buildings, and Small-scale features)	Section 5 (Grand Avenue)	Contributes to the historic setting
The Narrows		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
The Precipice		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
The Saddle		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Black Onyx		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Grand Canyon		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Cliff Walk		By period of significance	This narrow exposed ledge extends from Woodbury Pass to the top of Grand Canyon and was part of Morrison's New Entrance tour route, was edged by handrails no longer extant (see Circulation	Section 5 (Grand Avenue)	Contributes to the historic setting
Cecil's Accident		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Ellen's Grotto		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Moving Mountain		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Gist's Dome		By period of significance		Section 5 (Grand Avenue)	Contributes to the historic setting
Diamond Dome		By period of significance		Section 5 (Woodbury Pass)	Contributes to the historic setting
Virginia's Grotto		By period of significance		Section 5 (Woodbury Pass)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Register Hall		By period of significance	This block of stone was used by visitors to write their names during the early 20th century	Section 5 (Woodbury Pass)	Contributes to the historic setting
Aero Bridge Canyon		By period of significance	George Morrison strung a steel cable across and used a tram to transport materials (see Structures)	Section 5 (Grand Avenue)	Contributes to the historic setting
Heart Attack Hill		By period of significance		Section 5 (Grand Avenue-Aero-Bridge Canyon)	Contributes to the historic setting
Blair's Dome		By period of significance		Section 5 (Grand Avenue-Aero-Bridge Canyon)	Contributes to the historic setting
Section 6 – Lower Cave east of El Ghor-Belfry Avenue to Ultima Thule					
Turtle Hurdles		By period of significance		Section 6 (Belfry Avenue)	Contributes to the historic setting
Black Kettles		By period of significance		Section 6 (Belfry Avenue)	Contributes to the historic setting
Helictite Hall		By period of significance		Section 6 (Belfry Avenue)	Contributes to the historic setting
Mary's Grotto		By period of significance		Section 6 (Belfry Avenue)	Contributes to the historic setting
Galloway's Dome		By period of significance		Section 6 (**Blackstone Avenue)**	Contributes to the historic setting
Bishop's Domes		By period of significance		Section 6 (Coral Avenue)	Contributes to the historic setting
Nelson's Domes		By period of significance		Section 6 (Martel Avenue)	Contributes to the historic setting
Einbigler's Dome		By period of significance		Section 6 (Martel Avenue)	Contributes to the historic setting
Edna's Dome		By period of significance		Section 6 (Martel Avenue)	Contributes to the historic setting
Cathedral Domes		By period of significance	This area was used by George Morrison for a short time as an entrance into the cave with a	Section 6 (Hawkins Pass)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
			wooden staircase leading to the floor (see Circulation)		
Gerta's Grotto		By period of significance		Section 6 (Lida's Pass)	Contributes to the historic setting
Florence William's Dome		By period of significance		Section 6 (Pilgrim Avenue)	Contributes to the historic setting
Sansom's Dome		By period of significance		Section 6 (Goat Alley)	Contributes to the historic setting
Section 7 – Upper Level Aero-Bridge to Frozen Niagara					
New York Hippodrome		By period of significance	Trail extends through the space as an elevated travelway built on piled rock and edged by metal handrails (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Lover's Leap		By period of significance	From Hippodrome an old trail ascends to Lovers Leap (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Grand Central Station		By period of significance	Entering into Grand Central are several sections of concrete stairs edged by metal handrails (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Big Break		By period of significance	A series of switchbacks and narrow stairs lead up this pile of breakdown; there are also stone steps and a causeway built by the CCC (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Fairy Ceiling		By period of significance	There is a set of wooden benches beneath the stalactites (see Small-scale features)	Section 7 (Grand Avenue)	Contributes to the historic setting
No Man's Land		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
(Second) Lover's Leap		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
Flat Ceiling Room		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
Compass Needle		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
Thanksgiving Hall		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
Frozen Niagara		By period of significance	This is among the most famous formations in Mammoth Cave. It is a massive flowstone cascade. A causeway crosses Crystal Lake while a flight of stairs leads to the Drapery Room (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Onyx Colonnade		By period of significance	A metal fence separates Onyx Colonnade from the trail to protect the formations (see Small-scale features)	Section 7 (Grand Avenue)	Contributes to the historic setting
Moonlight Dome		By period of significance	Associated with Crystal Lake.	Section 7 (Grand Avenue)	Contributes to the historic setting
Rainbow Dome		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
St. Peter's Dome		By period of significance		Section 7 (Grand Avenue)	Contributes to the historic setting
Drapery Room		By period of significance	Metal stairs lead into the room (see Circulation)	Section 7 (Grand Avenue)	Contributes to the historic setting
Radio Room		By period of significance	This space near Frozen Niagara was used for radio broadcasts in the 1930s	Section 7 (Grand Avenue)	Contributes to the historic setting
Sinkhole associated with the New Entrance		By period of significance	Used by George Morrison to blast a new entrance into the cave in 1921	Section 7 (New Entrance)	Contributes to the historic setting
Roosevelt Dome		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Jawbone Dome		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting
Fossil Dome		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting
Wilson Dome		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting
Silo Pit		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting
King Solomon's Temple		By period of significance		Section 7 (New Entrance)	Contributes to the historic setting
Section 8 – Lower Level Ultima Thule to Frozen Niagara					
Bransford Barrier Pit		By period of significance		Section 8	Contributes to the historic setting
Responses to Natural Resources					
Use of the name Mammoth Cave		1810; *Richmond Enquirer* article first reference (Hobbs, 41)			
Historic Entrance at a natural sinkhole		By period of significance	Developed for access beginning circa early nineteenth century (see Structures section below)	Section 1	Contributes to the historic setting
Use of candle smoke and etching rocks to produce cave wall and ceiling signatures		Circa 1812 (Croghan); 1830s-1888 (at which time such "vandalism" was made unlawful)		Sections 1, 3, 5, 6	Contribute to the historic setting
Tour routes established to connect unique and dramatic cave features		19th and 20th centuries		Sections 1 through 8	Contribute to the historic setting
Development of trails, bridges, causeways, stairs, and elevated passages to provide access to toured portions of the cave		19th and 20th centuries		Sections 1 through 8	Contribute to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Use of materials in the cave to construct circulation features including cave sediment and breakdown rock		19th and 20th centuries		Sections 1 through 8	Contributes to the historic setting
Use of handrails, guardrails, and fencing for safety purposes		19th and 20th centuries		Sections 1 through 8	Contributes to the setting
Excavation of a passage through Ultima Thule		1908 by Max Kämper and Ed Bishop		Section 6	Contributes to the historic setting
Addition of lighting to facilitate passage through the darkness of the cave within some toured areas		George Morrison added lighting in 1915; electrical lighting added to Violet City in the 1930s; modern electrical lines were laid in the 1950s and upgraded in the 1960s		Sections 1, 2, 3, 5, 7	Contributes to the historic setting
Opening of Violet City Entrance to allow for tourism		1915 Morrison blasted opening; Expanded in 1931		Section 3	Contributes to the historic setting
Excavation of a breakdown pile at Grand Central to reach Frozen Niagara		1923			Contributes to the historic setting
Opening of Frozen Niagara Entrance to allow for tourism		1924 by George Morrison excavated tunnel		Section 7	Contributes to the historic setting
Opening of Carmichael Entrance to allow for tourism		1931 using blasting		Section 5	Contributes to the historic setting
Establishment of an Elevator to provide food service access (later ADA access)		1958		Section 5	Contributes to the historic setting
The addition of entrance air-lock features to address air flow and animal movement		1990s		Sections 3, 5, and 7	Does not contribute to the historic setting
Replacement of the electrical system and lighting causing algal growth on the cave walls		2009; 2017		Sections 1, 2, 3, 5, 7	Does not contribute to the historic setting
Industrial development of the cave to mine saltpetre		*1806-1815; may have followed*	*Evidence survives in the form of piled tailings,*	*Section 1*	*Missing*

