



# Foundation Document

## Timpanogos Cave National Monument

Utah

October 2016

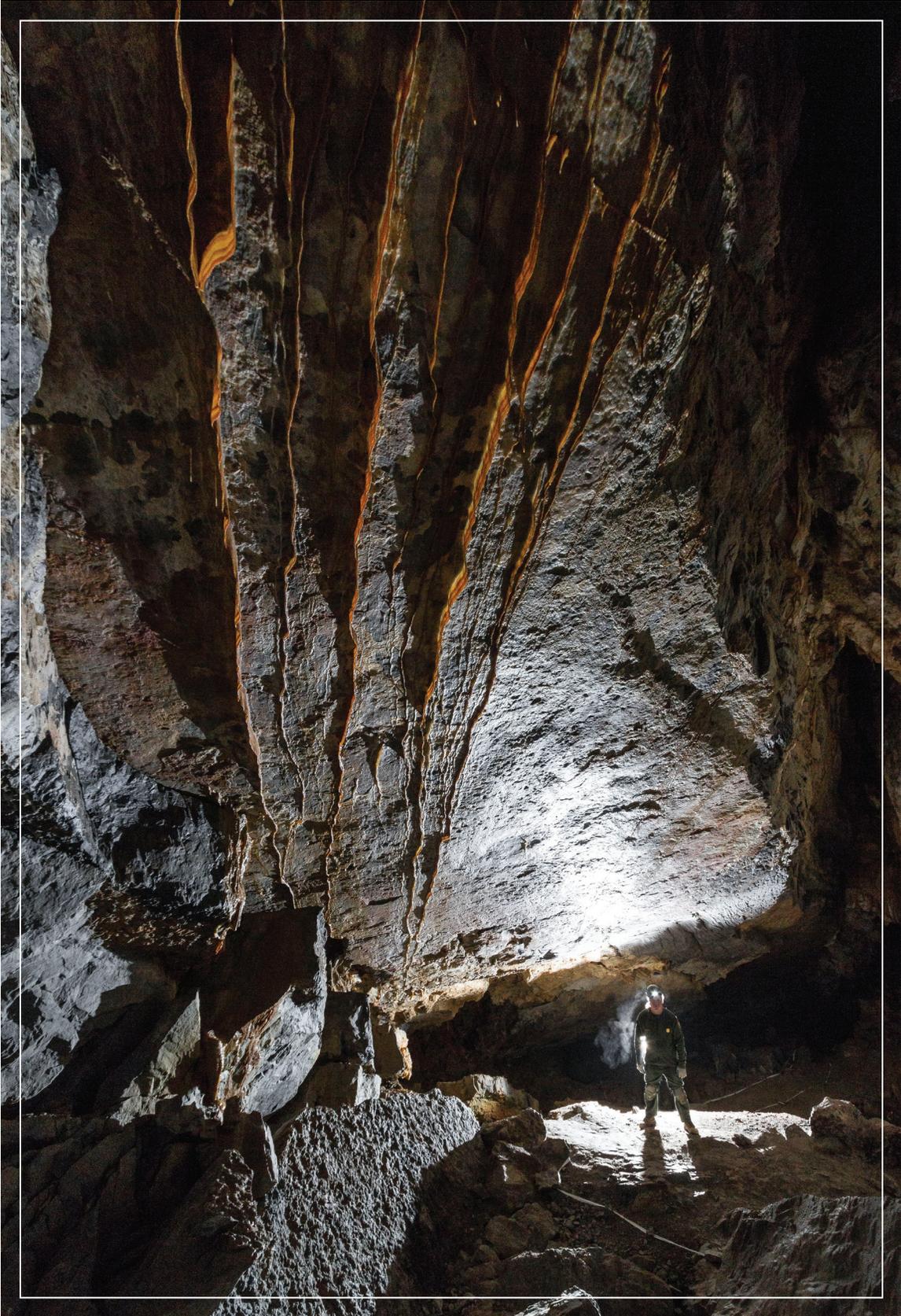




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## Mission of the National Park Service

The National Park Service (NPS) preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The National Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

The NPS core values are a framework in which the National Park Service accomplishes its mission. They express the manner in which, both individually and collectively, the National Park Service pursues its mission. The NPS core values are:

- **Shared stewardship:** We share a commitment to resource stewardship with the global preservation community.
- **Excellence:** We strive continually to learn and improve so that we may achieve the highest ideals of public service.
- **Integrity:** We deal honestly and fairly with the public and one another.
- **Tradition:** We are proud of it; we learn from it; we are not bound by it.
- **Respect:** We embrace each other's differences so that we may enrich the well-being of everyone.

The National Park Service is a bureau within the Department of the Interior. While numerous national park system units were created prior to 1916, it was not until August 25, 1916, that President Woodrow Wilson signed the National Park Service Organic Act formally establishing the National Park Service.

The national park system continues to grow and comprises more than 400 park units covering more than 84 million acres in every state, the District of Columbia, American Samoa, Guam, Puerto Rico, and the Virgin Islands. These units include, but are not limited to, national parks, monuments, battlefields, military parks, historical parks, historic sites, lakeshores, seashores, recreation areas, scenic rivers and trails, and the White House. The variety and diversity of park units throughout the nation require a strong commitment to resource stewardship and management to ensure both the protection and enjoyment of these resources for future generations.



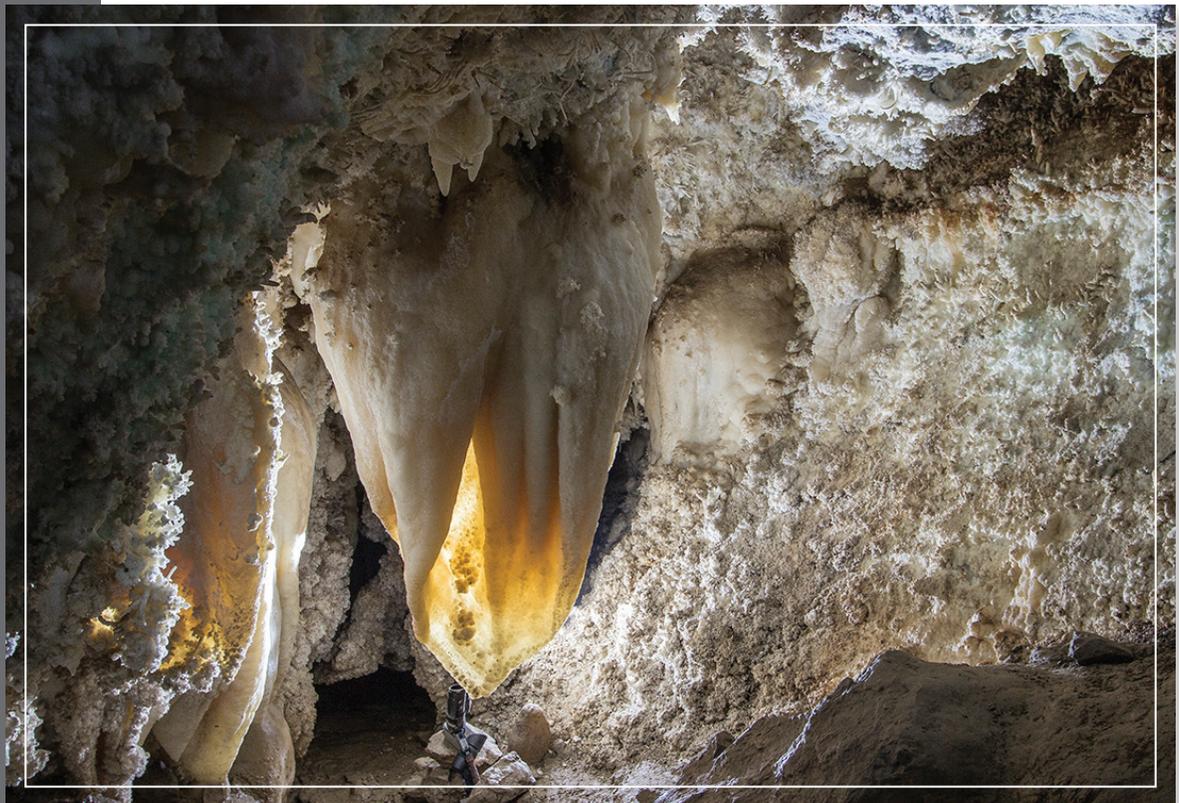
*The arrowhead was authorized as the official National Park Service emblem by the Secretary of the Interior on July 20, 1951. The sequoia tree and bison represent vegetation and wildlife, the mountains and water represent scenic and recreational values, and the arrowhead represents historical and archeological values.*

## Introduction

Every unit of the national park system will have a foundational document to provide basic guidance for planning and management decisions—a foundation for planning and management. The core components of a foundation document include a brief description of the park as well as the park’s purpose, significance, fundamental resources and values, other important resources and values, and interpretive themes. The foundation document also includes special mandates and administrative commitments, an assessment of planning and data needs that identifies planning issues, planning products to be developed, and the associated studies and data required for park planning. Along with the core components, the assessment provides a focus for park planning activities and establishes a baseline from which planning documents are developed.

A primary benefit of developing a foundation document is the opportunity to integrate and coordinate all kinds and levels of planning from a single, shared understanding of what is most important about the park. The process of developing a foundation document begins with gathering and integrating information about the park. Next, this information is refined and focused to determine what the most important attributes of the park are. The process of preparing a foundation document aids park managers, staff, and the public in identifying and clearly stating in one document the essential information that is necessary for park management to consider when determining future planning efforts, outlining key planning issues, and protecting resources and values that are integral to park purpose and identity.

While not included in this document, a park atlas is also part of a foundation project. The atlas is a series of maps compiled from available geographic information system (GIS) data on natural and cultural resources, visitor use patterns, facilities, and other topics. It serves as a GIS-based support tool for planning and park operations. The atlas is published as a (hard copy) paper product and as geospatial data for use in a web mapping environment. The park atlas for Timpanogos Cave National Monument can be accessed online at: <http://insideparkatlas.nps.gov/>.



## Part 1: Core Components

The core components of a foundation document include a brief description of the park, park purpose, significance statements, fundamental resources and values, other important resources and values, and interpretive themes. These components are core because they typically do not change over time. Core components are expected to be used in future planning and management efforts.

### Brief Description of the Park

Timpanogos Cave National Monument consists of 250 acres in the rugged American Fork Canyon within a 30-minute drive for more than 1 million residents of the rapidly growing southern Wasatch Front, equidistant from Salt Lake City 30 miles to the north and Provo to the south. The monument is primarily on the northern slope of 11,750-foot Mount Timpanogos and is surrounded by the Uinta-Wasatch-Cache National Forest.

The monument contains nine known caves including Timpanogos, Hansen, and Middle Caves, connected by artificial tunnels blasted in the 1930s, and together referred to as the Timpanogos Cave System. The Timpanogos Cave System runs along a fault zone roughly perpendicular to the nearby Wasatch Fault. The caves have become best known for the diversity and coloration of speleothems, and unusual speleogenesis, involving rising hydrothermal waters mixing with colder groundwater at the water table to dissolve the limestone along these faults. The other caves include the Grotto, a waiting area for tour operations, while the others are infrequently visited due to their small size, cliff exposure, and safety concerns related to access.

The limestone caves can only be reached by a challenging 1.5-mile hike up a paved trail with a nearly 1,100-foot elevation gain. The zigzag trail passes through native ecosystems that vary with elevation, offering the opportunity to view a variety of wildflowers that grow beneath Douglas-fir, white fir, maple, gambel oak, chipmunks, golden-mantled ground squirrels, lizards, and many bird species can also be seen along the trail. While traveling to the caves, visitors get an introduction to area geology while hiking past more than 200 million years of geologic time as they ascend the mountain passing many geologic layers. The grade of the trail provides a challenge to all visitors regardless of physical fitness level. Rockfall from the steep canyon walls is a safety concern, with particularly hazardous trail sections marked with a painted stripe where visitors are advised not to stop along the trail. The winding, scenic route offers outstanding panoramic views of American Fork Canyon, the Wasatch Range, and Utah Valley.





Visitor access to the caves is limited to ranger-guided cave tours, which are currently offered approximately 35 to 40 times daily throughout the summer season. The 55-minute cave tour is limited to 16 people and travels 0.5 mile along a surfaced, lighted route. Tours begin at the entrance to Hansen Cave, traveling through human-made tunnels to Middle Cave, then Timpanogos. The narrow passages and chambers reveal extraordinary cave features throughout the experience. The diversity of speleothems, including stalactites, draperies, and helictes in a variety of colors make the caves a memorable experience for visitors. The Great Heart of Timpanogos, a large stalactite, has long been a visitor favorite, as well as the abundance of helictes seen throughout the tour. While unseen, the cave environment contributes to the visitor experience with cool temperatures, high humidity, and occasionally the rarely seen, but ever present biodiversity of life forms in the caves.

Cave resources require careful management and documentation. Underground resources are generally insulated by the surrounding rock providing stable temperatures, airflow, and hydrology for cave ecosystems. However, changes in climate and surface management can create what may be perceived as small alterations but result in significant impacts on resources dependent on an unchanging environment.

In addition to the historic cave trail and the caves themselves, the monument maintains a visitor contact station, picnic areas, and a self-guided interpretive nature trail along the floor of the canyon.

The monument's mission is to preserve the cultural, natural, and scientific resources of the area, specifically the Timpanogos Cave System, while providing public use and enjoyment.

## Park Purpose

The purpose statement identifies the specific reason(s) for establishment of a particular park. The purpose statement for Timpanogos Cave National Monument was drafted through a careful analysis of its enabling legislation and the legislative history that influenced its development. The park was established when Warren G. Harding signed Presidential Proclamation 1640 on October 14, 1922 (see appendix A for enabling legislation). The purpose statement lays the foundation for understanding what is most important about the park.

*TIMPANOGOS CAVE NATIONAL MONUMENT  
protects a scientifically important high-  
elevation, fault-controlled cave system  
and associated natural processes while  
promoting research, public understanding,  
stewardship, and enjoyment.*

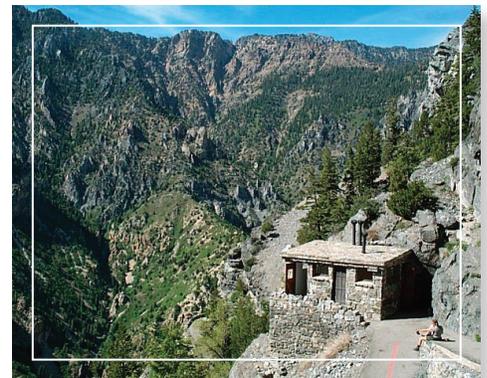


## Park Significance

Significance statements express why a park's resources and values are important enough to merit designation as a unit of the national park system. These statements are linked to the purpose of Timpanogos Cave National Monument, and are supported by data, research, and consensus. Statements of significance describe the distinctive nature of the park and why an area is important within a global, national, regional, and systemwide context. They focus on the most important resources and values that will assist in park planning and management.

The following significance statements have been identified for Timpanogos Cave National Monument. (Please note that the sequence of the statements does not reflect the level of significance.)

1. **Cave System.** The well-preserved, high-elevation cave system showcases delicate ecosystems with an abundance of cave formations in a variety of forms and colors, providing opportunity for scientific discovery and intimate access to the resources.
2. **Cave Geology.** A unique intersection of geological processes continues to create the canyon and caves. This began with rising hydrothermal fluids mixing with the water table dissolving passages and precipitating minerals along faults, resulting in an unusual combination of colored speleothems.
3. **Cave Trail.** The challenging 1.5 mile-long trail to the cave system ascends 1,067 feet, providing visitors the rare opportunity to hike through more than 200 million years of geologic time and immerses them in the constantly evolving landscape of American Fork Canyon and its rich diversity of wildlife and vegetation.
4. **Human Component.** The establishment of the monument in the early 20th century is a remarkable example of visionary, determined efforts by local citizens to protect an extraordinary natural resource. Today, its proximity to an ever-growing urban community provides opportunities for a diverse group of visitors to experience this preserved natural setting.



