

Geologic Resources Inventory Scoping Summary

Shiloh National Military Park, Tennessee

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The Geologic Resources Inventory (GRI) provides each of 270 identified natural area National Park System units with a geologic scoping meeting and summary (this document), a digital geologic map, and a geologic resources inventory report. The purpose of scoping is to identify geologic mapping coverage and needs, distinctive geologic processes and features, resource management issues, and monitoring and research needs. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity to discuss park-specific geologic management issues, and if possible include a site visit with local experts.

The National Park Service held a GRI scoping meeting for Shiloh National Military Park on March 23, 2009 at the Tennessee Division of Geology offices in Nashville, Tennessee. Tim Connors (NPS-GRD) facilitated the discussion of map coverage and Lisa Norby (NPS-GRD) led the discussion regarding geologic processes and features at the military park. Geologists from the Tennessee Division of Geology presented a brief geologic overview of the military park and surrounding area. Participants at the meeting included NPS staff from the park, Geologic Resources Division, and Cumberland Piedmont Network, geologists from the Tennessee Division of Geology, and cooperators from Colorado State University (see table 2). This scoping summary highlights the GRI scoping meeting for Shiloh National Military Park including the geologic setting, the plan for providing a digital geologic map, a prioritized list of geologic resource management issues, a description of significant geologic features and processes, lists of recommendations and action items, and a record of the meeting participants.

Park and Geologic Setting

Established on December 27, 1894, Shiloh National Military Park in Hardin County, southwest Tennessee preserves the scene of the American Civil War battle that took place on April 6-7, 1862. The military park includes the Shiloh National Cemetery, Shiloh Indian Mounds site, the Davis Bridge Battlefield site (in McNairy County, Tennessee) and the Corinth Battlefield (37 km, 23 miles to the southwest in Mississippi). The NPS manages 2,048.31 ha (5,061.48 ac) at Shiloh. The park is in the process of acquiring approximately 384 ha (950 ac) in Mississippi (legislation from 2000, authorized in 2007). The main park unit sits on Coastal Plain deposits in the west Tennessee River Valley at the edge of the western Tennessee uplands. The park lies on the greater Mississippi Embayment—a large synclinal trough that extends south to the Gulf of Mexico. Sediments in the embayment are younger towards the center of the embayment.

Exposed within Shiloh National Military Park are four geologic units: alluvium (Qal), terrace deposits (QT), the Coffee Formation (Kc), and the Eutaw Formation (Ke). The younger formations are Quaternary Tennessee River deposits that were originally a series of step-like alluvial terraces. Deposits include clay, sand, and gravel. The older, Cretaceous-age units reflect deposition during the last transgressive seas (high sea levels) that covered this portion of Tennessee. The Coffee Formation contains sands and clays deposited in lagoonal, barrier bar, and shoreline environments. The Eutaw Formation consists of nearshore marine clay, sand, and gravel. The older two units crop out in the lowermost reaches of the park and are exposed by erosion.

Primarily gentle, rolling hills and broad open areas define the landscape at the military park. However, several areas of very steep slopes flank the Tennessee River and smaller streams including Shiloh Branch, Old Creek, Glover (Tilghman) Branch, and Dill Branch.

Geologic Mapping for Shiloh National Military Park

During the scoping meeting, Tim Connors (NPS-GRD) showed some of the main features of the GRI's digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of being GIS compatible. The NPS GRI Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation for the GRI Program and allows for rigorous quality control. Staff members digitize maps or convert digital data to the GRI digital geologic map model using ESRI ArcGIS software. Final digital geologic map products include data in geodatabase and shapefile format, layer files complete with feature symbology, FGDC-compliant metadata, an Adobe Acrobat PDF help document that captures ancillary map data, and a map document that displays the map, and provides a tool to access the PDF help document directly from the map document. Final data products are posted at <http://science.nature.nps.gov/nrdata/>. The data model is available at <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>.