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		saltpetre mining beginning as early as the 1790s	*leaching vats, and pipes (see Structures section below)*		
Establishment of medical experiments related to use of cave atmosphere to cure tuberculosis, constant darkness to conduct sleep experiments		*1835-1836; 1930s*	*Evidence of tuberculin experiments survive in the form of two stone building ruins (see Buildings section below)*	*Section 1*	*Missing*
Commercial cultivation of mushrooms to take advantage of appropriate growing conditions		*1882*	*Evidence of commercial growth of mushrooms (see Buildings section below)*	*Section 1*	*Missing*
Use of ladders and wooden stairs to access vertical passages such as Corkscrew and the Cathedral Domes Entrance		*19th and 20th centuries*		*Various sections*	*Missing*
Boating tours within the cave		*19th and 20th centuries*	*Discontinued in 1965; reopened in 1980 and discontinued in 1992*	*Section 2, 7*	*Missing*
Fishing in the cave rivers		*19th and 20th centuries; Nick Bransford made money and bought his freedom catching and selling eyeless fish from the cave*	*No longer permitted*	*Section 2, 7*	*Missing*
Capturing wildlife and taking geological souvenirs		*19th and 20th centuries*	*Discontinued*	*Various sections*	*Missing*
Torch throwing by guides to light toured spaces		*19th and 20th centuries*	*Discontinued*	*Various sections*	*Missing*
Use of a ventilation shaft to cool the Mission 66 visitor center		*1959*	*Discontinued after discovery of radon*	*Section 1*	*Missing*
Opening of Cox Entrance		Circa 1916-1917; established by George Morrison	*Later closed*	*Section 7*	*Missing?*
Opening of New Entrance		Morrison blasted opening in 1921	*Closed in 1967*	*Section 5*	*Missing*
Opening of Cathedral Dome entrance		1930; established by George Morrison	*Collapsed in 1931*	*Section 6*	*Missing*

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Use of the cave as a civil defense shelter due to protective conditions		1950s		*Section 1*	*Missing*
Spatial Organization					
Cave Entrances (Historic Entrance, Violet City Entrance, New Entrance, Frozen Niagara Entrance, Carmichael Entrance, Elevator)		19th century through 1958		Sections 1, 5, and 7	Contributes to the historic setting
Horizontal Passages :		By period of significance		All Sections	Contributes to the historic setting
Adeline Avenue, Audubon Avenue, Backslider's Alley, Becky's Alley, Belfry Avenue, Bird Avenue, Bishop's Way, Blackall Avenue, Black Snake Avenue, Blackstone Avenue, Blue Spring Branch, Boiled Egg Passage, Boone Avenue, Bransford Avenue, Briggs Avenue, Broadway, Bryan's Pass, Buchanan's Way, Bunyan's Way, Burley's Way, Calypso Avenue, Carlos's Way, Carrie's Pass, Clark's Avenue, Cleaveland Avenue, Cliff Walk, Clinton Avenue, the Closet, College Heights Avenue, Coral Avenue, Coral Grove Branch, Cox Avenue, Cyclops Gateway, Dan's Avenue, Dante's Gateway, the Dark Room, Darnall's Way, Deserted Chambers, Dollar Pass, Edith's Avenue, El Ghor, Ella's Grotto, Elmore's Pass, Emerson's Pass, Emily's Avenue, Emily's Puzzle, Emmet's Ramble, Fat Man's Misery, Fishback Avenue, Flint Alley, Fort's Way, Fox Avenue, Franklin Avenue, Gallows Way, Ganter Avenue, Garvin Avenue, Gault's Way, Goat Alley, Gothic Avenue, Grand Avenue (Kentucky Avenue), Grand Crossing, Gratz Avenue, Great Relief, Great Walk, Grecian Bend, Harvey Avenue, Hawkins Pass, Helen's Grotto, Hell Hole, Hooflands Avenue, Houchins Narrows, Ike's Path, Infernal Regions, Jeanne's Avenue, Jesup Avenue, Kinney's Arena, Labyrinth, Lee's Way, Lida's Pass, Little Bat Avenue, Lively's Pass,					

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Logan Avenue, Lost Avenue, Lover's Leap Route, Lover's Retreat, Main Cave (including Broadway, Hanson's Cañon, Proctor's Arcade, Kinney's Arena, Settle's Gorge), Marion Avenue, Martel Avenue, Mayfield's Avenue, Mayme's Stoop, Miller Avenue, Minna's Way, Montie's Pass, New York Subway, Nicholson Avenue, Nickerson Avenue, No Man's Land, Opossum Avenue, Orpheus's Pass, Pass of El Ghor, Payne's Path, Pensacola Avenue, Pilgrim Avenue, Pinson's Pass, Proctor's Arcade, Purgatory, Ramble, Ranshaw Avenue, Rat Hole Branch, Rhoda's Arcade, Roaring River, Robertson Avenue, Rodgers Avenue, Rose's Pass, Saharan Desert, Sandstone Avenue, Sandy Avenue, Second Arch, Settle's Gorge, Shelley Avenue, the Side Cuts, Silliman Avenue, Silvan (Sylvan) Avenue, Sitgreave's Pass, Solitary Cave, Sophy's Avenue, Sparks Avenue, Stephen's Way, Stevenson Avenue, Thorpe's Avenue, Thorpe's Pit Trail, Valley of Humility, Valley Way Side Cut, Welcome Avenue, William Garvin's Way, Wilson's Way, Woodbury Pass					
Vertical passages:		By period of significance; stairs date to 19th and 20th centuries; tower date of origin not determined			Contributes to the historic setting
Corkscrew, the Chimneys, Scotchman's Trap					
Large Rooms, Halls, Alcoves		Historic Entrance natural; other entrances added during early to mid-20th century			Contribute to the historic setting
Aero-Bridge Canyon, Anzer's Hall, Bacon Chamber, Ball Room, Bandit's Hall, Black					

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Chambers, Booth's Amphitheater, Bottle Hall, Cascade Hall, Chief City, Croghan Hall, Deserted Chambers, Double Branch, Drapery Room, Echo Chamber, Flat Ceiling Room, Forks of the Cave, Frozen Niagara, Gothic Chapel, Grand Canyon, Grand Central Station, Ina's Hall, Kaemper Hall, Methodist Church, New York Hippodrome, Odd Fellows Hall, Old Scratch Hall, Ole Bull's Concert Hall, Owl Room, Potter Hall, Radio Room, Rafinesque Hall, Register Hall, Reveller's Hall, River Hall, Rotunda, Saint Catherine City, Scylla, Serpent Hall, Snow Room, Snowball Room, Snow Room, Star Chamber, Thanksgiving Hall, Vanderbilt University Hall, Vespertilio Hall, Violet City, Washington Hall, Wild Hall, Wooden Bowl Room, Wright's Rotunda					
Elevated Positions					Contributes to the historic setting
Aero-Bridge, Bottomless Pit, Bunker Hill, Lookout Mountain, Lover's Leap promontory (3), spaces overlooking Mammoth Dome, the Precipice, Pulpit Rock, Side-saddle Pit					
Narrow Crevices, Niches, Sharp Turns:					Contributes to the historic setting
the Acute Angle, Catacombs, Elbow Crevice, Fat Man's Misery, Grecian Bend, Horseshoe Bend, Humble Chute, Mole Hole, the Narrows, Pigeon Holes, "S" Bend, Seat of the Mummy, Snowball Arched Way, Snowball Arcade, Veil of Diamonds					
Domes and Pits:					Contributes to the historic setting
Albert's Domes, Alina's Dome, Anna's Dome, Annetta's Dome, Bishop's Dome, Bishop's Pit, Bismarck Dome, Black Hole of Calcutta, Blair's Dome, Blanche's Dome, Bottomless Pit, Bransford Barrier Pit, Bunker Hill, Cathedral Domes, Charlotte's Dome, Charybdis, Christopher's Dome,					