## Fundamental Resources and Values

Fundamental resources and values (FRVs) are those features, systems, processes, experiences, stories, scenes, sounds, smells, or other attributes determined to warrant primary consideration during planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance. Fundamental resources and values are closely related to a park's legislative purpose and are more specific than significance statements.

Fundamental resources and values help focus planning and management efforts on what is truly significant about the park. One of the most important responsibilities of NPS managers is to ensure the conservation and public enjoyment of those qualities that are essential (fundamental) to achieving the purpose of the park and maintaining its significance. If fundamental resources and values are allowed to deteriorate, the park purpose and/or significance could be jeopardized.

The following fundamental resources and values have been identified for Timpanogos Cave National Monument:

- Cave System.** This includes the entire cave system and its features, including developed, undeveloped, and undiscovered areas; the cave environment itself, including air flow, water flow, temperature, and scenery; subterranean lakes and seeping water; the overlying landscape and its geophysical features; and biological life including crickets, cave spiders, bats, and other life that makes up the cave ecosystem. This extends to the internal infrastructure that makes cave tours possible including lights, trails, handrails, tunnels, and doors that enable safe visitor movement in the caves.
- Visitor Experience.** Visitors to Timpanogos Cave National Monument have the opportunity to experience challenging recreation, the canyon soundscape, and exceptional cave resources in American Fork Canyon. The narrow cave passages provide visitors with a memorable experience while exposing them to a variety of speleothem types and colors that are unique to caves in the National Park Service. The initial discovery and subsequent preservation efforts by local citizens galvanized a tradition of preservation, stewardship, and enjoyment of the monument's resources. Because it is the only NPS unit within the greater Salt Lake City-Provo metropolitan area, the monument has an opportunity to provide outreach, awareness, recreation, and education to a young and rapidly growing urban population.
- Opportunities for Scientific Study.** Scientific interest has influenced the understanding of the complex geologic processes in the monument. The unique conditions and properties that contributed to the speleogenesis of the caves and in the continuing development of the subterranean environment and features are studied through geology, seismology, hydrology, biology, and other disciplines of speleology. All these research areas contribute to the body of knowledge shared with visitors, management, and researchers worldwide. Continued scientific research in the monument increases the ability to understand, interpret, and protect the resources and contributes to the broader fields of geoscience and climate change.
- Cave Trail.** The trail to the cave system is the hub of the monument. While initially built for access to the caves, it has become a fundamental resource in its own right and has become a destination for many monument visitors. With an average grade of 13%, the trail provides a challenging means of enjoying American Fork Canyon and the surrounding flora and fauna.



## Other Important Resources and Values

Timpanogos Cave National Monument contains other resources and values that are not fundamental to the purpose of the park and may be unrelated to its significance, but are important to consider in planning processes. These are referred to as “other important resources and values” (OIRV). These resources and values have been selected because they are important in the operation and management of the park and warrant special consideration in park planning.

The following other important resources and values have been identified for Timpanogos Cave National Monument:

- **Cultural Resources.** Historic structures associated with early monument and cave tour operations span a period of significance from 1921–1953. The majority of these structures are in the Camp Cave area and include the Rock House, comfort stations, bridge, and elements of the historic trail. In addition, the park contains extensive native stone masonry, mostly constructed by Works Progress Administration enrollees. The Timpanogos Cave Historic District was listed in the National Register of Historic Places in 1982 and retains its architectural integrity. Other structures within the monument eligible for listing in the National Register of Historic Places include the lower portion of the Cave Trail, the bridge to the administrative offices, cave tunnels, grotto, historic infrastructure inside the caves, and other historic resources.
- **Surface Ecosystem.** Mount Timpanogos and American Fork Canyon have a valuable ecosystem protected by the National Park Service. The American Fork River runs through the center of the canyon, bisecting the subalpine vegetation on the canyon and supporting varied wildlife inhabiting the monument.



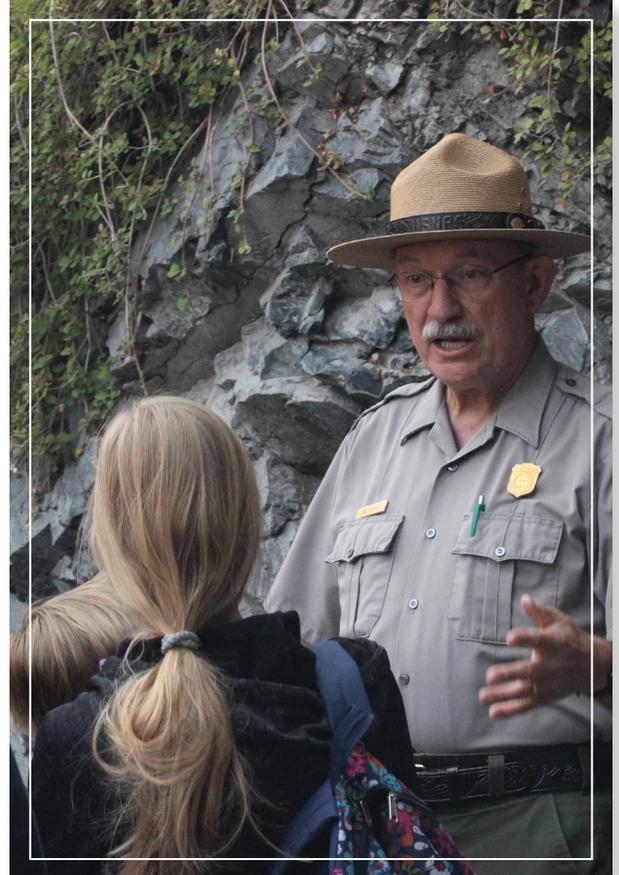
## Interpretive Themes

Interpretive themes are often described as the key stories or concepts that visitors should understand after visiting a park—they define the most important ideas or concepts communicated to visitors about a park unit. Themes are derived from, and should reflect, park purpose, significance, resources, and values. The set of interpretive themes is complete when it provides the structure necessary for park staff to develop opportunities for visitors to explore and relate to all park significance statements and fundamental and other important resources and values.

Interpretive themes are an organizational tool that reveal and clarify meaning, concepts, contexts, and values represented by park resources. Sound themes are accurate and reflect current scholarship and science. They encourage exploration of the context in which events or natural processes occurred and the effects of those events and processes. Interpretive themes go beyond a mere description of the event or process to foster multiple opportunities to experience and consider the park and its resources. These themes help explain why a park story is relevant to people who may otherwise be unaware of connections they have to an event, time, or place associated with the park.

The following interpretive themes have been identified for Timpanogos Cave National Monument:

- **Geology.** Formed through complex geologic processes, the narrow fault-controlled passages of the well-preserved, high-elevation Timpanogos Cave System provides an intimate experience with abundant cave formations in a variety of forms and colors. This diverse environment affords the opportunity for personal connections through cave science, research, and new discoveries.
- **Natural History.** Timpanogos Cave National Monument illustrates natural processes such as the water cycle, air quality, and ecological and climatological changes. The cave system and narrow, rocky canyon walls provide habitat for a variety of plants and animals, demonstrating the diversity, adaptability, and complexity of nature in the eastern Great Basin and western Rocky Mountains.
- **Cultural History.** American Fork Canyon has provided food, water, shelter, and recreation to generations of people over hundreds of years. Understanding the dynamic human influences on the region provides perspective and awareness of the relationship between people, the land, and its fragile resources.
- **Preservation and Stewardship.** The establishment of the monument in the early 20th century is a remarkable example of visionary, determined efforts by local citizens to protect an extraordinary resource for its beauty and scientific value. The legacy of these early preservationists leads to a continued tradition of preservation and stewardship of Timpanogos Cave National Monument.
- **Recreation.** The steep 1.5-mile trail provides a challenging and physically invigorating experience that immerses visitors in the constantly evolving landscape of American Fork Canyon, its rich diversity of wildlife and vegetation, and promotes physical fitness and a greater appreciation for the natural world.



## Part 2: Dynamic Components

The dynamic components of a foundation document include special mandates and administrative commitments and an assessment of planning and data needs. These components are dynamic because they will change over time. New special mandates can be established and new administrative commitments made. As conditions and trends of fundamental and other important resources and values change over time, the analysis of planning and data needs will need to be revisited and revised, along with key issues. Therefore, this part of the foundation document will be updated accordingly.

### Special Mandates and Administrative Commitments

Many management decisions for a park unit are directed or influenced by special mandates and administrative commitments with other federal agencies, state and local governments, utility companies, partnering organizations, and other entities. Special mandates are requirements specific to a park that must be fulfilled. Mandates can be expressed in enabling legislation, in separate legislation following the establishment of the park, or through a judicial process. They may expand on park purpose or introduce elements unrelated to the purpose of the park. Administrative commitments are, in general, agreements that have been reached through formal, documented processes, often through memorandums of agreement. Examples include easements, rights-of-way, arrangements for emergency service responses, etc. Special mandates and administrative commitments can support, in many cases, a network of partnerships that help fulfill the objectives of the park and facilitate working relationships with other organizations. They are an essential component of managing and planning for Timpanogos Cave National Monument.

#### Special Mandates

- Executive Order No. 6166 of June 10, 1933, ordered the transfer of jurisdiction of the national monument from the U.S. Forest Service (USFS) to the Secretary of the Interior to be effective August 10, 1933.
- Presidential Proclamation 3457 of March 27, 1962, redefined the external boundary of the monument to conform to a survey accepted by the General Land Office in 1945 that accurately depicts the boundaries of the monument.
- Public Law 107-329 of December 6, 2002, authorized the National Park Service to design and construct an interagency administrative and visitor facility at the entrance to American Fork Canyon, Utah, on land to be acquired by the U.S. Forest Service.

#### Park Special Designations

- Timpanogos Cave Historic District is listed in the National Register of Historic Places. The historic district is on the north side of Mount Timpanogos and is bisected by the American Fork River and Utah State Route 92. The district is set in rugged terrain but retains architectural integrity despite the fact that some early constructed buildings are no longer extant. The district currently consists of several buildings including an early residence, two comfort stations, and a storage building. Other contributing structures include two cold cellars, a bridge, and the cave trail that provides access to the Timpanogos Cave System. In 2007, a determination of eligibility was completed for stone monuments and rock walls. These structures can be added to the historic district as contributing features in the future.

For more information about the existing administrative commitments for Timpanogos Cave National Monument, please see appendix C.



## Assessment of Planning and Data Needs

Once the core components of part 1 of the foundation document have been identified, it is important to gather and evaluate existing information about the park's fundamental and other important resources and values, and develop a full assessment of the park's planning and data needs. The assessment of planning and data needs section presents planning issues, the planning projects that will address these issues, and the associated information requirements for planning, such as resource inventories and data collection, including GIS data.

There are three sections in the assessment of planning and data needs:

1. analysis of fundamental and other important resources and values
2. identification of key issues and associated planning and data needs
3. identification of planning and data needs (including spatial mapping activities or GIS maps)

The analysis of fundamental and other important resources and values and identification of key issues leads up to and supports the identification of planning and data collection needs.

### Analysis of Fundamental Resources and Values

The fundamental resource or value analysis table includes current conditions, potential threats and opportunities, planning and data needs, and selected laws and NPS policies related to management of the identified resource or value.



Fundamental Resource or Value	Cave System
Related Significance Statements	Significance statements 1 and 2.
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• Speleothems: Stalactites/stalagmites and other cave features are in fair to good condition. Along the tour route, they have been impacted by specimen collecting (before monument status), trail construction, and tours. Away from the tour route, there is little to no damage to features and they remain in good condition.</li> <li>• Microclimate: Fair, but improving. High levels of visitation, as well as the creation of tunnels linking the caves, negatively impacts the individual microclimates of each cave.</li> <li>• Sediments: Calcite dissolves from the limestone but other components of the rocks do not dissolve and remain in the form of residual sediments. When the caves formed, this clay and silica settled to the bottom of the cave as residuals. Sediment from cave development, river silt and cobbles, and other silt are in good condition away from the main trail. Some sediments have been covered by the trail but still remain in good condition under the trail. However, some has been altered by development.</li> <li>• Hydrology: Hidden and Hansen Lakes are in good condition with limited impacts from development or tours. Middle Cave Lake is in fair condition because the tour crosses it on the Middle Cave Bridge and visitors routinely drop personal items, litter, and other detectable contaminants.</li> <li>• Biology: Fair, due to impact of cave tours. Visitation introduces organic food into the cave (organic infrastructure, human skin cells and hair, litter, etc.) benefitting some organisms to the detriment of others and thus changing the natural biota.</li> </ul>

Fundamental Resource or Value	Cave System
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions (continued)</b></p> <ul style="list-style-type: none"> <li>• Cave Floor: Poor in areas where the entire floor has been developed or altered for the tour trail, such as Middle Cave where the entire floor is developed and rubble filled. Good in other areas (Hansen Cave natural cave floor, Chimes Chamber, most off-trail areas).</li> <li>• Entrances: Fair at Timpanogos and Hansen Caves due to development for visitor use. Doors on these entrances, while required for security, impact airflow, hydrology, and animal access. The natural entrance to Middle Cave, 110 feet above the cave trail and not readily accessible to visitors, is in good condition. All three entrances have a bat gate that allows bats movement into and out of the caves but prevents people from using the entrances.</li> <li>• Infrastructure: Fair overall. The new tunnel doors and the concrete trail are in good condition. Corrosion is evident on some components of the Middle Cave Lake bridge, and regular inspections by a qualified engineer will be required to accurately determine its condition, life expectancy, and maintenance requirements. The lighting system is deteriorating and requires continuous maintenance. The existing transformers are larger than needed for the newly installed light emitting diode (LED) lights, some wires are not in conduit or buried, and there is visible abandoned infrastructure remaining in the caves, all of which detract from visitor experience.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• Speleothems: Improving through better tour management and efforts to restore cave microclimates. Climate change may reverse this trend, as changes to precipitation patterns, temperatures, and CO2 will affect natural speleothem growth and could, under some circumstances, contribute to dissolution of formations.</li> <li>• Sediments: Stable. There is no active impact on sediments off-trail or in alcoves. Historically, some trenches were dug through sediment banks and the trail continues to be used in these areas, but the condition has not changed with modern use.</li> <li>• Entrances: Stable. The cave management plan calls for making a small animal entrance, but this has not yet been implemented.</li> <li>• Cave Floor/Walls: Improving due to regular, ongoing restoration efforts including rubble removal, cleaning flowstone, scraping mud from formations, power washing walls, and removing trail infrastructure that was impeding the natural flow of water in the caves.</li> <li>• Microclimate: Improving due to better tour management (e.g., reducing tour frequency and the number of visitors per tour) and infrastructure (e.g., changing the lighting from halogen to LED and new, tighter sealing tunnel doors to reduce unnatural airflow). There are noticeable small changes in temperature (warming), but it is not yet clear what is causing these increases.</li> <li>• CO2 trends are not yet determined with baseline data currently being collected.</li> <li>• Hydrology: The hydrology of the caves is being affected by a changing water cycle. The precipitation regime seems to be shifting to less snow, more rain, and greater storm severity, with a general trend of increased dissolved sulfate, calcium, and magnesium, and decreased dissolved oxygen. The lakes do not fill as early in the spring as they previously did, but they are continuing to reach historic levels. Hidden Lake has experienced a slight decline in water level over the last few years but no decline in water quality. Water levels in Hansen and Middle Cave lakes are stable, responding naturally to seasonal cycles (fill with snowmelt or heavy rain and the water level declines throughout the year). Middle Cave Lake continues to be impacted by litter and contaminants from tours crossing the lake.</li> </ul>