When possible, the GRI Program provides large scale (1:24,000) digital geologic map coverage for each park's area of interest, which is often composed of the 7.5-minute quadrangles that contain park lands (fig. 1). Maps of this scale (and larger) are useful to resource managers because they capture most geologic features of interest and are spatially accurate within 12 m (40 ft). The process of selecting maps for management begins with the identification of existing geologic maps (table 1) and mapping needs in the vicinity of the park. Scoping session participants then select appropriate source maps for the digital geologic data or develop a plan to obtain new mapping, if necessary.

Table 1. GRI Mapping Plan for Shiloh National Military Park

Covered Quadrangles	Relationship to park	Citation	Format	Assessment	GRI Action
Pittsburg Landing	Intersects park lands	Russell, E. E. 1964. Geologic Map and Mineral Resources Summary of the Pittsburg Landing Quadrangle. Scale 1:24,000. Geologic Quadrangle Map 13 NE. Nashville, TN: Tennessee Division of Geology.	digital	The digital map has not been finalized yet, but the digitization is done and available to the GRI.	Obtain GIS shapefiles digitized by the Tennessee Division of Geology and convert to GRI Geology-GIS Geodatabase Data Model.
Counce	Intersects park lands	Russell, E. E. 1968. Geologic Map and Mineral Resources Summary of the Counce Landing Quadrangle. Scale 1:24,000. Geologic Quadrangle Map 13 SE. Nashville, TN: Tennessee Division of Geology.	digital	The digital map has not been finalized yet, but the digitization is done and available to the GRI.	Obtain GIS shapefiles digitized by the Tennessee Division of Geology and convert to GRI Geology-GIS Geodatabase Data Model.

Covered Quadrangles	Relationship to park	Citation	Format	Assessment	GRI Action
Stantonville	Just west of park boundary, included for buffer area	Russell, E. E. 1967. Geologic Map and Mineral Resources Summary of the Counce Stantonville Quadrangle. Scale 1:24,000. Geologic Quadrangle Map 13 NW. Nashville, TN: Tennessee Division of Geology.	paper	The paper map has not been digitized yet.	Scan and digitize paper map using GRI Geology-GIS Geodatabase Data Model
Michie	Just southwest of park boundary, included for buffer area	Russell, E. E. 1967. Geologic Map and Mineral Resources Summary of the Michie Landing Quadrangle. Scale 1:24,000. Geologic Quadrangle Map 13 SW. Nashville, TN: Tennessee Division of Geology.	paper	The paper map has not been digitized yet.	Scan and digitize paper map using GRI Geology-GIS Geodatabase Data Model
Pocohontas, TN	Intersects newly acquired Davis Bridge Battlefield unit	Nicholson, S.W., Dicken, C.L., Horton, J.D., Labay, K.A., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia, , Open-File Report OF-2005-1324, 1:100000 scale	digital	digital statewide compilation	According to Mike Hoyal (Tennessee DOG) the best available coverage of this area is the statewide compilation.
Kendrick, MS	Intersects newly acquired Corinth, MS lands	Dicken, C.L., Nicholson, S.W., Horton, J.D., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina, , Open-File Report OF-2005-1323, 1:100000 scale	digital	1969 paper map digitized by USGS	According to David Thompson (Mississippi GS), best available maps of this area are these statewide compilations
Corinth, MS	Intersects newly acquired Corinth, MS lands	Dicken, C.L., Nicholson, S.W., Horton, J.D., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary integrated geologic map databases for the United States: Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina, , Open-File Report OF-2005-1323, 1:100000 scale	digital	1969 paper map digitized by USGS	According to David Thompson (Mississippi GS), best available maps of this area are these statewide compilations

