Chapter Three: Resource Evaluation

CHAPTER OVERVIEW

Proposals for new parks are carefully analyzed in a special resource study to ensure only the most outstanding resources are considered for addition to the national park system. In chapter three, the special resources of the Waco Mammoth Site are evaluated to determine if they are of national significance, and how suitable and feasible the resource may be for NPS designation, using criteria established by law and National Park Service policy.

EVALUATION OF NATIONAL SIGNIFICANCE

For the resources of the Waco Mammoth Site to be considered nationally significant, they must meet all four of the following standards:

- **Resource Quality** - It is an outstanding example of a particular resource type.
- **Interpretive Value** - It possesses exceptional value or quality in illustrating or interpreting the natural or cultural themes of our nation's heritage.
- **Potential for Use** - It offers superlative opportunities for recreation, public use and enjoyment, or scientific study.
- **Integrity** - It retains a high degree of integrity as a true, accurate, and relatively unspoiled example of the resource.

The study team used the Delphi process in the development of draft significance statements for the Waco Mammoth Site. The Delphi technique, originally developed by the Rand Corporation, is a structured process for collecting and distilling knowledge from a group of experts through a series of re-iterative questionnaires. This included identifying and inviting a panel of paleontological and other scientific experts to participate in the process. A series of questionnaires were distributed to the group for their input. In subsequent rounds, each participant received a composite of the feedback received from the entire panel in the previous round and was then asked to provide additional comment on the consolidated list. The process was repeated as necessary to help inform the documentation of the resource's significance.

The first round of the process included sending information on the Waco Mammoth Site to 32 individuals with an invitation to participate. This was initiated on November 22, 2005. We received positive responses to participate from 17 individuals.

The second round of the process was initiated on January 31, 2006, and included sending the following five questions to each of the 17 participants who had responded to the first round:

1. What do you think are the top three fossil sites, Pleistocene sites, and mammoth sites in the nation?

2. What criteria did you use to determine your choices?

3. What criteria would you use to classify a site as an exceptional example of paleontological resources in the United States?

4. What values do you believe a site should possess to further the understanding of paleontology in the United States?

5. What degree of integrity should a paleontological site retain to be considered a true, accurate, and relatively unspoiled example of a paleontological resource? Please explain.

6. Can the degree of integrity at a site be improved?

Five participants responded to the second round. The third round of the Delphi process was initiated on March 13, 2006, and included

sending the composite results of the input received from round two and asking for any additional input. Two participants transmitted additional comments to the composite.

The results of the third round provided the team with the parameters needed to craft an initial list of draft significance statements for the Waco Mammoth Site.

The fourth round of the Delphi process included transmitting this list on May 1, 2006, to all participants for their consideration and review.

Based on the input received throughout the process and further deliberation among the study team, the draft significance statements were refined and currently include the following findings regarding the four significance standards:

Resource Quality – Is the site an outstanding example of a resource type?

Fossil resources are found in over 180 units of the national park system and span the entire range of geological time from the Precambrian to the Pleistocene. Among these are parks specifically established because of their important fossil resources and include the following NPS units:

Agate Fossil Beds National Monument, Nebraska – Miocene

Badlands National Park, South Dakota – Cretaceous, Eocene, Oligocene

Dinosaur National Monument, Colorado – Utah – Jurassic

Florissant Fossil Beds National Monument, Colorado – Eocene

Fossil Butte National Monument, Wyoming – Eocene

Hagerman Fossil Beds National Monument, Idaho – Pliocene

John Day Fossil Beds National Monument, Oregon – Eocene, Oligocene, Miocene

Petrified Forest National Park, Arizona – Triassic

These parks are complemented by other parks that were not established specifically to protect fossil resources but are, nonetheless, equally important for the fossils they protect. These parks include the following NPS units:

Big Bend National Park, Texas – Cretaceous

Channel islands National Park, California – Pleistocene

Death Valley National Park, California—Nevada – Paleozoic, Miocene

Grand Canyon National Park, Arizona – Paleozoic, Pleistocene

Guadalupe Mountains National Park, Texas – Permian, Pleistocene

While Pleistocene fossils occur in numerous parks, interpretation in these parks does not focus on the Pleistocene biota. In this respect, the Waco Mammoth Site is a distinctive type of fossil resource that represents a portion of geological time that completes the story told by these other parks and complements and enhances the story told by the small number of parks with Pleistocene fossils.

Even though mammoth remains are known from other NPS units, they—like most records of mammoths in North America—consist mostly of isolated remains. The combination of both *in situ* articulated skeletal remains and the excavated specimens from the Waco Mammoth Site represent the only recorded instance in the United States of a nursery herd of Pleistocene mammoths. It is further unique in that the nature of the herd's preservation suggests evidence of group behavior and survival instincts during a naturally occurring catastrophic event.

Interpretive Value – Is the site an exceptional value/quality in illustrating/interpreting the natural or cultural themes of our nation's heritage?

The Waco Mammoth Site possesses exceptional value and quality for interpreting the geological and paleontological history of the nation, with a special focus on the late Pleistocene conditions and events occurring 68,000 years ago along the interface of two physiographic provinces: the Great Plains and Gulf Coastal Plains. In addition to the Columbian mammoth herd, other associated faunal remains provide additional opportunities for enhancing our understanding of a broader representation of life forms present during the later phases of the Pleistocene Epoch. (National Park Service's Natural History Theme #19 Geologic History, subtheme: Oligocene – Recent epochs as described in *Natural History in the National Park System and on the National Registry of Natural Landmarks* 1990*)*

Columbian mammoths are one of the iconic species of the Ice Age in North America, having been found at multiple localities in the United States (see figure 2). They are displayed in museums as whole skeletons or isolated bones and teeth; often the displayed skeletons are composites from multiple individuals—rarely are complete associated skeletons known. Sites in which the remains of more then one individual have been recovered are even rarer (see table #2) and are often the result of accumulation of individual animals over long periods of time such as those found at the tar pits at Rancho La Brea in Los Angeles, California, or the Mammoth Site at Hot Springs, South Dakota. Many sites containing this extinct species are the result of human hunting activities; they cannot be considered indicative of the mammoth's natural history but rather of human history. The Waco Mammoth Site is the first recorded discovery in North America that contains the remains of multiple individuals of different ages that died during a restricted period of time, apparently due to a catastrophic event. Ongoing research at the site is suggesting that not all of the mammoths found there had died during this single event but the remains may include individuals that died earlier or later. This raises an interesting aspect as to site fidelity by Columbian mammoths; the site may have been used frequently over time and during one of these visits the catastrophic demise of a nursery herd occurred. Both components of the site add to its importance as a keystone to understanding the natural history of this extinct species. It can serve as a reference point to which previous discoveries can be reexamined and new discoveries compared.

The site represents an excellent, modern day example of how the power of community commitment can foster preservation of our nation's natural heritage. Local citizens, Baylor University, and the city of Waco have been actively involved as a group to promote the national recognition of this site, to initiate and continue to provide protective measures for the resource, to pursue fund raising activities to support continued resource preservation efforts, and to provide volunteer efforts with excavation activities at the site.

Potential for Use – Does the site provide superlative opportunities for public enjoyment or scientific study?

The Waco Mammoth Site provides superlative opportunities for public enjoyment and scientific study. Effective interpretative programs could be developed for various educational levels. Such an effort could include programs for school groups at all levels: elementary, middle, and high school. It could offer programs for the public at a general adult level of education. It could also include scientifically detailed programs for students in college and graduate school. Baylor University has established a precedent for taking school groups to the site. The university has already involved undergraduate and graduate students with the site through its museum studies and geology programs. The site has the scientific potential to directly engage other disciplines besides paleontology such as botany, zoology, and geology.

The catastrophic event that resulted in the death and preservation of the herd of Columbian mammoths at the Waco Mammoth Site provides a rare opportunity to study a social group in the fossil record and infer group behavior in an extinct species. As such the site provides an opportunity to contribute to modern zoology by allowing a comparison between the herd dynamics and behavior patterns in an extinct elephant species with those of modern elephants. The study of the transition of the living biota into the fossil record and the potential biases that may be introduced is called taphonomy. Recognition of these biases is critical to better understanding the ecology of an extinct species and how it can provide insight into understanding the historical origins of the ecology of its living relatives. The Waco Mammoth Site provides an opportunity to demonstrate and explain to the public this sub-discipline of paleoecology and the methodologies involved in understanding the ecology of an extinct species as well as provide opportunities for future research.

The Waco Mammoth Site provides scientifically valuable study opportunities to compare mammoth specimens found in a natural accumulation with mammoth specimens found elsewhere in Paleo-Indian kill or butcher sites. The Waco Mammoth Site offers excellent taphonomic comparison opportunities with sites similar to the Lubbock Lake Landmark site where Paleo-Indians hunted mammoths.

Opportunities present themselves for conducting research and teaching about the contribution of the Waco Mammoth Site to the science of paleontology because approximately 30% of the known Waco mammoth specimens are still *in situ*. This situation provides researchers and visitor opportunities to examine firsthand the physical conditions governing the site, how the fossil site was formed, and how it was initially excavated by archeologists and paleontologists. Additional research would help further our scientific understanding to interpret to the public the conditions and sequence of events that led to the collective death of the mammoth herd at Waco.

The Waco Mammoth Site affords exceptional opportunities not only for public enjoyment or scientific study, but also for the public enjoyment ***of*** scientific study. These opportunities amount to fostering an understanding, appreciation, and respect for the science of paleontology. The preservation of a portion of the bones of the mammoth herd *in situ* provides opportunities to teach about the scientific method in general and about paleontology in particular as a historical science. Along with geology and archeology, paleontology's goal is to reconstruct events that have already taken place by attempting to find out what happened and why. Historical scientific methodologies and techniques are essentially different from those employed in the experimental sciences of biology, chemistry, and physics. The Waco Mammoth Site provides opportunities to demonstrate how knowledge of the experimental sciences plays a critical role in collecting information to reconstruct past events of the Earth's history. Specifically, such knowledge is useful when applied to questions at Waco, particularly as to when, how, and why most if not all of the mammoths found there died, herded together some 68,000 years ago.

Integrity – Does the site retain a high degree of integrity as a true, accurate, and relatively unspoiled example of a resource?

The Waco Mammoth Site retains a high degree of integrity as many of the *in situ* and excavated skeletons represent fully articulated specimens. Their location and position have been recorded; removed specimens have been encased in plaster jackets and placed in storage at the nearby Baylor University's Mayborn Museum Complex. There are sufficient undisturbed deposits to provide material for future study as approximately 30% of the known specimens are still *in situ*. Soil pillars have been retained within the excavated pit to provide a reference for future sediment studies.