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Clarissa's Dome, Corinna's Dome, Covered Pit, Crystal Lake / Moonlight Dome, Dead Sea, Diamond Dome, Dragon Pit, Dry Pit, Edna's Dome, Einbigler Dome, Elisabeth's Dome, Elise's Dome, Ellen's Dome, Felicia's Dome, Flint Dome, Fossil Dome, Florence William's Dome, France's Dome, Galloway's Dome, Garvn's Pit, Gist's Dome, Gorin's Dome, Great Gushing Mammoth Cascades, Hains Dome, Henry's Dome, Jawbone Dome, Joe's Pit, Joseph's Pit, Julia's Dome, Katherine's Domes, Kennedy Domes, King Solomon's Temple, Lena's Dome, Little Pit, Louisa's Dome, Lucy's Dome, Maelstrom, Mammoth Dome, Markolf's Dome, Moonlight Dome, Mountain Dome, the Mule Stall, Napoleon's Dome, Nelson's Domes, Olivia's Dome, Owen Pit, Parrish's Pits, Pluto's Dome, Putnam's Cabinet, Rainbow Dome, Rapier's Pit, Roosevelt Dome, Runt's Dome, St. Peter's Dome, Sansom's Dome, Sarah Margaret's Dome, Scylla, Sandstone Dome, Side-saddle Pit, Silo Pit, Skinley's Domes, Stella's Dome, Sydney's Domes, Symmes Pit, Tan's Pit, Thorpe's Pit, Waldach Dome, Wandering Willie Spring, Washington Dome, Washington's Pit, Water Clock, Well's Dome, William's Dome, Wilson Dome, Wyatt's Dome, Wycliff's Dome					
Cox Entrance		*1916-1917*	*Later closed*		*Missing*
Cathedral Domes Entrance		*1930*	*Later collapsed*		*Missing*
George's Path corridor			Collapsed		*Missing*
Land Uses					
Exploration		Since the 19th century, exploration of the cave passages has been popular		All Sections	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		and continues today			
Recreation		1816 is when Mammoth Cave became a show cave. Saltpetre miners were the first tour guides; discovery of a mummy (Fawn Hoof) in 1813, which led to acclaim and interest in touring below ground when touring above ground was not that popular (Hobbs); happenstance until Franklin Gorin purchased cave in 1838 to operate tours. Allowed slave Stephen Bishop to give tours, leased Mat and Nick Bransford for the same purpose		Sections 1 through 8	Contributes to the historic setting
Commerce		Tours provided at a cost since the early 19th century			Contributes to the historic setting
Scientific study		Constantine Rafinesque wrote about the geology in 1832 (Rafinesque Hall and the Rafinesque big-			Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		eared bat are his namesakes); Eyeless fish described by Robert Davidson in 1840 and discussed in Darwin Origin of Species in 1909; Edouard Martel visited cave in 1912 to research the passages in the emerging field of speleology; study of endangered Kentucky Cave Shrimp 1980s			
Commemoration		19th and early 20th century		Sections 1, 2, 3, 8	Contributes to the historic setting
Visitor services		Visitor services in the form of restrooms and opportunities for drinking water have been provided by the National Park Service since the 1940s		Sections 1, 2, 3, 5, and 7	Contributes to the historic setting
Museum/interpretation/education		National Park Service introduced interpretive information by Mission 66	Wayside exhibits postdate the period of significance		Contributes to the historic setting
Conservation		The National Park Service has implemented conservation protocols related			Does not contribute to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		to designation of Mammoth Cave as a World Biosphere Reserve since the end of the period of significance			
Communications		*Radio show broadcast from the Radio Room near Frozen Niagara during the 1930s*		*Section 7*	*Missing*
Industry		*1806-1815 saltpetre mining*		*Section 1*	*Missing*
Medicine		*1842 tuberculosis treatment, 1938 sleep study*		*Section 1*	*Missing*
Agriculture		*1882 mushroom cultivation*		*Section 1*	*Missing*
Performance		*19th and 20th century singing and acting performances*		*Section 1*	*Missing*
Communications		*1930s radio broadcasts*		*Section 7*	*Missing*
Military		*1950s civil defense shelter*		*Section 1*	*Missing*
Views and Vistas					
Views along horizontal passages		By period of significance			Contributes to the historic setting
Views into vertical domes and pits		By period of significance			Contributes to the historic setting
Views within large rooms		By period of significance			Contributes to the historic setting
Views into crevices and small openings		By period of significance			Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Views from overlooks and trail platforms, including natural features such as Lovers Leap(s) and cultural built overlooks		By period of significance, and generally by period of significance	Overlooks and platforms introduced after the period of significance do not contribute to the historic setting		Contributes to the historic setting
Geological Focal Points:		By period of significance			Contributes to the historic setting
Alice's Grotto, the Alligator, Angelica's Grotto, the Anteater, Ariadne's Grotto, Big Break, Black Kettles, Black Onyx, Blacksmith's Shop, Blarney Stone, Booth's Amphitheater, Bridal Altar, Caesar and Pomfrey, Cataracts, Cecil's Accident, Charlotte's Grotto, Charybdis, the Chimes, Cleopatra's Needle, Compass Needle, Cornelia's Grotto, Covered Way, Covington's Cabinet, Crystal Chamber, Cul de Sac, Devil's Cooling Tub, Devil's Bathtub, Devil's Looking Glass, Diamond Grotto, Dressed Turkey, Eagle's Nest, Edison Monument, Ellen's Grotto, Elephant's Heads, Epsom Salts Room, Fairy Ceiling, Fairy Grotto, Figured Ceiling, First Arch, Flora's Garden, Floral Cross, Fly Chamber, Fourth Arch, Frozen Niagara, Gerta's Grotto, Giant, Giant's Coffin, Grace's Grotto, the Grand Portal, Great Isle, Hanging Rocks, the Harbor, Heart Attack Hill, Helcite Hall, Hercules' Pillar, Hill of Fatigue, Holy Sepulchre, Hornet's Nest, Hurdle Race, Indian Mounds, Jenny Lind's Arm Chair, Jenny Lind's Dining Table, Kentucky Cliffs, Last Rose of Summer, Leopard's Arch, Limitation Hill, Loaded Camel, Lookout Mountain, Mammary Ceiling, the Marble Temple, Martha Washington's Statue, Mary's Grotto, Mary's Vineyard, Mat's Arcade, Maud's Grotto, Minnehana Island, Mount McKinley, Moving Mountain, Mummy Ledge, Nannie's Grotto, Napoleon's Breastworks, Natural Bridge,					