<b>Fundamental Resource or Value</b>	<b>Cave System</b>
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Speleothems: Human-based touching, breaking, and lint and dust accumulation are all threats to the preservation of the formations. Lint accumulates in caves due to the shedding of skin cells, hair, and clothing fibers from visitors, floating around on air currents and deposited on various cave surfaces. Unauthorized entry and vandalism are ongoing threats.</li> <li>• Climate Change: Climate change is affecting the cave environment by altering the hydrologic cycle. Rainfall has a different temperature and chemistry than snowmelt, and is altering the chemical composition and temperature of the cave lakes. Altered water chemistry may have an effect on speleothem growth. The composition of cave atmosphere (specifically levels of CO<sub>2</sub> content) results in decreased deposition of formations and climate change is impacting the composition of the atmosphere in the caves. The monument is also detecting a gradual rise in air temperature in the cave, but it is too early to definitively say that this increase is climate change-related.</li> <li>• Hydrology: Surface contaminants, litter from cave tours dropped into the lakes, and development of infrastructure has impacted the original hydrology. Because the watershed that feeds the cave system is not fully understood or delineated, it is difficult to identify all potential threats.</li> <li>• Microclimate: Formation growth is directly affected by the microclimate, including temperature, humidity, airflow, and atmospheric composition. Tours have an effect on all of these parameters. For example, heat input from lighting and people on cave tours artificially increases the natural cave temperatures. Air leakage through the artificial tunnels blends temperatures between the caves, which naturally have distinct temperatures, and causes drying in caves. Respiration by tour visitors increases carbon dioxide (CO<sub>2</sub>) levels in the cave.</li> <li>• Biology: Tours negatively impact cave biology (bats discouraged from hibernating, litter changes the nutrient input and brings in more packrats, etc.). Threats to the microbiology of the caves are poorly understood. Algae are an invasive caused by the introduction of light and algal spores into the cave environment. Algal treatments, in turn, negatively impact naturally occurring microbes in the caves. Current cave entrance doors unnaturally restrict large animals from using the caves. White-nose syndrome, a fungus severely impacting some bat species, is not currently present, but the monument is proactively managing to prevent introduction through tours and monitoring of the bat population.</li> <li>• The cave environment, especially the high humidity, is a threat to the infrastructure inside the cave. Wood and most metals are extremely susceptible to corrosion and decay.</li> <li>• Any future construction or maintenance of infrastructure could result in an impact on cave features unless properly mitigated.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Potential for blast rubble fill removal restoration projects in Middle Cave Fault Line and Big Room and in Lower Passage to restore cave floor/walls.</li> <li>• Strong public interest in bats and agency support for monitoring bats as part of white-nose syndrome mitigation efforts. This provides an opportunity to increase acoustic monitoring and analysis to assess bat behavior and trends in the caves.</li> <li>• Increase use of NPS Cooperative Ecosystem Studies Units to allow partnerships for interpretation, education, research.</li> </ul>

Fundamental Resource or Value	Cave System
<p><b>Threats and Opportunities</b></p>	<p><b>Opportunities (continued)</b></p> <ul style="list-style-type: none"> <li>• NPS Northern Colorado Plateau Inventory and Monitoring Network and State of Utah could assist with water quality testing to better manage the hydrology in the caves.</li> <li>• Volunteers: National Speleological Society cavers and grottos (caving clubs) currently assist with Cave Restoration Camp and could assist on other in-cave projects as needed including exploration, research, cleaning, and infrastructure updates/maintenance; teen volunteers in the “Behind a Tour Specialist” program help protect the cave features during tours. There is an overall opportunity to expand the use of volunteers.</li> <li>• Implementation of the cave management plan provides the opportunity of adaptive management. This plan should be reviewed and revised regularly based on monitoring. Example: Higher numbers of visitors on tours result in higher levels of CO2 in the cave microclimate but new tunnel doors and a CO2 monitoring program provide opportunities to improve management of this CO2 input.</li> <li>• New technology now allows for cost-effective upgrades to physical security systems at the cave entrances. Digital cameras and alarms can be connected to the monument’s computer network via a newly established wireless connection between the cave entrance and the headquarters building, allowing for 24-hour remote monitoring in case of vandalism, illegal intrusion, or other problematic activity. Improved locks and reinforced doors should also be installed as part of routine facility management.</li> <li>• Partnerships with the U.S. Bureau of Land Management and U.S. Forest Service provide opportunities for collaboration. The monument is well-suited to serve as a regional hub for cave management efforts in other agencies and would benefit from such a relationship.</li> <li>• Networking with other cave parks (National Park Service and other agencies that manage caves) would leverage capacity to work on specific cave issues because of the similarity in resources, issues, and problem solving.</li> <li>• The Utah Bat Conservation Cooperative collects bat data and the monument should continue to coordinate with the cooperative for standardized data collection and information sharing.</li> <li>• Occasional closure of the caves to visitors (for construction projects, maintenance, etc.) provides opportunities to perform cleaning, restoration, research, and data collection not possible while visitors are present. Construction of the visitor contact station might provide an opportunity for data collection that could not otherwise be accomplished.</li> <li>• Recent approval for technical assistance for a dye trace plan for delineating the cave watershed.</li> <li>• Infrastructure: There is some abandoned infrastructure remaining in the cave from previous years including remnants of older electrical systems, bolts and nails in walls, etc., and it would be beneficial to the caves and visitor experience to remove this infrastructure, except where it has historic significance. Project funds will support this work in fiscal years (FY) 2016–2017).</li> <li>• Routine replacement of light fixtures, bulbs, and other system components provide opportunities to further reduce energy consumption and algal growth by staying abreast of latest best available technology.</li> <li>• The U.S. Forest Service is launching a landscape-level climate change assessment in this area and participation might be beneficial for long-term monument use. The monument should explore active participation in the USFS led Intermountain Adaptation Partnership.</li> </ul>

Fundamental Resource or Value	Cave System
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Baseline cave data.</li> <li>• Cave watershed analysis.</li> <li>• Cave feature inventory.</li> <li>• Cave microclimate analysis.</li> <li>• Speleogenesis data.</li> <li>• Light spectrum data/color rendering index.</li> <li>• Structural assessment of Middle Cave Bridge.</li> <li>• Condition assessment of cave infrastructure.</li> <li>• Lighting and communication infrastructure assessment (inside caves).</li> <li>• Climate change vulnerability assessment.</li> <li>• Water quantity data inside caves.</li> <li>• Insect, reptile, and amphibian study.</li> </ul>
<p><b>Planning Needs</b></p>	<ul style="list-style-type: none"> <li>• Accessibility self-assessment and transition plan.</li> <li>• Resource stewardship strategy.</li> <li>• Climate change scenario plan.</li> <li>• Strategic plan.</li> </ul>
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Paleontological Resources Preservation Act of 2009 (16 USC §470aaa-470aaa-11)</li> <li>• Clean Water Act (33 USC §1251-1387, 33 USC §1151)</li> <li>• Federal Cave Resources Protection Act of 1988 (16 USC §4301-4310)</li> <li>• Clean Air Act (42 USC §7401 et seq.)</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> <li>• National Environmental Policy Act of 1969 (42 USC §4321)</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (4.6.1) "Protection of Surface Waters and Groundwaters"</li> <li>• NPS Management Policies 2006 (4.6.2) "Water Rights"</li> <li>• NPS Management Policies 2006 (4.6.4) "Floodplains"</li> <li>• NPS Natural Resource Management Reference Manual 77</li> <li>• Director's Order 77-2: Floodplain Management</li> </ul>



Fundamental Resource or Value	Visitor Experience
Related Significance Statements	Significance statements 1, 2, 3, and 4.
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• Visitors to the monument get a high-quality, immersive experience on the intimate cave tour. Cave infrastructure, including lighting and a safe trail, contributes to an accessible and enjoyable cave experience.</li> <li>• The hike to the caves provides a challenging and enjoyable visitor experience. Some visitors only participate in the hike, while others use it as a means to get to the caves. Visitors experience beautiful scenery including expansive views of American Fork Canyon, the surrounding Wasatch Range, and the Utah Valley below.</li> <li>• There is a wide variety of summer interpretive programming throughout the monument including cave tours, deck and grotto talks, and youth programs. Evening programs are currently scheduled on peak summer weekend evenings, but attendance is generally low.</li> <li>• Interpretive media are generally in fair to poor condition. Wayside exhibits require updating and there is currently a plan to do so. Brochures are old, need to be improved, and are in the process of being updated. Social media strategy and a standard park website are in place but need continuous updating and revision. The monument video is dated and should be updated, replaced, or removed from use.</li> <li>• The current visitor center is in fair to poor condition. A portable building, it was installed as a temporary replacement for the original, Mission 66-era visitor center that burned in 1991. The monument has occupied it for 25 years. It is a safety hazard for visitors and staff because it is situated in a high probability location for rockfall. A new visitor contact station, replacing the existing visitor center, has been approved and is slated for construction in early FY 2017.</li> <li>• The visitor safety program is good. Numerous precautions are taken to ensure employee and visitor safety around the visitor center and river area, along the trail, and in the caves.</li> <li>• There are two picnic areas that are in fair condition. There is heavy and steadily increasing use of the areas, resulting in declining condition. These picnic areas are the only fee-free picnic areas in the canyon.</li> <li>• Generally, the canyon has limited artificial light at night, allowing good opportunities to experience natural darkness. The night sky, however, is negatively impacted by ambient light and air pollution from adjacent urban development along the Wasatch Front.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• The overall cave tour experience is improving through ongoing implementation of the 2012 cave management plan, the ability to book a cave tour through the reservation system online, and tour management with designated tour sizes and times designed to improve tour experience.</li> <li>• The quality of the viewshed and soundscape within the monument is declining. Decline in the soundscape is directly attributable to population growth immediately adjacent to the monument and associated increases in canyon vehicle traffic. Rapid adjacent urban development also negatively impacts air quality and viewshed, as do factors such as emissions from distant coal-fired power plants, refineries and similar facilities, vehicle exhaust, wildfires, wind-borne high altitude dust, and, to the extent that it exacerbates these factors, climate change. Sulfur dioxide emissions have been reduced at Utah power plants. Additional reductions in nitrogen oxides emissions from the coal-fired power plants may be required with the U.S. Environmental Protection Agency’s (EPA) lowering of the national standard for ozone pollution in October 2015 or under the regional haze program for protection of nearby Class I areas. These reductions will also improve air quality conditions at the monument.</li> <li>• Personal services are improving. The monument perceives increasing demand for programs other than cave tours and has developed a wider variety of daily personal service programs to meet this need. Use of some nonpersonal services (videos, brochures, exhibits) are declining as they become more and more dated with the inability to regularly update.</li> </ul>

<b>Fundamental Resource or Value</b>	<b>Visitor Experience</b>
<b>Current Conditions and Trends</b>	<p><b>Trends (continued)</b></p> <ul style="list-style-type: none"> <li>• There has been a steady increase in the use of the trail by visitors, including fitness hikers.</li> <li>• Visitor safety is improving due to increased awareness and effective communication. A “Safety Stop” checkpoint at the cave trailhead started in 2011. There is also a trail patrol program with staff and volunteers so visitors on the trail regularly encounter people who can assist them, should they be having difficulty. The reservation system started two years ago and it sends out a safety list when reservations for cave tours are made and visitors are better prepared on arrival. There is also a greater capacity for emergency response with more training among monument staff.</li> <li>• The overall condition of and experience at the visitor center is declining. Interpretive exhibits and video offerings are dated and do not inspire further visitor enjoyment or investigation. It functions as an information hub for the entire canyon and other NPS sites in the state because of its proximity to Salt Lake City, but lacks adequate resources or information to fully meet this need. A new visitor contact station, replacing the existing visitor center has been approved and is slated for construction in early FY 2017.</li> <li>• Picnic area conditions are declining due to increased visitor use and impacts. Native vegetation is decreasing in the immediate vicinity of the picnic area due to trampling and erosion caused by heavy visitor use, especially in the riparian area and riverbank of the American Fork River, which flows through the picnic area and is a natural attractant for recreational use. Trees and larger vegetation are increasingly cut for firewood, and networks of social trails are growing in and around the picnic area. Monument staff is undertaking greater efforts for restoration of the environment surrounding the areas, but capacity to fully address this need is limited by other priorities.</li> <li>• Night sky resource quality is declining as rapid urban development increases the amount of ambient light immediately adjacent to the monument.</li> </ul>
<b>Threats and Opportunities</b>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• The viewshed down canyon from the cave trail is threatened by air pollution, infrastructure, and urban development. Scenic views are sometimes obscured by pollution-caused haze.</li> <li>• Similarly to the viewshed, air quality, dark night skies, and natural sounds are threatened because of increased population in the area. Air, light, and noise pollution from the nearby urban development, and as a result of increased crowding in the canyon, degrade these monument resources and create recreational user conflicts. At night, air pollution scatters artificial light, increasing the effect of light pollution on the night sky.</li> <li>• There is increasing demand for cave tour tickets with a static number of tickets available. The cave management plan limits tour size and the number of tours per day is limited by hours of daylight as well as funding and staffing limitations.</li> <li>• Climate change is resulting in changes to the seasons, and therefore to visitation patterns. Snow is melting earlier in the spring, and colder, snowy weather is not coming until later in the fall, so the visitation season is extended and the staff does not have the capacity to respond to the increased visitor needs. Additional concerns are increased risk of wildfire and extreme heat events.</li> <li>• The road through the monument (Utah State Route 92) can present a safety hazard to some types of visitor use, including those crossing the road between the visitor center and the facilities along the river.</li> <li>• The monument is within EPA-designated nonattainment areas for fine and coarse particulate matter found in pollution-caused haze, smoke, and dust, which can impact human health. In addition, ground-level ozone sometimes reaches levels that can make breathing difficult for sensitive groups.</li> </ul>

Fundamental Resource or Value	Visitor Experience
<p><b>Threats and Opportunities</b></p>	<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• The Friends of Timpanogos Cave, a philanthropic and support organization, is relatively new and there is great opportunity for working with them going forward. The greatest opportunity currently is the prospect of the friends group fundraising for visitor experience improvements.</li> <li>• The monument can work with existing NPS Intermountain Region Cooperative Ecosystem Studies Units to get interpretive and education interns who can assist with daily operations and development of interpretive material and programming.</li> <li>• The NPS Harpers Ferry Center has the capacity and expertise to assist with development of new brochures and media.</li> <li>• There are opportunities to enhance the volunteer program at the monument, including an expanded trail patrol, increased use of volunteers for facility maintenance and historic preservation, and a future interpretive and education docent program.</li> <li>• There are numerous opportunities for internships through avenues other than Cooperative Ecosystem Studies Units.</li> <li>• Partnerships with other local federal agencies, including the U.S. Forest Service, other cave-related parks (in the national park system and at state parks), local school districts, and other youth programs could be beneficial for all of those groups and for the monument.</li> <li>• Design and construction of a new visitor contact station will provide new interpretive components and opportunities for those who are unable to hike the trail.</li> <li>• A dark sky assessment and ongoing monitoring could be conducted with a local astronomy group. The monument can be an example of responsible outdoor lighting and can showcase and interpret this technology to the large, adjacent urban population. The monument could also become an International Dark Sky Park through the International Dark-Sky Association.</li> <li>• Use of more modern technology such as web cams and live, virtual tours with rangers would engage a wider audience, including those with limited accessibility to the trail and cave. Virtual cave tours could also be provided in the visitor center. Laser scan products such as video games, fly-through animation, and 3-D printing of cave features could also present more opportunities for engagement with the resources.</li> <li>• Expand interpretative and educational tools to communicate the connections between the cave system, surface ecosystems, air quality/pollution, scenic views, night sky, recreation, climate change, and other associated resources.</li> <li>• Work cooperatively with other federal and state air quality agencies and local stakeholders to reduce air quality impacts in the monument from sources of air pollution. Partnering with nearby developers or planners could similarly help increase awareness about the importance of monument scenic views, air quality, night sky, and natural sounds.</li> <li>• Improve monument sustainability and environmental leadership through the Climate Friendly Park certification including an Environmental Management System (Director's Order 13A).</li> </ul>
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Visitor count data.</li> <li>• Visitor demographic data.</li> <li>• Air quality, night sky, acoustic resource assessment and monitoring.</li> <li>• Visual resource inventory.</li> <li>• Interpretive program evaluation.</li> <li>• Infrastructure and communication assessment (outside cave).</li> <li>• Lighting and communication infrastructure assessment (inside caves).</li> </ul>