As a paleontological site, the Waco Mammoth Site is unusual in that it has only been excavated by a single institution; this means all specimens and the associated documentation are maintained by a single entity. Many sites, such as the Tar Pits at Rancho La Brea in Los Angeles, California, were excavated by multiple institutions and the specimens and data are housed in different places resulting in a logistical challenge to researchers. In other cases such as the Dent Mammoth site, in Colorado, while only a single institution excavated the site, some specimens were exchanged with other museums for exhibits; this requires an investigator to travel to multiple sites to examine the complete sample. At the Waco Mammoth Site, the housing of the excavated specimens and associated data together, along with the *in situ* material, creates a distinct advantage for researchers wishing to examine the entire sample.

While the actual paleontological resources at the site are finite, and at some point in the future all specimens will be uncovered, this is true for all fossil sites. It is merely a matter of scale. With regard to the Waco Mammoth Site, the point of complete discovery has not been attained; new material is still being discovered and could include additional individual mammoths. As these specimens are uncovered they also will presumably be left *in situ* which will add to the value of the site for both scientific research and educational opportunities. While other vertebrate species are not as well represented at the site as the mammoths, the presence of camel, tortoise, saber tooth cat, and antelope suggest that there is the potential for the recovery of additional taxa.

National Significance Findings

The paleontological resources of the Waco Mammoth Site meet the National Park Service's established criteria for national significance based on the following findings:

- The combination of both *in situ* articulated skeletal remains and the excavated specimens from the Waco Mammoth Site represents the nation's first and only recorded discovery of a nursery herd of Pleistocene mammoths. It is further unique in that the nature of the herd's preservation suggests evidence of group behavior and survival instincts during a naturally occurring catastrophic event.
- The site preserves at least two separate mammoth death events and provides an exceptional opportunity for scientific study, such as the opportunity to investigate Columbian mammoth herd dynamics. The matriarchal herd is represented by at least 19 of the mammoths uncovered so far which are from a single geomorphic surface and died during a single catastrophic event, while the presence of the other individuals not associated with this event indicates site fidelity by the mammoth. This site could serve as a keystone upon which previous discoveries of mammoths in other contexts can be re-examined and new discoveries compared. Future scientific studies will continue to inform the interpretation of the site for the benefit of the scientific community as well as the visiting public.
- The mammoth herd, together with the site's other recorded Pleistocene faunal remains provide an important opportunity for enhancing the interpretation and public understanding of a snapshot representation of biota existing along the interface of two physiographic provinces (Great Plains and Gulf Coastal Plains) during the late Pleistocene, better known as the Ice Age.

  The site also provides an exceptional opportunity to foster a public understanding of the science of paleontology. The *in situ* remains provide an opportunity to teach visitors about the scientific method and that paleontology, like geology and archeology, is a science in which researchers reconstruct events that have already taken place. Their methodologies are different from those in the experimental sciences such as chemistry, physics, and aspects of biology.

However, knowledge of the experimental sciences is critical to collecting the information needed to reconstruct an understanding of the earth's history and as such, the site provides a unique opportunity to link these two areas of science and provides a focal point to teach about all of the major sciences and how one discipline can contribute to another.

- The site retains a high degree of integrity. Many of the remains represent fully articulated specimens of varying age groups. Their location and position have been recorded; the stratigraphy of the site has been studied in detail; and removed specimens have been encased in plaster jackets and placed under the curatorial care of a single institution. Undisturbed deposits provide material for future study, as approximately 30% of the known specimens are still *in situ*.

EVALUATION OF SUITABILITY

An area that is nationally significant must also meet criteria for suitability to qualify as a potential addition to the national park system. To be determined suitable, the Waco Mammoth Site must represent a natural or cultural theme or type of recreational resource that is not already adequately represented in the national park system or is not comparably represented and protected for public enjoyment by another agency. Adequacy of representation is determined on a case-by-case basis by comparing the potential addition to other comparably managed areas representing the same resource type, while considering differences or similarities in the character, quality, quantity, or combination of resource values. The comparative analysis also addresses rarity of the resources, interpretive and educational potential, and similar resources already protected within the national park system or in other public or private ownership. The comparison results in a determination of whether the proposed new area would expand, enhance, or duplicate resource protection or visitor use opportunities found in other comparably managed areas.

Similar Resource Types Found Within the National Park System

The study team first examined whether or not this resource type is already adequately represented at other units of the national park system. Many national park system units contain fossil concentrations representing a broad range of geologic history. When asked "What criteria would you use to classify a site as an exceptional example of paleontological resources in the United States?" one of the Delphi participants noted…

> *"I would like to add that the National Park Service of the United States has identified over 180 units which have documented paleontological resources. Some of these were set aside specifically for the fossils such as Petrified Forest National Park or Dinosaur National Monument. Many are parks that fossils are contained in the geologic formations: Grand Canyon National Park, Big Bend National Park, etc. Collectively, these 180+ units of the national park system tell one great story about the history of life in the United States. From some very primitive blue green algae and bacteria preserved high in the mountains of Glacier National Park, to Pleistocene / Holocene wolves from caves in Yellowstone –fossils found in units of the national park system provide opportunities for science and education. Interestingly, we have parks that were set aside specifically to preserve fossils from many time periods within the Geologic Time Scale (i.e., Permian –Guadalupe Mountains NP; Triassic –Petrified Forest NP; Jurassic –Dinosaur NM; Cretaceous – Badlands NP; Eocene –Fossil Butte NM, John Day Fossil Beds NM; Oligocene –Florissant Fossil Beds NM; Miocene –Agate Fossil Beds NM; Pliocene –Hagerman Fossil Beds NM), however—and of real interest to this discussion—we do not have a park specifically set aside to tell the paleontological story of the Pleistocene. This is a real gap in terms of representation in the NPS."*

The search was further refined to examine national park system units containing

paleontological resources representing Pleistocene mammoths. When consulting scientific literature and the National Park Service's museum catalog system, 14 national park system units have recorded Pleistocene mammoth remains found within their boundaries:

Arches National Park
Isolated Columbian mammoth molars and bones

Bents Old Fort National Historic Site
Columbian mammoth tusk fragments

Bering Land Bridge National Preserve
Isolated woolly mammoth remains

Channel Islands National Park
Pygmy mammoth skeleton
Isolated pygmy and Columbian mammoth bones

Colorado National Monument
Columbian mammoth tooth

Craters of the Moon Nat'l Monument
Isolated Columbian mammoth bones

Death Valley National Park
Isolated Columbian mammoth molars and bones

Florissant Fossil Beds Nat'l Monument
Columbian mammoth bone fragments

Glen Canyon Nat'l Recreation Area
Columbian mammoth dung

Great Sand Dunes National Park
Columbian mammoth bone

Lake Mead Nat'l Recreation Area
Columbian mammoth bones

Nez Perce Nat'l Historical Park
Multiple Columbian mammoth skeletons

Wupatki National Monument
Isolated Columbian mammoth molars

Yukon-Charley Rivers National Preserve
Isolated woolly mammoth remains

These sites, containing resources relating to Pleistocene mammoths, represent less than 4% of the 390 units comprising the national park system. Even more interesting, there are only two units yielding articulated mammoth skeletons: Channel Islands National Park and Nez Perce National Historical Park.

In Channel Islands National Park, a nearly complete pygmy mammoth (*Mammuthus exilis*) fossil skeleton was discovered in 1994 on Santa Rosa Island. This was the first time an articulated specimen of this species was discovered. Previous to this find, descriptions of the pygmy mammoth were inferred from isolated bones recovered from park islands. The recovered specimen was determined to be an approximately 57-year-old bull that stood five and a half feet tall. He apparently died 13,000 years ago and was quickly covered by sand, accounting for the excellent articulation of the bones. The specimen was removed, fiberglass casts were made, and the replicas were placed on exhibit at the Santa Barbara Museum of Natural History and the Channel Islands National Park Visitor Center in Ventura, California.

Channel Islands National Park fully grown adult male pygmy mammoth.

The second national park system unit yielding complete skeletal remains of Pleistocene mammoths is Nez Perce National Historical Park's Tolo Lake unit. The park's purpose is to facilitate protection and offer interpretation of Nez Perce Indian sites in Idaho, Oregon, Washington, Montana, and Wyoming. The National Park Service owns nine of the thirty-eight sites included in the park.

The Tolo Lake unit is owned and managed by the state of Idaho. In 1994, a mammoth bone was discovered when the Idaho Department of Fish and Game lowered the level of the lake to initiate dredging for wildlife habitat enhancement. The Idaho State Historical Society, the University of Idaho, and the Idaho Museum of Natural History were subsequently involved in a cooperative excavation project that revealed a number of mammoth skeletons. While funding for investigative work did not allow for the full excavation of the find, approximately 400 bones of various animals including Columbian mammoths were recovered before the lake was refilled to its previous operational level.

The collection is currently housed in the Idaho Museum of Natural History, Pocatello, Idaho (460 miles southeast of Tolo Lake) where an exhibit of the reconstructed dig with interpretation of excavation methods and research findings is presented. Currently onsite interpretation of the discovery is not provided, although a resin replica of a Columbian mammoth is on display with interpretive information at nearby Eimers Park, managed by the Grangeville, Idaho, Chamber of Commerce.

Similar Resource Types Found Within Related Areas

In the General Authorities Act of 1970, an act to improve the administration of the national park system, a unit of the national park system was defined by law as any area of land and water administered by the secretary of the interior through the National Park Service for park, monument, historic, parkway, recreational or other purposes. The same law specifically excludes those properties that are neither federally owned nor directly administered by the National Park Service but are areas where the National Park Service provides assistance. These areas include four categories and are referred to as related areas. They include affiliated areas, national heritage areas, the national wild and scenic rivers system, and the national trails system. These areas and systems are closely linked in importance and purpose to units of the national park system, as they all preserve important elements of our nation's heritage. (*The National Parks: Index 2005 –2007)*

Affiliated areas comprise a variety of locations in the United States and Canada that preserve significant properties outside the national park system. Some of these have been recognized by acts of Congress, others have been designated national historic sites by the secretary of the interior under the authority of the Historic Sites Act of 1935. They represent properties that are neither federally owned nor directly administered by the National Park Service; however, the National Park Service is authorized to provide technical and/or financial assistance.

One affiliated area with related resources is Ice Age National Scientific Reserve. It includes nine nonfederal sites in Wisconsin containing nationally significant features of North American continental glaciations. While the focus of the interpretation is with the natural features shaped by glacial processes, there is limited interpretation of Pleistocene fauna.

The national trail system is the network of scenic, historic, and recreation trails created by the National Trails System Act of 1968. These trails provide for outdoor recreation needs, and promote the enjoyment, appreciation, and preservation of open-air, outdoor areas and historic resources. The National Park Service administers 19 of the currently 24 designated national trails; three are classified as units of the national park system.

A unit of the national trail system, the Ice Age National Scenic Trail is a 1,200-mile-long trail connecting six of the nine sites of the Ice Age National Scientific Reserve; it also has a similar interpretive focus.

Another Ice Age-related trail, located across Western Montana, the Idaho Panhandle, eastern and central Washington, and northern Oregon, is currently being considered for national trail designation by Congress. The Ice

Age Floods National Geologic Trail is being proposed as an auto tour route following the pathways of the Glacial Lake Missoula Floods. Even though the primary focus of interpretation is on the outstanding geological features created by this catastrophic event occurring some 12,000-17,000 years ago, there is potential for integrating the interpretation of Pleistocene fauna.