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Neptune's Cups, Newman's Spine, Nicholas's Monument, No Man's Land, Old Maiden's Kitchen, Olive's Bower, Onyx Colonnade, Orpha's Garden, the Pineapple Bush, Post Oak Pillar, Post Office, Pulpit Rock, Queen Victoria's Crown, Rock of Gibraltar, Rocky Mountains, Ruins of Karmak, the Saddle, Sea Serpent, Seat of the Mummy, Sea Turtle, Sentinel, Serena's Arbor, Shakespeare's Face, Shakespeare's Gallery, the Sheep Shelter, Split Rock, Standing Rocks, Tecumseh's Grave, Tower Rock, Tribble's Trouble, Two Serpents, Turtle Hurdles, Ultima Thule, Valley of Flowers, Veil of Diamonds, Virginia's Grotto, Walhalla, Wellington's Gallery, the Whale, Wife and Child, the Window					
Views of contemporary electrical boxes, light switch boxes, light fixtures, wayside exhibits, gates		Post 1967 introductions			Do not contribute to the historic setting
Circulation					
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave					
Approach to the Historic Entrance		An access road and trail lead to a plaza overlooking the cave entrance; the plaza was developed during Mission 66		Section 1	Contributing
Historic Entrance, including concrete stairs leading to cave interior		Natural opening expanded in early 19th century for saltpetre mining. Stairs and other access	Concrete stairs and metal handrails replaced Mission 66 features in 1990 and a metal gate added to control access, diminish	Section 1	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		features added over the years, including during Mission 66	integrity of feeling, materials, and design		
Houchins Narrows		Circa 1810s route developed to provide access during saltpetre mining era; current walk built during the 21st century	Surface varies from cave sediment to concrete, and hexagonal pavers and edged with lint guards and handrails that postdates period of significance and diminishes integrity of feeling, materials, and design	Section 1	Contributing
Rotunda		Walks and overlook platforms developed during Mission 66	Replaced with elevated path supported by stacked stone retaining wall; trail surfaced with concrete and hexagonal pavers edged by lint guards and handrails that postdate period of significance and diminish integrity of feeling, materials, design, and workmanship	Section 1	Contributing
Audubon Avenue (Big Bat Room, Hall of Audubon)		Trail surface of cave sediment dates to CCC, addition of rock edging undetermined	Sections updated with hexagonal pavers postdates period of significance and diminishes integrity of feeling and materials	Section 1	Contributing
Rock stairs to Olive's Bower at the end of Audubon Avenue	HS #007609	Circa 1880-1900		Section 1	Contributing
Little Bat Avenue		Trail surface cave sediment edged by placed rock likely built by CCC		Section 1	Contributing
Broadway (Great Gallery, Main Cave)		Piles of tailing date to saltpetre mining circa 1810s; paths	Catwalk removed replaced with contemporary walk during 21st century. Trail surface replaced with	Section 1	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		likely cleared through tailings during 19th and early 20th centuries; elevated wooden boardwalk and stair built Mission 66	hexagonal pavers, edged by lint guards and metal handrails postdates period of significance and diminishes integrity of feeling and materials		
Corkscrew		Used during the late 19th through the mid-20th century to travel between the upper and lower passages of the Historic Cave; ladders were used to facilitate passage	Ladders no longer extant; use of Corkscrew replaced with Mammoth Dome Tower in 1953	Section 1	Contributes to the historic setting
Mammoth Dome Tower		Steel tower built in 1953	Replaced in 2008	Section 1 to Section 2	Non-contributing
Backslider's Alley (Gothic Gallery)		Natural passageway		Section 1	Contributes to the historic setting
Gothic Avenue (Gothic Galleries, Haunted Chambers, White Hall)		Trail surface cave sediment edged by placed rock likely built by CCC		Section 1	Contributing
Steel stairs with FRP treads in Gothic Avenue		2007		Section 1	Non-contributing
Rock stairs leading through Gothic Avenue to Elbow Crevice	HS #007608	Circa 1880-1900	1966-1975	Section 1	Contributing
Concrete stair leading from Gothic Avenue through Elbow Crevice to Gratz Avenue		Possibly pre-park with formwork and saw marks; likely by 1969		Section 1	Contributing
Main Cave		Trail surface cave sediment edged by placed	Later replacement of some sections with hexagonal pavers edged by lint	Section 1	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		rock likely built by CCC	guards postdate period of significance and diminish integrity of feeling and materials		
Cyclops Gateway (Horn Room, Rocky Cave, Rocky Hall)		Natural passageway		Section 1	Contributes to the historic setting
Dante's Gateway		Natural passageway		Section 1	Contributes to the historic setting
Lost Avenue (Harvey Avenue, Harvey's Lost Way, Lost Way Found)		Natural passageway		Section 1	Contributes to the historic setting
Harvey Avenue (Harvey's Avenue, Harvey's Lost Way, Lost Avenue, Sick Room)		Natural passageway		Section 1	Contributes to the historic setting
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Black Snake Avenue (Arched Way, Bottomless Pit Branch, Ganter Avenue, Deserted Chambers)		Portions of the passage are paved with concrete and edged by placed rock, metal handrails, or guardrails; date of origin not determined		Section 2	Undetermined
The Steps of Time		27 concrete steps edged by a metal pipe handrail; date of origin not determined		Section 1 to Section 2	Undetermined
Payne's Path		Natural passageway		Section 2	Contributes to the historic setting
Lover's Retreat (Lover Avenue)		Natural passageway		Section 2	Contributes to the historic setting
Calypso Avenue		Natural passageway		Section 2	Contributes to the historic setting
Darnall's Way		Natural passageway		Section 2	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
William Garvin's Way (Garvin Way)		Natural passageway		Section 2	Contributes to the historic setting
The Labyrinth (Winding Labyrinth)		Natural passageway		Section 2	Contributes to the historic setting
The Ramble (Hovey's Ramble, Ray's Hall)		Natural passageway		Section 2	*Missing*
Pensacola Avenue (Pensicola Avenue, Pensico Avenue)		Natural passageway		Section 2	Contributes to the historic setting
Bunyan's Way		Natural passageway		Section 2	Contributes to the historic setting
Grand Crossing		Natural passageway		Section 2	Contributes to the historic setting
Valley of Humility (Humility Road, Vale of Humility, Valley of Humiliation)		Natural passageway		Section 2	Contributes to the historic setting
Scotchman's Trap		Natural passageway		Section 2	Contributes to the historic setting
Stone steps at Scotchman's Trap		Flight of stone stairs below a suspended rock likely present by 1969		Section 2	Contributing
Buchanan's Way		Natural passageway		Section 2	Contributes to the historic setting
Lively's Pass (Lively Avenue)		Natural passageway		Section 2	Contributes to the historic setting
Grecian Bend (Grecian Bend Avenue)		Natural passageway		Section 2	Contributes to the historic setting
Stair leading to Fat Man's Misery edged by a metal handrail		Date of origin not determined		Section 2	Undetermined
Fat Man's Misery (Fat Man's Hell, Winding Way)		Cave sediment trail built by CCC	Concrete used to pave sections of the trail; sometimes edged by handrails date of origin not determined	Section 2	Undetermined
Concrete stair edged by a mortared stone wall and metal handrail leading into Great Relief Hall from Fat Man's Misery		Postdates period of significance		Section 2	Non-contributing
Great Relief Hall (Clay's Cave, Hall of Great Relief, Happy Relief)		Paved with hexagonal pavers		Section 2	Non-contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		edged with lint guards, postdates period of significance			
Odd Fellows Hall		Concrete paved trail, concrete stairs with stainless steel handrails date of origin not determined		Section 2	Undetermined
River Hall (River Avenue)		Flight of 23 concrete stairs edged by metal handrails connects River and Bandit Halls date of origin not determined			Undetermined
Bandit Hall (Bandit's Chamber, Bandit's Grotto, Robber's Cave, Robber's Hall)		Concrete with stainless steel handrails postdate the period of significance		Section 2	Non-contributing
Carlo's Way		Natural passageway		Section 2	Contributes to the historic setting
Briggs Avenue		Natural passageway		Section 2	Contributes to the historic setting
Sparks Avenue (Bishop's Gorge)		Cave sediment sections built by CCC ; Concrete paved trail sections edged by stainless steel handrails likely date to Mission 66	Later improvements appear to postdate the period of significance and diminish integrity of feeling and materials	Section 2	Contributing
Silvan Avenue		Natural passageway		Section 2	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Fort's Way		Natural passageway		Section 2	Contributes to the historic setting
Gault's Way		Natural passageway		Section 2	Contributes to the historic setting
Gallows Way		Natural passageway		Section 2	Contributes to the historic setting
Orpheus's Pass		Natural passageway		Section 2	Contributes to the historic setting
Great Walk		Natural passageway		Section 2	Contributes to the historic setting
Echo River (River Jordan)		Natural passageway	Was used for boating historically	Section 2	Contributes to the historic setting
Minnehana Island		Natural passageway	Boat landing used for tours present historically now missing	Section 2	Contributes to the historic setting
Gratz Avenue (Cinder-bank Cave, Lower Branch)				Section 2	Contributes to the historic setting
Two staircases lead from Gratz Avenue to Gothic Avenue – one is stacked stone, the other very narrow concrete with a handrail on one side		Circa early 20th century		Section 2	Contributing
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Main Cave (Most sections paved with cave sediment, sometimes edged by placed rock, wooden dust catchers present)		Between Star Chamber and Violet City the trail is natural cave floor or cave sediment built by the CCC	Purposefully left undeveloped for lantern tour experience; dust is problematic	Section 3	Contributing
Fox Avenue		Natural passageway		Section 3	Contributes to the historic setting
Ranshaw Avenue		Natural passageway		Section 3	Contributes to the historic setting
Solitary Cave		Natural passageway		Section 3	Contributes to the historic setting
Coral Grove		Natural passageway		Section 3	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Rat Hole Branch		Natural passageway		Section 3	Contributes to the historic setting
Blue Spring Branch		Development moderate to allow for primitive cave experience		Section 3	Contributes to the historic setting
Blackall Avenue		The trail to Cul de Sac was excavated to allow for passage		Section 3	Contributes to the historic setting
Mayme's Stoop		Improved through excavation to facilitate passage		Section 3	Contributes to the historic setting
Stone steps present within Blackall Avenue		Built by or during 1930s		Section 3	Contributing
Albert's Stairway	HS #013016	1908; CCC added handrails circa 1933-1938		Section 3	Contributing
Steps from Elisabeth's Dome to Violet City		Steep double flight of stone stairs between Elisabeth's Dome and Violet City date of origin not determined		Section 3	Undetermined
Steps between Violet City and Violet City Entrance		Sixty-one concrete steps date of origin not determined		Section 3	Undetermined
Violet City Entrance	HS #090187	Morrison blasted opening in 1915; later expanded 1931		Section 3	Contributing
Ganter Avenue		Natural passageway		Section 3	Contributes to the historic setting
Rider Haggard's Flight		Flight of 100 stone steps		Section 3	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		connecting Ganter and Welcome Avenues built in 1880s			
Jessup Avenue		Development moderate to allow for primitive cave experience		Section 3	Contributes to the historic setting
Flint Alley		Natural passageway		Section 3	Contributes to the historic setting
Montie's Pass		Natural passageway		Section 3	Contributes to the historic setting
Lee's Way		Natural passageway		Section 3	Contributes to the historic setting
Minna's Way		Natural passageway		Section 3	Contributes to the historic setting
Edith's Avenue		Natural passageway		Section 3	Contributes to the historic setting