<b>Fundamental Resource or Value</b>	<b>Visitor Experience</b>
<b>Planning Needs</b>	<ul style="list-style-type: none"> <li>• Visitor use management plan.</li> <li>• Comprehensive position management plan.</li> <li>• Strategic plan.</li> <li>• Trails management plan.</li> <li>• Outdoor lighting plan.</li> <li>• Accessibility self-assessment and transition plan.</li> <li>• Climate change scenario plan.</li> <li>• Comprehensive interpretive plan.</li> <li>• Visual resource management plan.</li> <li>• Sign plan.</li> </ul>
<b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Americans with Disabilities Act of 1990 (42 USC §12101 et seq.)</li> <li>• Architectural Barriers Act of 1968 (42 USC §4151 et seq.)</li> <li>• Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines” (36 CFR 1191)</li> <li>• Rehabilitation Act of 1973 (29 USC §701 et seq.)</li> <li>• NPS Concessions Management Improvement Act of 1998 (54 USC §101912)</li> <li>• Clean Air Act (42 USC §7401 et seq.)</li> <li>• “Audio Disturbances” (36 CFR 2.12)</li> <li>• Secretarial Order 3289 “Addressing the Impacts of Climate Change on America’s Water, Land and Natural and Cultural Resources.”</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director’s Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS Management Policies 2006 (chapter 7) “Interpretation and Education”</li> <li>• NPS Management Policies 2006 (chapter 8) “Use of the Parks”</li> <li>• NPS Management Policies 2006 (chapter 9) “Park Facilities”</li> <li>• NPS Management Policies 2006 (chapter 10) “Commercial Visitor Services”</li> <li>• Director’s Order 6: <i>Interpretation and Education</i></li> <li>• Director’s Order 42: <i>Accessibility for Visitors with Disabilities in National Park Service Programs and Services</i></li> <li>• NPS Transportation Planning Guidebook</li> <li>• NPS Management Policies 2006 (4.10) “Lightscape Management”</li> <li>• NPS Management Policies 2006 (4.7) “Air Resource Management”</li> <li>• NPS Natural Resource Management Reference Manual 77</li> <li>• Director’s Order 47: <i>Soundscape Preservation and Noise Management</i></li> <li>• NPS Management Policies 2006 (4.9) “Soundscape Management”</li> <li>• NPS Management Policies 2006 (5.3.1.7) “Cultural Soundscape Management”</li> <li>• NPS Management Policies 2006 (8.2.3) “Use of Motorized Equipment”</li> <li>• NPS Management Policies 2006 (1.4) “Park Management”</li> <li>• NPS Management Policies 2006 (1.6) “Cooperative Conservation Beyond Park Boundaries”</li> <li>• NPS Management Policies 2006 (3.1) “General”</li> </ul>

Fundamental Resource or Value	Opportunities for Scientific Study
Related Significance Statements	Significance statements 1 and 2.
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>Monitoring: Current scientific monitoring includes the cave microclimates, tunnel airflow, bats, hydrology, CO2 levels, seismic activity, bark beetle infestation, and weather.</li> <li>Hydrology/Cave Watershed: The watershed boundaries are not delineated. Some studies are completed, but overall the knowledge of hydrology is fair because there is some information about where the water is coming from for some of the cave lakes, but more information is necessary. Dye traces have been conducted but were inconclusive and more research is needed.</li> <li>Surface Air Quality: Estimates for air quality indicators including visibility, ozone, and deposition are compared to NPS Air Resources Division benchmarks to determine condition. The degree of confidence in monument air quality conditions are medium because estimates are based on interpolated data from more distant air quality monitors.</li> <li>Night Sky: No current monitoring program.</li> <li>Soundscapes/Acoustic Resources: No current monitoring program. Geospatial modeling predicts that the monument wide surface sound levels are somewhat impacted by noise, but that sound levels remain relatively low.</li> <li>Geology: Ongoing study of the speleogenesis process is fair, but improving. There is ongoing research to understand the processes that occurred millions of years ago to create the caves, and the processes that continue to develop the cave system. Current research includes site visit reports and one master's thesis on faults, papers by White on mineralogy, and by Mayo on cave sediments. A seismology study has been ongoing for approximately four years. Photo-monitoring at specific points allows for ongoing monitoring in the caves (84 points).</li> <li>Climate Change: Douglas-fir beetle populations are increasing and the range is expanding, so the monument is currently using pheromone tags on trees near trails to prevent dead trees along trails and study the impacts of this attempt at prevention.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>All monitoring program activities are stable.</li> <li>Bat knowledge is improving due to training and new acoustic monitoring equipment.</li> </ul>
Threats and Opportunities	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>Scientific research is dependent on funding, and in some cases expertise, from sources outside of the national park system.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>Attract master's degree and PhD research projects on any and all above subjects from universities to increase the scientific inquiry and research that is ongoing at the monument.</li> <li>Coordinate and cooperate on landscape level work with other state and federal agencies, especially the U.S. Forest Service. Also coordinate with the U.S. Forest Service on partnerships for scientific studies and mitigation, such as recent collaborative efforts to understand Douglas-fir beetle impacts and scientifically test effectiveness of mitigation strategies such as pheromone packets to reduce beetle infestation in some monument tree stands.</li> <li>Opportunities for internships in the monument to conduct scientific research.</li> <li>There are no current programs surrounding research and monitoring of air quality, night sky, and acoustic resources, but there is great opportunity to conduct research in these areas.</li> <li>Opportunities for more research to be done using existing agreements with Cooperative Ecosystem Studies Units.</li> </ul>

<b>Fundamental Resource or Value</b>	<b>Opportunities for Scientific Study</b>
<b>Data and/or GIS Needs</b>	<ul style="list-style-type: none"> <li>• Beetle infestation data.</li> <li>• Microbial sampling.</li> <li>• Previous research inventory.</li> <li>• Speleogenesis data.</li> <li>• Cave watershed analysis.</li> <li>• Air quality, night sky, acoustic resource assessment and monitoring.</li> <li>• Baseline cave data.</li> </ul>
<b>Planning Needs</b>	<ul style="list-style-type: none"> <li>• Resource stewardship strategy.</li> <li>• Vegetation management plan.</li> <li>• Strategic plan.</li> </ul>
<b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Museum Properties Management Act of 1955, as amended (54 USC §102501-102504)</li> <li>• Paleontological Resources Preservation Act of 2009 (16 USC §470aaa-470aaa-11)</li> <li>• Federal Cave Resources Protection Act of 1988 (16 USC §4301-4310)</li> <li>• Endangered Species Act of 1973, as amended (16 USC §1531 et seq.)</li> <li>• National Invasive Species Act (16 USC §4701)</li> <li>• Lacey Act, as amended (16 USC §3371-3378)</li> <li>• Clean Water Act (33 USC §1251-1387, 33 USC §1151)</li> <li>• Clean Air Act (42 USC §7401 et seq.)</li> <li>• Executive Order 13112, "Invasive Species"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (1.6) "Cooperative Conservation Beyond Park Boundaries"</li> <li>• NPS <i>Management Policies 2006</i> (2.3.1.4) "Science and Scholarship"</li> <li>• NPS <i>Management Policies 2006</i> (4.1) "General Management Concepts"</li> <li>• NPS <i>Management Policies 2006</i> (4.1.4) "Partnerships"</li> <li>• NPS <i>Management Policies 2006</i> (4.2) "Studies and Collections"</li> <li>• NPS <i>Management Policies 2006</i> (4.4.1) "General Principles for Managing Biological Resources"</li> <li>• NPS <i>Management Policies 2006</i> (4.7.2) "Weather and Climate"</li> <li>• NPS <i>Management Policies 2006</i> (4.9) "Soundscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (4.10) "Lightscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (5.1) "Research"</li> <li>• NPS <i>Management Policies 2006</i> (8.10) "Natural and Cultural Studies, Research, and Collection Activities"</li> <li>• Director's Order 24: <i>NPS Museum Collections Management</i></li> <li>• Director's Order 47: <i>Soundscape Preservation and Noise Management</i></li> <li>• Director's Order 77-2: <i>Floodplain Management</i></li> <li>• <i>NPS-75 Natural Resources Inventory and Monitoring Guideline</i></li> <li>• <i>NPS Natural Resource Management Reference Manual 77</i></li> </ul>

Fundamental Resource or Value	Cave Trail
Related Significance Statements	Significance statements 3 and 4.
Current Conditions and Trends	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• Rock Walls: The retaining walls are in fair condition. They need constant repair due to natural forces including rock and snow slides. The rock trail barrier pillars, new as of spring 2015, and rock trail barriers (walls) are in good condition.</li> <li>• Trail Surface: The asphalt trail is in fair condition. Falling rocks routinely damage the asphalt, particularly during early spring freeze/thaw events. Melting winter snows and intense summer thunderstorms cause erosion, particularly along the edges of the trail surface.</li> <li>• Trail Facilities: The chains and post railing along the trail are all in good condition.</li> <li>• Trail Facilities: The “rock trap,” a rockfall attenuation barrier roughly 50 feet wide by 40 feet high, consists of a retractable steel-mesh curtain along with fences and gates in a large, active avalanche chute directly above the cave trail. The barrier is closed in summer to stop falling rocks but opened in winter to allow passage of snow avalanches. It is in good condition. It was repaired last year but with constant rockfall, there is an ongoing need for maintenance and component replacement over time.</li> <li>• Trail Facilities: The benches are in good condition overall and there are enough for those who need to use them.</li> <li>• Trail Facilities: Signs and wayside exhibits along the trail are generally in poor condition. Most are faded, some have inaccurate information, and the content needs to be updated on all of them. Updated signs and exhibits are currently being developed and will be installed in 2017.</li> <li>• Trail Facilities (restrooms): The Last Chance restroom, designed and built by the Works Progress Administration in 1939, and now in the List of Classified Structures database, was not designed to meet the demand it is currently experiencing. This original system uses a sludge vault, built in 1961, and no drain field. This system does not meet current soil percolation standards. A percolation test is needed to replace the original test. The low-soil, karst environment provides a strong possibility that effluent is not being properly filtered through the ground. The two composting toilets near the cave exit are in fair condition. The toilets were originally installed only for emergencies, but use has increased with growing visitation, and routine monitoring and safe disposal of compost material is an ongoing challenge. There are also safety concerns because they are located in a rockfall area and are accessible only by a closed trail. Both restrooms would be extremely challenging to relocate.</li> <li>• Trail Facilities (operations): The Grotto and Ranger Room, which are used for storage of daily equipment and electronics, are in fair to poor condition. An electric line runs under the asphalt from the cave system to the Ranger Room, powering a radio, telephone, security system, and computer. Because this is a naturally occurring cave, precipitation seeps through the rocks and pours from the ceiling into the Ranger Room. The electrical system components should be updated to operate as an outdoor electrical system.</li> <li>• Trail Facilities: The exit and entrance shelters for the caves need regular maintenance, but are in good condition.</li> <li>• Visitor Safety Program: Visitors receive an e-mail when they reserve tickets that explains safety concerns, recommends bringing food, water, and extra clothing, and lists prohibited items and behaviors. This information is reinforced in person by a ranger at a trailhead “safety stop” prior to hiking the trail. There are permanent post-and-chain fall protection barriers at identified high-risk areas. There are also indications on the trail itself in areas at risk for higher than average rockfall incidences where visitors should not stop, and there are rangers along the trail checking on the well-being of visitors hiking the trail.</li> </ul>

<p><b>Fundamental Resource or Value</b></p>	<p><b>Cave Trail</b></p>
<p><b>Current Conditions and Trends</b></p>	<p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• Rock Walls: The retaining walls, rock piers, and trail barriers are stable and regularly repaired.</li> <li>• Trail Surface: The surface is stable due to reoccurring resurfacing efforts. Management is trying to secure funds to resurface the top of the trail; it was last resurfaced in the 1990s with crack seal being done four years ago.</li> <li>• Trail Facilities: The chain and post railing have improved over the last five years. There are more post railings and chains on the trail and they are in more solid foundations.</li> <li>• Trail Facilities: The rock trap is stable but subject to rockfall and other natural forces.</li> <li>• Trail Facilities: The benches along the trail are stable.</li> <li>• Trail Facilities: The interpretive signage is declining due to fading and deterioration from exposure to the elements. Signs are taken down in winter to reduce exposure.</li> <li>• Trail Facilities / Restrooms: The Last Chance restroom and exit restroom are in a state of decline. There is increasing use of the toilets and the facilities are not able to keep up with demand. Use has surpassed the capacity of the vaults.</li> <li>• Trail Facilities: The exit/entrance shelters are stable.</li> </ul>
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Rockfall is a constant threat. It can damage all facilities along the trail, the trail itself, and has the potential to injure visitors and staff on the trail. Erosion accelerates rockfall and the potential damage to resources and threat to visitor safety.</li> <li>• Visitors destabilize slopes and increase erosion by going off-trail or taking shortcuts.</li> <li>• Climate change has the potential to increase rainfall and wildfire, destabilize the slope, and increase the natural forces that lead to trail damage, as well as shift ecosystems upslope and increase incidence of invasive species, altering trail viewsheds.</li> <li>• The freeze/thaw cycle common to this environment causes an acceleration of the deterioration of the trail and rock walls.</li> <li>• The viewshed from the trail is threatened from encroachment by monument and off-monument activities and structures such as the new powerline going to the cave.</li> <li>• The vault toilets are a threat to both the ecosystem (physical impacts) and the visitor experience (odor) because of the sludge from the vault effluent.</li> <li>• Beetle kill is a threat in the mixed fir forest environment because of the impacts on the trail. It could kill Douglas-fir trees, causing them to die and fall on the trail, which would be a safety hazard on the trail and increase erosion of the slope. It would also impact visitor experience on the trail.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• There are opportunities to partner with local communities and corporations to educate locals and visitors in order to mitigate negative impacts due to air quality and viewshed changes and climate change issues.</li> <li>• Partnerships with universities and geology clubs would be excellent sources of information to interpret trailside and canyon geology for increased positive visitor experience on the trail.</li> <li>• The monument could offer adopt-a-trail opportunities so locals could take stewardship of portions of the trail into their own hands and protect it.</li> <li>• The monument will continue to work with the Friends of Timpanogos Cave to support the improvement of interpretive services. In FY 2016 they successfully received a donation of approximately \$70,000 to replace all wayside exhibits along the cave trail.</li> <li>• The monument can maintain and expand the trail patrol, an adult volunteer program dedicated to hiking assistance and interpretation along the trail, and the youth volunteer "Behind a Tour Specialist" program to support cave tours.</li> </ul>