Located within one of the national trail system units, a site has been identified as yielding Columbian mammoth skeletal remains. Big Bone Lick State Park, owned and managed by the state of Kentucky, is a nonfederal certified site along the Lewis and Clark National Historic Trail. Certified sites are places where visitors can learn about or experience the 1804 –1806 Lewis and Clark Expedition. The trail, established in 1978, includes water routes, hiking trails, and marked highways that follow the explorer's outbound and return routes. Among the more than 120 certified sites along the trail, only 5 are owned and managed by the National Park Service.

Lewis and Clark each conducted their own excavations of material from the Big Bone Lick site during the early 19th century. In 1803 when Captain Meriwether Lewis was traveling to join Captain William Clark and the men assembling in Louisville for the Corps of Discovery, he stopped at Big Bone Lick and sent a box of specimens back to President Thomas Jefferson, along with an extremely detailed letter describing the finds. In 1807, Captain William Clark was commissioned by the President to excavate bones from Big Bone Lick for scientific study. This was the nation's first organized vertebrate paleontology expedition establishing the site as the first official paleontological collecting site in North America (*Kentucky Geological Survey, 2006 and National Park Service's Lewis and Clark Expedition: A National Register of Historic Places Travel Itinerary website 2006*).

Specimens collected from this expedition included woolly and Columbian mammoths as well as other Pleistocene mega fauna. The collection was divided, and various sections went to the National Museum of Natural History in Paris, to the Academy of Natural Sciences in Philadelphia, and to Jefferson's personal collection (*The Academy of Natural Sciences 2006*).

Similar Resources outside the National Park System and Related Areas

Sites outside the national park system and related areas that have yielded Pleistocene mammoth remains include thousands of recorded sites found throughout North America. An illustration of this distribution, compiled by the Mammoth Site in Hot Springs, South Dakota, is shown in figure 2.

The sites in 31 states were further compared to identify sites with skeletons, sites with multiple individuals, sites of natural accumulation and sites with a cultural association (sites associated with Paleo-Indian activities).Table 1 presents this information. The information is based on a review of available scientific literature with supplemental information from different researchers. It is not meant to be comprehensive or exhaustive, as review or summary papers have not been done for many states.

It is interesting to note that of the 2,083 mammoth records for the 31 states listed; only 3.3% of the recorded sites have yielded skeletal remains, i.e., more than just an isolated tooth, bone fragments, or trace fossils. Sites that contain multiple individuals are rarer yet, representing less than 1.6% of the total sites recorded, while only 1.0%, or 21 sites, represents multiple individuals found as a natural accumulation without a cultural association, such as the Waco Site.

Table 2 represents a more refined comparison of just those sites containing multiple individuals similar to the Waco Mammoth Site. These sites were then further differentiated to identify only those sites currently under protection by another entity providing onsite interpretation as shown in figure 3.

Table 3 compares some of the attributes of these seven sites. The size of the comparison sites range between 8 to 546 acres. There does not appear to be a correlation between size and abundance of fossil concentrations. All comparison sites include an ancient water source; in some cases, the water source is in combination with another geological feature that apparently attracted mammoths and other Pleistocene fauna. Some were trapped in the natural feature or they were killed and butchered by Paleo-Indian hunters. Of the three sites reflecting natural accumulations, mammoths accumulated over an extended period of time, in some cases over thousands of years. This is unlike the Waco Mammoth Site where a majority of the mammoth specimens appear to have died in a single natural event capturing a life assemblage. With the exception of the Waco Mammoth site, all comparison sites have been recognized as either a national natural landmark or national historic landmark, or are in the National Register of Historic Places. Site ownership ranges from governmental (city, county, state), university, to a nonprofit organization. Site management is the responsibility of a single entity, with the exception of the Waco Mammoth Site, which is jointly managed and owned partly by Baylor University and partly by the city of Waco. Sites with national landmark designation have dedicated science and technical staff assigned to the site, have an active on-going research program, and have highly developed educational outreach programs. The two sites discovered prior to 1900s are currently designated state parks. All locations examined provide onsite interpretative experiences for the public.

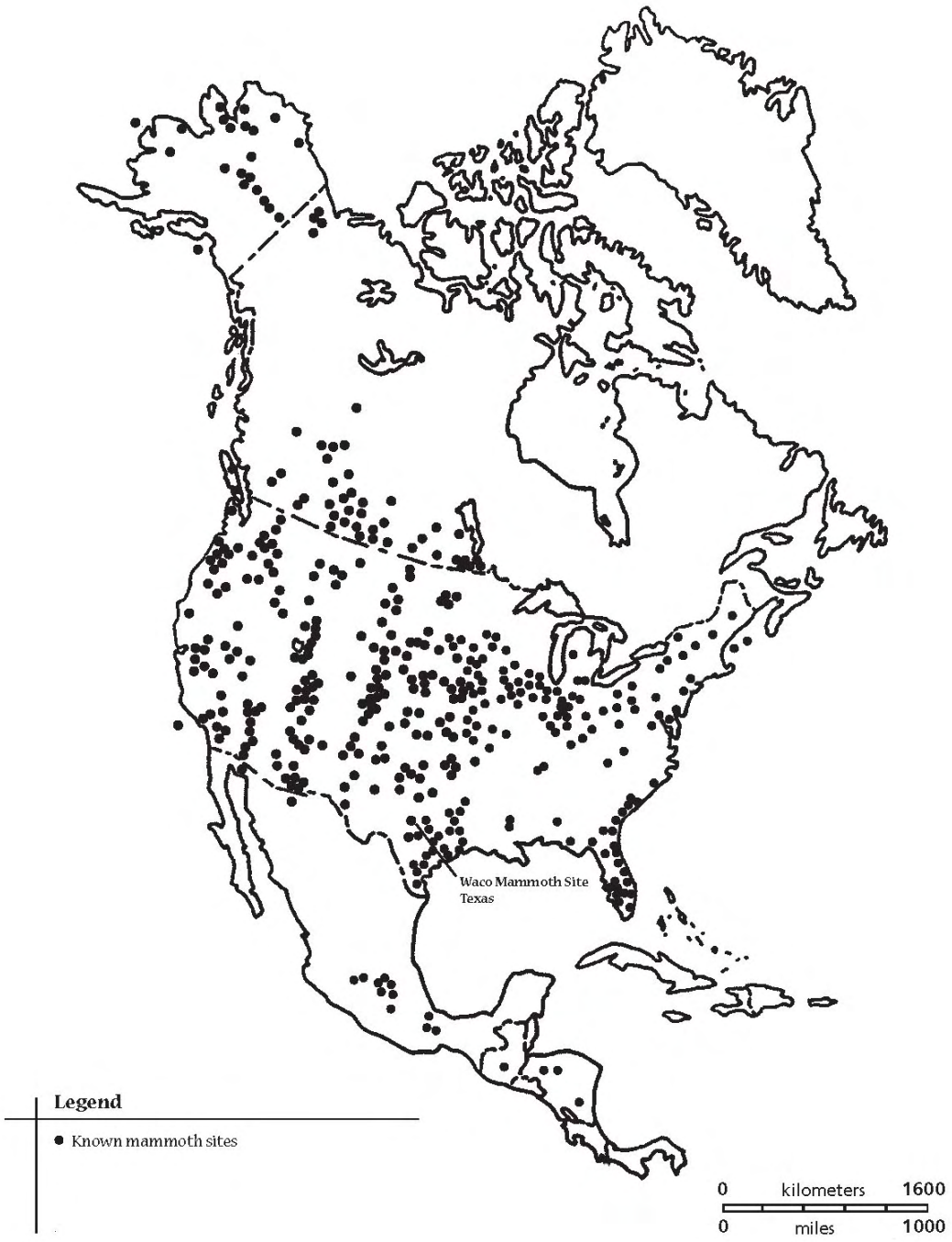
Suitability Findings

The national park system does not currently include a unit specifically set aside to tell the paleontological story of Pleistocene mammoths. While 14 park units have yielded mammoth remains, there are only two sites within the national park system that have yielded articulated skeletal remains: Channel Islands National Park (pygmy mammoth) and Nez Perce National Historical Park (Tolo Lake Columbian mammoths).

Looking at comparable resources found outside of the national park system, there are thousands of recorded sites within North America yielding fossil resources related to the mammoth species, however only 21 known sites represent natural accumulations of multiple, articulated Columbian mammoth remains. Many of these sites have accumulated over an extended period of time; in some cases over thousands of years. Many sites have been fully excavated and the specimens removed from their initial location. Few sites still contain *in situ* specimens. Only the Waco Mammoth Site has yielded a representative herd of Columbian mammoths, making the site unique in this regard.

The resources of the Waco Mammoth Site meet the National Park Service's established suitability criteria for consideration as a new unit of the national park system. Including this site would expand and enhance the diversity of paleontological resources already represented by parks in the system. While Pleistocene fossils, including isolated remains of Columbian mammoth, are present in other parks, they are incidental to the criteria for the park's creation. The nursery herd of Columbian mammoths preserved at the Waco Mammoth Site is unique in North America and as such has high intrinsic scientific and educational values.

Figure 2: North American Mammoth Locations



Map compiled by the Mammoth Site, Hot Springs, South Dakota. The known site distribution includes southern mammoth, Columbian mammoth, woolly mammoth and pygmy mammoth records. The range of discoveries represent sites yielding a single isolated tooth or bone fragment to fully articulated specimens of individual or multiple mammoths. To further refine the focus, a comparison of mammoth records for selected states was compiled in table 1.