Boiled Egg Passage		Natural passageway		Section 3	Contributes to the historic setting
Section 4 – Carmichael Entrance to Aero-Bridge Canyon					
Cascade Hall (Waterfall Chamber)		Natural passageway		Section 4	Contributes to the historic setting
Silliman Avenue (El Ghor, Infernal Regions, Railroad Tunnel, Sillamon Avenue, Silliman's Avenue, Sillimon's Avenue)		Natural passageway		Section 4	Contributes to the historic setting
Welcome Avenue (Fox Avenue, Ganter Avenue, Sunset Avenue)		Important "escape route from remote parts of the cave. Discovered in 1879 and widened by guides		Section 4	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Mayfield's Avenue		Natural passageway		Section 4	Contributes to the historic setting
Elmore's Pass		Natural passageway		Section 4	Contributes to the historic setting
Valley Way Side Cut		Natural passageway		Section 4	Contributes to the historic setting
Shelly Avenue		Natural passageway		Section 4	Contributes to the historic setting
Roaring River		Natural passageway (stream)		Section 4	Contributes to the historic setting
Hooflands Avenue		Natural passageway		Section 4	Contributes to the historic setting
Pass of El Ghor (El Ghor, Pass of Algore, Pass of Elchor, Pass of Eli Ghor, Pass of El Gau)		Natural passageway		Section 4	Contributes to the historic setting
Stone steps between Pass of El Ghor and Mary's Vineyard		Jacob's Ladder originally connected El Ghor with Mary's Vineyard in 19th century	Stone steps replaced ladder during period of significance	Section 4	Contributing
Jacob's Ladder			*Former access route between El Ghor and Mary's Vineyard*	Section 4	*Missing*
Ike's Path		Natural passageway		Section 4	Contributes to the historic setting
Stevenson Avenue (Stephen Avenue)		Natural passageway		Section 4	Contributes to the historic setting
Burley's Way		Natural passageway		Section 4	Contributes to the historic setting
Sitgreave's Pass		Natural passageway		Section 4	Contributes to the historic setting
Opossum Avenue		Natural passageway		Section 4	Contributes to the historic setting
Rhoda's Arcade		Natural passageway		Section 4	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Section 5 – Upper Cave East of El Ghor to Aero-Bridge Canyon					
Carmichael Entrance (Cleaveland Entrance)	HS #090173	1931	CCC improvements 1930s; reconstructed 1965; doors replaced in kind in the 1970s; altered 1980 diminish integrity of feeling and materials	Section 5	Contributing
Tunnel and stairs between Carmichael Entrance and Cleaveland Avenue		Tunnel excavated 1931; 182 stairs built to reach Sandstone Avenue likely by 1969		Section 5	Contributing
Sandstone Avenue		Trail surfaced with cave sediment by CCC		Section 5	Contributing
Franklin Avenue		Natural passageway		Section 5	Contributes to the historic setting
Croghan Hall (Groghan's Hall, Grophan's Hall)		Natural passageway		Section 5	Contributes to the historic setting
Cleaveland Avenue (Carmichael Passageway, Cleaveland's Cabinet, Cleveland Avenue, Crystal Avenue, Crystal Chambers, Elindo Avenue, Rodes Avenue, Avenue of Roses and Diamonds, Sparkling Gypsum Avenue		Trail surfaced with cave sediment built by CCC	Sections later updated with concrete as part of the accessible trail, also present at bridges, steps, stairways, and handrails	Section 5	Contributing
Curving concrete steps at the junction of Sandstone and Cleaveland Avenues		Date of origin not determined		Section 5	Undetermined
Helen's Grotto (Helen's Hall)		Natural passageway		Section 5	Contributes to the historic setting
Rodgers Avenue (Specimen Avenue)		Natural passageway		Section 5	Contributes to the historic setting
Orpha's Garden (Donna's Garden, Orpheus's Garden)		Natural passageway		Section 5	Contributes to the historic setting
Clark's Avenue (Marion Avenue, Dollar Pass)		Natural passageway		Section 5	Contributes to the historic setting
Dollar Pass		Natural passageway		Section 5	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Miller Avenue		Natural passageway		Section 5	Contributes to the historic setting
Marion Avenue		Connected with the Elevator. Accessible trail surfaced with concrete. Date of origin not determined		Section 5	Undetermined
Metal bridge over a pit near Mary's Vineyard in Marion Avenue		Date of origin not determined		Section 5	Undetermined
George's Path		Natural passageway		Section 5	Contributes to the historic setting
Elevator Entrance (Snowball Entrance)		1958		Section 5	Contributing
Sophy's Avenue		Natural passageway		Section 5	Contributes to the historic setting
Dan's Avenue		Natural passageway		Section 5	Contributes to the historic setting
Stephen's Way (Walnut Avenue)		Natural passageway		Section 5	Contributes to the historic setting
Boone Avenue (Boone's Avenue, Martel Avenue)		Sections of the trail surfaced with soil sediment built by CCC	Sections have been updated with concrete trail surfaces, sometimes edged with metal handrails (steel and aluminum), sometimes edged by placed rock. Numerous concrete stairs	Section 5	Undetermined
Steps connecting Boone Avenue and Pilgrim Avenue		Need description, need date		Section 5	Undetermined
Cox Avenue (Genie's Pass)		Natural passageway		Section 5	Contributes to the historic setting
Rose's Pass (Boone Avenue, New Discovery Route, Rose's Way)		Natural passageway		Section 5	Contributes to the historic setting
Jeanne's Avenue (Boone Avenue, New Discovery Route)		Natural passageway		Section 5	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Ella's Grotto (Chaperon, Sheep Shelter)		Natural passageway		Section 5	Contributes to the historic setting
Grand Avenue (Kentucky Avenue, Crystal Avenue, Majestic Avenue, Onyx Avenue)		Cave sediment and piled and stacked rock trail surfaces and causeways, platforms, and switchbacks (e.g. Mount McKinley) edged with metal handrails date to Morrison and CCC construction, evidence of tram use in Aero-Bridge Canyon with cable	Trail has been improved with concrete surfaces and associated safety features in 2010s, diminishing integrity of feeling and materials	Section 5	Contributing
Woodbury Pass		Overlook at end of trail		Section 5	Contributes to the historic setting
Cliff Walk		*Trail followed narrow ledge at end of Woodbury Pass and was edged by handrails and associated with a footbridge no longer present*		*Section 5*	*Missing*
Section 6 – Lower Cave East of El Ghor-Belfry Avenue to Ultima Thule					
Belfry Avenue (Coral Avenue, Black Kettle Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Blackstone Avenue		Natural passageway		Section 6	Contributes to the historic setting
Coral Avenue		Natural passageway		Section 6	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Hell Hole		Natural passageway		Section 6	Contributes to the historic setting
Mammoth River (Hickel's Trickle, Little Roaring River)		Natural passageway		Section 6	Contributes to the historic setting
Nicholson Avenue		Natural passageway		Section 6	Contributes to the historic setting
Emmet's Ramble		Natural passageway		Section 6	Contributes to the historic setting
Emily's Avenue		Development moderate to allow for primitive cave experience		Section 6	Contributes to the historic setting
Emily's Puzzle		Natural passageway		Section 6	Contributes to the historic setting
Mystic River (Elephant Trunk)		Natural passageway		Section 6	Contributes to the historic setting
Bird Avenue (Byrd's Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Clinton Avenue		Natural passageway		Section 6	Contributes to the historic setting
Bottle Hall (Lantern Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Martel Avenue (Bransford Avenue, Nicholson Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Bransford Avenue (Black Kettle Avenue, Bransford Way, East Bransford Avenue, Martel Avenue, West Bransford Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Hawkins Pass (Hawkins' Way)		Natural passageway		Section 6	Contributes to the historic setting
Cathedral Domes Entrance		*Excavated by George Morrison in 1930 and connected to a flight of wooden stairs*	*Collapsed in 1931*	*Section 6*	*Missing*
Becky's Alley (The Narrows, Lida's Pass)		Development moderate to allow for		Section 6	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		primitive cave experience			
Lida's Pass (Carrie's Pass)		Natural passageway		Section 6	Contributes to the historic setting
Pilgrim Avenue (Lower Boone Avenue, Miriam Avenue, Pilgrims Avenue)		Natural passageway		Section 6	Contributes to the historic setting
Metal stair/ladder in Pilgrim Avenue connecting to Thorpe's Pit Trail		Likely present by 1969		Sections 5 and 6	Contributing
Thorpe's Pit Trail		Natural passageway		Section 6	Contributes to the historic setting
Pinson's Pass		Natural passageway		Section 6	Contributes to the historic setting
Bishop's Way		Natural passageway		Section 6	Contributes to the historic setting
Fishback Avenue		Natural passageway		Section 6	Contributes to the historic setting
Carrie's Pass		Natural passageway		Section 6	Contributes to the historic setting
Emerson's Pass (Dave's Lost Sea, Goat Alley)		Natural passageway		Section 6	Contributes to the historic setting
Goat Alley (Dave's Lost Sea, Emerson's Pass)		Natural passageway		Section 6	Contributes to the historic setting
Section 7 – Upper Level Aero-Bridge to Frozen Niagara					
Grand Avenue		Contains examples of Morrison era trail routes with stone steps, CCC era cave sediment, and piled rock travelways and causeways, Kyrock surfacing and metal handrails and guardrails from	Trail improvements such as concrete surfacing and metal handrails and guardrails dating to 2010s diminish integrity of feeling and materials	Section 7	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		the early to mid-20th century			
Switchbacks and narrow steps ascending Big Break		Stone steps and causeway built by CCC	Later improvements constructed of concrete		Undetermined
Concrete steps edged by metal handrails beyond Fairy Ceiling in Grand Avenue		Date of origin not determined		Section 7	Undetermined
Concrete steps edged by metal handrails at the entrance into Grand Central		Date of origin not determined		Section 7	Undetermined
Lover's Leap Route		*Old trail no longer in use in Hippodrome*		*Section 7*	*Contributes to the historic setting*
Adeline Avenue (Adeline's Avenue, Adeline's Passageway)		A narrow stairway connects two sections of the passage; date of origin not determined		Section 7	Undetermined
Sandy Avenue		Trail surfaced with cave sediment and sometimes edged by metal handrails, built by CCC		Section 7	Contributing
Entrance from New York Subway to Grand Central			*Closed 1967*	Section 7	*Missing*
Aluminum stairs at New York Subway entrance to Grand Central Station		1987		Section 7	Non-contributing
Causeway across Crystal Lake		Likely postdates period of significance			Non-contributing
Galvanized steel stair leading to Drapery Room		Likely postdates period of significance			Non-contributing
Frozen Niagara Entrance		Excavated by George Morrison in 1924	Steel doors set in coursed sandstone wall lead to a revolving door to control air flow. Metal catwalk,	Section 7	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
			metal stairs, concrete trail edged by stainless steel railings and metal mesh postdate period of significance and diminish integrity of feeling, materials, and design		
New York Subway		Manufactured grate and concrete surface likely postdates period of significance		Section 7	Non-contributing
Big Gypsum Avenue (Gypsum Avenue)		Natural passageway		Section 7	Contributes to the historic setting
New Entrance (Hotel Entrance)		Excavated by George Morrison in 1921; evidence of historic concrete walks based on saw marks in the formwork that replaced Morrison's original wooden stair	Exterior concrete steps and handrails added by NPS, interior addition of metal staircase and metal catwalks, concrete walk, concrete causeway, 1990s, closed to public use, diminishes integrity of feeling, materials, and design	Section 7	Contributing
Section 8 – Lower Level Ultima Thule to Frozen Niagara					
Fox Avenue		Partially developed passage once developed and now abandoned; trails generally primitive (no electric lighting)		Section 8	Contributes to the historic setting
College Heights Avenue		Natural passageway		Section 8	Contributes to the historic setting
Logan Avenue		Natural passageway		Section 8	Contributes to the historic setting