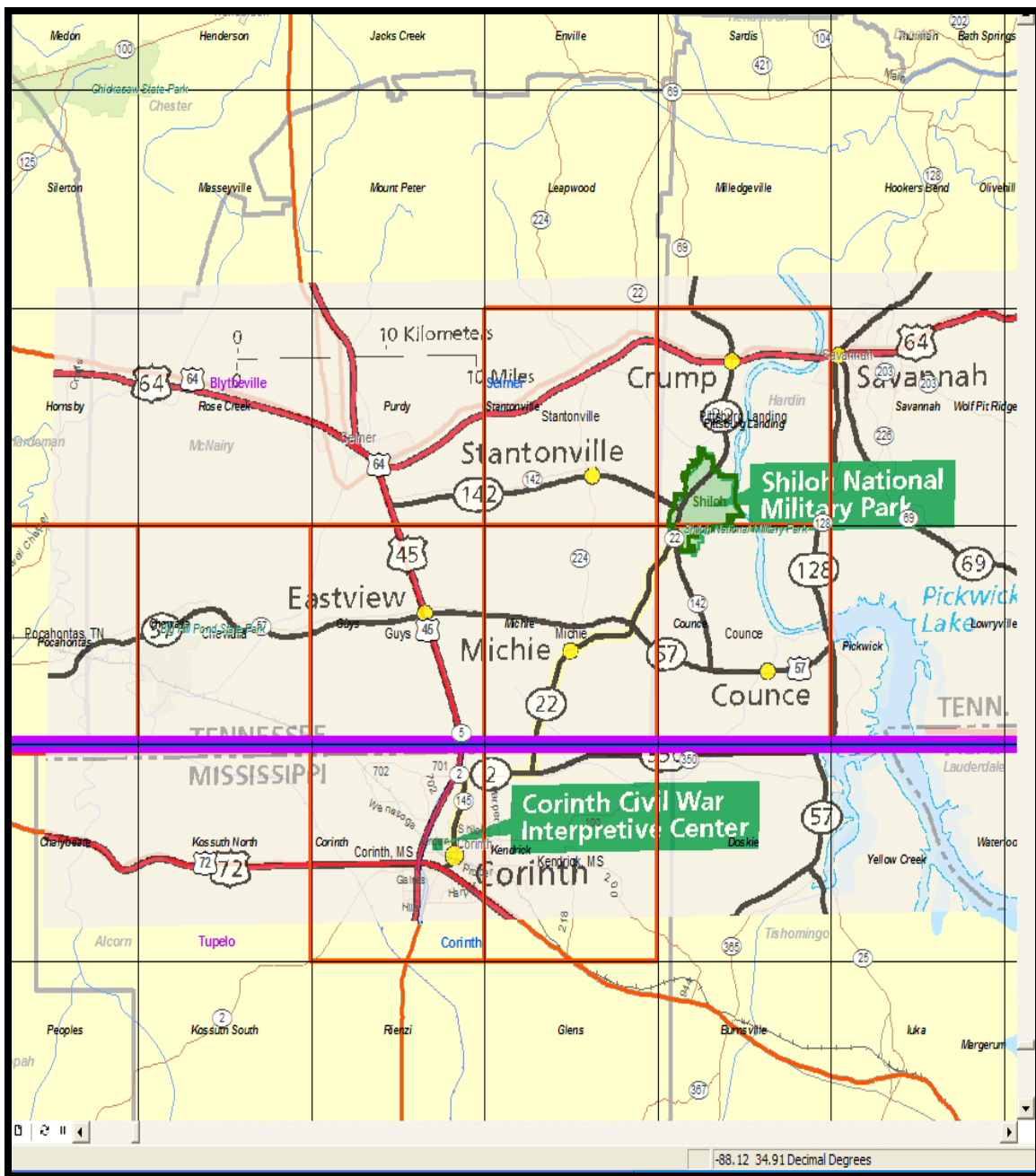


Figure 1. Area of interest for Shiloh National Military Park, Tennessee and Mississippi. The 7.5-minute quadrangles are labeled in black; text and outlines in blue indicate 30-minute by 60-minute quadrangles; purple text and lines indicate 1x2 degree quadrangles. Green outlines indicate national military park boundaries.