Table 1: Comparison of Mammoth Records for Selected States

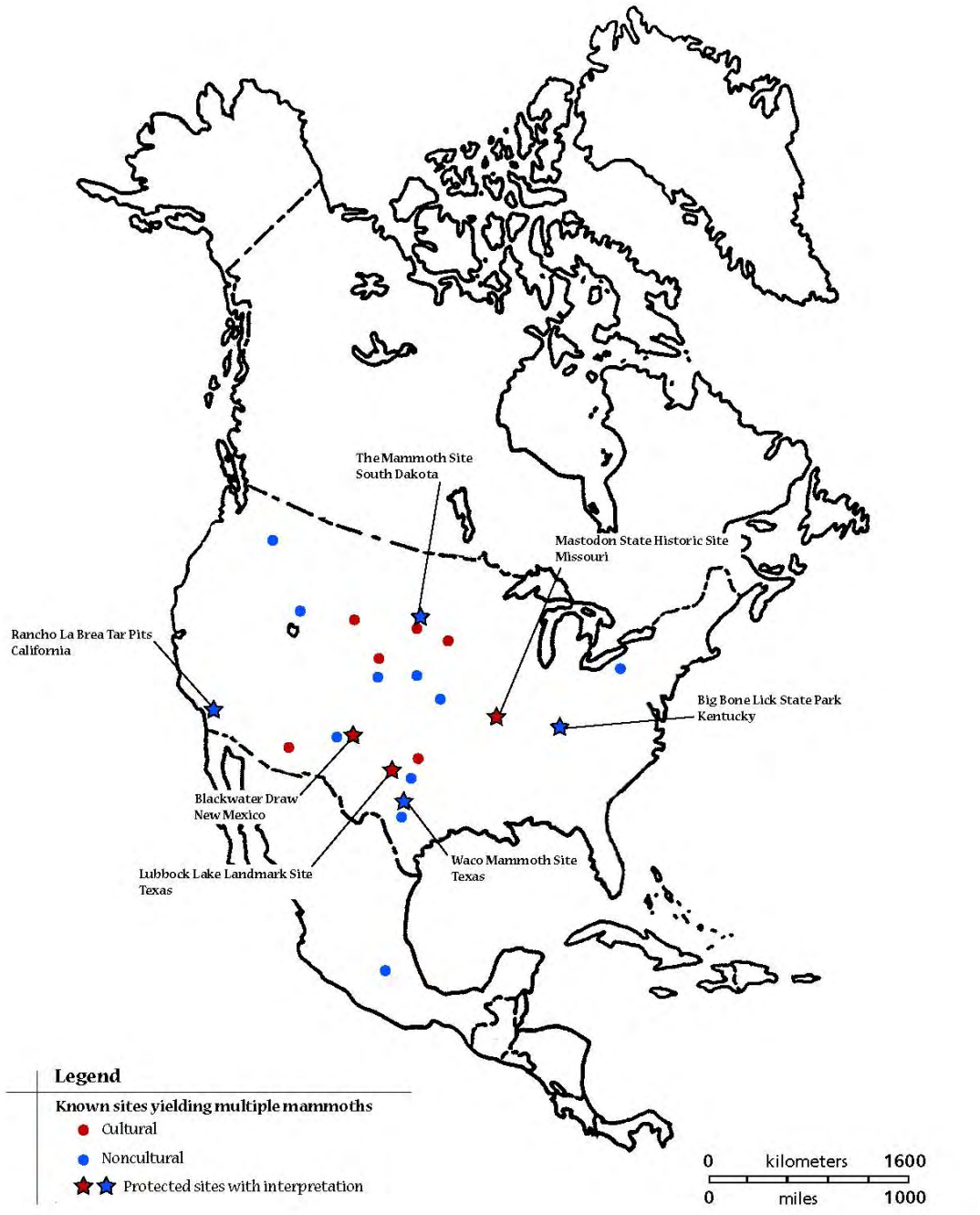
STATE	# of Mammoth Sites	Sites w/ Skeletons	% of Sites w/ Skeletons	Sites w/ Multiple Individuals	% of Sites w/ Multiple Individuals	Sites w/ Multiple Individuals Natural Accumulation	% Sites w/ Multiple Individuals Natural Accumulation	Sites w/ Cultural Association	% of Sites w/ Cultural Association	Reference/Source
Arizona	76	8	10.5%	2	2.6%	0	0.0%	6	7.9%	Mead et al, 2005
California	194	4	2.1%	4	2.1%	4	2.1%	0	0.0%	Jefferson, 1991
Colorado	94	1	1.1%	4	4.3%	1	1.1%	2	2.1%	Graham et al, 2003
Florida	84	3	3.6%	1	1.2%	1	1.2%	1	1.2%	FL Museum of Nat'l History
Idaho	48	2	4.2%	2	4.2%	1	2.1%	1	2.1%	Jefferson et al, 2002
Illinois	53	5	9.4%	0	0.0%	0	0.0%	0	0.0%	Saunders et al, 2006
Indiana	10	1	10.0%	0	0.0%	0	0.0%	0	0.0%	Richards 1984
Iowa	109	2	1.8%	0	0.0%	0	0.0%	0	0.0%	Agenbroad, 2002
Kansas	225	5	2.2%	1	0.4%	1	0.4%	0	0.0%	Kost 1987
Kentucky	6	0	0.0%	1	16.7%	1	16.7%	0	0.0%	Davis pers. communication
Michigan	49	2	4.1%	0	0.0%	0	0.0%	0	0.0%	Skeels 1962; Abraczinskas 2002
Minnesota	58	1	1.7%	0	0.0%	0	0.0%	0	0.0%	Agenbroad, 2002
Missouri	14	0	0.0%	2	14.3%	2	14.3%	0	0.0%	Saunders pers com 2006
Montana	36	1	2.8%	0	0.0%	0	0.0%	0	0.0%	Agenbroad, 2002; Hill, 2006
Nebraska	109	4	3.7%	1	0.9%	1	0.9%	0	0.0%	Agenbroad, 2002
Nevada	54	1	1.9%	0	0.0%	0	0.0%	1	1.9%	Jefferson et al, 2004
New Mexico	73	1	1.4%	2	2.7%	1	1.4%	2	2.7%	Lucas & Morgan, 2005
New York	15	0	0.0%	1	6.7%	1	6.7%	0	0.0%	Hartnagel & Bishop 1922
North Dakota	17	0	0.0%	0	0.0%	0	0.0%	0	0.0%	Agenbroad, 2002; Hoganson 2006
Ohio	57	1	1.8%	0	0.0%	0	0.0%	0	0.0%	McDonald, 1994
Oklahoma	40	2	5.0%	1	2.5%	0	0.0%	3	7.5%	Smith/Cifelli, Wyckoff & Czaplewski, 1997
Oregon	28	0	0.0%	0	0.0%	0	0.0%	0	0.0%	Jefferson et al, in prep A
South Carolina	3	0	0.0%	0	0.0%	0	0.0%	3	10.7%	Fields, personal communication, 2006
South Dakota	34	2	5.9%	2	5.9%	1	2.9%	1	2.9%	Agenbroad, 2002
Tennessee	4	0	0%	0	0%	0	0.0%	0	0.0%	Corgan and Breitburg, 1996
Texas	90	2	2.2%	6	6.7%	4	4.4%	4	4.4%	Fox et al, 1992
Utah	35	2	5.7%	0	0.0%	0	0.0%	0	0.0%	Jefferson et al, 1994
Virginia	3	0	0.0%	0	0.0%	0	0.0%	1	33.3%	Eshelman and Grady 1986
Washington	400	12	3.0%	2	0.5%	2	0.5%	0	0.0%	Jefferson et al, in prep B; Barton 1999,
Wisconsin	32	2	6.3%	0	0.0%	0	0.0%	0	0.0%	West and Dallman 1980; Johnson 2006
Wyoming	33	5	15.2%	1	3.0%	0	0.0%	2	6.1%	Agenbroad, 2002
TOTAL	2,083	69	3.3%	33	1.6%	21	1.0%	27	1.3%	

Table 2. Recorded Sites in the United States Yielding Multiple Columbian Mammoths

State	Locality	Site Ownership	Comments	Number of Individuals	Cultural Association	Articulated Skeletons	Bones Still *In Situ*	On-Site Interpretation	Status of Research	Potential for Future Mammoth Discoveries	Reference
Arizona	Lehner	Private	13 Clovis points found with 13 young mammoths, thought to indicate killing of family group.	13	Yes	Yes	No	No	Completed	Low	Haury et al. 1959
Arizona	Murray Springs	Private	Animals may have been scavenged by Clovis people rather than hunted. Has mammoth footprints preserved.	2	Yes	Yes	No	No	Completed	Low	Haynes, 1999
California	Rancho La Brea, Pit 9	City Park	Pit 9 is only tar pit at RLB in which mammoths were found. Long term accumulation.	29	No	No	Yes	Yes	Ongoing	High	Harris and Cox, 1993
Colorado	Dent	Private	First site in North America to provide unequivocal evidence of projectile points with mammoths. Skeletons exchanged to other museums by the Denver Museum.	14	Yes	Yes	No	No	Completed	Low	Saunders, 1999
Colorado	Dutton	Private	Isolated bones.	>5	No		No	No	Completed	Low	Agenbroad, 1984
Colorado	Lamb Spring	County Property	Associated stone tool and cobblestone brought into site.	30	No	No	Yes	No	Ongoing	Medium	Stanford et al, 1981
Colorado	Selby	Private	Isolated bones.	>5	No	No	No	No	Completed	Low	Agenbroad, 1984
Idaho	American Falls Reservoir	Bureau of Reclamation	Age of site is about 100,000 years. Isolated bones recovered.	8	No	No	No	No	Ongoing	Yes	Pinsof, 1998
Idaho	Tolo Lake	Idaho Dep't of Fish & Game	Site is only partially studied but appears to be a long term accumulation at a water hole.	10	No	Yes	Yes	No	Hiatus	High	Miller et al. 1998
Kansas	Penndennis	Private	Number of individuals based on count of isolated molars.	>50	No	No	No	No	Ongoing	Low	Agenbroad, 1984
Kentucky	Big Bone Lick	State Park	One of the first.	Unknown	No	No	No	Yes	Hiatus	Medium	Schultz et al, 1963 & 1967
Missouri	Kimmswick	State Park	Adult and juvenile based on isolated teeth.	>2	Yes	No	No	Yes	Completed	Medium	Haynes, 1999
Nebraska	Crawford	Private	Remains of two bull mammoths whose tusks became interlocked during a fight.	2	No	Yes	No	No	Completed	Low	Unpublished
New Mexico	Blackwater Draw	State Park	Series of mammoth sites, other species associated w/ extensive Paleo-Indian remains.	13	Yes	No	Yes	Yes	Completed	Low	Haynes, 1999
New Mexico	Mesa Redonda	Private	While the site contains multiple individuals no complete skeletons were recovered. The mammoth skeleton on display at NM Museum of Natural History is a composite.	6	No	Yes	No	No	Completed	Low	Morgan et al. 2001
Pennsylvania	Frankstown Cave	Private	Isolated bones.	7	No	No	No	No	Completed	Low	Agenbroad, 1984
South Dakota	Hot Springs	Private	All individuals at site are young male mammoths. Long term accumulation.	49	No	Yes	Yes	Yes	Ongoing	High	Agenbroad, 1990
South Dakota	Lange/Ferguson	Private	Adult and juvenile mammoth were butchered using tools made from a mammoth shoulder blade.	2	Yes	No	No	No	Completed	Low	Martin, 1987
Texas	Friesenhahn Cave	Private	Mammoth remains are of juvenile mammoths killed by the dirk tooth cat, *Homotherium*, and brought to den site.	>100	No	No	No	No	Completed	Low	Haynes, 1991
Texas	Lubbock Lake	State, managed by Texas Tech U.	Multiple cultural layers, small family units of three to five animals appeared to have been killed at different times.	2	Yes	No		Yes	Ongoing	Medium	Johnson and Holiday, 1985
Texas	Miami	Private	Mammoths found in association with Clovis artifacts.	5	Yes	No	No	No	Completed	Low	Sellards, 1938
Texas	Slaton	Private	There is no good age estimate of the Slaton Quarry. The mammoth has been identified as *Mammuthus imperator* suggesting it is much older than WMS.	4	No	No	No	No	Completed	Low	Agenbroad, 1984
Texas	Trinity River, Dallas	Private	Isolated bones of mammoths recovered from river channel deposits.	>28	No	No	No	No	Completed	Medium	Agenbroad, 1984
Texas	Waco	City	Matriarchal herd killed in single catastrophic event, possibly other individuals after.	24	No	Yes	Yes	No	Ongoing	High	Haynes, 1992
Wyoming	Colby	Private	An old stream channels where parts of mammoths were found stacked into piles, associated with stone points and a chopper.	7	Yes	No	No	No	Completed	Low	Frison, 1978; Frison and Todd, 1986; Madden, 1978

Note: The Waco Mammoth Site is highlighted in yellow. Characteristics of other locations similar to the Waco Mammoth Site are highlighted in gray, and locations that provide on-site interpretation are highlighted in red.