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Bransford Avenue (Black Kettle Avenue, Bransford Way, East Bransford Avenue, Martel Avenue, West Bransford Avenue)		Natural passageway		Section 8	Contributes to the historic setting
Robertson Avenue		Natural passageway		Section 8	Contributes to the historic setting
Goat Alley		Natural passageway		Section 8	Contributes to the historic setting
Nickerson Avenue (Carl Avenue, New Avenue)		Partially developed passage once developed and now abandoned; trails generally primitive (no electric lighting)		Section 8	Contributes to the historic setting
Buildings					
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave					
Consumptive Hut #1	HS #000888	1842		Section 1	Contributing
Consumptive Hut #2	HS #005019	1842		Section 1	Contributing
Wooden tuberculin huts		*1842-1843*		*Section 1*	*Missing*
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Great Relief Restrooms		1953		Section 2	Contributing
Section 5 – Upper Cave East of El Ghor to Aero-Bridge Canyon					
Elevator		1958	Aboveground structure altered and has lost integrity		Non-contributing
Snowball Room Restrooms		1957		Section 5	Contributing
Snowball Room Preparation Room		1958		Section 5	Contributing
Mount McKinley Restrooms		1965		Section 5	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Structures					
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave					
Metal gate at Historic Entrance		1990		Section 1	Non-contributing
Ventilation air shaft established to provide cool air to the hotel and visitor center		1959	No longer in use due to radon concerns	Section 1 (Houchins Narrows)	Contributing
Tulip poplar saltpetre mining pipes	HS #007611	Circa 1810		Section 1 (Houchins Narrows, Rotunda, Broadway)	Contributing
Leaching Vat #1 at Rotunda	HS #000887	Circa 1810		Section 1 (Rotunda)	Contributing
Leaching Vat #2 at Rotunda	HS #0005007	Circa 1810		Section 1 (Rotunda)	Contributing
Leaching Vat #3 at Rotunda	HS #0005008	Circa 1810		Section 1 (Rotunda)	Contributing
Rotunda Drain Tank	HS #0005015	Circa 1810		Section 1 (Rotunda)	Contributing
Stacked stone retaining walls that elevate the visitor walks within the Rotunda to view inside the leaching vats		Date of origin not determined		Section 1 (Rotunda)	Undetermined
Metal gates limiting access to passages beyond self-guided tour area in Broadway and Audubon Avenue		Likely postdate period of significance		Section 1 (Broadway, Audubon Avenue)	Non-contributing
Leaching Vat #1 at Booth's Amphitheater	HS #005009	Circa 1810		Section 1 (Broadway)	Contributing
Leaching Vat #2 at Booth's Amphitheater	HS #005010	Circa 1810		Section 1 (Broadway)	Contributing
Leaching Vat #3 at Booth's Amphitheater	HS #005011	Circa 1810		Section 1 (Broadway)	Contributing
Leaching Vat #4 at Booth's Amphitheater	HS #005012	Circa 1810		Section 1 (Broadway)	Contributing
Leaching Vat #5 at the Booth's Amphitheater	*HS #005009*	*1810*		*Section 1*	*Missing*
Leaching Vat #6 at the Booth's Amphitheater	HS #005014	Circa 1810		Section 1 (Broadway)	Contributing
Metal catwalk and stair structure near Booth's Amphitheater		Mission 66		Section 1 (Broadway)	Contributing
Stacked rock walls along Audubon Avenue		19th century		Section 1 (Audubon Avenue)	Contributing
Mushroom beds	HS #007610	1882	Remnants of commercial mushroom growing operation composed of six	Section 1 (Audubon Avenue)	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
			stacked stone wall based bedding areas		
Wooden platform in Rafinesque Hall for viewing Lookout Mountain		Date of origin not determined		Section 1 (Audubon Avenue)	Undetermined
Rock steps and walls leading to Olive's Bower	HS #007609	Circa 1880		Section 1 (Audubon Avenue)	Contributing
Rock wall at the base of Bridal Altar	HS #007607	1950s		Section 1 (Gothic Avenue)	Contributing
Rock wall at the base of Jenny Lind's Arm Chair	HS #007604	1950s		Section 1 (Gothic Avenue)	Contributing
Rock walls in Gothic Avenue	HS #007602	1825-1925		Section 1 (Gothic Avenue)	Contributing
Curved rock wall in Gothic Avenue		1953		Section 1 (Gothic Avenue)	Contributing
Rock wall at the end of Gothic Avenue near the entrance to Elbow Crevice	HS #007603	1950s		Section 1 (Gothic Avenue)	Contributing
Rock wall used to limit passage at the end of Harvey Avenue		1970s	Use to limit access by visitors during the self-guided tour era	Section 1 (Harvey Avenue)	Non-Contributing
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Metal grate catwalk used to cross Side Saddle Pit		Date of origin not determined		Section 2 (Black Snake Avenue)	Undetermined
Steel grate bridge edged by stainless steel railings inset with metal mesh panels over Bottomless Pit		Postdates period of significance		Section 2 (Black Snake Avenue)	Non-contributing
Wall blocking entry from Black Snake Avenue to Bottomless Pit		Date of origin not determined		Section 2 (Black Snake Avenue)	Undetermined
Concrete catchment basin at Richardson's Spring		Likely by 1969		Section 2 (Black Snake Avenue)	Contributing
Wooden bridge across Gorin's Dome		Date of origin not determined		Section 2 (Darnall's Way)	Undetermined
Sewage lift station behind Great Relief Hall Restrooms		Postdates period of significance		Section 2 (Great Relief Hall)	Non-contributing
Stone wall outside the Great Relief Restrooms		Postdates period of significance		Section 2 (Great Relief Hall)	Non-contributing
Stone wall edging the trail beyond Great Relief Hall		Postdates period of significance		Section 2 (Great Relief Hall)	Non-contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Mortared rock wall at Vanderbilt University Hall		Early 20th century		Section 2 (Bandit Hall)	Contributing
Former restroom features in Vanderbilt University Hall		Early 20th century		Section 2 (Bandit Hall)	Contributing
Boat landing at Echo River		Likely by 1969		Section 2 (Echo River)	Contributing
Steel I-beams in Sparks Avenue		1970s		Section 2 (Sparks Avenue)	Non-contributing
Metal bridge structure and chain link fencing crossing of Dead Sea		Likely by 1969		Section 2 (River Styx)	Contributing
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Cable and pulley system used to free the mummified remains of a prehistoric miner at Mummy Ledge		1935		Section 3 (Main Cave)	Contributing
Violet City Entrance	HS #090187	1931	Added by George Carmichael	Section 3 (Main Cave)	Contributing
Section 5 – Upper Cave East of El Ghor to Aero-Bridge Canyon					
Carmichael Entrance (Entrance No. 4)	HS #090173	1930s built by CCC	Doors replaced in kind in the 1970s		Contributing
Stone foundation ruins of former women's restroom facilities		Likely by 1969		Section 5 (Marion Avenue)	Contributing
Concrete platform for visitor placement of lanterns		Likely by 1969		Section 5 (Marion Avenue)	Contributing
Steel bridge structure conveys Marion Avenue over a pit near Mary's Vineyard		Date of origin not determined		Section 5 (Marion Avenue)	Undetermined
Aero-Bridge Canyon tram cable	HS #007606	1921-1922	George Morrison	Section 5 (Grand Avenue)	Contributing
Wooden platform and cable car associated with Aero-Bridge Canyon tram		*1921-1922*	*George Morrison*	Section 5 (Grand Avenue)	*Missing*
Section 6 – Lower Cave East of El Ghor—Belfry Avenue to Ultima Thule					
Cathedral Domes Entrance wooden staircase		*1930-1931*	*George Morrison*	Section 6 (Bishop's Way)	*Missing*