Geologic map coverage at 1:24,000 scale exists for at least four of the quadrangles of interest at the main unit for Shiloh National Military Park. Three quadrangles, Pocahontas, TN (Davis Bridge Unit), Corinth, MS, and Kendrick, MS do not have 7.5' quadrangle-based geologic mapping available, and the best known geologic maps are the digital statewide compilations by the USGS

from discussions with Mike Hoyal (Tennessee Division of Geology) and David Thompson (Mississippi Geological Survey).

Geologic Resource Management Issues

The scoping session for Shiloh National Military Park provided the opportunity to develop a list of geologic features and processes, which will be further explained in the final GRI report. During the meeting, participants prioritized the most significant issues as follows:

- (1) Flooding and fluvial processes,
- (2) External development, and
- (3) Slope processes.

Other geologic resource management issues discussed include seismicity, mineral resource development, historic preservation, and climate change.

Flooding and fluvial processes

The Tennessee River and its tributaries dominate the fluvial features and processes at Shiloh National Military Park. Nearly 2.4 km (1.5 mi) of erosion along the river's shoreline has removed 38 to 43 m (125 to 140 ft) of landmass since 1895. When the Tennessee Valley Authority (TVA) built the Pickwick Dam to impound the river in the 1930s forming Pickwick Lake, the river dynamics changed dramatically. During high water periods, backwater flows into Owl and Snake creeks. During channelization of the Tennessee River, developers cleared the vegetation in the riparian zone causing subsequent increases in erosion and sediment load. The Tennessee River shoreline is not stable. Within the last decade, approximately nine million dollars have been spent to stabilize the streambanks with limestone armoring along Riverside Road inside the military park (fig. 2). Limestone material for this project was imported from outside of the park.

The Tennessee River has been dredged upstream and downstream of the park, which may affect fluvial dynamics. However, the park noted no problems with deposition or sediment load at the mouths of any of the tributaries in the park. Most of the streams in the park are of low gradient and flow. These streams originate within and drain away from the military park and flooding is not a major park concern. They are excellent examples of intact watersheds in the region. Local flood control projects including canals intended to protect agricultural areas from inundation are largely unsuccessful in the park.

External development

Established in 1894, Shiloh National Military Park has benefited from a long history of preservation compared with many areas in Tennessee that have been impacted by urban development and farming. However, urban development and local sand and gravel quarries are threatening the areas surrounding the park. Just north of the park, but within the authorized boundary, the Santana Dredging and Coring Company acquired and renewed mining within a historic quarry. This quarry provides material for roadwork on U.S. Highway 64, and Tennessee Highway 22. The quarry is 9 to 12 m (30 to 40 ft) deep within the Cretaceous Eutaw Formation and extends from the northern limit of the park to the mouth of Snake Creek. Quarrying has destroyed cultural resources including Union troop camps and old homesites significant to the settlement of the area. It is unknown whether quarrying impacted or destroyed Native American archaeological sites, but given the concentration of prehistoric sites in the area, it is likely that some archaeological resources have

been damaged or destroyed. Mining activity at this quarry creates noise and viewshed issues. Due to the impacts at the site, it is unlikely that these lands will be acquired by the NPS.

Slope processes

Although it appears that there is minimal relief along the park tour road, there is 70 m (230 ft) of topographic relief on the battlefield, with slopes of 40-70% in some places. Most areas of the ≈2,400-ha (≈6,000-ac) battlefield have an average of 15-24 m (50-80 ft) of relief. Slope failures are common in steep ravines, especially following rain events that can reach 25-30 cm (10-12 in) of precipitation in 24 hours. Erosion creates incised gullies (fig. 3). At the time of the battle, much of the area was old growth oak-hickory climax forest. Settlers and developers removed much of the original forest. Attempts by the Civilian Conservation Corps (CCC) to reclaim agricultural land by planting loblolly pines in the park have been mostly unsuccessful.