Figure 3: Known sites in North America Yielding Multiple Mammoths



A comparative analysis was developed in table format between the Waco Mammoth Site and the protected sites yielding multiple mammoth remains with interpretation. The range of attributes compared include type, size, significance, site characteristics, ownership, management, science and technical staff, research activities, excavation efforts, specimens collected, education/outreach, and interpretation (see table 3).

Table 3. Comparative Analysis of Similar Resource Areas

	Waco Mammoth Site Waco, TX	**Rancho La Brea** Los Angeles, CA	**Big Bone Lick State Park** Boone County, KY	**Mastodon State Historic Site** Imperial, MO	**Blackwater Draw** Portalis, NM	**The Mammoth Site** Hot Springs, SD
Date of Site	~68,000 BP	~38,000 Before Present (BP)	~18,000 BP	~10,000-14,000 BP	~8,000-12,000 BP	~26,000 BP
Type of find	Natural en masse accumulation	Natural time-average accumulation	Natural time-average accumulation (?)	Clovis butcher site	Clovis to Archaic butcher site	Natural time-averaged accumulation
Size	~109 acres	23 acres	546 acres	425 acres	157 acres	8 acres
Significance	The only known site in North America to contain a Pleistocene herd of Columbian mammoths. Potential National Natural Landmark	One of the richest, most diverse, best preserved, and best studied assemblages of Pleistocene fossils (Ice Age flora and fauna) ever found. National Natural Landmark	First major New World fossil locality known to Europeans (1739), The first official paleontological collecting site in North America. Lewis and Clark each conducted their own excavations of material from the site during the early 19th century. Potential National Natural Landmark Lewis & Clark National Historic Trail (non-federal certified site) Nat'l Register of Historic Places	One of the first sites revealing solid evidence of the coexistence of prehistoric peoples and mega fauna. Nat'l Register of Historic Places	The site has yielded evidence of the fluted points and other stone and bone weapons, tools, and processing implements found in association with extinct Pleistocene mega fauna such as Columbian mammoth, ancient bison, large horses and large turtles. National Historic Landmark Nat'l Register of Historic Places	The world's largest Columbian mammoth exhibit and research center for Pleistocene studies. National Natural Landmark
Location	Northern edge of Waco, Texas	Downtown Los Angeles, California	Boone County, Kentucky	20 miles south of St. Louis, Missouri	8 miles north of Portales, New Mexico	Hot Springs, South Dakota
Site Characteristics	Narrow valley inset to a large paired alluvial terrace.	Tar pits where oil evaporated allowing water to pool atop the tar attracting thirsty animals and miring them in the sticky pitch.	Soft, swampy area surrounding salt and sulfur springs. Animals were attracted to the salt source.	The area was once swampy and contained mineral springs. Animals were attracted to the water source.	Small spring fed lake basins became popular hunting and resting spots for early North Americans and the mega fauna that coexisted with them.	Sinkhole formed 26,000 years ago warm artesian spring a steeply-sided pond. Animals were attracted to the water source.
Ownership	City of Waco & Baylor University	Los Angeles County	State of Kentucky	State of Missouri	Eastern New Mexico University	The Mammoth Site (501(c)(3))
Management	City of Waco & Baylor University	LA County's Natural History Museum	Kentucky Department of Parks	Missouri State Parks	Eastern New Mexico University (ENMU	The Mammoth Site (501(c)(3))
Research Activities	Baylor University graduate student just completed his master thesis (August 2007) which investigated the microstratigraphy and depositional history of the site.	Page Museum staff collect the sediment (matrix) around the fossils to learn about the microfossils—seeds and pollen, insects and mollusks, fish, amphibians and small birds and rodents—that provide paleontologists with detailed information about the habitats and climate present in Los Angeles during the waning phases of the last Ice Age. Preparation of excavated fossils continues today which are made available for research by professionals and students from around the world.	Dr. Glen Storrs, director of science research and curator of vertebrate paleontology for the Cincinnati Museum Center and board member of the Friends of Big Bone Lick, is promoting a partnership between the museum center, Northern Kentucky University, University of Cincinnati, and the University of Kentucky to prepare a comprehensive study of the site.	Research activities are not scheduled at this time.	Ongoing research is conducted by Eastern New Mexico University archaeologists, with periodic contributions from other institutions. The Smithsonian Institution conducted geological research under the direction of Dr. Dennis Stanford, with the principle investigator being Dr. Vance Haynes from the University of Arizona. Researchers from all over the world visit the site to view the archaeological excavations and further appreciate the importance of Paleo-Indian Studies.	The world's largest Columbian mammoth research center for Pleistocene studies. Sponsors the "Visiting Scientist" program every July, where a researcher is invited to study at the site during the month.

Table 3. Comparative Analysis of Similar Resource Areas (continued)

	Waco Mammoth Site Waco, TX	**Rancho La Brea** Los Angeles, CA	**Big Bone Lick State Park** Boone County, KY	**Mastodon State Historic Site** Imperial, MO	**Blackwater Draw** Portalis, NM	**The Mammoth Site** Hot Springs, SD
Highlights of Excavation Efforts	Active excavation activities were discontinued in 1994.	The first major excavations were conducted by the University of California, Berkeley in 1901 – 1912 Excavation activities in Pit 91 are scheduled every year over a two-month (usually July-August) summer season.	Baron Charles De Longueil, the commander of a French military expedition in 1739, collected some mastodon fossils and sent them to Paris for further study. Systematic excavations were conducted by the University of Nebraska in the 1960's. Most of the bones collected from this expedition are stored in a Nebraska paleontological warehouse although some bones are housed in the park's museum.	Beginning in 1839 Dr. Albert Koch unearthed skeletal remains which were later identified as *Mammut americanum* and later sold to the British Museum of Natural History in 1844 where they are still on display. Excavation activities were discontinued in 1984 to protect the bone bed.	Since its discovery, the Blackwater Locality #1 Site has been a focal point for scientific investigations by academic institutions and organizations from across the Nation. The Carnegie Institute, Smithsonian Institution, Academy of Natural Sciences, National Science Foundation, United States National Museum, National Geographic Society, and more than a dozen major universities either have funded or participated in research at Blackwater Draw.	Active on-site excavations which can be observed by visitors. Earth Watch Institute provides for a program for laymen assistant excavators during the summer months excavate and identify and study fossils.
Specimens Collected	18 Columbian mammoth specimens, giant tortoise, prehistoric camel skull stored at Mayborn Museum.	Nearly 3,500,000 specimens have been collected, over 650 species of Pleistocene plants and animals identified. Fossils recovered represent Columbian mammoth, mastodon, dire wolf, saber-toothed cat, short-faced bear, American lion, bobcat, coyote, weasel, ground sloth, dwarf pronghorn, extinct camel, peccary, tapir, llama, horse, bison, insect, plant, seed, bird, reptile, amphibian, and fish. One human skeleton ~9,000 BP and cultural artifacts.	Animals include mastodon, Wooly and Columbian mammoth, musk-ox, stag moose, ground sloth, extinct bison, extinct horse, deer and caribou.	Bones from more than 60 mastodons reportedly were taken from the pit in addition to Harlan's ground sloth and Columbian mammoths.	Pleistocene mega fauna such as Columbian mammoth, ancient bison, large horses, and large turtles. Other Pleistocene age animals visiting the site for food and water were tapir, camel, four-prong antelope, llama, tampulama, deer, dire wolf, ground sloth, short-faced bear, saber-tooth cat, shovel-toothed amebeledon, beaver, armadillos, and peccary.	Majority of fossils found are young adult, male Columbian mammoths. Evidence of three woolly Mammoths has also been discovered here, the first time both species have been found together. Fossils of other Ice Age animals have also been discovered; camel, llama, giant short-faced bear, wolf, coyote and prairie dog to name a few. Imprint fossils of bird feathers, complete fish skeletons, and thousands of mollusk shells have also been recovered.
Education, Outreach, and Interpretation	Interpretation off-site at the Baylor University's Mayborn Museum Complex.	Educational activities are ongoing Visitors can learn about Los Angeles as it was between 10,000 and 40,000 years ago, during the last Ice Age. A tank recreates how animals became stuck in the asphalt. Visitors can touch a massive leg bone of an extinct giant ground sloth or make a comparison of mastodon and mammoth by teeth, size, and diet. Life-size replicas of several extinct ice age mammals are featured. Special events are held annually.	Information available through the Earth Science Education Network (ESEN). website Outdoor museum presents the site history with displays of fossilized bones and artifacts from the last 18,000 years. A Discovery Trail gives visitors a glimpse of the drama that unfolded at the springs. Recreated grasslands, wetlands and wooded savannas lie along the trail leading to a "bog" diorama showing a woolly Mammoth, mastodon, giant sloth, bison, various skeletal remains, and scavengers feeding on the carcasses. The final portion of the loop, the Bison Trace, brings a live buffalo herd into view. Special events are held annually.	Museum admission and programs are free to student groups and their teachers/leaders. A variety of educational materials are free to teachers. Interpretive programs: slide show, interpreter-led presentation, museum tour and hike to the former excavation site. The program focuses on ice age mammals and early man. Other topics include: Prehistoric Life Skills; Early Man and Technology; and Fossils. A short trail accesses the bone bed. Special events are held annually.	An in-depth presentation of the site and its significance is on-line. A self guided ¼ mile interpretive trail is provided on-site. The Blackwater Draw Museum displays artifacts discovered at the site and interprets life at the site from Clovis times through recent historic period.	Staff available for outreach visits, "Mammoth In A Trunk" kits available, personal grade-level guided tours. Science Curricular Activities Booklets available for classroom or home schooling use, or interactive CD can be purchased. Guided tours into the sinkhole where the bones have been left *in situ*, exhibits in the Ice Age Exhibit Hall, peek in the windows of a working paleontology laboratory, view numerous short educational films on geology, Mammoth Site history, Hunting Mammoths with Dr. Larry Agenbroad, flint knapping techniques, and museum laboratory procedures.