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Section 7 – Upper Level Aero-Bridge to Frozen Niagara					
Frozen Niagara Entrance	HS #005566	1924	Altered 1933-1941	Section 7	Contributing
New Entrance	HS #000121	1921	Closed to public use in 1967	Section 7	Contributing
Crystal Lake Landing		Likely by 1969	Used for boat tours by George Morrison	Section 7 (Frozen Niagara)	Contributing
Small-scale Features					
Commemorative Features					
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave					
World War I commemorative markers		1922; reset 2018	Recognize local World War I soldiers	Section 1 (Rotunda)	Contributing
Gothic Avenue monuments and cairns	HS #007602	1825-1925		Section 1 (Gothic Avenue)	Contributing
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Vanderbilt University plaque		1907		Section 2 (Bandit Hall)	Contributing
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Monument Hill cairns and monuments		Late 19th and early 20th centuries		Section 3 (Main Cave)	Contributing
Section 8 – Lower Level Ultima Thule to Frozen Niagara					
College Heights Avenue plaque		Reads "College Heights Avenue. Honoring Western Kentucky State Teacher's College whose class in physiography was the first party to explore		Section 8 (College Heights Avenue)	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
		these passages October 20, 1928. Dedicated May 20, 1929."			
Site Furnishings					
Bench near the steel stairs in Gothic Avenue		Likely postdates 1969		Section 1 (Gothic Avenue)	Non-contributing
Benches by curved rock wall in Gothic Avenue		1953		Section 1 (Gothic Avenue)	Contributing
Wooden benches near Jenny Lind's Arm Chair		Date of origin not determined		Section 1 (Gothic Avenue)	Undetermined
Two rows of benches in Star Chamber		Date of origin not determined		Section 1 (Main Cave)	Undetermined
Lantern hangers		19th and early 20th centuries		Section 1 (Main Cave)	Contributing
Wooden boxes for guides to store props		Date of origin not determined		Section 1 (Main Cave)	Undetermined
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Stone and concrete benches outside the Great Relief Restrooms		Date of origin not determined		Section 2 (Great Relief Hall)	Undetermined
Drinking fountain near Great Relief Restrooms		Circa 1950s		Section 2 (Great Relief Hall)	Contributing
Rows of metal benches in River Hall		Date of origin not determined		Section 2 (River Hall)	Undetermined
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Wood and concrete benches along the trail in Chief City (two sets)		By 1969		Section 3 (Main Cave)	Contributing
Section 5 – Upper Cave East of El Ghor to Aero-Bridge Canyon					
Picnic tables in Snowball Dining Room		Date of origin not determined		Section 5 (Cleaveland Avenue)	Undetermined
Exposed aggregate drinking fountains at Snowball Dining Room		1950s		Section 5 (Cleaveland Avenue)	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Stone and concrete benches near the Snowball Room Restrooms		Date of origin not determined		Section 5 (Cleaveland Avenue)	Undetermined
Stone veneered concrete benches near the Mount McKinley Restrooms		Date of origin not determined		Section 5 (Grand Avenue)	Undetermined
Section 7 – Upper Level Aero-Bridge to Frozen Niagara					
Twenty rows of wooden benches in Grand Central Station		Date of origin not determined		Section 7 (Grand Avenue)	Undetermined
Wooden benches beneath the stalactites associated with Fairy Ceiling		Date of origin not determined		Section 7 (Grand Avenue)	Undetermined
Signs					
Section 1 – Historic Upper Level (Historic Entrance to "S" Bend at Main Cave					
Wayside exhibits and artifact display cases		Postdate period of significance		Section 1 (Rotunda, Audubon Avenue)	Non-contributing
Glass case used to display Lost John		After 1935		Section 1 (Cyclops Gateway)	Contributing
Section 2 – Historic Cave Lower Level (Black Snake Avenue and Gratz Avenue to River Styx)					
Fat Man's Misery identity sign		Date of origin not determined		Section 2 (Fat Man's Misery)	Undetermined
Bottomless Pit identity sign		Date of origin not determined		Section 2 (Black Snake Avenue)	Undetermined
High water markers in River Hall and river gauge features		Date of origin not determined		Section 2 (River Hall, Odd Fellows Hall, Bandit Hall)	Undetermined
Section 3 – Upper Level between "S" Bend near Wright's Rotunda and Violet City Entrance					
Walker survey markers		1935-1936		Sections 3, 5 (various locations)	Contributing
Section 4 – Carmichael Entrance to Aero-Bridge Canyon					
Hooflands Tonic advertisement painted on wall		Circa 1869		Section 4 (Hooflands Avenue)	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Utility features					
Chain link fencing, railings, and barriers to protect visitors and formations		Date of origin not determined		Throughout many toured sections of Mammoth Cave (Dead Sea, Black Hole of Calcutta, Adeline Avenue, Onyx Colonnade, Frozen Niagara)	Undetermined
Upright light poles		Circa 1950s			Contributing
Electrical light system composed of black cable and cone lights, light system switchboxes		Postdate period of significance		Throughout many toured sections of Mammoth Cave	Non-contributing
Electrical transformers/junction boxes		Postdate period of significance		Throughout many toured sections of Mammoth Cave	Non-contributing
Light fixture attachments to cave walls		1960s or 1970s		Section 5 (Boone Avenue)	Non-contributing
Evidence of former electrical wiring attachment to walls using concrete slurry		Date of origin not determined		Section 5 (Jeanne's Avenue)	Undetermined
Atmospheric stations (ultrasonic anemometers)		1996-1999 (wind vane anemometer); 2012 (ultrasonic anemometer)	Ultrasonic anemometers in Houchins Narrows, Gothic Avenue, stations in Broadway, Corkscrew, Audubon Avenue, Little Bat Avenue, Booths Amphitheater, Standing Rocks, Rafinesque Hall, Vespertilio Hall	Several locations	Non-contributing
Telephone boxes		Likely postdates 1969			Non-contributing
Transformer pads in Gothic Avenue, Sparks Avenue, Frozen Niagara		Likely postdates 1969		Section 1 Section 2	Non-contributing
Upside down well		1950s		Section 5 (Cleaveland Avenue)	Contributing
Electrical drop pipe		Date of origin not determined		Section 5 (Grand Avenue)	Undetermined
Pipe to convey water near Cathedral Domes		By 1969		Section 6 (Bishop's Way)	Contributing