Fundamental Resource or Value	Cave Trail
Data and/or GIS Needs	<ul style="list-style-type: none"> <li>• Rockfall hazard analysis.</li> <li>• Rock wall inventory.</li> <li>• Condition assessments on trail infrastructure.</li> <li>• Visual resource inventory.</li> </ul>
Planning Needs	<ul style="list-style-type: none"> <li>• Trails management plan.</li> <li>• Trail restroom plan.</li> <li>• Rockfall hazard mitigation plan.</li> <li>• Visual resource management plan.</li> <li>• Climate change scenario plan.</li> </ul>
<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the FRV</b></p> <ul style="list-style-type: none"> <li>• Clean Air Act (42 USC §7401 et seq.)</li> <li>• "Audio Disturbances" (36 CFR 2.12)</li> <li>• Paleontological Resources Preservation Act of 2009 (16 USC §470aaa-470aaa-11)</li> <li>• Clean Water Act (33 USC §1251-1387, 33 USC §1151)</li> <li>• Federal Cave Resources Protection Act of 1988 (16 USC §4301-4310)</li> <li>• Americans with Disabilities Act of 1990 (42 USC §12101 et seq.)</li> <li>• Architectural Barriers Act of 1968 (42 USC §4151 et seq.)</li> <li>• Architectural Barriers Act Accessibility Standards 2006 (36 CFR §1191.1)</li> <li>• Rehabilitation Act of 1973 (29 USC §701 et seq.)</li> <li>• NPS Concessions Management Improvement Act of 1998 (54 USC §101912)</li> <li>• Secretarial Order 3289 "Addressing the Impacts of Climate Change on America's Water, Land and Natural and Cultural Resources"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (1.4) "Park Management"</li> <li>• NPS <i>Management Policies 2006</i> (1.6) "Cooperative Conservation Beyond Park Boundaries"</li> <li>• NPS <i>Management Policies 2006</i> (3.1) "General"</li> <li>• NPS <i>Management Policies 2006</i> (4.7) "Air Resource Management"</li> <li>• Director's Order 47: <i>Soundscape Preservation and Noise Management</i></li> <li>• NPS <i>Management Policies 2006</i> (4.9) "Soundscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (5.3.1.7) "Cultural Soundscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (8.2.3) "Use of Motorized Equipment"</li> <li>• NPS <i>Management Policies 2006</i> (4.10) "Lightscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (4.6.1) "Protection of Surface Waters and Groundwaters"</li> <li>• NPS <i>Management Policies 2006</i> (4.6.2) "Water Rights"</li> <li>• NPS <i>Natural Resource Management Reference Manual 77</i></li> <li>• NPS <i>Management Policies 2006</i> (chapter 7) "Interpretation and Education"</li> <li>• NPS <i>Management Policies 2006</i> (chapter 8) "Use of the Parks"</li> <li>• NPS <i>Management Policies 2006</i> (chapter 9) "Park Facilities"</li> <li>• NPS <i>Management Policies 2006</i> (chapter 10) "Commercial Visitor Services"</li> <li>• Director's Order 6: <i>Interpretation and Education</i></li> <li>• Director's Order 42: <i>Accessibility for Visitors with Disabilities in National Park Service Programs and Services</i></li> <li>• NPS <i>Transportation Planning Guidebook</i></li> </ul>

## Analysis of Other Important Resources and Values

Other Important Resource or Value	Cultural Resources
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• Masonry walls along the river and road are in good to poor condition depending on the location. Most of the walls in visitor and administrative areas are in good to fair condition. All are subject to weather and erosion, and maintenance efforts prioritize those along trails, river, and road for safety, while those in administrative areas may be a lower priority for routine maintenance.</li> <li>• The historic district is in good condition as a result of ongoing maintenance efforts.</li> <li>• The rock house is in good condition as a result of ongoing maintenance efforts.</li> <li>• The bridges are in good condition as a result of ongoing maintenance efforts.</li> <li>• The historic trail up to the caves is generally in poor condition due to abandonment and difficulty to maintain. Some rock walls along the historic trail are in good condition.</li> <li>• The structures that have been determined eligible as contributing features in the historic district are in good to fair condition. Many of the structures are currently in use and should have been listed in the original national register nomination.</li> <li>• The museum collection and archives are maintained to NPS standards and are in good condition. The many items from monument archives and the cultural collection are at the NPS Western Archeological and Conservation Center in Tucson, Arizona.</li> <li>• The cave historic resources such as the tunnels, signatures, etc., are in fair to good condition. Some of the signatures were signed with a type of indelible ink (laundry markers) that has run over time due to moisture.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• The masonry walls are in decline, but the degradation exceeds the capacity of monument staff to repair or maintain.</li> <li>• The historic district, in general, is in stable condition. The sections of the historic cave trail in current use are mostly stable. The rock house is stable to improving due to recent renovations. The bridges are stable because they have a long lifecycle. The abandoned sections of the historic trail are declining due to erosion. Within the cave, some of the historic resources, including signatures, are declining because of the damp conditions of the cave, but the condition of the tunnels is stable to improving because of the installation of new doors.</li> <li>• The resources eligible for listing as part of the historic district are stable.</li> <li>• The museum collection and archives are in stable condition, with some of the museum collection items and archives sent to the NPS Western Archeological and Conservation Center possibly in improving condition.</li> </ul>
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Extreme weather and other natural events resulting from climate change have a high potential to damage historic resources.</li> <li>• A growing local population and greater activity in and around the monument is leading to a variety of threats including impacts from increased visitor use, vandalism, and other illegal activity.</li> <li>• The shower house is threatened because Utah State Route 92 is encroaching and increasing the risk for damage due to vehicle debris. The close proximity of the road increases the risk of damage to the resource.</li> <li>• External projects such as the American Fork City water system rehabilitation project, the highway right-of-way, the power right-of-way, etc., are all threats to the preservation of historic resources in the monument.</li> <li>• Erosion of historic resources due to natural and human processes is a threat to the ongoing preservation of such resources.</li> </ul>

Other Important Resource or Value	Cultural Resources
<b>Threats and Opportunities</b>	<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• There are opportunities to establish and strengthen partnerships with the state historic preservation office, the NPS Historic Preservation Training Center, and the NPS Western Center for Historic Preservation.</li> <li>• It would benefit the monument if staff had additional training in section 106 of the National Historic Preservation Act and historic preservation skills to be able to manage resources better with the staff available within the park unit.</li> <li>• There are opportunities for more education and interpretation of historic resources to promote greater appreciation and stewardship of these resources.</li> </ul>
<b>Data and/or GIS Needs</b>	<ul style="list-style-type: none"> <li>• Condition assessments of historic resources.</li> <li>• Rock wall inventory.</li> <li>• List of Classified Structures updates.</li> </ul>
<b>Planning Needs</b>	<ul style="list-style-type: none"> <li>• Cultural landscape report.</li> <li>• Resource stewardship strategy.</li> <li>• Climate change scenario plan.</li> </ul>
<b>Laws, Executive Orders, and Regulations That Apply to the OIRV, and NPS Policy-level Guidance</b>	<p><b>Laws, Executive Orders, and Regulations That Apply to the OIRV</b></p> <ul style="list-style-type: none"> <li>• Antiquities Act of 1906 (54 USC §320301-320303, 34 Stat. 225)</li> <li>• Historic Sites Act of 1935 (54 USC §320101 et seq.)</li> <li>• National Historic Preservation Act of 1966, as amended (54 USC §300101 et seq.)</li> <li>• Archeological and Historic Preservation Act of 1974 (54 USC §312502 et seq.)</li> <li>• Archaeological Resources Protection Act of 1979 (54 USC §302902)</li> <li>• Museum Properties Management Act of 1955, as amended (54 USC §102501-102504)</li> <li>• Executive Order 11593, "Protection and Enhancement of the Cultural Environment"</li> <li>• "Curation of Federally-Owned and Administered Archaeological Collections" (36 CFR 79)</li> <li>• "Protection of Historic Properties" (36 CFR 800)</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (chapter 5) "Cultural Resource Management"</li> <li>• Director's Order 24: <i>NPS Museum Collections Management</i></li> <li>• Director's Order 28: <i>Cultural Resource Management (1998)</i></li> <li>• Director's Order 28A: <i>Archeology (2004)</i></li> <li>• NPS <i>Museum Handbook</i>, parts I, II, and III</li> <li>• <i>The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation</i></li> </ul>

Other Important Resource or Value	Surface Ecosystem
<p><b>Current Conditions and Trends</b></p>	<p><b>Conditions</b></p> <ul style="list-style-type: none"> <li>• The ecosystem of the American Fork River is in fair condition because there are no native fish; they are out-competed by invasive species. The water quality of the river is good.</li> <li>• Recreationally desirable nonnative fish are stocked in American Fork Canyon by the Utah Department of Natural Resources.</li> <li>• Vegetation throughout the surface of the monument is in good condition because there is regular management of invasive weeds.</li> <li>• The condition of the wildlife in the monument is good because there is no rampant disease and a diversity of mammals.</li> <li>• Air quality indicators including visibility, ground-level ozone, and deposition of nitrogen and sulfur pollutants are all rated on average as moderate concerns based on NPS Air Resources Division benchmarks. Conditions vary due to inversions and seasonal variability. The Douglas fir beetle is native but is expanding its historic range due to climate change. This range expansion represents a new threat for the monument forest and is being mitigated as a climate change-related impact.</li> </ul> <p><b>Trends</b></p> <ul style="list-style-type: none"> <li>• The quality of the air is declining. Temperature inversions are a natural local phenomenon, trapping man-made pollutants. The Wasatch Front is in the preliminary stages of taking action to reduce pollutants. The monument is within EPA-designated nonattainment areas for fine and coarse particulate matter found in pollution-caused haze, smoke, and dust which can impact human health. In addition, ground-level ozone sometimes reaches levels that can make breathing difficult for sensitive groups.</li> <li>• An increase in bark beetle presence is beginning to be observed and monitored on fir trees in the park.</li> </ul>
<p><b>Threats and Opportunities</b></p>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• White-nose syndrome has not been detected in bats in the monument, but the risk of introduction is high.</li> <li>• The road and vehicles go through the middle of the monument and directly and indirectly impact the ecosystem.</li> <li>• There is a threat to the river due to devegetation and riverbank erosion, both natural and from social trails along the river. In addition, there is potential to impact water quality from hazardous materials and mining upstream. Finally, the river is channelized, meaning it is in a set course instead of being allowed to wander naturally.</li> <li>• There is a threat from invasive species overwhelming the native species.</li> <li>• Recently observed increases in bark beetle is a threat because it can kill trees, impacting the ecosystem and creating safety hazards on the trail.</li> <li>• Climate change projections indicate higher precipitation and more large storms as well as increases in average annual temperature and extreme heat events, increasing potential for flooding, erosion, wildfire, an upslope shift in ecosystems, and an increase in invasive species.</li> <li>• Air quality, viewshed, and the dark night sky are threatened from the encroaching urban environment. Air pollution, light pollution, and changes to the landscape could increase in the coming years. In general, the increasing population of the area increases the stress on the natural ecosystems.</li> <li>• Proximity to an urban area increases visitation and recreational use of all areas in the monument, with associated impacts (e.g., soil compaction, trampling of vegetation, increased social trails, graffiti, death of rattlesnakes, insect collection, removal of rocks, etc.). Cumulatively, these relatively minor impacts have a significant negative affect on the park ecosystem.</li> </ul>

Other Important Resource or Value	Surface Ecosystem
<p><b>Threats and Opportunities</b></p>	<p><b>Threats (continued)</b></p> <ul style="list-style-type: none"> <li>• Hunting occurs on USFS lands adjacent to the monument, and illegal hunting likely occurs undetected in the park. Year-round hunting season is open on mountain lions in the canyon. Hunters regularly work the area with dogs turned loose to track black bears and cougars. Given the small size of the monument and low population numbers for these species in the park and surrounding canyon, this ongoing hunting pressure negatively influences wildlife populations and dynamics in the monument.</li> <li>• The historic Last Chance restroom is leaching into karst terrain and that could be a threat to the ecosystem.</li> <li>• Natural communities on the surface are at risk for harmful effects of nutrient enrichment from excess deposition of nitrogen air pollutants. Nitrogen deposition levels are above critical loads for lichen, herbaceous, and forest vegetation. Wetland areas are sensitive to nutrient enrichment effects of excess nitrogen which can help invasive plant species (e.g., cheatgrass) to grow faster and out-compete native vegetation adapted to lower nitrogen conditions.</li> <li>• Ground-level ozone sometimes reaches levels that can cause injury to ozone-sensitive plants. There are several ozone-sensitive plants in the monument including quaking aspen, serviceberry, spreading dogbane, and common yarrow.</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Engage the local astronomy clubs to assist dark sky program.</li> <li>• Continue to use the scout and youth groups for resource management projects, such as vegetation projects.</li> <li>• Partner with universities to target study of insects, reptiles, and amphibians.</li> <li>• Continue to partner with the U.S. Forest Service and neighbors surrounding the monument for consistent resource management. Continue to work with Forest Health Division for bark beetle mitigation. The U.S. Forest Service has an initiative to work with landscape level planning, which would include and could benefit the park unit.</li> <li>• Actively monitor river water quality during dam construction to ensure that pollution is caught quickly and mitigated.</li> <li>• Improve monument sustainability and environmental leadership through the Climate Friendly Park certification including an Environmental Management System (Director’s Order 13A).</li> <li>• Expand interpretative and educational tools to communicate the connections between the cave system, surface ecosystems, air quality/pollution, scenic views, night sky, recreation, climate change, and other associated resources.</li> </ul>
<p><b>Data and/or GIS Needs</b></p>	<ul style="list-style-type: none"> <li>• Air quality assessment and monitoring.</li> <li>• River water quality data.</li> <li>• Fish species inventory.</li> <li>• Add to flora and fauna species lists.</li> <li>• Night sky assessment and monitoring.</li> <li>• Insect, reptile, and amphibian study.</li> <li>• Soil data.</li> <li>• Investigate air pollution impacts to sensitive monument ecosystems.</li> </ul>
<p><b>Planning Needs</b></p>	<ul style="list-style-type: none"> <li>• Resource stewardship strategy.</li> <li>• Climate change scenario plan.</li> <li>• Comprehensive interpretive plan.</li> </ul>