EVALUATION OF FEASIBILITY

An area that is nationally significant and meets suitability criteria must also meet feasibility criteria to qualify as a potential addition to the national park system. To be considered feasible, an area's natural systems or historic settings must be of sufficient size and shape to ensure long-term protection of resources and accommodate public use. The area must also have potential for efficient administration at a reasonable cost.

In evaluating feasibility, the Park Service considers a variety of factors, including the following:

- Access
- Size
- Landownership patterns
- Boundary configurations
- Local planning and zoning
- Current and potential uses of the study area and surrounding lands
- Existing degradation of resources
- Current and potential threats to the resources
- Public enjoyment potential
- Staffing requirements
- Costs associated with acquisition, development, restoration, and operation
- Socioeconomic impacts of designation as a unit of the national park system
- Level of local and general public support (including landowners)

The feasibility evaluation also considers the ability of the National Park Service to undertake new management responsibilities in light of current and projected availability of funding and personnel.

Access

The Waco Mammoth Site is centrally located within the state of Texas; it is located 90 miles south of Dallas/Fort Worth, 90 miles north of Austin, and 180 miles northwest of Houston. The site is located within 200 miles of 80% of the state's population, and is located less than 12 miles from Interstate 35, a well-traveled, primary north/south transportation corridor traversing the Midwest section of the country. In 2003, average daily traffic travelling on I-35 through the Waco area was 46,512 vehicles. The site is also located within a few miles of the Waco Regional Airport which primarily provides commuter service to the Dallas-Fort Worth International Airport and Houston's Bush Intercontinental Airport.

The property includes 952 feet of frontage along New Steinbeck Bend Road, a local arterial collector road. The site also includes 461 feet of frontage along Bogey Lane, a residential collector street that provides access to a residential area just east of the site.

It is anticipated that there would be limited impacts to existing transportation systems and adjacent neighborhoods as additional traffic could easily be accommodated on existing arterial roads without reducing the level of service or introducing additional traffic volumes into residential areas.

The location of the site provides not only convenient access from existing major transportation corridors, but it also provides for easy access by a large number of visitors traveling from outside the region.

Size and Landownership Patterns

Collectively, the city of Waco and Baylor University have acquired 109.34 acres of land referred to as the Waco Mammoth Site. On October 4, 1996, Sam Jack and Liz McGlasson donated 4.93 acres to the city, which included the excavation area that covers less than 5% of the tract. Conditions of conveyance require the city to use the property for research, educational, or tourism purposes, and require the city to enter into an agreement with Baylor University concerning the maintenance of the property as an educational resource for the citizens of Waco, visitors, and researchers.

Prior to the McGlasson land conveyance to the city of Waco, it appears Dr. James Hetjmancik was the previous landowner

during the period of initial discovery in 1978 through the en masse excavation and collection effort in 1990. He is credited with donating the collected specimens to the Strecker Museum (Fox et al. 1992). Baylor University is currently researching their museum records to confirm the chain of collection agreements with landowners prior to the conveyance of the property to the city of Waco.

Between 2000 and 2001, Baylor University acquired three additional tracts through private donor support, totaling 104.41 acres surrounding the site and extending along New Steinbeck Bend Road and the Bosque River.

Both the city and university have expressed full support for establishing the Waco Mammoth Site as a new unit of the national park system, as well as their willingness to transfer their properties, the paleontological collections, and archives without cost to the National Park Service for this purpose.

Boundary Configurations

The boundary configuration would follow the outline of the combined properties owned by the city of Waco and Baylor University described above. Copies of the warranty deeds and tract map are included in the appendix D.

The current boundary provides ample buffering between the excavation site and adjacent properties on the north, west and south sides of the property. Maintaining the existing vegetation found along the northeast edge of the property would continue to provide a visual screen of the excavation area located 180 feet from the northeast boundary of the site that follows the southwest side of Bogey Lane and an adjacent residential neighborhood.

If excavation activities are reinitiated at the site at some time in the future, the full extent of the resource could be confirmed. This may require a re-evaluation of the boundary configuration needed to ensure long-term protection of the special resource. For the purposes of this study, it is assumed that the current boundary configuration provides an adequate protection and buffering capability for the special resource.

Local Planning and Zoning

The Waco Mammoth Site and the lands surrounding the site lie with the R-1B Zone which allows for single family residential development, agriculture use, and public uses such as parks. It is anticipated that existing land use patterns surrounding the site would remain fairly stable.

The site is also within the Brazos River Corridor overlay district. The *City Comprehensive Plan* (2000) designates the Brazos River corridor as mixed use. The corridor, because it is an overlay district, takes precedence over the underlying zoning. The purpose of the overlay district is to ensure the development of the Brazos River Corridor as a center for quality recreation, convention, tourism, housing, commercial, retail, and office facilities. The regulations are designed to protect the special environmental character of the corridor and to promote continued private and public investment. Some of the goals contained in the mission statement for the corridor include:

- Preserve, protect, and enhance the historically, culturally, architecturally, and archeologically significant sites and structures which impact a distinct aspect of the city and serve as visible reminders of the city's culture and history.
- Recognize and protect the special distinctive qualities and ecosystems of both the Brazos River and the Bosque River and their tributaries.
- Encourage developments that interconnect for pedestrian access and circulation.

The city of Waco has recognized the significance of the Waco Mammoth Site by including the site within the boundaries of the Brazos River Corridor. By connecting the Waco Mammoth Site to the rest of the corridor, the city has made a commitment to

encouraging compatible land uses in the vicinity of the site. In addition, the city owns the parcel to the southeast of the Waco Mammoth Site as well as parcels south of West Lake Shore Drive. It is the intent of the city to provide continuous pedestrian access through these parcels to the Waco Mammoth Site.

Current and Potential Uses of the Study Area and Surrounding Lands

Lands surrounding the study area are primarily undeveloped, agricultural lands occasionally used for cattle grazing, although there is an adjacent residential development just northeast of the site. A public golf course operates just to the east of the site. It is anticipated that privately owned agricultural lands would continue to be converted to residential use. City property borders the southeast corner of the site along the Bosque River, and it is anticipated that future development would be for recreational purposes.

The moratorium on excavation activities in 2003 also included restricting visitor access. Current uses of the site include scientific investigation, preservation, and maintenance activities by the city staff, university staff, and students.

Potential uses of the 4.93-acre city parcel are restricted by the conveyance conditions that require the site be used for research, educational, or tourism purposes. However, to successfully achieve this requirement, the primary use of the study area should focus on the long-term preservation and security of the *in situ* specimens and geologic context. Public access to this feature and facility development for enhanced interpretation and administrative space must be secondary to the long-term preservation and security needs of the site. Once protection and security can be assured, there are a number of opportunities for introducing the public to the excavation area and the interpretation of how these features contribute to our understanding of the nation's natural history.

Over the course of the last eight years, there have been a number of development proposals prepared for the site. In 1999, the city of Waco commissioned the first development proposal, which was prepared by Beth Francell of Rebloom Design. The plan recommended the acquisition of four adjacent properties totaling an additional 195 acres of land (including the 104 acres eventually acquired by Baylor University in 2000 and 2001) and the development of the site as a 200-acre regional park with recreational amenities. The development program included a 7,500-square-foot visitor center with gift shop, food service, and exhibits, a 35,000-square-foot pavilion over the mammoth excavation area, access and service roads, 800 parking spaces, site utilities, four comfort stations, prairie restoration for a bison and longhorn pasture, an arboretum and nature trail, a Pleistocene themed playground, 26-site picnic area, a campground with 42 tent sites and 57 travel trailer (RV) sites, and boat/canoe and fishing access to the Bosque River. It was anticipated that providing a full spectrum of recreational activities would qualify the site for matching grants from Texas Parks and Wildlife's Texas Recreation and Parks Account Program.

Using visitation rates (+100,000 visits per year) recorded at the Mammoth Site at Hot Springs, South Dakota, as an indicator of the potential interest in the Waco Mammoth Site, the proposal anticipated and annual attendance of between 75,000 and 150,000 visitors. Total revenues were projected between $250,000 and $400,000 generated through gate receipts, gift shop sales, food service, and camping fees, and were anticipated to partially offset the projected $560,000 in annual operational expenses. The total initial cost of the proposal was estimated at $6.6 million (1999 dollars). The Waco City Council expressed concerns with the initial and operational costs of the proposal and decided not to pursue development of the site at that time, but remained committed to maintaining and securing the site.

In 2000, a second development plan, prepared by Calvin Smith and others, was presented as a cooperative venture offering a modified, small-scaled version of the first proposal. This plan recommended the acquisition of the 104 acres which was eventually acquired by Baylor University in 2000 and 2001 and proposed utilizing 75 of the 109 acres for development of the Waco Mammoth Site, while reserving the balance of the acreage for a future nature center and preserve to be funded by a local philanthropist and Texas Parks and Wildlife grants. Amenities included a 35,000-square-foot, climate-controlled pavilion over the mammoth excavation area with interpretive exhibits, gift shop, limited food service, and restrooms; site utilities; access and service roads; 250 parking spaces; 2 comfort stations; prairie restoration; interpretive trails; playground; 15-site picnic area; canoe launch; and fishing pier.

Attendance was projected to range between 100,000 to 200,000 visitors per year. Total revenues from admission fees, gift shop, and concessions were projected to fully offset the projected $362,160 in annual operational expenses. The total initial cost of the modified proposal was estimated at $3 million (2000 dollars). The proposal also anticipated a $3 million endowment to meet future maintenance/operations expenses, staff research, and programming needs.

A third proposal, developed by students from Baylor, included a narrative of the visitor experience potential and facility program which outlined space requirements for exhibits, theater, gift shop, restrooms, snack/vending area, classrooms, library, collections storage, preparation lab, exhibit fabrication workshop, administrative offices, storage, and mechanical equipment. The team projected a total need of 44,820 square feet for the facility; however, estimates of the implementation costs were not included in the proposal.

In 2003, a feasibility study was commissioned by the city and submitted by Lord Cultural Resources Planning and Management, Inc. The study analyzed conservation and preservation needs, visitor experience opportunities, space and facility needs, capital investment cost estimates, staffing, and governance. Baylor University provided assistance on the governance and staffing portion of the report. In this proposal, it was assumed that the Mayborn Museum Complex would serve as the primary gateway visitor center for the Waco Mammoth Site and would feature orientation, ticketing, transportation, retail and information services, enhanced exhibits, and an introductory film of the catastrophe and ongoing scientific investigations. Amenities developed at the Waco Mammoth Site would include a 6,900-square-foot visitor center covering and featuring an exhibit of the bones that remain *in situ*, additional exhibit space, museum shop, multipurpose room, restrooms, office space, site utilities, access and service roads, 60 parking spaces, and a covered walkway with interpretive waysides that would surround the original discovery area and feature a forensic outline, etched in stone or terrazzo, of the original position of the mammoth bones removed from the site.