Feature	CRIS Resource ID Number	Date of Origin	Alterations	Section	Contributing Status
Archeological Resources					
Petroglyphs					
Signatures					
Evidence of lighting the interior of Wright's Rotunda using oil soaked rags					
High concentration of American Indian artifacts, Ganter Avenue (burned cane reeds, gourds, slippers, copperlites)					
Maul trapped by fallen rock near Moving Mountain, Grand Avenue					
Tourism artifacts (lamps/lanterns, newspapers, wine bottles, food wrappers)					

Appendix B: Passages for Inclusion in the Mammoth Cave Historic District

Passages for Inclusion in the Mammoth Cave Historic District

Toured (Current)

Houchins Narrows

Rotunda

Audubon Ave

Rafinesque Hall

Broadway

Methodist Church (The Church)

Booths Amphitheatre

Giants Coffin

Main Cave

Indian Ave

Star Chamber

Proctors Arcade

Snow Room

Kinneys Arena

"S" Bend

Wrights Rotunda

Cataracts

Bryans Pass

Settles Gorge

Chief City

St Catherine City

Waldach Dome

Hains Dome

Maymes Stoop

Anzers Hall

Ultima Thule

Kaemper Hall

Elizabeths Dome

Alberts Staircase

Violet City

Gothic Ave

Dantes Gateway

Wooden Bowl Room

Steps of Time

Blacksnake Ave

Bottomless Pit

Valley of Humility

Scotchmans Trap

Grecian Bend

Fat Man's Misery

Great Relief Hall

River Hall

River Styx Trail

Orpheus Pass

Bandits Hall

Vanderbilt University Hall

Sparks Ave

Mammoth Dome

Ruins of Karnak

Little Bat Ave

Ganter Ave (part)

Jessup Ave (part)

Carmichael Ent

Sandstone Ave

Cleaveland Ave

Cleaveland Ave side passages

Orphas Garden

Clark Ave

Dollar Pass

Cleaveland's Cabinet

Snowball Room

Marion Ave (part)

Washington Hall

Marys Vineyard

Boone Ave

Roses Pass

Jeannes Ave

Kentucky Avenue

Mt McKinley

Grand Canyon

Aerobridge Canyon

Hippodrome

Wine Cellar

Grand Central Station

New Entrance

Roosevelt Dome

Fossil Dome

Fountain of Youth

Silo Pit

King Solomons Temple

New York Subway

New York Subway side passage

Big Break

Fairy Ceiling

Sandy Ave

Lovers Leap

Flat Ceiling

Thanksgiving Hall

Drapery Room

Onyx Colonnade

Crystal Lake overlook

Rainbow Dome

Frozen Niagara Ent

Pilgrim Ave

Pinsons Pass

Lantern Room

Martel Ave

Hawkins Pass

Cathedral Domes

Beckys Alley

Lidas Pass

Gretas Grotto

Carries Pass

Goat Alley

Robertson

Nickerson

Fox Ave

Big Gypsum

Big Break

Compass Needle

College Heights Blvd

Toured (Former)

Lookout Mountain

Bunker Hill

Mushroom Beds

Olives Bower

Corkscrew

Cyclops Gateway

Black Chambers

Cross Cave/(Fox Ave)

Solitary Cave

Fairy Grotto

Blue Springs Branch

Blackall Ave (Sims Pit Branch)

Gratz Ave

Calypso

Scylla/Charybdis

Labyrinth

Pensicola Ave

Lively Way

Great Relief Hall (part)

Charons Cascade

Briggs Ave

Charlottes Dome

Sylvan Ave

Wyatts Domes

Echo River

Sahara Desert

Mineahaha Island

Cascade Hall

Silliman Ave

Pass of El Gohr

Valley Way Side Cut

Welcome Ave

Ganter Ave (all)

Jessup Ave (all)

Franklin Ave

Croghan Hall

Maelstrom

Specimen Ave

Marion Ave

Morrison Ave

Woodbury Pass

Upper Route Hippodrome to Grand Central

KEA Room

Radio Room

Crystal Lake Boat landing and ride

Pre-Contact (Prehistoric) Exploration

Historic Ent to Ultima Thule

Blue Spring Branch

Blackall Avenue

Black Chambers

Indian Avenue

Cyclops

Solitary Cave

Black Snake (steps of time to bottemless)

Ganter

Harvey's Way

Lost Way

Wilson Way

Abo Avenue

Robbin's Run

Jessup, Flint Alley

Ranshaw, Minna, Boiled Egg

Gothic

Gratz

Audubon

Watson Trace

Little Bat

Corkscrew

Vanderbilt

Briggs

Sparks

Sylvan

Forts - Gaults- Gallows

National Park Service
U.S. Department of the Interior

Mammoth Cave Historic District
Mammoth Cave National Park
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Mammoth Cave, Kentucky 42259-0007

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