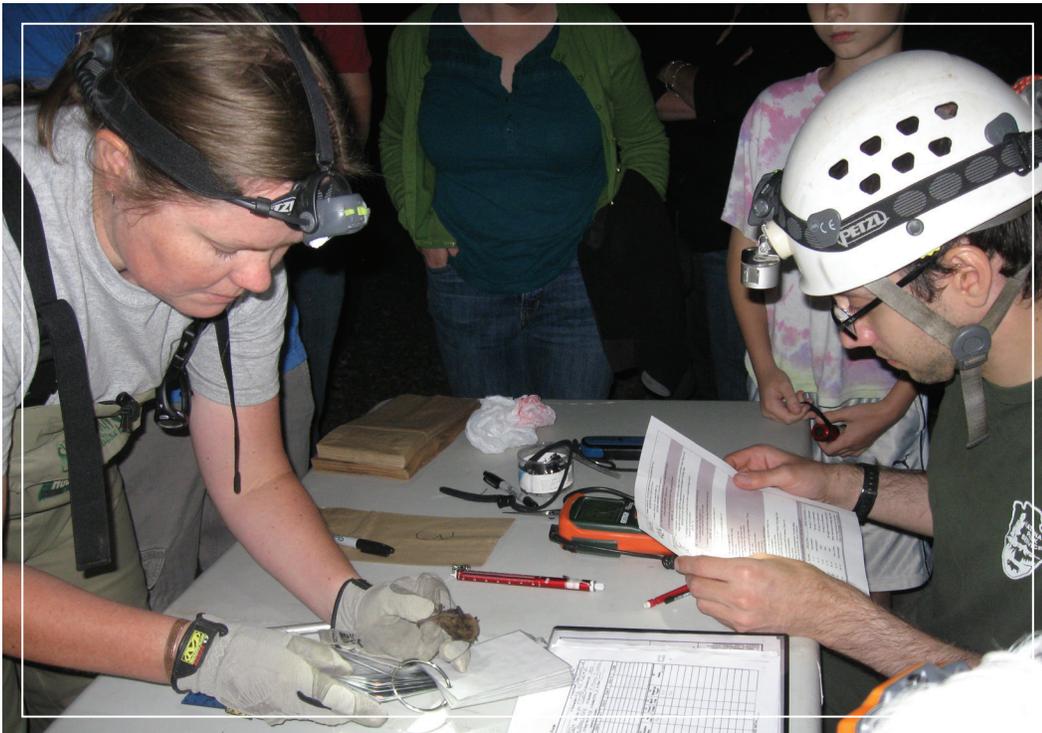
Other Important Resource or Value	Surface Ecosystem
<p><b>Laws, Executive Orders, and Regulations That Apply to the OIRV, and NPS Policy-level Guidance</b></p>	<p><b>Laws, Executive Orders, and Regulations That Apply to the OIRV</b></p> <ul style="list-style-type: none"> <li>• Endangered Species Act of 1973, as amended (16 USC §1531 et seq.)</li> <li>• National Invasive Species Act (16 USC §4701)</li> <li>• Lacey Act, as amended (16 USC §3371-3378)</li> <li>• Migratory Bird Treaty Act (16 USC §703-712)</li> <li>• Bald and Golden Eagle Protection Act (16 USC §668)</li> <li>• National Environmental Policy Act of 1969 (42 USC §4321)</li> <li>• Federal Noxious Weed Act of 1974, as amended (7 USC §2801 et seq.)</li> <li>• Clean Water Act (33 USC §1251-1387, 33 USC §1151)</li> <li>• Clean Air Act (42 USC §7401 et seq.)</li> <li>• Paleontological Resources Preservation Act of 2009 (16 USC §470aaa-470aaa-11)</li> <li>• Executive Order 13112, "Invasive Species"</li> <li>• Secretarial Order 3289, "Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources"</li> <li>• Executive Order 11514, "Protection and Enhancement of Environmental Quality"</li> <li>• Executive Order 11988, "Floodplain Management"</li> <li>• Executive Order 12088, "Federal Compliance with Pollution Control Standards"</li> <li>• National Flood Insurance Program</li> <li>• "Audio disturbances" (36 CFR 2.12)</li> </ul> <p><b>NPS Policy-level Guidance (NPS Management Policies 2006 and Director's Orders)</b></p> <ul style="list-style-type: none"> <li>• NPS <i>Management Policies 2006</i> (1.4) "Park Management"</li> <li>• NPS <i>Management Policies 2006</i> (1.6) "Cooperative Conservation Beyond Park Boundaries"</li> <li>• NPS <i>Management Policies 2006</i> (4.1) "General Management Concepts"</li> <li>• NPS <i>Management Policies 2006</i> (4.1.4) "Partnerships"</li> <li>• NPS <i>Management Policies 2006</i> (4.4.1) "General Principles for Managing Biological Resources"</li> <li>• NPS <i>Management Policies 2006</i> (4.7.2) "Weather and Climate"</li> <li>• Director's Order 18: <i>Wildland Fire Management</i></li> <li>• NPS <i>Natural Resource Management Reference Manual 77</i></li> <li>• NPS <i>Wildland Fire Management Reference Manual 18</i></li> <li>• NPS <i>Management Policies 2006</i> (4.6.1) "Protection of Surface Waters and Groundwaters"</li> <li>• NPS <i>Management Policies 2006</i> (4.6.2) "Water Rights"</li> <li>• NPS <i>Management Policies 2006</i> (4.6.4) "Floodplains"</li> <li>• NPS <i>Management Policies 2006</i> (4.7) "Air Resource Management"</li> <li>• Director's Order 47: <i>Soundscape Preservation and Noise Management</i></li> <li>• NPS <i>Management Policies 2006</i> (4.9) "Soundscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (5.3.1.7) "Cultural Soundscape Management"</li> <li>• NPS <i>Management Policies 2006</i> (8.2.3) "Use of Motorized Equipment"</li> <li>• NPS <i>Management Policies 2006</i> (4.10) "Lightscape Management"</li> </ul>

## Identification of Key Issues and Associated Planning and Data Needs

This section considers key issues to be addressed in planning and management and therefore takes a broader view over the primary focus of part 1. A key issue focuses on a question that is important for a park. Key issues often raise questions regarding park purpose and significance and fundamental and other important resources and values. For example, a key issue may pertain to the potential for a fundamental or other important resource or value in a park to be detrimentally affected by discretionary management decisions. A key issue may also address crucial questions that are not directly related to purpose and significance, but which still affect them indirectly. Usually, a key issue is one that a future planning effort or data collection needs to address and requires a decision by NPS managers.

The following are key issues for Timpanogos Cave National Monument and the associated planning and data needs to address them:

- **Climate Change.** Climate change has the potential to impact a variety of monument resources. Dry conditions can increase the frequency of fires while increases in frequency and volume of precipitation, particularly rain, could result in storm events causing flash floods. Both will result in impacts on the cave as the altered surface conditions increase debris infiltrating the caves through hydrologic inflows. Additionally, increases in surface temperatures cause warmer waters to flow into the caves, raising cave lake temperatures, potentially impacting the ecosystem that requires an unchanging microclimate. Weather records show an increase in frequency and intensity of storms outside of the traditional storm seasons for the region. Changes in precipitation and temperatures are extending the visitor season, affording the monument both the opportunity and the challenge of providing visitor services beyond its historic summer season.
  - *Associated Data Needs:* Climate change vulnerability assessment, environmental hazard assessment, rockfall hazard analysis
  - *Associated Planning Needs:* Climate change scenario plan, rockfall hazard mitigation plan





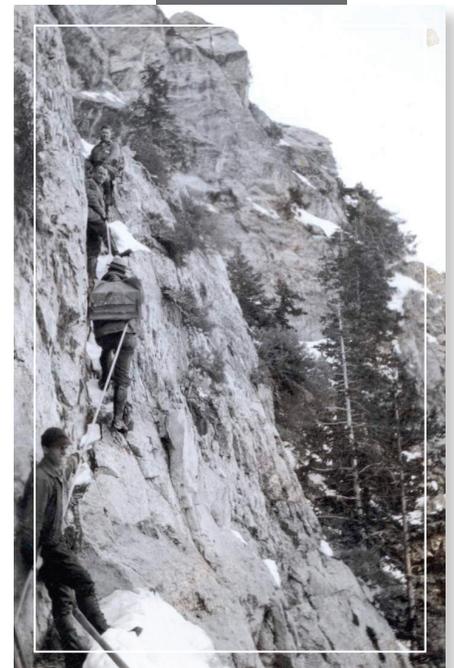
- **Development and Population Growth.** Locally, there is a trend toward increasing population and more development of the adjacent area. The increasing population in the area is leading to increased visitation and increasing demands on the resources. Fitness hiking, in particular, where local residents come to the monument daily, sometimes multiple times a day, to hike the trail, may result in parking issues for other visitors. Aside from fitness hikers, visitation in general is going up, putting a strain on the visitor resources. The picnic areas are crowded at peak times and suffering from negative impacts due to increased use. Congestion management in the monument and on the road that goes through the monument is becoming more of an issue. In combination with the growing population, the monument is seeing an increase in vandalism, especially graffiti, as well as periodic theft, and attempts to illegally enter the caves, which can have tremendous negative impacts on the cave resources. In addition, with increased population comes increased development of the Utah Valley and surrounding area. The growth of the area could have impacts on air, noise, and light pollution, impacting air quality, the viewshed, and the soundscape (acoustic resources) of the monument.
  - *Associated Data Needs:* Visitor count data, visitor demographic data, night sky assessment and monitoring, air quality assessment and monitoring, acoustic resources assessment and monitoring
  - *Associated Planning Needs:* Visitor use management plan, trails management plan, physical security plan, comprehensive interpretive plan

- **Monument Operations.** The monument has existed in essentially its current form and function since 1922, providing ranger-led cave tours to visitors from the time the winter snow melted from the trail in May until it began to fall again in late October, with a small picnic area and snack bar serving the needs of visitors, mostly from the local area, who came mostly on weekends and made a day-long outing to the cool canyon to escape the heat of summer in the valley below.

The monument staffing and operations model is still based, more or less, on that tradition, yet all of the parameters have changed, and some are changing rapidly and dramatically. The urban population has grown to the point where now more than 1 million people live within a 30-minute drive of the park, and many people visit the canyon daily to hike, jog, or bicycle for fitness. The narrow two-lane road that once carried a few hundred cars on a busy holiday weekend now routinely sees 3,000 to 4,000 every Saturday, and the long-term climate trend seems to be toward warmer winters with less snow, and more precipitation in the form of brief but very intense rain events. This results in more demand for nearly year round access and services, as well as increasing demand for traditional cave tours. All of this is compounded by the fact that the monument lost its visitor center and administrative building to a fire in 1991 and is still operating out of what were intended to be temporary buildings that do not provide adequate space for visitor services or staff. A new building is now planned for construction in 2017, but due to space and fiscal limitations, it will be smaller than the original and will not include the current concession operated gift shop or snack bar.

The monument must continue to develop its infrastructure and emphasize appropriate strategic planning as it adapts to changes in climate, technology, and population. Because it does not anticipate significant funding increases to support additional staff, it must look at maximizing the effective use of existing positions as well as augmenting its capacity with volunteers and partners.

- *Associated Data Needs:* Visitor count data, visitor demographic data
- *Associated Planning Needs:* Comprehensive position management plan, strategic plan, commercial services strategy





- **Infrastructure.** The current infrastructure at the monument does not adequately meet the needs of operation. Communication infrastructure is not sufficient for safe and efficient management. There is no cellular phone service on the canyon floor, and only intermittent coverage along the upper cave trail, which limits both staff and visitor use of cellular phones and related devices for voice or data communication. The infrastructure to bring public access internet into the canyon is currently not there. As demand grows and new technology emerges, it may be desirable to upgrade the services offered including Wi Fi and hotspots for visitors. A staff telephone has been installed in the entrance grotto, but there are no radio or telephone communications inside the cave system, which could negatively impact visitor and staff safety and emergency response. The monument should continue to investigate opportunities to install a telephone or intercom system for tour guides inside the caves.

The physical infrastructure of the monument is also a problem as it relates to the water and septic system. There is not a clear understanding of the watershed or the septic system in multiple locations in the monument. Additional information is needed in the Facility Management Software System database in order to support future management decisions and actions regarding these systems. Inadequate capacity, age and associated maintenance costs, and leaching of effluent from cave trail restrooms is a challenge. Surface runoff from some paved parking areas currently flows untreated into the American Fork River, although much of this will be improved during reconstruction of the visitor contact station parking lot in 2017.

*Associated Data Needs:* GIS layer of water system

## Planning and Data Needs

To maintain connection to the core elements of the foundation and the importance of these core foundation elements, the planning and data needs listed here are directly related to protecting fundamental resources and values, park significance, and park purpose, as well as addressing key issues. To successfully undertake a planning effort, information from sources such as inventories, studies, research activities, and analyses may be required to provide adequate knowledge of park resources and visitor information. Such information sources have been identified as data needs. Geospatial mapping tasks and products are included in data needs.

Items considered of the utmost importance were identified as high priority, and other items identified, but not rising to the level of high priority, were listed as either medium- or low-priority needs. These priorities inform park management efforts to secure funding and support for planning projects.

<b>Planning Needs – Where A Decision-Making Process Is Needed</b>			
<b>Related to an FRV, OIRV, or Key Issue?</b>	<b>Planning Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes</b>
Cave Trail (FRV)	Trail restroom plan	H	Need information to determine where trail restrooms should be, how many there should be, and what type are most conducive. The plan needs to evaluate if the restrooms should be moved and if they are moved what impacts there would be to moving them to a new location (visitor experience, resource impacts, etc.). The plan should assess how many restrooms are needed for the carrying capacity of the trail and evaluate if different types of restroom facilities would be better to eliminate potential impacts on the resources.
Development and Population Growth (Key Issue)	Physical security plan	H	The increased adjacent population has led to increased threats to visitors and resources, as evidenced by recurring vandalism and other illegal activity. The draft physical security plan should be reviewed, updated, and finalized.
Cave System (FRV); Opportunities for Scientific Study (FRV); Cultural Resources (OIRV); Surface Ecosystem (OIRV)	Resource stewardship strategy	H	This plan would provide desired future conditions of monument resources to help make management decisions and take actions to protect resources.
Cave System (FRV); Surface Ecosystem (OIRV); Climate Change (Key Issue)	Climate change scenario plan	H	This planning process would develop a range of plausible science-based scenarios of future conditions that would inform development of climate change adaptation strategies that serve monument planning needs, resources, and visitors in a rapidly changing environment. This plan would build from the climate change vulnerability assessment.
Cave Trail (FRV); Climate Change (Key Issue)	Rockfall hazard mitigation plan	H	This plan would help to mitigate impacts from rockfall incidents, both for resource and facility protection and for visitor safety. Information from the rockfall hazard analysis would feed into this plan.
Cave System (FRV); Opportunities for Scientific Study (FRV); Visitor Experience (FRV); Monument Operations (Key Issue)	Strategic plan	H	This plan would provide guidance regarding management, staffing, and funds for the monument.
Cultural Resources (OIRV)	Cultural landscape report	H	To provide landscape treatment recommendations. National register documentation may need to be amended to add cultural landscape information. This will be based on information from the cultural landscape inventory.
Visitor Experience (FRV); Monument Operations (Key Issue)	Comprehensive position management plan	M	The plan should help determine priorities for current staff and any potential additional staffing.
Cave System (FRV); Visitor Experience (FRV)	Accessibility self-assessment and transition plan	M	This plan would evaluate and assess physical barriers to accessibility. The outcome of the plan would be an accessible and spatially referenced document that would guide park staff and decision makers in assessing, prioritizing, and implementing solutions for increased accessibility, if deemed appropriate.