Projections for the attendance rate at the Waco Mammoth Site were re-evaluated based on market analysis, a more modest approach to the onsite development, and restricted, controlled access to the site to ensure resource protection and security. The study projected an attendance rate of 30,000 visitors per year after the third year of operation. They also projected annual operational expenses would range between $360,000 and $380,000, with anticipated revenue in the range of $131,000 to $196,000 from admissions, retail sales, and other self-generated revenue sources. Almost 60% of the operational expense would need to be subsidized to break even on operations.

Options to consider include securing an endowment, fundraising, grants, or contributed income. The total initial cost of the proposal was estimated at $5.5 million (2003 dollars).

In 2006, the city of Waco was awarded a $200,000 matching grant through the Save America's Treasures Program, a federal grant program administered by the National Park Service. The program was established to help preserve and protect nationally significant features. The grant was made for the purposes of providing protective measures for the resources of the Waco Mammoth Site. These measures include replacing the existing fabric tent that now covers the *in situ* specimens with a more durable shelter, redirecting site drainage away from the excavation area, providing for enhanced site security, and accommodating public access.

As part of the requirements for receiving grant-in-aid funds from the Save America's Treasures Program, the city entered into a 50-year conservation easement agreement with the Texas Historical Commission on July 17, 2007, for the purposes of assuring preservation of the property. The easement agreement further requires that the city provide public access to view the grant-assisted work or features no less than 12 days a year on an equitably spaced basis.

The city and Baylor University immediately pledged $100,000 each to match the grant and then chartered the Waco Mammoth Foundation to pursue additional fundraising to support the initiative. The city issued a request for proposals for the design of the structure and selected Cotera-Reed, an architectural firm based out of Austin, Texas, as the prime consultant for the work. Their design team included the landscape architectural firm EDAW office in Fort Collins, Colorado, as well as a number of engineering consultants. Part of the design services included the preparation of a master plan for the entire site so that the shelter could be developed within the context of the community's long-range vision for developing the site as a public park.

Once the master plan was completed by EDAW and accepted by the city's Department of Parks and Recreation, Phase I schematic designs were developed for the shelter structure. Provisions for accommodating controlled visitor access into the shelter were developed. In order to more fully protect the *in situ* specimens from the extremes of temperature and humidity, a climate control system was included. The expanded scope increased the total costs for Phase I to $3.2 million, which required a more intense fundraising effort by the Waco Mammoth Foundation. The local community rose to the challenge and from a variety of sources pledged an additional $2.5 million dollars, allowing the city to contract for construction of Phase I in 2008.

The development includes an 8,400-square-foot shelter, with limited air-conditioned interior space over the excavation area and *in situ* specimens. The development will also include interpretive exhibits, an access road, a small parking area with overflow parking that can accommodate bus and recreational vehicles, connecting trails to the excavation shelter, a small visitor contact station with restrooms, utility extensions, and enhanced security systems.

The Waco community's initiative ensures the excavation area will be protected from further erosion during storm events and other environmental threats, will protect the exposed *in situ* specimens from potential acts of vandalism; and for the first time, will allow for controlled public access into the area so that the resource can be shared with the local community as well as visitors to the area.

Figure 4: Waco Community's Phase I Plan for the Waco Mammoth Site

Existing Degradation of Resources

An assessment of the current condition of the site is based on two criteria: integrity of the geology and integrity of the fossil specimens. Both are critical to the long-term preservation of the *in situ* remains and the ability to conduct ongoing research critical to the interpretation of the site. Currently the site is covered by a large tent, which has provided some protection to the exposed geology and fossils. Unfortunately, while the tent has prevented direct impact to the fossils and geology from rain, it has not been completely effective. During the many years that the site has been exposed, it has suffered from water damage resulting from surface runoff; some of the runoff channeled by the tent. This has resulted in the erosion and collapse of the sides of the excavation, deposition of sediments in the bottom of the excavation, and pools of standing water that have contributed to the deterioration of bone and the growth of algae.

Despite the damage to the sides of the excavation, sediment columns left in place for reference have remained intact and there are major sections of the excavation walls that still retain sufficient detail to permit an analysis of the microstratigraphy of the site. If further water is prevented from flowing into the excavation, there should be no additional damage to the remaining exposed geology and bones.

Mammoth skeletons in the lowest part of the excavation, where water has collected and pooled, exhibit the most serious damage, primarily in the fragmentation of bones. Many of the bone fragments are still in their relative positions and repair should be possible although challenging. The primary concern is that they may become moved out of position making it more difficult to determine their original location and re-associate them with the source. Two mammoth skeletons, primarily a bull and a cow located at a higher level, have not been as severely damaged from surface runoff of water. The bull skeleton was molded with latex and it appears that most of the damage seen in this specimen, e.g. the fragmentation of individual bones, is the result of the molding process. The Mayborn Museum has initiated remedial action on the bull and is gluing bone fragments back together to ensure that pieces are not lost.

Once work has been completed on the bull mammoth, it should be followed by work on the other mammoths, preferably the two lowest ones. The upper female seems to be the least damaged and can be stabilized last. The camel skeleton appears to be in the best condition, although the skull was considered vulnerable and was removed. It is currently stored in a field jacket at the Mayborn Museum Complex. All repairs are being made with adhesives that are reversible and will allow for more permanent stabilization in the future.

Other forms of remediation that should be programmed include spraying all algae with a dilute bleach solution; this would reduce the growth of algae and would not negatively impact the bone.

Currently all collected fossil specimens and associated geological samples are stored in the geology/paleontology collections room at the Mayborn Museum Complex on the Baylor University campus. The mammoth fossils are primarily contained in their original field jackets with some individual bones and fragments stored in plastic bags or cardboard boxes. All specimens in field jackets are considered to be in stable condition, although prior to their current storage they were kept in a warehouse lacking environmental controls.

During part of the time in the warehouse, many of the jackets were open on top but have since been closed with plaster and burlap. Because they are currently sealed, it is not possible to assess if any damage has occurred to the bones during this time. Since it is anticipated that some of the jackets will be opened in order for sediment samples to be removed, it may be possible to conduct a preliminary condition assessment after they are opened. Some of the individual bones/fragments stored in boxes and bags may fit with bones in jackets. It is critical that all field identification numbers and other data remain associated with these specimens in order to facilitate their reattachment to these specimens.

Given the age of some of the original cardboard boxes and paper bags, Baylor University is currently repacking some of the specimens and placing them in recently purchased cabinets. In order for the scientific value of the site to be fully appreciated, all jacketed bones will eventually need to be prepared and this will be a multiyear project given the volume of material. Preparation is also needed in order for these specimens to be used in exhibits associated with the site. Based on a preliminary examination of material in boxes and bags, the bones appear to be in good shape, but the large number of fragments indicates the need for major efforts in the reassembly of broken specimens.

Current and Potential Threats to the Resource

Of primary concern is the current condition and continued protection of the exposed *in situ* specimens. Resource protection measures have been initiated by Baylor University by grants secured from the Cooper Foundation. In 1984, on the upper end of the drainage, a diversion dam was constructed to catch and divert storm water runoff. Additional fill has been placed at the upper end of the site to divert drainage. Spoil piles from the upper

excavation have been stockpiled downstream in the original discovery area. To enhance security, the city has erected a chain link fence with a locking gate completely around the excavation site. The site is patrolled by the Waco police to protect it from vandalism and unauthorized collecting, which have not proven to be a problem so far. Baylor University's Mayborn Museum personnel maintain the site and conduct site surveillance at least once a month in addition to reconnaissance after each rainfall event.

The 2003 feasibility study conducted by Lord Cultural Resources Planning and Management, Inc., outlined a number of protective actions to ensure long-term protection of the resource. These included stabilization and repair of all exposed specimens still in the ground, completion of documentation of the site, development of proper drainage away from the excavated area, and replacement of the existing temporary tent shelter with a more permanent shelter.

Following the completion of the report, excavation activities have been restricted to only those actions necessary to protect threatened resources such as the removal of the lower female mammoth and camel skull threatened by drainage patterns through the excavation pit.

The city of Waco, Baylor University, and the community are currently planning to contract for the installation of an 8,400-square-foot climate controlled excavation shelter to replace the existing tent over the exposed specimens. In addition, visitor access into the shelter will be accommodated. These efforts will protect the *in situ* remains from the effects of further erosion and weathering, as well as the potential for future vandalism.

Until the excavation shelter is completed, there is still potential damage resulting from animal activity. This includes mud dabber wasps that excavate wet mud in the vicinity of the bones. Their burrows were observed both on the sediment pedestals on which bones sit and in sediment filled cracks in larger bones. The incremental loss of the supporting soil structure continues to be a threat to exposed features. Since the site is open on the sides, it is regularly visited by skunks and raccoons which walk across specimens and cause minor damage. As long as the site remains open, it will not be possible to mitigate this problem.

Both from the standpoint of future scientific study and interpretation it is important that the current collection of specimens and their associated data remain intact as one unit and under single ownership/stewardship tied to the ownership and management of the site with material left *in situ*. Separation of these specimens will make their utilization more difficult and diminish their usefulness for future research. There are multiple options with regard to the curation and storage of these specimens. However, prior to curation, all specimens removed from the site will need to be prepared. Given the volume of material, this will be a lengthy and time-consuming process and will require a physical facility and support system to permit their proper and professional preparation.

Potential for Public Enjoyment or Scientific Study

The Waco Mammoth Site affords exceptional opportunities not only for public enjoyment ***or*** scientific study, but also for the public enjoyment ***of*** scientific study. These opportunities amount to fostering an appreciation and understanding of the science of paleontology. If access to the resource can be sensitively integrated with the needs for resource protection and security, the public could be provided a rare glimpse of a paleontological site like no other in the country. The preservation of a portion of the bones of the mammoth herd *in situ* provides opportunities to examine first hand the physical conditions governing the site, how the fossil site was formed, and how it was initially excavated by archeologists and paleontologists. It also affords opportunities to teach visitors about the scientific method and about how paleontology, along with

geology and archeology, is a historical science in which researchers are attempting to reconstruct events that have already taken place. Their methodologies are different from the experimental sciences such as chemistry, physics, and biology, although knowledge of the experimental sciences is critical to collecting the information needed to reconstruct an understanding of earth history. As such, the site provides a focal point to teach about all of the major sciences and how one discipline can contribute to another.

Effective interpretative programs could be developed at various educational levels, including programs for school groups at the elementary through high school levels, programs for the general public, and scientifically detailed programs for students in college and graduate school. Baylor University has established a precedent for utilizing the site for their museum studies and geology programs. The site has the potential to directly engage multiple scientific disciplines as well.

The Waco Mammoth Site provides scientifically valuable opportunities to compare mammoth specimens found in a natural state of death repose with mammoth specimens found elsewhere in Paleo-Indian kill or butcher sites. Questions related to such comparative research would be pertinent to paleontology because it is a historical science that deals with broad questions of evolution as well as detailed site-specific questions of taxonomy and how the arrangement of specimens like bones in the ground are influenced by ground disturbing events.