Base blowouts occur along the Tennessee River shoreline where the toe of the slope has eroded or been removed. Riprap has been placed to the 123-m elevation (402-ft) line to stabilize the base of the slope. Slope failures do not currently threaten park infrastructure or known cultural resources, except perhaps at the Indian Mounds site where the slope is eroding back towards a large mound on the river bluff. In February 1954, the old Pittsburg Landing site washed away over night losing approximately 60 m (200 ft) of the slope along the base of the slope at the cemetery. Slope failure of 24 m (80 ft) of bluff line at the Indian mounds has also occurred. The NPS installed gabion structures to stabilize the base of the slope. Approximately six million dollars was spent on an archeological recovery project at Mound A along the river which backfilled the site.

Erosion is occurring along some trails in the park. Attempts to mitigate trail erosion such as installing pavement have had limited success (fig. 4). Resource managers in the park do not currently consider social trails and other off-trail activities to be a major resource management issue.

Other geologic resource management issues

Seismicity

According to geologists at the Tennessee Division of Geology, Shiloh National Military Park is within an area of relatively low seismic risk (zones 1 and 2). Seismic activity along the New Madrid seismic zone west of the park, which experienced intense seismic activity in 1811-1812 would result in low to moderate impacts at Shiloh. The East Tennessee seismic zone, would have even less impact on park resources. According to the U.S. Geological Survey's Earthquake Hazards Program, there are frequent seismic events in the area and some earthquakes are strong enough to be felt by humans. Within the last decade, a magnitude 3-4 earthquake occurred with an epicenter near Savannah, TN, 16 km (10 mi) northwest of the park. Hazards associated with earthquakes that could threaten park resources include slumping along the waterways and liquefaction within water saturated, unconsolidated floodplain deposits along the Tennessee River and its tributaries. Seismic shaking, if strong enough, could damage park infrastructure including buildings, roads, trails, monuments, and bridges.

Historic mineral resource development

Clay, sand, gravel, and other mineral resources in the area have have been quarried over the past several centuries. Prehistoric quarrying to build the distinct mounds at the Shiloh Indian Mounds National Historic Landmark is evident in the park. Terrace deposits up to 15 m (50 ft) thick are

locally quarried by landowners. During the early development of the military park (under War Department management until the 1940s), shallow sand and gravel pits within the park provided materials for park road construction. The walls of these quarries, some of which are several stories high may be unstable. The park is reclaiming one quarry that has been used as an organic dump. An abandoned sand and gravel pit is just west of the park boundary. The Santana Quarry located just north of the park is described under “External Development”.

Exploration for iron deposits (ca. 1800s?) in the area has occurred but there is no record of actual mining. Iron content is elevated in park streams. Iron staining is noticeable at seeps and iron flocculant is found within gravel layers called ferrecrete. This distinctive, locally mined material forms the lower portion of the reconstructed Shiloh Church. The economic crash of 1929 halted the reconstruction of the church and builders used bricks to complete the reconstruction. The Civilian Conservation Corps (CCC) also locally mined rock material from streams during stream stabilization efforts such as the Causeway culvert. This mining activity within park boundaries ended in the 1930s.

Historic preservation and connections with geology

The roads within Shiloh National Military Park trace historic routes in place at the time of the Civil War battle. The battle was here because of roads and commerce routes that followed local ridges or high ground (underlain by terrace deposits) above frequently flooded and marshy floodplain areas along the Tennessee River Valley. Pittsburg Landing, formed in part by geomorphological processes, and local railroad courses to Corinth, Mississippi also converged on this location. Several trade routes went to Pittsburg Landing at the time of the battle.

The Corinth, Mississippi unit has remnants of fortifications and siege-related structures. Erosion and geomorphologic processes are diminishing these historic features.

In addition to the disturbed areas noted above, grazing persisted at the park until 1911. At the time of the battle 253 ha (625 ac) were cultivated. Current agricultural leases in the park ensure good crop rotation and stabilizing vegetation to prevent excess erosion and runoff in open areas. Leases are now in place to maintain a historic scene at the park.

Climate change

A special lichen species at Shiloh National Military Park only occurs at 11 other locations in the world. This species grows on rocks and is susceptible to degradation by changing climate. Other climate change concerns include effects on park vegetation (which has implications for erosion and slope stability), deer population, water quality, and preservation of monuments (bronze, marble, etc.).