Planning Needs – Where A Decision-Making Process Is Needed			
Related to an FRV, OIRV, or Key Issue?	Planning Needs	Priority (H, M, L)	Notes
Opportunities for Scientific Study (FRV)	Vegetation management plan	M	There is an existing nonnative weed plan but there is no vegetation management plan. This came to light with the beetle infestation. The monument requires a plan outlining how to best manage the fir forest near the trail, vegetation management on historic sites (cave campground), and fire management (which would be different in historic areas versus nonhistoric). This plan should address management of hazard trees and roadside vegetation.
Visitor Experience (FRV)	Sign plan	M	The park lacks a comprehensive sign plan that ensures uniformity and conformity with NPS standards. A plan would reduce the current proliferation of non-uniform signs throughout the park and improve the visitor experience with better information, interpretation, safety, and wayfinding information.
Park Operations (Key Issue)	Commercial services strategy	M	Evaluation of current concession contract and potential for commercial use authorizations in the future given changes to visitor contact station.
Visitor Experience (FRV); Cave Trail (FRV)	Visual resource management plan	M	The scenic views are a critical component of the visitor experience and the trail. A plan, using the accompanying inventory, would provide information to help the monument identify strategies for protecting scenic views.
Visitor Experience (FRV); Surface Ecosystem (OIRV); Development and Population Growth (Key Issue)	Comprehensive interpretive plan	M	A long-range interpretive plan was done in 2010, but an updated comprehensive interpretive plan would provide a more complete plan for addressing interpretation at the monument, especially in light of impacts from increased visitor use.
Visitor Experience (FRV); Development and Population Growth (Key Issue)	Visitor use management plan	L	As population increases and the monument has increased visitation, a management plan will be needed for visitors outside the cave (beyond the cave management plan), such as on the trail, in picnic areas, etc.
Cave Trail (FRV); Visitor Experience (FRV); Development and Population Growth (Key Issue)	Trails management plan	L	The cave trail is so central to the character of the monument and the visitor experience that it is included as an FRV in its own right. Management of the trail for safety, preservation of its historic character, and maintenance on steep, rockfall prone canyon walls is complex and frequently challenges funding and staffing limitations. A trail management plan would help identify priority needs, best practices, and cost estimating for long-term management of this resource.
Visitor Experience (FRV)	Outdoor lighting plan	L	A plan for the assessment and implementation of in-monument lighting and guidance for working with partners in the valley who could impact the dark night sky.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV, OIRV, or Key Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Visitor Experience (FRV); Development and Population Growth (Key Issue); Monument Operations (Key Issue)	Visitor count data	H	Need data about visitors using the monument (picnic areas, trail use by fitness hikers and general visitors).
Cave System (FRV); Climate Change (Key Issue)	Climate change vulnerability assessment	H	This information would help the monument better understand the impacts of climate change on monument resources. The finished assessment would inform the climate change scenario planning effort.
Visitor Experience (FRV)	Interpretive program evaluation	H	An overall evaluation of all interpretive programming is needed. This would provide information to evaluate all programming to prioritize needs in interpretation.
Cave Trail (FRV); Climate Change (Key Issue)	Rockfall hazard analysis	H	There needs to be a quantitative tool to analyze the hazards from rockfall. This is an issue for employee and visitor safety. Also, rockfalls can impact the trail and associated historic resources along the trail. The analysis would need to provide information about how often rockfall occurs, how much falls, where it falls, the damage caused, etc. These data would assist with the rockfall hazard mitigation plan.
Cave System (FRV)	Cave microclimate analysis	H	There is a significant amount of existing cave microclimate data that need to be assessed and summarized into a report.
Opportunities for Scientific Study (FRV)	Beetle infestation data	H	Photo monitoring of the forest (Douglas-fir, white fir, and limber pine) would track beetle infestation.
Climate Change (Key Issue)	Environmental hazard assessment	H	An assessment is needed to determine the probability and potential locations of floods, earthquakes, and fire incidents to understand impacts on resources and plan for management response actions.
Opportunities for Scientific Study (FRV)	Microbial sampling	H	There has been recent rapid spread of a pink growth on the cave walls and its composition is unknown. The increase may coincide with the recent switch from halogen to LED lighting, but sampling and identification is needed to improve management of this suspected microbe.
Cave System (FRV)	Cave feature inventory	H	There is no existing cave feature inventory. An inventory integrated with GIS would assist in cave feature management.
Cave System (FRV); Opportunities for Scientific Study (FRV)	Cave watershed analysis	H	The boundary of the watershed that feeds into the cave is currently unknown. A dye trace study should be done to define and map the cave watershed boundary to assist with management into the future.
Cultural Resources (OIRV)	Update List of Classified Structures	H	The List of Classified Structures currently shows 13 structures, all overdue for updates and condition assessments, which are required every six years. In addition, historic structures missing from the database need to be added.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV, OIRV, or Key Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Cave System (FRV); Opportunities for Scientific Study (FRV)	Baseline cave data	M	Need baseline data regarding the biology, microbes, and microclimate of the caves.
Cave System (FRV); Opportunities for Scientific Study (FRV)	Speleogenesis data	M	Sampling and dating of the speleothems would help determine the cave age.
Visitor Experience (FRV); Development and Population Growth (Key Issue); Monument Operations (Key Issue)	Visitor demographic data	M	The last visitor survey project was completed in 2005. Part of the American Fork Canyon vision project is conducting this on some level, but updated visitor data are needed.
Cave System (FRV); Visitor Experience (FRV)	Lighting and communication infrastructure assessment (inside caves)	M	Updating the lighting system could reduce impacts to the cave microclimate and provide an opportunity to integrate communication infrastructure to improve visitor experience. This assessment would provide a comprehensive evaluation of lighting and telephone or radio needs and opportunities in the cave system.
Infrastructure (Key Issue)	GIS layer of water system	M	Currently, there are no spatial data on the water system and changes have not been updated on existing hand drawings. The data would be extremely useful, especially if they included age, material, location, valves, and size of the lines and valves/water pressure at different locations as attributes of the GIS data.
Visitor Experience (FRV); Opportunities for Scientific Study (FRV); Surface Ecosystem (OIRV); Development and Population Growth (Key Issue)	Night sky assessment and monitoring	M	The monument is in need of baseline data and ongoing monitoring to determine how light pollution might be increasing and impacting the night sky. Interpretation of this information to visitors is also desired.
Cave System (FRV)	Light spectrum data / color rendering index	M	This information would assist in determining the best type of lighting to provide the best visitor experience in the cave without impacting the cave microclimate, specifically for algae monitoring.
Cave System (FRV)	Water quantity data inside cave	M	Monument staff has tried using tipping buckets and level loggers to understand how much water is coming into the caves. The Middle Cave Lake level is monitored by a pump and integrating a monitor on the pump may provide data about how much water is coming into the cave. Staff needs some sort of data to ascertain the amount of water coming into the cave throughout the year.
Visitor Experience (FRV)	Infrastructure and communication assessment outside cave	M	Monument management needs an assessment of communication systems (phone and internet) coming into the monument. This infrastructure needs upgrading because the monument currently does not have the capability of handling updated technological uses.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV, OIRV, or Key Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Surface Ecosystem (OIRV)	River water quality data	M	Rehabilitation of two dams upstream from the monument in the next two years might impact water quality. Establishing a baseline of water quality and constant monitoring after the dams are built would provide information about heavy metals in the water (related to mining districts up canyon). Also, the monument wants to do some stream bank stabilization and baseline water quality data collected before and after the project would be able to inform if the stabilization will improve water quality.
Cave System (FRV)	Structural assessment of Middle Cave Bridge	M	Middle Cave Bridge corrosion (current condition) could be an impact on cave resources if stability is in question. Replacing the bridge would also be a tremendous impact on the cave resource. A study on the structure of the bridge might provide some information about the remaining use-life.
Cave System (FRV)	Condition assessment of cave infrastructure	M	Updated condition assessments for infrastructure in caves (trail, catwalks, stairs, railings, etc.) for the Facility Management Software System database are needed.
Cultural Resources (OIRV)	Condition assessment of historic resources	M	In order to plan for and prioritize cultural resource preservation efforts, the monument needs a well-documented condition assessment for use in the Facility Management Software System and cultural resource management planning.
Cave System (FRV); Surface Ecosystem (OIRV)	Insect, reptile, and amphibian study	M	Though some limited work has been done over time, the monument lacks good baseline inventory of these fauna. Monitoring and protection programs, especially in the face of climate change, would require a comprehensive inventory.
Visitor Experience (FRV); Cave Trail (FRV)	Visual resource inventory	M	This inventory would identify the scenic quality and values of important views. The information could help better inform the partnerships with the community and others in helping to protect scenic views. The information could also complement the cultural landscape inventory.
Surface Ecosystem (OIRV)	Investigate air pollution impacts on sensitive monument ecosystems	M	Air pollution is an ongoing issue for the metropolitan area and there is increased concern for mercury and other heavy metals on the surrounding land and in the watershed, including the American Fork River. High mercury concentrations in birds, mammals, amphibians, and fish can result in reduced foraging efficiency, survival, and reproductive success. There is no monument-specific data, but surrounding areas have high to very high predicted concentrations of methylmercury in surface waters. Monument data will be essential for future planning.

<b>Data Needs – Where Information Is Needed Before Decisions Can Be Made</b>			
<b>Related to an FRV, OIRV, or Key Issue?</b>	<b>Data and GIS Needs</b>	<b>Priority (H, M, L)</b>	<b>Notes, Including Which Planning Need This Data Need Relates To</b>
Cave Trail (FRV)	Condition assessments on trail infrastructure	L	Condition assessments for rock retaining walls, the trail surface, chains and railing, the rock trap, and the restrooms along the trail would help for management purposes.
Visitor Experience (FRV); Opportunities for Scientific Study (FRV); Surface Ecosystem (OIRV); Development and Population Growth (Key Issue)	Air quality assessment and monitoring	L	Air quality is an important visitor experience/safety issue and also could have impacts on the ecosystem. There are regional data for this and localized baseline and ongoing monitoring of air quality data is needed to evaluate impacts on visitor safety, and ultimately, visitor experience.
Opportunities for Scientific Study (FRV)	Previous research inventory	L	The monument is missing data, reports, and specimens from previous research. Some permits where specimens were taken require the specimens to be returned to the monument and they have not. An inventory would assist in locating and inventorying reports done prior to the issuance of research permits or provide for the monument data/reports based on research that was conducted, but the monument never received the results.
Surface Ecosystem (OIRV)	Add to flora and fauna species lists	L	The monument needs additional data on invertebrate species and flora species. The data need to be expanded based on existing species lists.
Visitor Experience (FRV); Opportunities for Scientific Study (FRV); Development and Population Growth (Key Issue)	Acoustic resource assessment and monitoring	L	The monument staff would like to collect acoustic data to measure baseline acoustic conditions and assess potential noise pollution issues into the future.
Surface Ecosystem (OIRV)	Soil data	L	Currently, there are no data on soils outside the cave. The composition of soils, depending on location of soil, has potential impacts on cave resources and vegetation. Soil mineralogy and GIS modeling are needed to assess this issue.
Surface Ecosystem (OIRV)	Fish species inventory	L	Fishing is permitted in the monument, but most species are probably introduced. A fish study would identify if there were any native species within the monument boundaries.
Cave Trail (FRV); Cultural Resources (OIRV)	Rock wall inventory	L	Documentation of the locations and conditions of the rock walls on the trail would assist monument managers for maintenance purposes.

## Part 3: Contributors

### Timpanogos Cave National Monument

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### Photo Credits

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# Appendixes

## Appendix A: Enabling Legislation for Timpanogos Cave National Monument

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

October 14, 1922.

### A PROCLAMATION

WHEREAS, a natural cave, known as the Timpanogos Cave, which is situated upon unsurveyed lands within the Wasatch National Forest in the State of Utah, is of unusual scientific interest and importance, and it appears that the public interests will be promoted by reserving this cave with as much land as may be necessary for the proper protection thereof, as a National Monument.

Timpanogos Cave National Monument, Utah. Preamble.

NOW, THEREFORE, I, Warren G. Harding, President of the United States of America, by virtue of the power in me vested by section two of the Act of Congress approved June eight, nineteen hundred and six, entitled, "An Act for the preservation of American antiquities," do proclaim that there is hereby reserved from all forms of appropriation under the public land laws, subject to all prior valid adverse claims, and set apart as a National Monument, the tract of land in the State of Utah shown as the Timpanogos Cave National Monument on the diagram forming a part hereof.

National Monument, Utah. Vol. 34, p. 225.

The reservation made by this proclamation is not intended to prevent the use of the lands for National Forest purposes under the proclamation establishing the Wasatch National Forest, and the two reservations shall both be effective on the land withdrawn but the National Monument hereby established shall be the dominant reservation and any use of the land which interferes with its preservation or protection as a National Monument is hereby forbidden.

Use of Wasatch National Forest not affected.

Warning is hereby given to all unauthorized persons not to appropriate, injure, deface, remove, or destroy any feature of this National Monument, or to locate or settle on any of the lands reserved by this proclamation.

Reserved from settlement, etc.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE at the City of Washington this fourteenth day of October, in the year of our Lord one thousand nine hundred and [SEAL] twenty-two, and of the Independence of the United States of America the one hundred and forty-seventh.

WARREN G HARDING

By the President:  
CHARLES E. HUGHES  
*Secretary of State.*

## Appendix B: Glossary

Anthodites	Anthodites (from the Greek anthos meaning flower) are speleothems composed of needle-like crystals situated in clusters which radiate outward from a common base. They are colorless to white, radiating, spiky, quill-like crystal sprays.
Aragonite	A carbonate mineral, the second most common naturally occurring cave mineral, is the crystal form of calcium carbonate, CaCO <sub>3</sub> . It is a polymorph of calcite (which means both minerals have the same chemical composition, CaCO <sub>3</sub> , but crystallize in a different crystal system), and is metastable relative to a calcite which means that its internal structure will change to that of calcite over time. Aragonite typically takes a needle-like form in caves. Aragonite coexists with calcite in many speleothems, even when not apparent.
Boxwork	Boxwork formed when thin veins of calcite were deposited in cracks in the rock; the rock was preferentially removed at a later time, so that the veins now stick out in relief. When the veins cross each other at right angles, they often resemble post office boxes. Because it was formed by the removal of bedrock, boxwork is considered a speleogen, rather than a speleothem.
Calcite	Calcite is a carbonate mineral and the most abundant cave mineral. It is the constituent of most speleothem types.
Coralloids	Also called cave popcorn, coralloids consist of white knobs of calcite or aragonite formed through a process of evaporation of moisture from the cave walls.
Drapery	Draperies form when calcite-rich water runs down an overhanging wall over time leaving a thin sheet.
Flowstone	Flowstone is typically composed of sheet-like deposits of calcite resulting when water flows down walls or on the floors of a cave.
Frostwork	Frostwork is formed by evaporation of calcium-rich moisture. It can look similar to actual frost but consists of a form of calcium carbonate called aragonite.
Helictites	Helictites are fingers of calcite that defy gravity and twist and grow in any direction, deposited by seeping water.
Microclimate	A microclimate is the climate of a very small or restricted area, especially when this differs from the climate of the surrounding area.
Shelfstone	Shelfstone is a flat deposit attached as a ledge or eave-like projection to the edge of a cave pool or to other speleothems submerged in a cave pool.
Spar	The term spar typically refers to crystalline minerals that have readily discernible faces. The term has usually been used for calcite (calcite spar), fluorite (fluorspar), or barite (heavy spar).
Speleology	The scientific study of caves and other karst features, their make-up, structure, physical properties, history, life forms, and the processes by which they form and change over time.
Speleogenesis	The origin and development of caves. The primary development of caves, typically through limestone, cause by the presence of water with carbon dioxide dissolved within it, producing carbonic acid which permits the dissolution of the calcium carbonate in limestone.
Speleogen	A geological formation in a cave that has been created by the removal of bedrock, rather than as a secondary deposit.
Speleothem	A secondary mineral deposit formed in a cave.
Stalactite	A stalactite is an icicle-shaped formation that hangs from the ceiling of a cave, and is produced by precipitation of minerals from water dripping from the cave ceiling.
Stalagmite	A type of rock formation that rises from the floor of a cave due to the accumulation of material deposited on the floor from ceiling drippings.