The Waco Mammoth Site also affords opportunities to study the behavior of a mammoth herd under duress. This provides opportunities to design research projects to compare past mammoth behavior with the present-day behavioral patterns and herd dynamics of modern elephants. Special opportunities exist at the Waco Mammoth Site to utilize this fossilized social behavior in studying a mammoth community's floral and faunal interactions. Past and present habitat ecology would be relevant here. Scientifically, the method of controlled comparison in both historic and modern contexts would be the aspect of the overall scientific method to be researched and taught.

Additional research would help further our understanding of the conditions and sequence of events that led to the conditions of the mammoth herd found at Waco. As additional research is conducted, findings can be continuously integrated into the interpretive messages as another opportunity to enhance public enjoyment.

The site has great potential for public enjoyment and scientific study. It provides many opportunities for the interpretation of a variety of scientific disciplines and an opportunity to encourage visitors to get excited by science.

Costs Associated with Acquisition, Development, Restoration, and Operation

Acquisition

The costs associated with land acquisition are not anticipated to include the purchase of the properties as both the city of Waco and Baylor University have stated a willingness to transfer their lands without cost to the National Park Service. However, based on conversations with staff of the Land Resources Program Center for the National Park Service Intermountain Region, there would be costs associated with conducting a full title search/ insurance, completing a hazardous material survey, and preparing a legislative map for the properties (estimated at $30,000), which would only occur if Congress decides to designate the Waco Mammoth Site as a new unit of the national park system.

The National Park Service may also need to pursue a waiver from the Department of Justice with regards to the specific language in the city of Waco tract due to the conveyance stipulation regarding land use (to be used for research, educational, and/or tourism purposes) and the requirement of the Grantee (city of Waco) to enter into an agreement with

Baylor University concerning maintenance of the property as an educational resource. The National Park Service may also consider entering into a cooperative agreement with Baylor University for the same.

Development

The extent of facility development and the associated cost is dependent on the long-term vision and direction for managing the resource and the visitor experience. If the Waco Mammoth Site were to become a new unit of the national park system, the long-term vision would be determined through the National Park Service's general management planning process.

Some major management decisions need to be made regarding whether or not to re-engage the excavation effort to determine the full extent of the resource. If the decision is made to investigate the limits of the find, a systematic approach under the direction of a paleontologist would be initiated. Once the limits have been determined, appropriate facility configuration designs could be developed and evaluated to determine the best method for insuring protection of the full extent of the resource, while also allowing for continued research, public access, and interpretation.

A more conservative approach would be to defer additional excavations and focus on the protection and preservation of the existing *in situ* remains and to initiate the preparation effort of the collected specimens. At some time in the future, once the park is fully staffed, management could then re-evaluate the option to extend the excavation or to remain focused on the existing excavation area.

Assuming site development for enhanced security, an access road, parking facilities, and utilities is accomplished through the Waco community effort currently underway, the remaining development needs would include providing for administrative and maintenance support facilities.

Storage of the collected specimens does not necessarily have to occur onsite as Baylor University has provided this service since the resource was first discovered. It is anticipated that this could continue through a partnership arrangement outlined in a cooperative agreement between the National Park Service and Baylor University. As there is a volume of preparation work required prior to specimen curation, the potential exists for providing a small paleo-lab that could be integrated with the onsite interpretive facility. Visitors could have the opportunity to observe scientists and volunteers at work preparing specimens for further study and curation.

The space requirements for administrative and management support should include provisions for office areas, storage of office supplies and interpretive materials, and mechanical equipment. Space requirements for maintenance support should include workshop area, storage of maintenance supplies, and storage of equipment.

Collection Preparation

The collected specimens will require the dedicated effort of a professional fossil preparator over an extended period of time. The preparation effort would include establishing protocols and documentation methods; removing specimens from field jackets; removing sediment from the bones; hardening the bones with plastic, if needed; reassembling broken pieces; re-associating separated material with original specimens; documenting, cataloging, and placing prepared specimens in cabinets or on shelving; and making them available for study or for casting for interpretive exhibits.

There are 93 plaster field jackets with specimens. Currently many jackets occupy 18-4'x8' shelves on open shelving. Others are on pallets with multiple jackets on some pallets.

Estimate of preparation effort (for a single person):

12 jackets: 12.0 months/jacket = 144 months
30 jackets: 3.0 months/jacket = 90 months
51 jackets: 0.5 months/jacket = 26 months

Total preparation time: 260 months
(over 21 person years)

Based on field photos the bones tend to be highly fragmented; reassembly and gluing of pieces could add to the estimated time for preparation. Preparation protocols also need to be established to ensure that potential information, such as dermestid beetle marks and bone weathering, are not lost during the preparation process.

Approximately 30 to 40% of the 137 boxes contain bones washed out from skeletons during 1978, 1981, 1984, and 1986. The museum is sorting these specimens and trying to associate them with specific skeletons. At this time, specimens are not being reassembled but are bagged together. The time required for the reassembly of these bones cannot be calculated and has not been included in the estimate of required preparation time.

Staffing

The level of staffing required for proper management and maintenance of the resource is influenced by the need to provide for the following functions:

- Overall management responsibility
- Paleontological expertise
- Resource and visitor protection
- Research coordination
- Collections preparation, curation, and management
- Interpretation
- Educational outreach
- Volunteer coordination
- Facility management and maintenance
- Administrative support

Each function does not necessarily require a full time allocation of staffing resources; some responsibilities could be combined under one position if qualified candidates could be assigned. It is anticipated that 9 –11 FTE (full time equivalent) positions would be needed; this estimate includes multiple seasonal positions for interpretation and maintenance.

The Waco Mammoth Site is located in close proximity to Lyndon B. Johnson National Historical Park (LBJ NHP), which is located 50 miles west of Austin, Texas, and 144 miles southwest of Waco, Texas. This suggests that a mentoring relationship between the two park staffs would be feasible in that the latter could handle certain administrative and oversight functions of the former. Such a relationship would help to reduce the initial operational expenditures and provide guidance to the site manager of the Waco Mammoth Site and his or her presumed small staff.

One potential management scenario for the Waco Mammoth Site could include staffing support from LBJ NHP for contracting, purchasing, and hiring. At the Waco Mammoth Site, a superintendent would be assigned with overall management responsibility for the site. Key support staff would include a facility manager, who would be assigned the management responsibilities for site operations, maintenance, and security.

The facility manager would supervise a small staff, supplemented with limited contracted services. It is anticipated that law enforcement would be managed through a concurrent jurisdiction arrangement with the city of Waco. If additional support is needed for special events or criminal investigations, law enforcement rangers could be dispatched from LBJ NHP. Complementing the role of facility manager, a resource manager would guide the scientific, educational, and interpretive component of the site. Preferably, this assignment would be made to a professional paleontologist who would supervise a small staff. Other duties envisioned would include site investigations,

monitoring, and research coordination. Staff assigned to the resource manager would include a collections manager/preparator, interpretation/education specialist/volunteer coordinator, and seasonal interpreters.

Socioeconomic Impacts of a New Unit Designation

In 2001, a report entitled *The Economic Impact of the Waco Mammoth Park on the Central Texas Region* was prepared by Dr. Tom Kelly, economist and Director of Baylor Center for Business and Economic Research. In this study, Dr. Kelly projected that basic income would come from two sources: 1) from the construction, operations, and maintenance of the facilities and 2) from visitors traveling from outside the region and spending within the local economy. Dr. Kelly applied the central Texas region's expenditure multiplier for construction of new educational facilities (2.325) and the expenditure multiplier for tourism visitors (2.827) according to an input-output model estimated by the Ray Perryman Group. He also projected that 10% of the visitors to the site would spend at least one additional day in the central Texas region. Dr. Kelly used initial construction costs of $1.94 million and anticipated attendance between 100,000 to 200,000 visitors per year. He projected that the construction phase would add $4.5 million to the central Texas region. Staff and operation spending ($347,000) would have an on-going beneficial economic impact of $980,000. The economic impact of other visitor spending would be between $2.25 and $4.5 million each year. The total economic impact of the Waco Mammoth Site, not including other benefits in the form of setting aside additional open space, would amount to a one time impact of between $8 and $10 million, with a continuing annual impact of between $3.23 and $5.48 million to the central Texas region.

Another scenario uses the more modest attendance projections outlined in the 2003 Lord Report (30,000 visitors per year by the third year of operation versus 100,000 to 200,000 cited above), the total costs for the Waco community's Phase I construction of $3.2 million, the estimated annual operational costs of $380,000 (Lord Report), and the same multipliers used by Dr. Kelly in his 2001 report. In this scenario, the adjusted economic impact from the construction phase would be a onetime impact of $7.44 million, staff and operations would be an ongoing annual beneficial economic impact of $1.07 million, and visitation would be an ongoing annual beneficial economic impact of $0.68 million. The combined economic impact would amount to a one time beneficial impact of $9.19 million with a continuing annual benefit of $1.75 million added to the central Texas regional economy.

If the Waco Mammoth Site were to become a new unit of the national park system or a new municipal park, the economic impact would be beneficial and long term to the community in the form of enhanced tourism and increased revenue generated by this influx and the addition of new employment opportunities for managing and maintaining the site. The greatest socioeconomic impact is projected to be beneficial and long term to the general public, local and regional school groups, and the scientific community. This would be realized through enhancing onsite access and interpretation of the Waco Mammoth Site, encouraging research activities to help broaden the understanding of what occurred here, and enhancing educational opportunities for local school groups as well as other groups that may travel to the site. There would also be beneficial and long-term socioeconomic impacts resulting from the intangible value of collective community pride for the citizens of Waco who have supported the notion of establishing the Waco Mammoth Site as a new unit of the national park system for the entire nation to enjoy.

Level of Local and General Public Support

Both of the landowners, the city of Waco and Baylor University, as well as the local community, the paleontological community, members of Congress, and others who know of this site have expressed overwhelming support for

designating the Waco Mammoth Site as a new unit of the national park system.

Feasibility Findings

The total acreage of the Waco Mammoth Site includes 109.34 acres that appear to be of sufficient size and appropriate configuration to ensure long-term, sustainable resource protection and visitor enjoyment.

Surrounding land uses are likely to remain stable and compatible with park values. The site is well situated for public access and protection. There is an abundance of untapped potential for providing public enjoyment. The scientific community, general public, members of Congress, and existing landowners have expressed unflagging support of the site's consideration for inclusion into the national park system.

It may be feasible, even under current and anticipated NPS budget constraints, for the National Park Service to manage, maintain, and operate the resources of the site. The city of Waco and Baylor University have stated a willingness to transfer the lands without cost to the National Park Service. There are opportunities for efficient administration by the National Park Service at a reasonable cost, especially if existing partnership support could be maintained and enhanced through the use of cooperative agreements. Cooperative agreements identify the roles and responsibilities of each partner and are instruments not only for role definition but also for transferring funds, if that should be appropriate. The city of Waco and Baylor University have already established a partnership to manage the site, and such arrangements could be developed, maintained, and enhanced for the future. The National Park Service could also enter into partnerships with either or both of these entities or with others who wish to support the Waco Mammoth Site.