Figure 2. Limestone armoring the Tennessee River shoreline at Shiloh National Military Park along Riverside Road. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).



Figure 3. Erosion along an ephemeral stream or gully. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).



Figure 4. Erosion along a trail near Rhea Springs towards a Confederate burial trench. Note unsuccessful asphalt surface on the right side of the trail installed to improve access and curb erosion. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Features and Processes

Paleontological resources

Fossils are not common in the Quaternary and Cretaceous geologic units at Shiloh National Military Park. Surrounding areas contain deposits rich in fossils such as the McNairy sands at Coon Creek. Devonian fossil fish are buried beneath 1 to 120 m (3 to 400 ft) of younger sedimentary overburden, but may appear where they have been exposed along the Tennessee River bottom. Pleistocene fossils such as mastodons and other mammals are found in the region in caves and washes, but none have been found within park boundaries. At the Corinth unit, clays saturated with Pleistocene age water (consistency of putty) required excavation before development of infrastructure could commence. Shell middens are potential archaeological-paleontological resources at the park.

According to the NPS paleontological inventory report for Shiloh National Military Park, future field investigations within the park may reveal fossils within the park since they are documented in the same units outside of the park. Fossils from the Eutaw Formation include silicified logs, plant material, carbonized wood, mollusks, and trace fossil borings. Fossils from the Coffee Formation include plant remains, mollusks, insects, and trace fossil borings. Limestone used for monuments and shoreline anchoring could contain fossil remains. Erosion exposes new outcrops of the geologic units within the military park in road cuts, streams, creeks, gullies, and river bluffs and may uncover paleontological resources.

Seeps, springs, ponds, and wetlands

Two springs (Rhea Springs and Shiloh Spring) exist within park boundaries (fig. 5). Water percolates down through porous terrace gravels, intersects bedding overlying 1-2-m (3-6-ft) thick, clay-rich layers within the Coffee and Eutaw formations, and flows out to the surface. These clay-rich aquitard layers also underlie several natural ponds and wetlands within the park. Bloody Pond is nearly a half-acre in size and approximately 1 m (3.5 ft) deep. During management by the War Department, the pond was lined with concrete and surrounded by fencing. The NPS removed these structures to restore the pond to its historic condition. A ditch dug for mosquito control drained Water Oaks Pond. The NPS also reclaimed this pond. Restoration included the installation of a drain to prevent flooding of nearby cultural resources. There are several man made ponds on lands acquired by the park. It is unclear at this time whether they will be restored or not.



Figure 5. Rhea Springs. Photograph is by Trista L. Thornberry-Ehrlich (Colorado State University).

Action Items

1. GRI report author will investigate a reference by Bob Self (on stratigraphy) regarding lithified zones in the Coffee and Eutaw Formations that act as aquitards and are significant for springs and seeps at Shiloh. Other references by this author are also relevant to SHIL.
2. GRI mapping coordinator will contact the Mississippi Geological Survey (contact: Dave Thompson) regarding map coverage and/or needs within the Corinth, MS and Kendrick, MS quadrangles of interest.
3. GRI mapping coordinator will obtain field data and/or mylar coverage for the Pocahontas, TN quadrangle of interest.
4. GRI report author will use the CERES website at the University of Memphis in addition to the U.S. Geological Survey site when investigating seismic risk for Shiloh National Military Park.

References

Self, R. P. 2002. Petrology of cretaceous to quaternary gravels from the Western Valley of the Tennessee River. *Journal of the Tennessee Academy of Science* 77 (2): 52-56.

Meiman, J. 2007. Cumberland Piedmont Network Water Quality Report: Shiloh National Military Park. Natural Resource Report NPS/SER/CUPN/NRTR—2007/009. Atlanta, GA: National Park Service, Southeast Region.

Hunt Foster, R. and others. 2009 (in prep). Paleontological Inventory of Shiloh National Military Park. National Park Service.

Table 2. Scoping Meeting Participants

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