## Appendix C: Inventory of Administrative Commitments

Title / Agency / Organization	Purpose / Description	Dates	Responsible Party/Parties
<b>Memorandums of Agreement</b>			
Utah Division of State History (SHPO), American Fork City Utah	Mitigate impacts on historic resources from rehabilitation work on city owned water collection system in monument.		TICA Superintendent Mayor, American Fork Mayor SHPO, Brad Westwood
Friends of Timpanogos Cave	General support and philanthropic fund raising for the monument.	3/16/2015 through 3/16/2020	TICA Superintendent President, Friends of Timpanogos Cave, Rosalind Bahr
Dr. Dean W. Shelton	Serve as volunteer medical advisor for monument emergency medical services (EMS) program.	4/23/2014 – term indefinite	TICA Superintendent TICA EMS Coordinator Dr. Dean Shelton
<b>General Agreements</b>			
Lone Peak Fire Department (LPFD)	Mutual aid for structural fires and emergency medical response.	8/21/2012 through 8/21/2017	TICA Superintendent Chief, LPFD, Brad Freeman
State of Utah	Water rights settlement agreement.	Indefinite, signed 2004	Utah State Engineer
University of Utah Seismic Stations	Agreement to host seismograph at monument that ties into and reports to the Utah Seismic Stations network.	3/8/2012 – present	TICA Superintendent NPS Chief of Security Operations Intermountain Region (IMR) Chief of Information IMR IT Security Manager
<b>Special Park Uses</b>			
<b>Rights-of-Way</b>			
PacifiCorp DBA Rocky Mountain Power	Electric powerline that runs parallel to north boundary (RW 1550-13-00); annual fee collected.	7/3/2013 through 7/3/2023	TICA Superintendent
CenturyLink	Telephone line that runs underground adjacent to SR 92 (notes: SUP 1550-8-0001 expired 12/31/97, not renewed for reasons unknown to current staff. Previous permittee was Mountain Bell, successor is now CenturyLink).	TBD	CenturyLink
American Fork City, Utah	In progress: Waterline right-of-way. The monument anticipates issuance of a long-term right-of-way permit for a municipal water collection system and pipeline, probably in calendar year 2016.	In progress	TICA Superintendent Mayor, American Fork City

Title / Agency / Organization	Purpose / Description	Dates	Responsible Party/Parties
<b>Special Park Uses (continued)</b>			
<b>Rights-of-Way</b>			
PacifiCorp dba Rocky Mountain Power	Electric powerline that runs from canyon floor to point near Middle Cave entrance, supplies power to cave. Permit RW 1550-15-001. Also authorizes a donation of the line to TICA after construction is complete.	10/23/2015	TICA Superintendent
<b>Special Use Permits</b>			
Timpanogos Half Marathon	Half marathon starting at Tibble Fork Reservoir passing through the monument (EVNT-TICA-2501-005).	7/19/2014	David B. Murphy
American Fork Half Marathon	Half marathon starting at Tibble Fork Reservoir passing through the monument (EVNT-TICA-2501-005).	6/20/2014	Scott Mortensen
Memorial Living Urn	Plant a tree in a living urn in park revegetation program with small memorial service, NTE 8 participants (MEMR-TICA-2620-007).	6/14/2014	Matt Petty
Live Big LLC Memorial Bike Ride	Memorial bicycling event riding through the monument and the Uintah National Forest (EVNT-TICA-2501-008).	8/16/2014	Dave Bauerle
Studio D Productions, LLC	Filming within the scope of a general visitor perspective, on the cave trail as well as a guided tour in the cave system for a local outdoor adventure show.	8/18/2014	Dan Davis
St. Cloud Production Co.	Filming within the scope of a general visitor perspective, on the cave trail as well as a guided tour in the cave system.	9/17/2014	Valerie Douroux
<b>Commercial Services</b>			
<b>Concession Contracts</b>			
Timpanogos Cave Concessions	CC-TICA001-12. Food / beverage / gift shop service. Note: This contract may be terminated with construction of new visitor center facility in 2016–2017.	01/01/2012 – 12/31/2021	TICA Superintendent
Commercial Use Authorizations	None issued currently. Monument is currently considering use of a limited number of commercial use authorizations for limited food service as an alternative to current concession contract, but this is just conceptual discussion as this point.	TBD	N/A

Title / Agency / Organization	Purpose / Description	Dates	Responsible Party/Parties
<b>Interagency Agreements</b>			
Uinta-Wasatch-Cache National Forest	American Fork Canyon fee partnership. NPS assists USFS with fee collection operations and interpretive services in exchange for some revenue from USFS fee program.		TICA Superintendent / Administrative Officer (NPS), Pleasant Grove District Ranger, USFS
Uinta-Wasatch-Cache National Forest	Development of an interagency visitor center and administrative building in Highland, Utah.		TICA Superintendent , Pleasant Grove District Ranger, USFS
<b>Cooperative Agreements</b>			
State of Utah, USFS, and U.S. Department of the Interior for Wildland Fire Protection	Master Cooperative Wildland Fire Management and Stafford Act Response Agreement. The current Annual Operating Plan calls for USFS to assume initial attack responsibility for wildfires within the boundaries of TICA.	Signed 2008, implemented with annual operating plans, subject to review and approval each year	TICA Superintendent
<b>Cooperating Association Agreements</b>			
Western National Parks Association (WNPA)	Provide interpretive products and publications available in a small sales outlet within monument visitor center, support monument interpretation, education, and research with financial support from proceeds.		TICA Superintendent TICA Chief of Interpretation and Resource Management WNPA Executive Director
<b>Interpark Agreements</b>			
Northern Colorado Plateau Inventory and Monitoring Network	Provide inventory and monitoring of natural resources in a collaborative approach that leverages resources across a group of parks.	Indefinite	TICA Superintendent Washington Office Inventory and Monitoring Program Manager TICA Chief of Interpretation and Resource Management
Zone Safety Officer	Partner parks will be Dinosaur National Monument, Fossil Butte National Monument, Colorado National Monument, and Golden Spike National Historic Site.	TBD	TICA Superintendent Dinosaur National Monument Superintendent, Fossil Butte National Monument Superintendent, Colorado National Monument Superintendent, and Golden Spike National Historic Site Superintendent
Utah Parks Fire Management group	Agreement between Zion National Park and multiple small Utah parks, including TICA, for provision of a fire management officer and program support.	Expires 2018	TICA Superintendent Zion National Park Superintendent and Fire Management Officer

## Appendix D: Traditionally Associated Tribes

**Paiute Indian Tribe of Utah**  
440 North Paiute Drive  
Cedar City, UT 84721

**Skull Valley Band of Goshute Indians of Utah**  
PO Box 448  
Grantsville, UT 84029

**Ute Indian Tribe of the Uintah and Ouray Reservation, Utah**  
PO Box 190  
Fort Duchesne, UT 84026



## Appendix E: Past and Ongoing Park Planning and Data Collection Efforts

Document Name	Year
Iorio, R. <i>The History of Timpanogos Cave National Monument, American Fork Canyon, Utah</i>	1968
<i>Timpanogos Cave National Monument, Scope of Collections Statement</i>	1978
Frankowski, L. <i>Rocky Mountain Region Inventory of Archeological Sites Program: Timpanogos Cave National Monument</i>	1978
<i>Road Inventory and Needs Study for Timpanogos Cave National Monument</i>	1980
<i>National Register of Historic Places Inventory – Nomination Form: Timpanogos Cave Historic District</i>	1982
<i>Natural Resource Management Plan Timpanogos Cave National Monument</i>	1983
<i>General Management Plan, Development Concept Plan, Interpretive Prospectus: Timpanogos Cave National Monument, Utah County, Utah</i>	1983
<i>Cultural Resources Management Plan: Timpanogos Cave National Monument</i>	1984
<i>Timpanogos Cave National Monument Statement for Management</i>	1984
<i>Timpanogos Cave National Monument Statement for Management</i>	1986
<i>Timpanogos Cave National Monument Statement for Management</i>	1989
<i>Timpanogos Cave National Monument Statement for Management</i>	1991
<i>Cave Resource Management Plan Timpanogos Cave National Monument</i>	1993
<i>Environmental Impact Statement, General Management Plan, Development Concept Plan, w/Errata Sheet 11/93 and Record of Decision 1/94</i>	1993
<i>Resource Management Plan, Timpanogos Cave National Monument</i>	1995
<i>Timpanogos Cave National Monument Government Performance and Results Act, Annual Performance Plan Fiscal Year 1998, Strategic Plan</i>	1997
<i>Rapid Visual Screening of Buildings for Potential Seismic Hazards: Rocky Mountain Cluster</i>	1998
<i>Baseline Water Quality Data Inventory and Analysis: Timpanogos Cave National Monument</i>	1999
O'Brien, R.A. <i>Comprehensive Inventory of Utah's Forest Resources, 1993</i>	1999
<i>Timpanogos Cave National Monument Annual Performance Report Fiscal Year 2000, October 2, 1999 – September 31, 2000</i>	2000
<i>Report: Timpanogos Cave National Monument, Federal Highway Administration and Federal Transit Administration</i>	2001
<i>Timpanogos Interagency Center Design Concepts</i>	2001
<i>Timpanogos Cave National Monument Annual Performance Report Fiscal Year 2001, October 1, 2000 – September 31, 2001</i>	2001

Document Name	Year
<i>Timpanogos Cave National Monument Scope of Collection Statement</i>	2002
Koch, A.L., and V.L. Santucci. <i>Paleontological Resource Inventory and Monitoring: Northern Colorado Plateau Network</i>	2002
<i>Timpanogos Cave National Monument Annual Performance Report Fiscal Year 2002, October 1, 2001 – September 31, 2002</i>	2002
<i>Macroinvertebrates of Timpanogos Cave, Timpanogos Cave National Monument, Utah</i>	2003
Platenburg, R., and T. Graham. <i>Northern Colorado Plateau Network Herpetofauna Inventory, 2002 Annual Report</i>	2003
Haymond, S., et al. <i>2001–2002 Mammalian Inventory Final Report for Selected Northern Colorado Plateau Network Parks</i>	2003
Johnson, M., et al. <i>2001–2002 Avian Inventory Final Report for Northern Colorado Plateau National Parks: Cedar Breaks National Monument, Fossil Butte National Monument, Golden Spike National Historic Monument, Timpanogos Cave National Monument</i>	2003
Pulham, C. <i>Museum Housekeeping Plan: Timpanogos Cave National Monument</i>	2004
<i>Timpanogos Cave National Monument Water Rights Settlement Agreement, between United States and State of Utah</i>	2004
<i>Wildland Fire Management Plan for Timpanogos Cave National Monument</i>	2004
Garman, S.L., et al. <i>Climate Monitoring Protocol for the Park Units in the Northern Colorado Plateau Network</i>	2004
Kohut R.J. <i>Ozone risk assessment for Northern Colorado Plateau Network</i>	2004
<i>Northern Colorado Plateau Inventory and Monitoring Program: Vital Signs Monitoring Plan</i>	2005
Manni, M.F., Y. Le., and S.J. Hollenhorst. (2006). <i>Timpanogos Cave National Monument Visitor Study Summer 2005</i> . Moscow, ID.	2006
<i>The Road Inventory of Timpanogos National Monument TICA — 1550</i>	2006
<i>Weather and Climate Inventory National Park Service, Northern Colorado Plateau Network</i>	2006
Garman, S.L. <i>Northern Colorado Plateau Network Climate Monitoring Report: 2005</i> . Moab, UT.	2006
<i>Timpanogos Cave National Monument: Geologic Resource Evaluation Report</i>	2006
Thornberry-Erich, T. <i>Timpanogos Cave National Monument: Geologic Resource Evaluation Report</i> . Natural Resource Report NPS/NRPC/GRD/NRR—2006/013. National Park Service, Denver, CO	2006
Garman, S.L. <i>Northern Colorado Plateau Network Climate Monitoring Report: 2006</i>	2007
Richardson, D.J. <i>Intermountain Region New Deal Resources: Research Findings for Timpanogos Cave National Monument</i>	2008
Fertig, W., and N.D. Atwood. <i>Annotated Checklist of Vascular Flora Timpanogos Cave National Monument</i>	2009

Document Name	Year
Fertig, W., et al. <i>New Vascular Plant Species Discoveries in the Northern Colorado Plateau Network: 2008 Update.</i>	2009
<i>Install New Electric Line Environmental Assessment</i>	2009
Coles, J., et al. <i>Vegetation Classification and Mapping Project Report, Timpanogos Cave National Monument</i>	2009
Garman, S.L. <i>Climate Monitoring in the Northern Colorado Plateau Network Annual Report 2007</i>	2009
Witwicki, D. <i>Climate Monitoring in the Northern Colorado Plateau Network Annual Report 2008</i>	2009
Thoma, D., et al. <i>Water Quality Vital Signs Monitoring Protocol for Park Units in the Northern Colorado Plateau Network</i>	2009
Perkins, D.W. <i>Air Quality Monitoring in the Northern Colorado Plateau Network 2008 Annual Report</i>	2009
<i>Bat Species Baseline – Timpanogos Cave National Monument</i>	2009
<i>Construct Stairs and Roof Shelter Environmental Assessment</i>	2010
Fertig, W., S. Topp, and R. Meszaros. <i>New Vascular Plant Species Discoveries in the Northern Colorado Plateau Network: 2009 Update</i>	2010
Witwicki, D. <i>Climate Monitoring in the Northern Colorado Plateau Network Annual Report 2009</i>	2010
Perkins, D.W. <i>Air Quality Monitoring in the Northern Colorado Plateau Network Annual Report 2009</i>	2010
Perkins, D.W. <i>Air Quality Monitoring Protocol and Standard Operating Procedures for the Northern Colorado Plateau Network</i>	2010
Witwicki, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2009 (Non-sensitive Version)</i>	2010
Witwicki, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2009 (Sensitive Version)</i>	2010
Goolrick, F., et al. <i>Timpanogos Cave National Monument Long-Range Interpretive Plan.</i>	2010
Davis, P.E., S.W. <i>Geotechnical Investigation Proposed Trailhead Visitor Center – Timpanogos Cave National Monument, State Route 92, Milepost 10.5, Utah County, Utah</i>	2011
Sullivan, T.J., et al. <i>Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Nutrient Enrichment Effects from Atmospheric Nitrogen Deposition – Northern Colorado Plateau Network (NCPN)</i>	2011
Sullivan, T.J., et al. <i>Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition – Main Report</i>	2011
Sullivan, T.J., et al. <i>Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition – Northern Colorado Plateau Network (NCPN)</i>	2011
Thoma, D.P. <i>Remote Sensing of Vegetation Phenology and Snow-cover Extent in Northern Colorado Plateau Network Parks: Status and Trends 2010</i>	2011

Document Name	Year
Witwicky, D., et al. <i>Climate Monitoring in the Northern Colorado Plateau Network Annual Report 2010</i>	2011
Witwicky, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2010 (Non-sensitive Version)</i>	2012
Witwicky, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2010 (Sensitive Version)</i>	2012
Tweet, J. S., V. L. Santucci, T. Connors, and J. P. Kenworthy. <i>Paleontological resource inventory and monitoring: Northern Colorado Plateau Network</i> . Natural Resource Technical Report NPS/NCPN/NRTR—2012/585. National Park Service, Fort Collins, Colorado	2012
<i>Study Report Timpanogos Cave National Monument: Alternative Transportation Feasibility Study</i> . Prepared by Cambridge Systematics, Inc.	2012
Fertig, W., et al. <i>Vascular Plant Species Discoveries in the Northern Colorado Plateau Network Update for 2008-2011</i>	2012
<i>Timpanogos Cave National Monument Facility Development Environmental Assessment and General Management Plan Amendment</i>	2012
Witwicky, D., et al. <i>Climate Monitoring in the Northern Colorado Plateau Network Annual Report 2011</i>	2013
Witwicky, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2011 (Non-sensitive Version)</i>	2013
Witwicky, D. <i>Integrated Upland Monitoring in Timpanogos Cave National Monument: Annual Report 2011 (Sensitive Version)</i>	2013
Witwicky, D., et al. <i>Integrated Upland Monitoring Protocol for the Park Units in the Northern Colorado Plateau Network</i>	2013
Kennedy, R.E., et al. <i>Landscape Dynamics Monitoring Protocol for the Park Units in the Northern Colorado Plateau Network</i>	2013
Weissing, R., K. Keteles, and K. Dahlin. <i>Screening for Contaminants of Emerging Concern in the Northern Colorado Plateau Network, 2010 and 2012</i>	2013
Hackbarth, C., and R. Weissing. <i>Water Quality in the Northern Colorado Plateau Network, Water Years 2010–2012</i>	2013
<i>Timpanogos Cave National Monument Cave Management Plan Environmental Assessment</i>	2013
<i>Designations, Closures, Permit Requirements and Other Restrictions Imposed Under the Discretionary Authority of the Superintendent Title 36, Code of Federal Regulations, Chapter 1, section 1.7(b)</i>	2014
<i>Climate Change Resource Brief: Recent Climate Change Exposure of Timpanogos Cave National Monument</i>	2014
<i>Cave Camp Springs Rehabilitation: Environmental Assessment (Draft)</i>	2014
Weissing, R. <i>Screening for Contaminants of Emerging Concern in the Northern Colorado Plateau Network, 2013</i>	2014
<i>Timpanogos Cave National Monument (TICA) Species Full List with Details</i>	2015



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**Intermountain Region Foundation Document Recommendation  
Timpanogos Cave National Monument**

September 2016

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This Foundation Document has been prepared as a collaborative effort between park and regional staff and is recommended for approval by the Intermountain Regional Director.



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RECOMMENDED  
Jim Ireland, Superintendent, Timpanogos Cave National Monument

SEPTEMBER 29, 2016

Date



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APPROVED  
Sue E. Masica, Regional Director, Intermountain Region

10/18/16

Date



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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